TIMING OF RETURN TO HITTING FOLLOWING ULNAR COLLATERAL LIGAMENT RECONSTRUCTION IN PROFESSIONAL BASEBALL PLAYERS

Brandon Erickson, Brandon Erickson, Peter Chalmers, John D’Angelo, Kevin Ma, Scott Sheridan, Mark Steven Schickendantz, Anthony A Romeo. USA

Summary It take hitters roughly 150 days to begin a hitting program following ulnar collateral ligament reconstruction but over 300 days before they can return to sport.

Data Background Ulnar collateral ligament reconstruction (UCLR) is a common procedure in professional baseball position players. Timing of return to hitting following UCLR is unknown.

Purpose Determine the time to return to batting milestones after UCLR as well as the effect of UCLR upon batting performance in professional baseball players.

Hypothesis Position players would return to batting in an in-season game prior to fielding in an in-season game, and hitting performance would remain unchanged following UCLR.

Methods All professional position players who underwent UCLR between 2010–2018 were included. Time to batting milestones following UCLR was analyzed. Batting performance before and after UCLR was compared and analyzed.

Results Overall, 141 UCLRs (96% performed on the dominant arm) in 137 position players were included (86% minor leaguers). Four players underwent revision, all within one year of the primary UCLR. With regard to position, catchers and shortstops were over-represented. With regard to batting side, 57% batted from the right and 12% batted as switch-hitters, and thus 76% of surgeries were on the lead arm. While 91% of players were able to return to any throwing at all, there was a progressive gradual decline during the rehabilitation progress such that 77% were able to return to hitting in a real game and 75% were able to return to fielding in a real game. The first dry swing occurred at 150±49 days after surgery, first batting practice occurred at 195±58 days after surgery, and first hitting in a real game occurred at 323±92 days after surgery. However, players generally saw a decrease in hitting utilization in various milestones following UCLR.

Conclusion Professional position players begin swinging at 150 days following UCLR while they do not hit batting practice until 195 days and do not hit in a real game until 323 days following UCLR. Players saw a decrease in hitting utilization following UCLR.

A COMPARATIVE STUDY OF THE EFFECTIVENESS OF ULTRASOUND-GUIDED PUNCTURE-ASPIRATION VS. ARTHROSCOPIC TREATMENT FOR ROTATOR CUFF CALCIFIC TENDINOPATHY

Carlos Daniel Lobo-Oropeza, Carlos Daniel Lobo-Oropeza, Roger Rojas, Andrés Alex Faria. Venezuela

Summary Ultrasound-guided puncture-aspiration and arthroscopic treatment offer good results for the treatment of rotator cuff calcific tendinopathy. Both treatments bring about significant clinical and functional improvement in patients. In this study, no statistically significant differences were found in terms of improvements on the DASH scale or Constant scale at 6 and 12 months in patients treated by both treatments. Calcific tendinopathy of the rotator cuff is one of the main causes of the non-traumatic painful shoulder between 40–60 years of age. It can cause acute and chronic inflammatory symptoms with disabling pain. Objectives The objective of this study was to analyze a cohort with borderline dysplastic hips who were treated by hip arthroscopy to classify specific hip morphology subtypes according to radiographic abnormalities and to report the short-term clinical outcomes of these different clusters.

Methods Patients with a lateral center-edge angle (LCEA) between 18° and 25° who underwent hip arthroscopy between January 2015 and December 2016 were examined. According to the radiographic parameters, including the LCEA, Femoro-Epiphyseal Acetabular Roof (FEAR) index, anterior and posterior wall index (AWI and PWI), Tönnis angle, alpha angle and femoral neck-shaft angle, a hierarchical cluster analysis was performed to identify the hip morphology subtypes. In addition, the International Hip Outcome Tool-12 (iHOT-12) and a pain visual analog scale (VAS) were applied preoperatively and at follow-up and compared among the different clusters.

Results A total of 40 patients with an LCEA between 18° and 25° who underwent hip arthroscopy between January 2015 and December 2016 were identified. Thirty-six patients were available for evaluation at a mean follow-up of 43.8 months. In total, 4 different sex-independent clusters with different patterns of hip morphology were identified: cluster 1: the unstable anterolateral deficiency cluster; cluster 2: the stable anterolateral deficiency cluster; cluster 3: the stable lateral deficiency cluster; and cluster 4: the stable posterolateral deficiency cluster. At follow-up, all groups had significantly improved iHOT-12 (p<0.0001) and pain VAS scores (p=0.0001). Within the individual clusters, clusters 2 and 3 showed highly significant improvements, cluster 1 showed significant improvements, and cluster 4 showed no significant improvements.

Conclusion Evaluating and grading the hip morphology of patients with borderline dysplasia is crucial since the clinical outcomes differ among the various clusters. Hip arthroscopy produces excellent results for stable anterolateral and lateral deficiency borderline hips. In contrast, borderline dysplastic hips with additional acetabular retroversion showed no improvement after arthroscopic therapy.
of the study was to compare the therapeutic effectiveness of ultrasound-guided puncture-aspiration versus arthroscopic treatment for rotator cuff calcific tendinopathy in patients in whom conservative treatment has failed.

**Study Design & Methods** All patients treated by means of ultrasound-guided puncture-aspiration and/or arthroscopic treatment for rotator cuff calcific tendinopathy in our center from May 2017 to January 2019 were included. Demographic data, the morphology and location of the lesion, the therapeutic procedure as well as its clinical evolution were retrospectively evaluated using the Constant and DASH scales. The evaluations were carried prior to the procedures and at six months and one year after the intervention. A statistical analysis of the data was carried out using the SPSS Statistics software package.

**Results** The mean age of the 32 patients who were included was 46 years and 21 (65.6%) of them were women. Ultrasound-guided puncture-aspiration was carried out on 17 patients (53.1%) and 15 patients (46.9%) were treated with resection and arthroscopic repair. In 3 cases (9.3%), both therapeutic techniques were performed due to there being no clinical improvement after performing ultrasound-guided puncture-aspiration alone. The lesion affected the dominant shoulder in 91% of the patients. The lesion was located in the supraspinatus tendon in 94% of all the cases. The score on the DASH scale and Constant scale prior to treatment in the ultrasound-guided aspiration group was 51.2 and 39.8, respectively. After the therapeutic procedure, they stood at 17.3 and 82 at 6 months and 14.3 and 87 at 12 months, respectively. The DASH scale and Constant scale scores in the arthroscopic group were 49.2 and 42.5 before treatment. After surgery, they were 26.7 and 70.5 at 6 months and 16.6 and 84.5 at 12 months. No statistically significant differences were seen in the statistical analysis relative to the Constant and DASH scales in the evaluations prior to surgery. Neither were any statistically significant differences seen at 6 and 12 months for either of the two therapeutic procedures.

**Conclusions** Ultrasound-guided puncture-aspiration and arthroscopic treatment offer good results for the treatment of rotator cuff calcific tendinopathy. Both treatments bring about significant clinical and functional improvement in patients. In this study, no statistically significant differences were found in terms of improvements on the DASH scale or Constant scale at 6 and 12 months in patients treated by ultrasound-guided aspiration when compared to those treated with arthroscopic surgery.
19109  LOWER SOCIOECONOMIC STATUS ADVERSELY AFFECTS ACCESS TO CARE AND THE RATE OF INSTABILITY EVENTS AND BUCKET HANDLE MENISCUS TEARS FOLLOWING ANTERIOR CRUCIATE LIGAMENT TEARS

Edward S Chang, Blake M Bodendorfer, Andrew Curley, David X Wang, Christine Conroy, Mark Hopkins, Brian McCormick, Caroline Fryar. USA

10.1136/jisakos-2021-congress.5

Summary Insurance status, primary language spoken, education and income impact the access to and utilization of orthopaedic care after an ACL tear, which may affect preoperative instability events and concomitant injuries such as bucket handle tears of the meniscus at the time of ACL reconstruction.

Data

Introduction While cost is readily assumed to be a significant barrier to accessing healthcare, this may only be one of many factors that delay patients from seeking early treatment following musculoskeletal injuries. The primary aim of this study was to further define the impact of socioeconomic factors on the access to and utilization of orthopaedic care after an anterior cruciate ligament (ACL) rupture. The secondary goal was to determine if these variables were associated with preoperative instability events and bucket handle tears of the meniscus discovered at the time of surgery.

Methods All patients undergoing ACL reconstruction at our institution from October 2015 through November 2018 were surveyed to determine income, primary language, education level and preoperative instability episodes. A chart review was then performed for insurance status, dates of injury, first visit with orthopaedics, date of surgery, intraoperative pathology, and length of follow-up. Multivariate regression analysis was utilized to select independent predictors of outcome variables. A multiple linear regression model with stepwise backward elimination was used for continuous outcome variables. Multivariate logistic analysis was used for the presence of a bucket handle meniscal tear at the time of surgery. *P<0.05 was considered significant.

Results After application of inclusion criteria, 230 patients were included with a mean±SD age of 26.5±9.9 years. Insurance status, dates of injury, first visit with orthopaedics, date of surgery, intraoperative pathology and length of follow-up were thus available for these patients. 126 of these patients responded to the survey regarding income, primary language, education level and preoperative instability episodes. Patients with government insurance saw an orthopaedic surgeon 39.4 weeks later (*P=0.012) and had surgery 5 weeks later than those with private insurance (*P=.016). English speakers saw an orthopaedic surgeon 53.7 weeks earlier than Spanish speakers (*P=0.027) and had an average of 0.8 less instability episodes before surgery (*P<0.001). Non-English speakers had an increased risk of having a bucket handle tear at the time of surgery (OR=4.62; 95%CI%=1.7677–21.33). Patients with an income greater than $100,000/year had 0.325 less instability episodes before surgery (*P=.040). Patients with a college degree saw a surgeon 36.0±SD weeks earlier than patients without a college degree (*P=0.023). Patients with an annual household income less than $100,000 were more likely to have a bucket handle tear (OR=7.4; 95%CI%=1.2–53.4).

Conclusion Insurance status, primary language spoken, education and income impacted the access to and utilization of orthopaedic care after an ACL rupture, which may affect preoperative instability events and concomitant injuries such as bucket handle tears of the meniscus at the time of ACL reconstruction.

19110  THE OUTCOME OF BALANCE EXERCISES AND AGILITY TRAINING FOR POST ANTERIOR CRUCIATE LIGAMENT (ACL) RECONSTRUCTION: CLINICAL ASSESSMENT

Siti Maizatul Akmal Ismail. Malaysia

10.1136/jisakos-2021-congress.6

Summary Post Anterior Cruciate Ligament (ACL) reconstruction: clinical assessment

Data

Introduction Rehabilitation process was as important as the reconstruction surgery. Rehabilitation could be initiated after the surgery to ensure safe returned of patients to sports ACL reconstruction. To evaluate of the balance exercises and agility training for post ACL reconstruction. The Primary Outcomes such as the functional score assessments were the Lysholm and the Tegner system, Secondary Outcomes were the rollimeter, thigh circumference and physical assessment. To compare balance exercises and agility training for group 1 was the 18 weeks standard regime group which had one component only such as strength exercises, and group 2 was the 24 weeks new regime which had three components advantages such as balance exercises, agility training exercises, and strength exercises.

Methods The main objective of this researched was to show that one group had significant different values compared to the other group: ie *p<0.05. Patients data from ACL reconstruction in Selayang and Sg Buloh Hospitals from 2012 to 2016, in this studied from Malaysian Knee Ligament Registry (MKLR). All patients had single bundle reconstruction with autograft hamstring tendon (Semitendinosus and Gracilis). Evaluation format were based on clinical assessment (anterior drawer, lachman, pivot shifted, laxity with rollimeter, end pointed and thigh circumference) and (Lysholm knee scoring and Tegner activity levelled scale). Group 1 was the 18 weeks Standard Regime group which had one component only such as strength exercises, and group 2 was the 24 weeks New Regime which had three components advantages such as balance exercises, agility training exercises, and strength exercises. That the following evaluation at 24 weeks for primary outcomes were Lysholm and Tegner; and secondary outcomes were the rollimeter, thigh circumference and physical assessment.

Results The results of researched as the baseline socio-demographic characteristics between the participants in the two groups were compared. There was no significant difference in the baseline socio-demographic characteristics across the two groups. The extent and severity of measured by questionnaire demonstrated no statistically significant difference between the two groups. Summary of differences in participants’ baseline characteristics between groups. The two group were comparable in socio-demographic background, age, weight, height, gender (male/female) and BMI. After 24 weeks evaluation in the two groups, there no laxity recorded in the physical examination tests such as anterior drawer test (ADT), pivot test and, Lachman test.

Discussion and Conclusions The discussions of the researched such as the functional scores in the new regime were significantly higher than in the standard regime. The Standard
Superior capsule reconstruction does
partially restore glenohumeral stability in
massive posterosuperior rotator cuff
deficiency – a dynamic robotic shoulder model

**Methods**

Twelve fresh-frozen cadaveric shoulders were tested using a 6-degrees-of-freedom robotic arm (KR 60-3; KUKA Robotics). Kinematic testing was performed in 4 conditions: (1) intact, (2) simulated irreparable supraspinatus tendon tear, (3) simulated irreparable supraspinatus and infraspinatus tendon tear, and (4) SCR using a 3 mm thick dermal allograft (DA). Kinematic testing consisted of dynamic flexion and static 40° superior force tests at neutral abduction, 30°, 60° and 90° of abduction. In each test, superior glenoid translation was measured, and for static testing, linear mixed-effects models were used to compare across repeated measures shoulder conditions at each abduction angle.

**Results**

In dynamic flexion testing, there was an average increase in superior translation of 2.1±1.7 mm for the supraspinatus cut state, 2.8±1.8 mm for the supra- and infraspinatus cut state, and 1.3±1.7 mm for SCR, when compared to the native state. In static testing, in all degrees of abduction the supraspinatus cut and the supra- and infraspinatus cut states showed a significant increase in superior translation compared to the native state (all p<0.001). Supra- and infraspinatus cut increased superior translation significantly when compared to supraspinatus cut only in neutral and 60° of abduction (p=0.030 and p=0.022). SCR was able to significantly decrease superior translation in all degrees of abduction when compared to the supra- and infraspinatus cut (all p<0.02), and in neutral position and 60° of abduction when compared to supraspinatus cut only (all p<0.05). When compared to the native state, SCR was not able to restore superior stability with a significant increase of translation for neutral position, 30°, and 60° of abduction (p<0.001).

**Conclusion**

Superior capsule reconstruction using a dermal allograft partially restored superior stability of the glenohumeral joint in the presence of a simulated massive posterosuperior rotator cuff tear in a dynamic and static robotic shoulder model.

**Summary**

Presented surgical technique improved both valgus and anterior stability, and led to excellent short term results at final follow up.

**Data**

**Introduction**

Combined lesions of anterior cruciate ligament (ACL) and medial collateral ligament (MCL) are frequent in adult due to sports injury and trauma. In cases of chronic anterior cruciate ligament (ACL)-medial collateral ligament (MCL) lesions, nonoperative treatment of the MCL lesion may lead to chronic valgus instability and rotatory instability. The optimal management for patients who have combined ACL-MCL injuries remains controversial. Present study wants to evaluate the surgical technique for treatment of concomitant MCL and ACL lesion and report short term outcome result in our institute.

**Purpose**

To present a case series of 40 patients who underwent simultaneous ACL-MCL reconstruction with a year follow-up. STUDY DESIGN: Case series; Level of evidence, 4.

**Methods**

From October 2017 to December 2018, a total of 40 patients with chronic ACL-MCL injuries, for which the 2 ligaments were reconstructed arthroscopically during the same surgical procedure, were studied in National Institute of Traumatology and Orthopedics Rehabilitation (NITOR), Dhaka, Bangladesh. 40 Patients with chronic ACL rupture and grade III MCL-lesion were included. All patients received surgical treatment of concomitant MCL lesion by Ipsilateral semitendinosus tendon and ACL reconstruction by opposite semitendinosus with ipsilateral gracilis tendon All patients were available for follow-up for at least 1 years. The International Knee Documentation Committee (IKDC) subjective knee scores, valgus and sagittal stability, anteromedial rotatory stability, range of motion, and complications were assessed both preoperatively and postoperatively.

**Results**

At follow-up, valgus and sagittal laxity were not observed in any of the patients. The mean medial knee opening was significantly reduced to 0.80 ± 0.96 mm (range, −1.2 to 2.6 mm) postoperatively compared with 8.0 ± 1.3 mm (range, 6.1 to 10.7 mm) preoperatively (P < .01). The mean postoperative side-to-side difference measured with the KT-1000 arthrometer was reduced to 0.8 ± 0.9 mm (range, −1.2 to 2.3 mm) compared with 8.4 ± 1.6 mm (range, 6.2 to 13.2 mm) preoperatively (P < .01). Preoperative anteromedial instability was seen in 76% of patients (33/40), whereas...
none of the patients had anteromedial rotatory instability at the last follow-up. The mean IKDC subjective score improved overall from 45.3 ± 12.0 (range, 28.7–69.0) preoperatively to 87.7 ± 8.2 (range, 65.5–100.0) at the last follow-up (P < .01). Most patients (38/40) had normal or nearly normal range of motion of the knee joint; only 2 patient (5%) had a limitation of flexion of 15° compared with the contralateral knee at the last follow-up.

Conclusion In patients with chronic ACL-MCL lesions, presented surgical technique with simultaneous reconstruction of the ACL and MCL can significantly improve the medial, sagittal, and rotatory stability of the knee at short-term follow-up.

**19107** SIMILAR JOINT SPACE MEASUREMENTS ARE OBTAINED WITH SUPINE AND WEIGHTBEARING ANTEROPosterIOR PELVIS RADIOGRAPHS: RESULTS OF A PROSPECTIVE STUDY

Austin M Looney, Blake M Bodendorfer, Vishal A Mehta, Austin M Looney, Kenneth Tepper. USA

10.1136/jisakos-2021-congress.9

Summary Previous literature has presented conflicting data as to whether weightbearing and supine radiographs present different measurements for joint space width at the hip; we demonstrate no significant difference between measurements obtained during weightbearing and supine radiographs, and thus, orthopaedic surgeons may be able to avoid obtaining multiple radiographs.

Data

Introduction Osteoarthritis and joint space narrowing of the hip have been correlated with poor outcomes and conversion to arthroplasty after hip arthroscopy. However, a standardized protocol for radiographic measurement of minimal joint space width of the hip has not been developed and there is conflicting data as to whether weightbearing and supine radiographs present different measurements for joint space width at the hip. We hypothesized that minimal joint space width would be significantly lower on the affected side in weightbearing anteroposterior pelvis radiographs versus supine radiographs. We also hypothesized that radiographs with single-leg stance would show the lowest minimal joint space width. Lastly, we hypothesized that patients older than 50 years would have significantly lower joint space width compared to younger patients.

Methods Adult patients with hip pain were prospectively enrolled and each had single-leg and double-leg weightbearing and supine anteroposterior pelvis radiographs in a standardized position. Two independent investigators determined minimal joint space width by measuring joint space width at the lateral sourcil, middle sourcil and fovea of the hip. Differences between minimal JSW as well as interobserver reliability (intraclass correlation coefficient, ICC) were calculated. One and 2-way analyses of variance (ANOVA) were used to compare the measurements. Power analysis determined that recruitment of 30 patients was necessary to achieve 90% power. P<0.05 was considered significant.

Results Thirty-one consecutive adult patients were prospectively enrolled after informed consent and institutional review board approval. The mean ± SD age of participants was 53.8 ± 14.1. Female and male participants comprised 61.3% and 38.7% of the sample, respectively. Interobserver reliability was good (0.75 = ICC = 0.9) at the lateral sourcil and excellent (ICC > 0.9) at the middle sourcil and fovea. No significant differences in joint space width were found between supine or weightbearing radiographs for any pelvis site (P>0.770). Joint space width was significantly lower in those over 50 years of age as compared to younger patients for all stances (P=0.002).

Conclusion These findings suggest that either weightbearing or supine anteroposterior pelvis radiographs can be used to evaluate hip joint space width. Thus, orthopaedic surgeons may be able to avoid obtaining multiple radiographs for patients who are being evaluated for hip preservation surgery presenting with hip pain.

**19108** SIGNIFICANT VARIABILITY EXISTS IN PREOPERATIVE PLANNING SOFTWARE MEASURES OF GLENOID MORPHOLOGY FOR SHOULDER ARTHROPLASTY

Nicholas C Laucis, Alex R Webb, David X Wang, Daniel M Dean, Joseph L Rabe, David Matthew Lutton, Steven B Soleman, Blake M Bodendorfer. USA

10.1136/jisakos-2021-congress.10

Summary As preoperative planning software and patient-specific instrumentation are both becoming more frequently utilized in an effort to provide better outcomes for patients with glenohumeral arthritis, it is important to consider the accuracy of these software programs as compared to manual measurement; this study shows a high degree of variability among programs for glenoid version and inclination.

Data

Introduction Three-dimensional imaging and preoperative planning software have become increasingly utilized in an effort to improve component positioning in shoulder arthroplasty. We sought to assess the interrater reliability and concordance with a gold standard comparator of 4 different 3-dimensional preoperative planning programs for shoulder arthroplasty. We hypothesized that that there would be significant variation in measures of glenoid anatomy and these differences would be affected by glenoid deformity.

Methods A retrospective review of shoulder computed tomography (CT) scans of patients undergoing shoulder arthroplasty was undertaken. An a priori power analysis was performed and it was determined that 76 CT scans were necessary to achieve 80% power. CTs were uploaded to 4 separate templating software systems (VIP, BluePrint, TrueSight, ExactechGPS). Version and inclination of glenoids as measured by each software were extracted for comparison. Interrater reliability was assessed via a 2-way mixed effects intra-class correlation coefficient (ICC). ICC was also calculated when subgrouping glenoids by Walch classification. Lin’s concordance correlation coefficient (CCC) was calculated for each system with a musculoskeletal-trained radiologist’s measurements used as a gold standard.

Results Shoulder CT scans for 76 patients were obtained. Measures of glenoid version differed between at least 2 modes of measurement by 5°-10° in 58 (76%) glenoids and >10° in 10 (13%) glenoids. Measures of glenoid inclination differed between at least 2 modes of measurement by 5°-10° in 69 (91%) glenoids and >10° in 36 (47%) glenoids. ICC was good-to-excellent for version but only moderate-to-good for inclination. ICC was significantly higher for Walch A glenoids as compared to Walch B glenoids. VIP had the highest
concordance with gold standard while Tornier had the lowest when measuring version CCC. Tornier had the highest concordance with gold standard and ExactechGPS had the lowest when measuring inclination CCC.

**Conclusion** There is significant variability in CT-based measures of glenoid version and inclination between 4 different shoulder arthroplasty templating softwares which worsens with glenoid deformity. Concordance with a gold standard comparator is also variable. Further research is needed to better understand how this variability should be accounted for during preoperative planning for shoulder arthroplasty.

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**19122 RETURN TO PLAY AFTER ARTHROSCOPIC MANAGEMENT OF ROTATOR CUFF TEARS IN PROFESSIONAL CONTACT ATHLETES**

Luis A Vargas, Gautam Yagnik, Luis A Vargas, John W Uribe, John E Zvijac, Jacob Seiler. USA

10.1136/jisakos-2021-congress.11

**Summary** The majority (80%) of the professional contact athletes in this series were able to return to play at the same professional level after arthroscopic management of a symptomatic rotator cuff tear.

**Data**

**Objectives** The purpose of this study was to report on the clinical outcomes and return to play rates of professional contact athletes that underwent arthroscopic management of rotator cuff tears at our institution.

**Methods** A retrospective review was performed on 10 rotator cuff tears in 9 professional contact athletes that underwent arthroscopic management of a rotator cuff tear from 2002–2019 at our institution. 8 tears occurred in elite American football players. The remaining 2 were In professional hockey players. The average age of the players was 28.7 ± 4.8 years. The primary outcome measure was the ability to return to play and the number of games played after surgery. Return to play and career length data were collected through publicly available internet sources (NFL, CFL and NHL statistical websites) as well as from the team’s medical staff.

**Results** 80% of the athletes that underwent arthroscopic management of a rotator cuff tear in this study were able to return to play at the same professional level. The average age of the players that returned to play was 27.3 ± 4.2 years and the average time to return to play was 7.9 ± 1.9 months. The majority of the injuries in American football (6 of 8) occurred in defensive players. The 2 tears occurred in hockey were offensive players. All regained sufficient range of motion, strength and function to participate in at least one regular season game. For the football players, the average playing experience after surgery was 32 ± 25 games played. For the hockey players, 22 ± 11 games played. 9 of the 10 tears were full thickness that underwent arthroscopic repair while 1 was a partial tear that was debrided. The average tear size was 1.95 ±0.9 cm. The average number of suture anchors used was 1.35 ± 0.7. All tears involved the subsuprascapular rotator cuff tendon and 4 were classified as small tears (<1cm), 3 as medium tears (1–3 cm) and 2 as large tears (3–5 cm). 7 of the 10 tears underwent acute surgical repair (<2 weeks from date of injury), while 3 players underwent delayed surgical intervention at the end of the season. Post-operative imaging was available in 8 of the 10 tears and 7 of 8 (88%) demonstrated a healed repair. No intra-operative complications were noted. 2 players with large (3–5 cm) full thickness tears did not return to play. The average age was 34.5 years and both had > 10 years of professional playing experience. One was an NFL player with a repair failure at 6 months on post-operative imaging and elected to retire. The second was an NHL player that retired for reasons unrelated to his shoulder, despite a good clinical outcome and a healed repair on post-operative imaging.

**Conclusions** The majority (80%) of athletes in this series were able to return to play at the same professional level after arthroscopic surgery. Older players with > 10 years of professional experience and large rotator cuff tears were less likely to return to play after surgical intervention.

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**19200 ARTHROSCOPIC MENISCAL ALLOGRAFT TRANSPLANTATION WITH INTERMENISCAL LIGAMENT TENODESIS IS EFFECTIVE IN REDUCING INITIAL EXTRUSION**

Nicolas Pujol. France

10.1136/jisakos-2021-congress.12

**Summary** Adding a tenodesis or reconstruction of the IML can significantly limit early extrusion of the meniscal allograft. Clinical outcomes are not different when compared to standard procedure, but it may justify a long-term assessment of these patients in order to know if the incidence of osteoarthritis would decrease with technique.

**Data**

**Background** Meniscal allograft transplantation (MAT) is indicated in the treatment of post meniscectomised knee syndrome in young patients without severe cartilage loss. Its clinical efficiency is well established at short to mid-term but osteoarthritis still continues to progress with time. A meniscal extrusion occurs often initially and is irreversible. The aim of this study was to evaluate results of arthroscopic meniscal allograft transplantation associated with a reconstruction of the intermenisical ligament (IML). The hypothesis was that concomitant reconstruction of the IML would decrease the incidence of early allograft extrusion when compared to conventional soft-tissue techniques.

**Materials and methods** This is a monocentric retrospective comparative study of patients operated on between 2011 and 2018. There were two groups: Group IML (MAT with IML repair, n=14) and Group no IML (MAT without IML repair, n=20). Clinical outcomes were evaluated by using the KOOS score at last follow-up and by assessing the rate of secondary surgical procedures. MRI was performed at a minimum of 12 months (mean 35±25 months) to determine absolute and relative meniscal extrusion, sagittal anterior and posterior extrusion and index of cartilage coverage in the frontal and sagittal cuts.

**Results** The KOOS score was not significantly different between the two groups. There was no secondary procedure in Group IML and 4 in Group no IML (13%). There was a meniscal extrusion of the allograft in 43% (6/14) of the cases in group IML versus 85% (17/20) in the no IML Group (p<0.03). Absolute meniscal extrusion was 2.9 mm ([2.2–3.6] SD=1.2) in Group IML and 5.4 mm ([4.1–6.7]; SD=2.9) (p = 0.004) in Group no IML.
Discussion adding a tenodesis or reconstruction of the IML can significantly limit early extrusion of the meniscal allograft. Clinical outcomes are not different when compared to standard procedure, but it may justify a long-term assessment of these patients in order to know if the incidence of osteoarthritis would decrease with technique. Level of evidence: IV; retrospective cohort study

**19155** SEQUENTIAL CHANGE IN POSTERIOR TIBIAL TRANSLATION AFTER POSTERIOR CRUCIATE LIGAMENT RECONSTRUCTION: RISK FACTORS FOR RESIDUAL POSTERIOR SAGGING

Yuta Tachibana, Yoshinari Tanaka, Kazutaka Kinugasa, Masayuki Hamada, Shuji Horibe. Japan

10.1136/jisakos-2021-congress.13

Summary This study shows (1) posterior tibial translation significantly reduced from 10.1 ± 2.3 mm to −0.8 ± 1.2 mm immediately after PCLR, but it significantly increased within 3 months (4.1 ± 2.7 mm) and no further progression was observed over 2 years (4.4 ± 1.9 mm), and (2) preoperative grade III injury was independently associated with residual posterior sagging (OR: 26.8; 95% CI: 2.0–282.7; P < 0.001).

Data

Purpose Residual posterior sagging may occur after posterior cruciate ligament (PCL) reconstruction (PCLR), yet when it mainly occurs is not fully understood. This study aimed to elucidate sequential changes in radiographic posterior tibial translation (PTT) through PCLR.

Methods Radiographic findings from 22 patients who underwent bi-socket double-bundle PCLR for isolated grade II or III PCL injury from January 2007 to December 2016 with at least two years of follow-up (mean: 4.5 years; range: 2–12 years) were retrospectively investigated. On lateral radiographs with gravity sag views, PTT (side-to-side difference of the tibiofemoral relationship) was serially measured preoperatively and immediately, three and six months, and one and two or more years postoperatively. Risk factors for residual posterior sagging, indicating the PTT was 5 mm or more (grade = II) at two or more years postoperatively, were also investigated using a multivariable logistic regression analysis.

Results The PTT was 10.1 ± 2.3 mm preoperatively, then was reduced significantly to −0.8 ± 1.2 mm immediately after surgery (P < 0.001). Subsequently, the PTT was significantly increased by 5.2 ± 2.6 mm up to 4.1 ± 2.7 mm at three months postoperatively (P < 0.001). Then, no significant changes at six months (4.1 ± 2.5 mm), one year (4.4 ± 2.1 mm), and two or more years (4.4 ± 1.9 mm) postoperatively were observed. Seven cases of residual PTT with grade II at two or more years after PCLR were identified, whereas no patient underwent revision PCLR due to subjective recurrent instability and no instance of grade III injury persisted to the final follow-up. PTTs with residual posterior sagging were significantly larger than those without residual posterior sagging at all time points except for immediately postoperatively (preoperatively, 9.1 ± 1.6 vs. 12.2 ± 2.2 mm (P < 0.001); immediately postoperatively, −0.8 ± 1.3 vs. −0.8 ± 0.8 mm (P = 0.950); three months postoperatively, 2.7 ± 1.6 vs. 7.0 ± 1.8 mm (P < 0.001); and two or more years postoperatively, 3.4 ± 1.0 vs. 6.6 ± 1.4 mm (P < 0.001)]. Multivariate logistic regression analysis showed preoperative grade III injury was independently associated with residual posterior sagging (odds ratio: 26.809; 95% confidence interval: 2.037–282.672; P < 0.001). Meanwhile, the receiver operating characteristic analysis highlighted a cutoff value of 12.64 mm for the preoperative PTT as the optimal threshold for differentiating the two groups with and without residual posterior sagging (sensitivity: 71.4%; specificity: 100.0%).

Conclusion The initially reduced postoperative PTT significantly increased within three months with conventional rehabilitation protocols but no progression was observed up to 4.5 years after PCLR. Preoperative grade III injury was independently associated with residual posterior sagging. Therefore, we recommend that clinicians consider the preoperative PTT as a risk factor for postoperative residual posterior sagging and take meticulous care, especially in the early postoperative period, to protect the transplanted PCL graft even if the PTT could be reduced immediately after PCLR.

**19140** CLASSIC VS CONGRUENT-ARC LATARJET PROCEDURE IN ATHLETES WITH RECURRENT GLENOHUMERAL INSTABILITY AND A SIGNIFICANT GLENOID BONE LOSS

Luciano A Rossí, Ignacio Tanoira, Tomás David Gorodisher, Maximiliano Ranalletta. Argentina

10.1136/jisakos-2021-congress.14

Summary most of the athletes with recurrent glenohumeral instability who underwent either classic or congruent arc Latarjet surgery were able to return to sports at the same level they had prior to injury with full recovery of shoulder function and a similary rate of complications, regardless of the surgical technique used.

Data The purpose of this study was to compare return to sports, functional outcomes and complications of the “classic Latarjet” vs the “congruent arc Latarjet” procedures in athletes with recurrent glenohumeral instability and glenoid bone deficiency. Methods An analytical observational study was conducted with two retrospective cohorts of athletes with recurrent glenohumeral instability and glenoid bone deficiency who underwent surgery at our institution: (1) Cohort who underwent “classic” Latarjet surgery (January 2010 – December 2014); (2) Cohort who underwent “congruent arc” Latarjet surgery (January 2015 – May 2017). We evaluated return-to-sport, the sport level achieved and the time elapsed from surgery to return to competition. For the functional assessment of the shoulder, we measured the range of motion (ROM), the Rowe score, the visual analogue scale and the AOSSS score. Consolidation and correct positioning of the graft were evaluated by means of 3D computed tomography in all patients. All intraoperative and postoperative complications were documented. All the results were compared between the two patient cohorts. Results A total of 270 patients were evaluated; 150 (55.6%) were operated on using the congruent arc Latarjet technique and 120 (44.5%) were operated on using the classic Latarjet technique. The average follow-up period was 41.2 months (range of 24–90 months). Eighty-nine percent of the patients were able to return to sports and, of these, 91% were able to compete again at the same level. The global average interval between surgery and return to sports was 5.4 months. We found no significant differences in terms of the return-to-sport rate, the level achieved or the return-to-sport time among the groups operated on.
with either the congruent arc or the classic Latarjet surgeries. Range of motion, the Rowe score, the visual analogue score (VAS) and the ASOSS score showed significant improvement after surgery (P<0.001). We found no statistically significant differences in the range of motion nor in the functional scores between the patients who underwent the classic Latarjet surgery and those operated on with the congruent arc technique. In total, there were 40 complications (14.8%) and 10 reoperations (3.7%). No significant differences were found in terms of percentage of complications and reoperations between the two types of surgery. The follow-up 3D tomography was performed at an average of 3.4 months. The graft consolidated in 92.6% of the patients. From the axial view, 90.7% of the grafts were within the expected range (−5 mm to +3 mm). In contrast, 5% of the grafts were medialized and 4% were lateralized. At the end of the follow up period, 10% of the patients had mild arthrosis and 5.5% exhibited moderate arthrosis. Conclusion In conclusion, most of the athletes with recurrent glenohumeral instability who underwent either classic or congruent arc Latarjet surgery were able to return to sports at the same level they had prior to injury with full recovery of shoulder function and a simialry rate of complications, regardless of the surgical technique used.

**19197 SURVIVORSHIP AND PATIENT-REPORTED OUTCOMES AFTER COMPREHENSIVE ARTHROSCOPIC MANAGEMENT OF GLENOHUMERAL OSTEOARTHRITIS: MINIMUM 10-YEAR FOLLOW-UP**

Justin W Arner, Bryant Elrick, Daniel B Haber, Philip Nolte, Marilee P Horan, Peter J Millett, USA

10.1136/jisakos-2021-congress.15

**Summary** Significant improvement in patient reported outcomes were sustained at minimum 10-year follow-up in young patients with GHOA who underwent a CAM procedure.

**Data**

**Background** Few long-term outcome studies exist evaluating glenohumeral osteoarthritis (GHOA) treatment with arthroscopic management.

**Purpose** To determine outcomes, risk factors for failure, and survivorship for the comprehensive arthroscopic management (CAM) procedure for the treatment of GHOA at minimum 10-year follow-up. Study Design: Case series; Level of evidence, 4.

**Methods** The CAM procedure was performed on a consecutive series of patients with advanced GHOA who opted for joint preservation surgery that otherwise met criteria for total shoulder arthroplasty (TSA). At minimum 10-year follow-up, pre- and post-operative outcome measures collected included the American Shoulder and Elbow Surgeons (ASES), Single Assessment Numeric Evaluation (SANE), Short Form-12 (SF-12) Physical Component Summary (PCS), visual analog scale for pain, and satisfaction scores. Kaplan-Meier survivorship analysis was performed with failure defined as progression to arthroplasty.

**Results** Thirty-eight CAM procedures were performed with 10-year minimum follow-up (range, 10–14 years) with a mean age of 53 years (range, 27–68) at time of surgery. Survivorship was 75.3% at 5 years and 63.2% at minimum 10 years. Those who progressed to arthroplasty did so at a mean of 4.7 years (range, 0.8–9.6 years). For those who did not undergo arthroplasty, ASES scores significantly improved post-operatively at both 5 and 10 years (63.3–89.6, p<0.001; 63.3–80.6, p=0.007). CAM failure was associated with severe pre-operative humeral head incongruity in 93.8% of failures compared to 50.0% of patients who did not go onto arthroplasty (p= 0.008). Median satisfaction was 7.5 out of 10.

**Conclusions** Significant improvement in patient reported outcomes were sustained at minimum 10-year follow-up in young patients with GHOA who underwent a CAM procedure. Survivorship rate at minimum 10-year follow-up was 63.2%. Humeral head flattening and severe joint incongruity were risk factors for CAM failure. The CAM procedure is an effective joint preserving treatment for GHOA in appropriately selected patients with sustained positive outcomes at 10 years.

**19156 RADIOGRAPHIC INDICES ARE NOT PREDICTIVE OF CLINICAL OUTCOME AMONG 1,735 PATIENTS INDICATED FOR HIP ARTHROSCOPY: A MACHINE LEARNING ANALYSIS**

Prem N Ramkumar, Jaret M Karnuta, Heathor S Haebeler, Spencer Sullivan, Danyal H Nawabi, Anil S Ranawat, Bryan T Kelly, Benedict U Nwachukwu, USA

10.1136/jisakos-2021-congress.16

**Summary** No radiographic indices were found to be predictive of achieving the minimal clinically important difference (MCID) for the modified Hip Harris Score (mHHS), the Hip Outcome Score (both HOS-ADL and HOS-SS) or the international hip outcome tool (iHOT-33) in patients that underwent hip arthroscopy at either one or two-year postoperative follow-up.

**Data**

**Background** The relationship between the pre-operative radiographic indices for femoroacetabular impingement syndrome (FAIS) and post-operative patient-reported outcome measures (PROMs) continues to be under investigation with inconsistent findings reported. The purpose of the present study was to apply a machine learning model to determine which preoperative radiographic indices, if any, among patients indicated for arthroscopic correction of FAIS predict whether a patient will achieve the minimal clinically important difference (MCID) for one- and two-year PROMs.

**Methods** A total of 1,735 consecutive patients undergoing primary hip arthroscopy for FAIS were included from an institutional hip preservation registry. Patients underwent pre-operative computed tomography (CT) of the hip, from which the following radiographic indices were calculated by a musculoskeletal radiologist: alpha angle; beta angle; sagittal center edge angle; coronal center edge angle; neck shaft angle; acetabular version and femoral version angle. PROMs were completed preoperatively, one year postoperatively, and two years postoperatively for the modified Harris Hip Score (mHHS), the Hip Outcome Score (HOS) Activities of Daily Living Subscale (HOS-ADL) and Sport Specific Subscale (HOS-SS) as well as the international hip outcome tool (iHOT-33). Random forest models were created for each outcome measure at one and two years follow-up, with each outcome measures’ MCID used to establish clinical meaningfulness. Data inputted into the models included ethnicity, laterality, sex, age, body mass index (BMI), and radiographic indices. Comprehensive and separate models were built specifically to assess association
Magnetic resonance imaging (MRI) after anterior cruciate ligament (ACL) reconstruction demonstrates that hamstring grafts heal and integrate at different rates.

**Summary**: New MRI analysis at 1 and 2 years after ACL reconstruction demonstrates that hamstring grafts heal and integrate at different rates.

**Data**

**Purpose**: To establish whether a hamstring ACL reconstruction graft changes in appearance on MRI between 1 and 2 years, and whether it affects a patient’s ability to return to sport.

**Methods**: Patients with a hamstring autograft ACL reconstruction using adjustable suspensory fixation had MRI and clinical outcome measures at 1 and minimum 2 years. Signal intensity ratio (SIR) at multiple areas using oblique reconstructions both parallel and perpendicular with the graft were calculated alongside tunnel aperture sizes. Clinical outcome was side to side anterior laxity, and patient reported outcome measures (PROMs).

**Results**: Forty-two patients had full datasets. At 1 year the mean SIR for the graft was 2.7 ± 1.2, with proximal graft signal significantly higher than distal. Overall, there was no significant change at 2 years apart from those with the highest proximal graft signal (SIR > 4) at 1 year. This group had a reduction in signal and were also most likely to have a reduction in tunnel aperture area. The finding of tunnel aperture area reduction between 1 and 2 years was significant across the full cohort (mean tibial: –6.9 mm², p < 0.001, mean femoral: –13.5 mm², p < 0.001). A high patient sporting level was seen, with a median Tegner activity score of 6 [5–10], with a third of patients scoring either a 9 or 10. Overall, PROMs were not affected by MRI appearance.

**Conclusions**: In the majority of patients graft signal does not change after one year. However, a significant reduction is seen in those with high signal at one year. Tunnel contraction correlates with a reduction in graft SIR suggesting this could be a useful measure of graft integration.

**Abstracts**

**19120**

Superior Labrum Anterior-Posterior (SLAP) Repair versus Subpectoral Biceps Tenodesis for Isolated SLAP II Lesions in Overhead Athletes Aged Younger 35 Years: A Comparison of Minimum Two-Year Outcomes

Lucca Lacheta, 1Marilee P. Horan, 2Travis Dekker, 2Brandon Goldenberg, 2Grant J Dornan, 2Peter J Millett.

1Germany; 2USA; 3Australia; 4France

10.1136/jisakos-2021-congress.18

**Summary**: Both techniques of SLAP repair and subpectoral biceps tenodesis provide excellent clinical results with high return to overhead sports rate and low failure rate in a young and high-demanding patient cohort for the treatment of isolated SLAP type II lesions.

**Data**

**Objectives**: To evaluate clinical outcomes and return to sports rates in overhead athletes aged younger than 35 years suffering from symptomatic type II lesions who have undergone either biceps tenodesis or SLAP repair.

**Methods**: A retrospective analysis of prospectively collected data was performed in patients who underwent subpectoral biceps tenodesis (group I) or SLAP repair (group II) for the treatment of isolated SLAP type II lesions, were younger than 35 years at time of surgery, participated in overhead sports, and were at least two years out from surgery. Clinical outcomes were assessed by the use of the American Shoulder and Elbow Society Score (ASES), Single Assessment Numerical Evaluation Score (SANE), Quick Disabilities of the Arm, and Shoulder and Hand Score (QuickDASH) and the General Health SF-12 physical component. Return to sports and patient satisfaction were documented. Clinical failures requiring revision surgery and complications were reported.

**Results**: Minimum 2-year follow-up was obtained in 12/14 (85.7%) patients in group I and in 23/27 (85%) patients in group II. Preoperative baseline scores between both groups showed no significant differences (p > 0.05). When group I was compared to group II, no significant differences in postoperative outcome scores were detected (p > 0.05). For biceps tenodesis (Group 1) vs SLAP repair (Group II): ASES score was mean 91.6 ± 11.3 vs 88.6 ± 16.9, SANE score was mean 77.5 ± 28.0 vs. 82.3 ± 24.4, QuickDASH score was mean 9.2 ± 12.2 vs 9.4 ± 14.5, and SF-12 was mean 52.0 ± 6.1 vs 52.6 ± 7.8. No difference in return to sports rate (91% vs 91%, p > .05) was noted. 1 patient in group I and 2 patients in group II failed.

**Conclusion**: This study showed that both techniques of SLAP repair and subpectoral biceps tenodesis provide excellent clinical results with high return to overhead sports rate and low failure rate in a young and high-demanding patient cohort for the treatment of isolated SLAP type II lesions.

**19192**

Outcome Comparison of Graft Bridging and Superior Capsule Reconstruction for Large to Massive Rotator Cuff Tears

Jinrong Lin, Yaying Sun, Shaohua Liu, Zheci Ding, Jinwu Chen.

1Germany; 2USA; 3Australia

10.1136/jisakos-2021-congress.19

**Summary**: In general, graft bridging showed significantly better clinical and functional outcomes postoperatively than superior capsule reconstruction, with a similar complication rate.
Data
Background Graft bridging (GB) and superior capsule reconstruction (SCR) were developed to treat large to massive rotator cuff tears (RCTs); however, the outcome differences between GB and SCR remain unclear.

Purpose To systematically review and compare the outcomes of GB and SCR for large to massive RCT.

Methods A systematic review was performed via a comprehensive search of PubMed, Embase, and the Cochrane Library. Studies of GB or SCR were included according to the inclusion and exclusion criteria. The primary outcome was Constant-Murley score at the final follow-up. Secondary outcomes included the American Shoulder and Elbow Surgeons score, visual analog scale score for pain, active shoulder range of motion, and graft healing rate. Complication rate was the safety outcome measure. Outcomes were summarized into group SCR and group GB, and the results were compared statistically (P<0.05).

Results A total of 23 studies were included in this review: 238 repairs from the 5 studies in group SCR and 593 repairs from the 18 studies in group GB. For group SCR and group GB, the mean age was 61.6 and 63.3 years, and the mean follow-up was 18.0 and 40.1 months, respectively. Overall, both procedures demonstrated improvement of clinical outcomes. When compared with group SCR, group GB had significantly higher mean differences of the Constant-Murley score (41.9 vs 19.8), American Shoulder and Elbow Surgeons score (39.3 vs 33.8), visual analog scale score for pain (4.4 vs 3.4), and active external rotation at side (15.3 vs 9.3). No statistically significant difference was detected in the mean difference of active forward flexion, internal rotation, abduction, and graft healing rate between the groups. The complication rates were 0.84% (2 of 238) in group SCR and 0.67% (4 of 593) in group GB.

Conclusion In general, GB showed significantly better clinical and functional outcomes postoperatively than SCR, with a similar complication rate. The available fair-quality evidence suggested that GB might be a better choice for large to massive RCT. More high-quality randomized controlled studies are required to further evaluate the relative benefits of the 2 procedures.

Summary Meniscal repairs performed at the time of allograft ACL reconstruction are more likely to fail than those performed with bone-patellar tendon-bone autograft ACL reconstruction.

Data
Background Meniscal repair is commonly performed at the time of anterior cruciate ligament (ACL) reconstruction. However, the effect of ACL graft type on meniscal repair outcomes is unknown. The purpose of this study was to determine if ACL graft type influences the outcome of meniscal repairs performed at the time of ACL reconstruction. We hypothesize that meniscal repairs fail at the lowest rate when concomitant ACL reconstruction is performed with bone-patellar tendon-bone (BTB) autograft.

Methods Patients who underwent meniscal repair at the time of primary ACL reconstruction and had a minimum of 6-year follow-up data were identified from a longitudinal, prospective cohort. Meniscal repair failures, defined as any subsequent surgical procedure addressing the meniscus repaired at index surgery, were identified. After identifying patients with a subsequent meniscal surgery, operative notes were reviewed to accurately classify pathology and treatment of meniscus injuries. A logistic regression model was built to assess the association of ACL graft type, patient-specific factors (age, sex, and body mass index [BMI]), baseline Marx activity rating score, and meniscal repair location (medial or lateral) with the occurrence of repair failure at 6-year follow-up. Statistically significant results were determined by 95% confidence intervals that did not include the null value (1).

Results A total of 646 patients were included. (BTB and soft tissue (ST) autografts were used in 55.7% and 33.9% of cases, respectively. Various allografts were utilized in the remaining cases (10.4%). We identified 101 patients (15.6%) with a documented meniscal repair failure. The odds of meniscal repair failure within 6 years of index surgery for the BTB autograft group were 2.34 times that of the allograft group (95% CI: 1.1–4.9; P = 0.02). The odds of failure were 68% higher with medial versus lateral repairs (95% CI: 0.41–0.83; P < 0.001). There was a statistically significant, nonlinear relationship between baseline Marx activity level and the risk of meniscal repair failure—patients with low or high baseline activity were at the highest risk (odds ratio [OR]: 1.1; 95% CI: 1.05–1.3; P = 0.004). No significant differences in meniscal repair failure rate were observed based on patient age (OR: 0.87; 95% CI: 0.6–1.3; P = 0.48), sex (OR: 0.91; 95% CI: 0.6–1.5; P = 0.69) or BMI (OR: 0.8; 95% CI: 0.6–1.1; P = 0.13).

Conclusion Meniscal repairs performed at the time of ACL reconstruction with allograft are 2.3 times more likely to fail than those performed with BTB autograft. Medial repairs fail at a significantly higher rate than lateral repairs. Patients with low or high baseline activity levels are also at an increased risk.

Summary Following UKA a significantly higher proportion of the knee joint remains of native tissue. This may explain lower rate of infection in comparison to TKA, but may alter the response to the rare challenge of infection. It is suggested that as the higher proportion of the knee is natural around the much smaller implant of UKA, the knee immunological status and natural defenses are more effective than in TKA. Little data is available regarding the knee immunological status and natural defenses are more effective than in TKA. Little data is available regarding the
modern treatment of Periprosthetic Joint Infection (PJI) after UKA. The purpose of this article is to present the results of the largest multicenter clinical study of UKA PJI treated with DAIR.

Methods In this retrospective study, clinical data was collated between January 2016 and December 2019. Twenty patients had early infections, 19 of whom were submitted to Debridement, Irrigation, polyethylene liner exchange with Implant Retention (DAIR) and intravenous antibiotic therapy followed by oral treatment.

Results DAIR procedure showed an overall survivorship free from septic reoperation of 84.2%. The overall survivorship free from all-cause reoperation was 78.9%. The usage of DAIR procedure had a higher than expected success against earlier published data for UKA and significantly better than the same procedure in TKR. Analysis of UKA infected cases reveals the most common bacteria are coagulase-negative Staphylococcus, Staphylococcus aureus, and group B Streptococcus. Three patients underwent a second DAIR procedure successfully; one of these patients had a TKA for medial osteoarthritis and one was lost at follow up (FU). All other cases had no recurrence at last FU.

Conclusion Following UKA a significantly higher proportion of the knee joint remains of native tissue. This may alter the response to the rare challenge of infection. Surgeons might wish to adopt a slightly different strategy than in TKA infection, with more emphasis on the less invasive and potentially more successful DAIR procedure.

**19139 LOCAL ANAESTHETIC INFILTRATION (LIA) IS EQUALLY EFFECTIVE AS ADDUCTOR NERVE BLOCKS FOR PAIN RELIEF IN ANTERIOR CRUCIATE LIGAMENT (ACL) RECONSTRUCTIONS**

Mohammad Abou Salhab, Sonal Sonwalkar, Sanjeev Anand, Martin Stone. UK

Summary LIA technique provided equally good pain relief following ACL reconstruction when compared to ACB, while allowing for earlier rehabilitation, mobilisation and discharge.

Data Objectives To determine the effectiveness of LIA compared to adductor nerve blocks in providing pain relief and opiate usage in ACL reconstructions.

Materials and Methods In a consecutive series of ACL reconstructions, patients received three different postoperative regional and/or anaesthetic techniques for pain relief. Three groups were studied: group 1: general anaesthetic (GA)+ adductor canal block (ACB) (n=38); group 2: GA + ACB + local infiltration anaesthesia (LIA) (n=31) and group 3: GA +LIA (n=36). Adductor block was given under ultrasound guidance. LIA involved infiltration at skin incision site, capsule, periosteum and in hamstring harvest tunnel. Rest of analgesic medications were similar between the three groups as per standard multimodal analgesia (MMA). Patients were similar in demographics distribution and surgical technique/procedure. The postoperative pain and total morphine requirement were evaluated and recorded. The postoperative pain was assessed VAS at 0 hrs, 2 hrs, 4 hrs, weight bearing (WB) and discharge (DC).

Results There was no statistically significant difference in opiates intake amongst the three groups. When comparing VAS scores; there were no statistical difference between the groups at any of the time intervals that VAS was measured. Group 1 VAS scores at 0 hrs were mean(m) and 95% confidence intervals (CI) m=30.47±9.95 mm; at 2 hrs m=30.64±7.37 mm; at 4 hrs m=33.57±5.8 mm; at WB m=35.68±5.47 mm; and at DC m=36.89±5.67 mm. Group 2 VAS scores were at 0 hrs m=32.09±3.54 mm; at 2 hrs m=30.34±2.6 mm; at 4 hrs m=30.96±1.84 mm; at WB m=30.64±1.42 mm; and at DC m=30.96±2.42 mm. Group 3 VAS scores were at 0 hrs m=30.5±8.76 mm; at 2 hrs m=34.38±6.82 mm; at 4 hrs m=36.16±6.5 mm; at WB m=34.05±4.85 mm; and at DC m=35.45±4.73 mm. However, the GA+LIA group hospital’s LOS (MD=2.31 hrs, SD=0.75) was almost half that of GA+ACB group (4.24 hrs, SD=1.08); (conditions t(72)=8.88; p=0.000). There was no statistical significance in the incidence of adverse effects amongst the groups.

Conclusion LIA technique provided equally good pain relief following ACL reconstruction when compared to ACB, while allowing for earlier rehabilitation, mobilisation and discharge.

**19150 WHAT IS THE IDEAL HINGE AXIS POSITION TO REDUCE TIBIAL SLOPE IN OPENING WEDGE HIGH TIBIAL OSTEOTOMY?**

Claire D Eliasberg, Kyle Hancock, Erica Swartwout, Hugo Robichaud, Anil S Ranawat. USA, Canada

Summary Distalization/flexion and external rotation of the hinge axis position led to stepwise increases in posterior tibial slope, whereas proximalization/extension and internal rotation led to decreases in posterior tibial slope.

Data Background High tibial osteotomy (HTO) is a versatile surgical procedure which has been utilized in the treatment of medial compartment osteoarthritis, ligamentous instability, anterior cruciate ligament (ACL) deficiency, meniscal deficiency, and focal cartilage defects. Hinge axis position has been identified as a significant determinant in altering posterior tibial slope (PTS) during high tibial osteotomy (HTO). Therefore, when preparing for medial opening wedge HTO, careful preoperative planning is essential in order to determine not only the degree of correction in the coronal plane, but also to properly assess the change in PTS that will arise as a result of this coronal plane correction, a variable that can be challenging to predict. The purpose of this study was to evaluate the effect of hinge axis position on PTS in medial opening wedge HTO.

Methods Adults with medial compartment osteoarthritis who had CT scans available that were amenable to Bodycad Osteotomy software analysis were included. Virtual osteotomies were performed modeling a 10 mm medial opening wedge gap. The hinge axis was rotated internally and externally and proximized/extended and distalized/flexed with respect to the anterior tibial cortex for 5, 10, 15 and 20 degrees. Each resultant PTS was recorded and compared with the results obtained from the true lateral hinge position and with the preoperative PTS.

Results CT scans from ten patients were utilized. There were strong linear correlations with each hinge axis position change and the resultant PTS. The trendline differences were
AVOIDING STEM EXTENSION DURING REVISION TOTAL KNEE ARTHROPLASTY

Jean-Yves Jenny, France

Introduction

Both tibial and femoral extension stems after revision TKA were necessary only in 48% of the cases. The new MSIS classification offered only minor, non significant increase of the diagnostic accuracy in comparison to the conventional criteria.

Summary

Both tibial and femoral extension stems after revision TKA were necessary only in 48% of the cases. The new MSIS classification offered only minor, non significant increase of the diagnostic accuracy in comparison to the conventional criteria.
LONG TERM RESULTS OF COLLAGEN MENISCUS IMPLANT (CMI) AN ANALYSIS OF 156 CASES AT MEAN 11 YEARS OF FOLLOW-UP

Stefano Zaffagnini, Gian Andrea Lucid, Alberto Grassi, Stefano Di Paolo Eng, Piero Agostinone, Giacomo Dal Fabbro, Luca Macchiarola, Nicola Pizza, Stefano Zaffagnini.

Summary: The collagen meniscus implant provide a safe and durable option for the treatment of partial meniscus defects.

Data

Background: The collagen meniscus implant (CMI) was developed to treat patients with the clinical condition of post-meniscectomy syndrome. Particularly in the presence of a partial meniscal defects. The aim the study was to identify predictors of surgical failure after CMI implant a long term follow-up.

Methods: A database search from a single center was conducted in order to identify all the CMI implanted from a minimum 5 years of follow-up. Surgical failure was defined as partial or total scaffold removal, conversion to a meniscal transplant or unicompartmental/total knee arthroplasty. A logistic regression was performed by using sex, BMI, age at surgery, CMI laterality, Outerbridge grade (0-II vs III-IV), combined versus isolated procedure and “salvage procedure” (defined as Outerbridge grade III and an associated procedure) as independent variables. Survival analysis was performed with Kaplan-Meier curve.

Results: 156 patients (84%) with a mean age at surgery of 42.0 ± 11.1 were included in the final analysis at an average follow-up of 10.9 ± 4.3 years. The overall survival rate from surgical failure was 87.8%. When further evaluating the different subgroups of patients, an Outerbridge grade of III-IV (HR 3.8; P = .004), and lateral scaffold (HR, 3.2; P = .048) were identified as risk factors. Finally, 42 patients (26.9%) were considered either a surgical or clinical failure. Risk factors identified as risk factors were: an Outerbridge grade of III-IV (odds ratio [OR], 3.1; P = .000), and time from meniscectomy to scaffold greater than 10 years (OR, 2.7; P = .042).

Conclusion: The CMI showed a high surgical survival rate at a long-term follow-up. Lateral CMI, higher grade of cartilage degeneration and CMI implanted as a salvage procedure were found to be predictors of surgical failure. The results of this study are useful in the clinical setting to estimate the risk of failure and set patient’s expectation.
arthroplasty. Promising short-term outcome is described but a high rate of revision to knee arthroplasty has been reported at mid-term follow-up. It has been suggested that a more accurate implant positioning would enhance implant survival. A customized prosthesis and guide system was designed to precisely fit the cartilage defect in location and size has the potential to improve implant positioning and thereby avoid damage to the opposing cartilage. We hypothesize that good subjective outcome is preserved and that risk of osteoarthritis development and need for revision to knee arthroplasty is low at a minimum 5-year follow-up.

Methods Ten patients, focal chondral femoral injury and previous failed biological treatment. Surgery with a customized Cr-Co femoral condyle implant. Minimum 5-year follow-up with clinical and radiological examination. Subjective outcome, KOOS. Data on re-surgery.

Results Mean age at surgery 53 years. Mean 75 months follow-up (range 60–86 months). Two patients experienced limitation in range of motion. In one patient standing weight-bearing showed OA, Ahlbäck 1 at 84 months. Significant improvement in KOOS subscores pain (60–85), ADL (66–91), Sports (23–48), QoL (28–55) compared to pre-op. Tegner score from 3 to 4.

Conclusion Good subjective outcome and low risk of progression of degenerative changes and need for subsequent surgery were seen at mid-term follow-up with this customized focal knee resurfacing implant.

Summary High infection rate (20.6%) was reported after ACL reconstruction (ACLR) with xenograft. Improvements in future studies using xenografts are needed, otherwise xenograft should not be used in ACLR. Level of evidence: multicenter and double-blinded Randomized Controlled Clinical Trial, Level I.

XENOGRAFT FOR ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION WAS ASSOCIATED WITH HIGH GRAFT PROCESSING INJURY

1Giulio Maria Marcheggiani Muccioli, 2Willem M van der Merwe, 1Giulio Maria Marcheggiani Muccioli, 3Martin Lind, 3Peter Faunce, 4Kees van Egmond, 1Stefano Zaffagnini, 1Maurilio Marcacci, 2Ramon Cugat Bertomeu, 4Rene E Verdonschot, 5Ernique Ibanez, 1Italy; 2South Africa; 3Denmark; 4Netherlands; 5Spain; 6Belgium

10.1136/jisakos-2021-congress.29

Summary High infection rate (20.6%) was reported after ACL reconstruction (ACLR) with xenograft. Improvements in future studies using xenografts are needed, otherwise xenograft should not be used in ACLR.

Data

Introduction The purpose of this study was to evaluate clinical and radiological outcomes of anterior cruciate ligament (ACL) reconstruction with an immunochemically modified porcine patellar tendon xenograft controlled against human Achilles tendon allograft at 24-month minimum follow-up.

Methods 66 patients undergoing arthroscopic ACL reconstruction were randomized into 2 groups: 34 allografts and 32 xenografts treated to attenuate the host immune response. Follow-up was 24-month minimum. Anterior knee stability was measured as KT-1000 side-to-side laxity difference (respect to the contralateral healthy knee). Functional performance was assessed by one-legged hop test. Objective manual pivot-shift test and subjective (IKDC, Tegner and SF-36) outcomes were collected. MRI and standard X-Ray were performed.

Results 61 subjects (32 allograft, 29 xenograft) were evaluated at 12 and 24 months. Six of the subjects in xenograft group (20.6%) got an infection attributed to a water-based pathogen contamination in processing. Intention-to-treat analysis (using the last observation carried forward imputation method) revealed higher KT-1000 laxity in xenograft group at 24-month follow-up (P = .042). Also pivot-shift was higher in xenograft group at 12-month (P = .015) and 24-month follow-up (P = .038). Per-protocol analysis (missing/contaminated subjects excluded) did not revealed clinical differences between groups. Tibial tunnel widening in the allograft group was low, whereas xenograft tunnel widening was within the expected range of 20–35% as reported in the literature. No immunological reactivity was associated to xenograft group.

Discussion and Conclusion High infection rate (20.6%) was reported in xenograft group. Both groups of patients achieved comparable clinical outcomes if missing/contaminated subjects are excluded. Improved harvesting/processing treatments in future studies using xenografts for ACL reconstruction are needed to reduce infection rate, otherwise xenograft should not be used in ACL reconstruction. Level of evidence: multicenter and double-blinded Randomized Controlled Clinical Trial, Level I.

CLINICAL RESULTS OF EXTRACORPOREAL SHOCK WAVE THERAPY FOR OLECRANON STRESS FRACTURE IN BASEBALL PLAYERS

Hiroshi Hamada, Hiroyuki Sugaya, Norimasa Takahashi, Keisuke Matsuji, Morihito Tokai, Takeshi Morikita, Yusuke Ueda, Shota Hoshika. Japan

Summary Extracorporeal Shock Wave Therapy is a safe and viable option for an early return to play baseball, for the treatment of an olecranon stress fracture, and a persistence of the olecranon physis.

Data

Introduction An olecranon stress fracture and a persistence of the olecranon physis are seen in adolescent baseball players associated with valgus extension overload. They were often unable to return to sports early, however, because of cases of delayed union or refracture. And many doctors suggested the necessity of surgery. Extracorporeal Shock Wave Therapy (ESWT) has been reported to be effective in the treatment of stress fracture. However, there are no studies regarding ESWT exclusively for olecranon stress fracture in baseball players. The purpose of this study is to report clinical results of olecranon fracture in baseball players that were treated with ESWT.

Methods 13 baseball players (13 elbows) who were treated with ESWT were included in this study. All subjects were competitive level athletes, and all patients were male. All affected sides was their throwing side. The mean age was 15 (13–21). Exclusion criteria was olecranon tip fracture cases. The mean follow up period was 9 months. They played in the following positions: pitchers (8), outfielders (3), catcher (1) and infielder (1). Each subject received 1 to 2 times ESWT.

Results 19295

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on average (4–9). One patient returned to sport as the infielder from the pitcher. One of them had recurrence of symptoms 3 months after taking ESWT, but he returned to competition after the second ESWT and no recurrence. The complete competition return rate was 86%. In the off-season cases (5 patients), those return to competition time is at 16.4 weeks on average (8–28). Two of them had recurrence of symptoms 3 months and 52 months after taking ESWT, but they returned to competition after the second ESWT and no recurrence. The complete competition return rate was 100%. The mean period between presentation and initiation of ESWT was 2.9 months (09) in the season, 4.4 months (2-7) in the off-season. In the olecranon stress fracture cases, bone union was seen in 6 cases, improvement was seen in 2 cases, and no change was seen in 1 case. In persistence of the olecranon physis cases, closed physis was seen in 2 cases, improvement was seen in 2 cases, no change was 1 case. The mean period until bone union was 8.6 months (2.5-20) in the olecranon stress fracture cases and 19.8 month (10-27) in persistence of the olecranon physis cases.

Conclusion This study indicates ESWT is a safe and viable option for the treatment of an olecranon stress fracture and a persistence of the olecranon physis in adolescent baseball players. ESWT for those patients was effective for pain relief and shortened the period of return to sports. It also indicates that bone union of the olecranon stress fracture was promoted after several sessions of ESWT, and that closing of the olecranon physis might not be affected after several sessions of ESWT.

Summary Anatomical bi-cruciate retaining total knee arthroplasty.

Data Background The purpose of the present study is to measure the intraoperative joint gap using tensor device and pre- and postoperative variation of coronal stability at 0, 30 and 90° of flexion using stress radiograph and identify whether these factors influence patient reported outcome measurement (PROM).

Methods 53 knees with preoperative varus osteoarthritis of the knee were treated with anatomical BCR TKA with oblique 3° angle femorotibial joint line (Journey II XR; Smith& Nephew. Inc Memphis, TN, USA). The intraoperative joint gap (medial, lateral and varus-valgus) using a tensor device and varus-valgus gap angle were measured using stress radiographs. PROM was also evaluated at 1.5 years postoperatively.

Results There was no significant difference between pre- and postoperative flexion angle. Intraoperative medial laxity rather than medial tightness from full extension to 140° of flexion angle played an important role in influencing postoperative function of patellofemoral joint. Intraoperative varus laxity at full extension improved postoperative symptom in 2011 Knee Society Score (2011 KSS), while greater postoperative lateral stability at 30 and 90° of flexion with the varus stress test was found to contribute to the patient expectation in 2011 KSS. Greater postoperative valgus laxity at 90° of flexion with the valgus stress test improved the patient expectation and satisfaction in 2011 KSS, stiffness in WOMAC score and FJS-12.

Conclusion The findings in the present study suggest that the intraoperative joint gap after implantation is not rectangular but trapezoidal gap and greater postoperative varus stability and valgus laxity at 90° of flexion improved patient reported outcome measurement in anatomical BCR TKA.

Summary The Latarjet procedure in competitive athletes younger than 20 years old with a significant glenoid bone loss.

Data Purpose To analyze return to sports, functional outcomes, and complications following the Latarjet procedure in competitive athletes younger than 20 years old with a significant glenoid bone loss.

Methods Between 2010 and 2017 60 competitive athletes younger than 20 years old with a significant glenoid bone loss were operated with the Latarjet procedure. Return to sports, range of motion (ROM), the Rowe and the ASOSS score were used to assess functional outcomes. Complications and bone consolidation were also evaluated.

Results The mean follow-up was 38 months and the mean age was 16.3 years. Overall, 93% were able to return to sports and 84% returned at the same level. The Rowe and ASOSS scores showed statistical improvement after operation (P < .001). The total complication rate was 22% and the revision rate was 1.6%. The recurrence rate was 3.3%. The bone block healed in 93% of the cases.

Conclusions In competitive athletes younger than 20 years old with a significant glenoid bone loss, the Latarjet procedure resulted in excellent functional outcomes, with most of the patients returning to sports and at the same level they had before injury with a low rate of recurrences. However, this procedure is associated with a significant rate of complications and should preferably be performed by experienced surgeons.
Risk Factors for Grade 3 Pivot Shift in Acute ACL-Injured Knees

Introduction

Pre-operative high-grade pivot shift (PS) has been reported to be associated with higher rates of anterior cruciate ligament (ACL) failure, persistent instability and inferior patient reported outcomes. The aetiology of a high-grade PS is multifactorial and numerous factors have been suggested to be responsible. However, the literature is conflicting. In part, this is due to numerous underpowered studies that also fail to account for known risk factors. The aim of this study was to determine risk factors for high-grade pivot shift with a particular emphasis on addressing the limitations of previous studies, therefore including a comprehensive evaluation of both soft-tissue and osseous parameters in an adequately powered study.

Methods

A prospective evaluation of consecutive patients undergoing acute ACL reconstruction (within 10 days of injury) was undertaken. An a priori sample size calculation was performed in order to ensure recruitment of an adequate number of patients. At the time of surgery, the pivot shift test was performed in a standardized manner and graded (International Knee Documentation Criteria). Details regarding patient and injury characteristics were recorded, as were details of injuries to soft-tissue structures including the menisci, anterolateral structures (ALS), medial collateral ligament (other multi-ligament injuries excluded) and articular cartilage. Ossous parameters (femoral slope and condylar ratios) were evaluated using established magnetic resonance imaging (MRI) protocols. A multivariate logistic regression with Penalized Maximum Likelihood was used to identify risk factors associated with grade 3 pivot shift. Factors initially considered were those selected as statistically significant at the 25% threshold, or of previously reported clinical interest. A stepwise descending strategy was applied from the initial full model to determine the most parsimonious one.

Results

200 consecutive patients with a mean age of 28.3 ± 9.8 years were included in the study. 67.5% of patients were male. 35 (17.5%) of patients had a high grade (grade 3) pivot shift and 165 (82.5%) had a low-grade pivot shift (grades 1 and 2). Univariate analyses demonstrated that injury to the ALS was the only significant risk factor for high grade pivot shift. This finding remained true when factors reaching the 25% threshold or of previously reported clinical interest were included in multivariate analysis (OR 13.49; 95% CI, 1.80–1725.53). Although previous studies have suggested that there are other important risk factors for high grade pivot shift, this did not hold true in the current study.

Conclusions

This comprehensive evaluation of soft-tissue and osseous factors has identified that injury to the ALS is the most important risk factor for grade 3 pivot shift in acute ACL-injured knees.
Abstracts

PROSPECTIVE CLINICAL FEASIBILITY STUDY OF A PLLA SCAFFOLD IN PRIMARY ACL RECONSTRUCTION WITH 5-YEAR FOLLOW-UP

1Kees van Egmond, 2Robert A Arocho, 1Reinoud W Brouwer, 2Robert A Stanton. 1Netherlands; 2USA

Summary Recently, a bioresorbable, acellular, poly(L-lactic acid) (PLLA) scaffold was developed for ACL reconstruction, composed of three-dimensionally braided polymeric microfilaments to guide cellular infiltration and growth of new ligament tissue. Therefore, the object of this study was to assess the safety and feasibility of the PLLA scaffold, for primary ACL reconstruction in a prospective, consecutive, clinical study.

Data

Introduction Anterior cruciate ligament (ACL) rupture is one of the most serious sports-related injuries, and nearly 200,000 ACL reconstructions are performed each year in the US. Surgical reconstruction using an autograft remains the gold standard treatment option, but graft selection remains debated and outcomes are affected by the associated donor-site morbidity. The only alternative, allograft, is prone to higher rates of failure, and is inherently limited in quality and availability. To date, a demand remains for a safe, ‘off-the-shelf’ implant for ACL reconstruction, and tissue engineering is one approach that can provide a regenerative solution. Recently, a bioresorbable, acellular, poly(L-lactic acid) (PLLA) scaffold was developed for ACL reconstruction, composed of three-dimensionally braided polymeric microfilaments to guide cellular infiltration and growth of new ligament tissue. Therefore, the object of this study was to assess the safety and feasibility of the PLLA scaffold, for primary ACL reconstruction in a prospective, consecutive, clinical study.

Methods Fifteen patients (ages 18 to 46 years old) with ACL ruptures were implanted (<18 weeks post-injury) with a PLLA scaffold for ACL reconstruction. The primary endpoint for the study was defined as the absence of graft failure or revision ACL surgery at one year. The study was performed in a highly active patient cohort, with 11 of 15 patients reporting a pre-injury Tegner score of 9 out of 10. Secondary endpoints were determined by safety rates per complications, subjective patient-reported outcomes (2000 IKDC scale, KOOS pain, Tegner, and Lysholm scores), clinical function (Lachman test, KT-1000, pivot shift, anterior drawer, and single leg hop test), and imaging measures (radiographic, MRI, and CT). In the case of graft failure, arthroscopic confirmation was performed prior to or on the same day as revision surgery, and biopsies were taken from the intra-articular region during revision surgery and processed for histological and molecular weight analyses.

Results No infections, allergic reactions, or synovitis were reported indicating safety of the implant. Patient-reported IKDC scores (and additional patient-reported outcome measures, Table 1) showed progressive improvement at 6 and 12 months compared to baseline values. Physician-reported clinical evaluations of knee function showed little to no laxity or knee instability at the one year follow-up. However, review of MRI at 6 and 12 months showed a hyper-intense signal indicative of (what?), please complete sentence (Figure 1A). Five graft ruptures occurred between 12 and 36 months follow-up, with one additional rupture at 44 months in a total follow-up of 5 years. Five of the re-ruptures occurred while subjects were playing soccer. One re rupture occurred with a minor trauma. Histological analysis of graft biopsies obtained during revision surgeries revealed a fully cellularized scaffold containing a peripheral synovial cell layer, neovascularization, and robust extracellular matrix. A chronic inflammatory response, marked by foreign body giant cells, was observed adjacent to remnant PLLA (Figure 1A). For the remaining patients, MRI revealed thinning of the ligament and regional hyper-intensity that persisted through 18 and 24 months (Figure 1B). Although 10 individuals without failure at 36 months follow-up continued to report normal ACL function, IKDC scores decreased at 18 months and plateaued through 36 months follow-up though neither were statistically significant. (Table 1).

Discussion and Conclusion The first-in-man study of a PLLA scaffold for primary reconstruction of the ACL demonstrated the feasibility of an acellular tissue-engineered scaffold; however, tissue regeneration was inconsistent in this 15-patient cohort, resulting in clinically unacceptable failure rates in this limited study. Six patients experienced ruptures between 12 and 60 months, suggesting insufficient load-bearing capacity of the new ligament tissue in the presence of a weakening scaffold. These findings suggest that further innovation is required to optimize scaffold properties in order to achieve long-term clinical efficacy with a bioresorbable implant for ACL reconstruction.
Summary

Goutallier classification may need adjustments once the gross cuff tear retraction is present.

Data

Introduction

Goutallier classification is widely used to describe fatty infiltration within a rotator cuff muscle belly. Initially developed based on axial CT images, the grading system has been extrapolated to magnetic resonance imaging (MRI) over time. Goutallier classification based on MRI is widespread, but no one has yet studied if its reliability can be deteriorated by the size of the cuff retraction. The aim of our study was to evaluate whether the Goutallier grading system should be adjusted to the cuff tear size or if it is reliable regardless the amount of retraction.

Methods

This was a prospective observational study. MRIs of 81 patients reflecting a range of tear sizes were compiled and 3 parasagittal cuts from each series were extracted and de-identified (total 243 images). The image based on the coronal view with the greatest supraspinatus tendon retraction was used for tear-size classification according to Cofield classification. The most lateral cut in which the scapular spine is still attached to the scapular body represented the traditionally used ‘baseline’ cut for Goutallier classification.

Two additional cuts were obtained 3 and 6 slices medially from the first. Nine clinicians (3 fellowship trained upper extremity surgeons, 2 upper extremity fellows, 2 orthopedic residents and 2 fellowship trained musculoskeletal radiologists) assigned Goutallier classifications to each of the four RC muscles based on the three MRI cuts. Evaluation of all images was repeated 3 times with a 7-day gap between each session and images re-randomized for each session. A threshold of Krippendorff’s alpha of 0.8 was set to achieve a level of reliability. Reliability was evaluated using the purpose of repeating the impact of size of cuff tear and slice on Goutallier grade. Kruskall-Wallis analysis was repeated with the purpose of revealing the impact of size of cuff retraction. The aim of our study was to determine the impact of expertise on intra-rater reliability.

Results

Five of 9 clinicians achieved a level of 0.8 or higher reflecting high intra-rater reliability. Reliability was not significantly associated with expertise (p=0.3089). Based on only the raters with high intra-rater reliability, there was a significant difference in Goutallier grade between slices in supraspinatus (p=0.007), infraspinatus (p<0.001), and subscapularis (p=0.0193), but not teres major (p=0.4227). The tendency was to give the lower grade for same muscles, in more medial MRI cuts.

Conclusion: Goutallier classification is widely used to describe fatty infiltration within a rotator cuff muscle belly. Initially developed based on axial CT images, the grading system has been extrapolated to magnetic resonance imaging (MRI) over time. Goutallier classification based on MRI is widespread, but no one has yet studied if its reliability can be deteriorated by the size of the cuff retraction. The aim of our study was to evaluate whether the Goutallier grading system should be adjusted to the cuff tear size or if it is reliable regardless the amount of retraction.

Purpose

To determine the association between a delay in ACLR, age, gender, BMI and cartilage injuries, meniscus injuries, meniscus repair, and abnormal pre-reconstruction laxity.

Methods

A total of 3,976 patients who underwent primary ACLR at our institution from 2005 to 2017, with no associated ligament injuries, were included. Logistic regression analyses were used to evaluate whether delay in ACLR, age, gender and BMI were risk factors for cartilage and meniscus injuries, meniscus repair, and abnormal (side-to-side difference >5 mm) pre-reconstruction laxity.

Results

The risk of cartilage injury increased with a delay in ACLR (12–24 months: odds ratio[OR], 1.20; 95% confidence interval[CI], 1.05–1.29; P=0.05; and >24 months: OR, 1.20; 95% CI, 1.11–1.30; P<0.001) and age =>30 years (OR, 2.27; 95% CI, 1.98–2.60; P<0.001). The risk of medial meniscus (MM) injury increased with a delay in ACLR (12–24 months: OR, 1.20; 95% CI, 1.07–1.29; P=0.001; and >24 months: OR,1.22; 95% CI, 1.13–1.30; P<.001), male gender (OR, 1.16; 95% CI, 1.04–1.30; P=.04) and age =>30 years (OR, 1.20; 95% CI, 1.04–1.33; P=.008). The risk of lateral meniscus (LM) injury decreased with a delay in ACLR (3 months and age =>30 years (OR, 0.75; 95% CI, 0.66–0.85; P<.001), whereas it increased with male gender (OR,1.32; 95% CI,1.22–1.41; P <.001). MM repairs relative to LM injury decreased with a delay in ACLR (6–12 months: OR, 0.70; 95% CI, 0.54–0.92; P=0.1; 12–24 months: OR, 0.69; 95% CI, 0.57–0.85; P<.001; >24 months: OR, 0.61; 95% CI, 0.52–0.72; P<.001) and age =>30 years (OR, 0.60; 95% CI, 0.48–0.74; P<.001). LM repairs relative to LM injury only decreased with age =>30 years (OR, 0.34; 95% CI, 0.26–0.45; P <.001). The risk of having abnormal knee laxity increased with a delay in ACLR of >6 months and MM injury (OR, 1.52; 95% CI, 1.16–1.97; P=.002), whereas it
Changes in muscle strength and hop performance after ACL reconstruction. A randomized controlled trial comparing patellar tendon and hamstring tendon autografts with standard or accelerated rehabilitation

Riccardo Cristiani, PT Christina Mikkelsen, Peter Olov Wange, Daniel Olsson, Anders Stalman, Björn Engstrom. Sweden

Summary Asymmetries in muscle strength and hop performance are persistent even 24 months after ACLR performed with either of the 2 grafts. Rehabilitation protocols should be implemented and more time needs to be spent on muscle strength rehabilitation. The choice between BPTB and HT grafts strongly affects the pattern of recovery of muscle strength.

Data

Background The most commonly used autografts for anterior cruciate ligament (ACLR) are the hamstring tendons (HT) and the bone-patellar tendon-bone (BPTB). However, questions remain about how patients with either an HT or a BPTB autograft recover knee muscle strength postoperatively. Contrasting results have been reported in randomized studies comparing the two autografts at postoperative follow-ups ranging from 3 to 24 months after ACLR. Moreover, there is a lack of studies comparing the effects on the recovery of muscle strength and hop performance of an accelerated or a standard rehabilitation protocol for both autografts at several follow-ups after ACLR.

Purpose To evaluate and compare changes in quadriceps and hamstring strength and single-leg-hop (SLH) test performance over the first 24 postoperative months in patients who underwent ACLR with BPTB or HT autografts and followed either a standard or an accelerated rehabilitation protocol.

Methods A total of 160 patients undergoing ACLR were randomized in 4 groups depending on the graft that was used and the rehabilitation protocol (40 BPTB/standard rehab, 40 BPTB/accelerated rehab, 40 HT/standard rehab, 40 HT/accelerated rehab). Isokinetic concentric quadriceps and hamstring strength at 90°/s and the SLH test performance were assessed preoperatively and 4, 6, 8, 12 and 24 months postoperatively. The results were reported as the limb symmetry index (LSI) at the same time point. Linear mixed models were used to compare the groups at the different time points throughout the follow-up.

Results An average quadriceps strength LSI of 78.4% was found preoperatively. After ACLR, the LSI first decreased at 4 months and then increased from 6 to 24 months, reaching an overall value of 92.7% at the latest follow-up. The BPTB group showed a significantly decreased LSI at 4, 6, 8 and 12 months compared with the HT group. No significant differences between the graft groups were found at 24 months. An average hamstring strength LSI of 84.6% was found preoperatively. After ACLR, the LSI increased from 4 to 24 months in the BPTB group. In the HT group, the LSI first decreased at 4 months and then increased from 6 to 24 months. An LSI of 97.1% and 89.1% was found at the latest follow-up for the BPTB and the HT group respectively. The HT group showed a significantly decreased LSI at all follow-ups (4, 6, 8, 12 and 24 months) compared with the BPTB group. An average SLH test LSI of 81.0% was found preoperatively. After ACLR, the LSI increased from 4 to 24 months, reaching 97.6% overall at the latest follow-up. The BPTB group showed a significantly decreased LSI at 4 months postoperatively compared with the HT group. No significant differences between the graft groups were found at the other time points. No significant differences in any of the three tests were found between the standard and accelerated rehabilitation groups for either of the graft groups at any time point.

Conclusion Muscle strength and SLH test performance recovered progressively after ACLR overall, but they did not all fully recover, as the injured leg performed on average less than 100% compared with the uninjured leg even 24 months postoperatively. After ACLR, inferior quadriceps strength and a poorer SLH test performance were found at 4, 6, 8 and 12 months and at 4 months respectively for the BPTB group compared with the HT group. Persistent, inferior hamstring strength was found at all postoperative follow-ups in the HT group. Rehabilitation, standard or accelerated, had no significant impact on the recovery of muscle strength and SLH test performance after ACLR in any of the graft groups.

Arthroscopic superior capsular reconstruction with mesh augmentation for the treatment of massive irreparable rotator cuff tears

Erica Kholine, In-Ho Jeon. Indonesia

Republic of Korea

Summary Arthroscopic superior capsular reconstruction is a promising option to treat irreparable rotator cuff tears in young patients. Surgical modification using polypropylene mesh augmentation to the graft material may help reduce graft failure.

Data

Background Arthroscopic superior capsular reconstruction (ASCR) is an alternative to open surgery for irreparable chronic rotator cuff tears. This approach can provide static restraint while avoiding upward migration of the humeral head. However, graft tears and their impact on clinical outcomes following ASCR remain a debated topic.

Purpose This study aimed to evaluate the clinical outcomes of ASCR with mesh augmentation for the treatment of irreparable rotator cuff tears (IRCTs). Study Design: Retrospective case-control study.

Methods From 2013 to 2018, the data of 72 patients with IRCTs who underwent ASCR were retrospectively evaluated. Among them, 64 patients who met the inclusion and exclusion criteria were enrolled in this study. Fascia lata grafts augmented with a polypropylene mesh were used for 30 patients (group M) and grafts without mesh augmentation were used for 34 patients (group S). All patients were followed up for 36 months after the surgery.
BICONCAVE MEDIAL TIBIAL PLATEAU MORPHOLOGY AND THE ASSOCIATION WITH MEDIAL MENISCAL TEAR PATHOLOGY

Trevor Shelton, John Ryan Taylor, Joshua Mizels, Trevor Shelton, F Alan Barber, Mark Getelman. USA

Summary This newly established classification system for biconcave medial tibial plateaus (BMTP) will help surgeons identify and understand the Type II BMTP and provide the basis on which further research will determine the impact of tibial morphology on medial meniscal pathology and a treatment algorithm as type II BMTPs are at an increased risk of complex meniscal tears.

Data

Introduction There has been limited investigation regarding the consequence of tibial plateau morphology on the meniscus. A biconcave medial tibial plateau (BMTP) has been previously described as a coronal plane ridge of the medial tibial plateau, typically aligned near the inner margin of the posterior body of the medial meniscus. Further investigation of the designated BMTP morphology demonstrated specific patterns in the topographical anatomy and shape compared to the normal, flat medial tibial plateau. However, it remains unknown whether patients with BMTP morphology are more prone to complex meniscus tears which could have implications on treatment. As such, the purpose of this study was to: (1) present a classification system for BMTP morphology, and (2) determine whether patients with a certain type of BMTP and more susceptible to complex meniscal tears.

Methods Evaluated a 6-month consecutive series of all knee arthroscopies for BMTP morphology and meniscal tears using intraoperative video at time of surgery. Three distinct morphologies were identified. Those with a “flat” medial tibial plateau were classified as normal and served as the control group. Type I BMTP consisted of an oblique, narrow ridge of the medial tibial plateau. Type II BMTP of a transverse, wide, coronal plane ridge, separating the front two-thirds from the back of the medial tibial plateau. Demographic data, and arthroscopic knee pathology characteristics were also recorded. Intraclass correlation coefficient (ICC) was used to determine the interobserver reliability of the classification system. A Fisher’s exact test was used to determine differences in categorical data (i.e., complex medial meniscus tear) between groups while a single factor ANOVA was used to determine differences in continuous variables (i.e. age) between groups.

Results 147 consecutive knee arthroscopies were evaluated - 55 (37.4%) had a normal plateau, 43 (29.3%) had a Type I BMTP, and 49 (33.3%) had a Type II BMTP. There was excellent inter-observer reliability (kappa statistic=0.842). Those patients with Type II BMTP were three times more likely to have a complex medial meniscus tear than those with a Type I BMTP (odds ratio 3.2 [1.4, 7.6])(p=0.01) and two times more likely to have a complex medial meniscus tear compared to those with a flat plateau morphology or Type I BMTP (odds ratio 2.2 [1.1, .5])(p=0.04). There was no increased risk of a complex medial meniscus tear with a Type I BMTP compared to a flat plateau morphology (odds ratio 0.5 [0.3, 1.2])(p=0.15).

Conclusion Biconcave medial tibial plateau is best diagnosed at the time of arthroscopy and can be reliably classified into two distinct types. Type II BMTP occur in approximately 1/3rd of patients and are at an increased risk for complex meniscal tears when compared to patients with Type I BMTP or flat plateau. This newly established classification system will help surgeons identify and understand the Type II BMTP and provide the basis on which further research will determine the impact of tibial morphology on medial meniscal pathology and a treatment algorithm.
Abstracts

Methods A retrospective analysis of prospectively collected data from a single tertiary academic medical center of consecutive patients undergoing surgical treatment for massive irreparable RCT without arthritis using SCR, PR (using interval slide and/or margin convergence), or rTSA from 01/01/2006 to 01/01/2018 was performed. Patients were required to be at least 18 years of age and have intra-op confirmation of a massive, irreparable, RCT without arthritis. Patient demographics and pre-op clinical findings were collected. Post-op data included complications, patient satisfaction, strength and ROM, and patient reported outcomes. Multivariate analysis was also performed.

Results 32 patients met inclusion criteria for SCR, 24 for PR, and 42 for rTSA (mean follow-up years: SCR 3.2; PR 4.0; rTSA 3.5; p=0.02). The rTSA patients were older (66.2 years; SCR - 57.3; PR - 59.0; p=0.0001) and more likely to be female (61.9%; SCR - 12.5%; PR - 25.0%; p<0.001). Intra-op evaluation demonstrated the subscapularis to be non-functional in 37.5% for SCR, 4.2% for PR, and 21.4% for rTSA (p=0.01). Pseudoparalysis was present in 18.8% of SCR, 0% of PR, and 14.3% of rTSA patients (p=0.08). All groups saw significant post-op improvement in strength and patient reported outcomes (p<0.036). SCR and rTSA demonstrated improved forward elevation ROM post-op while PR did not (p=0.96). No group experienced improvement in IR or ER ROM post-op (p>0.12). rTSA had significantly worse post-op ROM in all planes compared to SCR and PR (p<0.003 for all). There were no differences between groups in post-op strength (p>0.16) or patient reported outcomes (ASES p=0.14; VAS p=0.86; SANE p=0.61). Patients were satisfied or somewhat satisfied in 81.2% of SCR cases, 87.5% of PR, and 95.3% of rTSA (p=0.33). Three of 32 (9.4%) SCR patients required conversion to rTSA, while 3 of 24 (12.5%) PR patients required reoperation (2 revision repairs, one conversion to rTSA). There were 3 surgical complications among 42 rTSA patients (7.1%) (2 acromial stress fractures; 1 dislocation requiring open reduction). There were 4 non-surgical complications in the SCR group and 1 stroke in the rTSA group. One SCR patient and 3 rTSA patients were deceased. Multivariate analysis demonstrated no independent predictors of revision surgery, and the only independent predictors of patient satisfaction to be improved post-op active ER ROM (p=0.03) and strength (p=0.048). An increased AH interval distance was an independent predictor of improved post-op strength (p=0.02).

Conclusion SCR, PR, and rTSA for massive, irreparable RCT without arthritis all significantly improved post-op strength and outcome scores with >80% patient satisfaction, but with rTSA having worse post-op ROM. For all patients, increased post-op ER ROM and strength correlated with improved patient satisfaction, while increased AH distance correlated with improved post-op strength.

Summary Low number of OA disease-modifying therapies in current clinical trial pipeline

Data

Introduction Osteoarthritis (OA) is a growing problem in the adult population, leading to morbidity, increased health costs and reduced participation in the workforce. Information on ongoing trials is essential to better understand future directions of clinical research for OA and optimize the use of research funding. The objective of this study was to conduct a review of active U.S. based clinical trials investigating prevention, symptom resolution, and disease-modifying therapies for osteoarthritis.

Methods A review of currently active clinical trials for OA using data obtained from the NIH U.S. National Library of Medicine ClinicalTrials.gov database as of August 2020 was conducted. Inclusion criteria were active studies registered in the U.S. that involved the prevention, treatment, or management of OA. Exclusion criteria were trials registered outside of the U.S., studies that evaluated outcome parameters as the primary endpoint that were unrelated to OA, study participants with inflammatory joint disease, non-active clinical trials, or in vitro investigations. Descriptive statistics were recorded and summarized from each trial. Subanalysis was performed for cellular biologics and pharmaceutical drugs.

Results 3859 clinical trials were identified and 310 were included in final analysis. Of the currently active trials, 89% (n=275) targeted symptom resolution in patients with existing OA, 6% (n=19) targeted OA disease-modifying therapeutic, and 5% (n=16) targeted the prevention of OA in high-risk patients. Primary interventions included medical devices (44%, n=137), pharmaceutical drugs (14%, n=42), surgical procedures (14%, n=42), cellular biologics (13%, n=41), and behavioral therapies (13%, n=41). There was a higher number of disease-modifying therapies for cellular biologics than pharmaceutical trials (30% vs.14%, respectively). The majority of trials targeted the knee joint (63%) with 38% of all trials evaluating joint arthroplasty. Of those reporting clinical trial phases (n=93), 2% were in early phase I, 18% were in phase II, 41% were in phase II, 22% were in phase III, and 17% were in phase IV. Funding was split between private sector and government (43% and 49%, respectively), with low rate of funding from industry (8%) partners.

Conclusion There is a broad pipeline of trials evaluating the treatment of OA, with the majority of focus including medical devices, joint replacement surgery, and therapeutic injections. Nearly 90% of currently active U.S. clinical trials target symptomatic resolution for patients with existing OA, with a low number of reported trials targeting OA disease-modifying therapies and prevention of posttraumatic OA development. There was a higher number of disease-modifying therapeutics in the clinical trial pipeline for cellular biologics than pharmaceutical drugs. This indicates a promising area of future clinical therapy for OA treatment. Current funding of clinical trials was split between private sector and government, demonstrating an overall lack of industry funding for the treatment and management of OA. The development of OA disease-modifying therapies is essential to reduce the cost and morbidity associated with the increasing prevalence of symptomatic OA in the U.S.
THE LATERAL FEMORAL NOTCH SIGN ENTAILS INCREASED ROTATORY LAXITY AFTER ACL-INJURY. PIVOT SHIFT QUANTIFICATION WITH SURGICAL NAVIGATION SYSTEM

Gian Andrea Lucidi, Fiero Agostinone, Stefano Di Paolo Eng, Alberto Grassi, Luca Macchiarella, Giacomo Dal Fabbro, Nicola Pizzo, Stefano Zaffagnini. Italy

Summary A lateral notch sign greater than 2 mm is indicative of high grade pivot shift.

Data

Background The lateral femoral notch sign (LNS) is a bony impression on the lateral femoral condyle correlated with anterior cruciate ligament (ACL) injury. Its presence is associated with lateral meniscus injury and higher cartilage degradation on the lateral femoral condyle.

Hypothesis/Purpose The present study aimed to investigate the effect and magnitude of LNS on rotatory instability. The hypothesis was that a positive LNS was correlated with a high-grade pivot shift (PS). Study design: Cross-Sectional Study; Level of evidence, 3.

Methods 90 consecutive patients with complete ACL tears from 2013 to 2017 underwent intraoperative kinematic evaluation with the surgical navigation system, and were included in the present study. The same surgeon performed a standardized PS under anesthesia. The PS was quantified through the acceleration of the lateral compartment during tibial reduction (PS ACC) and the internal-external rotation (PS IE). LNS presence and depth were evaluated on sagittal MRI images (1.5 Tesla).

Results In 47 patients, the LNS was absent. In 33, the depth was between 1 mm and 2 mm, and in 10 patients, it was higher than 2 mm. Patients with a notch deeper than 2 mm showed increase PS ACC and PS IE compared with the group without the LNS. However, no significative differences were present between the group with a notch between 1 and 2 mm and the patients without LNS.

Conclusion The presence of a lateral LNS deeper than 2 mm could be used to preoperatively identify patients with a high risk of increased rotatory instability. Clinical Relevance: The LNS could be useful in the clinical setting to set patient’s expectations and probably modify the surgical planning in terms of graft choice and additional lateral extra-articular procedures.

19318 NATURAL HISTORY OF FEMOROACETABULAR IMPINGEMENT: USING MACHINE LEARNING TO EVALUATE RISK FACTORS FOR OSTEOARTHRITIS IN A LARGE GEOGRAPHIC POPULATION OVER THE LONG-TERM

1Ayoosh Pareek, 2Sunho Ko, 1Heath Melugin, 3Changwung Jo, 1Ryan R Wilbur, 1Bryant M Song, 1Aaron J Krych, 1USA; 2North Korea; 3Republic Of Korea

Summary Machine learning allows accurate prediction of osteoarthritis in patients with FAI given imaging, patient, and physical exam parameters.

Data

Introduction/Purpose Femoroacetabular impingement (FAI) is a major factor for functional limitation and osteoarthritis, yet very little is known about the disease progression or future development of osteoarthritis. Most studies evaluating FAI are conducted with small cohorts or over the short-term. Therefore, the purpose of this study was to use machine learning to develop a predictive model of risk factors that influence progression to osteoarthritis (OA) in patients with FAI that did not have surgical intervention.

Methods Between 2000 and 2016, medical records of all patients diagnosed with FAI in the Rochester Epidemiology Project (REP) were reviewed. The REP is a medical record database providing access to the complete medical records (all medical encounters) for all residents of Olmsted County, Minnesota, USA; it has been described in detail previously and has been validated for reliability and accuracy in population-based studies. All available radiographs were reviewed. Patient demographics, physical exam, and imaging characteristics (ex: cam lesion, alpha angle, Tonnis grade) were included for model creation. For the initial prediction method, a Gradient Boosting Machine algorithm was selected due to its predictive power and efficiency. The primary outcome for progression

REATTACHMENT OF POSTERIOR CRUCIATE LIGAMENT BONY AVULSION WITHOUT CAPSULOTOMY USING TRANSVERSE POSTERIOR INCISION – ‘A TECHNICAL NOTE’

Sharath Kittanakete Ramanath. India

Summary A minimally invasive transverse incision is an effective surgical technique to fix posterior cruciate ligament avulsion fractures over its tibial attachment provided the surgeon has good understanding of the anatomy of the posterior aspect.

Data

Background Posterior cruciate ligament injuries are not as common as anterior cruciate ligament injuries with avulsion injuries over the tibial attachment of posterior cruciate ligament being even more uncommon. Avulsion fractures are traditional fixed by a large incision which increases pain and affects rehabilitation.

Purpose A minimally invasive approach to fix posterior cruciate ligament avulsion injuries using basic instruments.

Materials and Methods Single centre single surgeon study. The study included 12 males and 4 females. The mean follow-up period was 36.12 months. Fixation was done through a transverse incision over the posterior knee crease. Fixation was done with cannulated cancellous screws.

Results There was a significant improvement in the Lysholm score (from a mean of 7.6 before surgery to 93.6 after surgery). This improvement was statistically significant as tested by Wilcoxon Signed Ranks Test. All the patients achieved a good range of knee flexion at final follow-up (mean of 126 degrees) with no posterior sag. Radiological union at fracture site was noted in all the cases.

Conclusion A minimally invasive transverse incision is an effective surgical technique to fix posterior cruciate ligament avulsion fractures over its tibial attachment provided the surgeon has good understanding of the anatomy of the posterior aspect. This technique helps us to avoid the traditional large incisions which were used to fix these fractures and thus, improves the post-operative outcome and reduces the morbidity.
was radiographic progression of symptomatic hip osteoarthritis via Tonnis Grade. We used 10-fold nested cross-validation to determine accuracy of the model.

**Results**

Total of 1045 patients with a mean age of 28.5 years (SD 9.4), alpha angle of 61 degrees (SD 14.4), Tonnis angle of 4.4 degrees (SD 6.8), lateral center edge angle (LCEA) of 32.3 degrees (SD 6.9) were included. The mean follow-up was 24.9 years (SD 12.5 years). A machine learning model using the above methodology was created using two discrete steps. The first model was built using only imaging related parameters such as LCEA and Tonnis Grade (among others). The second model was build using both imaging related parameters in addition to patient (age, BMI, etc) and physical exam (FAI impingement signs, groin pain, etc) parameters. The overall area under the curve (AUC) of the first model was 72.5% (95% CI 67.8 to 77.1) which was significantly improved to 81.9% (95% CI 77.7 to 86.2). This model’s top two of the three features in order of importance were demographic related (age at diagnosis, BMI, Figure 1). This model was utilized to partition the patients into low- and high-risk groups based on probability of OA progression. The mean survival for the high-risk group was significantly lower (121.9 months) than the low-risk group (201.9 months) for OA progression corresponding to an approximate survival of 90.4% vs 56.7% at 10-year follow-up, respectively (p<0.001).

**Conclusion**

Femoroacetabular impingement continues to be a common cause of osteoarthritis in young patients. In this long-term follow-up of a large geographic cohort treated non-operatively, machine learning was successful in accurately predicting osteoarthritis progression given preoperative imaging, patient, and physical exam parameters. In addition, age, BMI, and Tonnis grade at initial presentation appear to be the most important three factors affecting osteoarthritis progression.

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**Predicting Factors for Achieving Minimally Clinical Important Difference After Primary Shoulder Arthroplasty: A Machine Learning Model**

Ayosh Pareek, Micah Nieboer, Jianing Man, Ronda Esper, Kalayan Pasupathy, Joaquín Sanchez-Sotelo. USA

**Summary**

Machine learning methodology identified age, BMI, and forward flexion as the most important factors in prediction of MCID after shoulder arthroplasty.

**Data**

Introduction/Purpose

Previous studies have tried to predict minimally clinical important difference (MCID) after total or reverse shoulder arthroplasty (TSA, RSA). However, they have been limited by either small sample sizes or lack of detail on the accuracy of their predictive results. The purpose of this study was to use machine learning to develop a predictive model for achieving MCID after TSA and RSA considering demographic, psychosocial, and physical exam factors.

Methods

All patients who underwent primary TSA or RSA by a single surgeon with preoperative and 1-year postoperative ASES scores were evaluated to determine whether they had achieved maximal clinical benefit from the procedures. Patients with complications or reoperations from the surgery within the first year were excluded due to obvious effect on ASES scores. The study population included 166 patients (49% male) that had undergone TSA (36%) or RSA (64%) with a mean age of 70.4 (SD 8.8). Data collected included patient demographics (age, BMI, gender, diabetes and other), psychosocial factors (tobacco use, mental health disorders), physical exam parameters type of implant, and indication for arthroplasty. Data was randomly divided into two sets (80% for training and 20% for testing) and various machine learning algorithms were compared (Neural Network, Regression Tree, XGBoost, and Random Forest). The XGBoost ensemble method had the highest accuracy and was chosen.

**Results**

Overall, the mean preoperative to postoperative ASES score change was 40.5 points (SD 22.9, p<0.001) and 74% patients achieved MCID. A machine learning model using the above methodology was created using two discrete steps. The first model was built using all parameters except for preoperative ASES score. The second model was built using imaging related parameters in addition to preoperative ASES scores to evaluate the increased accuracy in prediction. For the first model, the four most important variables were age at surgery, BMI, preoperative external rotation, and preoperative forward flexion (Figure 1). The overall area under the curve (AUC) of the test data model was 80%, which was deemed to be a very good model (Figure 2). The second model including preoperative ASES scores had an increased accuracy of testing data of 85%. In addition, this model did not rely on the same variables, as ASES became the most important variable in addition to BMI, age, and preoperative forward flexion (Figure 3).

**Conclusion**

In our study, 75% of the patients who had undergone primary shoulder arthroplasty had achieved MCID at one year. Machine learning methodology identified age, BMI, and forward flexion as the most important factors in prediction of MCID. The addition of preoperative ASES scores appears to improve model predictability when predicting which patients will achieve MCID.

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**Repeat Revision Tkr for Failed Management of Periprosthetic Infection Has Long Term Success But Often Require Multiple Operations: A Case Control Study**

Harshadkumar Rajgor, Huan Dong, Rajpal Nandra, Michael Parry, Jonathan Stevenson, Lee Jays. UK

**Summary**

Management of PJI should occur in specialist revision centres.

**Data**

Aims

Management of prosthetic joint infection (PJI) is associated with poor outcomes and catastrophic complications. The aim of this study was to present the outcomes of re-revision surgery for PJI of the knee following previous failed two-stage exchange arthroplasty.

Methods

We retrospectively analysed 32 patients who underwent re-revision knee arthroplasty, having already undergone at least one previous two-stage exchange for PJI, between 2009 and 2018, with a minimum follow-up of two years (mean follow-up 40 months (2 to 99 months)). Outcomes were compared to a matched control of two-stage revisions for PJI of a primary knee replacement. Primary outcomes investigated were eradication of infection and re-operation. Secondary outcomes were five-year mortality and limb-salvage rate.
Results Successful eradication of infection was achieved in 50% of patients following re-revision surgery at the first treatment episode, compared with 91% following two-stage exchange of primary knee replacement for PJI (p<0.001). Fourteen (44%) patients required further re-operation compared with three (9%) patients in the primary group (p=0.006). Amputation was performed in one case (3%) with thirteen patients (92%) had infection controlled by DAIR, further revision surgery or arthrodesis. Two patients died with infection (6%) and therefore the long-term rate for infection control was 91%. The mean number of procedures following surgery for the re-revision group was 2.8 (0-9) compared with 0.13 (0-1) for the primary two-stage group (p<0.001). Five-year patient survival was 90.6% (95% CI 77.1 to 100). Multi-drug resistant organisms were present in 14 (44%) patients in the re-revision group. The limb-salvage rate for the re-revision cohort was 97% at final follow-up.

Conclusion Outcomes for re-revision knee arthroplasty for PJI have higher re-operation and failure rates, but no worse mortality than in revisions of primary knee replacements for PJI. Failures can successfully be managed by further operation. This supports the move to concentrate expertise for eradication of recurrent knee PJI within specialist MDTs.

Abstracts
19238 A GOAL-BASED RETURN TO SPORT FOLLOWING KNEE ARTHROPLASTY: A PROSPECTIVE STUDY USING FUNCTIONAL CRITERIA AND GAIT ANALYSIS
Ahmed A Magan, Babar Kayani, Ricci Plastow, Justin Chang, Fares S Haddad. UK
10.1136/jisakos-2021-congress.49

Summary Goal-based RTS criteria have reduced time to sport compared to time-based criteria. Patients continue to improve for a considerable period after returning to sport.

Data
Introduction There is no consensus over time to return to sport (RTS) following arthroplasty; patients are usually given a period of three to six months. The objectives of this study were to determine criteria that would allow earlier return to sport.

Patients & Methods This prospective study included 50 patients that participated in amateur sports before the onset of their knee arthritis. The study included 28 males and 22 females with a mean age was 62 ± 4.5 years. All study patients underwent Total Knee Arthroplasty (TKA) by a single surgeon, and received a milestone-based rehabilitation programme with the goal of getting back to golf or tennis at the earliest opportunity. Functional outcomes were recorded after surgery at 3, 6, 9 and 12 weeks, and gait analysis was performed using a force plate treadmill after 3 months, and 24 months. Mean follow-up was 27.8 months (range, 24 to 35 months).

Results 96% (48) returned to their goal level of sporting activity. Mean time for full RTS activity was 10 ± 3.5 weeks, although some patients were able to start as early as 4 weeks after surgery. At two years follow-up, study patients had improved mean Oxford knee scores (40 ± 3.1 vs 16 ± 3.5 respectively, p<0.001), Forgotten Joint scores (46 ± 8.5 vs 8 ± 3.5 respectively, p<0.001) and improved lower extremity functional scores (68 ± 3.2 vs 29 ± 2.2 respectively, p<0.001) compared to preoperative values. Gait analysis revealed significantly better cadence, walking speed, stride length and stance time, for all sporting activities at 24 months compared to 3 months.

Conclusion Goal-based RTS criteria have reduced time to sport compared to time-based criteria. Patients continue to improve for a considerable period after returning to sport.

19249 CONCURRENT TREATMENT OF A DISPLACED BUCKET HANDLE AND ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION: A HIGHER RISK OF STIFFNESS?
Etienne Deroche, Cécile Batailler, John Swan, Sebastien Lustig, Elvire Servien. France
10.1136/jisakos-2021-congress.50

Summary There is an increased risk of revision for arthrolysis after simultaneous treatment of DBH and ACL reconstruction.

Data
Objectives Postoperative stiffness is feared after anterior cruciate ligament (ACL) reconstruction. A bucket handle meniscal tear associated with an ACL tear requires urgent surgical treatment and may delay full range of motion (ROM) recovery. We hypothesise that the concurrent treatment of a displaced bucket handle (DBH) meniscal tear and ACL reconstruction is associated with an increased risk of revision for arthroscopic arthrolysis.

Methods A retrospective case-control study of consecutive patients with ACL reconstruction performed between January 2009 and December 2018. Group A (cases) involved all patients who underwent simultaneous ACL reconstruction and DBH meniscal tear treatment, and patients in group B (controls for each case) underwent isolated ACL reconstruction. Groups were matched for age, sex, body mass index. The primary outcome was re-operation rate for arthrolysis <12 months after surgery. Other outcomes were stiffness in flexion and extension at 6 weeks and 6 months after surgery. Study Design: Case-control study, Level of Evidence: Level 3.

Results 69 patients were included in group A, 40 men (58%) and 29 women (42%) and 139 patients in group B, 68 men (49%) and 71 women (51%). Mean age was 29 +/- 11.2 years in group A and 30 +/- 10.4 years in group B. The revision rate for arthrolysis was higher in group A compared to group B, 7 (10.1%) and 4 (2.9%) patients respectively (p=0.044), with a survival rate of 89.7% (CI95% 82.7–97.2) and 97.1 (CI95% 94.3–99.9) respectively (p=0.023). There was more stiffness in flexion and in extension in group A after 6 weeks and after 6 months (p>0.05). The risk for arthrolysis was not statistically different regarding the delay from accident to surgery for the global series (p=0.421) and in group A specifically neither (p=0.887). The DBH was sutured for 39 patients (56.5%), with 3 failures (7.7%) after 12 months follow-up. Arthrolysis was performed for 6 patients treated by meniscal suture (15.4%) and for only one patient treated by meniscectomy (3.3%) (p=0.128).

Conclusion Our study confirms an increased risk of revision for arthrolysis after simultaneous treatment of DBH and ACL reconstruction. The influence of the delay for surgery after ACL rupture and the type of DBH treatment (suture or meniscectomy) on postoperative stiffness has not been demonstrated.
Summary
This study reinforces the safety of corticosteroid injection (CSI), as patients treated by CSI did now show significantly greater rates of osteoarthritis progress and new femoral head collapse.

Data
Introduction
In the absence of definitive Level I evidence regarding the safety of hip CSI, there have been an increasing number of retrospective case series studying outcomes after hip corticosteroid injection (CSI). Recent studies have suggested that hip CSI may be associated with increased rates of avascular necrosis (AVN), subchondral insufficiency fracture (SIF), femoral head articular surface collapse, and accelerated progression of osteoarthritis (OA), but these studies do not compare against a control arm matched for baseline OA severity or exclude patients with pre-injection AVN or SIF from analysis, causing selection bias.

Methods
For all patients at our institution who had undergone hip CSI between 2007 and 2019 and hip magnetic resonance imaging (MRI) within the preceding 12 months (CSI cohort), two musculoskeletal radiologists retrospectively reviewed hip radiographs taken within 12 months prior to and after CSI and graded OA severity (modified Kellgren-Lawrence classification) and femoral head collapse, blinded to cohort and time-point. The same was done for a hip control cohort (matched for age, sex, BMI, and OA severity on baseline radiograph reports) that had undergone hip MRI and pre- and post-MRI hip radiographs within 12 months. A third reader arbitrated discrepancies. OA progression was defined as an increase in modified Kellgren-Lawrence grade ≥1 between radiographs. Matched pairs with at least one incidence of pre-existing AVN or SIF on index MRI were excluded for analysis.

Results
186 hips in the CSI group [mean ±95% CI age: 55.8 ± 2.1, mean ±95% CI BMI: 27.5 ± 0.8, 69 (37.1%) males, 100 (53.8%) right hips] and 186 hips in the control group [mean ±95% CI age: 55.7 ± 2.3, mean ±95% CI BMI: 28.0 ± 0.8, 69 (37.1%) males, 96 (51.6%) right hips] were included in this study. There were no significant differences between groups in age, gender, BMI, laterality, baseline OA severity, or baseline AVN/SIF on index MRI. Analysis of adjudicated radiographic outcomes were performed after exclusion of 61 matched pairs with at least 1 instance of pre-existing AVN or SIF on index MRI. Analysis of adjudicated radiographic outcomes were performed after exclusion of 61 matched pairs with at least 1 instance of pre-existing AVN or SIF (Table 1).

Rates of OA progression (5.6% vs. 2.4%; p = 0.33), new AVN or SIF (1.6% vs. 0.0%; p = 0.50), and new femoral head collapse (3.2% vs. 2.4%; p = 1.000) were all similar between groups. Of the 3 cases of new femoral head collapse in the CSI group, 2 were classified as femoral head remodeling secondary to OA, leaving only one (0.8%) definitive femoral head collapses secondary to AVN or SIF. Of the 3 cases of new femoral head collapse in the control group, 2 were classified as femoral head remodeling due to an unknown etiology, leaving only one (0.8%) definitive femoral head collapses secondary to AVN or SIF.

Discussion
When controlling for baseline OA severity and pre-existing AVN or SIF, patients treated by CSI in our study showed OA progression in only 6% of cases and new femoral head collapse in only 3% of cases, which was not significantly greater than control and similar to the expected progression of natural disease. Future multicenter, randomized, double-blind, placebo-controlled trials investigating safety of hip CSI are needed.

Summary
This study reinforces the safety of corticosteroid injection (CSI), as patients treated by CSI did now show significantly greater rates of osteoarthritis progress and new femoral head collapse.

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Discussion
When controlling for baseline OA severity and pre-existing AVN or SIF, patients treated by CSI in our study showed OA progression in only 6% of cases and new femoral head collapse in only 3% of cases, which was not significantly greater than control and similar to the expected progression of natural disease. Future multicenter, randomized, double-blind, placebo-controlled trials investigating safety of hip CSI are needed.
CAN BMAC APPLICATION SAFELY DIMINISH PERIOPERATIVE PAIN IN PATIENTS UNDERGOING HIP ARTHROSCOPY?

Michael Peter Kucharik, Paul F Abraham, Mark R Nazal, Nathan Varady, Wendy Madeline Meek, Stephen M Gillov, Christopher T Eberlin, Scott Martin. USA

Summary Patients who received BMAC during arthroscopic labral repair reported significantly less pain than those who did not receive BMAC. Patients receiving BMAC also reported with minimal complications.

Data

Introduction The purpose of this study was to compare pain levels and medication use in the perioperative period in patients undergoing arthroscopic labral repair with and without BMAC application. The secondary purpose of this study was to report safety of the procedure by evaluating post-operative complications from the perioperative period to final follow-up.

Methods A prospective cohort of consecutive patients undergoing arthroscopic labral repair with possible BMAC application between January 2018 and March 2020 were offered enrollment into the study. BMAC was not used in patients with widespread degenerative changes or patients without any discernable degenerative changes. Each patient was prescribed 20 tablets of 5 mg oxycodone and was instructed to take 1 tablet for breakthrough pain of moderate intensity. Patients were instructed to complete a medication and visual analog scale (VAS) pain tracker and return it at their suture removal appointment, approximately 12–14 days after surgery. Outcomes collected from this tracker were compared between the group of patients treated with BMAC and the group not treated with BMAC. In addition, retrospective chart review was conducted for 171 patients who received BMAC by the senior surgeon during arthroscopic acetabular labral repair. Progress notes from the perioperative period until final follow-up were examined for possible complications related to BMAC harvesting and application.

Results Seventy patients [40 (57.1%) males] completed the medication and pain tracker. 59 (84.3%) of these patients underwent BMAC application. Mean (95% CI) age was 31.71 (29.52, 33.91). On postoperative day #1 (POD#1), VAS pain scores were lower in the BMAC group, approaching statistical significance (4.76 vs. 6.18 p=0.095). The BMAC group reported significantly less pain than the No BMAC group on POD#5 (3.53 vs. 5.18; p=0.010), POD #10 (2.23 vs. 3.73; p=0.014), and the suture removal appointment (1.80 vs. 3.18; p=0.008). The mean length of opioid (4.02 vs. 2.82 days; p=0.348) and NSAID (8.59 vs. 8.00 days; p=0.677) usage did not differ significantly between groups. The total number of opioid (8.47 vs. 7.45; p=0.715) and NSAID (27.83 vs. 21.36; p=0.464) pills taken also did not differ significantly between groups. The maximum number of opioid (2.61 vs. 2.64; p=0.973) and NSAID (5.07 vs. 5.55; p=0.708) pills taken in a single day was also similar. Among the 171 patients in the retrospective cohort, 19 (11.1%) had signs of heterotopic ossification (HO) on follow-up radiograph, 2 (1.2%) progressed to total hip arthroplasty (THA) by final follow-up, and 1 (0.5%) had evidence of neuropraxia. Zero patients had evidence of wound infection, joint infection, skin necrosis, hemorrhage, avascular necrosis, or required a repeat arthroscopic procedure.

Discussion Patients treated with BMAC at the time of hip arthroscopy had significantly lower VAS pain scores than those not treated with BMAC, despite undergoing bone marrow aspiration—normally a painful procedure. Furthermore, the patients treated with BMAC used opioids and NSAID medications at similar rates as those treated without BMAC. Patients treated with BMAC suffered minimal postoperative complications, as zero patients had evidence of joint infection, wound infection, or hemorrhage secondary to BMAC harvesting and application.
(AUC=0.94, Sn=95%, Sp=92%, OR=4) and edematous synovitis (AUC=0.94, Sn=91%, Sp=97%, OR=10) were highly accurate with very high specificity and sensitivity for the diagnosis of PSI. Complex joint effusion (AUC=0.86, Sn=86%, Sp=86%, OR=5.7) was found to be accurate with high specificity and sensitivity. Rotator cuff muscle edema (AUC=0.75, OR=3.6) and extrarticular fluid collection (AUC=0.71, OR=5.0) were both moderately accurate and while these criteria had very high specificity (> 90%) they had low sensitivity for diagnosing PSI. While the finding of a sinus tract finding in MARS MRI had a very high specificity (99%) with odds ratio of 9.3, the accuracy (AUC=0.63) and sensitivity (28%) were low. Periprosthetic edema and periprosthetic resorption or osteolysis had low accuracy, sensitivity, and specificity for diagnosis of PSI.

Conclusion This study demonstrates a high accuracy and reliability of MARS MRI for the making the diagnosis of PSI. This diagnostic test should be considered used when evaluating patients for PSI. These conclusions are based upon a specific MRI protocol with experienced musculoskeletal radiologists.

Identification of Predictive Risk Factors for the Development of a Stress Fracture Within 6 Months in Female Elite Long-Distance Runners

Haruka Tohyama, Tomoya Ishida. Japan
10.1136/jisakos-2021-congress.55

Summary Lumbar bone mineral density (BMD) < 81.1% of the young adult mean (YAM) predicted a prospective stress fracture within 6 months with 74% specificity and 88% sensitivity in female elite long-distance runners.

Data
Background Female runners have a higher risk of stress fractures than male runners. Literature about best practices for preventing stress fractures in female long-distance runners is lacking. We aimed to identify which factors predict the risk of stress fractures within 6 months in female elite long-distance runners. Study design: Cohort study.

Methods We measured bone mineral densities (whole body and lumbar spine) and body composition using dual-energy X-ray absorptiometry (DXA) in elite female long-distance runners aged 18 to 37 years old (N = 21) who belonged to a women’s track team. We followed participants prospectively for 6-month periods. Stress fractures were confirmed with bone scan, magnetic resonance imaging, and/or computed tomography findings. We used univariate logistic regression and stepwise multivariate logistic regression with the receiver operating characteristic curve to examine the ability of bone mass and body composition parameters alone or in combination to predict the occurrence of a stress fracture.

Results We performed 118 DXA measurements. Stress fractures (four sacral, three tibial, three calcaneal, two pubic, two femoral neck, one rib, one cuboid, and one metatarsal) occurred in nine runners within 6 months. Bone mineral densities (whole body and lumbar spine), total bone mineral content, lean body mass, and percentage total bone mineral content (relative to total body mass) were significantly associated with a stress fracture developing. The multivariate analysis showed that bone mineral density of the lumbar spine alone was the strongest predictive factor. Bone mineral density of the lumbar spine < 81.1% of the young adult mean predicted the occurrence of a stress fracture within 6 months, with and 88% sensitivity and 74% specificity.

Conclusion Female elite long-distance runners with lumbar spine bone mineral density <81.1% are at increased risk of a stress fracture within 6 months and should reduce their high-impact sports activities to avoid developing a stress fracture. Clinical relevance: The present study provides meaningful information that suggests a possible useful application of DXA measurement as a screening tool in regular medical examinations for predicting stress fractures in female long-distance runners.

Today’s Nonagenarians: Too Old for Arthroplasty?

William Bugbee, Stephen Sizer, Adam Rosen, Julie McCauley, William Bugbee. USA
10.1136/jisakos-2021-congress.56

Summary In our matched cohort study, nonagenarians had higher rates of complications than younger patients following total joint arthroplasty.

Data
Introduction Conventional wisdom suggests that nonagenarians may be “too old” and fail to undergo elective total joint arthroplasty (TJA). Historical studies have reported higher complication rates in nonagenarians. We questioned if this concept is still valid and hypothesized that today’s nonagenarians have equivalent outcomes to younger cohorts undergoing TJA.

Methods One hundred seventy-four patients undergoing primary TJA between 2010 and 2017 were included; 58 nonagenarians (age 90+) were matched with 58 octogenarians (age 80–84) and 58 septuagenarians (age 70–74). Groups were matched by gender, diagnosis, surgeon, operative joint, and year of surgery. Within each group, 31 patients (53%) underwent total hip arthroplasty (THA) and 27 patients (47%) underwent total knee arthroplasty (TKA). Comorbidities, American Society of Anesthesiologist (ASA) physical status scores, and Charlson comorbidity index scores were captured preoperatively. Complications, readmissions, and mortality occurring within 90 days postoperatively were evaluated.

Results The overall total complication rate was 12% for septuagenarians, 22% for octogenarians, and 45% for nonagenarians (p < 0.001). Nonagenarians were 3.1 times more likely than younger patients to have a complication, after controlling for arthroplasty type (THA vs. TKA), ASA score, Charlson comorbidity index, major medical comorbidities, and discharge disposition (home vs. skilled nursing facility) (p = 0.040). When complications were classified as medical, nonagenarians had the highest rate (33%) compared to septuagenarians (3%) and octogenarians (14%) (p < 0.001). Orthopedic (surgical) complications were similar between groups. Readmission occurred in 2% of septuagenarians, 5% of octogenarians, and 11% of nonagenarians (p = 0.118). There were two deaths (both nonagenarians).

Conclusion Nonagenarians were 3.1 times more likely than younger patients to have a complication following TJA. The incidence of medical complications was highest in nonagenarians compared to septuagenarians and octogenarians, but rates
of orthopedic complications were similar. These results did not support our hypothesis that nonagenarians would have equivalent outcomes to younger cohorts undergoing TJA.

19595  AUTOGRAFT VS ALLOGRAFT VS XENOGRAFT: CT SCAN EVALUATION OF GLENOID GRAFTING

Ettore Taverna, Caterina Albizzini Ohin, Vincenzo Guarrella, Carlo Perfetti. Italy

10.1136/jisakos-2021-congress.57

Summary Radiological comparison of different grafts and different fixation techniques.

Data Purpose to evaluate bone integration and osteolysis of glenoid grafting in the context of shoulder anterior-inferior instability.

Methods graft osteointegration and osteolysis was retrospectively evaluated with ct scan imaging performed at 12 months after surgery to compare results of Latarjet procedure, Bone block procedure with allograft and bone block procedure with xenograft. Screw fixation and double endobuttons fixation was also compared.

Results ct scan imaging of 123 patients were analysed. Of these 23 were performed in patients who underwent Bone Block procedure with xenograft and Endobuttons fixation, 55 underwent Bone Block procedure with allograft and Endobuttons fixation, 13 Latarjet procedure with screw fixation and 32 Latarjet with Endobuttons fixation. Osteolysis was inferior in Bone Block procedure compared to Latarjet procedure (12.8% vs 28.9%) but the result was not statistically significant (P value 0.10). Bone integration was higher in Bone Block procedure than Latarjet procedure but the result was not statistically significant (P value > 0.5). Within the Latarjet procedures Endobuttons fixation resulted in a higher integration rate (87.5% vs 73.6%) and lower osteolysis rate compared to screw fixation (25% vs 38.4%) but the result was not statistically significant. Within the Bone Block procedures the use of a Xenograft resulted in a higher integration rate (92%) and lower osteolysis rate (8%) compared to the use of an Allograft (16,3%) but the result was not statistically significant.

Conclusions Glenoid bone loss is a major risk factor for recurrence in anterior-inferior shoulder instability. Therefore high rate of bone graft integration and low rate of graft osteolysis are crucial to achieve optimal results. This study shows a lower rate of graft osteolysis after Bone Block procedure compared to Latarjet procedure. Other non statistically significant findings suggest better results in terms of osteolysis and graft integration with xenograft compared to allograft and with double endobuttons fixation compared to screw fixation.

19607  EVOLUTION OF GRAFT MATURATION AND TUNNEL WIDENING DURING THE FIRST YEAR FOLLOWING ALL-INSIDE GRAFT-LINK ACL RECONSTRUCTION: A SERIAL MRI STUDY

1Edoardo Monaco, 2Etienne Cavaignac, 3Fabio Marzilli, 1Riccardo Di Niccolo, 1Edoardo Gaj, 1Alessandro Carrozzo, 3Adrian Saitma, 1Giuseppe Argento, 1Andrea Ferretti. 1Italy; 2France; 3USA

10.1136/jisakos-2021-congress.58

Summary MRI evaluation of graft healing after ACL reconstruction with all inside graft link technique.

Data Background The all-inside graft-link ACL reconstruction technique is based upon the use of a quadrupled semitendinosus graft fixed with adjustable loop suspensory devices (ALD) on both femoral and tibial sides. This technique is gaining popularity due to potential benefits that may include faster recovery, reduced invasiveness, and reduced donor site morbidity, when compared to standard techniques. However, the main concerns with this technique are related to the magnitude of the overall cyclic displacement that may occur with two ALDs. In turn this leads to additional concerns, including the potential increased risk of inferior graft maturation/incorporation and tunnel widening (TW). Objective The primary objective of this study was to prospectively evaluate graft maturation and incorporation, and tunnel widening in a group of patients who underwent all-inside graft link ACL reconstruction using sequential 1.5 T MRI at 3, 6 and 12 months post-operatively.

Methods 20 patients were prospectively enrolled in the study. Inclusion criteria were: age between 16 and 50 years, chronic ACL tear (injury-surgery interval more than 2 weeks) confirmed by physical examination and preoperative MRI, a healthy contralateral side, and no prior injuries to the affected knee. 1.5 T MRI was performed at 3, 6 and 12 months post-operatively to evaluate graft maturation and incorporation and tunnel widening. The following parameters were considered at each follow-up: signal-to-noise quotient (SNQ), bone-graft integration scale (signal intensity at the bone-graft interface), ligament signal by Howell scale, and tibial tunnel widening. Radiological parameters were evaluated by an expert radiologist and an orthopedic surgeon. The final clinical evaluation was performed at a minimum follow-up of 2-years. This included physical examination, patient-reported outcomes (PROs) and KT-1000 arthrometer. The Mann-Whitney U test was used to analyze differences in imaging findings between different time points.

Results The mean signal-to-noise quotient (SNQ) was 4.4 ± 2.6 at 3 months post-op, 1.6 ± 0.7 at 6 months post-op and 1.9 ± 1.4 at 12 months post-op. There was a statistical difference between 3 and 6 months (p=0.028) and between 3 and 12 months (p=0.03) with no differences between 6 and 12 months. The mean tunnel widening was 41.2% ± 36.7% at 3 months, 52.4% ± 18.7% at 6 months and 45.5% ± 46.6% at 12 months. Tunnel widening reduced significantly at 12 months post-operatively when compared to 6 months post-operatively (p=0.5). The Howell scale showed statistically significance between 3 and 12 months, with patients identified as Grade 1 going from 30% to 70% (p=0.05). The bone-graft integration scale showed statistically significance between 3 and 12 months, with patients identified as Grade 1 go from 45% to 65%, comparing 3 and 12 months (p=0.01).

Conclusion Significant maturation and incorporation of all-inside graft-link ACL grafts occurs by 6 months post-operatively, with no further maturation apparent between 6 and 12 months. These promising results suggest that even if cyclic displacement occurs it does not compromise maturation and incorporation. These findings are supported by a significant reduction in tibial tunnel diameter and MRI evidence of graft healing occurring within the tibial socket by 12 months post-operatively.
Biomechanical Comparison of Stemless Humeral Components in Total Shoulder Arthroplasty

Ilya Voloshin, Raymond Chen, Emma Knapp, Anthony Miniaci, Hani Awad, Ilya Voloshin. USA

Summary The purpose of this study was to compare initial fixation strength between various stemless and stemmed humeral components and to correlate component fixation strength of each implant with bone mineral density (BMD).

Data

Background The ideal design for stemless humeral components in total shoulder arthroplasty is currently unknown. Comparison of primary stability between different designs is lacking. The purpose of this study was to compare initial fixation strength between various stemless and stemmed humeral components and to correlate component fixation strength of each implant with bone mineral density (BMD).

Methods Five humeral stem designs were included in this study: three stemless (Simpliciti, OVOMotion), one short stem (50 mm) and one standard stem (130 mm). 50 cadaveric human humerii were obtained and divided into five groups. BMD within the humeral head was determined for all samples via DEXA scan. The 25 samples with the lowest and highest BMDs were categorized as “Low” and “High”, respectively, with a BMD threshold of 0.35 g/cm2, creating BMD subgroups. Mean BMD was similar between groups. After implantation, each sample underwent a standardized biomechanical testing protocol, with axial loading followed by torsional loading. Sensors attached to the specimen recorded micromotion throughout testing. Axial loading consisted of cyclic loading for 100 cycles at 3 peak forces (220, 520 and 820 N). Torsional loading consisted of 100 cycles of internal/external rotation at 0.1 Hz at 6 peak torques, or until failure (± 2.5, 5, 7.5, 10, 12.5 and 15 Nm). Failure was defined as the torque at which any bone fracture, implant detachment from anchor/stem or an excess of 50° internal/external rotation occurred. Statistical analysis was performed to compare findings between groups and subgroups using one-way ANOVAs.

Results At maximal axial loading, Simpliciti demonstrated greater micromotion (540 μm) than OVOMotion (192 μm), p=0.003. Simpliciti and Sidus (387 μm) also had greater micromotion than Short stem (118 μm, p<0.001, p=0.03) and Standard stem (85 μm, p<0.001, p=0.01). When comparing low BMD samples at maximal axial loading, these differences were accentuated, but comparison of high BMD samples showed no significant differences between groups. Torsional testing demonstrated that Standard stem failed at greater torque (7.2 Nm) than Simpliciti (2.3 Nm, p<0.001), Sidus (1.9 Nm, p<0.001) and OVOMotion (3.9 Nm, p=0.01). When comparing torsional testing results of low BMD samples, both Standard stem and Short stem failed at greater torque than Simpliciti (p=0.02, p=0.003) and Sidus (p=0.03, p=0.004) but failed at a similar torque to OVOMotion. Torsional testing of high BMD samples showed that Standard stem failed at a greater torque than all stemless designs.

Conclusions Primary fixation of stemless and stemmed humeral implants depends on implant design and proximal humeral bone quality. OVOMotion demonstrated less micromotion than Simpliciti during axial loading testing. Stemmed implants (short and standard length) outperformed Simpliciti and Sidus in low BMD specimen (<0.35 g/cm2) during both maximal axial loading and torsional testing. Of the tested stemless designs, OVOMotion (central screw and peripheral rim-fit design), demonstrated greater primary stability at low BMD when compared to Simpliciti and Sidus, while all stemless designs performed similarly at high BMD.

Alpha Angle More Useful Than Femoral Head-Neck Offset to Predict Intra-Articular Damage in Patients with FAI Undergoing Hip Arthroscopy

Benjamin G Domb, Jacob Shapira, Jade Owens, David R Maldonado, Philip Joseph Rosinsky, Hari Krishna Ankem, Bezaal Peskin, Ajay C Lall, Benjamin G Domb. USA

Summary In a multivariate analysis, factors identified as preoperative predictors of intra-articular cartilage damage in patients with FAI were age, sex, ACEA, and alpha angle.

Data

Purpose To identify radiographic measurements and demographics that are predictive of intra-articular cartilage damage in patients with femoroacetabular impingement (FAI) undergoing hip arthroscopy. More specifically, to compare the predictive value of alpha angle and femoral head-neck offset in determining the preoperative likelihood and severity of intra-articular cartilage damage.

Methods Patients were included if they underwent primary hip arthroscopy between February 2008 and June 2020. A total of 13 variables were assessed in a bivariate comparison and analyzed in a multivariate logistic model. The Acetabular Labrum Articular Disruption (ALAD) and Outerbridge (OB) classifications were used to define acetabular cartilage defects. Those without damage or those with mild acetabular cartilage damage belonged to the ALAD/OB = 2 group and those with severe acetabular cartilage damage belonged to the ALAD/OB = 3 group.

Results The multivariate logistic regression selected age, sex, anterior center-edge angle (ACEA), and alpha angle. Every additional degree in the alpha angle was associated with a 6% increase in the odds of severe acetabular cartilage damage defined as ALAD/OB = 3 (OR, 1.06 [95% CI, 1.01–1.11]). The multivariate analysis did not identify femoral head-neck offset as a predictor. The odds of severe acetabular cartilage damage were 3.73 times higher in males than females (OR, 3.73 [95% CI, 0.01–1705.96]). Higher age (per log 10 unit) was found to increase the likelihood of ALAD/OB = 3 (OR, 1.04 [95% CI, 1.03–7.75]).

Conclusions In a multivariate analysis, factors identified as preoperative predictors of intra-articular cartilage damage in patients with FAI were age, sex, ACEA, and alpha angle. Femoral head-neck offset was not predictive, suggesting alpha angle may take precedence as a predictor of intra-articular cartilage damage. These findings may be helpful to the clinician’s efficient utilization and selection of radiographic predictors of intra-articular cartilage damage in patients with FAI undergoing hip arthroscopy.
LONG TERM CLINICAL OUTCOME OF COMBINED AUTOLOGOUS BONE AND ARTICULAR CARTILAGE CHIP TRANSPLANTATION FOR OSTEOCHONDRAL LESIONS IN THE KNEE

Bjørn Bonsøe Christensen, Morten Lykke Olesen, Casper B Foldager, Kris TC Hede, Jonas Jensen, Martin Lind. Denmark

Summary Autologous bone and cartilage transplantation for osteochondral injuries in the knee.

Data Purpose Osteochondral injuries have proven difficult to treat. Several treatments are available, but no gold standard treatment exists. Our group presented the short-term data on Autologous Dual-Tissue Transplantation (ADTT) in 2015. ADTT is a one-step, combined autologous bone and articular cartilage chips transplantation. The aim of this study was to investigate the long-term results using MRI, CT and subjective and functional clinical outcome scores.

Methods Eight patients (age 32 ± 7.5 years) suffering from osteochondritis dissecans in the knee were included. The lesion was debrided, and the osteochondral defect was filled with autologous bone, to a level at the base of the adjacent cartilage. Cartilage from the intercondylar notch was chipped using a scalpel and embedded in fibrin glue in the defect. Radiologic evaluation was performed using MRI and CT preoperatively, at one and at 7.5 years, and patient reported outcome scores were used to assess subjective and functional clinical outcome preoperatively and at one, two, five and 7.5 years (IKDC, KOOS and Tegner activity score).

Results The preoperative IKDC score increased from 35.9 to 68.1, 73.0, 75.3 and 72.9 after one, two, five and 7.5 years (p<0.01). The Tegner score improved from 2.5 to 4.7, 4.8, 4.8 and 4.6 at one, two, five and 7.5 years (p<0.001). All KOOS subscores improved at one year and the improvements persisted at two, five and 7.5 years (p<0.01). Cartilage tissue repair evaluated using MOCART score improved from 22.5 to 53.1 at one year (p<0.01), with a slight deterioration to 44.3 after 7.5 years (not statistically significant). CT imaging demonstrated good subchondral bone healing at one year, with an average bone defect filling of 80%. At 7.5 years CT showed an improvement in all patients with an average bone filling of 90% and a more even surface than at one year.

Conclusion ADTT resulted in good subchondral bone restoration and cartilage repair. Significant improvements in patient reported outcome was found at one year postoperative and the improvements persisted at two, five and 7.5 years. This study suggests ADTT as a promising, low-cost, treatment for osteochondral injuries.

HIGH MID-TERM SURVIVAL OF CONDYLLE RESURFACING IMPLANTS IN THE KNEE – A NATION-WIDE COHORT STUDY ON 379 OBSERVATIONS FROM THE DANISH KNEE ARTHROPLASTY REGISTRY

Bjørn Bonsøe Christensen, Anders El-Galaly, Jens Ole Laursen, Martin Lind. Denmark

Summary 80% Survival 10 years after treatment with Condyle Resurfacing Implants in the Knee.

Data Purpose Focal cartilage injuries are debilitating and difficult to treat. Biological cartilage repair procedures are suited for patients younger than 40 years, and knee arthroplasties are generally reserved for patients older than 60. Condyle resurfacing implants are well suited for patients in this treatment gap. Our objective was to investigate the midterm survival of condyle resurfacing implants from a nationwide cohort registered in the Danish Knee Arthroplasty Registry.

Methods In this retrospective cohort study, 379 registrations of condyle resurfacing implants were followed longitudinally in the Danish Knee Arthroplasty Registry from 1997 to 2020. The study’s primary endpoint was revision surgery. The survival of the condyle resurfacing implants was primarily analyzed by Kaplan Meier method.

Results 379 condylar implants were retrieved from the DKR. The mean age and weight of patients receiving condyle resurfacing implants were 50 years (SD: 11) and 84 kg (SD: 17). The indications for condyle resurfacing implants were: Secondary osteoarthritis (42%), primary osteoarthritis (32%) and osteochondral lesions (20%). Within the follow-up period, 70 (19%) of the implants were revised to arthroplasties. The 1-, 5- and 10-year revision free survival estimation was 0.95 (95% CI: 0.93–0.97), 0.84 (95% CI: 0.80–0.88) and 0.80 (95% CI: 0.75–0.84). The median time to revision was 2 years.

Conclusion The 10-year revision free survival rate of 80% is high compared with the available biological cartilage repair techniques. Improved patient selection could improve the implant survival rate further and can help fill the treatment gap of focal cartilage injuries in patients aged 40–60.

DYNAMIC RADIOSTEREOMETRY EVALUATION OF TWO DIFFERENT ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION TECHNIQUES: DOES SINGLE BUNDLE RECONSTRUCTION PLUS LATERAL PLASTY CAUSE KNEE OVER-CONSTRAINT?

Alberto Grassi, Stefano Di Paolo Eng, Piero Agostinone, Gian Andrea Ludidi, Erika Pinelly, Marco Bontempi, Laura Bragonzoni, Stefano Zaffagnini. Italy

Summary Dynamic radiostereometry evaluation of Lateral Plasty addition to ACL Reconstruction.

Data Background Lateral extra-articular tenodesis (LET) in the context of Anterior Cruciate Ligament (ACL) reconstruction are adopted to better control anterolateral knee instability in patients with high-grade pre-operative pivot-shift. However, several authors believe these procedures are harmful to knee cartilage since they cause lateral compartment over-constraint in daily life motion.

Hypothesis/Purpose The first aim of the present study was to identify kinematical differences between ACL-reconstructed knees with anatomic SB and SB plus lateral plasty (SBLP) techniques during the execution of an active under weight-bearing activity. The secondary aim was to compare these post-surgery kinematical data to the ones of the same knees before ACL reconstruction and of healthy contralateral knees, in order to investigate if ACL surgery was able to restore physiological knee biomechanics during squat execution. The hypotheses were that I) SBLP technique allows a better restoration of internal-external knee rotation than SB and that II)
Abstracts

DEGENERATIVE MEDIAL MENISCUS TEAR WITH A DISPLACED FLAP INTO THE MENISCOTIBIAL RECESS AND TIBIAL PERIPHERAL REACTIVE TIBIAL EDEMA PRESENTS GOOD RESULTS WITH ARTHROSCOPIC SURGICAL TREATMENT

Camilo P Helito, 1Paulo Helito, 1Marcel F Sobrado, 1Pedro N Giglio, 1Tales Mollica Guimarães, 1José R Pécora, 2Riccardo Gomes Gobbi, 1Marcelo Bordallo-Rodrigues, 2Bruno Vande Berg. 1Brazil; 2Belgium

10.1136/jisakos-2021-congress.64

Summary Arthroscopic surgical treatment of degenerative medial meniscal tears with a meniscal flap displaced into the meniscotibial recess and adjacent focal bone edema in the tibia shows good results in approximately 80% of cases. Smoking and KL grade 2 were associated with poor prognosis. The treatment of such lesions should be considered separately from the spectrum of degenerative meniscus lesions.

Data

Purpose To report the arthroscopic treatment results of a degenerative medial meniscus tear with a displaced flap into the meniscotibial recess, tibial peripheral reactive bone edema and focal knee medial pain.

Methods From 2012 to 2018 patients who had this specific meniscus pathology that underwent arthroscopic surgical treatment were retrospectively evaluated. Patients with diffuse pain, previous knee surgeries, inflammatory diseases, comitant surgical procedures and Kellgren-Lawrence (KL) classification greater than 2 were excluded. Patient demographic data, KL classification, the presence of an Outerbridge grade III or IV chondral lesion of the medial compartment, limb alignment, body mass index (BMI), and smoking were evaluated. The subjective outcomes included the International Knee Documentation Committee (IKDC) score, improvement in the pain reported by patients, and the Global Perceived Effect (GPE) scale score.

Results A total of 69 patients were evaluated. The mean age was 58.6 ± 7.1 years. The follow-up time was 48.7 ± 20.8 months. Fifty-five (79.7%) patients reported pain improvement. The postoperative IKDC was 62.6 ± 15.4, and the mean GPE was 2.3 ± 2.6. Fourteen patients (20.3%) showed no improvement in pain and seven patients (10.2%) presented complications. Groups that improved (GPE >0) and not improved (GPE<0) did not present differences regarding age, sex, follow-up time, chondral lesions, or BMI. Patients without improvement had a higher incidence of smoking (p=0.001), varus alignment (p=0.008), and more advanced KL classification (p<0.001). In the multivariate analysis based on the GPE score, KL classification (p=0.038) and smoking (p=0.003) were significant.

Conclusion Arthroscopic surgical treatment of degenerative meniscal tears with a meniscal flap displaced into the meniscotibial recess and adjacent focal bone edema in the tibia shows good results in approximately 80% of cases. Smoking and KL grade 2 were factors associated with poor prognosis of surgical treatment. Level of evidence: Level IV (case series)

IS SURGICAL TREATMENT AN ADVANTAGE WHEN TREATING ACUTE AC JOINT DISLOCATION TYPE III AND V? A PROSPECTIVE RANDOMIZED CLINICAL TRIAL


Summary No long-term difference in clinical outcome in patients with acute AC joint dislocation Rockwood type III and V treated with physiotherapy or surgery.

Aim To evaluate outcome after surgery and conservative treatment of acute acromioclavicular joint dislocation Rockwood type III and V.

Background Acromioclavicular joint (AC joint) dislocation is a common injury among sport-active young to middle-aged people. AC joint dislocations Rockwood type I and II are treated conservatively. Treatment of grade III is controversial, while surgery is often recommended for grade V.

Methods A prospective randomized clinical trial comparing the results after surgery or conservative treatment of acute Rockwood type III and V dislocation was performed. Patients aged 18–65 years were included after classification of the AC-joint dislocation on plain radiographs of both shoulders, information and written consent. Patients were randomized to surgical treatment with hook plate within 3 weeks after injury, or physiotherapy. The hook plate was routinely removed after 3 months. Clinical follow-up was performed at 3, 6, 12 and 24 months by an orthopedic surgeon and a blinded physiotherapist. Primary outcome was Constant score (CS). Secondary outcomes were Subjective Shoulder Value (SSV), QuickDASH, shoulder pain at rest and during activity on a Visual Analogue Scale 0-10, EQ5D and adverse events. Radiographic follow up with plain radiographs was performed at 24 months. Statistical data analysis was performed by an unbiased evaluator and data was analyzed by intention-to-treat (ITT).

Results 124 patients were enrolled and randomized in the study; 114 men and 10 women with a mean age of 40 years (range 18–64). At 1 month patients treated without surgery had significantly better EQ-5D index. At 3 months patients......
treated conservatively had significant better CS compared to patients treated with surgery (Rockwood III 81 vs 57, Rockwood V 84 vs 64, p<0.001) as well as significantly less pain during movement on a VAS scale compared to patients treated with surgery (Rockwood type III 1.5 vs 2.8, Rockwood V 1.5 vs 2, p=0.002). SSV at 3 months was significantly better for the conservatively treated patients (Rockwood III 73 vs 50, Rockwood V 73 vs 57, p<0.001) as well as Quick-DASH (Rockwood III 18 vs 34, Rockwood V 13 vs 32, p<0.001). Follow-up at 6, 12 and 24 months showed no significant difference between the groups. At 24 months CS for patients with Rockwood III and non-surgical treatment was 88 vs 91 after surgical treatment and for Rockwood V CS was 90 for non-surgical treatment vs 91 after surgical treatment, p=0.477. Of the patients assigned to physiotherapy, 11 patients (18%, 6 type III and 5 type V), chose to have secondary surgery within 19 months (range 6–19).

Conclusion Both treatments groups had very good restoration of shoulder function at 24 months, and operative treatment did not lead to better outcome compared to conservative treatment. In conclusion, our study did not support surgery with hook plate for patients with acute AC joint dislocation Rockwood type III or V.

Summary We documented a high rate of meniscal healing and no progression of cartilage degeneration and subchondral bone abnormalities with short-term MRI follow-up; however, there was worsening of meniscus extrusion, even in the immediate post-operative period.

Data

Background Prospective studies evaluating second look imaging of meniscus root repair using a transtibial pullout technique are limited; therefore, optimal surgical indications and technique for meniscus root repair remain uncertain.

Hypothesis/Purpose We hypothesized a high rate of healing, improvement in meniscus extrusion and prevention of articular cartilage degeneration and subchondral bone abnormalities following meniscus root repair. Study Design: Prospective cohort study; Level of evidence, 3.

Methods Consecutive patients undergoing transtibial root repair were prospectively enrolled at two orthopedic centers between March 2017 and January 2019. Pre- and post-operative MRIs were reviewed by a musculoskeletal radiologist in a blinded fashion for meniscus healing, quantification of extrusion, articular cartilage grade, subchondral bone changes, and coronary/meniscotibial ligament abnormalities. Given persistent extrusion observed on post-operative MRIs, an additional 10 patients were consented and enrolled for immediate (before weight-bearing) post-operative MRIs.

Results 45 patients (16 M: 29F) with an average age of 42.3 (SD 12.9) and BMI of 31.6 who underwent 47 meniscal root repairs (29 medial, 16 lateral, 2 had both) were prospectively enrolled in the study. Post-operative MRI was obtained on average 6.3 months following surgery (range 5.1–8 months). 98% of meniscus repairs had evidence of healing. Mean extrusion increased from an average of 1.94 mm (± 1.52) pre-operatively to 2.62 mm (± 1.44) post-operatively (p = 0.03). There was no significant progression of chondromalacia grade, subchondral edema, insufficiency fracture, subchondral cysts, or subchondral collapse. In the additional 10 patient cohort, the mean pre-operative extrusion increased from 1.64 mm (± 1.19) to 2.0 mm (± 0.98) post-operatively (p=0.23).

Conclusions Prospective MRI analysis of transtibial meniscus root repair confirms a high rate of meniscal healing and no observable progression of cartilage degeneration or subchondral bone abnormalities at short-term follow-up. However, meniscus extrusion worsens, even in the immediate post-operative period. Additional studies should evaluate techniques to improve meniscus extrusion are warranted to optimize meniscal root fixation techniques to decrease post-operative meniscal extrusion. Keywords: meniscus; meniscus root; meniscus extrusion; meniscal tear; transtibial pullout repair; prospective cohort

Summary The proximal fascia lata (PFL) graft used for arthroscopic superior capsular reconstruction is openly harvested, whereas the mid-thigh (MFL) graft is minimally invasively harvested. The purpose of this study was to compare their biomechanical properties. We hypothesized that, despite their different morphological characteristics, their biomechanical properties would not significantly differ.

Data

Background The proximal fascia lata graft construct (PFL) used for arthroscopic superior capsular reconstruction (ASCR) is openly harvested, whereas the mid-thigh (MFL) graft is minimally invasively harvested. Knowledge of how the MFL compares biomechanically with the PFL may assist orthopedic surgeons in the choice of the location, harvesting technique, and type of graft construct for ASCR. The purpose of the current study was to compare the biomechanical properties of PFLs and MFLs used for ASCR. The hypothesis was that, despite the different morphological characteristics of the PFL and MFL used for ASCR, their biomechanical properties would not significantly differ.

Methods Forty fascia lata (FL) specimens, twenty proximal-thigh and twenty mid-thigh, were harvested from the lateral thighs of ten fresh human cadavers (6 male, 4 female; average age, 58.60±17.20 years). The thickness of each 2-layered proximal- and 6-layered mid-thigh FL final graft construct was measured. Each construct was mechanically tested in the longitudinal direction, and the stiffness and Young’s modulus (YM) were computed. Data were compared by Welch’s independent t-test and analysis of variance. Statistical significance was set at P < 0.05.
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Results The average thickness of the PFL (7.17±1.97 mm) was significantly higher than that of the MFL (5.54±1.37 mm) [F (1,32)=7.333, p =0.011]. The average YM of the PFL and MFL was 32.85±19.54 MPa (range, 7.94–75.14 MPa; 95% CI, 23.71–42.99) and 44.02±31.29 MPa (range, 12.53–120.33 MPa; 95% CI, 29.38–58.66), respectively. The average stiffness of the PFL and MFL was 488.96±267.80 N/mm (range, 152.96–1086.49 N/mm; 95% CI, 363.63–614.30) and 562.39±294.76 N/mm (range, 77.46–1229.68 N/mm; 95% CI, 424.44–700.34), respectively. There was no significant difference in the average YM or stiffness between the PFL and MFL (p=0.185 and p =0.415, respectively). The main findings of this study were that the average values of the stiffness and YM did not significantly differ between the two types of FL graft constructs, despite the greater average thickness of the PFL. This study has several strengths: the PFL and MFL groups were equally sized with regard to the sex and age of the subjects, thereby avoiding the confounding influence of the sex- and age-dependent morphological and mechanical properties of the FL on the results; and the specimens were harvested from fresh cadavers, avoiding the significant influence of the fixation methods used to preserve fresh-frozen or embalmed cadaveric specimens on the mechanical properties of the FL. This study validates the biomechanical equivalence of the two types of FL graft constructs with regard to the stiffness and YM, and orthopedic surgeons and patients may find the mid-thigh harvesting of the graft advantageous versus the open harvesting technique because the MFL can be minimally invasively harvested using a reproducible technique, with a low donor site morbidity. This study defines material properties of PFLs and MFLs that can be used in computational studies regarding the role of the FL graft in ASCR.

Conclusion Despite the different morphological characteristics of the PFL and MFL used for ASCR, their YM and stiffness did not significantly differ.

19395 QUADRICEPS TENDON AUTOGRRAFT HAS LOWER MRI SIGNAL THAN HAMSTRING TENDON AUTOGRRAFT IN ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTIONS OF ADOLESCENT ATHLETES

David Alcoloumbre, Alexandra H Aitchison, Douglas Mintz, Frank A Cordasco, Daniel W Green. USA

10.1136/jisakos-2021-congress.68

Summary Quadriceps tendon autograft may have a superior rate of incorporation and synovialization as compared to hamstring tendon autograft

Data

Purpose Hamstring tendon autograft (HTA) is a common graft choice for anterior cruciate ligament (ACL) reconstructions in skeletally immature patients. However, quadriceps tendon autografts (QTA) have recently shown superior preliminary outcomes in this population. The purpose of this study was to evaluate graft maturity by comparing MRI signal intensity of HTA and QTA used in primary ACL reconstruction. Given the promising preliminary results of QTA reconstructions in our center, we hypothesized that QTA would have lower signal than HTA at both 6 and 12 months.

Methods Patients under the age of 18 who underwent a primary ACL reconstruction between 2011 and 2018 by the senior authors using either a HTA or QTA with available MRIs at 6 and 12 months post-operatively were included. Signal intensity ratio (SIR) was measured on sagittal MRI by averaging the signal at three regions of interest (ROIs) along the ACL graft and dividing each by the signal of the tibial footprint of the PCL. Statistical analysis was performed to determine interrater reliability and differences between time points and groups.

Results 71 patients (38 in the HTA group and 33 in the QTA group) were reviewed retrospectively. Age, sex, and type of surgery were not different between groups. There was no significant difference in SIR between groups on the 6-month MRI. At 12 months, SIR of the QTA group was significantly less that in the HTA group (p=.029). Within the HTA group, there was no significant difference in SIR between time points. In the QTA group, there was a significant decrease in SIR between the 6 month and 12-month post-operative MRI (p=.045).

Conclusion The decrease in signal between 6 and 12 months post-operatively suggests quicker graft maturation and improved structural integrity of QTA as compared to HTA.

19707 STRENGTH OF ELBOW FLEXION AND FOREARM SUPINATION AFTER LONG HEAD BICEPS TREATMENT DURING ROTATOR CUFF REPAIR

Yohei Harada, Shin Yokoya, Yasuhiko Sumimoto, Nobuo Adachi. Japan

10.1136/jisakos-2021-congress.69

Summary We compared the postoperative muscle strength ratio of elbow flexion and forearm supination in cases with differing long head of biceps tendon (LHBT) procedures during rotator cuff repair. There was no significant difference between the control, tenotomy, and tenodesis groups, suggesting that the presence of LHBT lesion and the difference in treatment methods have little effect on muscle strength.

Data

Introduction The effect of tenotomy or tenodesis of the long head of the biceps tendon (LHBT) during rotator cuff repair on biceps muscle strength is not well understood. In assessing muscle strength, preoperative muscle strength could be affected by pre-operative pain or cuff tear, therefore the postoperative muscle strength ratio of the affected and contralateral side is calculated. However, previous reports have not been able to eliminate the effects of the presence of rotator cuff tears on the healthy side or of cuff re-tear on the affected side. In this study, we only focused on cases with good rotator cuff healing on the affected side and without cuff tears on the unaffected side, in order to examine the effect of the LHBT treatment on muscle strength.

Methods This study comprised 104 patients (53 males and 51 females, mean age 65.7 ± 9.1 years) who underwent rotator cuff repair, and had good healing of rotator cuff (Sugaya classifications I and II) on MRI two years postoperatively, and no complaints and no rotator cuff tears on ultrasonographic evaluation in contralateral side were enrolled. Two years postoperatively, we compared the ratio of elbow flexion strength and forearm supination strength on the affected side to that on the normal side at in the following groups: The control group, comprising 59 patients with normal LHBT and preserved LHBT intraoperatively; the tenotomy group, comprising 27 patients with a pathological lesion of LHBT treated...
by simple tenotomy; and the tenodesis group, comprising 18 patients with pathological lesion of LHBT treated by tenodesis using interference screw. In addition, we also evaluated the presence of Popeye’s deformity and cramping pain.

**Results** The strength ratios of elbow flexion and forearm supination of the affected side to the healthy side were 0.96 ± 0.16 and 0.98 ± 0.26 in the control group; 0.92 ± 0.23 and 0.85 ± 0.20 in the tenotomy group; and 0.95 ± 0.12 and 0.98 ± 0.22 in the tenodesis group, with no significant difference between the three groups (p=0.71 and p=0.08). There were 0 cases with Popeye’s deformity and upper arm spasm in the control group; 2 (7.4%) and 5 (18.5%) cases in the tenotomy group; and 1 (5.6%) and 1 (5.6%) case in the tenodesis group, respectively.

**Conclusion** Some previous studies compared the muscle strength of biceps between tenotomy and tenodesis of LHBT, but the results were controversial. In the present study, the strength ratio of elbow flexion and forearm supination remained the same in both the tenotomy and tenodesis groups, even when cases without LHBT lesions were included in the comparison, suggesting that the presence or absence of LHBT lesions and the difference in treatment methods have little effect on muscle strength.

**Abstracts**

**19703 PREOPERATIVE TUNNEL WIDENING DOES NOT SIGNIFICANTLY INFLUENCE THE OUTCOMES OF A SINGLE-STAGE ONLY APPROACH TO REVISION ACL RECONSTRUCTION: AN ANALYSIS OF 409 CONSECUTIVE PATIENTS**

1Adnan Saithna, 2Charles Pioger, 3Johnny Rayes, 4Ibrahim Haidar, 5Thomas Fradin, 6Cédric Ngbilo, 7Thais Dutra Vieira, 8Etienne Cavaignac, 9Bertrand Sonnery-Cottet. 1USA; 2France; 3Canada; 4Switzerland; 5Brazil

**Summary** A single-stage approach to revision ACL reconstruction is associated with excellent clinical results when an outside-in drilling technique is utilized. The presence of pre-operative tunnel widening does not significantly influence patient reported outcome measures, knee stability, graft rupture rates or non-graft rupture related re-operation rates.

**Data**

**Introduction** Pre-operative tunnel widening is a frequently reported indication for performing a two-stage revision anterior cruciate ligament reconstruction (R-ACLR) instead of a single-stage procedure. However, the strength of the available evidence to support a two-stage strategy is low. The main purpose of this study was to evaluate the clinical outcomes of a single-stage only approach to R-ACLR. It was hypothesized that this approach would be associated with significant improvements from baseline in patient reported outcome measures (PROMS) and knee stability, and also that there would be no significant differences in any post-operative outcomes between patients with and without pre-operative tunnel widening.

**Methods** A retrospective analysis of a large series of consecutive patients undergoing R-ACLR, with a minimum follow-up of two years, was conducted. Pre-operative tunnel widening was assessed using digital radiographs. All patients underwent single-stage surgery, with an outside-in technique, even if they had tunnel widening. Clinical outcomes were compared according to whether tunnel widening was present (either tunnel = 12 mm) or not (both tunnels <12 mm). Comparisons between variables were assessed with the Chi-square or Fisher’s exact tests for categorical variables and the Student’s t test or Wilcoxon test for quantitative variables.

**Results** 409 consecutive patients with a mean follow-up of 69.6 ± 29.0 months were included in the study. At two years following R-ACLR, there was a significant reduction in the side-to-side AP laxity difference from 7.7 ± 2.2 mm pre-operatively to 1.2 ± 1.1 mm (p < .001). The mean IKDC and all KOOS subscales exceeded the patient acceptable symptom state (PASS) thresholds defined for primary ACLR. There were no significant differences between groups with respect to antero-posterior side-to-side laxity difference, graft rupture rates, non-graft rupture related re-operations, or contralateral ACL injury rates. There was also no significant difference between groups, exceeding minimal detectable change thresholds, for any of the PROMS recorded (ACL-RSI, Lysholm, Tegner, IKDC, KOOS).

**Conclusions** A single-stage approach to revision ACL reconstruction is associated with excellent clinical results when an outside-in drilling technique is utilized. The mean IKDC and all KOOS subscales exceeded the patient acceptable symptom state (PASS) thresholds defined for primary ACLR. The presence of pre-operative tunnel widening did not significantly influence PROMS, knee stability, graft rupture rates or non-graft rupture related re-operation rates. This suggests that two-stage R-ACLR is rarely warranted.

**19480 COMBINED ACL AND ANTEROLATERAL LIGAMENT RECONSTRUCTION CONFFERS SIGNIFICANTLY IMPROVED LONG TERM OUTCOMES WHEN COMPARED TO ISOLATED ACL RECONSTRUCTION: A MATCHED-PAIR ANALYSIS**

1Adnan Saithna, 2Ibrahim Haidar, 3Johnny Rayes, 4Thomas Fradin, 5Cédric Ngbilo, 6Benjamin Freychet, 7Thais Dutra Vieira, 8Herve Ouanezar, 9Bertrand Sonnery-Cottet. 1USA; 2France; 3Canada; 4Switzerland; 5Brazil, 6United Arab Emirates

**Summary** Patients who undergo combined ACL and anterolateral ligament reconstruction experience significantly better long-term ACL graft survivorship, a five-fold lower risk of graft rupture, lower overall rates of re-operation, and no increase in complications when compared to those who undergo isolated ACL reconstruction.

**Data**

**Introduction** Recent clinical studies have demonstrated significant advantages of combined anterior cruciate ligament and anterolateral ligament reconstruction (ACL+ALLR) over isolated ACL reconstruction (ACLR) with respect to reduced graft rupture rates, a lower risk of re-operation for secondary meniscectomy, improved knee stability, and higher rates of return to pre-injury levels of sport. However, due to the relative infancy of this procedure, long-term studies have not yet been published, and it remains to be seen whether the reported advantages of the combined procedure are maintained at long term follow-up. The primary objective of this study was to compare the long-term clinical outcomes of isolated ACLR versus combined ACL+ALLR. The hypothesis was that patients who underwent combined procedures would experience significantly lower ACL graft rupture rates at long term follow-up than their matched counterparts who underwent isolated ACLR.
**Methods** Patients undergoing primary ACL+ALLR between January 2011 and March 2012 were propensity matched in a 1:1 ratio to patients who had undergone isolated ACL reconstruction during the same period. Face-to-face post-operative follow-up was undertaken at 3 and 6 weeks, and 3, 6, 12 and 24 months. Due to the geographically mobile nature of young populations (particularly notable at long-term follow-up), and the impact of COVID-19, the final follow-up was conducted using a standardized telemedicine interview (between April and May 2020), completion of PROMs questionnaires and review of medical notes. The telemedicine interview and notes review sought to determine whether patients had sustained a further ipsilateral knee injury, had experienced any symptoms of knee instability or stiffness, or had undergone any re-operations or complications. As a result of these follow-up arrangements, physical examination findings (range of motion and knee stability) are reported at two-years follow up. Complications, re-operations and outcome measures including Lysholm, Tegner, IKDC and KOOS are reported at the final follow-up. Graft survivorship was assessed using Kaplan-Meier analysis. Logistic regression was performed in order to account for the potential impact of activity level on graft rupture rates.

**Results** 86 matched pairs were included in the study. The mean duration of follow-up was 104.33±3.84 months (range 97–111 months). Patients who underwent combined ACL + ALLR experienced significantly better ACL graft survivorship (96.5% vs 82.6%, p=0.0027), lower overall rates of re-operation (15.3% vs 32.6%, p<0.05), lower rates of revision ACLR (3.5% vs 17.4%, p<0.05), and no increase in complications, when compared to those who underwent isolated ACLR. Patients undergoing isolated ACLR were at more than five-fold greater risk of graft rupture (OR, 5.549; 95%CI 1.431 to 21.511, p = 0.0132), regardless of their pre-injury activity level.

**Conclusion** Patients who undergo combined ACL and anterolateral ligament reconstruction experience significantly better long-term ACL graft survivorship, lower overall rates of re-operation, and no increase in complications when compared to those who undergo isolated ACLR. In contrast, patients undergoing isolated ACLR had a greater than five-fold increased risk of undergoing revision surgery at a mean follow-up of 104.3 months.

**Summary** This systematic review reports good clinical results of arthroscopic debridement for chronic ankle anterolateral impingement but all papers had a low level of evidence and intraoperative observation of the ATFL and documentation of residual instability after surgery was lacking.

**Data**

**Background** Chronic anterolateral pain is a frequent complaint after an inversion ankle sprain and soft tissue anterolateral impingement (ALI) of the ankle can be the cause of this symptom. Arthroscopic debridement is a common surgical treatment for patients with ALI of the ankle. This procedure is widely accepted, however, some cases with residual feeling of instability or new inversion injury after surgery have also been reported. Although a history of ankle sprain is commonplace, information regarding the role of ankle instability in ALI is limited. The aims of this review were to (1) assess the clinical outcomes of arthroscopic surgical treatment for ALI of the ankle and (2) review the data regarding anterior talofibular ligament (ATFL) injury and lateral ankle instability in patients who underwent arthroscopic surgery for ALI.

**Method** A literature search of Pubmed and EMBASE were performed. Studies that met the following inclusion criteria were reviewed by two independent investigators: (1) human clinical studies investigating patients who underwent arthroscopic surgery for ALI; (2) results with at least one scoring system with minimum follow-up of six months. Exclusion criteria were: (1) review articles or case reports; (2) not written in English; (3) included patients with objective ankle instability; (4) included patients with previous injuries other than ankle sprains in the ipsilateral ankle. The quality of each study was evaluated using the Oxford CEBM tool to assess the level of evidence and the grade of recommendation. The data of patient characteristics, follow-up period, intra-operative findings of ATFL and anterior inferior tibiofibular ligament (AITFL) and clinical outcomes were extracted.

**Results** The electronic database search yielded 192 studies. Of these, 8 articles were included in this systematic review, all of which were graded level 4 with grade C recommendation. In total, 203 patients with a mean age of 32 years (ranging from 11 to 74) were analysed. The mean follow-up period was 36 months (range, 12 - 152 months). AOFAS score was used in 6 studies and scored 90.1 on average at follow-up. Two other studies used original scores. One study reported arthroscopic findings of the ATFL with damage to the ATFL observed in 20 out of 24 cases. AITFL impingement was mentioned in 3 studies, with the rate of AITFL impingement reported from 19.5–25.0%. Another study reported residual instability after surgery in 2 out of 31 patients. New ankle sprains during follow-up period were reported in 8.3–20.0% of patients in 4 studies.

**Conclusion** This review showed good clinical results of arthroscopic debridement for ALI but all papers were graded level 4 with grade C recommendation. Reports regarding arthroscopic observation of the ATFL and residual instability after surgery were lacking. Further investigation of what is frequently termed “ALI” should be made with higher level of evidence focusing more on ATFL injury and its effect on clinical outcomes.

**Summary** Risk factors for failure of arthroscopic posterior shoulder capsulolabral repair include smaller glenoid bone width and greater glenoid bone loss percentage. A threshold of 11% posterior glenoid bone loss implicated a 10 times higher surgical failure rate while a threshold of 15% lead to a 2.5 times higher surgical failure rate.
Data

Background Although critical bone loss for anterior instability is well defined, a clinically significant threshold of posterior bone loss has not been elucidated.

Hypothesis Patients who fail arthroscopic posterior shoulder capsulolabral repair will have increased posterior glenoid bone loss with a defined critical threshold.

Study Design: Case-Control Methods

Athletes greater than 18 years of age with unidirectional posterior instability treated with arthroscopic repair were evaluated at 2 year minimum follow-up. Failure was defined as revision surgery, ASES <60, or subjective instability score >5. MRIs measurements from 19 patients who failed arthroscopic posterior shoulder capsulolabral repair were compared with 56 patients who did not. MRIs measures included glenoid version, labral version, glenoid width, labral width, percent bone loss using the circle technique, labral height, percent subluxation, and recently described measures of defect slope, bone loss angle, and defect length. The $p$-value threshold was set at 0.05 and a multivariable logistic regression analysis was performed for evaluation of risk of surgical failure.

Results Smaller glenoid width and greater percent glenoid bone loss ($25.5 + 0.68$ mm vs $28.8 + 0.47$ mm, $p<0.001$; $6.8 + 0.64$% vs $4.6 + 0.43$%, $p=0.008$) was seen in those that failed surgery. There was no difference in glenoid version or other measurements between the failures and non-failures. A cutoff of $11\%$ glenoid bone loss resulted in a 10 times statistically higher surgical failure rate, while $15\%$ bone loss resulted in a 23 times statistically higher failure rate. Six patients had bone loss greater than $11\%$ (range, 11.1 - 19.3) and 1 patient had greater than $15\%$ bone loss.

Conclusion Risk factors for failure of arthroscopic posterior shoulder capsulolabral repair include smaller glenoid bone width and greater glenoid bone loss percentage. A threshold of $11\%$ posterior glenoid bone loss implicated a 10 times higher surgical failure rate while a threshold of $15\%$ lead to a 25 times higher surgical failure rate. Surgical failure of posterior capsulolabral repair, however, is relatively rare as it is an overall successful intervention.

Methods A cohort of 100 recurrent anterior instability patients with evidence of HSL with a mean age of 27.2 years (range = 18 to 43 years) were evaluated. 3-D models of unilateral proximal humeri were reconstructed from CT scans and the volume, surface area (SA), width, and depth of identified HSLs were quantified along with their location (medial, superior, and inferior extent). Multiple angular orientation measures of HSLs were recorded, including Hill-Sachs rim [HSLr] and Hill-Sachs center [HSLc] angles in order to classify the level and location of potential engagement. Mann-Whitney test was run to assess the relationship between measured parameters.

Results Larger HSL had greater HH SA loss ($p=0.001$), HSL width ($p=0.001$), were more medial ($p=0.015$), and more inferior ($p=0.001$). Additionally, more medial lesions had greater HSLr angles ($p=0.001$). The mean depth and width of identified HSLs were $3.3$ mm (range = $1.2 - 7.1$ mm) and $16.0$ mm (range = $6.2 - 30.4$ mm), respectively. The mean volume of the HSL was $449.2$ mm$^3$ (range = $62.0 - 1365.6$ mm$^3$). The medial border of the HSL extended to $17.2 \pm 4.4$ (range = $9.3 - 28.3$ mm) off the most medial edge of the HH cartilage margin (medialization). The mean HSLr and HSLc were $29.3 \pm 10.5^\circ$ and $30.1 \pm 11.2^\circ$, respectively.

Conclusion This is the first large study to analyze various HS parameters and their associations amongst each other by utilizing high quality 3-D modeling. There was a statistically significant association between more medialized HSL lesions and HSL volume, width, angles, humeral head SA loss and distance from the most superior point of the HH. More medialized lesions tended to have larger volume, width, SA loss and angles while being located more inferior. As it has been established that more medialized lesions have poorer clinical outcomes, this study highlights other HS parameters which are strongly associated with these more difficult lesions and therefore should be considered during evaluation.

Summary The knee rotation angle is an independent, inversely correlated predictor of the difference between TTTG measured on MRI and CT in patients with patellar instability.

Data

Purpose This study aimed to quantify the effect of lower limb rotational parameters on the difference in the tibial-trochlear-groove (TTTG) distance when assessed with magnetic resonance imaging (MRI) and computed tomography (CT) in patients with patellar instability. It was hypothesized that an increased knee rotation angle significantly contributes to an underestimation of TTTG by MRI.

Methods Forty patients with patellar instability who had undergone standard radiographs, MRI and CT scans were included in this retrospective study. A musculoskeletal radiologist assessed all imaging for TTTG, femoral and tibial rotation, knee rotation and flexion angle, and trochlear dysplasia. deltaTTTG was defined as the TTTG measured on MRI.
subtracted from the TTTG measured on CT. Statistical analysis determined the effect of these parameters on the calculated difference between TTTG, when measured on CT and MRI.

**Results** Equal knee flexion in MRI and CT resulted in a deltaTTTG of 0.1 ± 0.3° compared to 4.0 ± 3.3° in patients with different knee flexion angles in both imaging acquisitions (p=0.036). The knee rotation angle measured on CT was negatively correlated with deltaTTTG (r=-0.365; p=0.002), while neither tibial nor femoral rotation showed any associations with TTTG (n.s.). Trochlear dysplasia did not show any significant correlation with deltaTTTG, regardless of classification by Dejour or Lippacher (n.s.). Both the CT knee rotation angle and the MRI knee flexion angle were independent predictors of deltaTTTG, yet with an opposing effect (knee rotation: 95% Confidence Interval (CI) for beta: −0.468 to −0.154, p<0.001; knee flexion 95% CI for beta: 0.292 to 0.587, p<0.001). Patients with a CT knee rotation angle >20° showed a deltaTTTG of −5.8 ± 4.0° (MRI overestimates TTTG) compared to 0.9 ± 4.1° deltaTTTG (MRI underestimates TTTG) in patients with <20° CT knee rotation angle.

**Conclusion** The knee rotation angle is an independent, inversely correlated predictor of deltaTTTG, thus opposing the effect of knee flexion during MRI acquisition. Consequently, these results suggest that not only knee flexion but also knee rotation should be appreciated when assessing TTTG during patellar instability diagnostic evaluation as it can potentially lead to an overestimation of the TTTG distance on MRI.

**Abstracts**

**19754 AUTOLOGOUS MATRIX-INDUCED CHONDROGENESIS (AMIC) WITH CONCOMITANT LATERAL LIGAMENT STABILIZATION FOR OSTEOCHONDRAL LESIONS OF THE TALUS IN PATIENTS WITH ANKLE INSTABILITY**

Jakob Ackermann, Fabio A Casari, Christoph German, Lizzy Weigelt, Stephan Hermann Wirth, Arnd Viehöfer, Switzerland

10.1136/jisakos-2021-congress.76

**Summary** Concurrently performed AMIC and LLS in patients with OLT and ankle instability results in a clinical outcome that is comparable to isolated AMIC if postoperative ankle stability is achieved.

**Data**

**Background** Autologous matrix-induced chondrogenesis (AMIC) has shown to result in favorable clinical outcome in patients with osteochondral lesions of the talus (OLT). Yet, the influence of ankle instability on cartilage repair of the ankle has still to be determined. This study sought to compare the clinical and radiographic outcome in patients with and without concomitant lateral ligament stabilization (LLS) undergoing AMIC for the treatment of OLT. It was hypothesized that patients with concomitant LLS for the treatment of coexistent symptomatic ankle instability show comparable results to patients who underwent isolated AMIC for the treatment of OLT.

**Methods** This study evaluated AMIC that were implanted in patients for the treatment of symptomatic OLT with and without concomitant ankle instability. Postoperative MRI, Tegner, AOFAS and Cumberland Ankle Instability Tool (CAIT) were obtained at a minimum follow-up of 2 years. A musculoskeletal radiologist scored all grafts according to the MOCART 1 and 2.0 scores. Patients were stratified into two groups based on whether they underwent concomitant LLS for ankle instability. Patients without LLS served as controls. Patients were matched 1:1 for BMI, lesion size, follow-up and age.

**Results** Twenty-six patients that underwent AMIC with a mean follow-up of 4.2 ± 1.5 years were enrolled in this study (13 with and 13 without concomitant ankle instability). Patients’ mean age was 33.4 ± 12.7 years with a BMI averaging 26.2 ± 3.7. Patients with concomitant LLS showed worse clinical outcome measured by AOFAS (85.1 ± 14.4 vs. 96.3 ± 5.8, p=0.034) and Tegner (3.8 ± 1.1 vs. 4.4 ± 2.3, p=0.012). Postoperative CAIT and AOFAS scores significantly correlated in patients with concomitant LLS (r=0.766, p=0.002). A CAIT score of >24 (no functional ankle instability) resulted in AOFAS scores comparable to scores in patients with isolated AMIC (90.1 ± 11.6 vs. 95.3 ± 6.6; p=0.442). No difference was seen between both groups regarding MOCART 1 and 2.0 scores (p=0.714 and p=0.371, respectively).

**Conclusion** Concurrently performed AMIC and LLS in patients with OLT and ankle instability results in a clinical outcome that is comparable to isolated AMIC if postoperative ankle stability is achieved. Residual ankle instability, however, was associated with worse postoperative outcome highlighting the need for adequate stabilization of ankle instability in patients with OLT.

**19588 DERMAL PATCH AUGMENTED VERSUS STANDARD ROTATOR CUFF REPAIR: RANDOMISED CONTROLLED TRIAL**

Priyadarsi Amit, Martyn Snow, UK

10.1136/jisakos-2021-congress.77

**Summary** A human acellular dermal patch augmented cuff repair did not improve functional outcome or healing at 12 months post-surgery compared to standard double row rotator cuff repair.

**Data**

**Aim** The aim of this study was to compare the patient reported outcome measures and cuff healing at 12 months between standard and augmented rotator cuff repair with human acellular dermal patch.

**Background** Recurrent rotator cuff tear following repair has been reported in up to 60% of cases. Maximising mechanical repair through double row fixation has failed to significantly improve healing rates, consequently, there is focus on the biological enhancement of healing. Patch augmentation is one method to augment repair, however, there are very few comparative studies assessing their efficacy.

**Methods** A randomised controlled trial was conducted over patients undergoing arthroscopic repair of rotator cuff tear measuring between 1–5 cm. Patients were excluded for associated osteoarthritis, irreparable tear, or significant subscapularis tear. A total of 63 patients were recruited to the study between 2016 - 2019. Twenty-three patients were excluded leaving 40 patients in the final study population. They were randomised to one of two groups: augmented (cuff repair with human acellular dermal patch) and standard (double-row arthroscopic cuff repair). Functional assessment was performed at 3, 6, 9, and 12 months post-surgery with rotator cuff healing quantified on MRI scan at 12 months using Sugaya’s classification. Functional outcome was assessed using American Shoulder and Elbow score (ASES), Quick Disability of Arm,
Shoulder and Hand (Quick-DASH) score, Constant-Murley score and Western Ontario Rotator Cuff (WORC) index. Statistical analysis was performed with chi-square, paired and unpaired t-test to compare the outcomes between the two groups.

Results The mean age was 65.75 years in the augmented group and 69.25 years in standard group. The male:female ratio was 11.9 in the augmented group and 12.8 in the standard group. There was no significant difference in age, gender, tear size, fatty infiltration and pre-operative clinical outcome measures (p < 0.05) between the two groups. The mean ASES, qDASH, Constant, and WORC improved from 36.6, 52.2, 31.6, and 32.6 pre-operatively to 79.6, 17.1, 83.9, and 77.4 at 12 months in augmented; and from 31.9, 50.9, 31.4, and 25.2 pre-operatively to 74.8, 20.1, 71.1, and 74.9 at 12 months post-operatively in the standard group (p < 0.05). There was no significant difference in one-year clinical outcome measures between the two groups (p > 0.05). Compared to control group, greater number of patients in the augmented group achieved outcome scores more than the value of minimum clinically important difference (MCID) in three of the outcome measures (ASES 90% vs 84.2%, qDASH 85% vs 73.7%, Constant 100% vs 72.7%, WORC 84.2% vs 90%, augmented vs standard respectively). On MRI, re-Teur (Sugaya grade 4 and 5) was observed in 25% (4 of 18) in augmented and 27.7% (5 of 18) patients in standard group (p = 1.000). There was no difference in the 12-months post-operative Goutallier fatty infiltration grades between the two groups (p = 0.495). The progression of fatty infiltration grades on post-operative MRI as compared to pre-operative MRI was noted in 28.3% (2 of 7) in augmented and 50% (5 of 10) patients in standard group, although the difference was not statistically significant (p = 0.662).

Conclusions A human acellular dermal patch augmented cuff repair did not improve or healing at 12 months post-surgery compared to standard double row rotator cuff repair, however there was a trend of better clinical outcome scores and lower progression of fatty infiltration (although, not statistically significant) in dermal patch group.

**Clinical Outcomes of Primary ACL Reconstruction with Tibial Attachment Preserving Quadrupled Hamstring Graft: Does Graft Size Matter? - A Prospective Study with Review of Literature**

Shaival Dalal, Gihan N Aminake, Randy Guro, Amit P Chandratreya, Rahul Kotwal. UK

**Summary** Primary ACL reconstruction using tibial attachment preserving quadrupled hamstring graft is a simple and reproducible technique with an extremely low failure and complication rate and that gives excellent clinical and functional outcomes, irrespective of the graft diameter.

**Data**

**Introduction** Recent literature supports the preservation of tibial attachment of hamstring grafts to enhance “ligamentization” process and prevent the potential problems of a free graft such as pull-out or rupture in the early post-operative period. The aim of this study is to present our results of primary ACL reconstruction with preservation of the tibial attachment of the hamstring grafts along with loop-stitched quadrupled hamstring grafts fixed with suspensory fixation on the femoral side and an interference screw and a staple on the tibial side, and determine if the graft diameter influences the failure rate and patient-reported outcome scores. Methodology - Prospective single-surgeon case-series evaluating patients undergoing surgery by this technique. Patients were followed up clinically and using PROMS from NLR with EQ-5D, KOOS, IKDC and Tegner scores. Paired two-tailed student t-tests and ANOVA tests were employed for statistical analysis. Results - 64 cases (47 males, 17 females) with a mean BMI of 26.3 and mean age of 30.2 years were included. Mean graft length and diameter of quadrupled semitendinosus and gracilis tendons was 110 mm and 7.1 mm respectively. Mean interval from injury to surgery was 11.8 months. At a mean follow-up of 3 years, 80% (n=51) had complete peri-operative PROMS scores. Mean peri-operative EQ-5D VAS, EQ-5D Index, KOOS, IKDC and Tegner activity scores showed significant improvement (p < 0.001). At latest follow-up, there was no difference in the improvement of PROMS with regards to the graft diameter. Graft re-rupture was seen in 1 (1.5%) patient. 45 patients had associated meniscal tear with 73.3% undergoing repair. 3 cases (4.6%) returned to theatre including, MUA for arthrosis (n=1) and meniscal repair for recurrent medial meniscus tear (n=2). Conclusion - Primary ACL reconstruction using tibial attachment preserving quadrupled hamstring graft is a simple and reproducible technique with an extremely low failure and complication rate and that gives excellent clinical and functional outcomes, irrespective of the graft diameter. The natural tibial side insertion provides secure fixation and adds biology to the anatomic reconstruction.
 Abstracts

THE EFFECT OF OSTEochondROPLASTY ON TIME TO REOPERATION AFTER ARTHROSCOPIC MANAGEMENT OF FEMOROACETABULAR IMPINGEMENT

Jeffrey Kay, Nicole Simunovic, Olufemi R Ayeni, First Investigators. Canada

Summary This randomized, time-to-event analysis with 27-months follow-up demonstrates that for adults between the ages of 18 and 50 with femoroacetabular impingement, arthroscopic osteochondroplasty is associated with a two-and-a-half times lower hazard of reoperation at any point in time compared to arthroscopic lavage.

Data Purpose The purpose of this study was to assess and compare the effect of arthroscopic osteochondroplasty versus arthroscopic lavage without osteochondroplasty on the time to reoperation in adults aged 18 to 50 with femoroacetabular impingement (FAI) over 27-months post-operative using a time-to-event analysis.

Methods Using the comprehensive dataset from the multinational Femoroacetabular Impingement Randomized Controlled Trial (FIRST), all reoperations were identified until 27-months post-operative. All included subjects were randomized to a treatment of arthroscopic osteochondroplasty or arthroscopic lavage without osteochondroplasty. The primary analysis was conducted using a Cox proportional-hazards model, with the percentage of patients with a reoperation analyzed in a time-to-event analysis as the outcome. The independent variable was the procedure (osteochondroplasty versus lavage), with age and impingement severity subtype explored as potential covariates. The results from the Cox model were expressed as a hazard ratio (HR), corresponding 95% confidence interval (CI), and the associated p-value. All tests were two-sided with an alpha level of 0.05.

Results A total of 220 patients with FAI were first enrolled in the study. Six patients were later found to be ineligible resulting in 108 total patients included in the osteochondroplasty group and 106 in the lavage group. The mean age of the patients included in the study was 36.0 (SD=8.5) years. Overall, a total of 27 incident reoperations were identified within 27 months of follow-up for an incidence rate of 6.0 per 100 person years. Within the osteochondroplasty group, a total of 8 incident reoperations were identified for incidence rate of 3.4 per 100 person years. In the lavage group, a total of 19 incident reoperations were identified for an incidence rate of 8.7 per 100 person years. The hazard of reoperation for patients undergoing osteochondroplasty is 40% that of patients undergoing lavage (HR=0.40, 95% CI=0.17 to 0.91, p=0.029).

Conclusion This randomized, time-to-event analysis demonstrates that for adults between the ages of 18 and 50 with FAI, arthroscopic osteochondroplasty is associated with a 2.5-fold decrease in the hazard of reoperation at any point in time compared to arthroscopic lavage.

Bacterial contamination of irrigation fluid and suture material during ACL reconstruction and meniscus surgery

Benjamin Bartek, Tobias Winkler, Anja Garbe, Carsten Perka, Tobias M Jung. Germany

Summary Irrigation fluid during arthroscopic surgery shows bacterial contamination that increases over time.

Data Purpose Arthroscopic knee surgery uses irrigation fluid, which accumulates in a sterile reservoir during surgery. It has not yet been examined whether the irrigation fluid or suture material used during arthroscopic surgery show bacterial contamination. In the present study, we aimed to determine the time-dependent contamination rate and to clarify its relevance for postoperative infections.

MATERIAL AND METHODS We included 155 patients in the study, who underwent reconstruction of the anterior cruciate ligament (ACL) in 58 cases, meniscal surgery in 63 cases and combined ACL reconstruction and meniscus repair in 34 cases. During arthroscopic surgery, samples of the pooled irrigation fluid were obtained from the sterile reservoir every 15 minutes and additionally suture material of ACL graft and meniscus repair was examined for bacterial colonization. All samples were sent for microbiologic analysis with an incubation time of 14 days. Postoperative follow-up examinations for clinical signs of infections were conducted after 6 weeks, 12 weeks and 12 months in our orthopaedic outpatient participation (more than 7 hours/week), 10–20% glenoid bone erosion in computed tomography scans and at least 60 months of follow-up. The follow-up time was 5 years. The mean age was 26.4 years (range: 16–46 years).

Results Elevation and lateral rotation (passive and active) achieved values in the final follow-up similar to those found in the preoperative period. The mean postoperative scores after five years were as follows: ASES, 79,1 (range: 66–93); ASORS, 77,8 (range: 60–100); WOSI, 52,6 (range: 18–77); and VAS, 1,88 (range: 0–6). All of the results presented statistical significance. We did not have any case of redislocation. However, seven (17%) patients presented positive apprehension test (Three (16%) patients in the Bristow and four (18%) in the Latarjet group). Our results showed two cases of graft reabsorption that needed surgery to screw removal (one in each group). Two cases of screw malpositioning (with the graft being intra-articular). Both cases were in the Bristow group and were surgically revised in two weeks from initial surgery. Comparing both procedures we found no statistically significant difference in active external rotation and active elevation. We found a statistically significant difference in passive external rotation in favor of the Latarjet technique four weeks after surgery (Latarjet average: 29,1 degrees; Bristow average: 20,53 degrees; p=0,01). We also found a statistically significant difference in passive elevation in favor of the Latarjet technique eight weeks after the surgery (Latarjet average: 132,73 degrees; Bristow average: 120,21 degrees; p=0,04). We found no statistically significant difference between both techniques regarding the functional scores (ASES, ASORS and WOSI). Comparing both procedures regarding sports return and complications there was no statistically significant difference.

Conclusion The Bristow and Latarjet techniques showed significant improvement in functional scores, a low complication rate, an absence of recurrence, a good return to sports rate, and preservation of the shoulder range of motion. The Latarjet technique showed better results in the initial range of motion, but in the last follow-up, both procedures yielded similar ranges of motion.

19498

BACTERIAL CONTAMINATION OF IRRIGATION FLUID AND SUTURE MATERIAL DURING ACL RECONSTRUCTION AND MENISCUS SURGERY

Benjamin Bartek, Tobias Winkler, Anja Garbe, Carsten Perka, Tobias M Jung. Germany

Summary Irrigation fluid during arthroscopic surgery shows bacterial contamination that increases over time.

Data PURPOSE Arthroscopic knee surgery uses irrigation fluid, which accumulates in a sterile reservoir during surgery. It has not yet been examined whether the irrigation fluid or suture material used during arthroscopic surgery show bacterial contamination. In the present study, we aimed to determine the time-dependent contamination rate and to clarify its relevance for postoperative infections. MATERIAL AND METHODS We included 155 patients in the study, who underwent reconstruction of the anterior cruciate ligament (ACL) in 58 cases, meniscal surgery in 63 cases and combined ACL reconstruction and meniscus repair in 34 cases. During arthroscopic surgery, samples of the pooled irrigation fluid were obtained from the sterile reservoir every 15 minutes and additionally suture material of ACL graft and meniscus repair was examined for bacterial colonization. All samples were sent for microbiologic analysis with an incubation time of 14 days. Postoperative follow-up examinations for clinical signs of infections were conducted after 6 weeks, 12 weeks and 12 months in our orthopaedic outpatient trial (FIRST), all reoperations were identified until 27-months post-operative. All included subjects were randomized to a treatment of arthroscopic osteochondroplasty or arthroscopic lavage without osteochondroplasty. The primary analysis was conducted using a Cox proportional-hazards model, with the percentage of patients with a reoperation analyzed in a time-to-event analysis as the outcome. The independent variable was the procedure (osteochondroplasty versus lavage), with age and impingement severity subtype explored as potential covariates. The results from the Cox model were expressed as a hazard ratio (HR), corresponding 95% confidence interval (CI), and the associated p-value. All tests were two-sided with an alpha level of 0.05.

Results A total of 220 patients with FAI were first enrolled in the study. Six patients were later found to be ineligible resulting in 108 total patients included in the osteochondroplasty group and 106 in the lavage group. The mean age of the patients included in the study was 36.0 (SD=8.5) years. Overall, a total of 27 incident reoperations were identified within 27 months of follow-up for an incidence rate of 6.0 per 100 person years. Within the osteochondroplasty group, a total of 8 incident reoperations were identified for incidence rate of 3.4 per 100 person years. In the lavage group, a total of 19 incident reoperations were identified for an incidence rate of 8.7 per 100 person years. The hazard of reoperation for patients undergoing osteochondroplasty is 40% that of patients undergoing lavage (HR=0.40, 95% CI=0.17 to 0.91, p=0.029).

Conclusion This randomized, time-to-event analysis demonstrates that for adults between the ages of 18 and 50 with FAI, arthroscopic osteochondroplasty is associated with a 2.5-fold decrease in the hazard of reoperation at any point in time compared to arthroscopic lavage.
Prospective Study Comparing Leukocyte-Poor Platelet-rich Plasma Combined with Hyaluronic Acid and Autologous Microfragmented Adipose Tissue in Patients with Early Knee Osteoarthritis

Ignacio Dallo, Macarena Morales, Alberto Gobbi. Spain; Italy

Summary The purpose of this study is to evaluate the clinical efficacy of repeated doses of Leucocyte-poor Platelet-rich Plasma combined with Hyaluronic Acid and single dose of Adipose Derived Mesenchymal Stem Cells injections. It was hypothesised that Adipose Derived Mesenchymal Stem Cells could be superior to Leucocyte-poor Platelet-rich Plasma + Hyaluronic Acid for the treatment of early knee Osteoarthrits.

Data

Purpose The purpose of this study is to evaluate the clinical efficacy of repeated doses of Leucocyte-poor Platelet-rich Plasma combined with Hyaluronic Acid and single dose of Adipose Derived Mesenchymal Stem Cells injections. It was hypothesised that Adipose Derived Mesenchymal Stem Cells could be superior to Leucocyte-poor Platelet-rich Plasma + Hyaluronic Acid for the treatment of early knee Osteoarthritis at 12 months follow-up.

Methods Eighty knees in fifty patients (mean age: 61.3 years, range 40–80) with early knee osteoarthritis were allocated into two groups from November 2016 to December 2017. The group 1 composed of 40 knees were treated with three intra-articular injections (1 month apart) using autologous Leucocyte-poor Platelet Rich Plasma combined with Hyaluronic Acid and the group 2 composed of 40 knees were treated with a single dose of Adipose-derived Mesenchymal Stem Cell injection by supra-patellar approach. Outcomes were measured by PROMs Tegner, Marx, VAS, IKDC and KOOS.

Results All patients in both groups lead to clinical and functional improvement at 6 and 12 months. However, there is statistical significance evidence in favor of ADMSCs (Lipogems) only for the case of Tegner and KOOS Symptoms at 6 months and for Tegner at 12 months of follow-up.

Conclusion This study shows both groups lead to clinical and functional improvement at 6 and 12 months. ADMSCs (Lipogems) showed better clinical results in Tegner and KOOS Symptoms at 6 months and for Tegner at 12 months of follow-up. This finding will aid clinicians to analyse the cost versus benefit ratio and help them to formulate an algorithm when treating patients with early osteoarthritis.

Glenosphere Lateralization in Reverse Shoulder Arthroplasty Leads to Better Functional and Clinical Outcomes in Rotator Cuff Arthropathy Patients – A Systematic Review with Meta-analysis

Joni L Soares Nunes, Renato Andrade, Guilherme França, João Espregueira-Mendes, Nuno Servis. Portugal

Summary The RSA with a lateralized glenosphere implant improves active shoulder motion and clinical and functional outcomes in selected patients with rotator cuff arthropathy or pseudoparalysis. The clinical and functional outcomes after lateralized RSA seem comparable to those previously reported for Grammont design implants, but with the newsworthily lower rate of scapular notching.

Data

Background The use of reverse shoulder arthroplasty (RSA) has been constantly increasing and indications have expanded for many diagnoses. Medialization of the centre of rotation is one of the causes of glenoid notching and poor range of motion improvement. A more lateralized RSA has been suggested either at the glenoid or humeral side, but lateralizing the RSA yields a greater moment arm, generating greater torque at the glenoid baseplate-bone interface, which creates apprehension about early loosening and failure. The aim of this systematic review was to scope analyze the influence on the clinical and functional outcomes of reverse shoulder arthroplasty lateralized at the glenoid side in patients with rotator cuff arthropathy and/or pseudoparalysis.

Methods A systematic review was performed according to guidelines of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Pubmed and EMBASE databases were searched up to January 31, 2020. We included studies that comprised male or female adults with rotator cuff arthropathy or pseudoparalysis with or without osteoarthritis and that the RSA procedure was performed with a lateralized design implant. We excluded studies with less than 10 patients, that comprised patients reporting fractures, instability or escape, infection, rheumatologic or neurologic diseases, patients with revision surgeries or failed shoulder arthroplasty, and studies reporting only revision arthroplasties or mixed population that did not subgroup the primary RSA. The Methodological Index for Non-Randomize Studies (MINORS) was used to assess study methodological quality.

Results We included 9 studies comprising 6 retrospective studies (level III) and 3 prospective case series (level IV). The mean MINORS score was 11.7 ± 4.3. In total, there were 1,813 patients (61% female) with a mean age of 72.2 ± 3 years (range, 43–95) that underwent RSA with a lateralized design. The most common indications included pseudoparalysis without osteoarthritis (n = 362), rotator cuff arthropathy (n = 265) and pseudoparalysis with osteoarthritis (n = 111). The mean follow-up was 40.3 months (range, 28–52 months). Active forward flexion, abduction, external rotation and internal rotation improved with a mean change of 47 to 82°, 43 to 80°, 8 to 39° and 0.6 to 2 points, respectively. Functional scores also improved from pre to postoperative assessment including the American Shoulder and Elbow (mean change, 20 to 50), Constant (mean change, 28 to 40), Simple Shoulder Test (mean change, 3 to 7) and visual analogue score (mean change, -2 to -5). Complication ranged from 0 to 20% and accounted 85 complications (29% aseptic loosening, 9%
acromion fracture, 7% glenosphere dissociation, 6% instability, and 6% infection). Scapular notching from 0 to 30% and of those with scapular notching, 53% were grade I, 40% grade II, 7% grade III and 0% grade IV (Sirveaux-Nerot classification). Rate of patients undergoing revision shoulder arthroplasty varied from 0 to 13%.

**Conclusion** The RSA with a lateralized glenosphere implant improves active shoulder motion and clinical and functional outcomes in selected patients with rotator cuff arthropathy or pseudoparalysis. These results seem comparable to those previously reported for Grammont design implants, but with the newsworthy lower rate of scapular notching.

**19693 FEMALE ATHLETES DEMONSTRATE GREATER IMPROVEMENT IN PATIENT REPORTED OUTCOME SCORES AND EQUAL RETURN TO SPORT RATES COMPARED TO MALES AFTER HIP ARTHROSCOPY A GENDER BASED MATCHED COMPARISON OF HIGH-LEVEL ATHLETES**

Andrew Jimenez, Rachel Glen, Kara Miecznikowski, Benjamin Saks, Hari Krishna Ankem, Payam William Sabetian, Benjamin G Domb. USA

**Summary** Female Athletes Demonstrate Greater Improvement in Patient Reported Outcome Scores and Equal Return To Sport Rates Compared to Males

**Data**

**Background** No studies have compared outcomes or return to sport between a matched cohort of male and female athletes with minimum 2-year follow-up.

**Purpose** (1) To report minimum 2-year patient reported outcome scores (PROs) and return to sport for high-level female athletes undergoing hip arthroscopy for femoroacetabular impingement (FAI) and (2) to compare clinical results with a matched control group of high-level male athletes. Study Design: Cohort study; Level of evidence, 3.

**Methods** Data on all high-level female athletes who underwent primary hip arthroscopy between March 2009 and July 2018. Patients were considered eligible if they underwent hip arthroscopy for FAI and participated in high school, collegiate, or professional athletics. Minimum 2-year PROs were collected for the modified Harris Hip Score (mHHS), Nonarthritic Hip Score (NAHS), Hip Outcome Score-Sport Specific Subscale (HOS-SSS), visual analog scale (VAS) for pain, and return to sport (RTS) status. The percentage of patients achieving minimal clinically important difference (MCID) and patient acceptable symptomatic state (PASS) for the mHHS, NAHS, and HOS-SSS were also recorded. These patients were propensity score matched in a 1:1 ratio to male high-level athletes undergoing primary hip arthroscopy for FAI.

**Results** Seventy-three high-level female athletes were included with a mean follow-up of 65.1 ± 27.9 months. They demonstrated significant improvement from preoperative to latest follow-up for mHHS, NAHS, HOS-SSS, and VAS (P < .05). The rate of return to sport was 75.4%, and patients achieved PASS/MCID for mHHS, HOS-SSS, and NAHS at high rates. Female athletes received a greater percentage of capsular repair and iliopsoas fractional lengthening compared to male athletes (P < .001). When outcomes were compared to a propensity matched control group of male athletes, female athletes demonstrated significantly better magnitude of improvement (delta value) for mHHS, NAHS, and VAS (P < .05). Female athletes also achieved MCID for HOS-SSS and NAHS at higher rates than male athletes (P < .05). There was no difference in RTS rates between the two groups (P > .05).

**Conclusion** High-level female athletes undergoing primary hip arthroscopy for FAI demonstrate significant improvement in PROs and high rates of return to play. Female athletes exhibit greater improvement in PROs (mHHS, NAHS, VAS) and achieve MCID (HOS-SSS, NAHS) at higher rates when compared to a matched group of male athletes.

**19615 ACHIEVING SUCCESSFUL OUTCOMES IN HIGH-LEVEL ATHLETES WITH BORDERLINE HIP DYSPLASIA UNDERGOING HIP ARTHROSCOPY WITH CAPSULAR Plication and LABRAL Preservation: A Propensity Matched Controlled Study**

Andrew Jimenez, Peter Monahan, Kara Miecznikowski, Benjamin Saks, Hari Krishna Ankem, Payam William Sabetian, Ajay C Lall, Benjamin G Domb. USA

**Summary** High-Level Athletes with Borderline Hip Dysplasia Outcomes

**Data**

**Background** Return to sport (RTS) and patient-reported outcomes (PROs) after hip arthroscopy in athletes with borderline hip dysplasia (BD) has not been established.

**Purpose** (1) To report minimum 2-year PROs and RTS rates in high-level athletes with BD 10 who underwent hip arthroscopy for labral pathology in the setting of microinstability and (2) to compare clinical results with a matched control group of athletes with normal acetabular coverage. Study Design: Cohort study; Level of evidence, 3.

**Methods** Data were reviewed for surgeries performed between November 2012 and July 2018. Patients were considered eligible if they received a primary hip arthroscopy in the setting of borderline dysplasia [lateral center-edge angle (LCEA) 18–25°] and competed in high-school, collegiate, or professional sports. Inclusion criteria included preoperative and minimum 2-year follow-up scores for the modified Harris Hip Score (mHHS), Non-arthritic Hip Score (NAHS), Hip Outcome Score-Sport Specific Subscale (HOS-SSS), and visual analog scale for pain (VAS). BD athletes were matched to a control group of athletes with normal acetabular coverage (LCEA 25°-40°).

**Results** A total of 65 patients with BD were included in the study with a mean follow-up of 47.5 ± 20.4 months. Athletes with BD showed significant improvement in all outcome measures recorded, demonstrated high RTS rates (80.7%), and achieved PASS/MCID for mHHS at high rates (MCID: 86.2%, PASS: 90.8%). When compared to a propensity matched control group with normal acetabular coverage, capsular plication was performed more commonly in the BD athletes (P = .037). PROs, RTS rate, and PASS/MCID rates were similar between the BD and control groups (P > .05).

**Conclusion** High-level athletes with BD who undergo primary hip arthroscopy for labral pathology in the setting of microinstability may expect favorable outcomes with capsular plication and labral preservation. These results were comparable to the control group of athletes with normal coverage.
randomized prospective comparative study of 40 patients diagnosed with distal humerus intraarticular fracture admitted to our hospital from April 2017 to March 2019. Triceps reflecting approach (group A) was used in 20 patients and olecranon osteotomy approach (group B) in 20 patients. Elbow range of movements and MEPS was used to compare the outcome.

Results The mean elbow range of motion is $95.8 \pm 13.5$ degrees at 1 year follow up in Group A and $94.5 \pm 9.3$ degrees in 1 year follow up at 1 year follow up in Group B. The mean MEP score at end of 1 year in group A was $93.8 \pm 2.9$ and in the group, B was $91.5 \pm 3.2$ shows excellent results but there was no statistically significant difference between the MEP scores of the two groups. We observed 6 patients who developed extension lag less than 10 degrees in group A which was clinically insignificant and 7 patients developed hardware prominence in group B.

Conclusion Triceps reflecting Bryan Morrey approach is equally effective as the olecranon osteotomy approach in the treatment of distal humerus intraarticular fracture with less complication and operative time.

NERVE INJURY DURING ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION: A COMPARISON BETWEEN PATELLOFEMORAL AND HAMSTRING TENDON GRAFTS HARVEST

Jonathan Singer, Ehud Rath, Mustafa Yassin, Shlomo Bronak, Barak Haviv, Israel

Summary Harvesting tendon autografts for anterior cruciate ligament reconstructions by vertical incisions had high prevalence of saphenous nerve branches injury with a minimal possibility for complete recovery within the first year.

Data

Background Tendon harvesting for anterior cruciate ligament reconstruction often injures sensory branches of the saphenous nerve. The reports on the prevalence of these injuries are scarce, while the implications on patient satisfaction are not known. Our objective was to compare the prevalence of sensory nerve injuries in patellar to hamstring autograft harvesting for anterior cruciate ligament reconstructions and follow up their postoperative course.

Methods Between 2012 and 2014, patients who had a primary anterior cruciate ligament reconstruction with bone patellar tendon bone or hamstring autografts were included ($n = 94$). We evaluated and compared demographic details, level of activity and postoperative sensation disturbances between both groups. Data was analyzed retrospectively.

Results The mean postoperative follow-up time was 23 months. At the last follow-up 46 (77%) patients of the patellar tendon group and 22 (58%) of the hamstring tendons group reported on reduced sensation; however, in both groups a quarter of these patients experienced full recovery within an average of seven to eight months. There were more patients in the hamstring tendons group that reported on partial recovery. In most cases midline incisions for patellar tendons harvesting injured the infrapatellar branch and medial incisions for hamstring tendons harvesting injured the sartorial branch of the saphenous nerve.
Conclusions Harvesting tendon autografts for anterior cruciate ligament reconstructions by vertical incisions had high prevalence of saphenous nerve branches injury with a minor possibility for complete recovery within the first year. The loss of sensation was perceived by patients as a minor complication.

Data
Introduction A spectrum of anterolateral rotatory laxity exists in anterior cruciate ligament (ACL) injured knees. Understanding of the factors contributing to a high-grade pivot shift continues to be refined. The effect of a high-grade pivot shift on baseline patient reported outcome measures (PROMs) is unclear.

Purpose To investigate factors associated with a high-grade pre-operative pivot shift and to evaluate the relationship between a high-grade pivot shift and baseline PROMs.

Methods A post hoc analysis of 618 ACL deficient patients deemed high risk for re-injury enrolled in a randomised trial was performed. A binary logistic regression model was developed with a high-grade pivot shift (International Knee Documentation Committee [IKDC] Grade 3) as the dependent variable. Age, sex, Beighton score, chronicity, posterior third medial or lateral meniscus injury and tibial slope were selected as independent variables. The importance of knee hyperextension as a component of the Beighton score was assessed using receiver operator characteristic curves. Baseline PROMs were compared between patients with and without a high-grade pivot.

Results Six factors were associated with a high-grade pivot shift. These were Beighton score (each additional point, OR 1.17, 95%CI 1.06–1.30, p=0.002), male sex (OR 2.30, 95%CI 1.28–4.13, p=0.005), the presence of a posterior third medial (OR 2.55, 95%CI 1.11–5.84, p=0.03) or lateral meniscal injury (OR 1.76, 95%CI 1.01–3.08, p=0.05), tibial slope >9° (OR 2.35, 95%CI 1.09–5.07, p=0.03) and chronicity >6 months (OR 1.70, 95%CI 1.00–2.88, p=0.05). The presence of knee hyperextension improved the diagnostic utility of Beighton score as a predictor of a high-grade pivot shift. There was an interaction between tibial slope and posterior third medial meniscus pathology; tibial slope <9 degrees was only associated with a high-grade pivot in the presence of posterior third medial meniscus injury. Patients with a high-grade pivot shift had higher baseline 4-Item Pain Intensity Measure (P4) pain scores (11 ±13 vs. 8 ±14, p=0.04); however, there was no difference between baseline IKDC, ACL-Quality of life (ACL-QOL), Knee Injury and Osteoarthritis Outcome Score (KOOS) or KOOS sub-scales.

Conclusion Ligamentous laxity, male sex, posterior third medial or lateral meniscal injury, increased posterior tibial slope and chronicity are associated with a high-grade pivot shift in this population deemed high risk for repeat ACL injury. Knee hyperextension improves the prognostic utility of the Beighton score. The effect of tibial slope may be accentuated by the presence of meniscal injury, supporting the need for meniscal preservation. Baseline PROMs are similar between patients with and without a high-grade pivot shift.

LINERENTOUS LAXITY, MALE SEX, CHRONICITY, MENISCUS INJURY AND POSTERIOR TIBIAL SLOPE ARE ASSOCIATED WITH A HIGH-GRADE PRE-OPERATIVE PIVOT SHIFT: A POST HOC ANALYSIS OF THE STABILITY STUDY

Summary Ligamentous Laxity, Male Sex, Chronicity, Meniscus Injury and Posterior Tibial Slope are Associated with a High-Grade Pre-Operative Pivot Shift

Data
Introduction A spectrum of anterolateral rotatory laxity exists in anterior cruciate ligament (ACL) injured knees. Understanding of the factors contributing to a high-grade pivot shift continues to be refined. The effect of a high-grade pivot shift on baseline patient reported outcome measures (PROMs) is unclear.

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Conclusion Ligamentous laxity, male sex, posterior third medial or lateral meniscal injury, increased posterior tibial slope and chronicity are associated with a high-grade pivot shift in this population deemed high risk for repeat ACL injury. Knee hyperextension improves the prognostic utility of the Beighton score. The effect of tibial slope may be accentuated by the presence of meniscal injury, supporting the need for meniscal preservation. Baseline PROMs are similar between patients with and without a high-grade pivot shift.

TREATMENT MODALITIES AND OUTCOMES FOLLOWING ACETABULAR FRACTURES IN THE ELDERLY: A SYSTEMATIC REVIEW

Summary Elderly patients with acetabular fractures suffer from high rates of mortality and complications, and when
determining surgical treatment in this population, THA alone or concurrent with ORIF should be considered given the significantly lower rate of non-fatal complications and similar mortality rate.

Data

Introduction The treatment of geriatric acetabular fractures remains controversial. Treatment options include nonoperative management, open reduction and internal fixation (ORIF), total hip arthroplasty (THA) with or without internal fixation, and closed reduction with percutaneous pinning (CRPP). Determining the optimal management for a specific patient depends on several factors, including fracture pattern, concomitant injuries, and medical comorbidities. In young patients, ORIF often leads to favorable functional outcomes if anatomic reduction of the joint is achieved. Poor reduction quality and advanced age are associated with higher rates of failure and conversion to THA following ORIF. While arthroplasty is established as a treatment option for acetabular fractures and offers the benefit of early weight-bearing and mobilization, it is associated with high rates of deep infection and dislocation. The unique risks and complexities associated with acetabular fractures in the elderly make these injuries especially challenging for the orthopedic traumatologist. The purpose of this study is to compare adverse event rates, functional and radiographic outcomes, and intraoperative results between the various treatment modalities in order to help guide surgical decision making.

Study Design and Methods We performed a systematic review to identify studies including patients aged ≥55 with acetabular fractures. In accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, we searched PubMed, MEDLINE, Embase, and Web of Science electronic databases using a combination of controlled vocabulary and keywords (acetabulum or acetabular and fracture, fractures, or fractured) limited to the title or abstract fields.

Results Thirty-eight studies including 3,928 patients with a mean age of 72.6 years and a mean follow-up duration of 29.4 months met our eligibility criteria. The mean Harris Hip Score (HHS) for all patients was 81.9 and was highest in the nonoperative group (mean HHS=93.2). The pooled mortality rate of all patients was 21.6% (95% confidence interval [CI] =20.9–22.4%) with a mean time to mortality of 21.6 months, and the pooled non-fatal complication rate was 24.7% (95% CI=23.9–25.5%). Patients treated with ORIF had a significantly higher non-fatal complication rate than those treated with ORIF+THA, THA alone, CRPP, or nonoperative management (odds ratios [ORs]=1.87, 2.24, 2.15, and 4.48, respectively; p<0.01). Patients that underwent ORIF were significantly less likely to undergo subsequent THA than those treated with CRPP (OR=0.49, p=0.002) but were more likely to require THA than patients treated nonoperatively (OR=6.81, p<0.001).

Conclusion Elderly patients with acetabular fractures suffer from high rates of mortality and complications. There was a high rate of conversion to THA in patients treated with internal or percutaneous fixation. When determining surgical treatment in this population, THA alone or concurrent with ORIF should be considered given the significantly lower rate of non-fatal complications and similar mortality rate. Nonoperative management remains a viable option and was associated with the lowest non-fatal complication rate.

Summary The results of this study involving specific pain patterns in unhappy TKA patients, help to further differentiate and define the clinical picture of a painful TKA and place component positioning in the overall context of the "painful knee arthroplasty".

Data

Background Total knee arthroplasty (TKA) is a highly effective treatment method of end-stage osteoarthritis and most patients experience pain relief within 3–6 months. However, about 20% of the patients are not satisfied nor pain free. The causes for recurrent pain after TKA are manifold and range from knee joint-related factors such as infection, arthrofibrosis, patellofemoral problems, malposition or malalignment, loosening or instability to non-knee joint-related causes such as psychological disorders, vascular pathologies, back or hip problems. Hence, the diagnostic process is demanding. The primary aim was to assess characteristics of pain in patients with ongoing pain after TKA and link the identified pain patterns to underlying pathologies. The secondary aim was to investigate the position of TKA components and evaluate bone tracer uptake (BTU) using pre-revision SPECT/CT and correlate these findings with the pain characteristics.

Methods A prospectively collected cohort of 83 painful primary TKA patients was retrospectively evaluated. All patients followed a standardized diagnostic algorithm including 99mTc-HDP-SPECT/CT, which led to a diagnosis indicating revision surgery. Pain character, location, dynamics and radiation were systematically assessed as well as TKA component position in 3D-reconstructed CT. BTU was anatomically localised and quantified using a validated localization scheme. Component positioning and BTU were correlated with pain characteristics using nonparametric Spearman correlations (p<0.05).

Results Most frequent pain characters were pricking/lancinating (45.7%), pinching/crushing and dull/heavy (38.6%); 89.5% of all patients localized their knee pain anteriorly; 48.1% reported pain aggravations by descending stairs. Radiating pain was reported in 14% of the patients. Patella-related problems (56.7%) and instability (52.6%) were the most frequent pathologies. Significant correlations were found between pain and patients characteristics and SPECT/CT findings resulting in nine specific patterns. The most outstanding ones include: Pattern 1: More flexion in the femoral component correlated with tender/splitting pain and patella-related pathologies. Pattern 3: More varus in the femoral component correlated with dull/heavy and tingling/stinging pain during descending stairs, unloading and long-sitting in patients with high BMI and unresurfaced patella. Pattern 6: More posterior slope in the tibial component correlated with constant pain.

Conclusion The results of this study involving specific pain patterns in unhappy TKA patients, help to place component positioning in the overall context of the "painful knee arthroplasty". Furthermore, the findings further differentiate and define the clinical picture of a painful knee after TKA. Knowing these patterns enables a prediction of the cause of the pain to be made as early as possible in the diagnostic process before the state of pain becomes chronic.

19771 TYPICAL PAIN PATTERNS IN PATIENTS AFTER TOTAL KNEE ARTHROPLASTY

Dominic Thierry Mathis, Samuel Tschudi, Antonia Hauser, Amsler Felix, Helmut Rasch, Michael T Hirschmann. Switzerland

10.1136/jisakos-2021-congress.92
Abstracts

19620 TRANSTIBIAL PULLOUT AND PARTIAL MENISCECTOMY FOR MEDIAL POSTERIOR MENISCAL ROOT TEARS IN MIDDLE-AGED PATIENTS: RISK FACTORS AND MIDTERM CLINICAL OUTCOMES. A CASE-CONTROL STUDY
Lika Dzidzishvili, Irene Isabel Lopez-Torres, Jm Arguello, David Sáez, Amaya Barberia, Emilio Calvo. Spain
10.1136/jisakos-2021-congress.93

Summary Transtibial pullout repair of medial meniscus posterior root tears showed improved clinical outcomes in middle-aged patients with decreased progression of knee osteoarthritis compared with partial meniscectomy

Data Background There are limited data regarding the prognostic factors and clinical outcomes of medial meniscus posterior root tear in middle-aged patients with moderate knee osteoarthritis. Objectives This study aims at (1) comparing clinical and radiological outcomes, rate of conversion to knee arthroplasty in middle-aged patients undergoing transtibial pullout technique versus partial meniscectomy, (2) at establishing correlations between preoperative radiological findings as prognostic factors and postoperative clinical outcome. The hypothesis of this study was that the transtibial pullout technique would provide better functional outcomes overall, with lower conversion to knee arthroplasty compared to partial meniscectomy and one or more prognostic factors for poor clinical outcome could be identified among the study variables used.

Study Design and Methods A comparative case-control analysis was conducted. 65 patients between 40 and 70 years of age were included into two groups: 30 patients who underwent transtibial pullout technique (group 1) and 35 patients who underwent partial meniscectomy (group 2). Mean follow-up was set at 27.2 months. Primary clinical outcomes included Knee injury and Osteoarthritis Outcome Score and Lysholm Knee Questionnaire. Preoperative MRI and intraoperative arthroscopic findings were recorded. The correlation between these findings and patient-reported subjective outcome were assessed. Results The transtibial pullout group exhibited significantly greater improvement in clinical outcomes. A univariate model revealed that the presence of preoperative meniscal extrusion, body mass index (>30), osteochondral defect, and female gender were predictors of poor clinical outcome. Multivariate regression analysis showed meniscal extrusion and osteochondral defect as significant prognostic factors for both study groups.

Conclusions Medial meniscus root repair leads to significantly improved clinical outcomes compared to partial meniscectomy and may be considered a valid option in middle-aged patients with moderate osteoarthritis. Presence of meniscal extrusion, osteochondral defect, BMI >30, and female gender were predictors of poor patient-reported outcome.

19622 OUTCOMES OF ARTHROSCOPIC LATARJET PROCEDURE FOR ANTERIOR GLENOHUMERAL INSTABILITY IN PATIENTS WITH EPILEPSY. A CASE-CONTROL STUDY
1Lika Dzidzishvili, 2Claudio Calvo Palma, 1María Valencia Mora, 1Diana Morcillo Barrenechea, 1Antonio Foruria, 1Emilio Calvo. Spain; Chile
10.1136/jisakos-2021-congress.94

Summary Functional and subjective clinical outcomes of epileptic patients with anterior shoulder instability after arthroscopic Latarjet stabilization were comparable with those of non-epileptic patients

Data Background Outcomes following Latarjet for anterior shoulder instability in epileptic patients are still a matter of debate. Unacceptably high rates of re-dislocations after surgery, reoperation and coracoid nonunion were reported in patients with a seizure disorder after Latarjet repair. Objectives The main goal of this study was to evaluated functional and radiographic results, recurrence and coracoid nonunion rates of the arthroscopic Latarjet procedure for anterior shoulder instability in patients with epilepsy and comparing with the results of patients without epilepsy.

Study Design & Methods A comparative case-control analysis was conducted including nineteen patients (twenty-one unstable shoulders) with a seizure disorder and who underwent arthroscopic Latarjet procedure (epileptic-group) by the same senior surgeon, were matched with twenty-one patients without a history of seizure (non-epileptic group) who also underwent arthroscopic Latarjet repair. Clinical outcomes at a minimum of 3 years (range, 3–9 years) postoperatively included Rowe score, Western Ontario Shoulder Instability Index, Constant-Murley Shoulder Outcome score and Single Assessment Numeric Evaluation. Demographics, surgical indications and imaging data were collected. The incidence of complications, recurrent instability, re-dislocation, revision surgery, repeat seizure(s) and presence of coracoid nonunion were also examined.

Results After a mean follow-up of 5.8 years, no significant differences for functional results were found between epileptic and non-epileptic patients on the average Rowe; WOSI; Constant and SANE scores (P=0.500; 0.173; 0.193; 0.859; respectively). A total of five patients (seven shoulders) continued to have seizures post-operatively but no glenohumeral instability was documented. Osteo-arthritic changes of the glenohumeral joint were observed in five shoulders (26.3%) in the epileptic patient group and in three shoulder (15.0%) in the non-epileptic group (p=0.451). No case of coracoid nonunion or ostelysis were recorded in any of the two groups investigated. There was no statistically significant difference in postoperative athletic activity (p=0.660). However, epileptic patient reavealed significantly decreased postoperative sports participation (p<0.001).

Conclusions The functional and subjective clinical outcomes of epileptic patients with anterior shoulder instability after arthroscopic Latarjet stabilization were comparable with those of non-epileptic patients with no significant difference of coracoid nonunion and re-dislocation rate. However, decreased postoperative sports participation is expected in patient with a seizure disorder.

19445 THE ROLE OF JOINT LINE POSITION AND RESTORATION OF POSTERIOR CONDYLAR OFFSET IN REVISION TOTAL KNEE ARTHROPLASTY
Hany Elbardesy, Rehan Gul, James Harty. Ireland
10.1136/jisakos-2021-congress.95

Summary The role of joint line position and restoration of posterior condylar offset in revision total knee arthroplasty

Conclusions The role of joint line position and restoration of posterior condylar offset in revision total knee arthroplasty

Abstracts first published as 10.1136/jisakos-2021-congress on 18 November 2021. Downloaded from http://jisakos.bmj.com/ on December 12, 2021 by guest. Protected by copyright.
Summary Preservation of JL should be a major consideration when undertaking RTKA. Of note, increasing PFCO to balance the flexion gap while maintaining joint line should be well assessed intra-operatively.

Data Abstract Objectives The aim of this systematic review was to evaluate the evidence on restoration of posterior Femoral condylar offset (PFCO) and Joint line (JL) with improved functional results after Revision Total Knee Arthroplasty (RTKA). Methods A comprehensive search of PubMed, Medline, Cochrane, CINAHL, and Embase databases was conducted since the inception of the database to October 2020. All relevant articles were retrieved, and their bibliographies were hand searched for further references on Posterior condylar offset and revision total knee arthroplasty. The search strategy yielded 28 articles. After duplicate removal titles, abstracts and full text were reviewed. Nine studies were assessed for eligibility, four studies were excluded because they did not fully comply with the inclusion criteria. Sex articles were finally included in this systematic review. Results Based on this systematic review restoration of the JL and PFCO in RTKR is associated with significant improvement in the post operative range of motion, KSS, OKS, patellar function, and SF-36. Conclusion Preservation of JL should be a major consideration when undertaking RTKA. Of note, increasing PFCO to balance the flexion gap while maintaining joint line should be well assessed intra-operatively.

A HIGH RATE OF CHILDREN AND ADOLESCENTS RETURN TO SPORT AFTER SURGICAL TREATMENT OF OSTEONECROSIS DISSECSANS OF THE ELBOW: A SYSTEMATIC REVIEW AND META-ANALYSIS

Dan Cohen, Jeffrey Kay, Muzammil Memon, David Slawaska Eng, Nicole Simunovic, Olufemi R Ayeni. Canada

10.1136/jisakos-2021-congress.96

Summary This systematic review found that a high rate of children and adolescents return to sport at any level and at the competitive level after surgical management of osteochondritis dissecans of the elbow, with an overall return to any level of sport at 97.6% and a return to competitive sport of 86.9% with additional improvement in all postoperative functional outcome scores.

Data Purpose The purpose of this systematic review was to determine the return to sport rates following surgical management of osteochondritis dissecans of the elbow.

Methods The databases EMBASE, PubMed, and MEDLINE were searched for relevant literature from database inception until August 2020 and studies were screened by two reviewers independently and in duplicate for studies reporting rates of return to sport following surgical management of posterior shoulder instability. A meta-analysis of proportions was used to combine the rates of return to sport using a random effects model. A risk of bias assessment was performed for all included studies using the MINORS score.

Results Overall, 31 studies met inclusion criteria and comprised of 548 patients (553 elbows) with a mean age of 14.1 (range 10–18.5) and a mean follow-up of 42.5 months (range 5–156). Of the 31 studies included, 14 studies (267 patients) had patients who underwent open stabilization, 11 studies (152 patients) had patients who underwent arthroscopic stabilization, and 6 studies (129 patients) had patients who underwent arthroscopic assisted stabilization. The pooled rate of return to any level of sport was 97.6% (95% CI, 94.8%–99.5%, I2 = 32%). In addition, the pooled rate of return to the preinjury level was 79.1% (95% CI, 70%–87.1%, I2 = 78%). Moreover, the pooled rate of return to sport rate at the competitive level was 86.9% (95% CI = 77.3%–94.5% I2 = 64.3%), and the return to sport for overhead athletes was 89.4% (95% CI, 82.5%–95.1%, I2 = 59%). The overall return to sport after an arthroscopic procedure was 96.4% (95% CI = 91.3% - 99.6%, I2 = 1%) and for an open procedure was 97.8% (95% CI 93.7%–99.9% I2 = 46%). All functional outcome scores showed improvement postoperatively and the most common complication was revision surgery for loose body removal (19 patients).

Conclusion Surgical management of osteochondritis dissecans of the elbow resulted in a high rate of return to sport, including in competitive and overhead athletes. Similar rates of return to sport were noted across both open and arthroscopic procedures.
reinforcement group vs 0.2 ± 1.6° to 124.5 ± 13.6° in the control group (p = .591). At 2 years postoperatively, posterior drawer examination showed grade 1+ laxity in 4/19 (21%) of the suture tape cohort vs 6/31 (19%) of the control cohort. No grade 2 or grade 3 laxity was noted in either group. Kneeling radiographs showed no side-to-side difference between the two groups: 1.9 ± 1.8 mm in suture tape reinforcement group vs 2.6 ± 2.2 mm in control group (p = .360). There were no statistically significant differences between the suture tape and control groups in postoperative IKDC scores (79.3 and 79.6, respectively), Lysholm scores (87.5 and 84.3, respectively) and Tegner activity scores (5.6 and 5.7, respectively). One PCLR graft failure was documented in the suture tape group, and none in the control group. Overall, 5/19 (26%) suture tape patients and 3/31 (10%) control patients underwent reoperation (p = .232), including 2 superficial wound debridements, 2 multi-ligament reconstructions due to traumatic injuries, and 1 meniscal surgery in the suture tape group. There were 2 lysis of adhesions and 1 superficial wound debridement in the control group.

Conclusions All inside single bundle PCL reconstruction with independent suture tape reinforcement was performed safely with a low rate of complications, graft failure, and reoperation at minimum 2-year follow-up. All inside posterior cruciate ligament reconstruction with and without independent suture tape reinforcement resulted in similar patient reported outcomes and postoperative laxity at 2-year follow-up.

**19388 BEACH CHAIR VERSUS LATERAL DECUBITUS POSITIONING FOR PRIMARY ARTHROSCOPIC ANTERIOR SHOULDER STABILIZATION: A CONSECUTIVE SERIES OF 641 SHOULDERS**

Bobby Yow, Matthew Posner, Jon F Dickens, Ashley Bee Anderson, Zein Aburish, David J Tennent, Lance LeClere, John-Paul Rue, Brett D Owens, Michael A Donohue, Kenneth L Cameron. USA

10.1136/jisakos-2021-congress.98

Summary Equivalent outcomes may be anticipated with arthroscopic Bankart repair performed in the BC or LD position.

Data

Introduction There are no studies that directly compare beach chair (BC) versus lateral decubitus (LD) position for anterior instability. In the only systematic review evaluating BC vs. LD, bone loss is not accounted for in the recurrence rate. The purpose of this is to identify predictors of shoulder instability recurrence and revision after anterior shoulder stabilization surgery in a young, high demand population and evaluate surgical position and glenoid bone loss as independent predictors of the outcomes of interest, recurrence and revision at short- and mid-term follow-up.

Methods A consecutive series of 641 arthroscopic Bankart stabilizations were performed by sports medicine certified and fellowship trained orthopaedic surgeons from 2005–2019 in either the BC or LD position. Patients were included if they underwent an isolated primary arthroscopic anterior capsulolabral repair. Patients were excluded if concomitant labral repair and/or Remplissage procedures were performed at the time of surgery. Shoulders were additionally excluded if magnetic resonance imaging (MRI) was not available at the time of preoperative evaluation or the patient was lost to follow up. All shoulders were evaluated for glenohumeral bone loss using the perfect circle technique on the sagittal en-face MRI as well as for bipolar lesions according to the on/off-track method of DiGiacomo et al. Glenoid bone loss was grouped into three categories: <5%, 5–13.5%, and >13.5%. The primary outcomes of interest were recurrent instability and revision stabilization. Recurrent instability was defined as the presence of a recurrent subluxation and or dislocation event and/or the presence of a positive apprehension. Multivariable logistic regression models were used to assess the relationships of outcomes with age, position, glenoid bone loss group, and track.

Results A total of 641 shoulders with a mean age of 22.3 years (SD 4.45) underwent isolated arthroscopic Bankart repair and were followed for a mean 6 years. The overall one-year recurrent instability and revisions rates were 3.3% (21/641) and 2.8% (18/641), respectively. At one-year, recurrent instability was observed in 2.3% (11/487) and 6.5% (10/154) of BC and LD shoulders. The five-year recurrent instability and revision rates were 15.7% (60/383) and 12.8% (49/383). At five-years, recurrent instability was observed in 16.4% (48/293) and 13.3% (12/90) of BC and LD shoulders. When adjusted for age, position, and bone loss group, multivariable logistic regression modeling demonstrated surgical position was not associated with risk of recurrent instability after one-year (OR for LD vs BC = 1.39; p = 0.56) and five-year (OR for LD vs BC=1.32, p=0.43) follow-up time periods. However, after five-year follow-up younger age at index surgery was independently associated with higher risk of recurrent instability: OR = 1.73 per SD (4.1 years) decrease in age (P<0.05). After one-year and five-year follow-up time periods, surgical position results were similar in a separate multivariable logistic regression model of revision surgery as the dependent variable, when adjusted for age, branch, bone loss group, and track. After five-year follow-up, only younger age at time of index surgery remained an independent risk factor for revision: OR 1.68 per SD (4.1 years) decrease in age (P<0.05).

Conclusions Among fellowship-trained orthopaedic surgeons, there was no difference in rates of recurrent instability and revision surgery after performing arthroscopic stabilization for isolated anterior shoulder instability in a high demand population in either the BC or LD position. In multivariable analysis, younger age, but not surgical position, was an independent risk factor for recurrence.

**19390 PROGRESSION TO GLENOHUMERAL ARTHRITIS AFTER ARTHROSCOPIC ANTERIOR STABILIZATION IN A YOUNG AND HIGH DEMAND POPULATION**

Bobby Yow, Ashley Bee Anderson, Sean E Slate, Kelly Kilcoyne, Jon F Dickens. USA

10.1136/jisakos-2021-congress.99

Summary The progression to glenohumeral arthritis after anterior stabilization surgery occurred in 8% of a young and high demand patient population.

Data

Introduction Shoulder instability is a common cause of shoulder pain and dysfunction, particularly in young and active individuals. While arthroscopic stabilization for anterior glenohumeral instability has shown excellent success preventing
recurrent instability and allowing return to sport, eventual progression to glenohumeral arthritis remains a concern in these patients. Older age, higher number of anchors used, and greater capsular shrinkage have been previously established as risk factors for progression to glenohumeral arthritis in patients who underwent arthroscopic anterior stabilization. However, the rate of and risk factors for arthritis post-surgery in young and high demand populations have not been well characterized and may be important in guiding decision making when treating the young patient with first time shoulder instability. The purpose of this study was to evaluate the rate of progression to glenohumeral arthritis and identify potential risk factors after arthroscopic anterior stabilization in a young and high demand population.

Methods This study included 287 active duty servicemembers identified in the Military Heath System (MHS) with anterior shoulder instability who underwent primary arthroscopic surgical stabilization and had postoperative imaging or medical records available over a 12-year period between January 2004 and September 2016. All procedures were performed at a single institution. Patients were excluded if they had previously undergone a stabilization procedure on the shoulder of interest, if no preoperative imaging was available, if they did not have a minimum follow up of four years, or if operative information regarding the number of anchors used was unavailable. Presence of arthritis (yes/no) was defined over follow up using radiographic parameters as described by Samielsen and Prieto identifying patients with at least mild arthritis. Kaplan-Meier survival curves were estimated for development of arthritis and compared by patient characteristics using log-rank tests. Cox proportional hazard models were used to calculate Hazard Ratios (HR) with 95% confidence intervals (95% CI) associated with patient characteristics as predictors of the development of glenohumeral arthritis, adjusted for confounders identified in univariate analyses.

Results Among the 287 patients with anterior shoulder instability requiring surgical fixation, 8% (23/287) developed glenohumeral arthritis. The mean age of all patients was 22.7 years (SD 5.26). The median time to diagnosis of arthritis was 8 years and the median follow-up time was 9 years (IQR 6;11). Kaplan-Meier curves showed differences in time to arthritis among patient groups stratified by age, index surgery anchor number, and revision (yes/no), (log rank p for each <0.05). Adjusted for potential confounders in a multivariable Cox regression model, risk factors for the development of glenohumeral arthritis included age (HR=1.85, 95% CI, 1.34 to 2.55), index surgery anchor number (HR=1.54, 95% CI, 1.11 to 2.14), and revision before diagnosis with glenohumeral arthritis (HR=2.83, 95% CI=1.15 to 6.95).

Conclusion This is the largest series looking at glenohumeral arthritis after arthroscopic surgical stabilization for anterior shoulder instability. The progression to glenohumeral arthritis after anterior stabilization surgery occurred in 8% of a young and high demand patient population. Patient age and number of anchors used are statistically significant risk factors for progression to arthritis. Additionally, revision surgery was found to be a risk factor, which has not been previously reported in the literature. These results demonstrate decreased rates of arthritis when compared to older populations, which may advocate for early surgical intervention for a young patient presenting with shoulder instability.
Increasing Injury Risk Among Recent Generation of U.S.-Raised Players in the National Basketball Association: A 15-Year Perspective

Kelvin Kim, Robbie Birch, Brett Allen, Jason Nielson. USA

Summary The purpose of this study is to determine the epidemiology and trends of specific overuse injuries in U.S.-raised NBA players over the past 15 years.

Data

Purpose There is growing concern of increasing injury rates among the recent generation of players in the National Basketball Association (NBA). Although these concerns are limited to anecdotal evidence, the current thought focuses on recent trends in youth player development including early single-sport specialization, increasingly rigorous training regimens, and the high volume of games played annually. In an effort to protect and promote safe player-development practices among youth basketball players, and ultimately those who continue on to the collegiate and professional levels, the purpose of this study is to determine the epidemiology and trends of specific overuse injuries in U.S.-raised NBA players over the past 15 years. Additionally, a comparative injury analysis was performed between U.S. and foreign-raised players. Our hypothesis is that, over the past 15 seasons, there has been (1) an increased risk of overuse injuries among more recently drafted U.S.-raised players, (2) a higher risk of overuse injuries among U.S.-raised players than foreign-raised players.

Methods All overuse injuries sustained during players’ first 2 seasons were retrospectively analyzed between 2003–2019. Players were separated into cohorts based on whether they had spent the majority of their amateur careers playing in the U.S. (US) versus outside of the U.S. (OUS). Regression analysis was performed to analyze injury risk within the US cohort as well as between the US and OUS cohorts.

Results Five-hundred forty-nine (80.9%) and 129 players (19.0%) were identified in the US and OUS cohorts, respectively. A significantly higher risk of ankle sprains (OR 1.86, p<0.001, CI [95%] 1.937–8.775), toe sprains (OR 1.86, p<0.001, CI [95%] 1.024–3.380) and total injuries (OR 1.23, p<0.001, CI [95%] 1.061–1.446) was observed among more recently drafted US players. The OUS cohort did not show increased injury risk by body location or total injuries among recent draftees. When comparing injury risk between the US and OUS cohorts, the US cohort showed a significantly higher risk of knee sprains (OR 8.26, p=0.038, CI [95%] 0.610–1.330), foot sprains (OR 9.34, p=0.031, CI [95%] 1.221–71.421), and total injuries (OR 4.25, p=0.001, CI [95%] 2.374–7.600).

Conclusion Our findings reflect the growing concern of increasing injury risk among the newer generation of U.S.-raised NBA players. Insight into increasing injury rates may be found in the training methods used to develop foreign-raised players, who appear to be less injury-prone based on our study. This is the first published study to our knowledge analyzing overuse injury trends during the early stages of NBA players’ careers. In an effort to mitigate injury risk among competitive youth basketball players, incorporating injury prevention measures into routine training regimens as well as adherence to safe training guidelines is recommended.

Hip Osteochondroplasty May Benefit the Non-Ideal Patient with Femoroacetabular Impingement: Analysis from the Embedded Prospective Cohort of the First Trial

Mahmoud Almasri, Nicole Simunovic, Diane Heels-Ansdell, Olufemi R Ayeni. USA; Canada

Summary The benefits of the osteochondroplasty procedure shown in the FIRST trial, appear to also apply to patients commonly seen in regular practice.

Data

Background Randomized controlled trials (RCTs) typically have specific eligibility criteria that lead to the recruitment of optimized or ideal patient populations for the interventions under study. The Femoroacetabular Impingement Randomized Controlled Trial (FIRST) demonstrated the efficacy of arthroscopic osteochondroplasty when compared to arthroscopic lavage in the treatment of femoroacetabular impingement (FAI) in ideal patients at 2 years. During the FIRST trial, we concurrently ran an embedded prospective cohort study that enrolled patients who either did not meet the full trial eligibility criteria or who refused to participate in the RCT and therefore were treated with arthroscopic osteochondroplasty as per standard of care. We present the results of this embedded cohort study to determine if arthroscopic osteochondroplasty demonstrated effectiveness (i.e., the intervention was also beneficial to a non-ideal, pragmatic FAI patient population).

Methods All cohort patients were not randomized and were followed prospectively with a follow-up assessment protocol identical to that in the FIRST trial. The primary outcome was hip pain using a 100-point Visual Analogue Scale (VAS). Secondary outcomes included hip function (Hip Outcome Score, HOS; International Hip Outcome Tool, iHOT-12), health utility (EQ-5D), and health-related quality of life (SF-12 mental and physical component summary scores, MCS and PCS) at 12 months as well as operatively and non-operatively treated hip complications at 24 months. We performed multiple linear
regressions to compare these outcomes between 3 groups of patients: (1) those randomized to lavage in the FIRST trial, (2) those randomized to osteochondroplasty in the FIRST trial, and (3) those who received osteochondroplasty as part of the cohort study. Regression model covariates included: impingement sub-type, age, sex, severity of baseline impingement, presence of comorbidities at baseline, temporary pain relief from diagnostic hip injection prior to surgery, body mass index (BMI), and baseline score for all questionnaire outcomes.

Results Similar to the results of the FIRST trial, all groups had improvements in VAS pain scores from baseline to 12 months, and experienced similar improvements in hip function (HOS, iHOT-12), health utility (EQ-5D), and health-related quality of life (SF-12 MCS and PCS), with no significant differences between groups. From the logistic regression model adjusting for age, there were significantly more re-operations in the lavage trial group compared to those in the embedded cohort (i.e. ‘non-ideal’ patients who received osteochondroplasty) (adjusted odds ratio, OR 3.08; 95% confidence interval, CI 1.23 to 7.73; p = 0.016). There were significantly more non-operatively treated complications in the lavage trial group and in the osteochondroplasty trial group when compared to those in the embedded cohort (adjusted OR 3.81; 95% CI 1.19 to 12.17; p = 0.024 and adjusted OR 4.55; 95% CI 1.43 to 14.42; p = 0.010, respectively). These results were consistent across the adjusted and unadjusted analyses.

Conclusion Hip arthroscopic osteochondroplasty leads to improvement in hip pain, function, and health-related quality of life at 12 months across both RCT (ideal) and cohort (non-ideal) patients. Those receiving osteochondroplasty as part of the pragmatic cohort had significantly fewer re-operations and other complications when compared to RCT patients randomized to either arthroscopic lavage or osteochondroplasty. The benefits of the osteochondroplasty procedure shown in the FIRST trial, appear to also apply to patients commonly seen in regular practice.

### Abstracts

**19542** DOES MEDIALIZATION OF GLENOID BONE-BASEPLATE INTERFACE CAUSED BY ECCENTRIC REAMING INFLUENCE OUTCOMES OF REVERSE SHOULDER ARTHROPLASTY?

Prashant Meshram, Jorge Rojas Llevano, Stephen C Weber, Uma Srikumaran, Edward G McFarland. USA

Data: 10.1136/jisakos-2021-congress.103

**Summary** In primary RSA using a lateralized implant, medialization of glenoid bone-baseplate interface after eccentric reaming does not influence shoulder range of motion, patient-reported outcome scores, postoperative pain scores, baseplate loosening, or glenoid notching.

**Background** One of the major concerns with reverse shoulder arthroplasty (RSA) is dealing with the glenoid bone loss that is severe enough to compromise baseplate stability. The influence of increasing the medialization of the bone-baseplate interface (MBBI) resulting from reaming the glenoid while using a lateralized glenosphere RSA system has not been studied before. This study aims to determine (1) What is the influence of different magnitudes of MBBI on clinical outcomes including range of motion (ROM) and patient reported outcomes (PROs)? and (2) What is the influence of increasing MBBI on the incidence of baseplate failure and scapula notching?

**Methods** We retrospectively reviewed 91 patients who underwent primary RSA after a minimum 2-year follow-up. The amount of MBBI was estimated using a 3-dimensional CT scan-based computer planning software. Patients were categorized into three groups depending on whether MBBI was less than 3 mm (Group low MBBI, N = 32), between 3 mm to 5 mm (Group moderate MBBI, N = 30), or more than 5 mm (Group high MBBI, N = 29). Range of motion (ROM), American Shoulder and Elbow Surgeons (ASES) score, Simple Shoulder Test (SST) score, and scapular notching were compared between groups.

**Results** Mean MBBI was 1.5 mm (range, 0.5 - 2.5 mm) in low MBBI group, 3.5 mm (range, 3.0 - 5.0 mm) in moderate MBBI group, and 7 mm (range, 5.5–10 mm) in high MBBI group. At the last follow-up, there was no statistical difference (all P > 0.05) in clinical results when compared between low, medium, and high MBBI groups for mean ASES (74 vs 67 vs 75), SST (8 vs 7 vs 9), VAS for pain (1.3 vs 2.3 vs 2.7), abduction (121° vs 120° vs 123°), external rotation at 90° abduction (60° vs 60° vs 55°), and internal rotation at back (lumbosacral vs lumbosacral vs waist). There was no correlation between the amount of MBBI and improvement in ROM in any plane. There was no baseplate loosening in any patient.

**Conclusion** Hip arthroscopic osteochondroplasty leads to improvement in hip pain, function, and health-related quality of life at 12 months across both RCT (ideal) and cohort (non-ideal) patients. Those receiving osteochondroplasty as part of the pragmatic cohort had significantly fewer re-operations and other complications when compared to RCT patients randomized to either arthroscopic lavage or osteochondroplasty. The benefits of the osteochondroplasty procedure shown in the FIRST trial, appear to also apply to patients commonly seen in regular practice.

**19543** REVISION ROTATOR CUFF REPAIR VERSUS PRIMARY REPAIR FOR LARGE TO MASSIVE TEARS INVOLVING POSTEROSUPERIOR CUFF: COMPARISON OF CLINICAL AND RADIOLOGICAL OUTCOMES

Prashant Meshram, Bei Liu, Sang Woo Kim, Kang Heo, Joo Han Oh. USA; Republic of Korea

Data: 10.1136/jisakos-2021-congress.104

**Summary** Revision rotator cuff repair had similar clinical and radiological outcomes to the primary repairs of large to massive posterosuperior tears.

**Background** Outcomes of revision rotator cuff repair (rRCR) have conflicting results with a retear rate ranging 50 - 90%. Another group of patients who have unpredictable clinical outcomes are those who undergo primary RCR (pRCR) for large to massive rotator cuff tears (mRCT). The purpose of this study was to compare the clinical outcomes in patients who underwent pRCR for mRCT.
with posterosuperior rotator cuff tear who had a rRCR for tear of any size with those who had a pRCR for mRCT.

Methods Among patients with posterosuperior cuff tear operated between 2010 and 2017, the clinical outcomes of 46 patients who underwent a rRCR were compared to 106 patients who had a pRCR for mRCT. The mean follow-up was 26.4 months (range, 24–81 months). The difference in patient reported outcomes (PROs) at the final follow-up between the comparison groups was evaluated and compared with previously published minimal clinically important difference (MCID) values. Radiological outcome was evaluated using MRI or ultrasonography at a minimum one-year follow-up. To identify the risk factors for poor ASES score, a multivariate linear regression analysis was performed. A multivariate logistic regression analysis was used to assess the risk factors for healing failure.

Results The patients in each rRCR and pRCR group had a statistically significant and clinically relevant improvement in PROs and ROM when compared from preoperative to postoperative status at the final follow-up. Comparing the PROs at final follow-up between two groups, the pain VAS (2.1 vs. 1.0, P = 0.004), satisfaction VAS (6.9 vs. 8.6, P < 0.001), and ASES score (79.7 vs. 89.8, P = 0.001) in rRCR group were statistically significantly worse than pRCR group, whereas the Constant score (68.0 vs. 67.8, P > 0.05) was not statistically different between two groups. None of the above differences in PROs were clinically significant as they did not exceed the MCID threshold. The ROM in rRCR group was not statistically significant than pRCR group for flexion (158° vs 163°) and external rotation at 90° (85° vs 89°). The rate of healing failure in the rRCR group was 50% compared with the pRCR group (39%; P = 0.194). While comparing PROs within rRCR group, those who had a healing failure at follow-up showed significantly worse pain VAS score and ASES score than patients with intact cuff. Risk factors for worse ASES scores in patients of rRCR group were healing failure (P = 0.043, r = -11.3), lower body mass index (P = 0.032, r = 1.9), and lower preoperative pain VAS (P = 0.038, r = 2.3). The risk factors for healing failure in rRCR were preoperative high-grade fatty degeneration (Goutallier grade 3 and 4) of supraspinatus muscle (P = 0.026, OR 5.2) and hyperlipidemia (P = 0.035, OR 11.8).

Conclusion Revision rotator cuff repair had similar clinical and radiological outcomes to the primary repairs of large to massive posterosuperior tears. Patients with symptomatic failed rotator cuff repairs having high-grade fatty degeneration of supraspinatus and/or serum hyperlipidemia had a higher likelihood of healing failure after revision repair which was associated with poor functional outcomes. These patients should be considered for an alternative treatment.

19474 VALUE, LIMITATIONS AND RECOMMENDATIONS FOR USE OF METAL-REDUCTION KNEE MRI SEQUENCES FOLLOWING ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

Brandon Zhao, Nabil Khan, Mark F Sommerfeldt, Arukul Panu, Jacob L Jaremko, Catherine May Ting Hui. Canada

Summary Use of metal artifact reduction sequences (WARP and SEMAC) significantly improved diagnostic accuracy and confidence in detection of ACL graft tears. When the key clinical question is ACL graft integrity, our study supports adding a WARP sequence to the routine knee MRI scan protocol.

19494 IMPINGEMENT DUE TO GRAFT BUCKLING IS MORE PREVALENT AFTER ACL RECONSTRUCTIONS WITH AN ADJUSTABLE-LOOP COMPARED TO A FIXED-LOOP

Julian De Rover, Inge Van Den Akker-Scheek, Hugo Christiaan van der Veen. Netherlands

Summary Impingement Due to Graft Buckling Is more Prevalent after ACL Reconstructions with an Adjustable-Loop compared to a Fixed-Loop

Data Background Graft fixation in anterior cruciate ligament (ACL) reconstruction is achieved by interference screws, cortical...
OUTCOMES OF PROXIMAL HAMSTRING TENDON REPAIR IN PATIENTS OLDER THAN 50 YEARS OF AGE

Alexander Rainer Manuel Bitzer, Daniel Hurwit, Julian Joseph Sonnenfeld, Durham Weeks. USA

10.1136/jisakos-2021-congress.107

Summary Compare pain relief and functional outcomes in young (<50 years of age) versus older (>50 years of age) after primary proximal hamstring repair

Data

Background The majority of proximal hamstring tendon tears are treated conservatively with non-operative management. However, patients with certain injury patterns or failure of conservative management may benefit from operative intervention that leads to improved clinical outcomes. The majority of these outcomes have been reported in young and middle aged patients. We hypothesized that patients aged 50 years and older, who undergo primary proximal hamstring repair, would benefit from similar clinical improvements without an increased risk of complications when compared to younger patients.

Methods A retrospective analysis of prospectively collected data was performed using our institution’s research database. All patients who underwent primary proximal hamstring tendon repair between 2015 and 2019 by a single surgeon were evaluated. Patients were grouped into younger (age 16–49 years) and older (age > 50 years) age cohorts. The primary outcome was patient reported pain (Visual Analog Scale score, VAS). Pre- and post-operative VAS scores were compared between the two cohorts at an average follow-up of 26.3 months. Complications, satisfaction, and return to function were also compared at a minimum of 1-year follow-up. Results A total of 54 patients met the inclusion criteria for this study. The younger cohort included 24 patients (5 male, 19 female) while the older cohort included 30 patients (8 male, 22 female). There were no significant differences in patient characteristics between groups except for age (40.5 years versus 57.8 years, p < .001). At final follow-up, post-operative pain scores were significantly improved in both younger and older patient cohorts compared to pre-operative values (6 ± 1.3 to 1.3 ± 1.5 and 7.6 ± 1.5 to 1.4 ± 2, respectively, p < .001). Older patients had a more significant reduction in pain compared to younger patients after surgical repair (-6.2 ± 2.1 versus -4.75 ± 1.9, p = .01). There was no significant difference in complication rates between groups. Patient satisfaction and return to function was greater than 93% in both groups.

Conclusion Patients aged 50 and older obtain at least equivalent if not better improvements in functional outcome and pain relief after primary proximal hamstring tendon repair compared to their younger counterparts. Older patients are not at an increased risk for surgical complications after primary hamstring tendon repair.
two groups based on presence or absence of preexisting glenohumeral osteoarthritis. The groups were controlled for tear pattern, sex, BMI, tobacco/alcohol use, and common co-morbidities. The primary outcome was failure of repair, defined as need for revision repair or a re-tear confirmed on postoperative MRI. Secondary outcomes were patient-reported outcome measures (PROs) including visual analog pain scale (VAS), subjective shoulder value (SSV), and American Shoulder and Elbow Surgeons (ASES) score; active range of motion (ROM), including forward flexion (FF), external rotation (ER), and internal rotation (IR); and strength testing, including FF, ER, and IR. Within the osteoarthritis cohort, a subgroup analysis was conducted to compare outcomes between mild versus moderate to severe osteoarthritis. Outcomes were compared using Mann-Whitney U and Fisher’s Exact Test with \( p < 0.05 \).

**Results** There were 91 patients in the glenohumeral osteoarthritis group and 115 patients in the control group. There was a significant difference in the postoperative FF (153.55 ± 21.07 vs. 160.14 ± 17.26 degrees, \( p = 0.001 \)) and ER (46.91 ± 11.95 vs. 52.25 ± 11.60 degrees, \( p = 0.001 \)) ROM between the glenohumeral osteoarthritis and control groups, respectively. There were no significant differences between groups for revisions repairs, retears, postoperative IR ROM, all preoperative ROM, all PROs, and all strength parameters (all \( p > 0.05 \)). For the subgroup analysis, there were 70 patients in the mild osteoarthritis group and 21 patients in the moderate to severe osteoarthritis group. There was a significant difference in the postoperative FF strength (88.4% vs. 61.9% with 5/5 strength, \( p = 0.010 \)) and ER strength (89.9% vs. 71.4% with 5/5 strength, \( p = 0.046 \)) between the mild and moderate to severe groups, respectively. There were no significant differences between the groups for all other outcome measures.

**Discussion** Rotator cuff repair remains an excellent treatment in patients with pre-existing glenohumeral osteoarthritis. The data from this study demonstrates that rotator cuff repair in patients with pre-existing glenohumeral osteoarthritis have similar clinical and functional outcomes as repairs in patients without osteoarthritis with the exception of a slightly decreased postoperative FF and ER ROM. Patients with moderate to severe osteoarthritis may have slightly decreased FF and ER strength outcomes compared to those with mild osteoarthritis.

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**19682**

**THE FACTORS INFLUENCING POSTOPERATIVE CUFF INTEGRITY OF ARTHROSCOPIC ROTATOR CUFF REPAIR COMBINED WITH MUSCLE ADVANCEMENT FOR MASSIVE ROTATOR CUFF TEAR**

Yasuhiro Sumimoto, Shin Yokoya, Yohei Harada, Nobuo Adachi. Japan

10.1136/jisakos-2021-congress.109

**Summary** ISP retraction and TM atrophy may be the key factors for predicting postoperative cuff integrity when arthroscopic rotator cuff repair combined with muscle advancement for massive rotator cuff tear is performed.

**Data**

**Introduction** It is well known that the failure rate after arthroscopic rotator cuff repair (ARC) in the case of massive rotator cuff tear (mRCT) is high, and that the treatment is often difficult. We have reported that ARC combined with muscle advancement (MA) can be expected to reduce the failure rate of mRCT treatment. Nevertheless, failure is an inevitable risk, which has obvious negative implications for the clinical outcomes, so it is important to reveal what the potential risk factors are. Hence, our aim in this study was to research the factors that can influence postoperative cuff integrity of ARC combined with MA for mRCT.

**Methods** From October 2011 to September 2020, we examined 68 patients who underwent ARC with MA for mRCT, and postoperative MRI enabled us to evaluate whether cases healed or failed after surgery. There were 40 males and 28 females, and the average age at surgery was 66.6 ± 8.6 (39–81) years. We passed nylon thread through the supraspinatus tendon (SSP) and infraspinatus tendon (ISP), and pulled it with a tension meter at 30N in a 30 degrees’ abduction position. MA was performed in cases where full coverage of the footprint could not be achieved by the cuff stumps. We evaluated patient background (age, sex, diabetes mellitus (DM)), preoperative clinical scores (Constant shoulder score, University of California at Los Angeles Shoulder score, Numerical Rating Scale), preoperative X-ray findings (acromiohumeral interval, critical shoulder angle), preoperative MRI findings (rotator cuff retraction size, fatty infiltration, muscle atrophy), and intraoperative findings (Subscapularis tendon injury, long head biceps tendon injury, with or without a polyglycolic acid sheet). These items were divided into the healed group and failed group (Sugaya classification type IV and V were defined as failure by postoperative MRI). Univariate and multivariate logistic regression analysis was performed, and \( P < 0.05 \) was considered as significant.

**Results** Univariate analysis showed the DM, SSP and ISP retraction size, SSP fatty infiltration, global fatty degeneration index, and teres minor muscle atrophy (TM atrophy) to be significantly more pronounced in the failed group than in the healed group. Multivariate analysis showed the ISP retraction size and TM atrophy to be significantly higher in the failed group than in the healed group.

**Conclusion** We investigated the factors influencing postoperative cuff integrity of ARC combined with MA for mRCT. Multivariate analysis showed ISP retraction and TM atrophy to be significantly higher in the failed group than in the healed group. These factors may be crucial for the accurate prediction of postoperative cuff integrity when ARC is combined with MA for mRCT.

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**19676**

**OUTCOMES OF OBSTRUCTIVE SLEEP APNEA PATIENTS UNDERGOING ROTATOR CUFF REPAIR**

Andres Barandiarian, Rachel M Frank, Jonathan T Bravman, Adam Seidi, Eric C McCarty. USA

10.1136/jisakos-2021-congress.110

**Summary** Despite controlling for age and BMI, patients with obstructive sleep apnea report worse physical health and shoulder function post-rotator cuff repair compared to healthy patients, despite no pre-operative differences.

**Data**

**Introduction** Obstructive sleep apnea (OSA) prevalence in the general adult population is estimated to be 6–17%, and as high as 49% in older adults. These patients are at 45–59% greater risk of postoperative complications, such as hypoxemia, acute hypercapnia, as well as hyperalgesia, due to higher levels of inflammatory markers compared to patients without OSA.
While older adults are at higher risk of OSA, they are also at a higher risk of having a rotator cuff tear (RCT). Previous research has shown 30% of adults >60 years and 62% of adults >80 years have a RCT. Given the prevalence of OSA and RCT in older adults, OSA may negatively affect parameters of mental, physical health, and shoulder function in patients recovering from rotator cuff repair (RCR). The purpose of this study was to compare patient reported outcomes (PROs) between OSA patients and controls that underwent RCR.

Methods A retrospective review of patients who underwent RCR by 5 fellowship-trained orthopedic surgeons between 2014 and 2019 was performed. Patient medical history was screened for a diagnosis of OSA or deemed at high risk by STOP BANG questionnaire. All patients were asked to complete PROs pre-operatively, at 3, and 6 months post-operatively. A mixed-model ANOVA was performed with age and BMI as covariates due to higher age and BMI increasing OSA risk as well as being associated with worse outcomes following RCR.

Results Data from 91 (44 female) control and 89 (24 female) OSA patients were available for analysis. As expected as OSA risk increases with male sex, higher BMI, and age; mean BMI (25.1 ± 4.0 kg/m2 vs. 30.4 ± 5.1 kg/m2), age (57.7 ± 11.8 years vs. 61.7 ± 8.7 years), were significantly higher in the OSA group (p<0.05). In addition, there were also significantly less females in the OSA group compared to control (p<0.05). There was no significant effect of OSA for VAS, VR-12 mental scores, and SANE (p>0.05). However, OSA patients had a significantly lower ASES score compared to control (66.79 ± 21.03 vs. 60.95 ± 21.70, respectively, p<0.05) when adjusted for age and BMI, but no interaction effect with time (p>0.05). In contrast, VR-12 physical scores showed a significant interaction effect of time and OSA condition, when adjusted for age and BMI. More specifically, control patients at both 3 months (41.0 ± 1.0 vs. 37.1 ± 1.0, p<0.05) and 6 months (49.2 ± 1.2 vs. 42.3 ± 1.3, p<0.05) reported better physical health post-RCR compared to OSA patients. Lastly, the difference in 6-month VR-12 physical scores between groups met minimal clinical important difference (MCID) criteria.

Conclusion The findings of our study suggest PROs related to shoulder pain and mental health among OSA patients that underwent RCR are not significantly different from healthy patients. However, our results show despite controlling for age and BMI, patients with OSA report significantly worse physical health post-operatively and shoulder function compared to healthy patients.

Data

Introduction Intra-articular corticosteroid injection (CSI) is a conservative procedure used in shoulder pain patients to provide rapid relief of shoulder pain. While previous research has shown injections can induce or exacerbate hyperglycemia in patients with uncontrolled diabetes, these studies did not track patients on a daily basis or for longer than seven days. This makes it difficult for clinicians to advise patients on the time period they should monitor their blood glucose levels (BGLs) with increased caution. Hence, this study aimed to observe BGLs in patients with uncontrolled diabetes for 14 days post shoulder CSI.

Methods We recruited 20 patients with either type I or type II diabetes undergoing treatment for a single glenohumeral CSI. All patients had an HbA1C measurement within the last 3 months. All injections were standardized to a total injection volume of 6 mL, comprised of 5 mL 1% Lidocaine (without epinephrine) and 1 mL of Triamcinolone (40mg/mL). We excluded patients that had a prior CSI or had taken oral steroids 6 weeks prior to their injection date. We obtained baseline measure of BGLs using a glucometer prior to the CSI. Subsequently, we had patients record their BGLs using the glucometer and a diary daily for the first week post CSI, and then every other day for the second week. Descriptive statistics were performed to determine a normal distribution among our dataset, followed by a repeated-measures ANOVA with bonferroni corrections for longitudinal comparisons of BGLs.

Results 20 patients (25% male) measured their BGLs using a glucometer for two weeks post CSI. The mean age was 60.5 ± 13.3 years (range 35–78 years) with a mean BMI of 23.1 ± 7.5 kg/m2 and a mean HbA1C value of 7.7 ± 1.4%. Only 3 patients demonstrated a normal HbA1C level between 4–6%. Mean patient BGLs at baseline were 140.25 ± 8.26 mg/dL. We found BGLs were 68.7% (236.62 ± 14.6 mg/dL) and 91.0% (267.91 ± 16.8 mg/dL) higher on day of injection and post injection day 1 when compared to baseline, respectively (p<0.05). We also found post injections day 2, 3, and 4, were also 72.6% (242.13 ± 16.2 mg/dL), 38.9% (194.92 ± 12.5 mg/dL), and 34.46% (188.59 ± 8.85 mg/dL) higher when compared to baseline, respectively (p<0.05). Lastly, no other subsequent time points were significantly different from baseline (p>0.05).

Discussion The main finding of our pilot study suggests BGLs are significantly elevated during the injection day and first four post-injection days when compared to baseline, with the highest mean value occurring on the first post-injection day. Our results align with previous research of CSIs significantly increasing BGLs in diabetic patients with HbA1C levels greater than 7% in the first post-injection and injection day. We can extrapolate from our results that two weeks is enough time for BGLs to return to near baseline BGLs in our patient population. In conclusion, diabetic patients with elevated HbA1C should monitor their BGLs more closely after receiving a CSI.
Summary A computational analysis was designed to determine the role of the fascia lata graft in restoring shoulder stability in arthroscopic superior capsular reconstruction for irreparable rotator cuff tears. Shoulder stability was better restored when the graft was fixed with the shoulder at 5° to 10° of abduction, and in 10° of internal rotation, and when the long head of the biceps was preserved.

Data Background Arthroscopic superior capsular reconstruction (ASCR) for the treatment of irreparable rotator cuff tears (IRCTs) has been shown to produce excellent functional outcomes. However, the graft tear rate ranges from 4.2% to 75%. The position of the shoulder during graft fixation may be a key factor impacting the outcome of ASCR, and biomechanical evidence regarding the effect of initial graft positioning on the stability of the shoulder, and on the functional role of the graft is lacking. This study aimed to determine whether the position of the shoulder during graft fixation influences the stability of the shoulder and graft tear risk. The hypotheses were that ASCR would increase the stability of the shoulder after an IRCT, and different positions of the shoulder during graft fixation would influence shoulder stability and graft tear risk.

Methods A musculoskeletal model of the upper limb was modified to account for the fixation of the graft. A total of 126 shoulder positions of fixation were simulated to improve shoulder stability. The material properties of the graft were defined based on experimental data that the authors had collected previously from 20 cadaveric fresh fascia lata grafts. The rotator cuff tear was modelled assuming a full-thickness tear of the supraspinatus tendon. The effect of concomitant long head of the biceps (LHB) tenotomy was also studied. The biomechanical parameters evaluated included the strain of the graft and the glenohumeral joint reaction force, to estimate the integrity of the graft and shoulder stability, respectively. The positions of high risk of tear were defined as those for which the strain of at least one segment of the graft exceeded the strain failure of 15%. Analysis of variance (ANOVA) and Tukey’s test were used to compare the shoulder stability index among shoulder positions of fixation. The significance level was set to p < 0.05.

Results Fixation at abduction angles of >15° resulted in a high risk of graft tear when the arm returned to the resting position. For this reason, the stability of the shoulder, for these positions, was not evaluated. Shoulder stability significantly improved compared with the preoperative condition, regardless of the shoulder position of fixation (95% confidence intervals, p<0.001). Fixation of the graft with the shoulder at 5° to 10° of abduction and in 10° of internal rotation correlated with the most significant improvement in shoulder stability compared to the preoperative condition (p<0.001). Concomitant tenotomy of the LHB significantly decreased shoulder stability of ASCR (p=0.007).

Conclusion ASCR for IRCTs increases the stability of the shoulder compared to the preoperative condition. Fixing the superior capsular graft with the shoulder at 5° to 10° of abduction, and in 10° of internal rotation, and without concomitant LHB tenotomy, improves shoulder stability. Abduction angles >15° increase the graft tear risk. This study supports the relevance of the position of the shoulder during graft fixation both for the stability of the shoulder, and for graft integrity after ASCR. New studies should investigate the role of LHB tenodesis as an alternative to tenotomy to preserve the LHB’s stabilizing effect in ASCR.

19768 ACL DEFICIENCY INFLUENCES MEDIO-LATERAL TIBIAL ALIGNMENT AND KNEE VARUS-VALGUS DURING IN VIVO ACTIVITIES

Piero Agostinone, Stefano Di Paolo Erg, Alberto Grassi, Marco Bonitelli, Erika Pinelli, Laura Bragonzoni, Stefano Zaffagnini. Italy

10.1136/jisakos-2021-congress.113

Summary Dynamic radiostereometry evaluation of ACL deficiency

Data Purpose The role of the anterior cruciate ligament (ACL) in knee biomechanics in vivo and under weight-bearing is still unclear. The purpose of this study was to compare the tibiofemoral kinematics of ACL-deficient knees to healthy contralateral ones during the execution of weight-bearing activities.

Methods Eight patients with isolated ACL injury and healthy contralateral knees were included in the study. Patients were asked to perform a single step forward and a single leg squat first with the injured knee and then with the contralateral one. Knee motion was determined using a validated model-based tracking process that matched subject-specific MRI bone models to dynamic biplane radiographic images, under the principles of Roentgen stereophotogrammetric analysis (RSA). Data processing was performed in a specific software developed in Matlab.

Results Statistically significant differences (p < 0.05) were found for single leg squat along the frontal plane: ACL-deficient knees showed a more varus angle, especially at the highest knee flexion angles (40°–50° on average), compared to the contralateral knees. Furthermore, ACL-deficient knees showed tibial medialization along the entire task, while contralateral knees were always laterally aligned. This difference became statistically relevant (p < 0.05) for knee flexion angles included between 0° and about 30°.

Conclusion ACL-deficient knees showed an abnormal tibial medialization and increased varus angle during single leg squat when compared to the contralateral knees. These biomechanical anomalies could cause a different force distribution on tibial plateau, explaining the higher risk of early osteoarthritis in ACL deficiency. The clinical relevance of this study is that also safe activities used in ACL rehabilitation protocols are significantly altered in ACL deficiency.

19738 EVALUATION OF ROTATOR CUFF REPAIR WITH AND WITHOUT CONCOMITANT BICEPS TREATMENT: A RETROSPECTIVE REVIEW OF PATIENT OUTCOMES

Daniel Nemirov, Sommer Hammoud, Meghan E Bishop, Zachary J Herman, Ryan W Paul, Ari Clements, Matthew Beucherie, Christopher J Hadley, Michael G Ciccotti, Kevin Freedman, Brandon Erikson. USA

10.1136/jisakos-2021-congress.114

Summary The purpose of this study is to retrospectively compare the clinical outcomes between patients who underwent isolated RCR versus patients who underwent RCR with concomitant biceps treatment. Correcting biceps pathology when
performing RCR results in similar rates of cuff failure, revision RCR, complications, and pre- to post-operative change in ASES scores when compared to isolated RCR.

Data Bicipital pathology is common in patients with rotator cuff tears. Leaving biceps pathology untreated in rotator cuff repairs (RCR) may lead to suboptimal outcomes. The purpose of this study is to retrospectively compare the clinical outcomes between patients who underwent isolated RCR versus patients who underwent RCR with concomitant biceps treatment. In patients that received biceps treatment, we sought to compare (1) biceps tenodesis versus biceps tenotomy and (2) sub-pectoral tenodesis versus arthroscopic tenodesis.

Methods A retrospective chart review of 244 patients who underwent RCR at a single multicenter institution in 2016 was performed. Patient demographics, presence of concomitant biceps pathology, pre- and postoperative American Shoulder and Elbow Surgeons (ASES) scores, rates of rotator cuff failure, revision surgery, and all complications were compiled.

Results 101 patients underwent RCR with concomitant tenotomy (n=30) or tenodesis (n=71) for biceps treatment and 143 underwent RCR alone. Patients undergoing biceps treatment were older (59.1 years vs. 56.3 years; p=0.013) and more likely to be male (45.7% vs. 30.4%; p=0.029). Patients undergoing biceps treatment were more likely to have a sub-scapularis tendon repair (43.6% vs. 11.2%; p<0.001). Pre-operatively, biceps treatment patients had lower ASES scores (41.2 vs 49.3; p=0.003). Postoperatively, there was no significant difference in ASES scores (79.5 biceps treatment vs. 81.5 isolated RCR; p=0.532). There was no significant difference in rates of cuff failure (p=0.766), revision RCR (p=0.703), or all complications (p=0.102) after 2 years. There was no significant difference in average age (61.6 vs. 58.1 years; p=0.054) in the tenotomy versus tenodesis groups. Males were more likely to have tenodesis than females (76% vs. 48%; p=0.011). There were significantly lower preoperative ASES scores in the tenotomy group compared to the tenodesis group (34.3 vs 44.0; p=0.036). Postoperative ASES scores were not significantly different between groups (73.5 tenotomy vs 82.1 tenodesis; p=0.149). There were no significant differences in rates of cuff failure (p=1.000), revision RCR (p=1.000), or all complications (p=1.000) after 2 years. There was no significant difference in age between patients having subpectoral tenodesis (n=21) and those having arthroscopic tenodesis (n=50) (55.0 vs 59.4 years; p=0.058). Patients in the arthroscopic group were more likely to undergo subscapularis repair (52% vs. 40%; p=0.045). There were no significant differences in pre-operative ASES between the arthroscopic and subpectoral tenodesis groups (41.1 vs. 50.4; p=0.066). Postoperative ASES scores were not significantly different (83.2 arthroscopic vs 79.6 subpectoral; p=0.592). There was no significant difference in rates of cuff failure (p=1.000), revision RCR (p=0.507), or all complications (p=1.000) after 2 years.

Conclusions Addressing biceps pathology when performing RCR resulted in similar rates of cuff failure, revision RCR, complications, and improvement in patient-reported outcomes when compared to isolated RCR at two years postoperatively. Furthermore, when comparing tenotomy versus tenodesis and arthroscopic versus subpectoral tenodesis, comparable outcomes with regards to rate of rotator cuff repair failure, revision RCR, complications, and patient-reported outcomes were found.
Furthermore it shows how the menisci and tibial eminences resist movements of the femur in the coronal plane in abnormal JLO along with an increase in stress at these areas. This is important to consider when performing osteotomy especially in the athletically active patients.

**19951 INLAY TOTAL SHOULDER ARTHROPLASTY FOR THE TREATMENT OF ADVANCED GLENOHUMERAL ARTHRITIS IN POWERLIFTERS AND BODYBUILDERS; “THE RETURN TO LIFT”**

Luis A Vargas, John W Uribe, John E Zvijac, Kevin Allan West, Matthias Schurhoff, Kristina Kuklova. USA
10.1136/jisakos-2021-congress.116

**Summary** Stemless non-spherical humeral head and inlay glenoid replacement provide substantial pain relief and functional improvement and is a promising option for the management of symptomatic osteoarthritis in this challenging patient population. The procedure allows for a return to activities without restrictions.

**Data**

**Background** High-level bodybuilders and powerlifters are at risk to develop symptomatic glenohumeral arthritis (GHA) due to the excessive demands placed on their shoulders. Upon failure of conservative management, surgical treatment options are limited and pose clinical challenges due to a relatively young patient age combined with the desire of sport continuation. Arthroscopic management is limited, and stemmed arthroplasty remains controversial due to high glenohumeral stresses upon return to sport.

**Hypothesis/Purpose** The purpose of this study was to assessment inlay total shoulder arthroplasty (inlay TSA) utilizing a stemless non-spherical humeral head and inlay glenoid (IG) replacement for the treatment of advanced GHA in competitive and high-level recreational strength athletes.

**Study Design** Prospective Case Series.

**Methods** 18 shoulders in 14 male athletes with a mean age of 45.6 years (range 25–57) were included in this study. Pre- and postoperative evaluations included physical and radiographic assessment, patient reported outcomes (PRO) (ASES, WOOS, VAS-P), range of motion (ROM), patient satisfaction, and return to sport.

**Results** All procedures were performed on an outpatient basis. No intraoperative complications occurred, and no blood transfusions were required. The mean follow-up was 38 months (range: 25–51). The average ASES improved from 26-93, WOOS from 18-87, and VAS-P from 9-1. The mean ROM increased from 115-145 degrees (forward flexion), from 30–60 degrees (external rotation), and from the level of the scapula to L3 (internal rotation). Radiographic analysis at last follow-up showed no evidence of component loosening, glenoid migration, or signs of device failure. All patients were satisfied with the procedure and 12/14 returned to moderate or high level of weightlifting. One patient developed arthrofibrosis and required an arthroscopic capsular release and debridement which significantly improved function. Four patients decided to undergo inlay TSA on their symptomatic contralateral side within 6 months of their index procedure.

**Conclusions** Stemless non-spherical humeral head and inlay glenoid replacement provide substantial pain relief and functional improvement and is a promising option for the management of symptomatic osteoarthritis in this challenging patient population. The procedure allows for a return to activities without restrictions and leaves multiple arthroplasty options if revision becomes necessary.

**20085 INLAY TOTAL SHOULDER ARTHROPLASTY FOR PRIMARY GLENOHUMERAL ARTHRITIS**

John W Uribe, John E Zvijac, Luis A Vargas, David A Porter, Anshul Saxena, Matthias Schurhoff, Andrew Payomo. USA
10.1136/jisakos-2021-congress.117

**Summary** Treatment with inlay total shoulder arthroplasty demonstrated meaningful functional improvement, excellent pain relief, and patient satisfaction in patients with advanced shoulder arthritis and various glenoid stages.

**Data**

**Background** Anatomic total shoulder arthroplasty (TSA) with a non-spherical humeral head and inlay glenoid replacement has been introduced in the past, however clinical evidence remains limited. We hypothesized that patients with advanced glenohumeral arthritis demonstrate meaningful improvements.

**Methods** Prospective patient-reported outcomes (PRO) included the American Shoulder and Elbow Surgeons Score (ASES), pain visual analog scale (VAS-Pain), and satisfaction. Range of motion was compared to the preoperative status. A sensitivity analysis examined responder rates (RR) to literature TSA thresholds for minimal clinically important difference (MCID) and substantial clinical benefit (SCB). Glenohumeral staging and implant stability with zone-specific periprosthetic radiolucency were performed radiographically.

**Results** Thirty-nine shoulders in 36 patients (3 bilateral) with a mean age of 65.9 years (26 males, 13 females) and a mean follow-up of 41.0 months, were included. 93% had Grade III osteoarthritis, 7% Grade II. Glenoid stages included A1 (25%), A2 (25%), B1 (22%), B2 (25%) and C (3%). All PROs improved significantly (p<.001) with a mean ASES from 30.4–77.1, a VAS-Pain from 8.1–1.5, and excellent (9.1/10) patient satisfaction. PRO related RRs for MCID and SCB were >85%. Forward elevation improved from 106.50–154.90, and external rotation from 21.90–50.80. One intraoperative glenoid rim fracture led to advanced radiolucency; no other clinically relevant radiolucency was observed.

**Conclusion** Treatment with inlay total shoulder arthroplasty demonstrated meaningful functional improvement, excellent pain relief, and patient satisfaction in patients with advanced shoulder arthritis and various glenoid stages. Our initial evidence provides further support for this new option in primary shoulder replacement.

**20126 HIP DISORDERS IN BULL RIDERS: CLINICAL OBSERVATIONS AND OUTCOMES OF ARTHROSCOPY**

JW Thomas Byrd, Kay S Jones. USA
10.1136/jisakos-2021-congress.118

**Summary** Outcomes of hip arthroscopy among bull riders are often favorable, despite common findings of restricted motion, grade IV chondral damage and Tönnis 2 radiographic changes.

**Data**
Introduction Restricted range of motion, grade 4 chondral damage, and Tönnis radiographic changes greater than 1 are considered harbingers of poor outcome and possibly contraindications to hip arthroscopy. However, all of these findings are almost uniformly present among bull riders seeking treatment. The purpose of this study is to report on clinical observations in this population and outcomes of arthroscopic intervention, and how these observations may reflect on care in other cohorts.

Methods Patients undergoing hip arthroscopy are prospectively assessed with a modified Harris Hip Score. Twenty-one consecutive hips among 16 bull riders (5 bilateral) were identified that had achieved minimum 2 year followup, and represent the substance of this report. Results Among the 16 bull riders (21 hips) there were 14 professional and 2 collegiate cowboys. The average age was 26 years (range 20 - 33 years). Duration of symptoms averaged 33 months (range 2-130 months), and followup averaged 48 months (range 12 - 120 months). There were 10 right and 11 left hips. 14 of the cowboys were right handed, although only 13 rode right handed. The average weight was 155 pounds (range 125 - 170 pounds); height averaged 69” (range 66” - 72”). Range of motion was as follows: total arc averaged 31° (range 20° - 70°); internal rotation averaged 3° (range 0° - 20°); external rotation averaged 27° (range 20° - 50°). All had FAI, including 17 combined and 4 cam type. Among the cam types, 1 also had dysplasia and 1 borderline dysplasia. Radiographic Tönnis grades included 2 Tönnis 1; 18 Tönnis 2, 1 Tönnis 3. All had acetabular articular damage including: 14 grade 4; 6 grade 3; 1 grade 1. Nine underwent microfracture. Four had accompanying femoral chondral lesions (3 grade 3, 1 grade 4). There were 20 labral tears of which 14 underwent repair and 6 debridement. All but one (95%) were improved following surgery. One bilateral case underwent conversion to a resurfacing arthroplasty on one side and revision arthroscopy on the other. The average improvement was 22 points (preop 63; postop 85) with a range of –12 to 45 points. Thirty-three cowboys (83%) returned to bull riding at an average of 7 months (range 4–17 months) There were no complications.

Discussion and Conclusion Bull riders tend to be small framed like jockeys built for bulls. Tight hips associated with FAI may be a serendipitous adaptation for bull riders, providing a static (clothes pin) method for the thighs to grip the bull’s girth. Bull riders undergoing hip arthroscopy commonly carry a triple threat of predictors of poorer results: (1) Restricted motion, (2) grade 4 articular changes, and (3) Tönnis 2 radiographic findings. Despite these, with proper selection, they can often benefit substantially from arthroscopic intervention. Understanding the limits in this challenging population may help in deciphering the potential role of arthroscopy for challenging cases in other patient mixes.

Background Viable Cartilage Allograft (VCA) contains cryopreserved viable allogeneic cartilage fibers mixed with chondrogenic matrix. In-vitro and animal studies and a prospective case series were completed with VCA to assess safety and benefits in treating focal knee cartilage defects. Our hypothesis is that VCA is a safe single stage procedure in isolated chondral defects with results comparable or better than other single stage procedures.

Methods Cell viability and functionality of VCA was evaluated in-vitro. VCA was also evaluated in a goat cartilage repair model. 19 patients (7/12 M/F) were implanted, mean age 26.77 (15–56), mean BMI 27.59 ± 6.1, mean follow-up 19 months (range 12.0–26.3 months). Symptomatic International Cartilage Repair Society (ICRS) grade 3/4A lesions of the femoral condyle (n=4) or patella (n=14) were treated. Lesion sizes ranged from 1.4–6.0 cm² (mean defect size was 5.025 cm²). International Knee Documentation Committee (IKDC), Knee injury and Osteoarthritis Outcome (KOOS) subscales, Lysholm, Short Form-12 (SF-12), visual analog scale (VAS) and pain frequency levels were assessed. Radiographs and magnetic resonance imaging (MRI) were performed at 3 and 6 months (M).

Results In vitro assessment confirmed VCA contains viable and functional chondrocytes. The goat study confirmed VCA is effective for cartilage repair. Lysholm (25.3), KOOS: Pain (12.2), Symptoms (19.6), ADLs (14.5), Sports (13.7), and QOL (28.9) at 6 months increased from pre-operative baseline (POB) and were maintained at 12 months: IKDC (72.2), Lysholm (84.2), KOOS: Pain (87.8), Symptoms (80.7), ADL (97.6), Sports (72), and QOL (61.2). MRI imaging at 6 and 12 months showed viable preliminary cartilage tissue with no significant bone edema or graft delamination. Second look arthroscopy (2 patients) demonstrated complete fill and incorporation (Britoberg Scores 11/12). Functional scores improved at 24(M): IKDC (87.3), Lysholm (87.7), KOOS: Pain (92.5), Symptoms (86.2), ADLs (95.6), Sports (82.9), QOL (82.1).

Conclusion VCA is an off-the-shelf, single stage, conformable allogeneic graft that treats chondral defects with no additional fixation. Pre-clinical and short-term prospective clinical studies show VCA can safely treat chondral defects with potential advantages to existing options.
Visualization of an ALL tear in MRI is associated with a higher rate of failure of isolated primary ACL-R.

Methods Retrospective case-control study. Eighty-four patients (86 knees) with isolated primary ACL-R operated by the same surgical team with a complete imaging study where included, consisting of 43 knees with ACL reconstruction failure (cases) and 43 knees without it (controls). Patients with multi-ligamentary injuries, articular cartilage procedures and malalignment requiring correction were excluded. A musculoskeletal radiologist blind to the study underwent a pilot screening of sensitivity and specificity for the visualization of ALL tears, according to thickness and signal of the ligament in MRI. Patients with ACL tear and under anesthesia pivot shift examination +/+ in which anterolateral plasty/reconstruction was performed were considered positive. Patients examined under anesthesia with a pivot shift -/+ and without anterolateral plasty/reconstruction were considered negative. Subsequently, the visualization of the ALL, presence of tears and degree of injury were evaluated in all patient’s images of the primary ACL injury. The statistical analysis included logistic regression to calculate Odds Ratio (OR) between ALL tear and failure of the ACL-R. A power of 80% and significance of 5% were considered.

Results The visualization of an ALL tear in MRI is associated with a higher rate of failure of isolated primary ACL-R. Visualization of an ALL tear in MRI increases the rate of failure of an isolated primary ACL-R.

Methods Retrospective case-control study. Eighty-four patients (86 knees) with isolated primary ACL-R operated by the same surgical team with a complete imaging study where included, consisting of 43 knees with ACL reconstruction failure (cases) and 43 knees without it (controls). Patients with multi-ligamentary injuries, articular cartilage procedures and malalignment requiring correction were excluded. A musculoskeletal radiologist blind to the study underwent a pilot screening of sensitivity and specificity for the visualization of ALL tears, according to thickness and signal of the ligament in MRI. Patients with ACL tear and under anesthesia pivot shift examination +/+ in which anterolateral plasty/reconstruction was performed were considered positive. Patients examined under anesthesia with a pivot shift -/+ and without anterolateral plasty/reconstruction were considered negative. Subsequently, the visualization of the ALL, presence of tears and degree of injury were evaluated in all patient’s images of the primary ACL injury. The statistical analysis included logistic regression to calculate Odds Ratio (OR) between ALL tear and failure of the ACL-R. A power of 80% and significance of 5% were considered.

Results The visualization of an ALL tear in MRI increases the rate of failure of an isolated primary ACL-R.
5 pitchers returned to playing pitcher. One patient with a large defect and drilling underwent reoperation 11 years after the initial operation. Mean change in extension was 4.3° and that in flexion was 3.7°. Timmerman/Andrews score improved significantly from 160 (95% confidence interval 146.7–173.3) to 195 (95% confidence interval 185.2–204.8) at the most recent follow-up (p = 0.0001). Osteochondral defects detected on preoperative radiographs were small in 10 patients, moderate in 7, and large in 6. There was no significant between-group difference in extension, flexion, or Timmerman/Andrews score preoperatively or at the most recent follow-up.

Conclusions

Arthroscopic debridement with or without drilling allowed return to play in adolescent baseball players for positions other than pitchers. Long-term outcomes are likely durable regardless of lesion size.

20094

LOW COMPLICATION AND REDISLOCATION RATES ARE EVIDENT FOLLOWING PATELAR STABILIZATION SURGERY

Laurie A Hiemstra, George A Reed, Sarah Kerslake. Canada

Summary

This study demonstrated low complication (7.4%) and redislocation (3.0%) rates following patellar stabilization procedures that included an MPFL reconstruction.

Data

Background

Medial patellofemoral ligament (MPFL) reconstruction has demonstrated a very high success rate with improved patella stability, physical function, and patient-reported outcomes. Systematic reviews have demonstrated a very low redislocation rate, ranging from 2.1–5.1%. Previous studies have also reported a complication rate of up to 26.1% following MPFL surgery.

Purpose

The purpose of this study was to assess the complication rate as well as the number of subsequent surgical procedures in patients with recurrent lateral patellofemoral instability following a patellar stabilization surgery including an MPFL reconstruction.

Methods

Patients with recurrent patellofemoral instability who underwent a patellofemoral stabilization including an MPFL reconstruction (n = 363) were assessed at a minimum of 2-years post-operative. Of the 363 patients, 98 (27%) underwent a contralateral surgery during the study period, providing data for 461 knees. Pathoanatomic risk factors were assessed pre-operatively. Complications and redislocations as well as additional operative procedures were recorded. Disease-specific quality of life was assessed with the Banff Patellofemoral Instability Instrument (BPII). Descriptive statistics including rates, means, and standard deviations were calculated.

Results

Complications following surgery were recorded in 34/461 knees (7.4%). Redislocation of the patella occurred in 23/461 knees (5.0%). There were three deep infections and one superficial infection, five knees developed arthrofibrosis, there was one tibial tunnel fracture, and one non-union of a femoral osteotomy. There were no patella fractures, incorrect femoral tunnel placement, medial dislocations, implant failures, deep vein thromboses or pulmonary emboli. A subsequent surgical procedure was performed in 94/461 knees (20.4%), with 120 procedures completed in total. Subsequent surgeries included hardware removal in 54 knees (45% of additional procedures), knee arthroscopy in 39 knees (32.5%) and revision patellar stabilization procedures in 23 knees (19.2%). The most common reason for knee arthroscopy was pain secondary to chondral cartilage injury. The mean pre-operative BPII score was 25.5 (SD 13.4), and post-operatively was 65.7 (SD 14.6).

Conclusion

This study demonstrated a low overall complication rate of 7.4% following patellar stabilization using an à la carte approach to surgical treatment. The most common complication was re-dislocation in 5.0% of knees. Additional surgery was performed in 20.4% of knees, of which almost half was expected for removal of hardware. These results indicate a low complication and redislocation rate following patellar stabilization procedures that included an MPFL reconstruction.

20120

GENERALIZED JOIN HYPERMOBILITY MORE COMMON IN SURGICAL FAILURE CASES AFTER PATELLOFEMORAL STABILIZATION

Laurie A Hiemstra, Mark Lafave, Sarah Kerslake. Canada

Summary

This study reports a surgical failure rate for patellofemoral stabilization of 4.8%, with the sole risk factor statistically associated with graft failure being generalized ligamentous laxity.

Data

Background

Recurrent patellofemoral instability is a common knee problem for which medial patellofemoral ligament (MPFL) reconstruction with or without concomitant procedures has been shown to effectively and consistently improve function and quality of life outcomes. Management of patellofemoral instability is difficult due to the varying combinations of demographic and pathoanatomic risk factors that present and the controversy regarding the thresholds used to determine the need for concomitant procedures. Examination of surgical failures in this complex patient population is necessary to guide surgical management and develop an understanding of the interplay of these anatomic and biomechanical risk factors.

Purpose

The purpose of this study was to report and analyze the surgical failure rates for patellofemoral stabilization in a large patient cohort. The secondary purpose was to compare the presence of risky demographic and pathoanatomic risk factors in the surgical failures compared with successful stabilizations. Finally, cases of re-dislocation were analyzed to identify the most probable cause for failure.

Methods

This is a prospective case series of 590 knees with symptomatic recurrent patellofemoral instability that underwent a surgical patellofemoral stabilization between June 2008 and February 2017. All patients received an MPFL reconstruction with concomitant procedures performed when indicated to address significant pathoanatomic risk factors. Surgical failure was defined as re-dislocation of the patella. Patients with a successful stabilization procedure were compared to those with a surgical failure using Chi-squared or t-tests for demographic and pathoanatomic variables. The surgical failures were analyzed to determine the probable cause of failure.

Results

A total of 590 patellar stabilization procedures with a minimum follow-up of 24 months (range 24–137) were assessed. There were 28 re-dislocations of the patella for a surgical failure rate of 4.8%. The only risk factor associated
with failure was generalized joint hypermobility (Beighton score >5 (2.8) compared to <4 (2.9); p<0.01). The probable causes of failure were generalized joint hypermobility and trochlear dysplasia. The most common revision procedures were isolated MPFL reconstruction revision, MPFL reconstruction revision with tibial tubercle osteotomy, and MPFL reconstruction revision with trochleoplasty.

Conclusions This study reports a surgical failure rate for patellofemoral stabilization of 4.8% in a large single surgeon cohort. The only risk factor statistically associated with graft failure was generalized joint hypermobility. Overall, patellofemoral stabilization procedures provide good clinical results with very low failure rates. This information may be used to guide surgical decision-making and patient education in this complex patient population.

**20251** PATIENT SATISFACTION AND FUNCTIONAL OUTCOMES OF MULTIPLE JOINT REPLACEMENTS: A SURVEY STUDY OF PATIENTS WHO HAVE UNDERGONE TOTAL SHOULDER, TOTAL HIP, AND TOTAL KNEE

Joseph Michael Brutico, Justin E Palm, Lasya Rangavajjula, Somnath Rao, Steven B Cohen, James X Liu. USA

10.1136/jisakos-2021-congress.125

Summary Patient satisfaction following total joint replacement of the shoulder, hip, and knee for osteoarthritis.

Data

Introduction The number of patients who will undergo joint replacement of the shoulder, hip, and knee is expected to increase drastically in the next decade. While previous studies have examined patient satisfaction and postoperative recovery following total joint arthroplasty, no study has compared patient satisfaction and postoperative recovery in a single patient who has undergone total arthroplasty of the shoulder, hip, and knee. The purpose of this study is to determine which joint arthroplasty results in the greatest improvement in quality of life and provides the least painful and difficult recovery.

Methods Patients diagnosed with arthritis who electively underwent at least one total shoulder arthroplasty (TSA), total knee arthroplasty (TKA) and total hip arthroplasty (THA) over an eighteen-year period, 2000–2018, were identified and included in our analysis. Patients were contacted over the phone to complete the Modified Harris Hip Score (mHHS), the Knee Injury and Osteoarthritis Outcome for Joint Replacement (KOOS Jr.), and the American Shoulder and Elbow Surgeons (ASES) Score as well as a custom satisfaction survey designed to elicit their subjective surgical preferences.

Results Sixty-three patients (28 males, 44.4%) met the inclusion criteria and were available for analysis. The mean age at the time of total shoulder arthroplasty was 65.9 ± 9.0 years (range, 28 - 81). The mean follow-up after TSA was 6.62 ± 4.14 years (range, 2.04 - 19.05). The mean age at time of total hip arthroplasty was 65.4 ± 9.0 years (range, 27 - 79). The mean follow-up after THA was 7.01 ± 4.08 years (mean, 2.00 - 17.95). The mean age at the time of total knee arthroplasty was 65.5 ± 8.5 years (range, 35 - 82). The mean follow-up after TKA was 7.23 ± 3.90 years (2.00 - 19.23). The average postoperative functional outcome scores for the KOOS, Jr., ASES, and mHHS were 80.59, 82.37 and 83.73, respectively. The results of our custom survey demonstrated that the majority of patients (57.1%) reported that all three surgeries had an equally dramatic improvement on their quality of life followed by TSA (14.3%) and TKA (9.9%). With regards to greatest pain relief, the majority of patients again responded that all three surgeries equally improved their pain relief (39.7%) which was closely followed by TKA (28.6%), TSA (19.0%), and THA (11.1%). Notably, TKA was reported to be the most painful and difficult surgery in terms of recovery according to 55.6% and 49.2% of the respondents, respectively. Overall, the majority of patients reported that they would still recommend all three surgeries to friends and family (52.4%) and did not regret any of the surgeries (65.1%).

Conclusion The results of our study indicate that elective multiple joint arthroplasty indicated for debilitating arthritis does in fact provide highly satisfactory subjective outcomes for the majority of patients. At the same time, our survey revealed that TKA may be uniquely challenging for patients in terms of recovery and thus closely monitored rehabilitation is warranted. Further investigation into the post-operative course and rehabilitation of these three major arthroplasties is required.

**19891** EFFECT OF AGE, GENDER, AND BMI ON INCIDENCE AND SATISFACTION OF A POPEYE DEFORMITY FOLLOWING BICEPS TENOTOMY OR TENODESIS: SECONDARY ANALYSIS OF A RANDOMIZED CLINICAL TRIAL

Peter B MacDonald, Sheila McRae, Peter Lapner, Treny M Sasyniuk, Jason A Old, Gregory Adam Strange, Jamie Dubberley, Fleur Verhulst, Jamret M Woodmass. Canada; Netherlands

10.1136/jisakos-2021-congress.126

Summary Based on secondary analysis of a randomized clinical trial comparing biceps tenotomy versus tenodesis, biceps tenodesis may be favored in younger male patients to minimize risk of deformity and risk of dissatisfaction in the appearance of the arm following surgery.

Data

Background The purpose of this study was to determine the incidence of Popeye deformity following biceps tenotomy versus tenodesis and evaluate risk factors and subjective and objective outcomes.

Methods Data for this study were collected as part of a randomized clinical trial in which patients 18 years of age or older undergoing arthroscopic shoulder surgery for a long head of the biceps tendon lesion were allocated to undergo tenotomy or tenodesis. The primary outcome measure for this secondary analysis was rate of Popeye deformity at 24-months post-operative as determined by an evaluator blinded to group allocation. Those with a deformity indicated their satisfaction with the appearance of their arm on a 10 cm visual analog scale (VAS), rated their pain and cramping, and completed the American Shoulder and Elbow Score (ASES) and Western Ontario Rotator Cuff score (WORC). Isometric elbow flexion and supination strength were also measured. Cohen’s kappa was calculated to measure interrater reliability between patient and evaluator on the presence of a deformity. Logistic regression was performed to identify predictors of presence/absence of a Popeye deformity.

Results One hundred and fourteen patients were randomly assigned to two groups of which 42 to the tenodesis group...
and 45 to the tenotomy group completed a 24-month follow-up. Based on clinical assessment, the odds of a Popeye in the tenotomy group were 4.3 times greater than in the tenodesis group (p == 0.018) with incidence of 33% (15/45) and 9.5% (4/42), respectively. Surgical technique was the only significant predictor of perceived deformity with male gender trending towards significance (OR = 7.33, 95% CI 0.867–61.906, p == 0.067). Mean (SD) satisfaction score of those with a deformity regarding appearance of their arm was 7.3 (2.6). Increasing satisfaction was correlated with increasing age (r == 0.640; p == 0.025) but there was no association with gender (r == −0.155; p == 0.527) or BMI (r == −0.221, p == 0.057). Differences in subjective outcomes were dependent on whether the Popeye was clinician- or self-assessed.

**Conclusion** The odds of developing a perceived Popeye deformity was 4.3 higher after tenotomy compared to tenodesis based on clinician assessment. Male gender was trending towards being predictive of having a deformity. Younger patients were significantly less satisfied with a deformity despite no difference in functional outcomes at 24 months. Thus, biceps tenodesis may be favored in younger male patients to minimize the risk of Popeye and the risk of dissatisfaction in the appearance of their arm following surgery.

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**20009** RELATION BETWEEN SLEEP POSITION AND ROTATOR CUFF TEARS

David P Richards, Daniel Miller, David MacDonald, Stephen D Miller, Quinn F Stewart. ¹USA; ²Canada

Summary There is a significant relationship between side sleeping and rotator cuff tears.

**Data**

**Purpose** To determine whether sleep position was related to rotator cuff pathology (partial thickness or full thickness rotator cuff tears). Type of Study: Retrospective review.

**Methods** A consecutive series of patients that met the inclusion/exclusion criteria (n=58) were seen in clinic between July 2019 and December 2019. All of these individuals had a significant partial thickness (> 50%) or full thickness rotator cuff tear determined by either ultrasound, MRI or both. All patients in this series either had an insidious onset of shoulder pain or their symptoms were related to the basic activities of daily living. Traumatic rotator cuff tears (those associated with a significant traumatic event such as shoulder instability, motor vehicle accidents, sports related injuries, etc …) were excluded. Previous shoulder surgery, recurrent rotator cuff tears and Worker’s Compensation cases were also excluded from this series. As part of the history taking process, the patients were asked what was their preferred sleeping position – side sleeper, back sleeper or stomach sleeper. A Chi-square test was conducted to determine the relationship between rotator cuff pathology and sleep position.

**Results** Of the 58 subjects, 52 of the patients were side sleepers, 4 were stomach sleepers, 1 was a back sleeper and 1 preferred all 3 positions. Statistical analysis, utilizing the Chi-square test (p < .0001), demonstrated that rotator cuff tears were most often seen in side sleepers.

**Conclusion** These results demonstrate a significant relationship between rotator cuff pathology and side sleepers.

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**20058** PREDICTIVE SIGNS OF PERIPHERAL RIM INSTABILITY WITH MAGNETIC RESONANCE IMAGING IN NO-SHIFT-TYPE COMPLETE DISCOID LATERAL MENISCUS

Yusuke Hashimoto, Kazuya Nishino, Shinya Yamasaki, Yohei Nishida, Hiroaki Nakamura. Japan

Summary A linear fluid signal at the anterior meniscus and anterior parameniscal soft-tissue edema were important signs of anterior peripheral rim instability, whereas bulging of the margin had high specificity but low sensitivity in detecting posterior peripheral rim instability on routine MRI of no-shift-type CDLM.

**Data**

**Purpose** To investigate the associations between the preoperative MRI findings suggestive of meniscal instability and the intraoperative finding of peripheral rim instability (PRI) in patients with no-shift-type complete discoid lateral meniscus (CDLM).

**Methods** The records of 47 patients diagnosed with no-shift-type CDLM who underwent arthroscopic surgery were reviewed. We evaluated MRI findings of increased intrameniscal signal, anterior parameniscal soft-tissue edema, linear fluid signal at the anterior meniscal margin, bulging of the meniscal margin, absence of popliteomeniscal fascicles, hiatus widening on routine MRI. The positive predictive value (PPV), sensitivity, and specificity of these findings in predicting PRI were calculated; PRI was further investigated according to anterior and posterior location.

**Results** Linear fluid signal at the anterior meniscal margin and bulging had high PPV, specificity (P=.001 and =.003, respectively) for overall of PRI. The presence of either anterior parameniscal soft-tissue edema or linear fluid signal at the anterior meniscal margin predicted anterior PRI with high PPV, sensitivity, and specificity. Either bulging of the meniscal margin (P=.014) had high specificity but low PPV and sensitivity in predicting posterior PRI.

**Conclusions** A linear fluid signal at the anterior meniscus and anterior parameniscal soft-tissue edema were important signs of anterior PRI, whereas bulging of the margin had high specificity but low sensitivity in detecting posterior PRI on routine MRI of no-shift-type CDLM.

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**20138** SECOND-LOOK ARTHROSCOPIC EVALUATION AND CLINICAL OUTCOMES AFTER ANATOMICAL DOUBLE-BUNDLE ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION WITH GENERALIZED JOINT LAXITY OR HYPEREXTENDED KNEE

Yasunari Oniki, Taiki Murakami, Eiichi Nakamura. Japan

Summary Generalized joint laxity and/or hyperextended knee (GJL and/or HK) affect ligamentization of the grafts and clinical outcomes after anatomical double-bundle ACL reconstruction. GJL and/or HK was placed in L group, while the other group was placed in N group. There was no significant difference between the two groups in AMB, however it was significantly poorer ligamentation in PLB in L group.

**Data** Purpose There are many factors—such as the surgical techniques used, rehabilitation protocol, and structural and physiologic characteristics of the patients—that contribute to...
success after anterior cruciate ligament (ACL) reconstruction. Recent studies have suggested generalized joint laxity (GJL) and/or hyperextended knees (HK) as risk factors for graft failure after ACL reconstruction. The aim of this study was to investigate whether GJL and/or HK affect ligamentization of the grafts and clinical outcomes after anatomic double-bundle (AD) ACL reconstruction.

Materials and Methods One hundred twenty-six patients (mean age 20.6 ± 9.3 years) underwent ADACL reconstruction using semitendinosus tendon autografts. All operations were performed by one experienced surgeon. These patients consented to remove the post screw that fixed the grafts onto the tibia and to a second-look arthroscopic examination. The mean follow-up period after ACL reconstruction was 14.8 ± 3.6 months. Patients were divided into two groups. One patient group that had GJL and/or HK was placed in the laxity group (L group, n = 35), while the other group was placed in the normal group (N group, n = 91). The focus of the second-look arthroscopy was on graft thickness, apparent tension, and synovium coverage of the anteromedial bundle (AMB) and the posterolateral bundle (PLB) graft. Each bundle was evaluated as excellent, fair, or poor according to Hokkaido university classification. Functional evaluations involved instrument-measured side-to-side difference of anterior laxity (KS), peak isokinetic (60°/s) and isometric (80° of flexion) torque of the quadriceps and hamstrings, and one-leg hop test and heel height difference (HHD). Subjective evaluations included the International Knee Documentation Committee (IKDC) subjective score and Lysholm score. Results The second-look arthroscopic evaluation of the AMB graft revealed no significant difference between each group (P = 0.26). However, the PLB graft showed an excellent rating in 62.9%, a fair in 25.7%, and a poor in 11.4% of the L group; it also showed an excellent rating in 82.4%, a fair in 17.6%, and a poor in 0% of the N group. The L group (P < 0.01) showed statistically significant results. There was no significant difference between the two groups in KS (P = 0.74), mean peak isokinetic torque (quadriceps: P = 0.56, hamstrings: P = 0.44), isometric torque (quadriceps: P = 0.80, hamstrings: P = 0.52) torque, HHD (P = 0.49), one-leg hop test (P = 0.29), the IKDC subjective score (P = 0.31) or Lysholm score (P = 0.48).

Conclusion Our study showed poor ligamentization of the PLB after ADACL reconstruction due to GJL and/or HK. In the case with GJL and/or HK, rehabilitation management and the selection of surgical procedure may lead to more success graft ligamentization.

Summary The results of our study demonstrate that arthroscopic bridging reconstruction results in improved patient outcomes in both the primary and revision setting with low re-tear rates.

Data Background Large or massive rotator cuff tears make up between 10–40% of all rotator cuff tears, yet there is no agreement on the best treatment. Previous studies have shown that acellular human dermal allograft (AHDA) can be used for bridging reconstruction with positive patient outcomes. The use of this surgical technique has not been studied in the primary or revision surgical setting. OBJECTIVE: To compare the clinical and radiographic outcomes of patients who received primary or revision arthroscopic bridging reconstruction.

Methods This study is a retrospective review of a sequential series of patients who underwent arthroscopic bridging reconstruction (ABR) using AHDA by the primary author (IW). A total of 130 patients underwent ABR between 2010 and 2018. The inclusion criteria were patients with completed Western Ontario Rotator Cuff (WORC) questionnaire, Disabilities of the Arm, Shoulder, and Hand (DASH) score, or both pre-operatively and at multiple post-operative timepoints. Patients with missing WORC scores were excluded from the study. Eighty-three patients were included following chart review. Patients with available post-operative MRIs were also used for radiological assessment by an independent MSK-trained radiologist. Post-operative MRIs were reviewed to assess for graft integrity and changes to rotator cuff muscle atrophy (using the Warner classification) and fatty degeneration (using the Goutallier classification).

Results There were 46 patients who received primary ABR and 37 who received revision ABR. Forty-eight patients had a post-operative MRI available for review (Primary: 25; Revision: 23). The demographics are summarized in Table 1. Both groups showed a significant improvement in WORC score post-operatively (p<0.001). Primary ABR resulted in higher post-operative WORC scores as compared to revision ABR (p=0.015; Figure 1). The incidence of complete re-tears in the primary group was 8% and 17.4% in the revision group. More than 35% of patients in the primary group showed improvement in fatty infiltration of the infraspinatus and supraspinatus muscles. There was a higher progression in muscle atrophy in the revision group as compared to the primary group (74% and 30%, respectively).

Conclusion Arthroscopic primary arthroscopic bridging reconstruction for large/massive rotator cuff tears using acellular human dermal allograft had better improvement in their WORC scores compared to revision group at the final follow-up. Although the revision group had improved at the two-year follow-up, these changes in WORC score were not sustained at the final follow-up while the improvements were maintained for the primary group. The primary group had a smaller re-tear rate, better fatty infiltration and muscle atrophy as compared to the revision group. This suggests that primary bridging reconstruction provides better outcomes than a revision surgery.

Summary The Krackow stitch is the superior technique for maximizing strength, while minimizing suture pull through, construct elongation, or graft compression.
Abstracts

19904

COMPARISON OF PULL-OUT STRENGTH FOLLOWING LIGAMENTUM TERES RECONSTRUCTION IN THE HIP: PEEK CORKSCREW SUTURE ANCHOR VERSUS CORTICAL BUTTON FIXATION: A CADAVERIC STUDY

Ajay C Lall, Hari Krishna Ankem, Samantha Diulus, Benjamin G Domb. USA

Summary This cadaveric study highlighted the differences in pullout strength between two methods of graft fixation over the acetabular fossa that are commonly utilized in LT reconstruction.

Data

Introduction Soft tissue repair and reconstruction commonly utilize the Krackow stitch and commercially designed whipstitch techniques, and both have been biomechanically evaluated. Perpendicular multi-planar fixation may improve the biomechanical properties compared to the commonly used techniques, as has been demonstrated with fracture fixation. The purpose of this study was to compare the elongation, yield load, ultimate failure, stiffness, and mode of failure of the traditional Krackow stitch, whipstitch, and a multi-planar perpendicular whipstitch. The hypothesis was that the multi-planar technique would demonstrate superior biomechanical properties over the standard techniques.

Materials and Methods

Thirty tibialis anterior cadaveric tendons were randomly assigned into 3 groups of 10. Three suturing techniques: the Krackow stitch (KS), standard commercial non-locking whipstitch (WS), and a novel, multi-planar perpendicular whipstitch (MP) were performed. The MP stitch was performed with orthogonal throws starting right to left, front to back, left to right, and back to front. Each technique used 4 passes of Number 2 FiberWire spaced 5 mm apart and ending 10 mm from the end of the tendon. Tendons were secured to a custom clamp and the other end sutured. Tendons were pre-loaded to 5N, pre-tensioned to 50N at 100 mm/min for 3 cycles, returned to 5N for 1 minute, cycled from 5N to 100N at 200 mm/min for 100 cycles, and then loaded to failure at 20 mm/min. Elongation measurements were recorded after pre-tensioning and cycling, and recorded across the suture-tendon interface as well as from the base of the suture-tendon interface to markings on the suture limbs (total construct elongation). One-way analyses of variance were performed, with Bonferroni post hoc analysis when appropriate.

Results

There were no differences in cross-sectional area or stiffness among the 3 groups (p>0.05). The ultimate load for WS (183.33±57.44N) was significantly less compared to both MP (270.76±39.36N) and KS (298.90±25.94N) (p=.001). All 3 techniques were noted to have a decrease in tendon length at the suture-tendon interface during testing, termed compression. There was significantly more compression at the suture-tendon interface for WS compared to KS (p=.006). There was significantly less total construct elongation for KS compared to WS and MP for total displacement measured from pre-tensioning to the end of cycling (p<.001).

Conclusion

Based on these results, the Krackow stitch is the superior technique for maximizing strength, while minimizing suture pull through, construct elongation, or graft compression. If using the whipstitch for ease of use, the multi-planar perpendicular technique offers improved biomechanical properties over the standard whipstitch technique.

10.1136/jisakos-2021-congress.132
CLINICAL OUTCOMES AND COMPLICATIONS OF PERCUTANEOUS ACHILLES REPAIR SYSTEM VERSUS ISOLATED ENDOSCOPIC FLEXOR HALLUCIS LONGUS TENDON TRANSFER IN THE MANAGEMENT OF ACUTE ACHILLES TENDON RUPTURES. A RETROSPECTIVE CASE SERIES REPORT WITH A MINIMUM OF 30 MONTH

Nasef Mohamed N Abdelatif, Jorge Pablo Batista. 1Egypt; 2Argentina

10.1136/jisakos-2021-congress.133

Summary The current study demonstrated satisfactory and almost equally comparable results with minimal complications in patients with acute achilles ruptures when treated by both methods.

Data

Background The definitive management for Acute Achilles tendon ruptures (AATR) is yet to reach a final consensus. Both percutaneous and endoscopically assisted methods have been reported to produce good results in the surgical management of this injury. The aim of this study was to compare the clinical results between a percutaneous method and a recently described isolated endoscopically assisted Flexor hallucis longus (FHL) transfer method as surgical means of management in patients with acute Achilles tendon ruptures at a minimum follow-up period of thirty months.

Methods One hundred and seventeen patients with an average age of 36.25 years were primarily included in the current study. These were divided into two groups: patients who underwent percutaneous repair using PARS® instrumentation system (PARS Group), and another group who underwent isolated endoscopic FHL transfer (FHL transfer Group) for treatment of AATR. The followup period of both study groups was for a mean of 42.54 months. Overall, three patients were lost in followup. Ultimately the PARS group consisted of 59 patients and the FHL transfer group of 58 patients. There were no statistical differences in demographics between both these study groups. Both groups received the same postoperative rehabilitation protocol. Both groups were clinically evaluated using AOFAS Ankle-hindfoot score, ATRS, and ATRA measures. In addition, ankle plantarfexion power, FHL dynamometry and Tegner activity levels were also documented for all patients. Return to previous levels of activities was also documented for all included cases.

Results At 30 months postoperatively, ATRS, AOFAS, ATRA, ankle plantarfexion strength, and Tegner activity scores showed no statistical significance across both study groups. Overall complications were reported in 6 patients in the FHL group (10.3%) and in 8 patients in the PARS group (13.6%). MRI performed at a minimum of thirty months postoperative showed a homogenous continuous achilles tendon signal for 43 patients, and heterogenous signal intensity in 13 patients (23.21%). Ultimately, 54 patients and 53 patients returned to their same level of activity in the FHL (93.1%) and PARS groups (89.8%) respectively. No patients reported any great toe complaints or symptomatic deficits of flexion strength. No major neurovascular or skin complications were encountered.

Conclusion The current study demonstrated satisfactory and comparable results with minimal complications when comparing the utilization of isolated endoscopic FHL tendon transfer or percutaneous PARS® achilles tendon repairs in the surgical management of acute Achilles tendon ruptures.

PREOPERATIVE MENISCAL EXTRUSION PREDICTS UNSATISFACTORY CLINICAL OUTCOMES AND PROGRESSION OF OSTEOARTHRITIS AFTER ISOLATED PARTIAL MEDIAL MENISCECTOMY: A FIVE-YEAR FOLLOW-UP STUDY

João V Novaretti, Diego C Astur, Elton Luiz Batista Cavalcante, Camila Cohen Kaleka, Joicemar T Amaro, Moises Cohen. Brazil

10.1136/jisakos-2021-congress.134

Summary Patients with preoperative meniscal extrusion of 2.2 mm or greater had unsatisfactory clinical outcomes and progression of osteoarthritis after isolated partial medial meniscectomy at a minimum of five years follow-up. Higher BMI and horizontal and root tears were associated with greater preoperative meniscal extrusion.

Data

The objective of this study was to examine the association between preoperative meniscal extrusion of patients undergoing partial medial meniscectomy with clinical outcomes and progression of osteoarthritis and to determine the extent of meniscal extrusion associated with unsatisfactory clinical outcomes and progression of osteoarthritis. Ninety-five patients who underwent partial medial meniscectomy with a minimum follow-up of five years were retrospectively reviewed. Preoperative meniscal extrusion was evaluated with MRI. Patients were assessed preoperatively and postoperatively with Lysholm and IKDC subjective scores for clinical outcomes and with IKDC radiographic scale for osteoarthritis. An ANOVA was used to analyze the variations in meniscal extrusion and the clinical and radiological outcomes. A regression analysis was performed to identify factors that affect preoperative medial meniscus extrusion and that influence results after partial meniscectomy. An optimal cutoff value for meniscal extrusion associated with unsatisfactory clinical outcomes and progression of osteoarthritis was established. Significance was set at P<.05. The mean ± SD preoperative and postoperative Lysholm scores were 59.6 ± 13.5 vs. 83.8 ± 13.1 (P < .001) and the mean preoperative and postoperative IKDC subjective scores were 59.4 ± 16.8 vs. 82.0 ± 15.8 (P < .001). Meniscal extrusion greater than 2.2 mm (sensitivity, 84%; specificity, 81%) and 2.8 mm (sensitivity, 73%; specificity, 85%) was associated with unsatisfactory (poor/fair) Lysholm and IKDC subjective scores, respectively. The progression of osteoarthritis, characterized as a change of at least one category on the IKDC radiographic scale, occurred when meniscal extrusion was greater than 2.2 mm (sensitivity, 63%; specificity, 75%). Patients with higher BMI had significantly greater meniscal extrusion that patients with normal BMI (P < .001). The medial meniscus was more extruded in patients with horizontal and root tears. In conclusion, patients with preoperative meniscal extrusion of 2.2 mm or greater had unsatisfactory clinical outcomes and progression of osteoarthritis after partial medial meniscectomy at a minimum of five years follow-up. Higher BMI and horizontal and root tears were associated with greater preoperative meniscal extrusion.
### Abstracts

#### 20086 MANAGEMENT OF ACUTE KNEE DISLOCATIONS: A GLOBAL SURVEY OF ORTHOPAEDIC SURGEONS’ STRATEGIES

Santa-Marie Verter, Roopam Dey, Vikas Khanduja, Richard P von Bornmann, Michael Held. South Africa; UK

**Purpose** The purpose of the current study is to determine the impact of femoral version, combined version and impingement index on patient reported outcomes after primary hip arthroscopy for FAI.

**Methods** A retrospective chart review of prospectively collected data was conducted from 2010–2016 to identify consecutive patients who underwent primary hip arthroscopy for treatment of FAI. Inclusion criteria are pre-operative CT scan, Tonnis grade 1 degenerative changes, and minimum 1-year follow-up. Demographics, CT measurements (femoral version, acetabular version, alpha angle, and lateral center edge angle), and patient-reported outcomes scores (mHHS, HOS ADL, HOS Sport, QOL), were evaluated. McKibbin and impingement indices were calculated from CT measurements.

**Results** A total of 456 hips (200 males, 256 females) met inclusion criteria. The mean age at time of surgery was 28.2 years (±10). Average follow-up was 2.6 years (range 23–59 months). The cohort experienced clinical improvement (p<0.001) in all patient-reported outcome measures. The mean improvement was 21.4 points for mHHS, 17.4 for HOS ADL, 29.5 for HOS Sport, and 34.3 for QOL. There was no significant difference in outcomes scores when stratified by femoral version (<5, 5–20, >20), including at the extremes of femoral version (<5, >30). There was also no significant difference in outcomes scores when patients were stratified by McKibbin Index (<25, 25–40, >40). The net change in mean HOS Sport for impingement index >75 was also significantly lower than any other category (14.5 (>75) vs. 28.1 (45–75) vs. 35.2 (<45)).

**Conclusion** Clinically significant improvements can be expected for all femoral version values when a thoughtful algorithm is employed for indicating patients for hip arthroscopy with version abnormalities. However, patients with significant femoral retroversion and large cam lesions may experience less overall improvement compared to patients with normal or increased version. The impingement index may be a valuable tool for predicting outcomes of primary hip arthroscopy for FAI.

#### 19858 INTRODUCING THE IMPINGEMENT INDEX: A STUDY OF THE COMBINED EFFECT OF ALPHA ANGLE AND FEMORAL VERSION ON OUTCOMES AFTER HIP ARTHROSCOPY FOR FAI

Danyal H Nawabi, Ronak M Patel, Ryan S Selley, Matthew S Dooley, Stephanie S Buza, Anil S Ranawat, Bryant T Kelly. USA

**Summary** This questionnaire based study shows that treatment of knee dislocations varied significantly based on the economic status of the country.

**Data**

**Purpose** The aim of this study was to compare the management approach of acute knee dislocations (AKDs) by orthopaedic surgeons from nations with different economic status.

**Methods** A survey sent to members of the Societe Internationale de Chirurgie Orthopedique et de Traumatologie (SICOT) compared different management strategies for acute multiligament knee injuries (aMLKIs). These were compared after categorising surgeons into developed economic nations (DEN) and emerging markets and developing nations (EMDN) based on the gross domestic product (GDP) per capita.

**Results** 138 orthopaedic surgeons from 47 countries participated in this study. DEN surgeons had more years of experience and were older (p<0.05). Surgeons from EMDN preferred conservative management and delayed reconstruction with autograft (p<0.05) if surgery was necessary. Surgeons from DEN favoured early, single stage arthroscopic ligament reconstruction. Significantly more EMDN surgeons preferred clinical examination (p<0.05) and duplex doppler scanning (p<0.05) compared to DEN surgeons. More surgeons from EMDN did not have access to a physiotherapist for their patients.

**Conclusions** Treatment of aMLKIs varied significantly based on the economic status of the country. In EMDN, aMLKIs are often treated conservatively, ligament surgery is often delayed and staged, alternative vascular assessment methods are more commonly used, and access to physiotherapy is challenging. This calls for adjusted guidelines when treating patients in areas of low resource setting.

#### 20093 EVALUATING THE EFFICACY OF MICRO-FRAGMENTED ADIPOSE TISSUE AND INTRA-ARTICULAR CORTICOSTEROID INJECTIONS FOR SYMPTOMATIC KNEE OSTEOARTHRITIS: A RANDOMIZED, PLACEBO CONTROLLED STUDY. PRELIMINARY RESULTS

Dustin Richter, Joshua Harrison, Lauren Faber, Samuel Schnader, Anil K Shetty, Yiliang Zhu, Carina Suki Pierce PA-C, Robert C Schenck. USA

**Summary** For the treatment of symptomatic knee osteoarthritis, preliminary data show that the microfragmented adipose tissue injection group demonstrated consistently the largest improvement in outcome scores at 6–12 month follow-up compared with the placebo and corticosteroid groups.

**Data**

**Objectives** Knee osteoarthritis (OA) is a debilitating joint disorder affecting tens of millions of people worldwide. Non-operative treatment options have variable efficacy and none stop or reverse the progression of OA. Furthermore, there is a lack of literature supporting the efficacy of intra-articular corticosteroids, one of the most common treatment options. The purpose of this study is to evaluate pain relief and functional improvement after knee OA treatment with a novel therapeutic intervention, microfragmented adipose tissue, in
The Effect of Lateral Extra-Articular Tenodesis on Medial and Lateral Meniscus Loading in Response to Simulated Tests of the Pivot Shift and Anterior Laxity

Methods Patients with radiographic knee OA, a minimum pain score of 3 on the visual analog scale (VAS), and no prior knee injection were eligible for inclusion. Patients were randomized to one of three treatment groups: microfragmented adipose tissue (MFAT), corticosteroid (CS), or saline placebo (P) injection. Both the practitioner and patient were blinded to the injection in the CS and P groups. A sham liposuction procedure was not performed. For the MFAT group, both an orthopaedic surgeon and plastic surgeon performed the liposuction portion together under local anesthesia. The VAS pain scale, Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and the Knee Injury and Osteoarthritis Outcome Score scale (KOOS) were recorded pre-procedure and at specified time points post-procedure up to one year.

Results A total of 62 patients have been enrolled (92% follow-up), with a study goal of 75 total patients to achieve power. Patients were randomized to: MFAT = 22, CS = 21, P = 19. A preliminary analysis of these 62 patients was completed to compare post-procedure outcomes to pre-procedure pain and functionality. The WOMAC score improved in the MFAT group by a mean of 30 points at 1 year follow-up, compared to 10 in the CS and 11 in the P groups (p = 0.01). The KOOS pain score improved in the MFAT group by a mean 32 points at 1 year follow-up, compared to 8 in the CS and 11 in the P groups (p=0.03). VAS scores improved across all groups with average changes: MFAT 3.4, CS 1.5, P 1.4 (p = 0.14). When a linear mixed effects model was used to quantify changes in outcomes over the 1 year post-procedure period, the MFAT group demonstrated a consistently positive improvement across all five outcomes measures, whereas no consistent trend was noted in the P group and a negative trend was noted in the CS group after the initial 2 week improvement. Patients with more severe radiographic knee OA had poorer outcomes in the MFAT group.

Conclusions Nonoperative knee OA treatment options are limited with variable efficacy. It is critical to evaluate patient outcomes rigorously prior to instituting novel procedures or treatments. Preliminary data show the microfragmented adipose tissue injection group demonstrated consistently the largest improvement in outcome scores at 6–12 month follow-up compared with the placebo and corticosteroid groups.
ACL reconstruction and raises significant concerns regarding the reliability and validity of methods used to determine Return To Sport in ACL reconstruction literature

Data

Background Return to sport (RTS) after ACL reconstruction (ACLR) has been recognized as an important outcome, which is associated with success of the surgery and has been increasingly reported on in recent years based on non-standardized evaluation methods.

Purpose To assess the methods used to determine return to sport after ACLR in the published literature, report on variability of methods and evaluate their strength in establishing accurate RTS data. Study design: Systematic review of methodology.

Methods Electronic databases (PubMed, Cochrane Library and Embase) were searched via a defined search strategy with no limits, to identify relevant studies from January 2008 to January 2020 for inclusion in the review. A priori defined eligibility criteria included studies specifically measuring and reporting on return to sport after ACLR with a clear methodology. Each included study was primarily assessed for the methodology used to determine return to sport and level of sport.

Results 145 studies were included. Among the excluded studies, 54 studies reported on RTS after ACLR, but were not included due to unclear RTS evaluation method used. Of the included studies, five studies (3%) were level of evidence 1 and sixty-six studies (46%) were level of evidence 4. Thirty-six studies (25%) reported on return to a specific sport and tenor of evidence 2. Two categories of successful general RTS, four definition categories of successful return to pre-injury level of sport and four categories of different methods used to determine RTS were established. The most common method used to evaluate RTS was a non-validated study specific questionnaire (61 studies, 42%), which was administered in various ways to the patients. Time of RTS assessment was variable and ranged between 6 months to 27 years post-surgery.

Conclusion This review demonstrates high variability in defining, evaluating and reporting patterns of RTS following ACLR. The findings of this study raise concerns regarding the reliability and validity of methods used to evaluate RTS. Our findings highlight the challenges in interpreting and using RTS data reported in literature and should serve to caution clinicians to carefully evaluate the methods used in studies reporting on RTS after ACLR. Future research should focus on establishing standardized and validated methods for RTS evaluation.

Summary TXA did not decrease the incidence of hemarthrosis in those undergoing ACLR.

Data

Purpose The purpose of this double-blinded randomized controlled trial was to evaluate the use of intravenous (IV) tranexamic acid (TXA) in patients undergoing primary bone-patella tendon-bone (BTB) ACLR with regard to post-operative hemarthrosis, pain, opioid consumption, quadriceps atrophy and activation.

Methods A controlled, randomized, double-blinded trial was conducted in 110 patients who underwent ACLR with BTB autograft. Patients were equally randomized to the control and experimental groups. The experimental group received two 1-gm boluses of IV TXA, one prior to tourniquet inflation and one prior to wound closure; the control group did not receive TXA. If a clinically significant hemarthrosis was evident, the knee was aspirated, and the volume of blood (ml) was recorded. Additionally, perioperative blood loss (ml); Visual Analog Scale (VAS) on postoperative days (POD) 1-7 and post-operative weeks (POW) 1, 6 and 12; postoperative opioid consumption POD 1-7; range of motion (ROM) and ability to straight leg raise (SLR) at POD 1, 6, 12; and pre and postoperative thigh circumference ratio (TCR).

Results There was no significant difference in perioperative blood loss between the TXA and control groups (32.5ml v. 35.6ml, p=0.47). The TXA group had 23 knees aspirated; control group had 26 knees aspirated (p=0.56). No significant difference seen in postoperative hemarthrosis volume with IV TXA compared to those without (26.7ml v. 37.3ml, p=0.12). There was no significant difference in VAS score between the two groups (p=0.15), additionally, there was no difference in postoperative opioid consumption (p=0.33). There was no significant difference in ROM or ability to SLR, or post-operative TCR (p > 0.05 for all).

Conclusion IV TXA in patients who undergo ACLR with BTB autograft does not significantly impact perioperative blood loss, postoperative hemarthrosis, or postoperative pain levels. Additionally, no significant differences were seen in early postoperative recovery regarding ROM or quadriceps reactivation.

Summary Biceps tenodesis is a reliable alternative to arthroscopic repair, with a lower rate of revision surgery, and excellent patient reported outcomes.

Data

Purpose The purpose of the current study is to compare the outcomes of BT to AR for SLAP tears in patients under the age of 30. Our hypothesis was that there would be no statistically significant difference in outcomes between the two procedures. STUDY DESIGN: Retrospective Comparative Study; Level of evidence III

Methods A retrospective review of patients who underwent either isolated BT or AR for the diagnosis of a SLAP tear was performed. Patients with a follow-up duration of <24 months were excluded. The American Shoulder & Elbow Surgeons
Abstracts

TRANEXAMIC ACID HAS NO EFFECT ON POST-OPERATIVE HEMORRHAGE OR PAIN CONTROL FOLLOWING TIBIAL TUBERCLE OSTEOTOMY: A DOUBLE-BLINDED RANDOMIZED CONTROL TRIAL

Anna Blaeser, Eoghan T Hurley, Jordan W Fried, Kirk Anthony Campbell, Laith M Jazrawi, Eric Jason Strauss, Michael J Alaia. USA

Summary TXA did not decrease the incidence of haemorrhosis in those undergoing TTO.

Data

Background Tranexamic acid (TXA) is an antifibrinolytic, commonly utilized in orthopedic procedures for the purpose of reducing perioperative bleeding and need for transfusion.

Purpose To evaluate if IV TXA for tibial tubercle osteotomy (TTO) could reduce perioperative blood loss or postoperative intra-articular hemorrhosis without postoperative drains.

Methods A double-blind randomized controlled trial was conducted in patients who underwent TTO. Forty patients were randomized equally to the control and experimental groups. The experimental group received two 1-gram boluses of IV TXA, one prior to tourniquet inflation and one prior to wound closure; the control group did not receive TXA. The following outcomes were documented: perioperative blood loss (cc), postoperative hemorrhosis (cc), Visual Analog Scale (VAS) on postoperative days (POD) 1-7 and postoperative visits (POV) 1-3, postoperative opioid consumption POD 1-7 (morphine mg equivalents), range of motion (ROM) and ability to straight leg raise (SLR) at POV 1-3, and pre- and postoperative thigh circumference ratio (TCR). Study Design: Randomized Controlled Trial.

Results There was no significant difference found in perioperative blood loss between experimental and control groups (64.25cc v. 60cc, p=0.38). No statistical significance was observed in patient demographic characteristics. All patients were available at the first POV for hemarthrosis evaluation. There were 3 knees aspirated in each of the groups; no significant difference was found in postoperative hemorrhosis with use of IV TXA (3.3cc v. 14cc, p=0.09). Significantly reduced levels of pain were seen throughout the first postoperative week in both the experimental and control groups (p=0.022, p<0.0001), but no significant reduction in VAS score between the two groups (p=0.15). No significant difference was noted in post-operative opioid consumption by the end of the first week (120.21mg v. 120.58mg, p=0.5). No significant difference in ROM or ability to SLR at all three postoperative visits. No significant difference in pre- nor post-operative TCR (p=0.15, p=0.70).

Conclusion In patients undergoing TTO, intravenous TXA does not significantly impact perioperative blood loss, postoperative hemorrhosis, or postoperative pain control. Additionally, IV TXA did not impact ROM, ability to SLR, or TCR following TTO.
players who underwent ACL reconstruction, 12% of the male players and 11.5% of the female players progressed to the elite level at the age of 21 years compared with 10.3% of the men and 11.1% of the women among the uninjured players. **Conclusion** ACL reconstructive surgery in talented youth soccer players offers them the opportunity to become elite players as seniors and permits an activity level on a par with that of their uninjured peers. However, almost 1 in 4 requires further ACL surgery, so the players’ future knee health should be considered when deciding on a return to play.

### 20161 INFLUENCE OF STEM CELLS APPLICATION DURING SURGERY ON THE IMPROVEMENT OF VERTICAL JUMP IN PATIENTS AFTER ACHILLES TENDON RUPTURE

Magdalena Syrek, Urszula E Zdanowicz, Robert Smigielski, Michal Staniszewski. Poland

**Summary** Stem cells application in Achilles tendon reconstruction can accelerate rehabilitation programme’s progress resulting in better values of jump parameters after one year. **Data** This study was conducted to evaluate results of stem cells application during the Achilles tendon reconstruction. The evaluation was based on the measurements of vertical jump six months and one year after the surgery. The evaluated group included 60 patients (mean age: 37±5.1 years) who had undergone Achilles tendon reconstruction. Achilles tendon reconstruction procedures aimed at the restoration of the tendon’s three-bundle structure and anatomical rotation of its fibres stemming from the gastrocnemius and soleus muscles. Patients were randomly divided into two groups (30 persons each); one undergoing a standard surgical procedure (G1), in the second group (G2) the same procedure was extended by the direct application of autologous mesenchymal stem cells (MSC) harvested from the subject’s fat tissue. All patients started physiotherapy the next day postop and continued (tri-weekly) for about 6 months (avg. 6.1 months). All patients underwent a uniform rehabilitation protocol including concentric, eccentric and balance exercises. The objective evaluation was based on unilateral countermovement jumps (CMJ). Maximum Height (HVmax) and maximum Power (Pmax) was recorder on the force plate. Measurements were made 6 months after the surgery and repeated a year later to establish patients’ progress. The comparison of differences between the groups was performed with the U Mann-Whitney test. The normality of distribution was evaluated with the Shapiro-Wilk test. For both the test significance was set at \( p < 0.05 \). For the analysis of the test results, a statistical package by StatSoft, Inc. (2011) STATISTICA, v.10 was used. Testing performed 6 months postop has shown lower HVmax and Pmax in the operated limb compared to the healthy leg in both testing groups. After one year, statistically significant differences of both parameters were still visible in G1 group (\( p <0.05 \)). In G2 group, only HVmax remained significantly lower. Analysis of the operated limb in both groups conducted one year after surgery in comparison to 6 months results, has shown significantly improved Pmax value in G2 group. The use of stem cells during the reconstruction of the Achilles tendon increased the maximum power during the vertical jump of the operated limb, indicating that the use of stem cells may improve the tendon function and the patient’s faster return to pre-injury activity.

### 20062 AUTOLOGOUS SEMITENDINOSUS TENDON GRAFT AS MENISCAL TRANSPLANT – A PILOT STUDY

Erik Ronnblad, Pierre Rotzius, Karl Eriksson. Sweden

**Summary** Autologous semitendinosus tendon could potentially be an option for meniscus substitution in selected cases. **Data** **Introduction** Meniscectomy result in poor knee function and increased risk for osteoarthritis. Meniscal allograft transplantation is not widely used due to costs and availability. The semitendinosus tendon (ST) has the potential to remodel and revascularize in an intraarticular environment such as ACL reconstruction. The objective for this pilot study was to investigate whether the ST graft could function as a meniscal transplant. **Material and methods** The ST was doubled and sutured with running sutures and pull-out sutures in each end. Bone tunnels were used for root anchorage and the graft was sutured with all-inside, inside-out and outside-in technique. The pull-out sutures were fixed over a button. Partial weight bearing was allowed with limited range of motion in a brace for the first six weeks. Evaluation was assessed using clinical examination, radiology and patient reported outcome. Results A total of seven patients have been included between January 2018 and June 2020. Six medial transplants and one lateral transplant were performed. Mean age was 29 years. Four patients had completed the 12-month follow-up. Improvements were noted for IKDC Global Score \((p=0.004)\), KOOS pain subscale \((p=0.038)\) and Lysholm \((p=0.005)\). MRI indicate that the transplant became more wedge-like with visible roots and minor protrusion. The results will be updated accordingly before the presentation. **Conclusion** Even though this is primarily a technical report the follow-up data indicate that the transplant survives and adapts in shape and capabilities to an original meniscus. There were no adverse events and the patients seem to improve in terms of pain and quality of life.

### 19780 TRAUMATIC HIP DISLOCATIONS IN THE PEDIATRIC PATIENT: INJURY PATTERNS, NEED FOR AXIAL IMAGING, OUTCOMES, AND SELECTIVE HIP ARTHROSCOPY

Samuel C Willimon, Anthony Egger, Crystal A Perkins. USA

**Summary** Post-reduction advanced imaging following traumatic hip dislocations demonstrated posterior wall fractures in 78% and incarcerated fragments in 30%, and selective hip arthroscopy for the treatment of loose bodies and labral pathology was associated with excellent outcomes. **Data** **Introduction** Traumatic hip dislocations are uncommon injuries in the pediatric population. Injury recognition and prompt closed reduction is standard of care. The purpose of this study is to describe injury patterns, treatment (including hip arthroscopy), and patient reported outcomes of traumatic hip dislocation in pediatric patients. **Methods** A retrospective review was performed of all patients less than 18 years of age treated for a traumatic hip
Osteochondral Lesions of the Talus: Factors Predictive of Cartilage Integrity

Crystal A Perkins, John Erickson, Kiery Braithwaite, Michael T Busch, Samuel C Willimon. USA

Summary Physseal status, radiographic grade, MRI grade, and cartilage integrity on MRI are independent predictors of cartilage integrity at the time of ankle arthroscopy for patients with OLTs.

Data Background The integrity of articular cartilage in patients with osteochondral lesions of the talus (OLTs) guides treatment. The ability to predict cartilage integrity in OLTs, as previously published for OCD of the knee, would be beneficial. The purpose of this study is to evaluate the association of radiographic and MRI findings and articular cartilage integrity at the time of ankle arthroscopy for OLTs.

Methods A single-institution retrospective review identified patients 19 years of age and younger with operative treatment of OLTs from 2010–2017. Demographics and intra-operative findings at the time of ankle arthroscopy were identified by chart review. Radiographs were assessed for physis status, OLT location, and Berndt and Hardy grade. MRIs were reviewed for OLT size and location, modified Kramer grade, and cartilage status.

Results 53 patients with 54 OLTs and a mean age of 13.6 years (range 7–19 years) were included. OLTs were located in the posteromedial talus in 39 patients (72%). Physseal status was closed/closing in 32 patients (59%) and open in 22 patients (41%). On MRI, the cartilage was predicted to be disrupted in 40 patients (74%) and intact in 14 patients (26%). At the time of ankle arthroscopy, the cartilage was found to be disrupted in 38 OLTs (70%) and intact in 16 OLTs (30%). MRI classification of cartilage integrity was 95% sensitive and 75% specific for arthroscopic integrity, with 11% misclassification. In the 16 patients less than 13 years, MRI perfectly predicted arthroscopic cartilage integrity. In patients with open physis, MRI sensitivity was 92% and specificity 100%. In patients with closing/closed physis, MRI sensitivity was 89% and specificity 50%. Receiver operator curve characteristics of a model to predict arthroscopic cartilage integrity combining MRI cartilage integrity, physisal status, and radiographic grade has an AUC of 0.953.

Conclusions Physseal status, radiographic grade, MRI grade, and cartilage integrity on MRI are independent predictors of cartilage integrity at the time of ankle arthroscopy for patients with OLTs. Overall, MRI has 95% sensitivity and 75% specificity for cartilage integrity at the time of arthroscopy, which improves to near 100% sensitivity and specificity in patients with open physis. A model combining MRI cartilage integrity, physisal status, and radiographic grade has the highest predictability of intra-operative cartilage integrity.

20217 Does Oral Stain Use Affect Rotator Cuff Healing or Muscle Fatty Atrophy After Rotator Cuff Repair?

Priyadarsi Amit, Jan Herman Kuiper, Martyn Snow. UK

Summary Statin do not have any effect on rotator cuff healing or fatty atrophy of cuff muscles after repair.

Data Objectives: Statin use has been linked to structural and vascular changes in tendon and therefore there are concerns over a higher incidence of re-tear after repair. The objective of our study was to evaluate the effect of statins on rotator cuff healing following repair and also on the progression of fatty atrophy (Goutallier grade).

Methods A cohort of 77 patients undergoing rotator cuff repair for isolated posterior/superior rotator cuff tear were prospectively evaluated. Pre-operative details such as demographic profile and statin use were collected. Patient reported outcome measure (PROM) scores including Constant score, American shoulder and elbow surgeons (ASES) score and Disability of arm, shoulder and hand (DASH) score were collected preoperatively and at one year. All the patients had

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Methods A cohort of 77 patients undergoing rotator cuff repair for isolated posterior/superior rotator cuff tear were prospectively evaluated. Pre-operative details such as demographic profile and statin use were collected. Patient reported outcome measure (PROM) scores including Constant score, American shoulder and elbow surgeons (ASES) score and Disability of arm, shoulder and hand (DASH) score were collected preoperatively and at one year. All the patients had
MRI pre-operatively and at one year to quantify rotator cuff healing based on the Sugaya classification and Goutallier staging of fatty atrophy. All MRI’s were assessed by a blinded radiologist. Intra-operative details such as cuff tear size, method of repair (single row or double row), and concomitant procedures (biceps tenotomy/tenodesis, acromio-clavicular joint excision) were noted. Statistical analysis was performed with student t-test to assess improvement in PROM score. Spearman correlation test was used to evaluate association of statin with cuff healing and progression in fatty atrophy.

**Results** Our study population included 42 males and 35 females with mean age 60.97±7.0 (range 45–76) years. 38 patients had previous history of hyperlipidemia and were on a statin drug. 19 patients had single row and 58 had double row repair. Mean pre and 12-months post-operative PROM scores were 36.2±20.5 and 76.7±23.6 (ASES), 32.8±19.8 and 67.0±20.5 (constant), and 63.0±15.7 and 23.7±22.9 (DASH score) in statin group. Mean pre and 12-months post-operative PROM scores were 37.5±16.3 and 76.9±25.7 (ASES), 34.6±18.6 and 74.8±19.6 (constant), and 58.8±18.7 and 16.2±19.9 (DASH score) in no-statin group. PROT scores improved significantly in both groups (p<0.01). Cuff re-tear was seen in 4 patients [six (15.78%) and eight (20.51%) in statin and no-statin group respectively]. Progression of fatty atrophy was seen in eight patients [four (10.52%) and four (10.25%) in statin and no-statin group respectively]. The rate of cuff re-tear and progression of fatty atrophy was comparable in both groups. Statin use did not correlate significantly with either cuff healing (Ps=0.049, p=0.692) or progression of fatty atrophy (Ps=0.013, p=0.909).

**Conclusion** Our result proves that, contrary to previous literature, statin do not have any effect on rotator cuff healing or fatty atrophy of cuff muscles after repair.

## FROM OPEN TO ARTHROSCOPIC LATARJET; AN EVALUATION OF THE LEARNING CURVE OF THE FIRST 103 CASES

Berte Bøe, Ingvild Blich, Ragnhild Øydna Støen, Gilbert Moatshe, Tom Clement Ludvigsen. Norway

10.1136/jisakos-2021-congress.149

**Summary** Evaluation of the learning curve after 103 cases of arthroscopic Latarjet resulted in the recognition that the procedure was technically demanding but safe, with good outcomes and low recurrence rates.

**Data**

**Purpose** When changing from a standard open procedure to a novel technique, evaluating the effect of a learning curve is important. The aim of this study was to evaluate two experienced surgeons learning curve of the arthroscopic Latarjet procedure by comparing the outcomes and complications of the first 25 patients with the latter 25 patients. Material: A consecutive cohort of 103 patients operated with arthroscopic Latarjet procedure were prospectively registered from December 2014 until November 2019. Patients in this cohort represented the first cases for the two shoulder surgeons. No conversion to open surgery and no standard open Latarjet procedures were done in this period. All patients had a double screw fixation technique. We prospectively recorded WOSI score preoperatively and at 1 year follow up (FU), and 3D-CT preoperatively, post operatively and at 1 year FU. Patient demographics, intraoperative data, complications, WOSI scores, radiology scores, satisfaction rate and reoperations were all recorded. Complications were graded according to severity. Two groups; the first and last 25 patients, a total of 50, with complete data sets were compared.

**Results** 86 of 103 (83%) patients had complete sets of data available for analysis, 12 had incomplete WOSI scores, 5 were lost to FU due to drug abuse(3), death(1) and emigration (1). The patients undergoing arthroscopic Latarjet were predominantly male (90%), and the median age at surgery was 26 years in the first group and 32 years in the latter group. The median number of dislocations before surgery was 10 in both groups, 19 of 50 were reoperations after former instability surgery and we found no significant differences in patient demographics between the groups. Surgery time improved from 130 minutes to 105 minutes. There was no difference in patient postoperative satisfaction (84%), preoperative WOSI (45% in both groups) and postoperative WOSI scores (75% versus 80%). Graft placement and union rates on 3-D CT was better in the latter group than the first group (p<0.05). There were relatively high rates of graft resorption in both groups, 48% and 44% in group 1 and group 2 respectively. There were higher complication rates with a total of 23 minor complications that resolved without a need for intervention in the first group versus 14 in the latter. There were 3 major complications that needed reoperations, 4 in group 1 and 1 in group 2. No cases of recurrent dislocation were recorded and 3 subluxations were recorded in group 1. Discussion: We found an obvious learning curve when it comes to operating time and complications that lead to reoperations when introducing arthroscopic Latarjet. The outcomes in both groups were satisfactory and comparable to previous studies on the Latarjet procedure. There was a relatively high number of resorption of the coracoid graft after one year in both groups, and this finding explains the high number of minor complications. Bone resorption did not seem to influence the clinical result and did not cause any reoperations. These are challenging cases with many previous dislocations, high percentage of bipolar bone loss and previous surgery.

**Conclusion** Arthroscopic Latarjet is a technically demanding but safe procedure with good outcomes and low recurrence rates. Minor complications that resolve without a need for intervention are common in the beginning and major complications reduced from 4 (20%) to 1 (4%).

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**20171** HIGH RISK OF FAILURE AFTER POSTERIOR CRUCIATE LIGAMENT RECONSTRUCTION: STUDY FROM THE NORWEGIAN KNEE LIGAMENT REGISTRY 2004–2019

1Gilbert Moatshe, 1Andreas Persson, 1Anne Marie Fenstad, 2RK y l e M a r t i n, 1Berte Bøe, 2Robert F LaPrade, 1Lars Engerbretsen. 1Norway; 2USA

10.1136/jisakos-2021-congress.150

**Summary** High risk of subjective failure after posterior cruciate ligament reconstruction

**Data**

**Background** Posterior cruciate ligament (PCL) injuries are less common than anterior cruciate ligament injuries (ACL), and usually present with concomitant injuries. Outcomes after PCL...
reconstruction (PCLR) have been reported to be inferior to ACL reconstruction. Furthermore, combined ligament injuries have been reported to have inferior outcomes compared to isolated PCL injuries.

**Purpose** To report on clinical outcomes and failure rates after PCLR and compare isolated PCLR with combined PCL injuries (more than one ligament reconstructed, including PCL).

**Methods** All patients who underwent primary PCL reconstruction with or without concomitant ligament injuries registered in the Norwegian Knee Ligament Register from 2004 through 2019 were included. Patient reported outcomes with Knee Injury and Osteoarthritis Outcome Scores (KOOS) were collected preoperatively, and postoperatively at two years and five years. Primary outcome measure was failure, defined as either revision surgery or a KOOS quality of life (QoL) subscale below 44. Revision rates were calculated using the Kaplan-Meier analysis and hazard ratios (HR) for revision were calculated using a multivariable Cox regression model.

**Results** There were 585 primary PCLR reconstructions registered in the period with 176 (30%) isolated PCLR reconstructions and 409 (70%) combined reconstructions with a median follow-up time of 7.2 and 7.1 years, respectively. The most commonly used graft for PCLR reconstruction was hamstring autograft (69% for isolated PCLR reconstruction, 49% for combined injuries). Allografts were used in 18.2% and 27.9% in isolated and combined PCLR, respectively. For isolated PCLR, graft size was recorded in 74 patients (<8 mm n=7, 8–10 mm n=52, >10 mm n=15). Most patients with PCLR injuries had poor preoperative knee function as defined by a KOOS QoL <44 (91.2% for isolated PCLR and 84.4% for combined PCLR injuries; p=0.08). There were significant improvements in KOOS subscores after surgery in both groups; however, subjective failure (KOOS QoL <44) of isolated PCLR (46.6%) and combined PCLR (44.7%) by two years was common (p=0.81). At five years the subjective failure rates (KOOS QoL <44) of isolated and combined PCLR were 49.3% and 36.7%, respectively (p=0.07). There was no statistically significant difference in revision rates between the groups at two or five years (2.4–3.8%). In a multivariable cox regression model, no factors were associated with revision at 2 years.

**Conclusion** Patients who underwent PCLR had improved KOOS scores versus their preoperative state; however, the subjective failure rate was high but few patients underwent revision surgery. Patients with isolated PCLR reconstructions can be expected to have similar failure rates as combined ligament reconstructions within the first two years. Future studies should evaluate the impact of recent advancements in PCL surgical and postoperative rehabilitation techniques on outcomes and failure rates.

**19893**

**DIAGNOSTIC ACCURACY OF MRI FOR OSTEOCHONDRAL LESIONS OF THE TALUS: A SYSTEMATIC REVIEW AND A META-ANALYSIS**


10.1136/jisakos-2021-congress.151

**Summary** Magnetic resonance imaging is accurate to detect osteochondral talus lesions (as compared to arthroscopy) providing good diagnostic performance for diagnostic odds ratio (96.2) and AUC (0.94), and showing high sensitivity (80%) and specificity (96%). Radiologists and orthopaedic surgeons can trust in magnetic resonance imaging results to accurately diagnose osteochondral talus lesions.

**Data**

**Background** Poor diagnosis and inadequate treatment of osteochondral lesions of the talus (OLTs) may result in further pain and progression to osteoarthritis. Magnetic resonance imaging (MRI) has an important role in diagnosing and staging OLTs, but its accuracy has not been systematically established. The purpose of this systematic review with meta-analysis was to evaluate the accuracy performance of MRI (as compared to arthroscopy) in diagnosis OLTs.

**Methods** We included studies published up to October 24, 2020 that reported the accuracy of MRI in diagnosing OLTs and using arthroscopy as reference standard. The risk of bias was assessed through the QUADAS-2 tool. Quantitative syntheses with 95% confidence intervals (CI) were performed to calculate the pooled sensitivity, specificity, positive likelihood ratios (LR+) and negative likelihood ratios (LR-), diagnostic odds ratio (DOR) and summary receiver operating characteristic (SROC) curves.

**Results** Fourteen studies were included for qualitative analyses and twelve studies were included for quantitative synthesis. A total of 711 participants and 436 OLTs with a weighted mean age of 37.9±5.6 years (mostly males, 77%) were included. The MRI analyses were performed by one or two musculoskeletal radiologists using most commonly a 1.5T MRI. Staging of OLTs was determined using heterogeneous grading scales and thus not considered for quantitative analyses. Pooled sensitivity (80%, 95% CI 67–89%), specificity (96%, 95% CI 82–98%), LR+ (19.7, 95% CI 4.16–93.40), LR- (0.20, 95% CI 0.12–0.36) and DOR (96.20, 95% CI 19.31–479.28) were obtained. The SROC curve showed an excellent area under the curve (AUC) for diagnosing OLTs (0.94, 95% CI 91–96%). The hierarchical SROC was comparable to results from the bivariate model and was symmetrical (ß=0.588, 95% CI 0.342–0.832). The value of ? was 4.237 (95% CI, 2.98–5.49), indicating a high diagnostic accuracy. The I-squared was 79.8%, 91.3%, 83.4%, 79.4% and 94.7% for sensitivity, specificity, LR+, LR-, and DOR, respectively, indicating heterogeneity. The Cochrane Q statistic was 32.20 (p<0.05) for AUC estimation, indicating that heterogeneity was due to non-threshold effects. After inferences by the bivariate model, the proportion of heterogeneity likely due to threshold effect was 27%. The pre-test probability of 25%, 50% and 75% showed that a positive result improved the post-test probability up to 87%, 95% and 98%, while a negative result decreased the post-test probability to 6%, 17% and 38%. Sensitivity analysis (goodness-of-fit, bivariate normality, influence and outlier detection analyses) demonstrated that the bivariate model was moderately robust and did not identify outliers. Five studies presented high risk of selection bias and when excluding these 5 studies, the diagnostic features were similar; the DOR was considerably lower (67 versus 96) but the CIs were very large. Meta-regression (age, time from MRI to arthroscopy, magnetic field intensity) showed no statistical correlation. Publication bias was negligible and not statistically significant (p=0.56), showing a symmetric funnel plot.
Conclusion MRI examination is accurate to detect OTLs (as compared to arthroscopy) providing good diagnostic performance for DOR and AUC, and showing high sensitivity and specificity.

THE RESULTS OF 16S DNA DEEP SEQUENCING IN CULTURE-NEGATIVE PERIPROSTHETIC JOINT INFECTIONS WITH DRAINING SINUS TRACT

Nicole Kennard, Arianna Mixon, Aniruth Srinivasaraghavan, Daniel Mohammadi, Gerhard E Maale. USA

10.1136/jisakos-2021-congress.152

Summary Next-generation 16S deep sequencing is shown to be more accurate, reliable and provide more in-depth analysis for the detection of microbial and fungal growth when compared to traditional culture methods.

Data

Background Traditional culture methods have long been used to identify the presence of organisms in periprosthetic joint infections (PJI). However, increased false negative rates have decreased the clinical applicability of traditional culture methods. In cases where joints present with acute inflammation, clinicians will often treat with antibiotics and surgical debridement despite negative cultures. Prosthetic joints can also be infected despite cultures from aspirates and intraoperative samples showing negative results. Retrieval rates of less than 15% are seen at the time of surgery in patients with open draining sinus tracts, even for one organism. Furthermore, current literature has found a stark difference in accuracy between culture data and modern molecular diagnostic methods. To overcome deficiencies in traditional culture, more and more clinicians are looking for more robust organism identification methods such as Next Generation 16S DNA deep sequencing technologies.

Methods 24 patients were identified with open draining sinus tracts around an infected prosthesis, including 16 knees, 6 hips, 1 humerus, and 1 femur. All patients had several operations prior to referral to our clinic. All wounds were open and were culture negative. Each open wound was swabbed and underwent PCR and 16S deep sequencing on an orthopedic platform by Microgen. Upon receipt of the sample, Microgen extracts the microbial DNA and runs it through the Roche Light Cycler for PCR sequencing and the Illumina MiSeq for clonal amplification in order to gather data for analysis. The platform consists of 50,000 species of bacteria in their library with a readout from Illumina.

Results None of this patient population had a positive culture.

Conclusion Our findings indicate that in our entire patient population, culture was not sufficient to detect bacterial infection in patients following joint replacement arthroplasty. Next-generation 16S deep sequencing is shown to be more accurate, reliable and provide more in-depth analysis for the detection of microbial and fungal growth. Additionally, it has utility in identifying antibiotic resistance and guiding more suitable treatment utilizing antibiotic local carriers and systemic antibiotics.

POSTERIOR TIBIAL PLATEAU IMPACTION FRACTURES ARE NOT ASSOCIATED WITH INCREASED KNEE INSTABILITY: A QUANTITATIVE PIVOT SHIFT ANALYSIS

Brian M Godshaw, Joshua C Setliff, Jonathan D Hughes, Volker Musahl. USA

10.1136/jisakos-2021-congress.153

Summary Posterolateral tibial plateau impaction fractures in the setting of ACL tears do not significantly impact rotatory knee instability.

Data

Background Impaction fractures of the posterolateral tibial plateau have been well described in association with injury to the anterior cruciate ligament (ACL). No consensus has been reached on the role these injuries play in rotatory knee stability, with some studies suggesting that increasing severity of the fracture leads to increased rotatory knee instability. The purpose of this study was to evaluate these injuries and how they contribute to rotatory knee stability via the use of quantitative data.

Methods Two hundred eighty-four consecutive patients with complete ACL tears had data prospectively collected. All patients underwent ACL reconstruction by a single, fellowship-trained orthopaedic sports medicine surgeon. Basic demographic information was obtained via chart review. The magnetic resonance imaging (MRI) of each patient was reviewed to identify posterolateral tibial plateau impaction fractures. Patients were placed into two cohorts: fractures or no fractures. The cohort with fractures were further categorized based on fracture morphology: extra-articular, articular-impaction, or displaced-articular fragment. All data were collected during the exam under anesthesia (EUA). This included a standard, subjectively graded, pivot shift test graded by the examiner and quantitative data including the Rolimeter measurement of anterior tibial translation, quantitative pivot shift (QPS) exam, and acceleration during the pivot shift. The PIVOT application, a previously verified application for a computer tablet, was used for the QPS. An accelerometer was used to obtain the knee’s acceleration during the pivot shift exam. These quantitative exams were compared to the contralateral knee. The quantitative pivot, Rolimeter, and accelerometer were used to remove any subjective bias of the physical exam. Significance was met if p<0.05.

Results The prevalence of posterolateral impaction fractures was 39.44%. Of the fractures, 63.4% were extra-articular, 25.0% were articular-impaction, and 11.6% were displaced-articular. There were no differences in patient demographics or time from injury to surgery. There was no difference in the average of subjectively graded pivot shift in those with fractures vs those without (1.8±0.3 vs1.7±0.4, respectively, p=0.81). Similarly, the QPS revealed no statistically significant difference regardless of presence or not of a fracture (2.4±1.6 mm vs 2.7±2.2 mm, respectively, p=0.26). Anterior tibial translation measurements were not statistically significant different whether or not a fracture was present (5.5±2.7 mm vs 5.4±2.6 mm, respectively, p=0.74). The acceleration of the knee during the pivot did not reveal a statistically significant difference with or without a fracture (1.7±2.3 m/s^2 vs 1.8±3.2 m/s^2, respectively, p=0.86). When the fractures were
further subdivided, there were no statistically significant differences noted in any of the measured exams between the variants.

Conclusion The results of this study demonstrate posterolateral tibial plateau impaction fractures in the setting of ACL tears do not significantly impact rotatory knee instability. Therefore, surgeons may consider in-situ fixation of these injuries in patients with ACL tears.

Summary Changes in scapular and GH kinematics following superior capsular reconstruction suggest a convergence towards a more similar and potentially more efficient movement pattern following superior capsular reconstruction.

Data
Introduction Patients with irreparable rotator cuff tears exhibit functional limitations while performing activities of daily living. One viable treatment is superior capsular reconstruction (SCR). SCR has been shown to restore stability of the gleno-humeral (GH) joint in cadavers, but its effect on in vivo scapular and humeral motion is unknown. The aims of this study were to determine the effect of SCR on in vivo scapular and humeral kinematics during a functional hand-to-head motion and to identify associations between shoulder kinematics and patient-reported outcomes (PROs). We hypothesized that the functional task would be accomplished by using more GH based movement and less scapular movement after SCR, and there would be a positive correlation between kinematics changes and improved PROs.

Methods Ten patients (8M, 2F, age 63 ± 7 years) with irreparable RCT consented to participate in this prospective IRB-approved study. ASES, DASH, and WORC surveys were completed before (PRE) and 1-year after (1YR-POST) SCR. PRE and 1YR-POST, participants were seated and instructed to move their hand from their lap to the back of their head while synchronized biplane radiographs of the shoulder were collected at 50 images/s for 3 trials. Subject-specific CT-based bone models of the humerus and scapula were matched to the biplane radiographs with respective implants were created from CT scans and matched to the biplane radiographs to measure scapular and humerus motion with sub-millimeter accuracy. The center of the contact region of the polyethylene and glenosphere was determined at 5-degree increments while synchronized biplane radiographs of the shoulder were collected at 50 images/s for 2 seconds. Subject-specific models and PROs were evaluated with Pearson’s correlation. Significance was set at p<0.05 for all tests.

Results End-range GH I/E rotation was 12° lower (p=0.03) while end-range scapular protraction was 6° degrees higher 1YR-POST compared to PRE (p=0.01). Inter-subject variability in rotational contributions to the movement decreased 4.0% in GH abduction and 2.6% in GH I/E rotation (p=0.047, and p=0.005, respectively) from PRE to 1YR-POST. The PRE to 1YR POST change in contribution from GH abduction was positively correlated to the change in contribution from GH I/E rotation (R=0.8, p=0.001) and negatively correlated to the change in contribution from scapular protraction (R=-0.94, p=0.001). Changes in the horizontal plane elevation contribution were positively correlated with changes in ASES scores (R=0.635, p=0.048).

Discussion Changes in rotational contributions of the scapula and humerus to the hand-to-head movement after SCR were inconsistent across subjects, however, inter-subject variability in GH abduction and I/E rotation were reduced following surgery, suggesting the participants’ movement strategy converged toward a more similar and possibly more efficient movement pattern following SCR. End-range I/E rotation decreased and scapular protraction increased, which contradicts our first hypothesis. In addition, increased GH horizontal plane elevation contribution following surgery was associated with improved ASES scores, supporting our second hypothesis. This may be consistent with improved glenohumeral kinematics and efficiency of movement during a functional task following SCR.

Summary In vivo kinematics and strength data suggest surgical technique affects in vivo contact patterns and strength after reverse shoulder arthroplasty.

Data
Introduction Reverse shoulder arthroplasty (RSA) is a procedure to reduce pain and restore function in patients with rotator cuff arthropathy. In vitro studies suggest that modifications in prosthesis design and surgical technique can improve functional outcomes after RSA, but little work has been done to quantify in vivo kinematics following RSA. The aim of this ongoing study is to determine the effects of surgical technique and prosthesis geometry on in vivo functional outcomes after RSA. We hypothesized that greater humeral retroversion would be related to a more posterior contact path and that greater lateralization would be related to greater strength and better patient-reported outcomes (PROs).

Methods 17 patients received RSA (10M, 7F, age 69.5±7.4 years) using a standard 145-degree humeral implant (Wright Med/Tornier) or 135-degree humeral implant (Arthrex) within 2.5±1.2 years of participating in this IRB-approved study. Surgical parameters of glenoid lateralization and humeral retroversion were recorded from surgical notes. ASES, DASH, and Constant-Murley surveys (CMS) were completed at testing. Participants performed 3 trials of scapular plane abduction while synchronized biplane radiographs of the shoulder were collected at 50 images/s for 2 seconds. Subject-specific models of the humerus and scapula with respective implants were created from CT scans and matched to the biplane radiographs to measure scapular and humerus motion with sub-millimeter accuracy. The center of the contact region of the polyethylene and glenosphere was determined at 5-degree increments.
of glenohumeral (GH) abduction and averaged across trials. Isokinetic torque was recorded over the full ROM for flexion/extension, abduction/adduction, and internal/external rotation at 30°/second using a Biodex. Both the peak torque and the total work done were used to quantify strength. Pearson’s correlations were used to identify associations between the anterior-posterior and superior-inferior location of the center of contact at every 5° of GH abduction and surgical parameters. Spearman’s correlations were used to identify associations between strength, surgical factors, and patient-reported outcomes (PROs) with significance set at p<0.05.

**Results** Ten patients had 20° of humeral retroversion, four had 30°, and two had 40°. Ten patients had 0–2.0 mm lateralization, three had 2.1–4.0 mm, and four had 4.0–7.0 mm. During abduction, the center of contact path was posterior and inferior to the center of the glenosphere in all subjects. Increased retroversion was positively correlated with a more superior location of the center of contact between 35° and 60° of GH abduction (all p<0.01; R>0.85). No other correlations were found for center of contact (all p>0.31). Total adduction work was correlated with lateralization (r=0.58, p=0.015), and peak torque in external rotation was correlated with lateralization (r=0.57, p=0.017). CMS was correlated with total work in abduction, external and internal rotation (all p<0.048, all p<0.047).

**Discussion** Retroversion is associated with in vivo contact kinematics, and increased glenoid lateralization is associated with increased strength and better PROs after RSA, supporting our hypothesis. The results indicate surgical technique is associated with strength and PROs. Our results provide in vivo evidence confirming previous computational modeling and cadaver-based studies that demonstrated increased strength following RSA with lateralized designs.

**Summary** Younger age (< 25 years), shorter time from injury to primary ACLR (< 12 months) and a quadriceps strength LSI of => 90% 6 months after primary ACLR increased the odds of revision ACLR within 2 years.

**Data**

**Background** There is a need for a comprehensive and detailed analysis of preoperative, intraoperative and postoperative risk factors for revision ACLR. An awareness of the effect of multiple factors on the risk of revision ACLR could help clinicians to counsel patients undergoing primary ACLR about this complication. In addition, knowledge of potentially modifiable risk factors for revision ACLR might be used to target these factors and reduce the risk of this serious event.

**Purpose** To identify preoperative, intraoperative and postoperative factors associated with revision ACLR within 2 years of primary ACLR.

**Methods** Patients who underwent primary ACLR at our institution, from January 2005 to March 2017, were identified. The primary outcome was the occurrence of revision ACLR within 2 years of primary ACLR. Patients who underwent revision ACLR at our institution or other institutions in the country were identified through their unique personal identity number in the Swedish National Knee Ligament Registry. Univariate and multivariate logistic regression analyses were used to evaluate preoperative (age, gender, body mass index [BMI], time from injury to surgery, pre-injury Tegner activity level), intraoperative (graft type, graft diameter, medial meniscus [MM] and lateral meniscus [LM] resection or repair, cartilage injury) and postoperative (side-to-side [STS] KT-1000 anterior laxity, limb symmetry [LSI] for quadriceps and hamstring strength and single-leg-hop test performance at 6 months) risk factors for revision ACLR.

**Results** A total of 6,510 primary ACLRs were included. The overall incidence of revision ACLR within 2 years was 2.5%. Univariate analysis showed that age < 25 years, BMI < 25, time from injury to surgery < 12 months, pre-injury Tegner activity level => 6, LM repair, STS laxity > 5 mm, quadriceps strength and single-leg-hop test LSI of => 90% increased the odds, whereas MM resection and the presence of a cartilage injury reduced the odds of revision ACLR. Multivariate analysis revealed that revision ACLR was significantly related only to age < 25 years (OR 6.25; 95% CI, 3.57 - 11.11; P < 0.001), time from injury to surgery < 12 months (OR 2.27; 95% CI, 1.25 - 4.17; P = 0.007) and quadriceps strength LSI of => 90% (OR 1.70; 95% CI, 1.16 - 2.49; P = 0.006).

**Conclusions** Age < 25 years, time from injury to surgery < 12 months and 6-month quadriceps strength LSI of => 90% increased the odds of revision ACLR within 2 years of primary ACLR. Understanding the risk factors for revision ACLR has important implications when it comes to the appropriated counselling for primary ACLR. We have analyzed a large spectrum of potential risk factors for revision ACLR in a large cohort. Advising patients regarding the results of an ACLR should also include potential risk factors for revision surgery.
hamstring ACL reconstruction (AHACL). 32 consecutive patients underwent combined AHACL and modified Lemaire anterolateral tenodesis between January 2017 and December 2018 were prospectively evaluated (Group 1). The control group was an historical cohort of skeletally immature patients (n=34) that had had surgery from October 2014 to December 2016 (Group 2). In the control group only AHACL have been performed. Patients were classified as skeletally immature when both tibial and femoral physis were still open on MRI. Bone skeletal age was evaluated on X-Ray. The femoral tunnel was performed using a phyesal-sparing technique and a transcphysial tunnel was drilled in every case. A Lemaire modified anterolateral tenodesis was additionally performed in the patients of group 1. The exclusion criteria included rupture of other ligament rather than ACL, root or bucket handle meniscal tears, ramp lesion or any cartilage injury that needed surgical treatment. Graft diameter, Pedi-IKDC subjective knee evaluation, graft failure and return to sports were recorded. Pre and postoperative objective laxity of the knee was also measured using KT-1000 arthrometer and the KiRA triaxial accelerometer. Postoperative lower limb deformity or growth disturbances were recorded.

Results The mean age in group 1 was 13.8 (range 12–16) years and 14 (range 12–16) years in group 2 (p=0.48). The mean graft diameter was 8.2 (range: 7–9) mm, with no significant differences between the groups (p=0.63). The mean follow-up was 26.1 ± 4.2 months for group 1 and 29.6 ± 7.2 months in group 2 (p = 0.11). Three patients had a <3° genu valgus deformity on the operated limb, two of which belonged to group 1 and one to group 2. Both better antero-posterior stability measured with KT-1000 (p = 0.041) or KiRA (p = 0.033) and better rotational stability measured with a KIRA (p = 0.019) have been detected in group 1. The graft failure rate was also lower in group 1 (11.8% group 2 vs 6.2% group 1; p = 0.042). The patients in group 1 had a return to sports rate of 91%, while in group 2 this rate was of 83%, without statistical difference (p=0.069). The Pedi-IKDC subjective knee evaluation recorded for both groups showed no difference between the 2 groups (p = 0.27).

Conclusion From the data obtained in the present study we can conclude that adding an anterolateral modified Lemaire tenodesis to hamstring anatomic ACL reconstruction improve objective stability and reduce failure rate in skeletally immature patients with a low risk of growth-related changes.

**Abstracts**

**20077** IS LENGTH CHANGE PATTERN OF THE POSTEROLATERAL CORNER OF THE KNEE RESTORED BY CURRENT RECONSTRUCTION TECHNIQUES?

Johannes Glasbrenner, Hadi Nasri, Michael J Raschke, Andre Frank, Christian Peez, Thorben Briese, Elmar Herbst, Christoph Kittl. Germany

Summary Length change pattern of current reconstruction techniques of the posterolateral corner of the knee were compared in a biomechanical study.

Data Background Several operative techniques are used by knee surgeons to treat instability of the posterolateral corner of the knee (PLC). The purpose of the present study was to examine the length change pattern of current reconstruction techniques of the PLC and compare them to length change pattern of the corresponding anatomic structures. It was hypothesized, that anatomic reconstructions (according to LaPrade or Frosch) would better mimic length change pattern of the native PLC than isometric reconstructions (according to Arciero, Larson or modified Larson). Study Design: Controlled laboratory study. Methods In 8 fresh frozen human cadaveric knees dissection of the lateral collateral ligament (LCL), popliteus tendon (PT) and the popliteofibular ligament (PFL) was performed. Quadriceps muscle was loaded physiologically using cables and hanging weights, according to the muscle fiber orientations and cross-sections, with the knee mounted in a custom-made open chain flexion-extension rig. Pins were inserted at the anatomic insertions of the LCL, PT and PFL and at the insertion of reconstructions techniques according to Larson, Arciero, LaPrade, Bousquet and Frosch. Threads were mounted between these pins. Length change pattern was measured using a rotary arm.

**20017** EARLY POSTOPERATIVE RESULTS OF THE FIRST LATIN-AMERICAN EXPERIENCE WITH ROBOTIC-ARM-ASSISTED TKA VERSUS CONVENTIONAL TECHNIQUE

David H Figueroa, Rodrigo Guloff, Tomas Prado, Juan Jose Sotomayor, Alberto Alarcon, Alex Vaisman, Rafael Calvo. Chile

Summary The early clinical postoperative results of this first Latin-American comparative experience of robotic-arm-assisted TKA versus conventional technique showed lower opioids requirements and faster functional recovery of ambulation in those patients operated with the robotic system; nevertheless, surgical times were higher, without differences in postoperative complications. There were no statistica

Data Early results with robotic-arm-assisted total knee arthroplasty (TKA) are encouraging; nevertheless, literature might be unrepresentative, as it comes mostly from Anglo-Saxon and Asian countries, and there is limited experience and no comparative clinical reports in Latin America. This study aims to compare the early postoperative results of the first Latin-American experience with robotic-arm-assisted TKA versus conventional TKA. A cohort study was performed, including 181 consecutive patients (195 knees) with advanced symptomatic knee osteoarthritis (OA) undergoing primary TKA between March 2016 and October 2019. The cohort included 111 consecutive patients (123 knees) undergoing conventional TKA, followed by 70 consecutive patients (72 knees) undergoing robotic-arm-assisted TKA. The same surgical team (surgeon 1 and surgeon 2) performed all procedures. Patients with previous osteotomy, posttraumatic OA, and revision components were not considered. The same anesthetic and rehabilitation protocol was followed. The investigated clinical outcomes were: surgical tourniquet time, time to home discharge, time to ambulation, postoperative daily pain [Visual Analog Scale (VAS)], opioid use, range of motion (ROM), blood loss, complications, and postoperative mechanical axis. The early clinical postoperative results of this first Latin-American comparative experience of robotic-arm-assisted TKA versus conventional technique showed lower opioids requirements and faster functional recovery of ambulation in those patients operated with the robotic system; nevertheless, surgical times were higher, without differences in postoperative complications. There were no statistical differences for the other clinical outcomes.
Coaching education can improve adherence to a NMT program and delivery of alignment cues. Coaches should receive in-person training on NMT and how to deliver alignment cues to their athletes while performing the exercises. This study was funded by an ISAKOS Clinical Outcomes Research Grant.

**Survivability of Primary Anterior Cruciate Ligament Reconstructions in a Physically High Demand Population**

Ashley Bee Anderson, Travis Dekker, Veronika Pav, Timothy C Mauntel, Matthew T Provencher, John M Tokish, Jon F Dickens. USA

**Summary**

The overall clinical failure rate of service members with ACLR is nearly 18% with minimum 4-year follow-up, where more patients are likely to fail due to revision surgery than medical separation.

**Data**

**Background**

Anterior cruciate ligament tears and anterior cruciate ligament reconstruction (ACLR) are common in young athletes. The modifiable and non-modifiable factors contributing to ACLR failure and reoperation are incompletely understood. The purpose of this study was to determine ACLR failure rates in a physically high-demand population and identify the patient specific risk factors that portend to failure.

**Methods**

A consecutive series of military service members with ACLR with and without concomitant procedures (meniscus [M] and/or cartilage [C]) done at military facilities between October 2008 to September 2011 was completed via the Military Health System Data Repository. Patients had to be continuously enrolled with no history of knee surgeries for two years prior to the primary ACLR. ACLR failure was defined as revision ACLR or the inability to return to the minimum military physical standards (medical separation) within four years following the primary ACLR. Kaplan-Meier survival curves were estimated and evaluated with Wilcoxon test. Cox Proportional Hazard Models calculated hazard ratios (HR) with 95% confidence intervals (95% CI) to identify demographic and surgical factors that influenced ACLR failure for the isolated ACLR (KA), ACLR Meniscus (KMA), ACLR Cartilage (KCA), ACLR Meniscus and Cartilage (KAMC).

**Results**

Of the 2,735 primary ACLRs included in the study, 17.7% experienced ACLR failure within four years, including 9.5% (261/2,735) undergoing revision ACLR and 8.2% (224/2,735) due to medical separation. The factors that increased failure include: Army Service (HR 2.188, 95% CI: 1.668, 2.870), >180 days from injury to ACLR (HR 1.550, 95% CI: 1.157, 2.076), tobacco use (HR 1.429 95% CI: 1.174, 1.738), and younger patient age (HR 0.977, 95% CI: 0.958, 0.996).

**Conclusion**

The overall clinical failure rate of service members with ACLR is 17.7% with minimum four year follow-up, where more patients are likely to fail due to revision surgery than medical separation. The cumulative probability of survival at for years was 78.5%. Smoking cessation and treating ACLR patients promptly are modifiable risk factors impacting either graft failure or medical separation.
EVALUATION OF MEDIAL PATELLOFEMORAL LIGAMENT RECONSTRUCTION IN INMATURE SKELETON. A COMPARATIVE STUDY BETWEEN TWO TECHNIQUES
Juan Miguel Del Castillo, Martin Sierra, Juan Dupont, Johan von Heideken, Juan Enrique Kenny Pujadas, Uruguay
10.1136/jisakos-2021-congress.162

Summary
Our study evaluates the functional results of two groups of patients treated by two different techniques of MPFL reconstruction, one anatomic with autologous semitendinosus and the other non-anatomic with autologous quadriceps tendon.

Data
Patellofemoral dislocation accounts for 3% of traumatic knee injuries, with two-thirds occurring in patients under 20 years of age. Recurrence after the second episode is greater than 50%, which can cause great functional limitation in young patients, reducing their quality of life. The immature skeleton implies a therapeutic problem since the remaining growth potential must be preserved. Medial patellofemoral ligament (MPFL) is the main medial stabilizer of the patella at 30° flexion, currently its anatomic reconstruction preserving the physis appears to be the best option in these cases until they are candidates for other corrective surgeries. Our study evaluates the functional results of two groups of patients treated by two different techniques of MPFL reconstruction, one anatomic with autologous Semitendinosus (ST) and the other non-anatomic with autologous quadriceps tendon (QT). Both groups were evaluated through the Kujala score before surgery and during follow-up. Means and score items were compared using Wilcoxon signed-rank test. Twenty-two knees were evaluated, eleven in each group. Patient's age ranged between 8 and 15 years old. The mean follow-up was 19.4 months (range 7–30). Results show an improvement in the average Kujala scores for the ST group from 51 to 88 and in the QT group from 52 to 97. Kujala score was statistically significantly higher in the postoperative evaluation with both technics (p-value 0.003 for both groups) while we did not find any statistical difference between both techniques in Kujala score at follow up. Only one case of patella redislocation from the QT group was registered during the study period. In conclusion, we can affirm that MPFL reconstruction is a valid therapeutic option for patellofemoral dislocation and the proposed techniques are reliable choices in patients with immature skeleton.

LOW PERCENTAGE OF SURGEONS MEET THE MINIMUM RECOMMENDED UNICOMPARTMENTAL KNEE ARTHROPLASTY USAGE THRESHOLDS: ANALYSIS OF 3,037 SURGEONS FROM THREE NATIONAL JOINT REGISTRIES
Antonio Klasan, David A Parker, Peter L Lewis, Simon W Young, Austria
10.1136/jisakos-2021-congress.163

Summary
A low number of surgeons is meeting the UKA thresholds.
Data
Purpose Unicompartmental knee arthroplasty (UKA) has a faster recovery and less perioperative morbidity than total knee arthroplasty (TKA), but has a significantly higher revision rate. The reported usage of UKA is around 10% in the UK, Australian and New Zealand joint registries. However, some authors recommend that a higher UKA usage of 20%, or a minimum 12 UKA cases per year, would reduce revision rates. The purpose of this study was to analyze the percentage of surgeons performing the recommended thresholds in these 3 registries. Methods Data from the UK, Australian and New Zealand registry databases was utilized from the time period since their respective introduction until 2017. All primary TKA and UKA performed for the diagnosis of osteoarthritis by surgeons with more than 100 recorded knee arthroplasties in their respective registry were included. The results between the registries were compared and a pooled analysis was performed. The number of surgeons meeting the recommended caseload of >20% UKA yearly or 12 UKA cases yearly was calculated. Results We identified 3,037 knee surgeons performing 1,556,440 knee arthroplasties, of which 131,575 were UKA (8.45%). Over 50% of knee surgeons in each registry had a proportion of less than 5% UKA of their knee replacement procedures. After pooling of data, median surgeon UKA usage was 2.0% (IQR 0–9.1%). The percentage of surgeons meeting the proposed caseload criteria was highest in New Zealand, 16.3%, followed by the UK at 12.4% and Australia 11.3% (p=0.28).
Conclusion More than 50% of knee surgeons in UK, Australian and New Zealand joint registries perform less than 5% of UKA yearly. The majority of experienced knee surgeons are not meeting the recommended minimum thresholds, which might indicate that the recommended thresholds are not feasible for the vast majority of knee surgeons. The reasons behind this require further research.

THE EFFECT OF SURGEO USAGE OF MEDIAL UNICOMPARTMENTAL KNEE ARTHROPLASTY ON BOTH UNICOMPARTMENTAL AND TOTAL KNEE ARTHROPLASTY OUTCOMES
Antonio Klasan, Mei Lin Tay, Chris Frampton, Simon W Young, New Zealand
10.1136/jisakos-2021-congress.164

Summary
Increased UKA usage decreases TKA outcomes.
Data
Background Surgeons with higher unicompartmental knee arthroplasty (UKA) usage have lower UKA revision rates. However, in order to increase UKA usage in arthroplasty patients, surgeons will decrease their usage of total knee arthroplasty (TKA). The purpose of this study was to investigate the influence of UKA usage on survivorship and patient reported outcomes (PROMs) of UKA, TKA, and UKA/TKA results.
Methods
Using the New Zealand Registry Database, surgeons were divided into 6 cluster groups, based on their UKA usage: <1%, 1–5%, 5–10%, 10–20%, 20–30% and >30%. A comparison of UKA, TKA and UKA/TKA revision rates as well as PROMs using the Oxford Knee Score (OKS) between the groups was performed.
Results
We identified 91,895 knee arthroplasties, of which 8,271 were UKA. Surgeons with higher UKA usage had lower UKA revision rates, but higher TKA revision rates. The lowest TKA and UKA/TKA revision rates were observed in the 1–5% UKA cluster, compared to highest TKA and UKA/TKA in the >30% UKA cluster (Log Rank p<0.001 TKA; p<0.001 UKA/TKA). No clinically important differences in combined OKS scores were seen between UKA usage groups at 6 months, 5 years, or 10 years.
Conclusions Surgeons with higher UKA usage have lower UKA revision rates, however, their UKA/TKA revision rate is the highest. An increase in TKA revision rate was observed for highest volume UKA users (>30%). Increased UKA usage did not result in higher PROMs. Surgeons need to be aware of the impact of increasing UKA usage on the UKA/TKA revision rate and clinical outcomes.

Summary UKA is appropriate in 15% of patients, if more than radiologic criteria are applied.

Aims: Indications for unicompartmental knee arthroplasty (UKA) are controversial. Studies based solely on radiographic criteria suggest up to 49% of patients with knee osteoarthritis (OA) are suitable for UKA. In contrast, the ‘Appropriate use criteria’ (AUC), developed by the American Academy of Orthopedic Surgeons, applies both clinical and radiographic criteria to guide surgical treatment of knee OA. The aim of this study was to analyse patient suitability for TKA, UKA and osteotomy using both radiographic criteria and AUC in a cohort of 300 consecutive knee OA patients.

Patients and Methods Included were consecutive patients with clinical and radiographic signs of knee OA referred to a specialist clinic. We collected demographic data, radiographic wear patterns and clinical findings that were analyzed using the AUC. Patients with bilateral knee OA were analyzed separately for each knee. We compared the radiographic wear patterns with the treatment suggested by the AUC as well as the Surgeon Treatment Decision.

Results There were 397 knees in 300 patients available for analysis. Median age was 68 [IQR 15], BMI 30 [6] with 55% females. We found excellent consistency for both the radiographic criteria and the AUC criteria. Based on radiological criteria, 41% of knees were suitable for UKA. However, when using the AUC criteria, UKA was the appropriate treatment in only 13.3% of knees. In 19.1% of knees, no surgical treatment was appropriate at the visit, based on the collected data.

Conclusion Application of isolated radiologic criteria in patients with knee OA results in a UKA candidacy that misleadsingly high. Appropriate Use Criteria that are based on both radiological and clinical criteria suggest UKA is appropriate in less than 15% of patients.

Summary Resistance to new antibiotics is increasing.

Aims: Management of periprosthetic joint infection (PJI) after total knee arthroplasty (TKA) is challenging. Antibiotic management remains elusive due to differences in epidemiology and resistance between countries and reports. Before the efficacy of surgical treatment options is investigated, it is crucial to investigate the bacterial strains causing PJI, especially for cases where a culture could not be obtained.

Methods A review of all revision TKAs between 2006 and 2018 in a tertiary referral center was performed. Included were cases meeting the consensus criteria for PJI, with identified cultures. Using a cluster analysis, 3 chronological time periods were created. We then evaluated antibiotic resistance of identified bacteria between these clusters and the effectiveness of our antibiotic regime.

Results We identified 129 PJI with 161 culture identified bacteria. Coagulase-negative Staphylococci (CNS) were diagnosed in 46.6% cultures, followed by Staphylococcus aureus in 19.8% of cultures. Overall antibiotic resistance (p=0.454) has not increased during the study period. CNS resistance to teicoplanin (p<0.001), fosfomycin (p=0.016) and tetracycline (p=0.014) has increased. Vancomycin had an 84.4% overall sensitivity and 100% CNS sensitivity and was the most effective agent.

Conclusion Although we were unable to show an overall increase in antibiotic resistance in organisms that cause PJI after TKA during the study period, this was not true for CNS. It is concerning to note that when specifically looking at CNS resistance to new antibiotics, but not vancomycin, it has increased in little more than a decade. This study suggests that referral centres should continuously monitor obtained cultures as this has significant implications for both prophylactic treatment in primary as well as empirical antibiotic treatment in PJI.

Summary Numbness around replaced knee negatively correlated with patient-reported outcome measures and affected kneeling. Knee replacements performed via an anteromedial incision may be at higher risk for numbness. Male sex, better knee flexion and less numbness were positively affected kneeling.

Aims: Management of periprosthetic joint infection (PJI) after total knee arthroplasty is challenging. Antibiotic management remains elusive due to differences in epidemiology and resistance between countries and reports. Before the efficacy of surgical treatment options is investigated, it is crucial to investigate the bacterial strains causing PJI, especially for cases where a culture could not be obtained.

Methods We retrospectively reviewed 404 patients (514 knees) underwent knee replacement at our institution between May 2007 and April 2019. PROMs, including the Numbness score, New Knee Society Score (KSS), Knee Injury and Osteoarthritis Outcome Score (KOOS), and Forgotten Joint Score-12 (FJS-12), and other clinical and radiological data were collected from 311 patients (394 primary knee replacements) with complete data. Kneeling ability was evaluated using kneeling-
specific items in KSS. Results Numbness score correlated with KSS-Symptoms (r=0.44) and KSS-Satisfaction (r=0.41), KOOS-Symptom (r=0.42), KOOS-Pain (r=0.44), KOOS-ADL (r=0.36), and KOOS-QOL (r=0.38), and FJS-12 (r=0.42). A multivariable regression analyses with the numbness score as the response variable suggested that the numbness score was better after midline incision than after anteromedial incision. A multivariable regression analyses with KSS-Kneeling as the response variable suggested that male sex, better postoperative knee flexion, and better numbness score were factors associated with better kneeling.

Conclusion A worse Numbness score was correlated with inferior PROMs and affected inferior kneeling. Less numbness, male sex, and better knee flexion angle were positively associated with better kneeling.

Summary Our study sets outs to assess the clinical outcome and complications rates between patients undergoing simultaneous versus staged surgery for bilateral hip femoroacetabular impingement.

Data

Introduction Femoroacetabular impingement (FAI) typically involves both hips and presents a surgical dilemma when symptomatic at the same time. Bilateral simultaneous surgery can reduce the overall rehabilitation period compared to a staged surgery. However, the disadvantages are longer surgical time and possible higher complications. We hypothesize that there is no difference in the outcome and complication rates between bilateral simultaneous and staged surgery for FAI.

Methods Patients who underwent simultaneous and staged bilateral primary hip arthroscopy for FAI between June 2005 and December 2018 were identified from our surgical database. Those who had their second surgery within 1 year of their index surgery were included in the staged group. The control group comprised patients who underwent a unilateral hip arthroscopy within the same timeframe. Patient Reported Outcome Measures (PROMs) including the 12-item International Hip Outcome Tool (iHOT-12), Non-Arthritic Hip (NAH) Total and Hip Disability and Osteoarthritis Outcome (HOOS) scores were collected pre-operatively and at regular intervals post-operatively up to 10 years. Two-year follow-up scores were included in analysis if they were available, or later follow-ups if they were not. We also gathered data on complications and revision surgery rates including conversion to arthroplasty from a national registry.

Results A total of 186 patients (372 hips) in the bilateral simultaneous and 83 patients (166 hips) in the bilateral staged groups were included in analysis if they were available, or later follow-ups if they were not. We also gathered data on complications and revision surgery rates including conversion to arthroplasty from a national registry.

19818 TREATMENT OF BILATERAL HIP FEMOROACETABULAR IMPINGEMENT: SIMULTANEOUS OR STAGED?

Gen Lin Foo, Catherine J Bacon, Matthew J Brick. Singapore; New Zealand

10.1136/jisakos-2021-congress.168

Summary

Bilateral simultaneous surgery did better in most PROM scores than staged surgery after statistically adjusting for the differing pre-operative scores. Overall, the staged group performed worse in all scores (p<0.05 for all). There was no difference in revision rates between groups, but simultaneous surgeries were less likely to undergo conversion to arthroplasty within the study period. There were no differences in follow-up duration, patients undergoing simultaneous and staged procedures.

19923 HIGH SPECIALIZATION AMONG FEMALE YOUTH SOCCER PLAYERS IS ASSOCIATED WITH AN INCREASED LIKELIHOOD OF SERIOUS INJURY: A CROSS-SECTIONAL STUDY OF YOUTH, COLLEGE, AND PROFESSIONAL SOCCER ATHLETES

Michelle Xiao, Jacie L Lemos, Calvin E Hwang, Seth L Sherman, Marc R Safran, Geoffrey D Abrams. USA

Summary

High specialization in female youth soccer players is associated with an increased likelihood of sustaining a serious injury.

Data

Introduction Sport specialization is increasingly common for youth athletes and can contribute to a higher likelihood of injury. Few studies have examined injuries as it relates to sport specialization in high-level female soccer players. The purpose of this study was to assess the associations between serious injury (>3-month time loss) and level of specialization among high-level female soccer players and to compare the specialization and college commitment ages of female youth soccer players to Division I college and professional soccer athletes.

Methods Youth, college, and professional female soccer players in the United States playing in the top league at each level were recruited to complete an anonymous online survey. The survey collected information about player demographics, soccer specialization and training patterns, history of serious injuries from soccer (defined as sidelining a player for three months or more), and perceptions surrounding soccer specialization. Descriptive summaries were presented for demographic data. Data from Division I and professional athletes were combined for analysis. Comparisons between groups were performed using 2-sample t-tests, chi-squared analyses, and binary logistic regression models controlling for differences in age. A p-value of less than 0.05 was set as significant.

Results A total of 1,018 (767 youth, 251 college/professional) athletes completed the survey. Serious injuries affected 23.6% of youth and 51.4% of college/professional athletes. Anterior cruciate ligament (ACL) tears were the most common injury subgroup and were more prevalent in college/professional players compared to youth athletes (18.3% vs 4.0%; p <
0.001). Highly specialized youth athletes (66.5%) were more likely to have sustained a serious injury from soccer compared to athletes with low specialization (OR = 2.28 [1.38–3.92]; p=0.008) but not moderate specialization (OR = 1.37 [0.83–2.27]; p=0.43). Current youth soccer players started playing competitive soccer (7.4 + 2.2 vs 8.6 + 2.5 years; p < 0.001) and committed to play college soccer (15.3 + 1.6 vs 16.2 + 1.2 years; p < 0.001) at a younger age compared to college/ professional athletes. A higher proportion of youth athletes specialized at a young age (< 10 years) compared to college/ professional players (44.2% vs 25.9%; p < 0.001).

Conclusion High specialization in female youth soccer players is associated with an increased likelihood of sustaining a serious injury. Current youth soccer players are specializing earlier and committing to play college soccer at a younger age compared to when current college and professional players did.

Summary This machine learning analysis of a national knee ligament register can predict a patient’s risk of primary ACL reconstruction failure (defined as a subsequent revision surgery). The resulting algorithm supports the creation of an easy-to-use calculator for point-of-care risk stratification which can be used to guide surgical discussions with patients and quantify their specific risk of failure.

Data Background Several factors are associated with an increased risk of anterior cruciate ligament (ACL) reconstruction failure. However, due to the multiple patient, surgical, and rehabilitation factors that influence outcome, the ability to accurately translate these factors into a quantifiable risk of failure at a patient-specific level has remained elusive. Our hypothesis was that machine learning analysis of existing large national knee ligament registers has the potential to improve our predictive capability. The purpose of this study was to determine if machine learning analysis of primary ACL reconstructions in the Norwegian Knee Ligament Register (NKLR) can: (1) identify the most important risk factors associated with undergoing a subsequent revision ACL reconstruction, and (2) develop a clinically meaningful calculator for predicting the risk of requiring a revision operation.

Methods Machine learning analysis was performed on the NKLR dataset. The primary outcome was probability of revision ACL reconstruction within 1, 2, and/or 5 years. Data was split randomly into training (75%) and test (25%) sets. Four machine learning models were tested: Cox Lasso, survival random forest, generalized additive model, and gradient boosted regression. Concordance and calibration were calculated for all four models.

Results The dataset included 24,935 patients, and 4.9% underwent revision surgery during an average follow-up of 8.1 years (SD 4.1). All four models were well-calibrated, with moderate concordance (0.67–0.69). The Cox Lasso model required only five variables for outcome prediction: graft choice, femoral fixation device, KOOS QOL score at surgery, years from injury to surgery, and age at surgery. The other models either used more variables without an appreciable improvement in accuracy or had slightly lower accuracy overall. An in-clinic calculator was developed which can estimate the risk of graft failure (https://swastvedt.shinyapps.io/calculator_rev/). Whereas the overall risk of revision in the registry was 4.9%, this calculator can quantify risk at a patient-specific level.

Conclusions Machine learning analysis of a national knee ligament register can predict the risk of a patient undergoing a subsequent revision ACL reconstruction after primary surgery with moderate accuracy. This algorithm supports the creation of a machine learning calculator for point-of-care risk stratification prior to primary surgery based on the input of only five variables. Similar analysis using larger or more comprehensive data may improve the accuracy of risk prediction.

Summary Patients with elevated posterior tibial slope >=12 degrees have increased knee angular velocity during a double-leg landing task when compared to patients with posterior slope < 12 degrees.

Data Objectives Increased posterior tibial slope (PTS) has been identified as a risk factor for anterior cruciate ligament (ACL) injuries and ACL reconstruction failure. The relationship between PTS and sagittal plane knee biomechanics (such as knee angular velocity) has not been evaluated. Prior work has identified that higher knee angular velocities are associated with faster peak ACL strains, which may have implications on risk of ACL graft rupture. The purpose of this study was to evaluate the relationship between PTS and sagittal plane mechanics during jump landing in a cohort of patients after ACL reconstruction. It was hypothesized that sagittal plane landing mechanics would differ between those with PTS >= 12 degrees compared to those with PTS < 12 degrees.

Methods A cohort of patients who underwent primary, unilateral ACL reconstruction at a single institution were identified in a prospectively collected ACL database. At 2-years post-ACL reconstruction a follow-up visit was conducted to collect biomechanics data and patient reported outcome scores, including Marx Activity Score, International Knee Documentation Committee (IKDC) Score, and Knee Injury and Osteoarthritis Outcome Score (KOOS). Three-dimensional motion analysis data were collected during the initial landing phase of a bilateral drop vertical jump task. Lateral posterior tibial slope (LPTS) was measured on lateral knee radiographs of the injured knee. Biomechanical variables of interest included ground reaction forces and sagittal plane knee kinematic and kinetic variables on the reconstructed limb. Pearson correlations were calculated to evaluate the association between LPTS and biomechanical variables of interest (a=0.05). The cohort was categorized based on LPTS into low slope (PTS < 12 degrees) and high slope (PTS >= 12 degrees) groups.
Demographic, outcomes, and biomechanics data were compared between the groups with independent samples t-tests (α=0.05).

**Results** A total 29 patients with lateral radiographs for LPTS measurements and complete biomechanics data were included (17 females) with a mean age of 22.3 years (range 17 to 35 years). There were no significant differences in age, body mass index, Marx activity score, IKDC Score, or KOOS subscales between the high slope and low slope groups. The mean LPTS was 13.4 ± 0.9 degrees and 8.7 ± 1.2 degrees in the high slope and low slope groups respectively. During landing, higher involved knee angular velocity was associated with higher LPTS (r=0.43, p=0.02). Individuals with high LPTS had significantly higher involved knee angular velocity compared to patients with low LPTS.

**Conclusion** At 2 years post-ACL reconstruction, there were no differences in activity or patient reported outcome scores in those with high or low LPTS. During a double-leg landing task, high LPTS is associated with higher involved knee angular velocity. Further investigation of the associations among anatomic considerations (such as PTS), knee mechanics, and ACL graft strain are needed to identify patients at higher risk of graft rupture and inform post-operative rehabilitation and discussions regarding graft failure risk.

**RELATIONSHIP BETWEEN BODY MASS INDEX AND MID- TO LONG-TERM PATIENT OUTCOMES AFTER MULTI- LIGAMENTOUS KNEE INJURY**

Robert A Duerr, Danny Tan, Robert A Magnussen, Alex C Dibartola, Christopher C Kaeding, David C Flanigan. USA

**Summary** Morbid obesity is associated with poorer mid- to long-term patient reported outcomes following surgical treatment of multiligament knee injuries compared to patients with BMI < 30 kg/m2.

**Data**

**Objectives** Multi-ligamentous knee injuries (MLKI) can be debilitating and result in persistent functional limitations. These severe injuries are seen with increasing frequency in patients with elevated body mass index (BMI). The impact of elevated BMI on mid- to long-term outcomes after MLKI is not clear. We hypothesize that patients with elevated BMI demonstrate worse patient-reported outcome scores at mid- to long-term follow-up after surgical treatment of MLKI.

**Methods** Records were reviewed to identify patients treated surgically for MLKI at a single institution between July 2005 and June 2018. Chart review was performed and patient demographics, injury information, and surgical data were collected. Patients were subsequently contacted and asked to complete a patient-reported outcomes assessment including the Tegner activity scale and Knee Injury and Osteoarthritis Outcome Score (KOOS). Patients were categorized by BMI into three categories based on Centers for Disease Control and Prevention (CDC) guidelines: normal/overweight (BMI < 30 kg/m2), obese (BMI from 30 to 39.9 kg/m2), and morbidly obese (BMI = 40 kg/m2). Patient-reported outcomes were compared among the three groups using ANOVA testing. Multiple linear regression analysis was used determine whether obesity or morbid obesity were associated with poorer patient-reported outcomes compared to the BMI < 30 group, controlling for age at injury and mechanism of injury.

**Results** A total 58 patients with 62 MLKI completed patient-reported outcomes scores at a mean follow-up of 8.1 years from surgery (range: 2.6 to 14.9 years). Mean age at the time of injury was 30.2 years (range: 17 to 63 years) and mean BMI at the time of injury was 30.3 kg/m2 (range 18.5 to 78.8 kg/m2). Overall patient reported outcome scores at follow-up were: Tegner: 4.8 ± 2.1, KOOS symptoms: 76.8 ± 17.3, KOOS pain: 82.3 ± 16.7, KOOS ADL: 87.7± 15.6, KOOS Sport: 63.8 ± 30.2, and KOOS Knee QOL: 58.6 ± 25.6. Morbidly obese patients (BMI = 40 kg/m2) were noted to have lower KOOS scores than those with BMI < 30 kg/m2 (p < 0.05). Significantly lower Tegner score were noted in the morbidly obese group (2.1 ± 1.2) compared to the obese (5.1 ± 2.0) and BMI < 30 kg/m2 (5.2 ± 2.0) groups (p < 0.05). No significant differences in KOOS or Tegner scores were noted between obese patients (BMI from 30 to 39.9 kg/m2) and those with BMI < 30 kg/m2. Multiple linear regression demonstrated poorer patient-reported outcomes in the morbidly obese group compared to the BMI < 30 kg/m2 group (all p < 0.05), but no significant differences were noted between the obese group and the BMI < 30 kg/m2 group, controlling for patient age and mechanism of injury.

**Conclusion** Morbid obesity is associated with poorer mid- to long-term patient-reported outcomes following surgical treatment of MLKI compared to patients with BMI < 30 kg/m2, controlling for age and mechanism of injury. Patients with BMI between 30 and 40 did not have poorer outcomes compared to patients with BMI < 30.
positions (%), the mechanical femorotibial angle (mFTA) and the mechanical medial proximal tibial angle (mMPTA) were determined (mean±SD [range], PACS). After conducting the preoperative planning for each case with the WBL crossing the tip of the lateral eminence, the ‘planned’ mFTA and mMPTA were measured (Dugdale method). All measurements were conducted in two-fold by two blinded observers. The intraclass correlation coefficient (ICC) and the eminence imaging correlation statistics were performed in SPSS 26.0.

RESULTS For the 70 HTO cases, the medial tibial eminence was located at 41.8±1.9 [38–47%] in 2-D and 42.2%±2.0 [38–48%] in 3-D showing a high correlation (r=0.8271 (0.7349 to 0.8893)). The lateral tibial eminence was located at 58.3%±1.9 [55–63%] in 2-D and 57.3%±2.2 [53–63%] in 3-D showing a high correlation (r=0.7657 (0.6472 to 0.8481)). A good to excellent ICC (ranging 0.8346–0.9193) was observed. For the 100 HTO cases only measured in 2-D, the medial eminence was positioned at 42.1%±1.7 [38–47%]. The lateral eminence at 58.5%±1.8 [54–65%], the preoperative mFTA was 173.8°±2.3 [167.8–177.5°], and mMPTA 85.8°±2.2 [81.5–91.2°]. While aiming the WBL on the lateral eminence, the planned mFTA was 181.8°±0.3 [181.2–182.5°] and the mMPTA was 93.8°±2.2 [89.2–100.7°]. The ICC was found to be good for the planned mFTA (0.804) and excellent for all other parameters (ranging 0.953–0.995).

Conclusion Although frequently used as a target while planning corrections for HTO procedures, little is known about the exact position and variance of the lateral tibial eminence throughout the population. This study found that, in the average HTO patient, the medial and lateral eminences are located at respectively 42% and 57%–58% on the tibia plateau with both showing a 10% maximal variance. Good agreement between the 2-D and 3-D imaging modalities was found while evaluating tibial eminence positions in the coronal plane. Furthermore, aiming the WBL through the lateral tibial eminence during HTO planning, will consistently produce 2° of valgus (±1°) mFTA. Meanwhile, the planned mMPTA remains highly dependent on the existing bony varus deformity of the tibia.
shoulder instability. Radiographic measurements of glenoid diameter, glenoid bone loss, Hill-Sachs interval (HSI), HS/glenoid track (HS/GT) ratio, and hill-sachs depth were performed for all patients with magnetic resonance imaging (MRI). All patients were contacted at final follow-up to collect outcome scores (PASS and SANE scores, activity level). All patients had minimum 24-month follow-up. Failure was defined as revision surgery or post-operative subjective instability.

Results 59 patients, 46 males and 13 females with a median age of 16 years [15, 17] were included. 10 patients (17%) had revision surgery and 8 patients (14%) had subjective instability without revision. In univariate analysis, patient height was the only patient factor which was significantly different between the revision/instability (RI) cohort and the non-revision/instability (NRI) cohort. Intra- and inter-rater reliability (ICCs) for radiographic measurements were good to excellent for all measurements. The only radiographic variable which was statistically significantly different between the RI and NRI cohorts was glenoid diameter. Percent glenoid bone loss, glenoid track, HSI, and HS/GT ratio, were no different. 5 patients measured "off track" with a HSI:GT >1, but this was not associated with RI. Subgroup analysis of 38 patients with a hill-sachs defect identified significantly greater HSI and HS depth in the revision surgery cohort (20.9 mm, 6.8 mm respectively) as compared to no revision (13.9 mm, 5.0 mm respectively), (p=0.001, p=0.031 respectively). Among patients with a HSI >/=15 mm, there was a 50% rate of revision surgery. Patient reported outcome measures were obtained in all patients PASS and SANE scores at final follow-up were significantly lower in the RI cohort (75.5 and 67.5, respectively) as compared to the NRI cohort (98 and 98 respectively), p<0.001. 74% of NRI patients returned to the same or higher level of sport following surgery, as compared to 56% of RI patients, but this did not reach statistical significance (p=0.225).

Conclusions 31% of adolescent patients in our cohort had revision instability surgery or reported subjective feelings of instability following arthroscopic bankart repair. This was associated with inferior PASS and SANE scores and lower rates of return to sports. Off-track lesions, as measured by HS/GT ratio, were identified in 8.5% of our cohort, but were not predictive of failure with primary bankart repair. Among patients with a HS defect, greater HSI and HS depth was associated with revision surgery. This study includes the highest risk patient population for recurrent instability based on prior studies – male, adolescent, contact sport athlete – and this likely is a confounding factor in identifying additional clinical and radiographic predictors of failure. In our adolescent series, the current definition of "off-track" does not appear to reliably predict failure with isolated bankart repair.

Summary Mesenchymal stem cell exosomes and hyaluronic acid combination administered at a clinically acceptable frequency of three intra-articular injections promote osteochondral repair with significantly improved morphological, histological, and biomechanical outcomes in a clinically relevant porcine model.

Data Purpose We had previously reported the efficacy of human mesenchymal stem cell (MSC) exosomes in repair of critical-size osteochondral defects in rats and rabbits. To enable clinical translation of MSC exosomes, we proposed a validation of the efficacy of MSC exosomes in a large animal model.

Materials & Methods Bilateral osteochondral defects (6 mm diameter and 1 mm depth) were surgically created on the medial femoral condyles of 24 knees in 12 micropigs. Immediately after surgery and at days 8 and 15 post-surgery, 6 micropigs in exosome/HA group received sequential administration of 1mg exosomes in 1ml phosphate-buffered saline (PBS) followed by 1ml hyaluronic acid (HA; Synvisc®) in both knees, whereas the other 6 micropigs in the HA group received 1ml of PBS followed by 1ml HA in both knees. Except for MRI performed on day 15, 2 and 4 months, macroscopic, histological, biomechanical, and micro-CT assessments were performed at 4 months.

Results At 4 months, exosome/HA-treated defects had significantly higher MRI scores than that for HA-treated defects at day 15 (4.46 vs 3.63; P=0.017), 2 months (7.83 vs 5.79; P=0.023) and 4 months (9.25 vs 6.71; P=0.024). Exosome/HA-treated defects also had significantly better ICRS macroscopic score (9.22 vs 7.25; P=0.008) and ICRS II histological score (79.71 vs 65.10; P=0.032) than HA-treated defects. The mean Young’s moduli of exosome/HA-treated defects were higher than that of HA-treated defects in the defect periphery (19.92 vs 3.50MPa; P=0.003) but modestly in the defect centre (15.17 vs 3.53MPa; P=0.119). Micro-CT analysis revealed structural improvements in the subchondral bone with significantly higher BV/TV and Tb.Th in exosome/HA-treated defects than in HA-treated defects. Importantly, no adverse responses or systemic alterations were observed.

Conclusion MSC exosomes and HA combination administered at a clinically acceptable frequency of three intra-articular injections promote osteochondral repair with significantly improved morphological, histological, and biomechanical outcomes in a clinically relevant porcine model.

Summary One of the most common complications in anterior cruciate ligament reconstructions is high donor site morbidity. We propose that contralateral quadriceps graft could be a reasonable option especially in patients that have poor tolerance to pain and need to return to work sooner.

Data Introduction One of the most common complications in anterior cruciate ligament reconstructions is high donor site morbidity and postoperative pain, which is often associated with difficulties in the restoration of motion and delayed return to
daily activities. The objective of this paper is to compare postoperative pain, time to return to daily activities, and other clinical outcomes, in two groups of patients undergoing primary ACL reconstructions with autologous bone-quadriceps tendon (BQT) graft from the ipsilateral or contralateral knee. We propose that contralateral BQT could be a reasonable option especially in patients that have poor tolerance to pain and need to return to work sooner.

Methods Patients with primary ACL reconstruction using autogenous BQT graft were non-randomized and prospectively evaluated. Patients were given the choice of where to obtain the graft from, either from the ipsilateral knee (injured) or from the contralateral knee (healthy). It was explained to the patients that, according to our experience, patients operated on with contralateral knee graft suffered less pain in the immediate postoperative period, because the surgical trauma was divided between the two knees and that they could have a sooner return to daily activities or light work. It was also explained to the patients that, as a disadvantage, a totally healthy knee was being operated on, with possible surgical complications. The inclusion criteria were isolated ACL tears, less than one year from injury to surgery, use of an autologous quadriceps tendon graft, and correct follow-up. Patients with associated ligament injuries, meniscal repairs, Outerbridge II or higher osteochondral injuries, patellofemoral pathology, and revision surgeries were excluded. We evaluated postoperative pain, the amount of analgesics consumed, time to full range of motion, and time to return to activities of daily living and sport activities.

Results Seventy-eight patients with primary ACL reconstruction using autogenous BQT graft were prospectively evaluated. In 34 patients (Group A) the graft was obtained from the ipsilateral knee, in the others 44 patients (Group B) the graft was obtained from the contralateral knee. Patients in Group B had less postoperative pain than Group A (1.8 ± 0.6 - 3.1 ± 0.6 - p < 0.0001) consumed less amount of pain medication (p<0.0001), and re-established flexion and extension faster than those with ipsilateral graft harvest (P < 0.0001). Group B patients also returned earlier to their daily activities (26.3 ± 15.3 days) than those in Group A (37 ± 11.42 days) (p < 0.0001). Patients in group B return to work sooner than group A (Graph 3). There was no difference in time to return to sport.

Conclusions Patients operated with contralateral quadriceps tendon graft have less postoperative pain, achieve earlier full mobility, consume less pain medication post-operatively, and return faster to activities of daily living and work than those undergoing ipsilateral graft harvest. We think contralateral harvest of BQT graft is an excellent choice especially for patients who have poor pain tolerance and in those in which a quicker return to their activities of daily living or work is a priority.

Summary High-grade acromioclavicular dislocation is a frequent injury in rugby players. Even though surgical treatment of Type IV and V, is the treatment of choice, we think that conservative treatment could be a reasonable option in this kind of collision athletes.

Data

Introduction There is a consensus that surgical treatment is the treatment of choice of Type IV and V acromioclavicular dislocations (ACD). When it comes to the treatment of high-grade ACD in rugby players, however, we believe that this pathology could be handled from a different perspective, as return-to-play is these patients’ main concern and aesthetic deformities do not usually present a problem for them. On the other hand, collision athletes are exposed to a high risk of recurrence. The objective of this study is to report the long-term results of conservative treatment of grade IV and V acromioclavicular dislocation in a group of rugby players.

Methods We retrospectively evaluated nonoperatively treated male rugby players with grade IV and V ACD at a minimum of a five-year follow-up. All patients were evaluated by the UCLA and Constant scores, and the visual analogue scale of pain (VAS) from 0 to 10, as well as the satisfaction degree from 0 to 10, were obtained. Return-to-sport time and whether the patient received local corticosteroids injections were also documented. Possible comorbidities such as pain for daily activities, cosmetic discomfort, mobility deficit, and any limitations concerning recreational sports activities were additionally recorded. A comparative Zanca view X-ray was performed for all patients.

Results There were 87 patients, 72 (82.75%) with type V AC joint dislocation and 15 (17.25%) with type IV. The average age at the time of injury was 24.2 years (14 - 37) and the average follow-up time was 13.8 years (5 - 23). The return to sports time was 3.8 weeks (1 - 12), the average return-to-play time for the patients that received a cortisone injection was 2.1 weeks (1 - 9), whereas for the no injection group it was 4.9 weeks (2 - 12). Of the 87 patients, 49 (56.32%) reported no pain for daily activities, 33 patients (37.5%) had some minor pain or discomfort, 5 patients (5.74%) continued to experience moderate pain, and no patients presented with severe pain. The visual analogue scale average was 2.2 points (0 - 5). Regarding aesthetic discomfort, only 4 patients (4.59%) experienced significant discomfort, 29 (33.33%) manifested less discomfort, and the remaining 54 patients (62%) did not present any aesthetic discomfort. The result of the UCLA score was 31.3 points (28 - 35), Constant score average was 88.2 points (68 - 100) and the VAS was 2.2 (0 - 5). The average separation in the Zanca View X-ray was 198% (106 - 309%). Only 3 patients (3.45%) underwent surgery in the chronic face due to bad results. The degree of satisfaction was 7.8 points (5-10) and no patient regretted not undergoing surgery.

Conclusions Rugby players with type IV and V ACD, have good long-term functional results with conservative treatment. We believe that it is an acceptable therapeutic option in this type of patients as it allows for an almost immediate return to play and, in case of failure, these patients can still undergo an anatomical reconstruction in a delayed form.
Combining Sensor and Robotic Technologies to Balance Total Knee Arthroplasties

Julien Bardou-Jacquet, Jérôme Murgier, François Laudet. France

Summary The primary objective of this study was to demonstrate the ability to achieve a quantitatively balanced knee by combining robotic arm (MAKO, Stryker, Kalamazoo, Michigan, USA) and intra-operative load sensors (Verasense, Orthosensor, Inc, Dania Beach, Florida, USA), while avoiding any soft tissue corrections. Achieving a balanced total knee throughout the entire range of motion leads to improved patient reported outcomes and satisfaction (Hasegawa et al., 2018; Golladay et al., 2019). Sensor-assisted technology allows the surgeon to quantitatively assess and address imbalance through either soft tissue releases or bone recuts (Meneghini et al., 2016; Gustke et al., 2017). However, balancing through soft tissue releases leads to unpredictable gap increments and frequently, to early over-releases (Kwak et al., 2016). The primary objective of this study was to demonstrate the ability to achieve a quantitatively balanced knee by combining robotic arm (MAKO, Stryker, Kalamazoo, Michigan, USA) and intra-operative load sensors (Verasense, Orthosensor, Inc, Dania Beach, Florida, USA), while avoiding any soft tissue corrections. During a consecutive and prospective series of 45 robotic arm total knee arthroplasties, intra-operative load sensors, were used following the initial bone resections to quantitatively assess the knee’s state of balance through the range of motion with trial components in place. Load measurements were taken at 10 and 90 degrees of knee flexion. A balanced knee was defined as a force between the femur and the tibia between 22 and 200 Newton, with a difference between the lateral and medial side less than 66 Newton (Gustke et al). Depending on these parameters, the thickness of the polyethylene insert and/or a bone recut(s) is made. The bone recuts are made with the interface of the robotic arm in the three planes of space, half-millimeter by half-millimeter with between each new recut a control by the load sensor. The initial load numbers were recorded as well as the number and type of subsequent corrections needed to achieve quantitative balance. Of the 45 robotic cases, only 18 (40%) were well-balanced after the initial bone cuts (restricted kinematic alignment adjusted after tensioning collateral ligaments during surgery). In 26 cases, one or two, and rarely, even three bone recut(s) were required to balance the knee. It should be explicitly noted that no soft tissue releases were done for any of the 45 cases. The posterior cruciate ligament was left intact. At the end of the procedure 42 cases (93%) were well balanced in extension, 39 (86%) in flexion and 37 (82%) in flexion and in extension. Based on this preliminary series, an opportunity to combine multiple technologies to achieve a quantitatively balanced knee through a full range of motion has been demonstrated. This study emphasizes the prospect of achieving a balanced knee joint while only relying on patient-specific bone recuts guided by intra-operative load sensor readings, thus sparing the soft tissues surrounding the knee joint. The data collected will help make the procedure reproducible, predictable and thus enhance concepts of ligament balancing in total knee arthroplasty, thereby potentially improving patient satisfaction.

A New Posterior Triceps Approach for Total Elbow Arthroplasty in Patients with Osteoarthritis Secondary to Fracture: Clinical Experience

Andrea Celli. Italy

Summary We describe a novel triceps exposure approach for TEA, the anconeus-triceps lateral flap, which has proved valuable in patients with distal humeral and olecranon fractures malunion, and its preliminary results at a minimum follow-up of 24 months.

Data

Aim We describe a novel triceps exposure approach for TEA, the anconeus-triceps lateral flap, which has proved valuable in patients with distal humeral and olecranon fractures malunion, and its preliminary results at a minimum follow-up of 24 months.

Background Over the past decade, total elbow arthroplasty (TEA) procedures have increased due to an increase in the number of trauma patients. Most current posterior approaches to the elbow provide excellent joint exposure, but involve the risk of extensor mechanism injury and eventual insufficiency, particularly in patients with osteoarthritis (OA) secondary to fracture.

Methods Twenty consecutive patients with OA due to distal humeral and olecranon fractures malunion underwent TEA by the anconeus-triceps lateral flap approach, which preserves the olecranon insertion of the medial portion of the triceps proper tendon.

Results At a mean follow-up of 33 months, the mean Mayo Elbow Performance Score rose from 41.3 to 94.3. The mean score of the visual analog scale for pain fell from 7.1 to 1.1. There were no patients with insufficiency or secondary detachment of the triceps tendon reporting grade 4 to 5 of the Medical Research Council scale. Discussion: These preliminary data suggest that preservation of the insertion of the medial portion of the triceps proper tendon enables earlier active rehabilitation. Moreover, the new approach provides optimum exposure of the olecranon also in patients with OA secondary to intra-articular fracture of the distal humerus and olecranon, where scarring and bone deformity usually hamper joint exposure.

Conclusion The present preliminary data suggest that preservation of the medial portion of the triceps tendon insertion in patients undergoing TEA for OA secondary to fracture: i) reduces the risk of triceps insufficiency and enables early active rehabilitation; ii) affords optimum surgical exposure of the olecranon articular surface, especially in elbows with severe fracture malunion, like the patients described here; iii) and allows adequate alignment of the olecranon and the posterior ulnar surface without the interposition of the entire triceps muscle-tendon unit between the planes, since the relationship between them is a key landmark for ulnar component positioning.
CLINICAL RESULTS OF THE BIPOLAR RADIAL HEAD REPLACEMENT IN ACUTE AND CHRONIC LESIONS OBSERVED IN LARGE GROUP OF THE PATIENTS

Andrea Celli. Italy

Summary The aims to analyse the advantages and disadvantages of this design and to evaluate the types and clinical aspects of the complications observed.

Data

Introduction The radial head prosthesis are useful for restoring the elbow and forearm stability when the radial head is unrepairable in acute and chronic lesions. Little information with small series of patients have been reported in the literature on the bipolar radial head design used in acute and chronic elbow lesions. The propose of the current study is to report the results obtained in large series of the patients treated using the bipolar design for acute and chronic elbow lesions.

Materials and Methods

We performed in our Institution between 2000 to the end of 2009, 95. implants of bipolar radial head prosthesis. 70 consecutive patients were followed up with a minimum of 24 months, 39 implant were used in acute elbow lesions and 31 for chronic post-traumatic lesions. All the surgical procedures were performed using the same bipolar prosthesis. All the patients underwent clinical and radiographic evaluations. The clinical data were collected and analysed using the Mayo elbow performance score and the Dash score and the patient’s satisfaction. The radiographic evaluations were performed in static view (antero-posterior and lateral views) and in dynamic way using the fluoroscopy evaluations. The complications were divided in two groups, involving the prosthesis or the elbow joint to better understand the disadvantage of this prosthesis design.

Results

70 patients (47 males and 23 females, mean age 44.5 years) were followed up with mean follow-up of 39.1 months. According to MEPS, in the acute group we obtained 32 excellent results and 2 good, one fair, four poor, in chronic group the excellent result were observed in 22 patients, four good, one fair and four poor. According to Dash in the acute lesions we observed at the last follow-up a mean value of 11.6 points (range from 0 to 62.5), in the chronic lesion the mean value was 8.5 points (range from 0 to 35.3). The complications observed correlated to the implant design were found in 6 patients (31.6% of all the complications), 68.4% of complications were correlated to the joint and not to the implant.

Discussion and Conclusion

From our experience, the bipolar design obtain significant advantage in the treatment chronic elbow lesion in particular if associated to the ulna fracture that involve the less sigmoid notch. The bipolar design can adapt itself to the anatomic variability of the elbow and can compensate the malreduction of the radial sigmoid notch, this consideration was confirmed by our results.

CHOICE OF DISTALISING TIBIAL TUBERCLE OSTEOTOMY DOES NOT SIGNIFICANTLY AFFECT RISK OF TIBIAL SHAFT FRACTURE AT TIME ZERO: A COMPOSITE SAW BONE AND FINITE ELEMENT ANALYSIS (FEA) STUDY

Alexander S Nicholls, Samuel Grasso, Tegan Cheng, Myles RJ Coolican, David Little. Australia

Summary Choice of distalising tibial tubercle osteotomy does not significantly affect risk of tibial shaft fracture (at time zero)

Data

Introduction Tibial tubercle osteotomy (TTO) is a commonly used surgical treatment for patients with recurrent patellofemoral instability. The presence of significant patella alta is an indication for distalisation of the tibial tubercle and this necessitates a cut in the anterior cortex of the tibia. This causes a weakness in the tibia which may result in the rare complication of tibial shaft fracture during the perioperative period. A step cut is thought to cause the greatest stress riser. Our hypothesis was that a step cut at the distal end of a TTO would cause a greater stress riser than a bevelled cut at time zero. METHODS Composite saw bones with cortical and cancellous components which are mechanically validated against human bones were used. Three types of osteotomy were performed using 3D-printed cutting jigs (step cut, bevelled cut and “V” cut; n = 4 per group) and compared to a control group with no osteotomy (n = 4). Tibia were stressed to the point of fracture using a 4-point bending technique in a 10 kiloNewton Instron machine. Mechanical data was then entered into an FEA model for further analysis.

Results

Mean differences between groups were as follows: control vs step cut 2935 N (95% CI 1113–4758; p = 0.0022), control vs V cut 3752 (95% CI 1929–5574, p = 0.0003), control vs taper cut 4050 N (95% CI 2228–5873; p = 0.0001), V cut vs step cut –816 (95% CI –2639–1006; p = 0.56), V cut vs taper cut 298 N (95% CI -1524–2121; p = 0.96), step cut vs taper cut 1115 N (–707–2937; p = 0.31).

Conclusion All types of TTO were associated with increased tibial shaft fracture risk at time zero (mean 39.6% reduction in tibia strength versus control group). Contrary to our hypothesis, TTO with distal step cut was not associated with an increased fracture risk. Consequently, bevelled and “v-shaped” cuts were not associated with reduced fracture risk. All data is tested at time zero and does not account for duration of healing or fixation used in vivo. Despite using symmetrical lab-tested saw bone models there was variation in loads to failure in each group.

RETURN TO SPORTS AFTER PAEDIATRIC ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION (ACLR): NORMAL POPULATION VS AN ACLR COHORT

1Alexander S Nicholls, 2Jillian Lee, 1Yoong Lim, 1Quang Dao. 1Australia; 2New Zealand

Summary 12 months after ACLR, most children demonstrate significant deconditioning on their uninjured leg relative to a normative population

Data

Introduction Return to sport (RTS) functional testing post-ACLR relies on the comparison against the healthy limb (with >90% performance considered satisfactory). Limited normative paediatric population data exists. In addition, the effect of leg dominance in this population is unknown. We hypothesised that the normal limb (uninjured limb) in paediatric patients 12 months post-ACLR would differ from the normal population values, in functional RTS testing. In addition, we hypothesized that limb dominance would account for significantly better
ROLE OF HUMAN AMNIOTIC MEMBRANE AND PRF IN UNCEMENTED TANTALUM METAL COMPONENTS IN TOTAL KNEE ARTHROPLASTY: 11- TO 15-YEAR OUTCOMES OF A SINGLE-BLINDED RANDOMIZED CONTROLLED TRIAL

Matthew Hampton, Junaid Mansoor, Paul M Sutton. UK
10.1136/jisakos-2021-congress.185

Summary The use of an un cemented trabecular metal tibial implant can afford better long-term clinical and radiographic outcomes when compared to cemented tibial components of a matched design.

Data

Introduction Total knee arthroplasty is an established treatment for knee osteoarthritis with excellent long-term results, but there remains controversy about the role of un cemented prostheses. We present the long-term results of a randomized trial comparing un cemented tibial metal tibial components with
Materials and Methods 90 Patients of 70 years or less with symptomatic osteoarthritis of the knee were randomized to receive either an uncemented tantalum metal tibial monoblock component or a standard cemented modular component. The same cruciate retaining total knee system was used in both groups. All patients received an uncemented femoral component and no patients had their patella resurfaced. Patient outcomes were assessed preoperatively and postoperatively using the modified Oxford Knee score, knee Society score, and 12-Item Short-Form Health Survey questionnaire (SF-12) score. Radiographs were analysed using the American Knee Society Radiograph Evaluation score. Operative complications, reoperations or revision surgery were recorded.

Results The mean patient age at time of recruitment to the study was 63 years (50-70), 46 (51.1%) knees were in male patients and the mean BMI was 30.4 (21-36). At last review, all patients were between 11 and 15-years following surgery, 11 had died and 2 were lost to follow-up. Of the remaining patients 41 of the knees were cemented and 36 uncemented. There were no revisions in the cemented group and one revision in the uncemented group for fracture. At long term follow-up the uncemented group reported better improvements in Oxford and Knee Society scores compared with the cemented group. These improvements were statistically and clinically significant (p = 0.001). The global (SF-12) scores demonstrated no statistical difference (P=0.81). Uncemented knees had better radiological analysis compared with the cemented group (p < 0.001)

Conclusion Use of an uncemented trabecular metal tibial implant can afford better long-term clinical outcomes when compared to cemented tibial components of a matched design. However, both have excellent survivorship up to 15 years after implantation.

Summary PSI is better in terms of achieving neutral mechanical alignment much more consistently than conventional instrumentation. The technique provides additional advantages of lesser blood loss, decreases surgical time and improves predictability of implant size. The technique has no impact on clinical outcomes at least in the short term.

Data

Introduction Following anterior cruciate ligament (ACL) injury, quantitative pivot shift (QPS) testing using the PIVOT technology can detect high- and low-grade rotatory instability.(1,2) Previously, preoperative rotatory knee laxity measured using an optical tracking system with manual load application was shown to predict postoperative rotatory knee laxity following ACL reconstruction (ACLR).(3) However, this study was performed with non-standardized external loads leading to potential error. To better inform treatment decisions, we aimed to determine whether a correlation exists between preoperative QPS and postoperative knee kinematics during running at 6 and 12 months following ACLR with or without lateral extraarticular tenodesis (LET) using a highly precise in vivo analysis system.(4) A positive correlation between preoperative QPS and postoperative anterior-posterior tibial translation and internal-external tibial rotation at 6...
and 12 months following ACLR with or without LET was hypothesized.

**Methods** Twenty patients with an ACL injury (age 20.8 ± 6.8 years, 12 males) were randomized to undergo anatomic ACLR with or without LET using either bone-patellar tendon-bone or quadriceps tendon autograft as part of a prospective randomized trial (No. NCT0291340). To be included in this study, preoperative examination under anesthesia demonstrating high-grade rotatory instability (=3 mm of lateral compartment translation or a side-to-side difference =50% using PIVOT technology) was required.(2) At 6 and 12 months postoperatively, in vivo kinematic data was collected using dynamic bilanar radiography superimposed with high-resolution computed tomography scans of patients’ knees during downhill running at 2 m/s.(4) Total (maximum subtracted by minimum) anterior-posterior tibial translation and internal-external tibial rotation were calculated from foot-strike to mid-stance of the gait cycle. Spearman’s rho was calculated to evaluate for correlation between preoperative QPS and postoperative kinematics using SPSS statistics (IBM) with p<0.05.

**Results** Preoperatively, all patients were confirmed to have high-grade rotatory knee instability with a QPS of 5.0 ± 1.6 mm. No statistically significant correlations were observed between preoperative QPS and total anterior-posterior tibial translation, or between preoperative QPS and total internal-external tibial rotation at 6 and 12 months postoperatively for combined ACLR and ACLR with LET patients as well as ACLR patients or ACLR with LET patients analyzed separately. Discussion: The main finding of this study was that there were no significant correlations between preoperative QPS and postoperative in vivo kinematics at 6 and 12 months following ACLR with or without LET. These findings suggest that preoperative QPS does not correlate with postoperative rotatory knee stability following anatomic ACLR as there are likely other patient, injury, and surgical factors which play a role in determining postoperative knee kinematics. In addition, additional LET does not appear to be necessary in all cases of high-grade rotatory instability as other factors such as graft choice may be more important. In conclusion, additional LET does not appear to be required in all cases of high-grade rotatory instability as preoperative instability does not correlate with postoperative in vivo kinematics following ACLR with or without LET. References: 1)Musaalh. AJSM. 2016. 2)Hoshino. KSSTA. 2012. 3)Signorelli. Scand J Med Sci Sports. 2013. 4) Anderst. Med Engl Phys. 2009.

**Background** Acute Achilles tendon rupture is one of the most common sports injuries affecting 18 per 100,000 population, and its operative repair has been gaining ground since the mid-1900s. Traditionally, surgical open repair has provided improved functional outcomes, reduced rupture rates, and quicker recovery and return to activities at the expense of increased wound complications of infection and skin necrosis in comparison to nonoperative management. Ma and Griffith in 1977 introduced the percutaneous approach, and over the following decades, multiple improved techniques, and modifications thereof, have been described with comparable outcomes to the open repair. AIM: The current study aims to provide updated evidence comparing the open and minimally invasive (MIS) through a comprehensive search of literature published in English, Spanish, Portuguese, and German while avoiding limitations of previous studies such as heterogeneous study designs and a small number of included studies. LEVEL OF EVIDENCE: I, meta-analysis of RCTs.

**Methods** Following the PRISMA guidelines, two independent team members searched several databases to identify randomized controlled trials comparing open and MIS Achilles tendon repairs. The primary outcomes were (1) Sural nerve injury, (2) Skin complications, (3) Infection (deep/superficial) whereas the secondary outcomes were (1) AOFAS/ATRS score, (2) surgical time, (3) re-rupture (4) adhesions (5) ankle range of motion.

**Results** Ten RCTs qualified for the meta-analysis with a Total of 522 patients. 260 (49.8%) patients had open repair while 262 (50.2%) had MIS repair. The mean surgical time was 51 and 29.7 minute for open and MIS repair, respectively with statistically significant difference (MD= 21.13, 95%CI= 15.50–26.75, p < 0.001; I2= 15%). The pooled mean total complication rate was 15.5% (0–36.4%) in open repair and 10.4% (0–45.5%) in MIS repair, with non-significant difference (RR= 1.50, 95%CI= 0.87–2.57, p = 0.14; I2=40%). The mean re-rupture rate was 2.5% (0–6.8%) in open repair vs. 1.53% (0–4.6%) with MIS repair, with non-significant statistical difference (RR= 1.56, 95%CI= 0.42–5.70, p = 0.50; I2=0%). No cases of sural nerve injury were reported in the open repair group. The mean sural nerve injury was 3.4% (0–7.3%) in the MIS repair group, that was statistically significant (RR= 0.16, 95%CI= 0.03–0.46, p = 0.02; I2=0%). The mean overall deep infection rate reported in the open group was 1.4% (0–5%) while no deep infection was reported in MIS, with no statistically significant difference (RR= 3.24, 95%CI= 0.48 to 20.54, p = 0.23; I2=0%). The mean overall superficial infection rate was 6.04% (0–18.2%) and 0.40% (0–4.5%) for open and MIS repairs, respectively, with statistically significant difference (RR= 5.70, 95%CI= 1.80–18.02, p< 0.001; I2=0%). Average postoperative American Orthopedic Foot and Ankle Society (AOFAS) score was 94.8 and 95.7 for open and MIS repair, respectively with non-significant difference (MD=0.73, 95%CI=1.70–2.05, p=0.14; I2= 0%, p< 0.001). There were no significant differences between open and MIS repair groups in skin necrosis and dehiscence rate, adhesions rate, or keloid scar rate.

**Conclusion** Open Achilles tendon repair is associated with longer surgical time, higher risk of superficial infection and ankle stiffness, while MIS repair is associated with greater risk of temporary sural nerve palsy. Re-rupture rate and functional outcomes are mostly equivalent. We found MIS to be a safe and reliable technique, however, high quality standardized RCTs are still needed before recommending MIS as the gold standard for the management of Achilles tendon rupture.
OUTCOMES OF ARTHROSCOPIC VS. OPEN BROSTRÖM SURGERY FOR CHRONIC LATERAL ANKLE INSTABILITY. A SYSTEMATIC REVIEW AND META-ANALYSIS OF COMPARATIVE STUDIES

Ahmed Khalil Attia, 1 Tarek Taha, 1 Karim Mahmoud, 1 Kenneth J Hunt, 1 Sameh (Sam) A Labib, 2 Pieter D Hoogeve. 1 USA; 2 Qatar

Summary While technically more demanding, arthroscopic Broström is superior to open Broström-Gould surgery in AOFAS functional scores at six and twelve months, time to return to weight-bearing, and VAS pain scores.

Data Background Ankle sprains are the most common ankle injury accounting for up to 85% of all ankle injuries, and nearly 20% of acute ankle sprains progress to chronic lateral ankle instability that requires surgical intervention. In recent years, there has been a growing interest in arthroscopic Broström techniques as an alternative to open surgery. In the past two years alone, four comparative studies have been published. Recent case series and cohort studies showed reliable improvement in clinical and radiographic outcomes with arthroscopic surgery. AIM. The current study aims at providing the foot and ankle surgery community with the most updated evidence comparing outcomes of open to arthroscopic Broström procedure for chronic lateral ankle instability.

Methods This article was performed following the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines. Relevant comparative studies in English literature were identified between database inceptions to May 2020. The primary outcomes were (1) Functional scores (KAFS, AOFAS) and (2) Pain score on VAS, whereas the secondary outcomes were differences in (1) anterior drawer and talar tilt, (2) surgical time and complications rate, (3) time to return to sports and weight-bearing. Level of Evidence: III

Results A total of 408 patients in eight studies met the inclusion criteria were subjected to analysis. 193 (47.3%) patients underwent open surgery, while 215 (52.7%) patients underwent arthroscopic surgery. All included studies were retrospective comparative studies except for one randomized controlled trial. The Mean six months-AOFAS was 82.4 vs. 92.25 in open and arthroscopic repair, respectively (MD=11.36, CI=0.14–2.56, I2=90%, p=0.03). The one year-AOFAS was 80.05 vs. 88.6 in open and arthroscopic surgery, respectively (MD=–11.96, CI=–21.26, –2.76, I2=82%, p=0.01). The mean six month-VAS was 1.7 and 1.4 in open and arthroscopic repair, respectively (MD=–0.38, CI=–0.54, –0.21, I2=78%, p<0.001). The mean one year VAS was 2.05 and 1.45 in open and arthroscopic repair, respectively (MD=0.31, CI=0.09 to 0.54, I2=0%, p<0.001). The mean postoperative KAFS was 82.7 and 87.5 in open and arthroscopic repair, respectively, with insignificant differences (p=0.63). The mean time to weight-bearing was 14.25 weeks and 9.0 weeks in open and arthroscopic repair, respectively (MD=1.89, CI=1.24 to 2.54, I2=99%, p<0.001). There were no statistically significant differences in the time to RTP postoperative anterior drawer, postoperative talar tilt, and operative repair. The total complications rate in open and arthroscopic repair was 21.3% vs. 10%, with statistical insignificance (OR=0.73, 95%CI=0.39 to 1.38, I2=0%, p=0.34).

Conclusion While technically more demanding, arthroscopic Broström is superior to open Broström-Gould surgery in AOFS functional scores at six and twelve months, time to return to weight-bearing, and VAS pain scores. Operative time, complications rate, talar tilt, and anterior drawer tests are excellent and statistically comparable. Long-term clinical trials are required before recommending arthroscopic Broström as the new gold standard.

RETURN TO PLAY AND FRACTURE UNION AFTER SURGICAL MANAGEMENT OF JONES FRACTURE IN ATHLETES. A SYSTEMATIC REVIEW AND META-ANALYSIS

Ahmed Khalil Attia, 1 Tarek Taha, 2 Geraldine Kong, 2 Abduljabbar Alhammoud, 1 Karim Mahmoud, 1 Mark Myerson. 1 USA; 2 Qatar

Summary Intramedullary screw fixation is superior to conservative management as it leads to a higher rate of return to play, shorter time to return, higher rate of union, shorter time to union, and improved functional outcomes.

Data Background Proximal fifth metatarsal fractures are among the most common forefoot injuries in athletes. Management of this injury can be challenging due to delayed union and refracture. Intramedullary screw fixation rather than conservative management has been recommended in the athletic population. AIM: This meta-analysis aims to provide an updated summary of return to play (RTP) rate and time with regard to the management, whether operative or non-operative, after Jones fractures in athletes only. We also explore the characteristic of the union such as time and rate, and complications such as refracture.

Methods Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, two independent team members searched several databases including PubMed, MEDLINE, EMBASE, Web of Science, Cochrane Library, and ClinicalTrials.gov throughout November 2019 to identify studies reporting on Jones fractures of the 5th metatarsal, exclusively in athletes. The primary outcomes were return to play rate and time to return to play, whereas the secondary outcomes were union rate, time to union, and refracture.

Results Out of 168 studies identified, 22 studies where eligible for meta-analysis with a total of 646 Jones fractures. The overall RTP rate was 98.4% (97.3%–99.4%) in 626 out of 646. The RTP rate in IM screw only was 98.8% (97.8%–99.7%), in other surgical fixations methods (plate, mini fix) was 98.4% (95.8%–100%) whereas in conservative management was 71.6% (45.6%–97.6%). There were three studies directly comparing the RTP in surgical versus conservative management, which showed significant superiority in favor of the surgical group OR: 0.033 CI:(0.005–0.215) P-value <0.001. The RTP according to type of sport was 99% (97.5%–100%) in American football, 91.1% (82.2%–99.4%) in basketball and 96.6% (92.6%–100%) in Soccer. The overall time to RTP was 9.6 (8.5–10.7) weeks. The time to RTP in the surgical group (IM screw) was 9.6 (8.3–10.9) weeks, significantly less than conservative groups, which was 13.05 (8.15–17.95) weeks. The pooled union rate in operative group (excluding refracture) was 97.3% (95.1%–99.4%), whereas the pooled union rate in the conservative group was 71.4% (49.1%–93.7%). The overall time to union was 9.1 (7.7–10.4) weeks.
weeks. Time to union in IM screw group 8.2 (7.5–9) weeks was shorter than conservative group 13.7 (12.7–14.6). The rate of delayed union was 2.5% (1.2%–3.7%), and the overall refracture rate was 10.2% (5.9%–14.5%).

Conclusion Return to play following surgical management of Jones fractures in athletes is excellent regardless of the implant used and sport. Intramedullary screw fixation is superior to conservative management as it leads to a higher rate of return to play, shorter time to return, higher rate of union, shorter time to union, and improved functional outcomes. The authors recommend surgical fixation for all Jones fractures in athletes.

20240 COMPARISON OF OUTCOMES OF HIGH TIBIAL OSTEOTOMY USING TWO PRINCIPLES OF PRE-OPERATIVE PLANNING

Nisang Shah, Rafael Sales Fernández, Kevin Syam, Benjamin Coupe, Sijith Sasi. UK

10.1136/jisakos-2021-congress.191

Summary Comparison of radiological and functional outcomes of high tibial osteotomy between two principles of pre-operative planning

Data

Objective High tibial osteotomy (HTO) is a useful alternative to knee replacement in the relatively young and active patient with medial compartment osteoarthritis. Careful pre-operative planning is required to attain the desired correction of mechanical axis. It is also important to prevent excessive proximal tibial valgus in order to avoid adverse outcomes. The objective of this study was to compare the radiological and functional outcomes of HTO by two different principles of pre-operative planning.

Methods A total of 100 patients (109 knees), 67 (71 knees) under surgeon 1 and 33 (38 knees) under surgeon 2 were retrospectively studied. Surgeon 1 used ‘Miniaci’ method for planning with focus on achieving Mikulicz point at 62.5% (principle 1). Surgeon 2 employed planning software (Trauma-Cad) and tried to keep the mechanical medial proximal tibial angle (mMPTA) < 930 (principle 2). Mikulicz point and mMPTA were compared on long leg radiographs, taken before and 3 months post surgery. Under correction was defined as Mikulicz point < 50% and over correction as > 70%. Functional outcomes were determined using Oxford Knee Score (OKS), Knee Injury and Osteoarthritis Outcome Score (KOOS) and EQ5D5L pre-operatively, at 1 and 2 year follow up.

Results Pre-operative Mikulicz point, mMPTA and functional scores were comparable between the groups. Mean post-operative mMPTA was significantly higher in group 1 (93.95 (SD 2.76)) compared to group 2 (92.13 (SD 2.37)) (p=0.01). In Group 1, 81.7% patients had post-operative correction between 50–70% compared to 65.8% in group 2. But this was not statistically significant (p=0.06). However, there were significant number of under corrections in group 2 (32.4%) in comparison to group 1 (9.8%) (p=0.003). Mean OKS and KOOS improved significantly in both the groups after surgery, while EQ5D improved only in group 1.

Conclusion The conservative approach (principle 2) of planning for an HTO appears to be effective in preventing excessive valgus at the proximal tibia, but with a higher possibility of under correction. Though not statistically significant, there appears to be a trend towards the principle 1 being more consistent in achieving the desired correction. The functional outcomes showed more positive trend with principle 1. A longer follow up is needed to study the long-term implications of these principles.

20227 RETURN TO SPORTS FOLLOWING MEDIAL PATELLOFEMORAL LIGAMENT RECONSTRUCTION FOR RECURRENT PATELLAR DISLOCATION

1Pierre Meynard, 1Matthieu Malatray, 1Elliot Sappey-Marinier, 2Robert A Magnussen, 1Sebastien Lustig, 1Elvire Servien, 1France, 2USA

10.1136/jisakos-2021-congress.192

Summary Isolated MPFL reconstruction allowed return to pre-injury sports in 91% of patients, with 67% of patients returning to the same or higher level than pre-injury.

Data

Background Recurrent patellar dislocation (RPD) is a common knee disorders in young, active patients. Medial patellofemoral ligament reconstruction (MPFLR) can restore knee stability and function, but the rate of return to sports is less clear.

Purpose to evaluate rate of return to sport following treatment of RPD with isolated MPFLR.

Methods Between January 2011 and May 2018, 113 patients with RPD were treated with isolated MPFLR at an academic center. Pre-injury sports participation and Tegner score, pre-operative subjective IKDC score, time to return to sports, and post-operative Tegner and subjective IKDC scores were collected, with a minimum of follow-up of 2 years.

Results One hundred and three patients (91%) were evaluated at a mean of 4.5 ± 2.5 years post-operative. Ninety-two patients (89%) participated in sports prior to onset of patellar instability. At final follow-up, 84 of these 92 patients (91%) were able to return to sports. The mean time from surgery to return to sports was 10.4 ± 8.6 months (range: 2 to 48 months). Sixty-two patients (74%) returned to the same (50 patients) or higher (12 patients) level. Twenty-two patients (26%) returned at a lower level. Nineteen of these patients attributed this decreased participation to ongoing knee problems. The mean Tegner score was noted to decrease from 5.2 ± 1.6 pre-injury to 4.7 ± 1.4 post-operatively (p=0.02).

Conclusion Isolated MPFL reconstruction allowed return to pre-injury sports in 91% of patients, with 67% of patients returning to the same or higher level than pre-injury. Mean time to return to sports was 10 months and post-operative Tegner score was noted to be modestly decreased from pre-injury level.

20225 RESTORING KNEE PHENOTYPE AND JOINT LINE OBliquITY REDuces POSTOPERATIVE PAIN AFTER PRIMARY TKA

Elliot Sappey-Marinier, Cécile Batailler, John Swan, Elvire Servien, Sebastien Lustig. France

10.1136/jisakos-2021-congress.193

Summary Restoring constitutional apex distal joint line obliquity resulted in improved outcomes with less postoperative pain.

Data

Aim In Total Knee Arthroplasty (TKA), knee phenotype including joint line obliquity are of interest regarding surgical
redesignation strategies. This study aims to assess the effect of restoring knee phenotype on clinical outcomes.

Methods A retrospective analysis was performed on prospective data, including 1078 primary osteoarthritic knees in 936 patients. International Knee Society Scores and standardized long-leg radiographs were collected preoperatively and two years postoperatively. Patients were categorized using the Coronal Plane Alignment of the Knee (CPAK) classification including the Lateral-Distal-Femoral-Angle (LDA) and Medial-Proximal-Tibial-Angle (MPTA), allowing knee phenotypes to be categorized considering the arithmetic Hip-Knee-Ankle (aHKA) angle (MPTA-LDFA) as measure of constitutional alignment, and Joint Line Obliquity (JLO) (MPTA+LDFA). Patients with surgically restored preoperative constitutional knee phenotype were compared with patients without restored constitutional knee phenotypes. Results 33.4% of patients had constitutional knee varus with apex distal JLO. 63.5% of patients had preoperative apex distal JLO. Postoperatively, 57.8% of patients had a neutral HKA (−2° to 2°) and a neutral JLO (−3° and 3°), with only 18% of patients with restored constitutional knee phenotype. Of these patients, less postoperative pain was observed in patients where apex distal JLO was restored compared to non-restored apex distal JLO (pain score 46.7 vs. 44.6; p=0.02). Other categories of restored JLO or HKA angle were not associated with improved outcomes.

Conclusion Restoring constitutional apex distal joint line obliquity resulted in improved outcomes with less postoperative pain. This emphasizes the need for a personalized TKA surgical realignment strategy that considers joint line obliquity and not only the HKA angle.

19926 INCREASED GLENOHUMERAL JOINT LOADS DUE TO A SUPRASPINATUS TEAR CAN BE REVERSED WITH ROTATOR CUFF REPAIR: A BIOMECHANICAL INVESTIGATION OF JOINT PRESERVATION

Lukas Nawid Muench, Knut Beitzel, Daniel P Berthold, Alexander Otto, Felix Dyma, Ryan M Bell, Elifho Obopilwe, Mark P Cote, Andreas B Imhoff, Augustus D Mazzocca. Germany, USA

Summary In a dynamic biomechanical cadaveric model, increased glenohumeral joint loads due to a full-thickness supraspinatus tear can be reversed with rotator cuff repair, while preventing superior humeral head migration and decreasing compensatory deltoid forces.

Data Background Rotator cuff tears (RCT) have been shown to result in altered shoulder kinematics with disruption of the biomechanical synergy of the rotator cuff and deltoid muscles, which may be responsible for the correlation between RCTs and degenerative changes of the glenohumeral joint. The purpose was to evaluate the effect of an isolated full-thickness supraspinatus (SSP) tear on glenohumeral kinematics, contact mechanics, and quantify improvement following rotator cuff repair (RCR). The authors hypothesized that RCR would reverse the increased glenohumeral joint loads caused by a full-thickness SSP tear.

Methods Ten fresh-frozen cadaveric shoulders (mean age: 63.1 ± 4.6 years) were tested using a dynamic shoulder simulator. A pressure mapping sensor was placed between the humeral head and glenoid. Each specimen underwent the following three conditions: (1) native, (2) isolated full-thickness SSP tear, (3) RCR. Maximum abduction angle (MAA) and superior humeral head migration (SHM) were measured using 3D motion tracking software. Cumulative deltoid force (CDF) and glenohumeral contact mechanics, including contact area (GCA) and contact pressure (GCP), were assessed at the resting position as well as at 15°, 30°, 45°, and 60° of glenohumeral abduction. An a priori power analysis was performed to determine detectable differences in contact pressure given estimated standard deviations. Assuming a common standard deviation of 15kPa, a sample size of 6 specimens would provide 80% power to detect a 25kPa difference in pressure at an a level of .05. Repeated measures analysis of variance was performed to examine differences in MAA, SHM, glenohumeral contact mechanics, and CDF among the various testing conditions. When significant, post-hoc paired t tests with a Bonferroni corrected alpha were performed to determine which pairwise comparisons were statistically significant. The alpha level for all analyses was set at .05.

Results Compared to native, the SSP tear resulted in a significant decrease in MAA (Delta: −8.3°; P < .001) along with a SHM of 6.4 ± 3.8 mm, while significantly increasing CDF (Delta: 20.5N; P = .008), GCP (Delta: 63.1kPa; P < .001), and peak GCP (Delta: 278.6kPa; P < .001) at each degree of abduction. RCR reduced SHM to 1.2 ± 2.5 mm, while restoring native MAA, CDF (Delta: 1.8N), GCA (Delta: 4.5 mm²), GCP (Delta: −45.8 kPa; P < .001) at each degree of glenohumeral abduction. RCR reduced SHM to 1.2 ± 2.5 mm, while restoring native MAA, CDF (Delta: 1.8N), GCA (Delta: 4.5 mm²), GCP (Delta: −45.8 kPa; P < .001) at each degree of abduction (P > .999, respectively).

Conclusion In a dynamic biomechanical cadaveric model, increased glenohumeral joint loads due to a full-thickness SSP tear can be reversed with RCR. More specifically, RCR restored native glenohumeral contact area and contact pressure, while preventing superior humeral head migration and decreasing compensatory deltoid forces. These time-zero observations indicate that isolated full-thickness SSP tears should undergo repair, in order to reverse altered loading conditions and improve overall shoulder function. More importantly, this potentially prevents progressive cartilage degeneration, while preserving the native glenohumeral joint.

19928 COMPARISON OF LOWER TRAPEZIUS AND LATISSIMUS DORSI TRANSFER FOR IRREPAIRABLE POSTEROSUPERIOR ROTATOR CUFF TEARS: A DYNAMIC BIOMECHANICAL INVESTIGATION

Lukas Nawid Muench, Augustus D Mazzocca, Daniel P Berthold, Cameron Kia, Elifho Obopilwe, Mark P Cote, Andreas B Imhoff, Bastian Schweiderer, Basem T Elhassan, Knut Beitzel. Germany, USA

Summary In the setting of irreparable posterosuperior rotator cuff tears, transfer of the lower trapezius may restore native glenohumeral kinematics more sufficiently when compared to latissimus dorsi transfer, while preventing loss of abduction motion and superior humeral head migration.

Data Background Anatomically, lower trapezius transfer (LTT) may be better positioned for restoring the muscular force couple in the setting of irreparable posterosuperior rotator cuff tears (PSRCT) when compared to latissimus dorsi transfer (LDT). The purpose was to evaluate the effect of LTT and LDT on maximum abduction angle (MAA), superior humeral head...
migration (SHM), and cumulative deltoid forces (CDF) using a dynamic shoulder model. It was hypothesized that the LTT would better restore native glenohumeral kinematics when compared to the LDT.

Methods Ten fresh-frozen cadaveric shoulders (mean age: 56.5 ± 17.2 years) were tested using a dynamic shoulder simulator. MAA, SHM, and CDF were compared across four conditions: (1) native; (2) irreparable PSRCT; (3) LTT using an Achilles tendon allograft (mean graft thickness: 5.3 ± 0.5 mm), as previously described by Elhassan et al.; and (4) LDT. MAA and SHM were measured using 3-dimensional motion tracking. CDF was recorded in real time throughout dynamic abduction motion by load cells connected to actuators and was calculated as the summation of anterior, middle, and posterior deltoid forces. A sample size of 6 specimens will provide 80% power to detect a 1° difference in shoulder angle at an alpha level of 0.05. Repeated measures analysis of variance was performed to examine differences in MAA, SHM, and CDF among the various testing conditions. When significant, post-hoc paired t tests with a corrected alpha using the Holm Bonferroni sequential correction method were performed to determine which pairwise comparisons were statistically significant. The alpha level for all analyses was set at 0.05.

Results Compared to the native state, the PSRCT resulted in a significant decrease (Delta: −24.1°; P < 0.001) in MAA, with a subsequent significant increase after LTT (Delta: 13.1°; P < 0.001) and LDT (Delta: 8.9°; P < 0.001). LTT achieved a significantly greater MAA than LDT (Delta: 4.2°; P = 0.004). Regarding SHM, both LTT (Delta: −9.4 mm; P < 0.001) and LDT (Delta: −5.0 mm; P = 0.008) demonstrated a significant decrease when compared to the PSRCT state. LTT also achieved significantly less SHM compared to the LDT (Delta: −4.4 mm; P = 0.011). Further, only the LTT resulted in a significant decrease in CDF when compared to the PSRCT state (Delta: −21.3N; P = 0.048), while LTT and LDT showed similar CDF (Delta: −11.3N; P = 0.346). However, none of the techniques was able to restore MAA, SHM, and CDF of the native shoulder (P < 0.001, respectively).

Conclusion LTT and LDT achieved a significant increase in maximum abduction angle along with significantly less superior humeral head migration compared to the PSRCT state. While LTT required significantly less cumulative deltoid forces compared to the PSRCT state, this was not observed for LDT. Further, LTT prevented loss of abduction motion and superior head migration more sufficiently when compared to LDT. In the challenging treatment of irreparable PSRCTs, transfer of the lower trapezius may restore native glenohumeral kinematics more sufficiently, potentially leading to improved post-operative functional outcomes.

Reverse Shoulder Arthroplasty Humeral and Glenoid Variations Influence on Range of Motion: A Standardized Computer Model Study

Antonio Arenas-Miquelez, 1Richard James Murphy, 2Andrea Rosa, 3Davide Caironi, 3Matthias A Zumstein, 1Australia; 2UK; 3Switzerland

Summary The semi-inlay 145° stem combined with 4 mm lateralization and 2 mm inferior eccentricity glenosphere is the middle ground for the most all-purpose approach in RTSA.

Data

Background There have been multiple modifications to the initial reverse total shoulder arthroplasty (RTSA) designed by Grammont to improve range of motion (ROM) and avoid notching. The effect of these changes in shoulder kinematics and the best compromise for ROM is still under debate

Purpose To evaluate on a computer model scenario the influence of humeral design, humeral neck-shaft angle (NSA), glenoid lateralization, and glenoid eccentricity on ROM of RTSA. Methods We created a 3-dimensional computer model from computed tomography scans of 13 patients with primary osteoarthritis simulating implantation of a standardized reverse shoulder arthroplasty. We created 7 different stem and 7 different glenosphere configurations to analyze the effect of 4 different variables on impingement-free ROM: humeral design (inlay vs. semi-inlay vs. onlay), humeral NSA (135° vs. 145° vs. 155°), glenoid lateralization, and glenoid eccentricity on ROM. Statistical analysis was performed using Kruskal-Wallis analysis to compare ROMs and applied a Dunn correction for multiple inter-group comparisons. Results The use of different humeral stem designs did not have a significant effect on total global ROM. Reducing NSA demonstrated a significant increase in abduction, and external and internal rotation in adduction, whereas a decrease in abduction and external rotation in abduction. Glenosphere lateralization was the most effective method for increasing total global ROM (P < 0.0001); however, extreme lateralization (+12 mm) did not show significant benefit compared with moderate lateralization (+4 mm). Glenosphere eccentricity increased only abduction and internal rotation in abduction.

Conclusion Only glenoid lateralization has a significant effect on increasing total global ROM in RTSA. The use of the semi-inlay 145° model combined with 4 mm lateralization and 2 mm inferior eccentricity represents the middle ground and the most universal approach in RTSA.

WHAT IS THE MOST RELIABLE METHOD OF MEASURING GLENOID BONE LOSS IN ANTERIOR GLENOHUMERAL INSTABILITY? A CADAVERIC STUDY COMPARING DIFFERENT MEASUREMENT TECHNIQUES FOR GLENOID BONE LOSS

Antonio Arenas-Miquelez, 1Dané Dabirrahmani, 1Gaurav Mahesh Sharma, 1Petra Graham, 1Richard Appleyard, 1Desmond John Bakor, 1John Read, 1Kalman John Piper, 1Sumit Raniga, 1Australia; 2India

Summary Glenoid bone loss calculation presents variability depending on the measurement technique, with different consistencies and accuracies. The Barchilon method, based on area measurement, should be used in the surgical decision making process as it presented the best combined consistency and accuracy.

Data

Background Preoperative quantification of bone loss has a significant impact on surgical decision making and patient outcomes. Various measurement techniques for calculating glenoid bone loss have been proposed in the literature. To date, no studies have directly compared measurement techniques in order to determine which techniques, if any, is the most reliable. The aim of this investigation was to identify the most consistent and accurate measurement technique(s) for measuring glenoid bone loss in anterior glenohumeral instability.

10.1136/jisakos-2021-congress.196
Methods Six fresh-frozen human shoulders with 3 incremental bone defects were sequentially created resulting in a total of 18 glenoid bone defect samples. Two- and three-dimensional representative CT scan end face images were used for analysis. Six observers (three experienced and three with less experience) measured the bone defect of all the samples with HOROS imaging software using 5 commonly employed methods. The methods included 2 linear techniques (Shaha, Griffith), 2 surface techniques (Barchilon, PICO) and one statistical shape model formula (Giles). Intraclass correlation (ICC) using a consistency model was used to determine consistency between surgeons for each of the measurement methods. Paired t-tests were used to calculate the accuracy of each measurement technique relative to physical measurement.

Results For more experienced observers, all methods indicated good consistency (ICC>0.75), except the Shaha method which indicated moderate consistency (0.65<ICC<0.75). Estimated consistency among the experienced observers was better for 2D than 3D images though the differences were not significant (intervals contained 0). For less experienced observers the Giles method in 2D had the highest estimated consistency (ICC: 0.88, 95% CI: 0.76, 0.95), though Giles, Barchilon, Griffith and PICO were not significantly different. Among less experienced observers the 2D images using Barchilon and Giles methods had significantly higher consistency than the 3D images. Regarding accuracy, most of the methods significantly overestimated the actual physical measurements by a small (mean within 5%) amount. The smallest bias was observed for the 2D Barchilon measurements and the largest differences were observed for Giles and Griffith methods for both observer types.

Conclusion Glenoid bone loss calculation presents variability depending on the measurement technique, with different consistencies and accuracies. We recommend the use of the Barchilon method by surgeons who frequently measure glenoid bone loss because it presents the best combined consistency and accuracy. However, if glenoid bone loss is measured occasionally, the most consistent method is Giles method, although an adjustment for the overestimation bias may be required.

Purpose The aim of this study was to determine (1) the priorities of surgeons and patients when making decisions regarding ACLR and (2) the magnitude of reduction in ACLR graft failure risk that orthopaedic surgeons require before changing practice.

Methods This study followed a cross-sectional survey design. Three distinct electronic surveys were administered to pre-operative ACLR patients, post-operative ACLR patients, and orthopaedic surgeons in the ACL Study Group. Patients and surgeons were asked about the importance of various outcomes and considerations pertaining to ACLR. Surgeons were asked scenario-based questions regarding changing practice for ACLR based on new research.

Results Surgeons were more likely to prioritize outcomes related to the surgical knee itself, whereas patients were more likely to prioritize outcomes related to their daily lifestyle and activities. Knee instability and risk of re-injury were unanimous top priorities among all three groups. A mean relative risk reduction in ACLR graft failure of about 50% was required by orthopaedic surgeons to change practice regardless of the type of change, or patient risk profile.

Conclusion There are discrepancies between the priorities of surgeons and patients, and orthopaedic surgeons appear resistant to changing practice for ACLR.
MENISCAL REPAIR AT THE TIME OF PRIMARY ACLR
DOES NOT NEGATIVELY INFLUENCE SHORT TERM KNEE STABILITY, GRAFT RUPTURE RATES, OR PATIENT REPORTED OUTCOME MEASURES: THE STABILITY EXPERIENCE

1Andrew Firth, 1Hana Marmura, 1Lachlan Batty, 1Dianne M Bryant, 1Alan Getgood, 1Stability Study Group, 2Canada; 3Australia

Abstracts

Summary The reduction in patient reported outcome scores associated with medial meniscal repair at the time of primary ACL reconstruction are not clinically significant.

Data

Background Concomitant meniscal injury is frequently seen in the anterior cruciate ligament (ACL) deficient or injured knee. Higher rates of osteoarthritis have been demonstrated in ACL injured knees when concomitant meniscal injury is present and higher rates of ACL graft failure have been seen in meniscal deficient knees. In this context, there has been significant interest in meniscal repair at the time of ACL reconstruction.

Purpose To assess how meniscal repair and excision impact patient reported outcome measures (PROMs), knee stability, and early graft rupture rates following primary hamstring anterior cruciate ligament reconstruction (ACLR) in a group of young active patients where meniscal repair is commonly advocated.

Methods Six hundred and eighteen patients under 25 years of age at high-risk of graft failure following ACLR were recruited to the Stability 1 study. Multivariable regression models were developed to identify surgical and demographic predictors of Knee Osteoarthritis Outcomes Survey (KOOS), International Knee Documentation Committee Subjective Knee Form (IKDC), ACL Quality of Life Questionnaire (ACL-QOL) and Marx Activity Rating Scale (MARS) scores. Chi Square tests of independence were used to explore the association between meniscal treatment, graft rupture, and rotatory knee laxity.

Results Medial meniscus repair was associated with worse outcomes on the KOOS (B = −1.32, 95% CI: −1.57 to −1.10, p = 0.003), IKDC (B = −1.66, 95% CI: −1.53 to −1.02, p = 0.031) and ACL-QOL (B = −1.25, 95% CI: −1.61 to 1.02, p = 0.087). Other important predictors of post-operative PROMs include age, sex, and baseline scores. The associations between medial meniscal treatment and outcome scores indicated small, clinically insignificant changes based on reported minimal important differences. There was no significant association between meniscal treatment and graft rupture or rotatory knee laxity.

Conclusion While repairing the medial meniscus may result in a small reduction in PROM scores at two-year follow up, these differences are not likely to be important to patients or clinicians. Any surgical morbidity associated with meniscal repair appears negligible in terms of PROMs. Meniscal repair does not affect rotatory laxity or graft failure rates in the short term.

THE "BANKART KNEE": BIOMECHANICAL CONSEQUENCES OF A POSTEROLATERAL TIBIA PLATEAU IMPRESSION FRACTURE AS CONCOMITANT INJURY OF ACL RUPTURE

1Danko Dan Milimkovic, 1Christoph Kitzl, 1Elmar Herbst, 2Christian Fink, 2Robert Smigielski, 1Friedrich Greiss, 1Michael Jaschke, 1Mirco Herbst, 1Germany; 2Austria; 3Poland

Summary The results of this biomechanical study show that the high-grade impression fractures of the posterolateral aspect of the tibial plateau increase the anterolateral instability in ACL-deficient knees.

Data

Introduction Posterolateral impression fractures of the tibial plateau seen as depression of the articular surface with breach of the cortical bone are common concomitant injuries of an ACL rupture. They are caused by the mechanism of high-energy pivot-shift trauma, in which the lateral tibial plateau subluxate anteriorly, resulting in a violent collision of the anterolateral aspect of the lateral femoral condyle and postero-lateral area of the tibial plateau. Aim: The aim of this biomechanical cadaver study was to evaluate the destabilizing effect of high-grade posterolateral tibia fracture on kinematics of the ACL-deficient joint.

Material and Methods 8 human fresh-frozen cadaveric knees were tested using a six-degree of freedom freedom robotic setup (KR 125, KUKA Robotics, Augsburg, Germany) with an attached optical tracking system (Optotrack Certus Motion Capture, Northern Digital, Ontario, Canada). After the passive path from 0°–90° was established, simulated Lachman test and pivot-shift test as well external rotation (ER, 4Nm) and internal rotation (IR, 4Nm) were applied at 0°, 30°, 60°, and 90° of joint flexion under constant 200 N axial loading. All the parameters were initially tested in the intact and the ACL-deficient state, followed by 2 different types of posterolateral impression fractures in the ACL-deficient knees. The dislocation height was 10 mm and the width 15 mm constantly in both groups. The intraarticular depth of the fracture corresponded to the half of the width of the posterior horn of the lateral meniscus in the first group (Bankart 1), and 100% of the meniscus width in the second group, marked Bankart 2. A two-way repeated measures ANOVA with post-hoc Bonferroni corrections for multiple comparisons was performed to evaluate the effect of different states over different angles on tibial translation. The significance level was set to 0.05.

Results There was a significant decrease in knee stability after both types of additional posterolateral tibial plateau fractures in the ACL-deficient specimens with increased anterior translation following the simulated Lachman test in up to 30° of knee flexion (p < 0.05). The same effect was recorded in regards to the anterolateral rotational (ALR) instability. Simulated Pivot shift test in near extension position (0° and 30°), as well as IR test (0° to 30°), showed significantly increased instability in both types of additional fractures in ACL-deprived state (p < 0.05). Following ER and posterior drawer
test, ACL deficiency and concomitant fractures did not influence knee kinematics.

Conclusion The results of this study demonstrate that high-grade impression fractures of the posterolateral aspect of the tibial plateau increase the instability of the ACL-deficient knees and result in a considerable increase in translational and ALR instability. Comparably to the shoulder with its integrity of the labrum and the glenoid as his bony ground, the posterolateral tibia plateau impression fracture seems to work like a bony Bankart lesion which results in instability of the joint by destabilizing the posterior horn of the lateral meniscus. Considering their potential effects on the kinematics of the ACL-deprived knees, these fractures should be taken into consideration in the overall treatment decision-making process.

Summary The results of this cross-sectional study show that among various demographic, clinical, and pathoanatomic factors, increased BMI and presence of high-grade J-sign have a significant impact on subjective disease-specific QOL in patients with LPD.

Data

Background Although the prevalence and combined prevalence of pathoanatomic risk factors for lateral patellar dislocation (LPD) and their impact on postoperative outcome scores have been described, there is still limited evidence regarding their influence on patients’ disease-specific quality of life (QOL).

Purpose The goal of this study was to determine whether and to what degree certain demographic, clinical, and pathoanatomic factors impact subjective disease-specific QOL in patients with LPD.

Methods A total of 182 consecutive patients (male/female 70/112; mean age 23.6 ± 7.3 years) with a history of LPD were prospectively enrolled in this study. Patient age, body mass index (BMI), number of dislocations, reversed-dynamic patellar apprehension test (ReDPAT), and J-sign severity were assessed. In addition, evaluation of pathoanatomic risk factors included assessment of trochlear dysplasia, tibial tubercle-trochlear groove (TT-TG) distance, tibial tubercle-posterior cruciate ligament (TT-PCL) distance, Caton-Deschamps (CD) index, and valgus/valgus malalignment. The statistical analysis evaluated the relationships among those variables and determined their ability to predict the Banff Patellofemoral Instability Instrument 2.0 (BPII 2.0) as a disease-specific QOL measure. Using Spearman correlation, ANOVA and Fisher’s exact test, all variables with ANOVA p = 0.1 or Spearman’s abs (rho) > 0.1 were entered into a multivariate linear model using backwards stepwise selection.

Results Analysis of the individual variables’ ability to predict BPII 2.0 score values revealed ‘age’, ‘BMI’, ‘ReDPAT’, ‘high grade of trochlear dysplasia’ (Dejour B-D), and ‘high grade J-Sign’ (Grade II and III) as possible relevant variables (one-way ANOVA (p = 0.1); Spearman’s correlation (abs(rho) > 0.1)). Backward-stepwise multivariate regression analysis yielded a final parsimonious model that included the factors ‘BMI’ and ‘J-Sign (Grade II and III)’ as the most relevant parameters influencing BPII 2.0 score values (adjusted R2 = 0.418; p < 0.001), with a cutoff value for BMI found at 28 kg/m2 (Tukey test; p=0.01).

Conclusion The main results of this study indicate that the presence of a high-grade J-sign and an increased BMI contribute significantly to inferior QOL score values in patients with recurrent LPD when evaluated with the BPII 2.0. Because BMI is a modifiable factor, this information might be helpful for the clinical decision-making process.

Summary Also at long-term follow-up, a higher Critical Shoulder Angle and Acromion Index significantly increased the retear risk after arthroscopic supraspinatus tendon repair.

Data

Aim To evaluate the long-term effect of the critical shoulder angle (CSA) and acromion index (AI) on the postoperative healing rate after arthroscopic supraspinatus tendon repair.

Background The negative effect of a high CSA and AI on the short-term healing rate after arthroscopic repair of the supraspinatus tendons is already known. No studies with a long-term follow-up are yet published.

Methods Patients with a symptomatic, single-tendon, full-thickness supraspinatus tear in whom non-operative management had failed were treated with an arthroscopic repair. Preoperative radiographs were used to measure CSA and AI. Eight years postoperatively MRI-studies were performed and evaluated on repair integrity. Patient Reported Outcome Measurements (PROMs) were collected pre- and postoperative.

Results Thirty-one patients were evaluated 8 years postoperatively. The mean age at time of the surgery was 61 ± 9 years. MRI evaluation showed that 20 (65%) patients had an intact repair and 11 (35%) had a full-thickness retear. No significant differences were found between the intact and retear groups regarding to age (P = 0.605), initial tear size (P = 0.485), retraction grade (P = 0.439) and all PROMs. The mean CSA for the intact group (33° ± 1°) was significantly lower than the CSA in the retear group (38° ± 1°; P = 0.004). The odds ratio of having a retear is 5.50 if the CSA =35° leads to an 5,5-fold increased risk of retear. An AI =0.75 leads to a 6-fold increase in risk of retear after arthroscopic supraspinatus tendon repair.

Conclusion Also at long-term follow-up, a higher CSA and AI significantly increased the retear risk after arthroscopic supraspinatus tendon repair. A CSA =35° leads to an 5,5-fold increased risk of retear. An AI =0.75 leads to a 6-fold increase in risk of retear after arthroscopic supraspinatus tendon repair.
Summary
Arthroscopic posterior tibial nerve neurolysis a cadaveric study
Data Arthroscopic Posterior Tibial Nerve Neurolysis A. GHABCHA, N. BAUDRIER, A. HARDY, T. BAUER
Introduction The indications for an ankle arthroscopy are expanding, neuropathy of the tibial nerve could be one of them, the purpose of our study is to discuss the safety and feasibility of the arthroscopic neurolysis of the posterior tibial nerve proximal to the tarsal tunnel.
Materials and Methods Fourteen lower limbs of seven fresh frozen cadavers were dissected. Posterior tibial nerve neurolysis was done arthroscopically starting 5cm proximal to the medial malleolus until 2cm distal to the medial malleolus (proximal border of the tarsal tunnel) using standards posteromedial and posterolateral arthroscopic portals, then open dissection was done at the same level of the neurolysis to identify any iatrogenic nerve injury, vascular injury or tendon injury. The main judgment criteria were the achievement of the neurolysis of the posterior tibial nerve, the secondary criteria were the presence of any nerve lesion, vascular lesion, flexor hallucis longus lesion.
Results The Neurolysis of the Posterior Tibial Nerve was successful in 14 ankles, no nerve lesion was noted, we had 1 arterial lesions in 14 ankles (7%), no flexor hallucis longus lesion was observed.
Conclusion The neurolysis of the posterior tibial nerve proximal to the Tarsal Tunnel can be done Arthroscopically, the risk of the vascular lesion remains high, the procedure should be done by experienced surgeon familiar with ankle anatomy and arthroscopy to minimize this rate. Key Words: Arthroscopic Neurolysis, Posterior Tibial Nerve, Ankle

Results
At baseline 41% of the entire study population (n=167) had a meniscal tear on MRI. During the two-year follow-up 28 meniscal procedures were performed in 25 patients randomized to early ACL reconstruction (29%, 25/85 patients) and 20 procedures in 17 patients randomized to rehabilitation plus optional delayed reconstruction (21%, 17/82 patients) (between group difference 9% with 95% confidence interval −4% to 22%). In patients who received early ACL reconstruction (n = 82) and patients who received delayed ACL reconstruction (n = 41), 5% of the patients had an additional meniscal procedure after ACL reconstruction. In patients who received no ACL reconstruction (n=41), 10% (n=4) had a surgical procedure for a meniscal tear during the two-year follow-up period.
Conclusion The results of this study suggest that initial non-surgical treatment of ACL ruptures does not lead to a higher number of meniscal procedures compared to early ACL reconstruction over a two-year follow-up period.

MENISCAL PROCEDURES ARE NOT INCREASED WITH DELAYED ACL RECONSTRUCTION AND REHABILITATION: RESULTS FROM A RANDOMIZED CONTROLLED TRIAL
Sabine van der Graaff, Max Reijman, Eline van Es, Sita Bierma-Zeinstra, Jan Verhaar, Duncan E Meuffels. Netherlands
10.1136/jisakos-2021-congress.205
Summary We assessed whether non-operative treatment of anterior cruciate ligament ruptures leads to more meniscal procedures compared to early ACL reconstruction. We found that initial non-operative treatment does not lead to more meniscal procedures compared to early ACL reconstruction over a two-year follow-up period.

20081 WHY, WHEN AND WHO FAILS NON-OPERATIVE TREATMENT OF ANTERIOR CRUCIATE LIGAMENT INJURY – AN EXPLORATORY ANALYSIS OF THE COMPARE TRIAL
Sabine van der Graaff, Duncan E Meuffels, Sita Bierma-Zeinstra, Eline van Es, Jan Verhaar, Vincent Eggerding, Max Reijnman. Netherlands
10.1136/jisakos-2021-congress.206
Summary We investigated why, when and which patients with an anterior cruciate ligament rupture who initially started with rehabilitation therapy eventually required reconstructive surgery. Patients who experienced instability complaints, pain during activity and had a low perception of their knee function were unsuccessful with non-operative treatment.

Objective To investigate why, when and which patients with an anterior cruciate ligament (ACL) rupture who initially started with rehabilitation therapy required reconstructive surgery.

Methods In the COMPARE trial, 167 patients with an ACL rupture were randomized to early ACL reconstruction or rehabilitation therapy plus optional delayed ACL reconstruction. We conducted an exploratory analysis of a subgroup of 82 patients from this trial, who were randomized to rehabilitation therapy plus optional delayed ACL reconstruction. The reasons for surgery were registered for the patients who underwent a delayed ACL reconstruction. For these patients we determined International Knee Documentation Committee (IKDC), numeric rating scale (NRS) pain and instability question from the Lysholm questionnaire before surgery. To determine between group differences between the non-operative treatment and delayed ACL reconstruction group, IKDC and pain scores during follow-up were determined using mixed models and adjusted for sex, age and BMI.

Results During two-year follow-up of the trial 41 of the 82 patients received a delayed ACL reconstruction after a median time of 6.4 months after inclusion (IQR 3.9–10.3). Most reconstructions occurred between three and six months after inclusion (n=17, 41.5%). Ninety percent of the patients (n=37) reported knee instability complaints as reason for surgery at the moment of planning surgery. Of these patients, 18...
had an IKDC score below 60, 29 had a pain score of 3 or higher and 33 patients had knee instability complaints according to the Lysholm questionnaire. During follow-up, IKDC scores were lower and pain scores were higher in the delayed reconstruction group compared to the non-operative treatment group. At baseline, patients in the delayed reconstruction group had a significant lower age (27.4 versus 35.3 years, p=0.001) and higher pre-injury activity level compared to patients in the non-operative treatment group.

**Conclusion** Patients who experienced instability complaints, pain during activity and had a low perception of their knee function were unsuccessful with non-operative treatment. Most patients received a delayed ACL reconstruction after 3 to 6 months of rehabilitation therapy. At baseline, patients that required reconstructive surgery had a lower age and higher pre-injury activity level compared to patients that were not reconstructed.

**Summary** A retrospective review of 898 patients revealing similar mid-term Patient Reported Outcome Measures between Index THA and THA after previous Hip Arthroscopy (HA), with higher risk of poor THA outcomes associated with multiple previous HAs compared to a single previous HA.

**Data**

**Background** Whilst Total Hip Arthroplasty (THA) remains a popular and reliable operation, the number of Hip Arthroscopy (HA) procedures performed has significantly increased in frequency over the past few years. Globally today, more patients are likely to undergo THA after previous HA (Conversion THA). The impact on post-operative clinical and functional outcomes remains controversial. We, therefore, aimed to compare the Patient-Reported Outcomes Measures (PROMs), satisfaction rates and complication rates after Conversion THA (>1 previous HA) with patients after Index THA (No previous HA).

**Methods** We performed a retrospective case review of 898 consecutive patients for Primary THA by a high-volume surgeon with minimum 2-year follow-up using the Direct Anterior Approach. Demographic data and PROMs were recorded. All cases were assessed for complications and re-operations. Implant survival was calculated using Kaplan-Meier analysis. Statistical significance was p<0.05.

**Results** This study included 804 (89.53%) patients for Index THA (mean age 56.54 years; BMI 28.54 kg/m²) and 94 (10.47%) for Conversion THA (mean age 47.53 years; BMI 29.91 kg/m²), respectively. Satisfaction rates were similar for Index and Conversion THA patients (93.78% vs. 91.49%; p=0.009). The Patien Joint Perception (PJP) scores were “Native/Natural joint” for 68.78% of Index THA patients and 63.83% for Conversion THA patients (p=0.046). The mean pain score (p=0.003), modified Harris Hip Score (mHHS) (p=0.001) and Forgotten Joint Score-12 (p<0.000) favoured Index THA over Conversion THA patients. Conversion THA patients that had a single HA were 1.2-fold more likely to have a “Native/Natural joint” PJP compared to multiple HAs before THA (OR 1.42,1.18; p=0.008). Conversion THA patients that had a single HA are 2.01-fold more likely to have an mHHS >80 compared to multiple HAs (OR 3.3,1.64; p=0.018). Surgical complication rate was 7.45% for Index THA and 8.64% for Conversion THA (p=0.004). Deep PJI incidence for Index THA was 0.50% compared to 1.06% for Conversion THA (p=0.037). Total implant survival at 3 years was 97.9% (SE 0.005; 95%CI 96.9–98.9) for Index THA and 96.6% for Conversion THA (SE 0.019; 95%CI 92.9–1.00).

**Conclusion** Medium-term PROMs are similar for Conversion THA and Index THA patients. However, Conversion THA following multiple HAs show an increased risk for poor patient clinical outcomes compared to single HA.

**Summary** This randomized controlled trial evaluating outcomes 5 years after TKA using either PS or BCR prostheses showed equivalent patient-reported outcomes in both groups at the last follow-up but an overall implant survivorship superior in the PS group.

**Data Abstract**

**Background** High rates of chronic pain and dissatisfaction are still being reported following total knee arthroplasty (TKA). Bicruciate retaining (BCR) prostheses have been identified as one promising avenue to improve patient satisfaction by optimizing the restoration of normal knee kinematics. The purpose of this prospective was to investigate whether BCR prostheses provide better clinical and radiologic outcomes compared to traditional posterior-stabilized (PS) prostheses.

**Material and Methods** This single-blind randomized controlled trial enrolled a total of 79 patients (96 knees) who underwent TKA between 2011 and 2019. Eligible patients were randomized intra-operatively and followed for 5 years. Radiologic, clinical and patient-reported outcomes were recorded at each follow-up. KOOS, WOMAC and IKS scores (old version) were analyzed and compared between groups. Statistical analyses were performed using Chi² test, student t-test and Kaplan-Meier.

**Results** A total of 60 patients (77 knees) were randomized, with 38 knees and 39 knees assigned in the PS and BCR groups respectively. No statistically significant differences were noted in KOOS, WOMAC or SF-12 scores within the 5 years of observation. At 6 weeks, 6 months and 12 months, knee flexion was significantly higher in the PS group compared to BCR group (p=0.002). At 5 years, the overall implant survivorship was 87.2% in the BCR group compared to 100% in the PS group (p=0.053).

**Discussion and Conclusion** PS and BCR prostheses were associated with similar clinical and patient-reported outcomes. Despite superior flexion in the PS group, both techniques yielded equivalent improvements of pain, function and range of motion at 5 years. Further research is warranted to...
determine whether or not BCR prostheses can yield significant advantages compared to other designs on the market. Level of evidence: I. Randomized control trial. Keywords: Total knee arthroplasty, bicruciate-retaining, posterior-stabilized, knee, hinge fracture.

**DISLOCATED HINGE FRACTURES PREDISPOSE FOR MALUNION AFTER LATERAL CLOSING WEDGE DISTAL FEMORAL OSTEOTOMY**

Marco-Christopher Rupp, Philipp Wilhelm Winkler, Patricia Maria Lutz, Markus Irger, Philipp Forkel, Andreas B Imhoff, Matthias Feucht. Germany

Summary The risk for medial cortical hinge fractures - a common finding after lateral closing wedge distal femoral osteotomy - increases with osteotomy wedge height and a hinge position close to the medial cortex. A dislocation of medial hinge fracture >2 mm should be avoided, as an association to malunion could be shown.

Data

Objectives To date, there remains a scarcity of evidence evaluating hinge fractures after closing wedge lateral distal femoral osteotomy (LCW-DFO) for varus malalignment. The aim of this study was to evaluate the morphology, incidence, and complications of hinge fractures following LCW-DFO and to identify technical and constitutional risk factors predisposing for hinge fracture and associated complications.

Methods Seventy-nine consecutive cases of LCW-DFO for symptomatic varus malalignment (47 ± 12 years, 66% male) between 01/2007 and 03/2018 with a minimum of two-year postoperative follow-up were included in this monocentric retrospective study. Medical and surgical records were assessed. The incidence and morphology of medial cortical hinge fractures was assessed based on postoperative anterior-posterior knee radiographs and measurements evaluating the two-dimensional location of the hinge and osteotomy cut (wedge height, cut length, hinge angle) were performed. Technical and constitutional factors associated with an increased incidence of a medial cortical hinge fracture and complications were analyzed. A total sample size of 76 subjects to detect a difference of 1.5 mm of absolute correction, at a calculated effect size of 0.66 in order to achieve a statistical power of 0.8 was determined in an a priori power analysis. Statistical Analysis Results Medial cortical hinge fractures were detected in 48%. A novel classification is proposed based on fracture morphology, differentiating extension fractures were detected in 48%. A novel classification is proposed based on fracture morphology, differentiating extension (68%), proximal (21%) and distal fracture types (11%). An increased wedge height in mm (6.5±1.9 vs. 7.9±3; p=0.040), an increased length of the osteotomy cut in mm (53.1±10.9 vs. 57.7±9.6; p=0.049) as well as position of the hinge in the medial sector of an established sector grid (p=0.049) were observed to be significantly associated with the incidence of a hinge fracture. Regarding complications, malunions after hinge fracture (14%) were significantly increased after mediolateral dislocation of the medial cortical bone > 2 mm (p<0.05).

Conclusion Hinge fractures can be detected in a substantial part of LCW-DFO cases. With increasing osteotomy wedge height and a hinge position close to the medial cortex, the risk of sustaining a hinge fracture is increased. A dislocation of medial hinge fracture >2 mm should be avoided, as an association to malunion could be shown.

**CLINICALLY SIGNIFICANT IMPROVEMENT AND HIGH RETURN TO SPORTS AND WORK RATES AFTER DOUBLE LEVEL OSTEOTOMY FOR SEVERE VARUS MALALIGNMENT**

Marco-Christopher Rupp, Lukas Nawid Muench, Yannick Ehmann, Alexander Thementesl, Philipp Wilhelm Winkler, Julian Mehl, Andreas B Imhoff, Matthias Feucht. Germany

Summary Patients undergoing double level osteotomy for severe symptomatic varus malalignment experienced clinically significant improvement with high rates of return to sports and work at a minimum 2-year follow-up, with similar outcomes to be expected when performing single surgery compared to a two-stage procedure.

Data

Background To date, there remains a scarcity of evidence evaluating clinical outcomes after double level osteotomy (DLO) for severe symptomatic varus malalignment. Thus, the aim of this study was to evaluate the clinical outcomes as well as return to sport (RTS) and work (RTW) rates following DLO, and to compare these outcome parameters among patients undergoing a single surgery or two-stage procedure. It was hypothesized that patients undergoing DLO would achieve significant improvement in functional outcomes along with high RTS and RTW rates, and that there would be no difference in outcomes between single-stage and two-stage procedures at a minimum 2-year follow-up.

Methods Thirty-two consecutive patients with a mean age of 44±13 years who underwent DLO for symptomatic varus malalignment at the senior author’s institution between December 2007 and March 2018 and had a minimum 2-year follow-up were enrolled in the study. Outcome measures included the international knee documentation committee (IKDC) score, Lysholm score, Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Tegner Activity Scale, and visual analogue scale for pain (VAS), which were collected preoperatively and at a minimum of two years postoperatively. Return to sports and work were evaluated by questionnaire. These outcome measures were further compared between patients who underwent DLO in a single operation versus a two-stage approach in a subgroup analysis. An a priori power analysis was performed to determine the sample size allowing for detecting the minimal clinically important difference of the WOMAC score (15 points). Assuming a common standard deviation of 10 points, a total sample size of 18 subjects would provide 80% power to detect a 15 points difference in WOMAC score at an a level of 0.05.

Results Mean follow-up was 56.9±35.3 months (range 24–148). Compared to preoperatively, patients significantly improved in IKDC (50.4±13.9 to 66.1±15.4, p<.001; 95% CI=10.5–21.5), WOMAC (29.7±19.2 to 11.8±13.5; p<.001; 95%CI=7.5–30.5) scores along with significant reduction of pain (5.0±3.0 to 2.5±2.4; p<.001; 95%CI=4.0–2.0) at final follow-up. Postoperatively, 96% of patients returned to sports at a mean of 7.7±4.8 months. However RTS was observed at a lower frequency (10.8±7.3 vs 8.2±7.5 h/week; p=0.01) and to fewer disciplines (3.3±2.0 vs. 2.6 ±2.3; p=0.005) with a shift in disciplines to low-impact sports, with an overall tendency to improvement of the Tegner activity level (3.3±2.1 to 3.7±1.6; p>0.05). 90% of the patients returned to work at a mean 5.9±9.4 months, with 79% reporting a similar or superior working ability.
While it took patients undergoing a two-stage procedure significantly longer to fully return to work (9.0±3.1 vs 9.8 ±3.8 months, p=0.047; 95%CI=7–0), no other outcome measures significantly differed between patients undergoing a two-stage compared to a single-stage procedure.

**Conclusion**

Patients undergoing DLO for severe symptomatic varus malalignment experienced clinically significant functional improvement at minimum 2-year follow-up. Return to sports and work rates are high, however, a shift to lower impact sports disciplines has to be expected. Similar clinical outcomes can be expected when performing DLO via single surgery or a two-stage procedure.
When applying the pathologic cut-off of TT-TG>20 mm and TT-TG/PL>0.5; the calculated odds ratios for above cut-off were as follows; TT-TG distance alone OR of 7.9 (95% CI 1.8–35.47, p=0.006) and TT-TG/PL ratio OR of 22.12 (95% CI 2.93–166.81, p=0.003). In the multivariable analysis, adjusted for height and weight, the association between TT-TG distance alone and patellar dislocation remained statistically significant with adjusted OR of 5.2 (CI 1.04–26.00, p=0.045) compared to TT-TG/PL ratio adjusted OR of 21.11 (CI 2.46–181.38, p=0.005).

Conclusion PIRs are significantly more reliable indicators, in terms of diagnostic reliability, sensitivity and specificity, and intra/inter reader reliability, when evaluating for patellar instability.

### 19940 EFFECTS OF BLOOD FLOW RESTRICTION THERAPY FOR MUSCULAR STRENGTH, HYPERTROPHY AND ENDURANCE IN HEALTHY AND SPECIAL POPULATIONS: A SYSTEMATIC REVIEW AND META-ANALYSIS

Edward Perera, Y Ming Zhu, T Nolan Horner, A Ashsheh Bedi, O Olufemi R Ayeni, M Moin Khan, UK; Canada; USA

Summary BFR training has demonstrated potential for increasing muscular strength, hypertrophy and endurance.

Data
Objectives The purpose of this study was to investigate the effectiveness of BFR training protocols relative to other forms of training on muscle strength, hypertrophy and endurance.

Data Sources: Systematic searches of Medline, Embase, PubMed were performed using relevant search terms. Methodological quality of included studies was assessed using the Cochrane risk of bias tool.

Main Results 53 randomized controlled trials were included in the review with 31 included in meta-analyses. For muscular strength comparing low-intensity BFR (LIBFR) training to high-intensity resistance training (HIRT), pooled mean difference (MD) for 1 repetition maximum was 5.34 kg (95% CI: 2.58–8.09, p < 0.01) favoring HIRT. When comparing LI-BFR training to HIRT for torque, MD was 6.35 Nm (95% CI: 0.5–12.3, p = 0.04) also favoring HIRT. However, comparing LI-BFR to low-intensity resistance training (LIRT) for torque there was a MD of 9.94 Nm (95% CI: 5.43–14.45, p < 0.01) favoring BFR training. Assessing muscle hypertrophy, the overall MD in cross-sectional area (CSA) was 0.96 cm² (95% CI: 0.21–1.7, p = 0.01) favoring pooled BFR training protocols compared to non-occlusive training protocols. For assessment of endurance, VO2 Maximum demonstrated a greater mean increase of 0.37 mL/kg/min (95% CI: −0.97–3.17, p =0.64) in BFR endurance training compared to endurance training alone.

Conclusion LI-BFR training has demonstrated potential for increasing muscular strength, hypertrophy and endurance. Comparing LI-BFR training to HIRT, HIRT was a significantly better training modality for increasing muscle hypertrophy and strength. However, LI-BFR was superior when compared to a similar low-intensity protocols.
Summary This systematic review of the literature indicates that while acetabular or femoral retroversion yield similar outcomes following hip arthroscopy to patients with normal acetabular or femoral version, patients with excess femoral anteversion had mixed functional outcomes postoperatively and higher rates of conversion to total hip arthroplasty (THA) at final follow-up.

Data

Purpose The purpose of this systematic review was to evaluate the impact of femoral and acetabular version on clinical outcomes following arthroscopic hip surgery.

Methods Three databases (MEDLINE, EMBASE, and PubMed) were searched by two reviewers independently on December 15, 2020. Titles, abstracts, and full-text articles were screened in duplicate. Studies examining femoral and acetabular version in primary hip arthroscopy with patient-reported outcomes were included. The Methodological Index For Non-Randomized Studies (MINORS) instrument was used for quality assessment of studies. A random effects model was used to pool comparative post-operative outcomes between groups.

Results Overall, 14 studies met the inclusion criteria and comprised 1754 patients (1763 hips), 1062 femora, and 701 acetabula, with a mean age of 29.8 (range 14–74.7) and mean follow-up of 40.4 months (range 4.8–113.4). Femoral version was measured on cross-sectional imaging in all studies investigating femur-based abnormalities. The most common lower bound defined for normal femoral version was 5 degrees, while the most common upper bound was 20 degrees. Patients with femoral retroversion had no significant difference in postoperative outcomes compared to those with normal version with mean differences (95% CI, p-value) in post-operative mHHS, HOS-SSS, VAS and NAHS scores of 1.68 (-3.19 to 0.37, p=0.53), 4.03 (-3.29 to 11.35, p=0.18), 0.05 (-0.42 to 0.53, p=0.82), and 3.38 (-1.96 to 8.71, p=0.22), respectively. In the high femoral anteversion groups, the mean difference (95% CI, p-value) in post-operative mHHS score was significantly lower than in the normal version groups [-4.28 (-8.20 to -0.37, p=0.03)] while there was no significant difference in the mean difference in post-operative HOS-SSS [-7.82 (-21.98 to 6.34, p=0.08)]. Of note, conversion rate to THA at final follow-up was 7.7% (n=11) in patients with femoral retroversion, and 13.6% (n=6) in patients with high femoral anteversion. In the acetabular retroversion group, there were no significant differences noted postoperatively for the VAS, mHHS, and HOS-SSS scores compared the groups with normal acetabular version.

Conclusion While the definition of normal version of the hip varied within the literature, arthroscopic surgery in patients with femoral or acetabular retroversion generally resulted in equivalent functional and radiographic outcomes when compared to patients with normal version. However, patients with retroverted femora also had important conversion rates to total hip arthroplasty (THA). Postoperative functional outcomes in patients with high femoral anteversion compared to patients with normal femoral version were largely inconclusive, yet rates of conversion to THA were even higher in excessively anteverted femora. Further prospective studies would be useful in identifying precise surgical indications for safe arthroscopic surgery in patients with version abnormalities of the femur and acetabulum, particularly those with femoral anteversion.

Summary

We conclude that arthroscopic meniscectomy had no advantage over conservative treatment in terms of clinical outcomes and osteoarthritis progression for degenerative medial meniscus posterior root tear.

Data

Purpose Recently, various treatment methods for medial meniscus posterior root tear (MMPRT) have been introduced. Although fixation of the torn meniscus is an ideal method theoretically, the merits of fixation have been disputed. Arthroscopic meniscectomy and conservative treatment have also been considered as treatment options for MMPRT, especially in patients with mechanical symptoms. This study aimed to compare the clinical and radiological outcomes of arthroscopic meniscectomy and conservative treatment for degenerative MMPRT.

Material and Methods From January 2007 to December 2014, 255 patients who were diagnosed with degenerative MMPRT with a minimum follow-up duration of 2 years were selected. Of the 255 patients, 148 underwent meniscectomy, and the remaining 107 underwent conservative treatment. After excluding patients who underwent meniscal repair or other ligament surgery, combined surgery, had a Kellgren-Lawrence (K-L) classification grade of > III, or >5° varus or valgus malalignment, 146 patients (Meniscectomy group, 90; Conservative group, 56) were finally evaluated. Clinical outcomes were assessed and compared between the two groups using the Visual Analog Scale (VAS), International Knee Documentation Committee (IKDC) subjective scoring scale, Tegner activity scale, and Lysholm knee scoring scale at the final follow-up. Regarding the radiological outcomes, we evaluated the progression of osteoarthritis (OA) according to the K-L classification of the medial compartment of the knee. We compared the hip-knee-ankle angle (HKAA), medial proximal tibial angle (MPTA), tibial posterior slope angle (TPSA), and width of medial joint space between the groups. After an average follow-up of 6.3 years, the survivorship was analyzed using the Kaplan-Meier method. The endpoint of survival was conversion to total knee arthroplasty (TKA), unicompartmental knee arthroplasty (UKA), or high tibial osteotomy (HTO) on the same knee.

Results Although all clinical outcomes had significantly improved in both groups after treatment, the meniscectomy group did not show better improvement than the conservative group. The VAS score (p=0.07), IKDC subjective score (p=0.18), Tegner activity scale score (p=0.08), and Lysholm knee score (p=0.53) showed no significant differences between the two groups at the final follow-up. The progression of OA according to the K-L classification, HKAA and width of articulation.
medial joint space was significantly advanced in the meniscectomy group (p=0.03, 0.04, 0.03, respectively). During the final follow-up, conversion to TKA, UKA, or HTO had occurred in six patients in the meniscectomy group and four patients in the conservative group; the difference was not significant (p=0.82). The 10-year survival rates in the meniscectomy and conservative groups were 87% and 88%, respectively.

Conclusions This study demonstrated that both conservative treatment and meniscectomy provided symptomatic relief to patients with degenerative MMPRT without advanced OA and malalignment. However, it was confirmed that OA progression was more severe in the meniscectomy group than in the conservative group. The 10-year survival rates were not different between two groups. We conclude that arthroscopic meniscectomy had no advantage over conservative treatment in terms of clinical outcomes and OA progression.

Summary While patient reported scores indicated worse outcomes in the revision group, the significant clinical improvement in DASH and WOSI, along with the lack of recurrent instability provides evidence that AAGR is a better option for primary treatment of anterior shoulder instability with bone loss as compared to revisions of failed Bankart procedures.

Background Revision surgeries after prior shoulder stabilization are known to have worse outcomes as compared to their primary counterparts. To date, no studies have looked at the utility of arthroscopic anatomic glenoid reconstruction (AAGR) as a revision surgery. Many treatment algorithms list this procedure as a salvage procedure for failed prior stabilizations, however, there has yet to be a comparative study looking at the outcomes of primary and revision AAGR. The purpose of this study was to assess the clinical outcomes of primary versus revision AAGR for anterior shoulder instability with bone loss.

Methods We performed a retrospective review on consecutive patients with prospectively collected data who underwent AAGR from 2012 to 2018. Patients who received AAGR for anterior shoulder instability with bone loss and had a minimum follow-up of two years were included. Exclusion criteria included patients with rotator cuff pathology, multidirectional instability and glenoid fractures. There were 68 patients (48 primary and 20 revision) who met inclusion/exclusion criteria. Our primary outcome was measured using the Western Ontario Shoulder Instability Index (WOSI) and Disabilities of Arm, Shoulder, Hand (DASH) scores. Secondary outcomes included post-operative complications and post-operative recurrent instability.

Results The primary group showed a significant improvement in most-recent post-operative WOSI from 62.7 to 20.7 (p<0.001, a=0.05) and in DASH from 26.89 to 6.7 (p<0.001, a=0.05). The revision group also showed a significant improvement in WOSI from 71.5 to 34.6 (p<0.001, a=0.05) and in DASH from 39.5 to 17.0 (p<0.05, a=0.05). When comparing between groups, the revision group had worse WOSI scores (34.6) at most recent follow-up compared to the primary group (20.7); p<0.05. The most-recent DASH scores also showed the revision group (17.0) having worse outcomes than the primary group (6.7); p<0.05. Important to note that the minimal clinically important difference (MCID) was met for WOSI (MCID=10.4) but not DASH (MCID=10.83). There were no post-operative reports of instability in either group. For complications, one hardware failure (suture anchor) was seen in the primary group, and two hardware removals were seen in the revision group.

Conclusion While patient-reported scores indicated worse outcomes in the revision group, the significant clinical improvement in DASH and WOSI, along with the lack of recurrent instability provides evidence that AAGR is a better option for primary treatment of anterior shoulder instability with bone loss as compared to revisions of failed Bankart procedures.
KNEE CT ARTHROGRAPHY IS RELIABLE AND PROVIDES A BETTER REFLECTION OF CARTILAGE DAMAGE ESPECIALLY IN FEMORAL TROCHLEA, COMPARED WITH CONVENTIONAL MR IMAGING

Kyung Jun Min, Byoung-Hyun Min, Keun Soo Kim, Do-Young Park, Jun-Young Chung, Keun Soo Kim, Sumin Lim. Republic of Korea

Summary Knee CT arthrography is reliable and provides a better reflection of cartilage damage especially in femoral trochlea, compared with conventional MR imaging

Data

Background In assessing articular cartilage lesion grade in knee osteoarthritis patients, conventional MR imaging has been used as a gold standard diagnosing tool. However, conventional MR imaging has limitations in accurately evaluating cartilage lesions because it is difficult to distinguish the boundary between the subchondral bone and the calcified cartilage, and the boundary between the superficial layer of cartilage and the synovial fluid or infrapatellar fat pad. Clinically, conventional MR imaging is often different from the intra-operative status, especially for trochlea lesions. The trochlear cartilage lesion is an important factor in determining the knee arthroplasty options (unicompartamental or total knee arthroplasty). In several studies, CT arthrography compared conventional MR image, but few studies focused on trochlea. The purpose of this study was to compare knee CT arthrography and conventional MR imaging with intra-operative status to find out which tests evaluate trochlea cartilage lesions better.

Method We evaluated 24 patients (31 knees) who had both CT arthrography and MR imaging among patients who underwent total knee arthroplasty (TKA) or unilateral knee arthroplasty (UKA) in our institution. The femoral articular cartilage was divided into 14 areas (medial 6, lateral 6, and trochlea 2 areas), and each area was evaluated by CT arthrography, MR imaging, and intra-operative status using ICRS grading system. In addition, in 5 cases of the patients who underwent TKR, the resected osteocartilage was evaluated by histological analysis in 14 areas and compared with CT arthrography and conventional MR imaging. Result The total sensitivity was 87.6% for CT arthrography and 79.2% for MR imaging, and the sensitivity of CT arthrography was high in all areas except 2 areas of lateral femoral condyle. The total specificity was 93.5% for CT arthrography and 90.9% for MR imaging. In particular, the specificity of the trochlear area was 96.8% for CT arthrography and 83.9% for MR imaging.

Conclusion CT arthrography has higher sensitivity and specificity when evaluating femoral articular cartilage than MR imaging. Especially in trochlear lesions, CT arthrography has a high sensitivity and specificity, which is useful for determining knee arthroplasty options.

20141 BONE MARROW LESION IN ALL COMPARTMENT DOES NOT AFFECT THE LONG-TERM CLINICAL FOLLOW-UP AFTER MEDIAL UNICOMPARTMENTAL KNEE ARTHROPLASTY

Kyung Jun Min, Byoung-Hyun Min, Do-Young Park, Jun-Young Chung, Keun Soo Kim, Sumin Lim. Republic of Korea

Summary Evaluation of correlation between bone marrow lesion and medial unicompartamental knee arthroplasty outcomes.

Data

Background Bone marrow lesion is significantly related to pain in knee osteoarthritis. New or enlarging bone marrow lesions are associated with accelerated cartilage loss. Unfortunately, the size of the bone marrow lesions of the natural history rarely decreases (0.6%), often remains unchanged (73%), and sometimes increases (27%). In a few previous literature, conflicting results have been raised regarding the effect of preoperative bone marrow lesions on course after unicompartmental knee arthroplasty. The purpose of this study is to compare pain and functional outcomes between patients with medial unicompartmental knee replacement based on the location and size of bone marrow lesions at long-term follow-up.

Method We retrospectively evaluated patients who underwent medial unicompartmental knee arthroplasty in our institution between 2002 and 2015. Preoperative MRI was evaluated, and 6 compartments (medial femoral condyle, lateral femoral condyle, medial tibial condyle, lateral tibial condyle, trochlea, and patella) were recorded as 4 grades (0, 1, 2, 3) each. Preoperative and postoperative WOMAC index and range of motion (ROM) were compared between patients based on the location and size of bone marrow lesion. We also evaluated the effect of medial unicompartmental knee arthroplasty comparing with patients who had bone marrow lesions and kept on conservative care.

Results A total of 158 patients (167 knees) had a mean follow-up period of 10.02 years. The medial femoral condyle and medial tibial condyle showed high prevalence of bone
marrow lesions of 86% and 81%, respectively. The presence of bone marrow lesions was associated with preoperative WOMAC in all compartments except lateral femoral condyle compartment. The bone marrow lesions of lateral femoral condyle, lateral tibial condyle, trochlea, and patella were related to preoperative range of motion (p=.001, p=.05, p=.06, and p=.03, respectively). The presence and severity of bone marrow lesions in all compartments did not significantly adversely affect the postoperative WOMAC index.

Conclusion Bone marrow lesions in all compartments were not associated with inferior outcomes at long-term follow-up after unicompartamental knee arthroplasty. These findings suggest that unicompartamental knee arthroplasty is associated with a reduction in pain and dysfunction in daily life from bone marrow lesions. Therefore, osteoarthritis with bone marrow lesions may be an appropriate indication for unicompartamental knee arthroplasty.

**Summary**

Thermal imaging of knees after total knee replacement correlates significantly with extent of edema and limitation of range of motion.

**Data**

**Background**

The rehabilitation period following total-knee arthroplasty (TKA) is characterized by pain, edema, and limited range of motion (ROM). Infrared Thermal Imaging is a noninvasive technology used here for measuring spatial distribution of skin temperature. Objective: This study assesses the correlation between thermal imaging and clinical outcomes following TKA.

**Methods**

This was a cross-sectional study of 81 patients who underwent thermal imaging at 4 time points from TKA (ethics-approval-#0251-20-HMO): (1) prior to TKA (pre-TKA, n=20), (2) 2-weeks post-TKA (n=20), (3) 6 weeks post-TKA (n=20), and (4) 1 year post-TKA (n=21). Thermal images were captured and skin temperature measured with a FLIR-One-Pro thermal camera and software (FLIR Systems, Wilsonville, OR). Normal thermal distribution over the knees was measured in non-operated controls (n=13). A difference of =1°C between knees was considered pathological. Knee ROM on extension and flexion were measured by digital goniometry. Edema was assessed by measuring leg circumference around the patella (circumference). Skin temperature by thermal imaging was correlated with edema and range of motion.

**Results**

A pathological increase in skin temperature of the operated-vs-non-operated knee was detected in all patients at 2 and 6 weeks following TKA, but only in 4 of 21 (19%) patients 1 year after TKA. In controls and pre-TKA patients, pathological increases in temperature were detected in only 1 of 20 (5%) and 1 of 13 (8%) respectively (p<0.001, by Chi square contingency). The difference in skin temperature between knees was significant across all patients but was significantly higher at 2 and 6 weeks post-

TKA compared to pre-TKA and 1 year post-TKA (Pre-TKA=0.3±0.5°C; 2-weeks post-TKA=2.5±0.7°C; 6-weeks post-TKA=2.4±0.7°C; 1y post-TKA=0.6±0.7°C, p<0.05 by mixed-design ANOVA with Bonferroni). Edema, extension, and flexion correlated positively with the skin temperature (r=0.66, r=0.62, and r=0.52 respectively, p<0.001 by linear regression).

**Conclusions**

Thermal imaging of knees correlates significantly with extent of edema and limitation of ROM after TKA. Further studies using advanced thermal properties are in progress to refine the assessment of these and other clinical outcomes.

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20159 THERMAL IMAGING FOLLOWING TOTAL KNEE ARTHROPLASTY – A CROSS SECTIONAL DIAGNOSTIC STUDY

Lilach Gavish, Leonid Kandel, Gurion Riskin, Itay Perets, Mattan Yoav, Meir Liebergall, S David Gertz, ?????? Hoffer. Israel

**Summary**

Moving the apex closer to the tibial plateau reduces the overall fracture risk but with an increased risk of type III fractures; a sharp increase in the failure load occurs as the lateral hinge width is increased.

**Data**

**Aim**

The most common complication in medial opening wedge high tibial osteotomies is a lateral hinge fracture, with a reported incidence of 20%. Lateral hinge width guidance ranges from 5 mm to 15 mm and the distance from the apex to the tibial plateau is defined relative to the tibiofibular joint. We sought to analyse the impact of changing the horizontal and the vertical position of the osteotomy apex on fracture risk and type, as well as map Takeuchi fracture types on the rectangular apex profile.

**Methods**

Artificial bone models and Perspex plates were utilised. For artificial bone models, osteotomy cuts started 40 mm from the tibial plateau and the apex was positioned 16 mm from the joint line; lateral hinge widths ranged from 4 mm to 22 mm. For Perspex models, the cut started 40 mm from the tibial plateau; the apex from the joint line was varied at 13 mm, 16 mm and 19 mm. At each height, lateral hinge widths ranged from 4 mm to 25 mm. Wedge opening angle at failure, failure load and fracture type were recorded in an opening-to-failure test in using cameras and an Instron machine. R2 values were calculated to assess correlation.

**Results**

Reducing the lateral hinge width reduces the overall fracture risk and Takeuchi type III fracture risk. Reducing the osteotomy apex to joint line distance reduces overall fracture risk but increases Takeuchi type III fracture risk. No Takeuchi II fractures were seen. A steep increase in the failure load with increasing hinge width was observed; there was no consistent impact of varying the apex to joint line distance.

**Conclusion**

Our study has demonstrated the correlation between fracture risk and hinge widths, as supported by different modelling methods. Moving the apex closer to the tibial plateau reduces the overall fracture risk but with an increased risk of type III fractures. A sharp increase in the failure load occurs as the lateral hinge width is increased. By mapping Takeuchi fracture types on the...
rectangular apex profile, we demonstrate a significant potential for simplifying future analysis of lateral hinge fracture mechanics.

20176 ULNAR NERVE DISLOCATION AND SUBLUXATION FROM THE CUBITAL TUNNEL ARE COMMON IN COLLEGE ATHLETES
Keisuke Tsukada, Youichi Yasui, Hirotaka Kawano, Wataru Miyamoto. Japan
10.1136/jisakos-2021-congress.223

Summary Ulnar nerve dislocation and subluxation from the cubital tunnel are common in college athletes.

Data
Purpose Ulnar nerve dislocation or subluxation from the cubital tunnel has been proposed as a risk factor of ulnar neuropathy. Previous studies reported that the frequency in the general population was up to 50%, while little is presently known in athletes despite their high demand. This study aims to clarify (1) the frequency of ulnar nerve dislocation or subluxation and (2) frequency of subjective symptoms and objective findings of ulnar neuropathy in athletes.

Methods The chart review of a medical check for the college athletes in our institute between March and November 2018 was retrospectively conducted. The subjects consisted of the four club activities of our college; Baseball, Rugby, Soccer, and Long-distance running. Inclusion criteria were a male athlete. Athletes with a history of elbow fracture were excluded. The location of ulnar nerve was assessed under ultrasound (US) examination by a board-certified orthopedic surgeon, an expert of ultrasound examinations for the musculocutaneous disorder. According to the criteria suggested in previous literature, three conditions were defined as the following; ulnar nerve dislocation (Type D, figure 1), a subluxation (Type S, figure 2), and normal (Type N, figure 3).

The subjective symptoms and objective findings evaluated were as follows: Tinel sign, nerve tension test (NTT), Froment’s sign, and weakness of strength of opponens digiti minimi muscle. Another board-certified orthopaedic surgeon who was blinded for US assessment evaluated these. Statistical analysis was made on the difference in frequency between club activities.

Results Two hundred and forty-six athletes (246 male, 0 female, mean age 19.7 years, 492 elbows) were included in the present study (table 1). There were 226 elbows (46%) of type D, 147 elbows (29.8%) of type S, and 119 elbows (24.2%) of type N. Of those with type D and S, pain was in 9%, dysesthesia was 4.5%, Tinel sign was 6%, NTT was 1.3%, Froment’s sign was 0.5%, weakness of strength of opponens digiti minimi muscle was 8%. Type D and S were more frequent in Baseball and Rugby athletes than in Soccer and Long-distance running (p<0.001). In those, the US examination showed that the medial head of triceps pushed the ulnar nerve from the cubital tunnel (figure 4-a, 4-b).

Conclusions The outcomes from the present study showed that 75.8% of college athletes had ulnar nerve dislocation or subluxation from the cubital tunnel. Notably, the athlete who had a high demand for their upper limbs sustained those abnormalities more frequently. The findings could help early diagnosis of ulnar neuropathy in college athletes.

20198 DOES SMALL POSTERIOR MALLEOLUS FRACTURE OSTEOSYNTHESIS IN TRIMALLEOLAR ANKLE FRACTURES HAVE SIGNIFICANTLY DECREASE TRANS-SYNDESMOTIC SCREW NEED?
Hugo Marques Ribeiro, António Serrano, João Silva, Raquel Teixeira, Isabel Rosa. Portugal
10.1136/jisakos-2021-congress.224

Summary This is the first study to evaluate the trans-syndesmotic screw frequency after trimalleolar ankle fractures osteosynthesis with a posterior malleolus fracture involving < 25% of the articular surface.

Data
Background Most authors agree that posterior malleolus fragments worsen patient clinical outcomes. There are continuing debates as to whether small posterior malleolus fragments (< 25% of joint surface affected) should be anatomically reduced and fixed. In the past, internal fixation of tibial posterior malleolus fragments was performed in cases wherein > 25% of the articular surface was involved for only 2 reasons: smaller fragments did not alter joint biomechanics and step defects < 2 mm did not affect the functional results. However, many studies have confirmed the role of the posterior malleolus as an important contributor to the alignment and stability of the ankle mortise and syndesmosis.

Objectives To our knowledge this the first study to evaluate the trans-syndesmotic screw frequency after trimalleolar ankle fractures with a posterior malleolus fracture involving < 25% of the articular surface.

Study Design & Methods
Retrospective comparative study Patients with trimalleolar ankle fracture who underwent surgery between January 2011 and January 2018 were identified within the department’s fracture database. General demographics, treatment details and fracture specific details (CT-scans) were assessed. Patients were grouped per the posterior malleolus fragment treatment: osteosynthesis (group 1) and non-osteosynthesis (group 2).

Results 64 patients, 58.6 ±17.8 years (range: 23–75), 68.8% female were eligible and follow up time was 43.1 ±22.2 (range 24–96) months. The mean size of the posterior malleolus fragment was 14.7 ±5.3% (range: 5–24). Posterior malleolus fragment treatment distribution: osteosynthesis (group 1) 31.2% and non-osteosynthesis (group 2) 68.8%. Osteosynthesis of the posterior malleolus fragment significantly reduced the frequency of trans- syndesmotic screw (0%) compared to non-osteosynthesis posterior malleolus fragment (15.9%) (p < 0.05).

Conclusions Posterior malleolus fragments (< 25% of the articular surface) have significantly decrease trans-syndesmotic screw need following osteosynthesis.

20187 ALL-CAUSE REPAIR FAILURE RATES INCREASE WITH TIME FOLLOWING MENISCAL REPAIR DESPITE FAVORABLE OUTCOMES: A SYSTEMATIC REVIEW AND META-ANALYSIS
1Zachariah Gene Wing Ow, 1Michelle Shi Ni Law, 1Cheng Han Ng, 2Aaron J Krych, 2Daniel Saris, 3Pedro Debieux, 1Keng Lin Wong, 1Heng An Lin. Singapore; 1USA; 2Brazil
10.1136/jisakos-2021-congress.225

Summary Due to the large variation in reported failure rates of meniscal repairs, we performed a meta-analysis of all-cause meniscal repair failure rates. We found that the pooled rates
of failure increased with respect to time, despite other favorable outcomes such as increased return to sport. Rates of failure when adjusted for concomitant ACL reconstruction were comparable.

Data

Purpose Current literature reporting the failure rate of meniscus repairs is varied, with little information reporting the incidence of meniscal repair failure at specific timepoints post-surgery. Hence, we propose that a pooled analysis of studies on meniscus repair outcomes will provide an accurate estimate of what outcomes can be expected following a meniscal repair at specific postoperative timepoints.

Methods A meta-analysis of meniscal repair failure (defined as persistent symptoms, lack of healing on MRI or revision surgery) and other clinical outcomes was performed following meniscal repair. Patient included had traumatic, non-degenerative meniscal tears, were skeletally mature, and had mature time-points after surgery. Repairs included were performed either in isolation, or with concomitant ACL reconstruction. Prior to pooling, binary outcome data underwent a Freeman-Tukey double arcsine transformation in order to stabilize the variance, as well as to account for zero events. Due to the inherent heterogeneity of single-arm meta-analyses, pooled analyses were performed utilizing the DerSimonian and Laird random-effects model.

Results Rates of all-cause meniscal repair failure was pooled to be 12% at 0-1 years (95% CI: 0.09–0.16), 15% at 2-3 years (95% CI: 0.11–0.20), and 19% at 4-6 years (95% CI: 0.13–0.24). After sensitivity analysis, pooled rates of failure incidence were relatively comparable at 11% at 0-1 years (95% CI: 0.08–0.13) and 15% at 2-3 years (95% CI: 0.08–0.22) following surgery. Development of osteoarthritis (OA), in patients with knees previously free from articular pathologies, was 4% at 2-3 years (95% CI: 0.02–0.07), and 10% at 4-6 years (95% CI: 0.03–0.25). Rates of reoperation were observed to be 12% at 0-1 years (95% CI: 0.08–0.17), 15% at 2-3 years (95% CI: 0.05–0.28). The return to pre-injury levels of activity in patients was 46% at 0-1 years (95% CI: 0.30–0.62), 88% at 2-3 years (95% CI: 0.79–0.95), and 96% beyond six years (95% CI: 0.81–0.99).

Conclusion Meniscus repair for traumatic injuries have an all-cause failure rate that increases from 12% to 19% through six years (95% CI: 0.81–0.99). Rates of reoperation were observed to be 12% at 0-1 years (95% CI: 0.08–0.17), 15% at 2-3 years (95% CI: 0.05–0.28). The return to pre-injury levels of activity in patients was 46% at 0-1 years (95% CI: 0.30–0.62), 88% at 2-3 years (95% CI: 0.79–0.95), and 96% beyond six years (95% CI: 0.81–0.99).

Discussion Sex-specific differences in muscle activity after ACL injury and reconstruction parallel those of kinematic and kinetic changes. While both sexes attempt to normalize inter-limb differences after pre-operative physical therapy, after surgery females have more asymmetries in muscle activity 6 months post-operatively than males when compared to health controls. Future work should consider the sex-specific effects of targeted post-operative rehabilitation to address the aberrant kinematic, kinetic, and muscle activation deficits after ACL injury. These sex-specific biomechanical changes may provide important targets for rehabilitation.

REFERENCES


Males and Females Have Different Walking Muscle Activity Patterns after ACL Injury and Reconstruction

Elanna Ashos, Stephanie Di Stasi, Erin Heather Hartigan, Lynn Snyder-Mackler. USA

Summary Identifying meaningful sex-specific changes in muscle activity is an important step to further characterize the aberrant biomechanical profiles during gait after ACLR and to provide targets for rehabilitation.

Data

Introduction After anterior cruciate ligament (ACL) injury and reconstruction (ACLR), sex differences are prominent during walking, cutting, and jumping tasks. \(^1\) \(^2\) Aberrant walking mechanics predominate in males and females, persist up to 2 years after ACLR, \(^3\) \(^4\) and are associated with the development of posttraumatic osteoarthritis. \(^5\) \(^6\) Kinematic and kinetic variables show continued walking asymmetry in females after ACLR compared to their male counterparts. \((2)\) While these sex differences are important, muscle activity, which may provide further insight to sex-specific adaptations to injury, has not been explored. Muscle timing variables (i.e., onset, peak activity, and offset) may provide insight into neuromuscular changes after ACL injury and ACLR. The purpose of this study was to explore sex-specific changes in muscle activity during gait in non-copers after diagnosis of ACL rupture, and after pre- and post-operative physical therapy. The secondary purpose was to compare muscle activity patterns during gait in individuals 6 months after ACLR to an uninjured control group.

Methods Thirty-nine non-copers (12 females, 27 males) who participated in >50 hours per year in Level I or II sports and diagnosed with a complete ACL rupture were enrolled. Participants were excluded if they had concomitant grade III knee ligament injuries, meniscal tears with >3 sutures, or chondral lesions >1cm². Uninjured controls were age, sex, and activity-level matched to participants after ACLR. Gait data were collected at pre- and post- pre-operative physical therapy, and 6 months after ACLR. Surface electromyography (EMG) data were collected at each time point from 7 muscles bilaterally: vastus lateralis and medialis (VL, VM), lateral and medial hamstrings (LH, MH), lateral and medial gastrocnemius (LG, MG), and soleus (SOL). General linear models with generalized estimating equations were used to detect the effects of limb (involved, uninvolved) and time (baseline, after pre-operative physical therapy, 6 months post-ACLR) for muscle activity timing variables of interest, run separately for each sex.

Results Males presented with more asymmetries than females at pre- and post- pre-operative physical therapy in the VL on (p<0.001) and off (p=0.007), VM on and off (p<0.001), MH off (p<0.001), and SOL off (p=0.021), but resolved most of their asymmetries by 6 months. Conversely, females presented with fewer asymmetries, with only VL off (p=0.027), VM on (p=0.003), and LG (p=0.012) at pre- and post- pre-operative physical therapy. In support of our second hypothesis, females continue to demonstrate asymmetries at 6 months compared to uninjured control participants in the VL on (p=0.001), VM on (p<0.001), VM off (p=0.033), LH off (p=0.030), MH on (p=0.041), LG on (p=0.009), and SOL on (p=0.004).

Discussion Sex-specific differences in muscle activity after ACL injury and reconstruction parallel those of kinematic and kinetic changes. While both sexes attempt to normalize inter-limb differences after pre-operative physical therapy, after surgery females have more asymmetries in muscle activity 6 months post-operatively than males when compared to health controls. Future work should consider the sex-specific effects of targeted post-operative rehabilitation to address the aberrant kinematic, kinetic, and muscle activation deficits after ACL injury. These sex-specific biomechanical changes may provide important targets for rehabilitation.
OUTCOMES AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR IN PATIENTS 65 AND OLDER: A MATCHED ANALYSIS

Scott Andrew Wu, Vehniah K Tjong, Mark Andrew Plantz, Erik Gerfach, Nicholas Arpey, Peter Swiatek, Colin Cantrell, John Carney, Haley Smith, Eric Sanders. USA

Summary This study is a matched analysis assessing outcomes following arthroscopic rotator cuff repair in patients 65 years and older.

Data

Introduction As the population of the United States ages, there is increasing demand for elective orthopaedic procedures in elderly individuals. One of the more common pathologies affecting elderly patients’ quality of life is rotator cuff pathology. The purpose of this study is to use exact matching of a large national database to assess the safety of performing arthroscopic rotator cuff repair in elderly patients.

Materials and Methods The ACS NSQIP database was queried to identify patients that underwent arthroscopic rotator cuff repair between December 31, 2015 and January 1, 2017. Patients were split into two age groups: (i) between 40-65 years old and ii) 65 years and older. Exact matching was used to control for various potential confounding variables, including sex, body mass index (BMI), American Society of Anesthesiologists (ASA) classification score, and various medical comorbidities. After matching, the incidence of various 30-day patient outcome measures were compared between the two groups. Multivariate logistic regression was also used to compare the association of age and short-term outcome measures.

Results A total of 17,880 patients were included in the study. 69.4% (n=12,404) patients were between 40-65 years old and 30.6% (n=5,476) patients were 65 years and older. After matching, 9,586 patients were included in the final analysis. In the matched analysis, patients 65 years and older were more likely to experience 30-day unplanned readmission (p=0.043) and medical complications (p=0.006), mainly driven by pneumonia (p=0.039) and urinary tract infection (p=0.071). However, there were no significant differences in most 30-day outcome measures, including mortality (p=0.0625), reoperation (p=0.432), non-home discharge (p=0.237), surgical complications (p=0.267), and several medical complications, including myocardial infarction (p=0.118), deep venous thromboembolism (p=0.387), pulmonary embolism (p=0.617), and cerebrovascular accident (p=0.625) between the two age groups.

Conclusions Generally, arthroscopic rotator cuff repair is safe in appropriately selected patients 65 years and older. However, these older patients are more likely to experience unplanned readmission and pneumonia in the postoperative period. These risks should be considered and discussed with patients prior to proceeding with surgery.

LOWER EXTREMITY ALIGNMENT IN PROFESSIONAL SOCCER PLAYERS

Spencer M Stein, William Tyler, Bert R Mandelbaum. USA

Summary We investigated lower extremity alignment in male professional soccer players and demonstrated they have a statistically significant increased degree of genu varum, with a smaller medial proximal tibia angle and smaller medial neck shaft angle, as compared to age and sex matched controls.

Data

Introduction Variations from neutral lower extremity alignment can have long term consequences on the musculoskeletal health of an athlete. Genu varum is associated with a higher prevalence of knee pathologies, such as meniscal tears, patellofemoral syndrome and ultimately osteoarthritis. Previous research has identified increased genu varum in athletes and in soccer players of all levels. However, no studies to date have specifically investigated the radiographic lower extremity alignment of elite soccer players. Our aim was to define the normal range of lower extremity alignment in a cohort of elite male soccer players. We hypothesized that professional soccer players have increased genu varum as compared to controls.

Methods Full lower extremity leg length alignment anteroposterior (AP), AP knee, and 45-degree posteroanterior knee (Rosenberg) radiographs were reviewed from professional male soccer players. Hip-Knee Angle (HKA), Medial Proximal Tibia Angle (MPTA), Lateral Distal Femur Angle (LDFA), degree of tibial bowing, degree of femoral bowing, and Medial Neck Shaft Angle (MNSA) were measured on alignment radiographs. The interbone distance between the distal femur and proximal tibia was measured in millimeters on the knee AP and Rosenberg radiographs. A cohort of age and sex matched controls was selected and radiographic measurements were obtained for comparison. As the data was determined to be normally distributed, statistical analyses were performed using unpaired t-tests with the P value set at 0.05.

Results 32 male elite soccer players were included in the cohort. There was no statistical difference in age between the soccer athletes and the control cohort. The soccer athletes had significantly more varus alignment then controls (2.9 ± 3 versus 0.4 ± 2.3, P<0.001). Additionally, soccer players had significantly smaller MPTA and smaller femoral MNSAs than the controls did. Soccer professionals also had significantly smaller interbone distance than controls in the medial compartment on Rosenberg radiographs but significantly smaller interbone distance in both compartments on AP radiographs.

Discussion We demonstrated that a cohort of male professional soccer athletes have an increased degree of genu varum as compared to age and sex matched controls. While the contribution to genu varum is likely multifactorial, it seems probable that proximal tibia (MPTA) and proximal femur (MNSA) alignment contribute to this phenomenon. The observed decreased joint space in the medial compartment on Rosenberg radiographs as compared to controls is consistent with previous hypotheses that genu varum in athletes is secondary to increased activity and narrowing of the joint space. However, our findings that MPTA and MNSA in the athletes were significantly lower from controls indicates that skeletal alignment factors contribute to the observed genu varum. What remains unknown is if varus alignment develops due to increased load over time or if a varus alignment is a beneficial trait resulting in increased performance in the athlete. We are the first to examine professional soccer athletes radiographically for leg length alignment and have aimed to establish what the “normal” is for these elite athletes. Future longitudinal investigations could help determine causal relationship for genu varum and what the long-term risk for injury is.
Summary A robotic cadaveric biomechanical comparison of three different acromioclavicular joint reconstruction implants

Background Persistent acromioclavicular joint (ACJ) disruption following high grade injuries can cause symptomatic multidirectional instability. The importance of horizontal plane stability is increasingly recognized, but most studies have only imaged the ACJ in the coronal plane in order to measure superior elevation of the clavicle, while imaging of the transverse plane is difficult. There is little evidence of the ability of current implant methods to restore native ACJ laxity in the vertical and horizontal planes.

Purpose To measure the ability of three implant reconstructions to restore native ACJ stability. Study design: Controlled laboratory study.

Methods Three groups of nine fresh-frozen shoulders were mounted into a robotic testing system. The scapula was stationary and the robot displaced the clavicle to measure native anterior, posterior, superior and inferior (A,P,S,I) laxities at 50N force. The ACJ capsule, conoid and trapezoid ligaments were cut and the ACJ was reconstructed using one of three commercially available systems. Two systems (Lockdown and Infinity-Lock) wrapped a tape around the clavicle and coracoid, the third system (Dog Bone) passed directly through holes in the clavicle and acromion. Two modified reconstructions were also tested. The laxities were remeasured. The data for A-P and S-I laxities were analyzed by ANOVA and repeated-measures Student t-tests with Bonferroni correction to contrast each reconstruction laxity versus the matching native ACJ data for that set of 9 specimens, and to examine contrasts among the reconstructions.

Results All three reconstructions restored the range of A-P laxity to that of the native ACJ. However, the coracoid loop devices shifted the clavicle anteriorly, so the anterior laxity was larger than the native laxity (p<0.0167) and the Lockdown overconstrained posterior laxity (p<0.001). For range of S-I laxity, only the Dog Bone reconstruction did not differ significantly from native ligament restraint. The mean S-I position was elevated 2 mm for Infinity-Lock and Dog Bone procedures and 4 mm for Lockdown, which had residual superior laxity (p<0.001). The addition of an Internal Brace to the Dog Bone reconstruction, across the anterior aspect of the ACJ, increased anterior laxity.

Conclusion Only the reconstruction that passed directly though tunnels in the clavicle and coracoid restored all laxity measures (A,P,S,I) to the native values. The tape implants wrapped around the bones allowed relatively greater superior laxity to persist and led to the unloaded position of the clavicle being anteriorized, with resulting anterior laxity underconstrained and posterior overconstraint. The devices that were wrapped around the coracoid and clavicle were less effective at restoring superior stability than a reconstruction method that passed directly in a superior-inferior axis through both clavicle and coracoid. These differences may be due to the orientations of the devices between the bones and

Abstracts

20273 LIGAMENTOUS AND CAPSULAR CONTRIBUTIONS TO ANTERIOR-POSTERIOR AND SUPERIOR-INFERIOR STABILITY OF THE ACROMIOCLAVICULAR JOINT

1Mohamed Alkoheji, 2Jillian Lee, 3Hadi El Daou, 4Adrian Carlos, 5Livio Di Mascio, 6Andrew A Amis. 1Bahrain, 2New Zealand; 3Ut

Summary Robotic biomechanical cadaveric analysis of anatomical structures contributing to acromioclavicular joint stability

Data Background Approximately 9% of shoulder girdle injuries involve the acromioclavicular joint (ACJ). There is no clear gold standard or consensus on surgical management of these injuries, in part perpetuated by our incomplete understanding of native ACJ biomechanics. There is increasing interest in the role of anterior-posterior (AP) instability, which is not reported as often as superior-inferior (SI) displacement from clinical imaging. We have therefore conducted a biomechanical study to measure the amount of restraint provided by each of the stabilizing structures of the ACJ in both SI and AP translation.

Methods Twenty fresh-frozen cadaver shoulder girdle specimens were prepared and mounted in a robotic testing system. The inferior scapula was cemented into a fixed mounting beside the base of the robot. The medial clavicle was cemented into a tubular holder on the end of the moving arm of the robot. The intact native joint was tested in SI and AP translations under 50N displacing force. Each specimen was re-tested after sectioning of its stabilizing structures in the following order: investing fascia, ACJ capsular ligaments, trapezoid ligament, and conoid ligament. Their contributions to resisting ACJ displacements were calculated by measuring the reduction of the force needed to displace the clavicle after each cut. The force contributions of each of the cut structures were tested for statistical significance using repeated measures one-way ANOVA with multiple contrasts and Tukey’s correction. Differences were taken to be significant with p <0.05.

Results In the intact native ACJ, mean anterior displacement of the clavicle was 7.9 ± 4.3 mm and mean posterior displacement was 7.2 ± 2.6 mm (p=0.632). Mean superior displacement was 5.8 ± 3.0 mm and mean inferior displacement 3.6 ± 2.6 mm (p=0.042). The conoid ligament was the primary and only significant stabilizer of superior displacement (46%; p<0.001). The ACJ capsular ligament was the primary stabilizer of inferior displacement (34%; p<0.001), but did not provide significant resistance to superior displacement (p=0.167). The capsular ligament and conoid ligament contributed equally to anterior stability, with 23% and 25% respectively (p=0.001). The capsular ligament was the primary contributor to posterior stability (38%; p=0.002) while the conoid ligament contributed 14% (p=0.001).

Conclusion The conoid ligament is the primary stabilizer of superior displacement of the clavicle at the ACJ and contributes significantly to A and P stability. Consideration should be given to reconstruction of the ACJ capsular ligament for complete AP stability in high grade and horizontally unstable ACJ injuries. These data provide a better understanding of this joint’s complex biomechanical characteristics, thus aiding development and evaluation of reconstructive techniques.
the difficulty of avoiding soft tissue interposition. Clinical relevance: This study provides novel ‘time zero’ data that compared the ability of three commercially available ACJ implant systems to restore both anterior-posterior and superior-inferior stability of the ACJ. These data will assist surgeon choice of reconstruction method.

Summary

For the first time, frictional behaviour of large intact and meniscectomized animal joints was determined to investigate the role of the menisci on the overall friction within the knee joint.

Data

Introduction The menisci play a decisive role within the healthy knee joint by increasing the contact area and thereby reducing contact pressure on the articulating cartilage. Although increased signs of wear could be observed after meniscus injury and/or (sub-) total meniscectomy, only little research has been performed to examine the importance of the menisci in low-friction motion. Therefore, the aim of this study was to investigate the influence of meniscectomy on overall friction in the knee joint.

Materials and Methods

Six ovine knee joints were ordered from a local butcher and tested within a customized pendulum friction test setup under simulated stance- (axial load: FN = 1kN, initial deflection: d = 5°) and swing phase (FN ~ 250N, d = 12°) conditions. To investigate the influence of menisci on knee friction, each joint was consecutively dissected and tested in 3 steps: intact, resection of medial posterior meniscal attachment and meniscectomy. After initially deflecting the joint, the resultant pendulum oscillation was recorded via a motion-capturing system (OptiTrack, NaturalPoint Inc., USA). To evaluate the joint friction, two mathematical models analysing the decay in flexion-extension angle were used. While the linear model (µlin) of STANTON assumes an energy loss due to friction, the CRISCO-model additionally considers the time-dependency of viscoelastic materials by a damping coefficient (c). Differences in friction between the knee joint conditions were compared with a chi loading condition and mathematical model using 1-way ANOVA.

Results

Meniscectomized joints showed significantly lower friction coefficients during swing phase than intact joints when assessed via STANTON, while the CRISCO-model revealed no significant differences in friction but a significant decrease in the damping properties c. During stance phase, only an increasing tendency for µlin and c were found between the three dissection steps. However, the overall recorded kinematics showed a notable increase in tibial rotation up to 100% after resection of the posterior meniscal attachment and meniscectomy, especially during swing phase conditions.

Discussion: For the first time, frictional behaviour of large intact and meniscectomized animal joints was determined. However, the obtained friction coefficient of intact joints was generally higher compared to previous studies, which might be due to the difference in size and loading conditions. Nevertheless, no major influence of the menisci on the knee joint friction could be observed expect during swing phase using the Stanton-model. However, an increased tibial rotation after resecting the posterior meniscal attachment and meniscectomy was identified. Therefore, further studies should not only consider motion in flexion-extension but also include the overall joint movement.

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Summary Post-operative tibial slope was not associated with failure however it was associated with greater pain following fixed-bearing medial UKA.

Data

Background Excessive posterior tibial slope in medial unicompartmental knee arthroplasty (UKA) has been implicated in early failure. The purpose of this study was to evaluate the relationship of preoperative posterior slope and postoperative posterior slope of the implant with outcomes following medial non-robotically assisted fixed-bearing medial UKA.

Methods Patients who underwent medial UKA between 2002 to 2017 with a minimum 2-year follow-up were included. Preoperative posterior tibial slope and postoperative slope of the tibial implant were measured on radiographs. Failure was defined as conversion to total knee arthroplasty. Outcomes measures included KOOS, WOMAC, Lysholm, and VR12.

Results One hundred thirty-one patients (70 females, 61 males; average age of 65 ± 10 years average BMI of 27.9 ± 4) were included in the study. Four patients (3%) converted to TKA. The mean survival time was 15.2 years [95% CI: 14.6–15.7]. Survivorship was 98% at 5 years and 96% at 10 years. No patients who converted to TKA had a postoperative posterior slope of the implant of >7°. At a mean follow-up of 8 years (range 2 to 15), there were no significant correlations between preoperative posterior tibial slope or postoperative posterior slope of the implant and outcome scores. Increasing postoperative posterior slope of the implant was associated with worse pain. Postoperative posterior slope of the implant negatively correlated with KOOS pain scores (rho=-0.24; p=0.014). KOOS pain scores were lower in patient with >7° postoperative posterior slope of the implant. Seventy six percent of patients with >7° of postoperative posterior slope of the implant reached PASS for KOOS pain while only 59% of patients with >8° of postoperative posterior slope of the implant reached PASS for KOOS pain. (p=0.015).

Conclusion Posterior tibial slope, preoperatively or postoperatively, was not associated with failure or most outcomes following non-robotically assisted, fixed-bearing medial UKA using modern implants with intramedullary rods, jigs and guides, similar to TKA. However, larger postoperative posterior slope of the implant (=8°) had significantly worse pain but function was similar.

20827 RASCH ANALYSIS OF RELIABILITY AND VALIDITY OF SCORES FROM THE KNEE INJURY AND OSTEOARTHRITIS OUTCOME SCORE IN PATIENTS UNDERGOING UNICOMPARTMENTAL KNEE ARTHROPLASTY

Kevin D Plancher, Lauren M Matheny, Karen Briggs, Jasime Brite, Stephanie C Petterson. USA

10.1136/jisakos-2021-congress.234

Summary In this Rasch analysis of the KOOS score for use following UKA we found only 3 of the 5 subscales were sufficient to measure outcomes.

Data The purpose of this study was to determine the reliability and validity of the KOOS scores, using Rasch analysis for reporting outcomes following UKA.

Methods This study was conducted at a single center with all surgeries performed by a single surgeon. Data was collected prospectively as part of quality control and retrospectively analyzed. This study was approved by an institutional review board. From 2002 to 2017, 168 medial UKA's and 49 lateral UKA's were performed for unicompartement osteoarthritis. Patients were included if they completed a postoperative questionnaire at a minimum of 2 years follow-up. A volunteer sampling method was used, in that all patients who presented to the tertiary orthopedic referral clinic with an unicompartement osteoarthritis were asked by a clinical staff member to participate in quality monitoring by completing a follow-up questionnaire. All subscales of the KOOS score were included in the analysis. To investigate unidimensionality, meaning that all of the items for the KOOS subscales only measure the single construct of pertaining to each specific subscale, which is an assumption of the Rasch model, a principal component analysis (PCA) was conducted, and a scree plot was produced.

Results Person reliability was acceptable for the KOOS Sport at 0.8 and KOOS QOL at 0.85. KOOS Pain and KOOS ADL were close with 0.71 and 0.78 respectively. The item reliability was above 0.9 threshold for all subscales (KOOS Pain =0.96; KOOS Symptom =0.93; KOOS ADL =0.96; KOOS Sport =0.91; KOOS QOL =0.97). The person separation index was 1.56 for KOOS Pain, 0.96 for KOOS Symptoms, 1.87 for KOOS ADL, 1.98 for KOOS Sport, and 2.4 for KOOS QOL. KOOS ADL, KOOS Sport, and KOOS QOL were near or above the recommended 2.0. Overall, KOOS Sport, KOOS ADL, KOOS QOL had good evidence of validity. To assess internal scale validity, the infit MNSQ values were calculated. KOOS Sport and KOOS QOL were the only subscales will all acceptable values. The KOOS pain subscale had poor person separation and reliability and 1 question had poor infit and outfit MNSQ. The KOOS symptom subscale also had poor person separation and reliability and 1 question had poor outfit MNSQ.

Conclusion In this Rasch analysis of the KOOS score for use following UKA we found only 3 of the 5 subscales were sufficient to measure outcomes. The KOOS ADL subscale has acceptable person separation and reliability and 1 question had poor infit and outfit MNSQ. The KOOS Sport and KOOS QOL performed the best in the analysis with acceptable or borderline person separation and reliability. These results show that not all scales of the KOOS perform adequately when used in a population of patients following UKA.
ENDOSCOPIC TRIGGER FINGER RELEASE: OUTCOMES OF A NOVEL MINIMALLY INVASIVE TECHNIQUE FOR THE TREATMENT OF STENOSING TENOSYNOVITIS

Ather Mirza, Justin Bruno Mirza, Luke C Zappia, Terence Thomas, Robert Talay, Jagger Corabi. USA

10.1136/jisakos-2021-congress.236

Summary This novel technique offers an effective, minimally invasive approach for the surgical treatment of trigger finger.

Data

Introduction Stenosing tenosynovitis is a commonly encountered pathology in orthopedic hand surgery. Traditional open trigger finger release may leave patients with a visibly unappealing scar. Endoscopic release may mitigate these scar concerns while producing effective outcomes. The purpose of this study is to introduce a novel endoscopic technique for the treatment of patients with stenosing tenosynovitis of the fingers. We present the short term functional and objective outcomes of patients treated with this technique. We believe that our improved endoscopic trigger finger release technique and associated outcomes will support the effectiveness and efficiency of an endoscopic approach.

Methods 48 patients (62 fingers) who failed conservative treatment for trigger finger were admitted to an outpatient surgery center for surgical treatment. For this endoscopic technique, a 0.5cm transverse incision is made at the distal palmar crease proximal to the A1 pulley of the affected finger. Release of the A1 pulley was performed with a scope mounted blade and a 2.7 mm, 0-degree arthroscope. Patients returned for follow-up where outcomes were assessed via grip and pinch strength, finger range of motion, Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaires, and Visual Analog Scale (VAS) pain score.

Results Outcomes are reported for 48 patients, 28 males and 20 females. Mean age was 69.1 years. Of the 62 fingers operated on, 9 were index, 21 were middle, 28 were ring, and 4 were little fingers. No thumbs were operated on. Compared to the contralateral side, gross grasp, lateral pinch, three-jaw chuck, and precision pinch recovered 85%, 90%, 82%, and 90% respectively. At final follow-up, average VAS scores decreased from 5.7 preoperatively to 2.2 postoperatively (p<0.01). The mean DASH score at final follow-up was 11. There were no instances of a A2 pulley severance or digital nerve injury.

Conclusion This novel technique offers an effective, minimally invasive approach for the surgical treatment of trigger finger. Endoscopic visualization provided by this technique may decrease the incidence of complications compared to percutaneous measures. Furthermore, the minimally invasive nature of this technique may reduce visible scar appearance compared to open release measures. All patients returned to normal functionality of the hand within one month and reported significant subsidence in pain.

MEASURED RESECTION MECHANICALLY AND KINEMATICALLY ALIGNED TKA’S OFTEN RESULT IN AN IMBALANCED KNEE

1Mark G Clatworthy, 2Donald Hansom, 3Nicola Blucher. 1New Zealand; 2UK

10.1136/jisakos-2021-congress.236

Summary This study shows that is uncommon to achieve an optimally balanced TKA with a mechanical alignment or kinematic alignment surgical technique. This is achieved 24% of the time with MA and 33% of the time with KA

Data

Introduction The majority of total knee replacements are performed using a measured resection technique aiming for a neutral mechanical axis with 3° of external femoral rotation. This technique assumes that all knees are the same. Recent anatomic studies have shown large variation in the bony anatomy of the knee with only 1/1000 knees have a neutral tibia and femur. This maybe one of the factors why up to 20% of TKAs are unhappy. Recently kinematic alignment TKA has been advocated as this technique enables an anatomic resurfacing of the knee however it doesn’t factor in the variable soft tissue envelope. The Brainlab 3 CAS system enables the surgeon to evaluate the balance consequence of a mechanically aligned and a kinematically aligned TKA.

Method We carried out a single surgeon prospective study off 340 consecutive patients undergoing a navigated Brainlab 3 TKA between January 2019 and November 2020. After osteophyte removal the native knee was stressed in flexion and extension. We then virtually positioned the implant to achieve neutral mechanical axis tibial and femoral cuts with the posterior femur cut at 3 degrees of external rotation relative to the posterior condylar axis. We then assessed the flexion and extension gaps. TKAs who had laxity of greater than 2 mm in extension, flexion or flexion extension mismatch were determined. The same process was then repeated, virtually positioning the implant kinematically, with zero degrees of rotation on the femur with equal posterior femoral condyle cuts and anatomical distal femoral and tibial cuts.

Results In the mechanically aligned group 41% were found to have an extension imbalance (Range −10 mm - 7.5 mm) while 46% had a flexion imbalance (Range −8 mm - 8.5 mm). A medial flexion/extension mismatch was present in 42% of patients (Range −12 mm - 8.5 mm) while 39% demonstrated a lateral flexion/extension imbalance (Range −8.3 mm - 6.5 mm). Only 24% had a balanced extension and flexion gap and flexion/extension extension gap. With trials inserted the imbalance could not be corrected in 40%. In the kinematically aligned group, 20% were found to have an extension imbalance (Range −6.5 mm - 5.5 mm) while 34% had a flexion imbalance (Range −10 mm +8 mm). A medial flexion/extension mismatch was present in 22% of patients (Range −10 mm - 6.5 mm) while 34% demonstrated a lateral flexion/extension imbalance (Range −10 mm, +8 mm). Only 33% had a balanced extension and flexion gap and flexion/extension gap. With trials inserted the imbalance could not be corrected in 42%. Balanced MA KA Extension 59% 80% Flexion 54% 66% Medial Flexion/Extension 58% 78% Lateral Flexion/Extension 61% 66% All Gaps 24% 33% Uncorrectable 40% 42%.

Conclusion This study shows that is uncommon to achieve an optimally balanced TKA with a mechanical alignment or kinematic alignment surgical technique. This is achieved 24% of the time with MA and 33% of the time with KA if a > 2 mm tolerance is used. More importantly balance could not be achieved with selective ligament releases due to the variable imbalance in 40% of MA TKAs and 42% of KA TKAs. For this reason we perform a patient specific alignment CAS ligament guided balanced TKA whereby the prosthesis is implanted as anatomically as possible with small changes made
Summary

Range of hip motion may help predict if a patient has hip microinstability as compared with FAI.

Data

Objective

Clues to the diagnosis of hip microinstability is still evolving. We hypothesized that hip range of motion (ROM) will be greater in patients with hip microinstability than in patients with femoroacetabular impingement (FAI) alone.

Methods

After IRB approval, a retrospective chart review was performed for patients undergoing arthroscopic surgery for hip microinstability (thus arthroscopically confirmed microinstability) and FAI at an academic center. A power analysis determined 25 patients were needed in each group to detect a 5 degree difference. After adjusting for gender, BMI, age, and smoking status, multivariable generalized linear models were used to detect differences. Sensitivity and specificity were determined for multiple flexion plus rotation arc measures.

Finally, a logistic regression was used to create a model to determine the probability of microinstability with a given gender, BMI, age and degree of flexion. Microinstability was defined as any patient requiring capsular plication for instability based on previously published intra-operative parameters at our institution. FAI was defined as alpha angle >55 degrees, center edge angle >35 degrees, or other radiographic parameter of pincer impingement, such as crossing sign. ROM including hip flexion, internal rotation, external rotation and rotation arc were recorded in degrees.

Results

Seventy five patients were included in this study: 25 with isolated hip microinstability, 25 with isolated FAI, and 25 patients had combined microinstability with FAI (CM-FAI). No difference in ROM was found between microinstability and CM-FAI groups for all ROM parameters. However, the isolated microinstability and CM-FAI groups had significantly greater hip flexion (128°, 135°) than FAI only (113°, p=0.003, p<0.001). Isolated hip microinstability and CM-FAI groups also had significantly greater flexion plus rotation (218°, 224°), than FAI only (180°, p=0.015, p=0.004). Flexion plus internal rotation was greater in the isolated microinstability and CM-FAI groups (162°, 168°) than in FAI only (131°, p=0.005, p<0.001). CM-FAI had a greater flexion plus external rotation (190°) than FAI only (162°, p=0.012).

Rotational parameters alone showed no difference between instability and FAI groups in isolation. When flexion plus rotation arc was greater than 197.5 degrees, there was an 84% sensitivity and 76% specificity that a component of instability present. Furthermore, a risk of instability profile may be built using hip flexion, BMI, age and gender determine the probability of instability.

CONCLUSIONS

Hip microinstability is associated with a significant increase in multiple ROM parameters, even in the presence of FAI. Flexion was the most important parameter. An in-office calculation of flexion plus rotation arc greater than 197.5 degrees can be used to suggest the potential of hip microinstability as a component hip pain. Finally, flexion, BMI, age, and gender can be combined to determine the probability of hip microinstability and potentially predict the need for capsular plication.

ENDOSCOPIC ILIOPSOAS LENGTHENING FOR TREATMENT OF RECALCITRANT ILIOPSOAS TENDINITIS AFTER TOTAL HIP ARTHROPLASTY

Marc R Safran, Justin Hopkins, Katia Elizman, Andrea Finlay, Nicole Alexandria Segovia, James I Huddleston. USA

Summary

Endoscopic iliopsoas lengthening can successfully treat recalcitrant iliopsoas tendinitis after total hip arthroplasty and factor affecting negative outcomes can be identified preoperatively.

Data

Purpose

Iliopsoas (IP) tendinitis may cause persistent groin pain after an otherwise successful total hip arthroplasty (THA). It is generally thought to be due to IP impingement upon the acetabular component. Historically, operative treatment involved either open iliopsoas tenotomy or acetabular component revision. We sought to evaluate a single surgeon series of patients treated with endoscopic iliopsoas tenotomy for IP impingement after THA.

Methods

At our institution, patients with persistent pain after total hip arthroplasty who had an evaluation ruling out infection, loosening wear and/or instability, who also had pain with resisted hip flexion that was markedly (at least 50%) relieved, even for a short time, from an ultrasound guided anesthetic injection were diagnosed as having iliopsoas tendinitis. A consecutive series of 24 patients with IP impingement after THA were treated with endoscopic iliopsoas lengthening from 2012 to 2020 at a single-center academic institution. Twenty one patients were available for follow up at a mean of 6.9 months (range 1–28 months). The primary outcome was the Modified Harris Hip Score (mHHS). Secondary outcomes included International Hip Outcome Tool 12 (iHOT-12), visual analog scale for pain (VAS), patient satisfaction, graded psoas strength, complications, and acetabular component positioning.

Paired and two sample t-tests were used for statistical analyses in RStudio version 1.1.456 (Boston, MA) using a two-sided level of significance of 0.05.

Results

The mean mHHS preoperatively was 57.3 (range 35.1–81.3, SD 12.2) and postoperatively was 76.3 (range 31–100, SD 18.9, p = 0.0001). Significant improvements in mHHS correlated with increased patient satisfaction (p = 0.013) and VAS pain scores of less than 5 (p = 0.027). Clinically meaningful improvements in mHHS were seen in patients with an acetabular cup prominence of >8 mm, a BMI of >30, and those who had their index THA within 2 years. At final follow up, 72% of patients were satisfied with their surgery, and satisfaction was associated with improvement in mHHS (p = 0.013) and shorter time from index THA (p = 0.011). One patient developed an infection 7 months postoperatively (felt not to be related to the endoscopic procedure) requiring a two-stage total hip arthroplasty revision, and one patient underwent an open psa release for persistent pain, yet with only partial relief from each surgery.

Conclusion

Endoscopic IP tenotomy for impingement after THA may be a safe alternative to open tenotomy or...
AMNIOTIC SUSPENSION ALLOGRAFT INJECTION FOR HIP OSTEOARTHRITIS: PROSPECTIVE PILOT STUDY WITH 1 YEAR FOLLOW UP
Marc R Safran, Molly Claire Meadows, Katia Elisman, Shane Nho. USA
10.1136/jisakos-2021-congress.239

Summary Cryogenically preserved Amniotic Suspension Allograft hip injection appears to be a safe, effective treatment for moderate hip osteoarthritis, with sustained clinical benefit at one year post-injection in this pilot study.

Data
Background/Purpose There is increasing interest in strategies for management of patients with moderate osteoarthritis (OA) of the hip. Treatment of these patients can be challenging, as they are less likely to benefit from arthroscopy but may not yet be indicated for arthroplasty or due to age, are trying to delay arthroplasty. One orthobiologic solution includes cryogenically preserved amniotic suspension allograft (ASA). This is an allograft tissue composed of particularized amniotic membrane and cells from the amniotic fluid, which has been shown to improve pain in patients with knee OA. The purpose of our study was to evaluate the safety and efficacy of one ASA product injection in a patient population with moderate hip OA. We hypothesize that clinical results, as measured by patient-reported outcome tools (PROMs), will demonstrate at 12 months post-injection.

Methods This was an IRB approved, multi-center, open-label pilot study of a cryogenically preserved ASA delivered as a single intra-articular injection for treatment of moderate hip OA. Ten patients with symptomatic hip osteoarthritis, defined as Tonnis grade 1 or 2 on radiographic examination, were prospectively enrolled. Other inclusion criteria included a minimum score of 2 on the Tegner activity scale, a seven-day average pain score of 4 or greater for the involved hip, and body mass index (BMI) less than 40. Exclusion criteria included a history of diabetes mellitus, rheumatoid arthritis or other autoimmune disorders, malignancy within 5 years, morbid obesity (BMI >40), pain medication or NSAID within 15 days prior to injection, use of pain medication for conditions unrelated to hip OA, anticoagulant use, use of immunosuppressive medication, corticosteroid or viscosupplementation injection within 6 months, infection within 3 months, hip dysplasia (CEA < 25 degrees and/or Tonnis angle > 10 degrees) and surgery of either hip within 6 months. PROMs, including the iHOT12, mHHS, and SANE scores, were recorded at baseline, 6 months, and 12 months post-injection. A linear regression model was performed to detect differences in outcome scores from baseline.

Results Ten patients were enrolled per the protocol. One patient did not feel the injection was properly administered, and had total hip arthroplasty 6 weeks after the injection. This left nine patients, all had completed 12-month data and were available for analysis. The cohort includes 5 males and 4 females, ages 47–67. iHOT scores demonstrated a significant improvement between baseline and 12 months (p = 0.02). SANE scores demonstrated a significant difference between baseline and 6 months (p < 0.01), and between baseline and 12 months (p < 0.01). mHHS scores demonstrated a significant difference between baseline and 6 months (p = 0.02) and baseline and 12 months (p = 0.01). There were no major adverse events in the course of the study period.

Conclusion The ASA hip injection is a safe, effective treatment for moderate hip osteoarthritis, with sustained clinical benefit at one year post-injection. Further randomized controlled trials are needed to compare the results of this ASA hip injections to other traditional treatment modalities and other ASA products.

ENDOSCOPIC SHELF ACETABULOPLASTY CONCOMITANT WITH LABRAL REPAIR, CAM OSTEOPATHY, AND CAPSULAR Plication FOR TREATING ARTISTIC DANCERS IN THE SETTING OF ACETABULAR DYSPLASIA: A CASE SERIES
Soshi Uchida, Yoichi Murata, Hajime Utsumiyama, Tsukamoto Manabu, Akhirsa Hatakeyama, Shiro Kanezaki, Akinori Sakai. Japan
10.1136/jisakos-2021-congress.240

Summary Endoscopic shelf acetabuloplasty enabled artistic dancers to return to play with a high success rate.

Data
Background Knowledge of clinical outcomes and return to play after endoscopic shelf acetabuloplasty (ESA) for acetabular dysplasia in artistic athletes is lacking.

Hypothesis Hip arthroscopic surgery including ESA will enable artistic athletes to return to play with a high success rate, significantly improved acetabular coverage, and preserved joint cartilage. Study Design: Case series; Level of evidence, 4.

Methods We reviewed 28 hips in 23 female artistic athletes (sport: 14 ballet, 9 rhythmic gymnastics, 4 dance, 1 baton twirling) who underwent arthroscopic labral preservation, capsular plication, and ESA. The mean age was 25.8 ± 10.2 years. Preoperatively, all patients had generalized joint laxity (Beighton score, 7.1 ± 1.8). Preoperative and postoperative radiographs and outcome scores (modified Harris hip score [mHHS]; nonarthritic hip score [NAHS]; International Hip Outcome Tool 12 [iHOT-12]; Vail hip score [VHS]; and Hip Outcome Score-Sports [HOS-Sports]) were evaluated. Statistical analysis was performed using paired t tests and Bonferroni correction.

Results The mean follow-up was 32.5 ± 12.5 months. The mean LCEA significantly increased from preoperatively (15.7° ± 5.3°) to postoperatively (39.8° ± 8.2°; p < 0.001) and at the final follow-up (33.7° ± 8.6°; p < 0.001). The VCA angle significantly improved from preoperatively (16.2° ± 8.8°) to final follow-up (33.6° ± 8.0°; p < 0.001). All hips maintained a Tönnis grade of 0 or 1 at the final follow-up. Overall, 20 patients (87%) were able to return to their preinjury level. All outcome scores improved from preoperatively to postoperatively: mHHS, from 68.5 ± 18.1 to 88.3 ± 18.5; NAHS, from 50.8 ± 17.7 to 69.0 ± 11.4; iHOT-12, from 36.9 ± 19.3 to 75.2 ± 19.8; VHS, from 53.8 ± 13.7 to 79.4 ± 19.4; and HOS-Sports, from 59.9 ± 17.0 to 79.6

J ISAKOS 2021;6:380–591
ADIPOSE-DERIVED CULTURE-EXPANDED MESENCHYMAL STEM CELLS IMPLANTATION FOR FOCAL KNEE LESIONS IMPROVES RADIOLOGICAL AND CLINICAL OUTCOMES

Theofylaktos Kyriakidis, Ioannes Melas, Estathios Michalopoulos, Theophanis Chatzistamatiou, Michail I Ioefidis. Greece

Summary Culture-expanded adipose derived mesenchymal stem cells (AD-MSCs) implantation offers a reliable and stable over time solution for cartilage lesions

Data

Purpose The present study aims to evaluate the long-term results of a single-stage cell-based procedure for symptomatic focal cartilage defects in the knee and to compare them with that of the mid-term evaluation. It was hypothesized that the good outcomes of culture-expanded adipose derived mesenchymal stem cells (AD-MSCs) implantation reported in previous series would not deteriorate with time.

Methods Thirty consecutive patients underwent cartilage repair in the knee with adipose-derived culture-expanded mesenchymal stem cells were prospectively followed for 6 years. To assess functional outcomes patients-reported tools were used including two validated subjective knee questionnaires, the Injury & Osteoarthritis Outcome Score (KOOS) and the International Knee Documentation Committee (IKDC) score, the Tegner activity scale and the visual analogue scale (VAS) for pain. Clinical evaluation was quantified by the IKDC examination form. Radiological evaluation of the repair tissue was performed using the MOCART score.

Results All scores recorded a statistically significant improvement (p < 0.05) at the final follow-up compared with baseline. The KOOS evaluation showed increased scores in all subcategories. More precisely, KOOS-pain was improved from 62.6 (range 44.0–70.1) to 95.5 (range 92.0–100.0), KOOS-Symptoms from 60.9 (range 46.3–68.0) to 96.0 (range 89.0–96.0), KOOS-ADL 60.0 (range 46.8–74.6) to 92.0 (range 87.8–97.0), KOOS-Sports/Rec from 32.5 (range 20.0–45.0) to 70.0 (range 55.0–85.0) and KOOS-QOL from 34.4 (range 23.5–51.5) to 84.5 (range 73.5–88.0). The average IKDC score increased from 40.2 (range 33.9–49.7) to 76.6 (range 68.4–84.7). Sport activity evaluated using Tegner Activity Score as well as VAS for pain demonstrated the same tendency of significant improvement. MRI findings confirmed complete filling of the defect and integration to the border zone for 68% of the patients. Three patients underwent postoperative biopsies and the histological analysis demonstrated the presence of hyaline-like tissue.

Conclusions Adipose-Derived culture-expanded mesenchymal stem cells were shown to be an efficient and safe single-stage cell-based procedure for symptomatic, full-thickness knee chondral lesions. The findings of the present study demonstrate that all patients presented significant long-term clinical, functional and radiological improvement. Keywords: chondral lesion, adipose derived stem cells, cartilage repair, regenerative medicine, tissue engineering, scaffolds, cell culture expansion.
pronounced in patients failed repairs. More specifically, patients with successful repairs had significantly lower Kellgren-Lawrence score (mean 0.54, SD±0.45) in comparison to patients with failures (mean 2.09, SD±0.61) p = 0.019.

Conclusion High percentage of clinical failure was observed after meniscal repair of bucket-handle tears. However, successful treatment led to significantly lower rates of knee osteoarthritis development at mean 10-years follow-up. Thus we recommend meniscal repair of bucket-handle tears in patients younger than 40 years without evidence of preexisting knee osteoarthritis.

Summary The intra-operative injection of autologous micro-fragmented adipose tissue is safe and effective in improving short-term clinical and functional results after arthroscopic rotator cuff repair.

Data

Background Nonexpanded autologous micro-fragmented lipoaspirate tissue has been recently introduced in orthopaedics to support and accelerate tissue regeneration. Liposprites contain human derived adipose stem cells and produce growth-factors, such as platelet derived growth-factor (PDGF), fibroblast growth-factor (FGF), transforming growth-factor beta (TGF-?), and vascular endothelial growth-factor (VEGF), which are known to play important regulatory roles in cellular functions, including adhesion, chemotaxis, proliferation, migration, matrix synthesis, differentiation, and angiogenesis. Herewith, autologous micro-fragmented lipoaspirate tissue is expected to create a suitable microenvironment for tendon repair and regeneration. Up to date, no prospective study exist, which evaluated the use of this product in vivo on rotator cuff tendons repair. The aim of this prospective, randomized, controlled trial was to evaluate safety and efficacy of autologous lipoaspirate tissue in arthroscopic rotator cuff repair.

Methods Patients with degenerative postero-superior rotator cuff tears were prospectively enrolled and randomized into two groups: the treatment group was treated with a single-row arthroscopic rotator cuff repair followed by intra-operative injection of autologous micro-fragmented adipose tissue processed with an enzyme-free technology (Lipogens®); the control group was treated with a single-row arthroscopic rotator cuff repair without adipose tissue injection. Post-operative protocols were identical for both groups. Pain was daily assessed using the Visual Analogue Scale (VAS) for the first four post-operative weeks. Patients’ outcomes were collected pre-operatively and at 3, 6, 12, 18 and 24 months post-operatively using the American Shoulder and Elbow Surgeons Shoulder Score (ASES), the Simple Shoulder Test (SST), and the Constant-Murley Score (CMS). Eighteen months after surgery, magnetic resonance imaging was conducted to assess tendon integrity and calculate re-rupture rate. Analysis of covariance was used to compare response means among two or more groups (Categorical variables) adjusted for a quantitative variable (Covariate), thought to influence the outcome (Dependent).

Results One hundred and seventy-seven consecutive patients were screened for inclusion, 52 were enrolled and randomized and 44 completed the 24-months follow-up period (control group: 22; treatment group: 22). All patients showed significant clinical improvement after treatment. Statistically significant differences between the two groups of patients were found in terms of CMS, ASES, SST at 6 months (p = 0.006, p = 0.009 and p = 0.009 respectively), revealing a superiority of the treatment group. No significant differences were found at later follow-up points. No significant difference between the two groups was encountered in the complication rate and in the re-rupture rate at final follow-up. No serious adverse events were encountered.

Conclusions This prospective, randomized, controlled trial demonstrated that the intra-operative injection of autologous micro-fragmented adipose tissue is safe and effective in improving short-term clinical and functional results after arthroscopic rotator cuff repair. Although still in the early stages of application, augmentation of surgical rotator cuff repair with autologous micro-fragmented adipose tissue appears a suitable strategy to enhance tendon repair and regeneration.

Summary The aim of this prospective randomized controlled double-blind clinical trial is to evaluate the efficacy of intra-articular injections of PRP and HA for the treatment of early stages of knee degenerative joint disease in improving joint function and reducing pain, compared to the intra-articular injections of PRP and HA alone.

Data Osteoarthritis (OA) of the knee is a debilitating disease whose prevalence has increased across the world with aging population. Platelet-Rich Plasma (PRP) and Hyaluronic Acid (HA) injections appear to be two of the main strategies for conservative treatment of knee OA. The effectiveness of both treatments, however, is still under debate because contrasting results have been described in the current literature. Some pre-clinical studies has evaluated the association of PRP and HA with encouraging results, highlighting the possibility of a synergistic effect between the two compounds and suggesting a possible use through combined intra-articular injections. The aim of this prospective randomized controlled double-blind clinical trial is to evaluate the efficacy of intra-articular injections of PRP and HA for the treatment of early stages of knee degenerative joint disease in improving joint function and reducing pain, compared to the intra-articular injections of PRP and HA alone.

Methods Patients with early knee OA were prospectively enrolled and then double-blinded randomly divided into three groups of fifty-eight subjects each: HA alone, PRP alone and PRP+HA group. Patients received three intra-articular injections with two-week interval period among each dose. Patients clinical outcome was evaluated through five questionnaires.
Background Paralabral cysts emanating from posterosuperior labral tears may compress the supraspinatus nerve and induce neuropathy. This study prospectively assessed patients with labral tears and symptomatic tears treated with labral repair and no cyst decompression. Pain relief, time to cyst resolution, reversibility of muscular edema, atrophy, fatty infiltration, and bone erosion were evaluated.

Material and method Forty-seven patients with a posterosuperior labral tear and a symptomatic cyst were treated with arthroscopic debridement of the glenoid rim and labral repair with suture anchors. All patients had MRI performed the day before surgery, at six and twelve weeks postoperative or until cyst resolution. In addition, fifteen patients had MRI the first postoperative day and at two weeks. The median cyst size was 6.8 cm³ (range, 2.1-88.9; standard deviation (SD), 18.3 cm³). Preoperatively, twenty patients (43%) had muscular atrophy and radiological edema on MRI, eight had varying strength in abduction and external rotation. Musculoskeletal ultrasound had been used to evaluate the integrity of the repaired cuff.

Results A number of 38 (71%) patients (PRP=17; control=21) with a median age of 71 [64.75–76.50] years have been evaluated. Satisfaction at follow-up is high (90%), without statistically significant difference between the two groups. We report good and excellent clinical results in both groups (PRP vs control): CMS (81.62 [72.47–85.75] vs 77.97 [69.52–82.55] points), UCLA (34 [29.00–35.00] vs 33 [29.00–35.00] points), VAS (0.34 [0.00–1.85] vs 0.70 [0.00–2.45] cm), ASES (100.00 [94.17–100.00] vs 93.33 [68.33–100.00] points), SANE (100 [80–100] vs 80 [70–90] points), SST (12.00 [11.00–12.00] vs 12.00 [9.00–12.00] points), shoulder abduction strength (3.92 ± 2.30 vs 3.20 [1.72–4.65] kg), shoulder external rotation strength (5.31 ± 2.77 vs 4.36 ± 2.05 kg). It was not possible to find a statistically significant difference for the variables analysed, except for few subjective variables (ASES, SANE). On average, 37% of the operated patients had a re-rupture at the ultrasound examination, with no significant difference between the two groups (p=1.00). Compared with the previous radiological control at the 2-year follow-up, new retears occurred in 6% of the patients that received PRP treatment, whereas in the control group the percentage raises to 14% (p=0.61).

Conclusion The clinical and radiological outcomes at the 10-year follow-up show a substantial uniformity of results between the two groups. The minor differences that had been observed at 2-year follow-up disappeared at long term. Patients’ satisfaction is still high 10 years after surgical treatment.

Summary Isolated labral repair in patients with symptomatic paralabral cysts leads to significant pain relief with cyst resolution within 2–3 months and secondary muscle pathology (ie, edema, atrophy and fatty infiltration) may be partially or completely reversed.

Data

Background

Material and method

Methods

Data

Objectives

Results

Conclusion

Infiltrative treatments for knee OA are an important therapeutic strategy, especially for those patients who are not suitable for surgery. To date, the current literature presents many contrasting studies about the effectiveness of PRP or HA, but only a few consider the combined use of PRP and HA as attractive therapeutic option. Our study has not shown any significant difference in clinical and functional outcomes among the three experimental groups, suggesting a substantial equivalence of these three treatments. Cost-effectiveness studies are needed to help define the most suitable intra-articular therapeutic approach.
degrees of fatty infiltration, and three patients presented scapular erosion caused by cyst compression.

**Results** The mean time to cyst resolution and regression of muscular edema was 11 weeks (range, 3–20; SD 8.8 weeks) and 14 weeks (range, 3–52; SD 10.6 weeks), respectively. Pre-operative fatty infiltration grade I and II of the supraspinatus and infraspinatus muscles was reduced in two patients. Bony erosions remodeled after cyst resolution. Mean pain ratings (1-10 scale) improved from 7.7 (SD, 1.8) to 1.3 (SD, 1.3; 95% confidence interval of difference, 5.5-6.8; p < .001.

**Conclusion** Labral repair without cyst decompression leads to significant pain relief with cyst resolution within 2-3 months in the majority of the patients. Patients with muscular edema on MRI preoperatively have a good prognosis for regaining normal muscle. In a few cases, fatty infiltration seems to be reversible, but it may take a long time. Scapular bone erosion caused by cyst compression, may be reversed after cyst resolution, eliminating the need for bone grafting.

**Summary 4-DOMAIN PROM TAILED FOR ORTHOPEDIC SPORTS MEDICINE**

**Data**

**Background** Patient reported outcome measures (PROMs) have come to the forefront in the evaluation of outcomes of treatment for musculoskeletal ailments. Although different PROMs have been validated and used in clinical practice, it is essential to realize that there is a clear void of a PROM designed for the field of sports medicine. The adequate assessment of the outcomes requires suitable tools to collect data on the treatment received from the patient’s point of view, especially in athletes and physically active individuals that have physical expectations and psychological goals that differ from general populations. Moreover, physical needs in sports may vary according to each sports dynamics and consequently the pattern and type of musculoskeletal injury may also differ. In this context, we considered that the properties of PROMs should be defined according to the target patients.

Objective to validate a 4-domain questionnaire tailored for Orthopedic Sports Medicine considering the evaluated clinical conditions such as pre-injury and post-injury status, patient’s expectations of treatment and their evaluations of post-operative care and end-results.

**Methods** The validation of a 4-domain PROM tailored for Orthopedic Sports Medicine was carried out through an item generation, item scaling, validity and reliability testing, statistical analysis, item reduction. Conbrach’s alpha was used to verify item homogeneity, i.e. their accuracy or consistency. The data were obtained from four groups of 25 patients each. Group 1 consisted of patients who had undergone surgery because of pathologies of the foot and ankle; Group 2 hip pathologies; Group 3 knee pathologies and Group 4 shoulder and elbow. For the statistical analysis, descriptive statistics was calculated with mean values, standard deviation, minimum and maximum and median values. Fisher’s exact test was used to analyze categorical variables and questionnaire responses. For the binary variables, Mann-Whitney and Kruskal-Wallis tests were used, in addition to Spearman correlation coefficient.

**Conclusion** This PROM showed acceptable statistical accuracy, clinical applicability, and reproducibility for a variety of surgical treatments, regardless of the anatomical injury sites. Additionally, this PROM considers the athletes’ primary physical demands in the non-injured baseline condition, their motivation to continue sports practice and participation, and the influence of sports practice on their quality of life. This 4-domain PROM for Orthopedic Sports Medicine appears to be a valid tool to assess athletes and high-performing practitioners with sports injuries, recording their perception of injury, expectations of treatment; evaluation of postoperative care and treatment received, and perceived outcomes compared to their pre-injury status of physical demands in sports activity. The tool is unique, allowing direct comparisons between athletes’ perception of pre-injury baseline, injury, treatment, and outcome. This PROM tailored for Orthopedic Sports Medicine will be a welcome adjunct to the sports medicine professional’s tool box when assessing athlete’s status and outcome after injury and intervention.

**Effect of Graft Choice on 6-Year Outcomes of Revision Anterior Cruciate Ligament Reconstruction in the Multicenter ACL Revision Study (MARS) Cohort**

Rick W Wright, USA

**Summary** Graft choice at the time of revision impacts outcome 6 following revision ACL reconstruction.

**Data**

**Background** Most surgeons believe that graft choice for ACL reconstruction is an important factor related to outcome. Although graft choice may be limited in the revision setting based on previously used grafts, it is still felt to be important.

**Methods** Revision ACL reconstruction patients were identified and prospectively enrolled by 83 surgeons over 52 sites. Data collected included baseline demographics, surgical technique and pathology, and a series of validated patient reported outcome instruments. Patients were followed up for 6 years, and asked to complete the identical set of outcome instruments. Incidence of additional surgery and re-operation due to graft failure were also recorded. Multivariate regression models were used to determine the predictors (risk factors) of PROs, graft re-rupture, and re-operation rate at 6 years following revision surgery.

**Results** 1245 patients were successfully enrolled with 721 (58%) males. Median age was 26. In 87% this was their first revision. 370 (30%) were undergoing revision by the surgeon that had performed the previous reconstruction. 598 (48%) underwent revision reconstruction utilizing an autograft, 609 (49%) allograft, and 37 (3%) both autograft and allograft. Median time since their last ACL reconstruction was 3.4 years. Questionnaire follow-up was obtained on 810 subjects (65%), while phone follow-up was obtained on 949 subjects (76%). The IKDC, KOOS, and WOMAC scores (with the exception of the WOMAC stiffness subscale) all significantly improved at the 6-year follow-up time point (p<0.001). Contrary to the IKDC, KOOS, and WOMAC scores, the 6-year MARX activity scale demonstrated a significant decrease from

10.1136/jisakos-2021-congress.248
the initial score at enrollment (p<0.001). Graft choice proved to be a significant predictor of 6-year Marx activity level scores (p=0.005). Specifically, the use of an autograft for revision knee reconstruction predicted improved activity levels [Odds Ratio (OR) = 1.54; 95% confidence intervals (CI) = 1.14, 2.04]. Graft choice proved to be a significant predictor of 6-year IKDC scores (p=0.018), in that soft tissue grafts predicted higher 6-year IKDC scores [OR = 1.62; 95% confidence intervals (CI) = 1.09, 2.414]. For the KOOS subscales, graft choice did not predict outcome score. Graft re-rupture was reported in 55/949 (5.8%) of patients by their 6-year follow-up: 37 allografts, 16 autografts, and 2 allograft + autograft. Use of an autograft for revision resulted in patients 6.04 times less likely to sustain a subsequent graft rupture than if an allograft was utilized (p=0.009; 95% CI=1.57, 23.2).

**20689**

**PATIENT-REPORTED OUTCOME AND SURGICAL CONVERSION RATE AFTER TREATMENT WITH A PHYSIOTHERAPY-LED PROGRESSIVE EXERCISE PROGRAM PLUS A SUPPORT BRACE IN PATIENTS WITH AN ACUTE INJURY OF THE POSTERIOR CRUCIATE LIGAMENT**

Randi Rasmussen, Julie Jacobsen, Birgitte Blaabjerg, Torsten G Nielsen, Lene L Miller, Martin Lind. Denmark

10.1136/jisakos-2021-congress.249

**Summary**

Physiotherapy-led progressive exercise program plus a support brace in patients with an acute injury of the PCL results in good subjective clinical outcome.

**Data**

**Objectives**

Posterior Cruciate Ligament (PCL) injuries occur isolated or in combination with knee dislocations. PCL injuries can be treated surgically or with progressive exercises in combination with a support brace. However, larger prospective studies reporting outcome of exercise-related treatment are lacking. The aim was to investigate changes in patient-reported and muscular strength outcome of a physiotherapy-led progressive exercise program plus a support brace in patients with an acute injury of the PCL over a 24-months follow-up. Furthermore, to report conversion to surgical reconstruction.

**Methods**

In the period from June 2015 to January 2017, 50 patients with an acute injury of the PCL were consecutively enrolled in a prospective case-series study. The patients were treated with a support brace the first 12 weeks and furthermore underwent a 16-week physiotherapy-led progressive exercise program including strength, stability and coordination training. PCL lesions were diagnosed by magnetic resonance imaging and tibial offset using the posterior drawer test. Changes in patient-reported outcome was investigated with the International Knee Documentation Committee Subjective Knee Form (IKDC-SKF) from baseline (diagnosis given) to 1 and 2 years follow-up. Changes in isometric knee flexion and extension strength was measured with a static strength force gauge from 16 weeks to 1 year after initiating the exercise program. Finally, conversion to surgical treatment was determined.

**Results**

The IKDC-SKF score increased statistically significantly from 35 (SD 9.7) points at baseline to 62 (SD 15) points after 2 years. Isometric knee flexion strength of the injured knee increased statistically significantly from 0.93 (SD 0.36) Nm/kg to 1.1 (SD 0.36) Nm/kg, corresponding to an increase of 16%. In contrast, isometric knee extension of the injured knee did not change from 16 weeks to 1 year (0.10 (-0.022-0.21) Nm/kg, p=0.107). The isometric knee flexion strength of the healthy knee was 1.1 (SD 0.47) Nm/kg at 16 weeks and 1.2 (SD 0.47) Nm/kg at 1 year, while isometric knee extension of the healthy knee was 1.8 (0.52) Nm/kg at 16 weeks and 1.8 (0.50) at 1 year Nm/kg. In the study period, seven patients (14%) converted to PCL reconstruction resulting in 43 patients for 1-year follow-up that completed the combined brace and rehabilitation treatment. Of the patients converting to reconstruction, two patients had an isolated ligament injury and five patients had dislocation of the knee.

Conclusions Treatment with progressive exercises in combination with a support brace after acute PCL injury demonstrated clinically relevant improvements in patient-reported outcome after one and two years and an improvement of 16% in flexion strength from 16 weeks to 1 year. Furthermore, treatment with progressive exercises in combination with a support brace resulted in a 14% conversion rate to surgical treatment due to continued instability. Consequently, clinically relevant improvements in subjective outcome and strength and a low surgical conversion rate after the progressive exercise program can be expected with the exercise/brace treatment concept for PCL injury.

**20292**

**CORONAL PLANE ALIGNMENT OF THE KNEE (CPAK) CLASSIFICATION: A NEW SYSTEM FOR DESCRIBING KNEE PHENOTYPES AND ITS APPLICATION IN KINEMATICALLY AND MECHANICALLY ALIGNED TOTAL KNEE ARTHROPLASTY**

1Samuel J MacDessi, 2Will Griffiths-Jones, 3Johan Bellemans, 1Ian A Harris, 1Darren Chen. 1Australia; 2UK; 3Belgium

10.1136/jisakos-2021-congress.250

**Summary**

The new CPAK classification provides a simple and comprehensive system for describing knee alignment in the arthritic and healthy knee. In addition, CPAK allows determination of which patients are most likely to benefit from kinematic alignment when optimization of soft tissue balance is prioritized.

**Data**

**Aims**

A comprehensive classification for coronal lower limb alignment with predictive capabilities for knee balance would be beneficial in total knee arthroplasty (TKA). This paper describes the Coronal Plane Alignment of the Knee (CPAK) classification and examines its utility in preoperative soft tissue balance prediction, comparing kinematic alignment (KA) to mechanical alignment (MA). Patients and Methods A radiographic analysis of 500 healthy and 500 osteoarthritic (OA) knees was used to assess the applicability of the CPAK classification. CPAK comprises nine phenotypes based on the arithmetic HKA (aHKA) that estimates constitutional limb alignment and joint line obliquity (JLO). Intra-operative balance was compared within each phenotype in a cohort of 138 computer-assisted TKAs randomised to KA or MA. Primary outcomes included descriptive analyses of healthy and OA groups per CPAK type, and comparison of balance at 10° of flexion within each type. Secondary outcomes assessed balanced at 45° and 90° and bone recuts required to achieve final knee balance within each CPAK type. Results There was similar frequency distribution between healthy and arthritic groups.
across all CPAK types. The commonest categories were Type II (39.2% healthy vs 32.2% OA) and Type I (26.4% healthy vs 19.4% OA). Across all CPAK types, a greater proportion of KA TKAs achieved optimal balance compared to MA. This effect was largest, and statistically significant, in CPAK Types I (100% KA versus 15% MA, p<0.001), Type II (78% KA versus 46% MA, p<0.02) and Type IV (89% KA versus 0% MA, p<0.001).

Conclusions CPAK is a pragmatic, comprehensive classification for coronal knee alignment, based on constitutional alignment and JLO, that can be used in healthy and arthritic subjects. CPAK identifies which knee phenotypes may benefit most from KA when optimization of soft tissue balance is prioritized. Further, it will allow for consistency of reporting in future studies.

### 20363 SYSTEMATIC REVIEW OF ARTHROSCOPIC RECONSTRUCTION OF ISOLATED SUBSCAPULARIS TENDON TEAR: RESULTS, ROLE OF CORACOPLASTY AND MANAGEMENT OF THE BICEPS TENDON

Pablo A Narbona, Rafael N Martinez Gallino, Manuel Olmos, Gabriel Arce. Argentina

10.1136/jisakos-2021-congress.251

**Summary** This systematic review report good outcomes of arthroscopic repair of isolated subscapular tendon tears with a 86 to 100% healing on MRI and suggest that management of the long head of the biceps tendon with tenotomy or tenodesis is necessary while the coracoplasty as an associated procedure it is not frequently done.

**Data**

**Purpose** To systematically review the literature to identify all studies reporting outcomes of arthroscopically repaired isolated subscapular tendon tears, the frequency and management of associated long head of biceps pathology, and the MRI integrity of subscapular tendon reconstruction.

**Methods** A systematic literature review in spanish and english language using the PubMed/MEDLINE, EMBASE y LILACS databases with the term of: “Arthroscopic reconstruction of isolated subscapular tendon tears”. Only studies evaluating the techniques, outcomes, management of the long head of the biceps tendon, management of the coracoid and MRI integrity of the reconstruction of isolated subscapularis repair were included. Descriptive analysis was provided for the available literature.

**Results** In the initial search of the literature, we obtained 155 articles. We eliminated 108 articles in the evaluation of the titles because they were not related to the purpose of the study. We evaluated 47 articles by the abstracts, and we considered 23 articles for evaluation reading the full text. After applying the inclusion and exclusion criteria, we considered 7 articles to include in this systematic review. The studies were done in between 2003 to 2013, 207 patients with a mean age of 51 years old. A traumatic injury was the most frequently mechanism reported. All studies had a minimum follow-up of 24 months with an average follow-up of 38.85 months (24–131 months). Improvements in patient outcome scores were substantial after arthroscopic subscapularis repair. Six of the 7 studies evaluated 100% of their patients with MRI preoperatively. In the postoperative, 4 studies evaluated 100% of the patients with MRI, while in the remaining three studies they evaluated 86%, 77% and 71% of the patient with postoperative MRI. Excellent MRI tendon to bone integrity with 86 to 100% healing. With regard to coracoplasty, only the comparative study by Kim et al performed coracoplasty systematically in one of the study groups comparing results with a comparative group without coracoplasty did not find significant differences in functional outcomes or tendon integrity of the reconstruction in the MRI evaluation. The rest of the included studies did not perform coracoplasty. Of the 207 patients evaluated in the 7 studies, 6 studies clearly mention the behavior in relation to the long head of the biceps tendon. Tenotomy was performed in 96 patients, tenodesis in 51 and in 34 patient no surgical procedure was performed. In the remaining cases the management of the biceps tendon were not specify.

**Conclusions** The result of our systematic review of arthroscopic subscapular repair supports our hypothesis that it is a good treatment option with favorable clinical results. The pathology of long head of the biceps tendon is related to lesions of the subscapularis in 31 to 56% of cases, so it is recommended to perform tenotomy or tenodesis. In relation to coracoplasty most of the studies in this systematic review do not consider coracoplasty necessary as an associated procedure in the arthroscopy reconstruction of the subscapularis tears. Level of Evidence: IV Type of study: Systematic review

**Key words:** Arthroscopic Reconstruction Subscapular Tendon; Isolated Tear

### 20559 COMPARATIVE STUDY OF “CONCOMITANT PATELLAR TENDON RUPTURE WITH ANTERIOR CRUCIATE LIGAMENT TEAR AND PATELLAR TENDON RUPTURE WITH MULTI-LIGAMENTOUS KNEE INJURY -MLKI”

Sundararajan Ramasamy, Ramakanth Rajagopalakrishnan, Rajasekaran Shanmuganathan. India

10.1136/jisakos-2021-congress.252

**Summary** Single stage patellar tendon repair with Arthroscopic ACL reconstruction gives good results with supervised physiotherapy. Patellar tendon injury with MLKI requires staged manner and rehabilitation is prolonged to get extensor function.

**Data**

**Background** Results of largest case series of concomitant patellar tendon tear with Anterior cruciate ligament and multiligament knee injuries (MLKI) injuries following road traffic accident (fall from motor bike) from Level 1 - Tertiary care Trauma centre were assessed and reported.

**Methods** Retrospective case series of patients operated between 2010 and 2019 with concomitant patellar tendon tear with ACL and MLKI including bony avulsion injuries. Peri-articular fractures around the knee, isolated cruciate and MLKI without patellar tendon tears were excluded. N=31 patients (1 female and 27 male) divided into 2 groups, Group 1 (11 patients) Patellar tendon tear and ACL tear and group 2 (20 patients) Patellar tendon tear with MLKIs. Patients were taken up for single stage/staged repair and reconstruction depending on the severity and associated injuries. All the patients were followed up regularly and IKDC and Lyshom’s score were taken and Objective radiological stress x-rays were taken from 6 months postoperatively and during each follow up.

**Results** The mean age was 35.09±11.96 SD(group1) and 36.55±11.89 SD(group2). The average follow-up was 34.45 months ± 12.86SD (group 1) and 35.3 months ± 15.75 SD
(group 2). Mean postoperative Lysholm score and IKDC score of the group 1 were 91.09 (SD 3.83) and 83.68 (SD 3.68) and group 2 were 81.35 (SD 7.96) and 71.85 (SD 8.12) respectively and the difference in mean was statistically significant as p value of 0.01. Mean postoperative ROM of the two groups were 132.73 (SD 6.46) (Group 1) and 111.75 (15.75) (Group 2) and the difference in mean was statistically significant as p value <0.01. Residual lag of 200 seen in all patients, Knee extensor lag restored by 3rd month in group and 6th month in group 2; group 1 the Mean post op laxity for ACL is 2.65 mm (±0.7) whereas in group 2 is 2.17 mm±1.2 for ACL, 1.97±2.16 for PCL, medial laxity 5.07±12.18, lateral laxity 1.01±1.76 and SD of of Knee stiffness seen in 1 patient and superficial infection in 2 patients.

**Conclusion** Single stage PT repair with ACL reconstruction gives adequate stability and extensor lag is eminent and needs supervised physiotherapy to restore the extensor function. PT with MLKI is a challenging scenario needs can be performed in staged manner depending on the combination of the injuries. Restoration of extensor function is delayed and needs prolong rehabilitation.

**20661 HIGH TibIAL OSTEOTOMY COMBINED INLAY RESURFACING ARTHROPLASTY: LESS PatellofemORAL PAIN AND NO CORRECTION LOSS**

Tahsin Beyzađeoglu, Kerem Yildirim. Turkey

**Summary** HTO with inlay resurfacing arthroplasty is an effective treatment method for active middle-aged patients with medial joint narrowing and focal cartilage defects of medial femoral condyle and/or trochlea with the additional benefit of preventing postoperative correction loss, and also provides a treatment solution for patients with patellofemoral chondral lesions.

**Data**

**Purpose** Focal full-thickness chondral defects combined with angular deformities may progress to osteoarthritis if left untreated. High tibial osteotomy (HTO) is advocated to correct the mechanical malalignment and compartmental overload. However, with this approach, the articular cartilage defect is not addressed, cartilage degeneration continues and progression of varus malalignment and/or postoperative correction loss may occur. Moreover, patellofemoral arthritis is a relative contraindication for HTO, and inlay arthroplasty (IA) may provide a treatment solution for patients who are not perfect candidates due to patellofemoral lesions but are otherwise eligible for HTO. The aim of this study was to compare clinical and radiological results of combined HTO and IA to those of HTO and microfracture in active, middle-aged patients with a follow-up of at least 48 months.

**Methods** A retrospective analysis was undertaken for consecutive patients, who underwent medial opening wedge high tibial osteotomy (MOWHTO) combined with IA (group 1) or MOWHTO and microfracture (group 2) between 2010 and 2016. Patients with a varus malalignment =7°, no history of previous knee surgery, no ligamentous instability, intact lateral compartment, and a minimum follow-up of 48 months were included. Patients with patellofemoral instability and/or malalignment/congruency were excluded. WOMAC, KSS, and Kujala scores, plain x-rays, and orthoroentgenograms were evaluated preoperatively, at 6 months postoperatively, and yearly thereafter.

**Results** Forty-one knees as group 1 and 62 knees as group 2 were enrolled. Mean follow-up was 92.3 months. All knees in both groups were realigned to a neutral mechanical axis of 0°. The mean WOMAC and KSS scores were improved for both groups. There was no significant difference between groups regarding both scores (p=0.12). Mean Kujala score improved significantly from 55 to 79 (p<0.001) for patients with trochlear IA in group 1 and from 58 to 72 (p=0.012) for patients with patellofemoral lesions in group 2 (p=0.035). There was no loss of correction in group 1 at final follow-up, but group 2 showed a correction loss of 0.65°±1.2°.

**Conclusion** HTO with inlay resurfacing arthroplasty is an effective treatment method for active middle-aged patients with medial joint narrowing and focal cartilage defects of the medial femoral condyle and/or trochlea with the additional benefit of preventing postoperative correction loss. This combination also provides a treatment solution for patients with patellofemoral chondral lesions.

**20587 ADDING A LATERAL EXTRA-ARTICULAR TENDODESIS SIGNIFICANTLY REDUCES ACL GRAFT RUPTURE RATES IN PEDIATRIC AND ADOLESCENT PATIENTS WHEN COMPARED TO ISOLATED ACL RECONSTRUCTION**

1Andrea Ferretti, 2Adnan Saithna, 1Alessandro Carrozzo, 1Alessandro Annibaldi, 1Fabio Marzilli, 1Edoardo Monaco, 1Italy; 2USA

**Summary** Combined ACLR+LET is associated with significant advantages over isolated ACLR in pediatric and adolescent patients, as a 12.8-fold reduction in graft rupture rates, better knee stability, and higher Tegner activity level with no increase in the rate of non-graft rupture related re-operations or complication.

**Data** Young patients undergoing ACLR are at particularly high risk of graft rupture when compared to adults. Recent studies in adults have demonstrated significant reductions in graft rupture rates in high risk populations when a lateral extra-articular procedure is performed, but comparative studies in pediatric and adolescent populations do not exist. The purpose of this study was to compare the clinical outcomes of isolated ACLR versus combined ACLR+LET when using the Arnold-Coker modification of the MacIntosh procedure in young patients. The hypothesis was that combined procedures would be associated with a significantly reduced risk of graft rupture.

**Methods** A retrospective analysis of prospectively collected data for consecutive pediatric and adolescent patients who underwent ACLR at (institution blinded for journal review), between January 1, 2013, and December 31, 2017 was conducted. Only patients with additional risk factors for graft rupture (high grade pivot shift grade, high level of sporting activity, participation in pivoting sports, and those with Segond fractures) were offered a LET in addition to ACLR. This was performed using the Arnold Coker modification of the MacIntosh procedure. All patients were recalled for in-office evaluation between September 2019 and June 2020. Clinical outcomes including graft-rupture rates, PROMS (state which ones), knee stability, return to sport rates, re-operation rates and complications were assessed. Comparisons between
variables were assessed with Chi-square or the Fisher exact test for categorical variables and the Student test or Wilcoxon test for quantitative variables. Multivariate analyses were undertaken to evaluate risk factors for graft rupture.

**Results** 111 patients with a mean follow-up of 43.8 ± 17.6 months (range, 24–89 months) were included in the study. 40 patients underwent isolated ACLRs and 71 underwent ACLR + LET. The addition of an LET to ACLR was associated with a significantly lower graft rupture rate when compared to isolated ACLR (15% vs 0%, OR=16.96, 95% CI 1.91–142.85, P = .01). It was also associated with significantly better knee stability (rate of grade 3 pivot shift, 0% ACLR+ LET, 11% ACLR, p <0.01; side-to-side AP laxity difference >5 mm 0% ACLR+LET, 17.2%, p=0.01) and Teperg activity level (isolated ACLR, 6; ACLR+LET 7 P=.01). There were no significant differences exceeding known MCID thresholds with respect to any of the other outcome measures evaluated, and no differences in the rate of non-graft rupture related re-operations or complications between groups.

**Conclusions** Combined ACLR+LET is associated with significant advantages over isolated ACLR in pediatric and adolescent patients. These advantages include a 16.9-fold reduction in graft rupture rates, better knee stability, and higher Tegner activity level with no increase in the rate of non-graft rupture related re-operations or complication.

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**20690 ANCHOR ARTHROPATHY AFTER ARTHROSCOPIC SHOULDER STABILIZATION: HISTORY, EXAM, AND IMAGING FINDINGS**

Matthew T Provencher, Peter J Millett, Robert Walz, Jeffrey Wong, Annalise Peebles, Petar Golijanin, Joseph J Ruzbarsky, Justin W Arner, Liam A Peebles, Jonathan Godin. USA

**Summary** Our study examines the clinical, radiographic, and arthroscopic characteristics of anchor-induced arthropathy after arthroscopic shoulder stabilization procedures and defines risk factors for the development of anchor-induced arthropathy.

**Data**

**Purpose** To describe the clinical, radiographic, and arthroscopic characteristics of anchor-induced arthropathy after arthroscopic shoulder stabilization procedures and secondarily, to define risk factors for the development of anchor-induced arthropathy.

**Methods** A total of 23 patients who underwent revision arthroscopic shoulder surgery and were diagnosed with glenohumeral arthropathy were retrospectively identified from prospectively collected data registries between January 2000 and May 2018. Data included initial diagnosis and index procedure performed, presenting arthropathy symptoms including duration, and exam findings prior to revision surgery. Pre-revision imaging was used to assess presence of glenohumeral osteoarthritis and chondromalacia, anchors/sutures, loose bodies, and labral pathology. The same parameters were recorded intraoperatively during revision surgery. Descriptive statistics were performed for demographic data and means with standard deviations were calculated for continuous data. A McNemar-Bowker test was used to analyze marginal homogeneity between preoperative radiographs and intraoperative findings.

**Results** Mean age at presentation was 33.4 ± 11.7 years (range = 16 to 59, 17 male; 6 female). More than half (13/23) developed significant symptoms within 10 months after index arthroscopic procedure (mean 36.3 ± 50.0 months, range 2.3 to 166.1 months) with pain (87%) and loss of motion (100%). Plain radiographs demonstrated humeral osteoarthritis in 57% (13/23) of patients, MRI revealed recurrent labral pathology in 19/23 (83%) patients, implant concerns in 12/23 (52%), and loose bodies in 12/23 (52%). Intraoperatively, all had evidence of osteoarthritis; 22/23 (96%) had prominent implants. Humeral head chondromalacia was present in 21/23 patients (91%), the majority of which was linear stripe wear, and 6/23 (26%) had severe global glenohumeral osteoarthritis. Statistical analysis revealed 54.5% (95% CI [0.327, 0.749]) sensitivity of MRI identification of proud implants with a specificity of 100% (95% CI [0.055, 1]). The ability of MRI to accurately assess chondromalacia of the humeral head (p = 0.342) or glenoid (p = 0.685) was not statistically significant.

**Conclusion** Anchor arthropathy is characterized by symptoms of pain and stiffness and in many cases presents very early after stabilization surgery (<10 months). Although implants were implicated in the majority of humeral head chondromalacia, the timing of implant related damage is unknown. MRI’s may produce false negative identification of proud implants and can be a poor predictor of the severity of chondromalacia and intraarticular pathology, thus a high index of clinical suspicion is necessary in patients with stiffness and pain postoperatively. Clinical Relevance: Surgeons should have a low threshold for early arthroscopic intervention to assess the painful and stiff shoulder after instability repair if anchor arthropathy is suspected.

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**20706 ADVANCED 3-DIMENSIONAL ANALYSIS OF THE INTERPLAY BETWEEN HILL-SACHS LESIONS AND GLENOID BONE LOSS**

Matthew T Provencher, Liam A Peebles, Petar Golijanin, Annalise Peebles, Justin W Amer. USA

**Summary** This study qualitatively and quantitatively analyzes the interplay between Hill-Sachs lesions (HSL) and glenoid bone loss (GBL) in a cohort of anterior instability patients using 3-dimensional (3-D) imaging software.

**Data**

**Purpose** To (1) qualitatively and quantitatively analyze the interplay between Hill-Sachs lesions (HSL) and glenoid bone loss (GBL) in a cohort of anterior instability patients using 3-dimensional (3-D) imaging software and (2) assess significant relationship between amount of GBL and HSL characteristics.

**Methods** A cohort of 100 anterior shoulder instability patients presenting with evidence of both HSL and GBL confirmed on computed tomography (mean age: 27.9, range = 18–43 years) were identified. 3-D models of the unilateral proximal humeral head and en face sagittal oblique view of the glenoid were reconstructed using MIMICS (Materialise NV, Leuven, Belgium) software. The volume, surface area (SA), width, and depth of identified HSLs were quantified along with their location (medial, superior, and inferior extent). Multiple angular orientation measures of HSLs were recorded, including Hill-Sachs rim [HSLr] and Hill-Sachs center [HSLc] angles in order to classify the level and location of potential osteoarthritis and chondromalacia, anchors/sutures, loose bodies, and labral pathology. The same parameters were identified. 3-D models of the unilateral proximal humeral head and en face sagittal oblique view of the glenoid were reconstructed using MIMICS (Materialise NV, Leuven, Belgium) software. The volume, surface area (SA), width, and depth of identified HSLs were quantified along with their location (medial, superior, and inferior extent). Multiple angular orientation measures of HSLs were recorded, including Hill-Sahrs rim [HSLr] and Hill-Sahrs center [HSLc] angles in order to classify the level and location of potential osteoarthritis and chondromalacia.
engagement. Glenoid bone loss, surface area (SA), width, defect length, and glenoid track width were quantified. Analysis of variance was computed to analyze significant differences (p < 0.05) between severity of GBL (0–10%, 11–20%, 21–30%, and 31–40%) and HSL parameters.

Results GBL width, percent glenoid width loss, defect length, and glenoid track width significantly differed across the four GBL groups (0–10%, 11–20%, 21–30%) (p < 0.03). Greater GBL was significantly associated with greater average HSL width (p = 0.001) and depth (p = 0.002), as well as maximum HSL width (p = 0.002). Patients presenting with greater GBL presented with greater humeral head SA loss (p = 0.006). Patients with 0–10% GBL had significantly narrower (average and max width) (p < 0.03) and deeper (p < 0.03) HSL’s than all other GBL groups.

Conclusion HSL’s present with significantly different characteristics depending on extent of GBL. Larger amounts of GBL have HSL’s that are wider, and shallower due to a larger surface area of glenoid-humeral interaction, while smaller glenoid defect size is associated with narrower and deeper HSL’s likely as a result of the hardness of the glenoid bone producing deeper, more localized defects on the humeral head. While additional work is needed to validate clinical outcomes, this study sheds important light on how HSL’s present with increasing amounts of GBL that may present clinically useful.


Havard Vinnes, Tone Gifstad, Andreas Persson, Stein Håkon Låstad Lygre, Lars Engbergsten, Jon Olav Droget, Ove Furnes. Norway

10.1136/jisakos-2021-congress.257

Summary Ten years after an ACL reconstruction, the overall cumulative risk of knee arthroplasty (KA) was 0.5%. Revised ACL reconstruction, cartilage injury at time of ACL reconstruction and KOOS (two years post-operatively, Sport/Rec) <44 were major risk factors for subsequent KA.

Data Background Anterior cruciate ligament (ACL) injury is considered a risk factor for osteoarthritis. Aim: The primary aim of the study was to investigate the cumulative risk and risk factors associated with a subsequent knee arthroplasty (KA) after an ACL reconstruction. The secondary aim was to compare the relative risk for KA after ACL reconstruction compared with the general population.

Methods Cumulative risk and possible risk factors for KA after ACL reconstruction were analyzed by combining data from two national registries, the Norwegian Knee Ligament Register and the Norwegian Arthroplasty Register in a Cox regression model. The relative risk of KA for ACL patients compared with the general population was calculated in stratified age groups.

Results One hundred and one knees underwent KA out of the eligible study population of 25,931 knees. We found a 0.5% (CI: 0.4–0.6) cumulative risk of KA 10 years after ACL reconstruction. The cumulative risk of knee replacement was significantly higher in patients who were older at the time of their index ACL reconstruction. Revision of the ACL (HR: 4.8, CI: 2.6, 8.9), deep cartilage injury, ICRS (International Cartilage Repair Society) 3–4 (HR: 3.9, CI: 2.4, 6.3) and two-year post-operative KOOS Sport/Rec sub-score<44 (HR: 3.6, CI: 1.7, 7.7) were important risk factors for KA surgery. We found a higher risk of KA at the age of 30–39 years after a previous ACL reconstruction compared to the general population (RR: 3.4 (CI: 1.6–7.1)) Discussion: Some comparable studies have found a slightly higher risk of KA after 10 years than our study, but indications for KA may vary between countries.

Conclusion Ten years after an ACL reconstruction, the overall cumulative risk of KA was 0.5%. Revised ACL reconstruction, cartilage injury at time of ACL reconstruction and KOOS (two years post-operatively, Sport/Rec) <44 were major risk factors for subsequent KA. Patients with previous ACL surgery at age 30–39 had a 3.4 times higher risk of KA than the general population. Level of Evidence: level II prospective cohort study.

20460 PREDICTOR OF POOR PRE-OPERATIVE PSYCHOLOGICAL STATUS IN CARTILAGE DEFECT PATIENTS

David C Flanigan, Alex C Dibartola, Matthew Wiet, Joshua Scott Everhart, Robert A Magnusson, Laura C Schmitt, Charles Emery. USA

10.1136/jisakos-2021-congress.258

Summary Patients undergoing cartilage repair can have poor psychological status preoperative that may be predicted.

Data Background Cartilage injuries of the knee affect a large number of people in United States annually, and many of these patients undergo surgical intervention. Identifying factors predictive of the psychological status of surgical patients may be advantageous in determining which patients will benefit from additional screening and potentially intervention. To evaluate the risk factors for pain catastrophizing, kinesiophobia, and elevated depressive symptoms among patients undergoing high-grade cartilage defect surgery. We hypothesized that cartilage patients would demonstrate high scores on pain catastrophizing, kinesiophobia, and depression testing prior to surgery.

Methods Two hundred and ten patients undergoing surgery for high-grade cartilage defects (56% chondroplasty, 36% microfracture, 22% autologous chondrocyte implantation) completed a preoperative survey before undergoing surgery. Outcome scores assessed were IKDC-S score, Tegner activity score, Pain catastrophizing scale (PCS), Tampa scale for kinesiophobia (TSK-11), and Patient Health Questionnaire depression scale (PHQ-9). Multivariate logistic regression was used to determine what pre-operative factors predicted pain catastrophizing, kinesiophobia, and depressed depressive symptoms.

Results The mean pre-operative Tegner score was 5.8 (SD 2.4) and IKDS-S score was 44.7 (SD 11.1). Prior to surgery, 19% had abnormal pain catastrophizing (PCS = 20 points), 14.4% had moderate-severe depression (PHQ = 10), and 49.0% had high kinesiophobia (TSK-11 = 25). Lower pre-operative Tegner scores predicted moderate-severe depressive symptoms (per point decrease, OR 1.36, 95% CI 1.06, 1.76; p = 0.008). Predictors of elevated pain catastrophizing were lower pre-operative IKDC-S scores (per 5-point decrease, OR 1.28, 95%
CI 1.08, 1.51; p= 0.002) and symptom duration >6 months (OR 2.20 CI 1.14, 4.32; p= 0.02). A lower pre-operative IKDC-S score (per 5-point decrease, OR 1.17, CI 1.03, 1.33; p= 0.02) predicted elevated kinesiophobia.

Conclusion Low self-reported function, low activity level and symptom duration greater than six months are associated with poor preoperative psychological status. The relatively high prevalence of pain catastrophizing, kinesiophobia, and depressive symptoms warrants consideration of preoperative psychological screening in patients undergoing high-grade cartilage defect (ICRS Type III or IV) repair.

**21049 HIGHER RETURN TO PRE-INJURY ACTIVITY LEVELS FOLLOWING ACL RECONSTRUCTION WITH BONE-PATELLAR TENDON-BONE VERSUS HAMSTRING TENDON AUTOGRRAFT IN HIGH ACTIVITY PATIENTS: RESULTS FROM THE NEW ZEALAND ACL REGISTRY**

Simon W Young, Richard Rahardja, Mark G Clatworthy, Paul Monk, Hamish Love. New Zealand

Summary The use of a BTB autograft increased the odds of a return to pre-injury activity level at 2 years following ACL reconstruction.

Data Background In primary anterior cruciate ligament (ACL) reconstruction, a bone-patellar tendon-bone (BTB) autograft is associated with lower ipsilateral failure rates. BTB grafts are associated with a higher rate of contralateral ACL injury, which some clinicians view as a marker of success of the BTB graft. However, there is a lack of evidence on whether BTB grafts improve the rate of return to activity and sport.

Purpose To compare the rate of return to pre-injury activity levels between the BTB autograft and the hamstring tendon autograft in high activity patients. Study Design: Cohort Study.

Methods This study followed a high-activity (pre-injury Marx score >12) cohort of 1,844 patients who underwent primary ACL reconstruction between 2014 and 2018. Prospectively collected data from the New Zealand ACL Registry, including pre-injury and post-operative Marx activity scores, were analyzed. The proportion of patients who returned to their pre-injury activity level at 1- and 2-year follow-up were compared between graft types.

Results Overall, 11.3% (208 out of 1,844) of patients returned to their pre-injury activity level at 1-year follow-up, while 15.5% (184 out of 1,190) returned at 2-year follow-up. At 1-year follow-up, 17.2% of patients with a BTB autograft returned to their pre-injury activity level compared to 9.3% of patients with a hamstring tendon autograft (adjusted OR = 1.59, 95% CI 1.17–2.17, p = 0.003). At 2-year follow-up, 23.3% of BTB patients returned to their pre-injury level compared to 13.3% of hamstring tendon patients (adjusted OR = 1.63, 95% CI 1.14–2.34, p = 0.008). Male sex and younger age were associated with a higher return to activity at both follow-up timepoints.

Conclusion The use of a BTB autograft increased the odds of a return to pre-injury activity level at early follow-up. A higher return to activity is a possible explanation for the higher rate of contralateral ACL injury with BTB autograft use.

**21021 A RANDOMIZED CONTROLLED TRIAL COMPARING PATELLAR STABILIZING, MOTION RESTRICTING KNEE BRACE VS. SHAM BRACE IN NON-OPERATIVE TREATMENT FOR FIRST-TIME TRAUMATIC PATELLAR DISLOCATION**

Essi Salonen, Petri J Sillanpää, Aleksi Reito, Heikki Mikael Mäenpää, Ville M Mattila. Finland

Summary First-time patellar dislocation is a common injury and majority of dislocators are suitable for nonoperative management. There is no consensus about the most preferable method for nonoperative treatment after first-time patellar dislocation.

Data Purpose First-time lateral patellar dislocation (LPD) is a common injury in physically active adolescents and may lead to recurrent LPD. Management for first-time traumatic LPD is controversial. Surgical management may result in a lower risk for recurrent LPD, though majority of first-time dislocators are suitable for nonoperative management. There is no consensus about the most preferable method for nonoperative treatment after first-time LPD. Main purpose of this study was to evaluate the efficacy of patellar stabilizing, motion restricting knee brace vs non-hinged sham brace in non-operative treatment for first-time LPD. Primary outcome was patellar redislocation rate in a three-year follow-up.

Methods 101 skeletally mature patients with first-time traumatic LPD were enrolled to the study. After verification for the diagnosis by MRI, nine patients were excluded because of concomitant injury in affected knee. Additional ten patients were excluded because of primary MPFL reconstruction or surgical repair of osteochondral fracture was performed, based on discretion by the surgeon. Eventually 79 patients with first-time traumatic LPD were randomized and allocated to two study groups; group A with patellar stabilizing, motion restricted knee brace (hinged to allow knee range of motion between 0–30 degrees only) and group B with non-hinged sham brace (neoprene sleeve brace not restricting any knee motion, but similar in size than group A brace). Both groups received similar physiotherapeutic instructions and were advised to use the brace continuously for four weeks, after which they were allowed to regain their physical activity freely. 15 patients were lost from the follow-up or failed to use the study brace as supervised and were excluded. Altogether 64 patients completed the trial.

Results For primary outcome measure, the reported LPD redislocation rate in group A (restricted ROM brace) was 11 out of 32 patients (34.4%) and 12 out of 32 patients (37.5%) in group B (sham brace) (p=0.794). Patients in group B (sham brace) had better knee ROM than patients in group A (restricted ROM brace) at four weeks (115 vs. 90 degrees, p=0.000) and at 3 months (133 vs 125 degrees, p=0.028). At six-month follow-up no difference was observed. Patients in group B (sham brace) had less quadriceps muscle atrophy than patients in group A (restricted ROM brace) at four weeks (16/32 vs. 24/32, p=0.048) and at 3 months (16/32 vs 24/32, p=0.048). At six month follow-up patients in group B (sham brace) reported better functional outcome than patients in group A (restricted ROM brace) (Kujala score 93.6 vs 89.0, mean difference 4.6, p=0.012), though no difference was found at three years.

Conclusions According to this randomized controlled study, motion restricting patellar stabilizing brace for four weeks...
after first-time traumatic LPD does not decrease redislocation rate in a three-year follow-up. More importantly, knee immobilization has harmful effect on knee function, presented as more quadriceps muscle atrophy, slower regain of knee range of motion and lower functional outcome.

**DESCRIPTIVE EPIDEMIOLOGY STUDY OF THE JUSTIFYING PATELLAR INSTABILITY TREATMENT BY EARLY RESULTS (JUPITER) COHORT**

Meghan E Bishop, The JUPITER Group, Beth Ellen Shubin Stein, Shital N Parikh, Jacqueline M Brady, Simone Gruber, Matthew William Veerkamp, Joseph T Nguyen, Benton E Heyworth, Marc Tampkins, Daniel W Green, Eric J Wall. USA

**Summary** Description of the formation of the JUPITER cohort and preliminary descriptive analysis of patient demographics and clinical features for this prospective cohort

**Data**

**Purpose** The purpose of this study is to describe the formation of JUPITER and provide preliminary descriptive analysis of patient demographics and clinical features for the initially enrolled patients in this prospective cohort. Patellar instability is common in young patients and can lead to significant morbidity and arthritis. Its management is controversial. JUPITER (Justifying Patellar Instability Treatment by Early Results) is a hypothesis-driven, multi-center, multi-armed, prospective cohort study developed to obtain sufficient subjects to better describe clinical characteristics and predictors of clinical outcomes in the young patellar instability population.

**Methods** After training and institutional review board approval, surgeons began enrolling patients between 10–30 years of age who had sustained a patellar dislocation event. Information regarding patient demographics, dislocation history, physical exam characteristics, and baseline validated patient reported outcome scores were collected.

**Results** As of December 2020, 21 surgeons from 12 sites had prospectively enrolled a total of 1492 patients (1523 knees) with patellar instability. 62.4% were female and the mean age of the cohort was 17.7 years. 71% knees were enrolled in the operative group and 29% in the non-operative group. 59% of knees reported that they had more than 1 dislocation (operative group 89.7%; non-operative group 10.2%, p<0.001). Operative treatment was indicated in 42.9% of first-time dislocators and 89.7% of recurrent dislocators (p<0.001). The recurrent and operative group patients were noted to have a higher percent of positive physical exam findings on both knees. Significance: This epidemiologic study provides demographic information, clinical presentation and baselines PROs of patients with patellar instability. These baseline characteristics would help to identify the at-risk population and compare outcomes over time.

**RELIABILITY OF RADIOLOGIC ASSESSMENTS OF CLINICALLY RELEVANT GROWTH REMAINING IN KNEE MRIS OF CHILDREN AND ADOLESCENTS WITH PATELLOFEMORAL INSTABILITY**

Peter D Fabricant, The JUPITER Group, Beth Ellen Shubin Stein, Shital N Parikh, Madison Heath, Matthew William Veerkamp, Simone Gruber, Daniel W Green, Sabrina M Strickland, Eric J Wall, Douglas Mintz, Kathleen H Emery. USA

**Summary** Evaluation of the interrater reliability among surgeons of varying experience levels and specialty training backgrounds when evaluating skeletal maturity in the distal femur and proximal tibia of children and adolescents with patellofemoral instability.

**Data**

**Purpose** Surgical decision-making and pre-operative planning for children and adolescents with patellofemoral instability relies heavily on skeletal maturity status. In order to be clinically useful, radiologic assessments of skeletal maturity must demonstrate acceptable interrater reliability and accuracy. The purpose of this study was to evaluate the interrater reliability among surgeons of varying experience levels and specialty training backgrounds when evaluating skeletal maturity in the distal femur and proximal tibia of children and adolescents with patellofemoral instability.

**Methods** Cross-sectional study design was used Six fellowship-trained orthopedic surgeons (4 pediatric orthopedic, 2 sports medicine) who perform a high volume of patellofemoral instability surgery examined 20 blinded and randomized knee radiographs and MR images. They assessed these images for clinically relevant growth (open physesis) or clinically insignificant growth (closed/physes remaining in the distal femoral and proximal tibial physis. Fleiss’s kappa was calculated for each measurement. After initial ratings, raters discussed consensus methods to improve reliability and assessed the images again in order to determine if training and new criteria improved interrater reliability.

**Results** Reliability for initial assessments of distal femoral and proximal tibial physes was poor (Kappa range: 0.01–0.58). After consensus building, all assessments demonstrated almost perfect interrater reliability (Kappa = 0.99 for all measurements).

**Conclusion** Surgical decision-making and pre-operative planning for children and adolescents with patellofemoral instability relies heavily on radiologic assessment of skeletal maturity. This study found that initial interrater reliability of physes status and clinical decision making was unacceptably low. However, with the addition of new criteria, a consensus-building process, and training, these variables became highly reliable. Significance: Treatment of patellofemoral instability heavily relies on skeletal maturity status. Physes assessments of the knee must be reliable and clinically relevant to ensure optimal patient care. Lack of assessment reliability can jeopardize patient care, both when determining surgical indications as well as choosing an appropriate procedure based upon.
skeletal maturity. Physeal assessment of the knee without training can be unreliable among fellowship trained orthopedic surgeons. Surgeons should focus on using reliable imaging metrics in children and adolescents with patellofemoral instability, and measurements that remain unreliable after consensus building and training should be removed from clinical decision-making algorithms. With consensus building and training in the use of the methods described in this manuscript, physical assessments can demonstrate almost perfect reliability.

**Methods**

Two fellowship-trained musculoskeletal radiologists assessed 50 patients on several common patellofemoral instability radiographic parameters used for patellofemoral instability and the attempts to improve reliability through training and consensus building around measurement definitions.

**Data**

Purpose Surgical decision making for children and adolescents with patellofemoral instability relies heavily on radiographic findings and measurements. In order to be clinically useful, radiographic parameters must demonstrate acceptable interrater reliability. The purpose of this study was (1) to evaluate the interrater reliability of several common radiographic parameters used for patellofemoral instability, and (2) to attempt to improve reliability for those measurements demonstrating unacceptable interrater reliability.

**Methods**

Two fellowship-trained musculoskeletal radiologists assessed 50 patients on several common patellofemoral instability radiographic measures including the trochlear crossing sign, Caton-Deschamps index, and congruence angle (Table 1). Intraclass Correlation Coefficients (ICC) were calculated for each measurement. For those measurements demonstrating unacceptable interrater reliability (ICC < 0.6), raters discussed consensus methods to improve reliability and examined 20 images from a separate set of subjects. If reliability was still low after the second round of assessment, the measure was considered unreliable.

**Results**

Of the 50 selected participants, 22 (44%) were male and the average age at the time of imaging was 14 ± 2 years. Interrater reliability for 5 radiographic and 7 MRI assessments was initially acceptable, 4 radiographic and 2 MRI assessments improved after consensus training, and 6 radiographic and 3 MRI assessments remained unacceptably unreliable even after consensus training (Table 2).

**Conclusion**

This study found that interrater reliability of many clinically relevant patellofemoral instability parameters was unacceptably low. Some measurements were initially unreliable, but improved with training and consensus building around measurement definitions. Unreliability may persist for those measurements with a high level of difficulty or ambiguity, or for indices that are infrequently assessed. Significance: Lack of measurement reliability can jeopardize patient care both when determining surgical indications as well as choosing an appropriate procedure based upon skeletal maturity. Physicians should ensure they are using a standardized definition or technique for radiographic measurements in children with patellofemoral instability, and unreliable measurements should be removed from clinical decision-making algorithms.
EDS and joint hypermobility is not a contraindication to MPFLR but caution is recommended in managing patient expectations. Significance: This study will influence management and help improve the outcomes for patients with EDS or joint hypermobility and patellar instability.

**20911 DIFFERENCES IN GLENOHUMERAL JOINT CAPSULE DIMENSIONS ON MR ANALYSIS IN ADOLESCENT PATIENTS WITH MDI AND BANKART TEAR**

Mason Cole Yoder, Colin McDonald, Shital N Pankh. USA

10.1136/jisakos-2021-congress.265

**Summary** The purpose of this study was to identify objective criteria for MDI diagnosis based on glenohumeral capsular dimensions and compare it to those with traumatic Bankart tears.

**Data**

**Purpose** Multidirectional Instability (MDI) of shoulder in adolescents is a clinical diagnosis and there are no defined objective criteria to validate the diagnosis. Most patients with MDI have no identifiable labral or capsular tear pattern on MR imaging. In contrast, patients with Bankart tear usually have a definitive history of dislocation, positive clinical findings and typical capsulolabral tear pattern. The purpose of this study was to identify objective criteria for MDI diagnosis based on glenohumeral capsular dimensions and compare it to those with traumatic Bankart tears.

**Methods** In a comparative retrospective study, the clinical records and MR arthograms of adolescent patients treated for shoulder instability at our center between 2008 and 2019 were reviewed. 24 patients diagnosed and treated for MDI were age-matched to 25 patients diagnosed and treated for Bankart tears. The width and depth of the rotator interval and linear dimensions of the glenohumeral capsule in multiple directions were measured on MR arthrography. These dimensions were compared between the 2 groups using a Student’s t-test.

**Results** 24 patients (33 shoulders) 20 females, 4 males were in the MDI group; average age at time of surgery was 15.2 years (range, 8–20 yrs). The Bankart group consisted of 25 patients (28 shoulders), 9 females, 16 males; average age at time of surgery was 15.5 years (range, 11–19 yrs). The rotator interval depth was significantly greater in the MDI group than the Bankart group (MDI 8.5 mm; Bankart 6.1 mm) (p <0.01). Similarly, the inferior, posteroinferior, and posterior dimensions of the glenohumeral joint capsule were significantly greater in the MDI group (inferior 24.5 mm; posteroinferior 26.4 mm, posterior 22.5 mm) than in the Bankart group (inferior 20.4 mm, posteroinferior 21.9 mm, posterior 19.3 mm) (p <0.01). Rotator interval width and all other capsular dimensions showed no statistically significant difference between the 2 groups.

**Conclusion** This study concluded that depth of the rotator interval and dimension of the glenohumeral joint capsule in the inferior, posterior, and posteroinferior direction on MR arthrography were significantly greater in adolescent patients with MDI as compared to patients with Bankart tears. This information needs to be further validated in prospective fashion and compared to normal capsular dimensions to calculate cut-off values for MDI diagnosis on MR analysis. Significance: Measurement of glenohumeral capsular dimensions on MR arthrography can be used to supplement clinical diagnosis of MDI.

**20980 SHOULDER SURGERY POST-OP IMMOBILIZATION: AN INTERNATIONAL SURVEY OF 499 SPECIALIST SHOULDER SURGEONS**

1Michael T Freehill, 2Iain Robert Murray, 3Emilio Calvo, 4Alexandre Lädermann, 1Uma Srikumaran. 1USA; 2UK; 3Spain; 4Switzerland

10.1136/jisakos-2021-congress.266

**Summary** This international survey of 499 shoulder surgeons reveals considerable geographic and experience related variation in the type and duration of shoulder immobilization following an array of arthroscopic and open elective shoulder procedures.

**Data**

**Introduction** There is no consensus on immobilization protocols following shoulder surgery. The purpose of the study was to establish patterns of sling use in the United States and Europe and to identify factors associated with variation.

**Methods** An online survey was sent to members of the American Shoulder and Elbow Society (ASES) and the European Society for Surgery of the Shoulder and Elbow (ESSSE) in April 2020. Demographic questions included: location of practice, years in clinical practice, and type and duration of sling use following arthroscopic Bankart repair (ABR), Latarjet procedure, arthroscopic superior/posterosuperior rotator cuff repair (ARCR) of tears <3cm and >3cm, anatomic total shoulder arthroplasty (aTSA), reverse TSA (rTSA) and isolated biceps tenodesis (BT). The relationships between physician location and sling type for each procedure were analyzed using Fisher’s exact tests and post-hoc tests using Bonferroni-adjusted p-values. The relationships between a physician’s experience and sling duration were analyzed using Spearman’s correlation tests. All analyses were completed in RStudio ver. 1.1.456 using a two-sided level of significance of 0.05.

**Results** Responses were received from 499 surgeons with median years in practice of 15 (interquartile range 9–25). 54.7% of respondents were based in the US, with 45.3% of respondents based in Europe. Respondents from the US reported significantly higher use of abduction pillow slings than European respondents for ABR (62% vs 15%, p<0.0001), Latarjet (53% vs 12%, p<0.001), ARCR <3cm (80% vs 42%, p<0.001) and >3cm (84% vs 61%, <0.001), aTSA (50% vs 21%, p<0.001), rTSA with subscapularis repair (61% vs 22%, p<0.001) and without subscapularis repair (57% vs 17%, p<0.001), and isolated BT (18% vs 7%, p=0.006). Respondents from Europe reported significantly higher use of simple slings than US respondents for ABR (74% vs 31%, p<0.001), Latarjet (78% vs 44%, p<0.001), ARCR <3cm (50% vs 17%, p<0.001) and >3cm (34% vs 13%, p<0.001), aTSA (69% vs 41%, p<0.001) and rTSA with subscapularis repair (70% vs 35%, p<0.001) and without subscapularis repair (73% vs 39%, p<0.001). Increasing experience was negatively correlated with sling duration for ABR (r=-0.20, p<0.001), Latarjet (correlation coefficient −0.25, p<0.001), ARCR of tears <3cm (r=-0.14, p=0.014) and >3cm (r=-0.20, p<0.002), aTSA (r=-0.37, p<0.001), rTSA with subscapularis repair (r=-0.10, p=0.049) and without subscapularis repair (r=-0.19, p=0.022) meaning more experienced respondents tended to recommend shorter durations of immobilization.
sling use. US surgeons reported significantly longer sling durations for arthroscopic Bankart repair (4.8 vs 4.1 weeks, p<0.001), the Latarjet procedure (4.6 vs 3.6 weeks, p<0.001), ARCR <3 cm (5.2 vs 4.5 weeks p<0.001) and >3 cm (5.9 vs 5.1 weeks, p<0.001), aTSA (4.9 vs 4.3 weeks, p<0.001), rTSR without subscapularis repair (4.0 vs 3.6 weeks, p=0.031) and isolated BT (3.7 vs 3.3 weeks, p=0.012) than respondents from Europe. There were no significant differences between regions of both the US and Europe.

Conclusions There is significant variation in the type and duration of immobilization advocated by surgeons following shoulder surgery with geographic location and years of clinical experience influencing patterns of sling use. Future work is required to establish the most clinically beneficial protocols for immobilization following shoulder surgery.

**20727** A MULTICENTER RANDOMIZED CONTROLLED TRIAL COMPARING SINGLE-ROW WITH DOUBLE-ROW FIXATION IN ARTHROSCOPIC CUFF REPAIR: LONG TERM FOLLOW-UP

Peter Lapner, Ang Li, J Whitcomb Pollock, Tinghua Zhang, Katie McIquham, Sheila McRae, Peter B MacDonald. Canada

10.1136/jisakos-2021-congress.267

Summary Purpose compare the effects of single versus double-row suture techniques in arthroscopic repair of tears of the rotator cuff at 10 year follow up. No statistically significant differences in functional outcomes were seen between groups at 10 years. Analysis of 2-year to 10-year change scores demonstrated a decrease in WORC scores in the single row group not observed in the double row group

Data

Background The long term comparative outcomes of single row versus double row fixation in arthroscopic rotator cuff repair is not currently known.

Purpose To compare the treatment effects of single versus double-row suture techniques in arthroscopic repair of full thickness tears of the rotator cuff at 10 year follow up. Study Design: Multicenter randomized controlled trial.

Methods Patients were evaluated at 10 years post-operatively. The primary outcome measure was the Western Ontario Rotator Cuff index (WORC). Secondary outcome measures included the American Shoulder and Elbow Surgeons score (ASES), Constant score, and incidence of revision surgery. Ultrasound was used to evaluate the rotator cuff to determine repair integrity. Statistical analyses consistent with those of the main trial were applied.

Results Of the original 90 participants, 75 (83%) returned at a mean follow-up of 10 years. There were no statistical or clinically significant differences found between single and double-row fixation at final long-term follow-up. Comparison of change in WORC scores from 2-year to 10-year follow-up within groups demonstrated little difference in the double-row group (1.1, 95% CI -10.3–12.5, p=0.85) but a significant decrease in the single-row group (14.7, 95% CI 5.1–24.4, p=0.003). Similarly, a decrease in the ASES scores was observed between 2 and 10 years in the single-row group (11.6, 95% CI 2.9–20.2, p=0.009), as well as decrease in both single and double-row Constant scores (10.6, 95% CI 1.5–19.7, p=0.02 and 15.8, 95% CI 5.2–26.3 p=0.003) respectively. Three participants developed a full-thickness tear after 2 years, two from the double-row group, and one from the single-row group. One participant from each study group underwent revision surgery after the 2-year time-point.

Conclusions No statistically significant differences in quality or functional outcomes were identified between single-row and double-row fixation techniques at long-term follow-up at 10 years. Between 2- and 10-year follow-up, a decrease in several outcome measures were observed in both the single-row and double-row groups. Analysis of 2-year to 10-year change scores demonstrated a decrease in WORC and ASES scores in the single row group not observed in the double row group.

**20522** INTER- AND INTRA-RATER RELIABILITY OF MEASURENEBT OF ACL TUNNELS WITH RADIOGRAPHS, CT, AND MRI

Robert A Magnussen, Christopher C Kaeding, David C Flanigan, Alexander Sparks, Jacy Leon, Matthew Colatruglio, Joshua Bowler, James Oosten, Alex C Di Bartola, Joshua Scott Everhart, Robert A Duerr. USA

10.1136/jisakos-2021-congress.268

Summary MRI and CT scans show similar intra- and inter-rater reliability for tunnel measurement following failed ACL reconstruction and both demonstrate higher reliability than plain radiographs.

Data

Background Multiple imaging modalities are used to assess tunnel diameter following ACL reconstruction in preparation for revision surgery. The aim of this study is to assess the intra- and inter-rater reliability of each imaging modality for the measurement of tunnel morphology.

Methods 26 patients were identified who had pre-revision plain films, MRI, and CT imaging of the knee. Two reviewers independently measured tibial and femoral tunnel diameter for each patient using all three imaging modalities. For radiographs, the tibial and femoral tunnels were measured as the widest segment on both AP and lateral views. For both MRI and CT, the long and short axes of the tunnels were measured. Intra- and inter-class correlation (ICC) values were computed to determine intra-rater and inter-rater reliability for each modality. Values less than 0.5, between 0.5 and 0.75, 0.75 and 0.9, and greater than 0.9 were considered poor, moderate, good, and excellent reliability, respectively. In addition, one reviewer reviewed all images in duplicate and the mean tunnel measurement for each location (tibia short axis, tibia long axis, femur short axis, femur long axis) was calculated. The mean tunnel measurements for each location were compared between MRI and CT and between XR and CT using Student’s t-tests.

Results Inter-rater (table 1) reliability was moderate for tibial plain radiographs and poor for femoral plain radiographs. Inter-rater reliability was moderate for tibial MRI and good for femoral MRI. Inter-rater reliability was moderate - good for tibial CT, and good - excellent for femoral CT. There was no difference in mean tunnel measurements when comparing MRI and CT scans (tibia short axis p = 0.76, tibia long axis p = 0.15, femur short axis p = 0.12, and femur long axis p = 0.84). However, mean XR measurements did differ from mean MRI measurements at all locations (tibia short axis p = 0.036, tibia long axis p = 0.01, femur short axis p = 0.02, and femur long axis p < 0.001). XR estimates of tunnel diameter differed from CT by >2 mm 50%, 79%, 75%, and 92% of the time at the short tibia, long tibia, short femur, and
long femur sites respectively. XR estimates of tunnel diameter differed from CT by >5 mm 4%, 38%, 21%, and 75% of the time at the short tibia, long tibia, short femur, and long femur sites respectively. MRI estimates of tunnel diameter differed from CT by >2 mm 38%, 50%, 63%, and 79% of the time at the short tibia, long tibia, short femur, and long femur sites respectively. XR estimates of tunnel diameter differed from CT by >5 mm 13%, 21%, 0% and 29% of the time at the short tibia, long tibia, short femur, and long femur sites respectively.

Conclusions MRI and CT scans show similar intra- and inter-rater reliability for tunnel measurement following failed ACL reconstruction and both demonstrate higher reliability than plain radiographs. In addition, at all locations, mean tunnel measurements did not differ when comparing measurements on MRI to CT. Mean tunnel measurements did differ at all locations when comparing XR to CT. Taken together, these findings suggest that MRI may be equivalent to CT for tibial tunnel measurement.

Conclusion The majority of ice hockey officials experience musculoskeletal injuries during their career. We support the IIHF recommendation to add officials to their Injury Reporting System. The risk of trauma to the wrist and hand could be possibly be reduced by equipment modifications including protective gloves. Greater emphasis should be placed on injury prevention programs and officials can be encouraged to intermittently take time away from the ice.

21209 AUTOMATIC VOLUMETRIC ANALYSIS OF THE DISTAL TIBIOFIBULAR SYNDROMATIC INSTABILITY

Summary Automatic 3D WBCT volumetric measurements may represent a useful non-invasive diagnostic tool for subtle and chronic syndromatic instability

Data

Introduction Chronic subtle distal tibiofibular syndromatic instability (DTFSI) is relatively common, and consequences of undiagnosed injuries can be devastating. Diagnosing acute and chronic injuries is challenging, and the most commonly used diagnostic tools are physical exam, weightbearing conventional radiographs, non-weightbearing bilateral CT scans, and MRI. Arthroscopic assessment, an invasive method, is currently considered the gold standard. Weightbearing CT has just emerged as an excellent dynamic non-invasive diagnostic test. Recent literature highlighted the accuracy of syndromatic incisura area measurements in diagnosing subtle DTFSI.

Purpose of the Study The aim of our study was to develop and validate the use of a novel automatic 3D volumetric assessment of the tibiofibular incisura, and to compare the measurements between patients with surgically confirmed DTFSI and controls.

Methods In this IRB-approved case-control study, patients with suspected unilateral chronic subtle DTFSI underwent bilateral standing weightbearing CT (WBCT) examination before surgical treatment. DTFSI was confirmed by arthroscopic assessment. We also included control patients that underwent WBCT tests for forefoot related problems and no history of syndromatic injuries. The syndromatic incisura volume (mm^3) was measured starting at the level of the ankle joint to two proximal points, 10 and 15 mm proximally to the joint. A 3D automatic measurement algorithm composed of automated segmentation of the distal tibia and fibula and recognition of the incisura volume based on Hounsfield units (HU) assessment was performed. Measurements were compared between DTFSI patients and controls. A partition prediction model, ROC curves and area under the curve (AUC) were performed to assess the diagnostic accuracy of the automatic volumetric analysis to detect DTFSI. P-values of less than 0.05 were considered statistically significant.

Results In this preliminary report, four patients with DTFSI and seven controls were included. Mean value and 95% CI for 3D Syndromatic Incisura volumetric measurements at 10 and 15 mm points were: 1457 mm^3 (1233 to 1680)/2241 mm^3 (1951 to 2531) for controls, and 1679 mm^3 (910 to 2447)/2425 mm^3 (1408 to 3443) for patients with DTFSI (p-
values of respectively 0.35 and 0.55). When comparing injured and uninjured DTFSI ankles, volume measurements at 10 and 15 mm points were increased on injured ankles, with a Hodges-Lehmann difference of respectively 287 mm³ (p=0.19), and 186 mm³ (p=0.31). The partition model demonstrated that the volume of the first 10 mm was the best predictor of DTFSI when the incisure volume was bellow 1291 mm³ (AUC=0.71).

Conclusion Our study aimed to describe and validate the use of a novel automatic 3D volumetric measurement of the distal tibiofibular incisura in patients with chronic subtle ankle syndesmotic instability and controls. Our preliminary results demonstrated increased volumes on injured ankles when compared to contralateral uninjured ankles and controls. Measurements performed within the first 10 mm length of the syndesmosis were found to predict better the presence of syndesmotic instability, with a volume of 1291 mm³ representing an important diagnostic threshold. Automatic 3D WBCT volumetric measurements may represent a useful non-invasive diagnostic tool for subtle and chronic syndesmotic instability.

**21211** EXERCISE AS A MECHANICAL TRIGGER FOLLOWED BY COLLAGENASE INJECTIONS REPLICATING INTRINSIC FACTORS AND THE CHRONIFICATION OF THE PATHOLOGIC PROCESS: AN EVOLUTION OF THE ANIMAL MODELS OF ACHILLES TENDINOPATHY

Nacime Salomao Barbachan Mansur, Cesar de Cesar Netto, Nacime Salomao Barbachan Mansur, Mario H Lobao, Christopher Cychosz, Kyle R Duchman, John E Femino, Kevin Dibbern, Matthieu Lalevee, Ruth Chimenti. USA

10.1136/jisakos-2021-congress.271

Summary When compared to other models and to controls, the proposed Achilles tendinopathy animal model, induced by a mechanical trigger and sustained by chemical stress, demonstrated progressively increased histological tendinopathic scores.

Data

Introduction A variety of Achilles tendinopathy animal models have been proposed in the literature. These models typically involve the induction of tendinopathic findings by either chemical (most commonly with one or more injections of collagenase, mimicking intrinsic factors) or mechanical stress (by repetitive exercise-induced stress with treadmill running exercises, simulating extrinsic risk factors). To date, no study has evaluated the combination of a mechanical trigger followed by collagenase injections, replicating the logical and sequential steps involved in the development of the human pathology. Our goal was to develop this novel animal model of Achilles tendinopathy and to compare histological and functional findings with animals subjected to isolated mechanical or chemical stress, as well as to controls.

Methods Sixty-four Sprague-Dawley rats were divided into four groups (n=16): isolated treadmill running protocol (150 uphill running, 20 meters/minute, 1 hour/day, 3 weeks duration, weeks 2–4); isolated injections of collagenase (0.1mg each, 3 injections total, weeks 5–7); treadmill protocol (weeks 2–4) followed by three consecutive collagenase injections (weeks 5–7); and controls, no running and three injections of normal saline (weeks 5–7). Five animals from each group were sacrificed at weeks 8 and 10. Six animals by group were sacrificed at week 12. Gait analysis was performed at weeks one (after acclimation), five (following running protocol), eight (following injection protocol) and twelve (just before latest sacrifice time-point). Histological findings were assessed by the Movin Tendinopathy Score (eight parameters, scored from 0–3, total score 0–24), assessing collagen arrangement, structure, and stainability, cellularity, vascularity, nuclear rounding, hyalinization and presence of glycosaminoglycans. Gait parameters included stand and swing times, stride length, duty cycle and swing length.

Results After 8 weeks, significantly increased tendinopathic scores (p<0.001) were found in animals subjected to collagenase injections (16, CI 13.1–18.9) and to running/collagenase (17.4, CI 14.4–20.3), when compared to running alone (3, CI 0.1–5.9) and controls (1.6, CI –1.1–4.5). Similarly, after 10 weeks, significantly increased scores were found in the same groups, with slight severity regression: controls (1, CI –0.8– 2.8), running (2.2, CI 0.4–4.0), collagenase (10, CI 8.2–11.8) and running/collagenase (17.6, CI 15.8–19.4). After 12 weeks, the collagenase group demonstrated reversal of the findings (3.3, CI 1.6–5.1), and was no different than control (2.1, CI 0.4–3.9) and running groups (2.5, CI 0.3–4.7). However, significantly increased pathological findings were noted in the running/collagenase group (20.0, CI 18.2–21.8) consistent with chronification of the tendinopathic process. Gait analysis results are presented in Figure 1.

Conclusion When compared to other models and to controls, the proposed Achilles tendinopathy animal model, induced by a mechanical trigger and sustained by chemical stress, demonstrated progressively increased histological tendinopathic scores after 12 weeks. Findings observed after isolated mechanical or chemical stresses were temporary and not maintained at final follow-up. The steps involved in the development of the pathology, as well as the observed histological results of the combined running/collagenase model, better replicate the findings of human chronic Achilles tendinopathy. Applications for this novel model are promising, potentially supporting a better understanding of early/late findings as well as treatment options for Achilles tendinopathy.

**21210**  

**ACL – PCL FIXATION SEQUENCE DURING MULTIGLIGAMENT KNEE RECONSTRUCTION DOES NOT AFFECT KNEE LAXITY**

1Carola F van Eck, 2Aly Maher Fayed, 3Ryc Kanto, 1Taylor M Price, 1Michael Dinenna, 1Monica A Linde, 2Patrick J Smolinski. 1USA; 2Egypt; 3Japan

10.1136/jisakos-2021-congress.272

Summary In this biomechanical study on combined ACL-PCL multiligament knee reconstruction, no statistically significant difference was found between both sequences in terms of anterior or posterior tibial translation.

Data

Introduction There is no consensus regarding which graft should be tensioned and fixed first in combined anterior (ACL) and posterior (PCL) multiligament reconstruction. Most clinical studies tend to tension and fix the PCL first, however there is no biomechanical evidence to support this. The purpose of this study was to determine which sequence of tensioning and fixation better restores normal knee laxity. The hypothesis was that tensioning and fixing ACL first, better restores knee kinematics.

Methods Fifteen unpaired fresh frozen human cadaveric knees were tested after being prepared by dissecting the soft tissue
Abstracts

Comparing Methods of Stress Radiography for Dual Bracing for Ulnar Collateral Ligament (UCL) Graft Tensioning and Fixation First on Tibial Side (at 30°) and PCL Fixation First, and (4) ACL-PCL Reconstruction with ACL Fixation First, and (4) ACL-PCL Reconstruction with PCL Fixation First. The 3rd and 4th states were randomized. The ACL graft tensioning and fixation first on tibial side (at 30° of knee flexion) followed by PCL fixation (at 90° of knee flexion) then the order of tensioning was reversed for each knee. Anatomic ACL and PCL reconstruction was performed using a single bundle (9 mm) quadriceps tendon autograft for the anterior cruciate ligament (ACL) graft and a single bundle (9.5 mm) hamstrings autograft for the PCL. Both grafts were tensioned equally at 40 Newton. One-way repeated measures analysis of variance (ANOVA) with Bonferroni correction was used to compare knee kinematics between intact, deficient, ACL fixation first, and PCL fixation first. The p value prior to Bonferroni correction was set at 0.05. Results There were no statistically significant differences between both sequences regarding knee kinematics. Both sequences failed to fully restore the intact knee kinematics. ACL first showed no statistically differences for anterior tibial translation (ATT) as compared to the intact state at all tested knee flexion angles, while PCL first showed higher than intact ATT at 90° knee flexion (9.05 ± 3.05 mm vs. 5.87 ± 2.40 mm respectively, p = 0.018). Both sequences failed to restore posterior tibial translation (PTT) back to the intact state at 30° (p = 0.001), 60° (p < 0.001) and 90° (p < 0.001). Conclusion The most important finding of this study is that no statistically significant difference was found between both sequences in terms of ATT and PTT. ACL first tensioning and fixation restored intact ATT at all tested knee flexion angles. Neither sequence fully restored PTT to the intact state. This is consistent with clinical studies indicating residual posterior laxity after PCL reconstruction whether in isolation or after multi-ligament knee reconstruction.

Methods Between January 2015 and July 2019, all patients presenting at our clinic with unilateral PCL insufficiency were included. Before the initiation of the study, a kneeling system (KS) was designed to allow simple and reproducible patient and x-ray cassette positioning. Bilateral kneeling stress radiographs were performed using both our KS and the TD to allow comparison of the amount of PD between the injured and uninjured knee. Six independent observers (4 residents and 2 faculty members) were involved. All radiographs were measured according to the landmarks described by Jacobsen and Staubli, by each of the investigators on 2 separate occasions, at a minimum of 2 weeks apart. The results were expressed as the side-to-side difference (SSD). Statistics included consistency-of-agreement Intraclass Correlation Coefficients (CA-ICC), absolute-agreement ICC (AA-ICC) between raters, as well as Lin’s concordance correlation coefficient for the comparison of the two methods. The mean differential bias between the two-measurement methods was estimated according Bland and Altman.

Results 2736 x-rays were measured on 57 patients. For SSD measure, CA-ICC was 0.87 [95% CI, 0.82-0.91] with the TD, and 0.72 [95% CI, 0.63–0.80] with the KS. AA-ICC for the SSD was 0.86 [95% CI, 0.81–0.91] for the TD and 0.71 [95% CI, 0.62–0.79] for the KS. The KS and TD offered a concordance agreement for SSD measures of all observers at 0.80 [95% CI, 0.71–0.89]. The KS slightly underestimated the TD measurements for SSD with an average of 1.2 mm [95% limits of agreement: −3.6, 6.1]. This variability of SSD measured with the KS increased with the magnitude of the instability. SSD measured with the KS can be recalibrated by computing: (TD SSD – 0.97)/0.72. No statistical significant difference could be observed between trial 1 and 2 measurements for SSD with KS for all observers.

Conclusion This new KS for stress radiography in posterior knee instability demonstrates high interobserver and intraobserver reliability. Compared to the TD, it offers good concordance even if it slightly underestimates the SSD. This difference is not clinical relevant and can be adjusted with a simple correction formula. This KS might offers an easier and cost effective alternative to the TD.

Comparing Methods of Stress Radiography for Posterior Knee Instability

Robin Martin, Trieu Hoai Nam Ngo. Switzerland

Summary A new simple kneeling device offers similar accuracy and reliability to the Telos system.

Data

Introduction The Telos device (TD) has shown excellent intraobserver and interobserver reliability for posterior drawer (PD) stress radiography. However, it is technically difficult to use, time consuming and expensive. The kneeling view has been proposed as a more cost effective and accessible approach. However, it failed to show similar precision to the Telos device in small comparative studies. We hypothesized that this could be attributed to unreliable patient and cassette positioning. Aims: Evaluation of the accuracy and reliability of a new self-designed kneeling system for posterior drawer radiographs compared to the TD in a large prospective study.

DUAL BRACING FOR ULNAR COLLATERAL LIGAMENT INJURIES RESTORES NATIVE VALGUS LAXITY AND NATIVE MEDIAL JOINT GAPPING OF THE ELBOW


Summary This study provides biomechanical data on valgus stability of a new ligament bracing concept for acute MUCL lesions and shows that native valgus joint laxity as well as native medial joint gapping can be restored by this technique.

Data

Background Despite growing evidence on the role of the posterior ulnar collateral ligament (pMUCL) in elbow stability, current ligament bracing techniques are mainly focused on the anterior ulnar collateral ligament (aMUCL). The purpose was to biomechanically compare aMUCL bracing, Dual Bracing that addressed aMUCL as well as pMUCL, and aMUCL reconstruction. It was hypothesized that lesser joint gapping would occur after Dual Bracing in higher degrees of elbow...
flexion and that Dual Bracing provides equal primary valgus stability.

Methods 21 unaired human elbows (11 right, 10 left; 57.19 ± 11.72 years) were randomized into 3 groups. Laxity testing was performed with 25 N applied 12 cm distal to the elbow joint for 30 seconds at randomized flexion angles (0°, 30°, 60°, 90°, and 120°). After assessment of the native condition the laxity test protocol was repeated for each surgical technique. A calibrated motion capture system (Vicon®) was used for assessment. Repairs were then cyclically tested through a materials testing machine (Bionix 858; MTS Systems) starting with 20 N for 200 cycles at a rate of 0.5 Hz. The load was increased stepwise by 10 N for 200 cycles until displacement reached 5.0 mm or complete failure occurred.

Results aMUCL bracing and Dual Bracing resulted in significantly (p = 0.045) lower joint gapping in 120° of flexion than aMUCL reconstruction. Between the surgical techniques no significant differences for valgus laxity were found. Each type of surgical repair showed no significant differences between the native and the postoperative state for valgus laxity and joint gapping. There was no significant difference between the different types of surgery for cycles to failure and failure load.

Conclusion Dual bracing of the medial ulnar collateral was able to restore native valgus joint laxity and medial joint gapping. Furthermore, it was able to restore joint gapping in higher flexion significantly better than aMUCL reconstruction. Dual Bracing reached similar primary stability regarding failure outcomes.

20990 THE ORIENTATION OF THE ACROMION IS NOT ASSOCIATED WITH DIFFERENT ASYMMETRIC POSTERIOR GLENOID EROSION PATTERNS

1Alexander Otto, 2Bastian Scheiderer, 3Julian Meh!, 2Eliho Obopilwe, 4Patrick J Denard, 5Anthony A Romeo, 6Augustus D Mazzocca. 1Germany; 2USA

Summary The variability of B2 glenoids and their association to the acromial orientation were assessed in 3D models that were reconstructed from CT scans.

Data Background Posterior glenoid wear remains a challenge in anatomic and reverse total shoulder arthroplasty (rTSA) due to an asymmetric erosion with altered retroversion. It has been suggested that orientation of the acromion influences glenohumeral joint reaction forces and thus the development of posterior glenoid erosion. The purpose of this study was to assess glenoid morphology and acromial orientation in posterior glenoid erosion patterns by utilizing 3D models.

Materials and Methods CT shoulder scans from three study centers of patients awaiting rTSA between 2017 and 2018 were converted into 3D models (Mimics®, 3-Matic®, Materialise®, Leuven, Belgium) and analyzed by two observers. Morphology, orientation and greatest depth of erosion, inclination, current retroversion and premorphed retroversion, surface areas of the glenoid, and external acromial orientation as well as posterior acromial slope were assessed. Measurements were compared by wear patterns, entities and gender.

Results In the complete cohort of 68 patients (63.8 ± 10.0 years; 19 females, 49 males) a mean of 85.9° (± 22.2°) was observed for the glenoid erosion orientation. Additionally, a further distinct classification of the glenoid erosion as posterior-central (pc, N = 39), posterior-inferior (pi, N = 12), and posterior-superior (ps, N = 17) wear patterns was possible. These wear patterns significantly (P < 0.001) distinguished by erosion orientation (pc = 86.9° ± 12.0°, pi = 116.3° ± 10.3°, ps = 62.3° ± 18.9°). The greatest depth of erosion found was 7.3 mm ± 2.7 mm in pc wear patterns (ps vs. pi: p = 0.03; pc vs. ps: n.s.; pi vs. ps: n.s.). Overall the observed erosion divided the glenoid surface into a paleoglenoid proportion of 48% (± 11%) and neoglenoid proportion of 52% (± 12%). For the complete cohort, glenoid inclination was 85.4° (± 6.6°), premorphed glenoid retroversion was 80.7° (± 8.1°), current glenoid retroversion was 73.4° (± 7.4°) with an estimated increase of 6.9° (± 6.0°). Mean external acromial orientation was 118.2° (± 8.9°), and the mean posterior acromial slope was 107.2° (± 9.6°). There were no further significant differences if parameters were compared by wear patterns, entities and gender.

Conclusion The current analysis was able to distinguish three significantly different orientated wear patterns (posterior-superior, -central, -inferior) in shoulders demonstrating posterior wear on axillary imaging. No significant differences between the observed erosion patterns or any relevant correlations were found regarding the orientation of the acromion.

20836 THE APPLICATION OF ULTRASOUND GUIDED KNEE ARTHROSCOPY FOR CALCIFIED PATELLAR TENDINOPATHY IN ELITE WEIGHTLIFTERS

George D Tsikouris, Nikolaos D Gravvanis, Georgia S Dedoussi, Ioannis K Antonopoulos, Fanis P Papadakis, Demetrios P Tsikouris, Vassilis N Psychoyios, Theodoros G Troupis. Greece

Summary The Application of Ultrasound Guided Knee Arthroscopy for Calcified Patellar Tendinopathy in Elite Weightlifters. Data The application of ultrasound Guided Knee Arthroscopy for calcified patellar tendinopathy in Elite Weight Lifters Tsikouris D. Georgios1, 2, Gravvanis D. Nikolaos1, Dedoussi S. Georgia1, Antonopoulos Ioannis1, Papadakis P. Theofanis1, Tsikouris P. Demetrios1, Psychoyios N. Vasilios1, Troupis G. Theodoros1. 1. Athens Kolonaki Kalamata Orthopaedic & Sports Medicine Institute (AKKOSMI). 2. Doctor for World Weightlifting Federation. 3. Director 5th Orthopaedic Clinic General Hospital “Asklipieio” Voulas Athens. 4. Professor of Anatomy Department, Athens Medical School. 5. Anatomy Department Athens Medical School. 6. PhysioKinisis Rehabilitation Centre, Kalamata.

Introduction/Background Patellar tendinopathy is commonly observed in Weight Lifters due to overuse injury from deep squatting or knee protraction in snatch and clean and jerk exercises. The repetitive movements predispose to initial tendinitis and subsequently calcification of the patellar tendon in various positions and particularly at its insertion, and is more frequently observed in patients with a history of Osgood-Schlatter disease. Aim of the study was to define the clinical outcomes following the concomitant use of ultrasound scan with knee arthroscopy in the management of calcified patellar tendinopathy.

Methods Elite weightlifters with calcified patellar tendinopathy resistant in conservative treatment were included in the study. Clinical examination and Magnetic Resonance Imaging (MRI) were used for diagnosis. All patients underwent arthroscopy
by a single surgeon. Arthroscopy was performed under ultrasound guidance. Calcified lesions within the tendon were identified with the use of ultrasound scan intra-operatively and subsequently the lesions were removed arthroscopically. The clinical outcome was assessed by recording and comparing the IKDC score pre- and post-operatively and at a minimum 1-year follow-up post-operatively.

**Results** Twelve weightlifters (11 males, 1 female) with mean patient age 24.2 (range: 18–31) years were included in the study. Three patients had a known history of Osgood-Schlatter disease. The mean IKDC score improved from 26.5% (range: 22.9–29.8%) pre-operatively to 96.8% (range: 85.4–98.9%) post-operatively, indicating excellent clinical outcomes. All patients returned back to full activity within 3 (range) months. One patient, with history of Osgood-Schlatter disease, was required to have a revision operation in a 3-month period.

**Conclusion** Ultra-sound guided knee arthroscopy is a safe and effective method for the management of calcified patellar tendinopathy. Excellent clinical outcomes and satisfying return to sport rate were observed in these athletes at a mean 4-year follow-up time.

**20513 USE OF PATIENT SPECIFIC IMPLANT TECHNOLOGY DID NOT IMPROVE TibIAL COMPONENT POSITIONING**

Bryan T Hanypsiak, Makenna Wilbrett, USA

**Summary** In our hands, patient specific instrumentation did not provide superior results to conventional instrumentation with regard to tibial component positioning.

**Data**

**Purpose** Component malposition remains a leading cause of early implant failure. The authors sought to reduce the variance observed in tibial component placement utilizing standard instrumentation. Our purpose was to evaluate the effect of patient specific instrumentation (PSI) on tibial component positioning in total knee arthroplasty.

**Hypothesis** The utilization of Patient Specific Instrumentation would lead to improved component positioning on plain radiographs. Study design: Cohort study (prognosis); Level of evidence: 2.

**Methods** The authors reviewed a consecutive series of 113 total knee arthroplasties that were performed by the same surgeon. Post-operative radiographs consisting of AP, Rosenberg, lateral and merchant views were obtained for each patient by the same technologist. These were analyzed for degree of varus/valgus angulation and tibial slope utilizing a Digital x-ray management system (AGFA, Mortsel Belgium). An independent author, blinded to the surgical technique utilized, reviewed all X-rays. Three measurements were taken for each X-ray at separate sittings and the results averaged to minimize intraobserver error. Means were determined for both PSI and conventional instrumentation with regard to angulation and slope. A t-test was utilized to compare the means. A power analysis conducted prior to data collection indicated the study was adequately powered.

**Results** 64 patients had a TKA with PSI. 51 patients had a TKA with conventional instrumentation. Patients undergoing TKA with conventional instrumentation averaged 2.3 degrees of varus/valgus (range = 0.5 to 6.2) and 5.9 degrees of tibial slope (range = 3.5 to 10.9). Patients undergoing TKA with PSI averaged 2.6 degrees of varus/valgus (range: 0.3 to 12.4) and 6.4 degrees of tibial slope (range: 2.5 to 12.4). There was no statistically significant difference in tibial component positioning with regard to angulation in the AP plane (p=0.136) or tibial slope (p=0.121).

**Conclusion** Utilization of patient specific instrumentation did not improve tibial component positioning with regard to varus/valgus and posterior slope on plain radiographs. The authors found no significant difference between knees replaced with conventional instrumentation and those replaced with patient specific instrumentation. While the authors acknowledged reduction in OR time with PSI utilization, the increased cost of the molds and models may not warrant widespread utilization for all patients. Keywords: Case series with retrospective collection of data; knee; arthroplasty; tibial component; patient specific instrumentation.

**21024 CONVERSION TO MEDIAL CONGRUENT POLYETHYLENE FROM ULTRACONGRUENT DID NOT AFFECT FINAL RANGE OF MOTION IN PATIENTS UNDERGOING TOTAL KNEE ARTHROPLASTY**

Bryan T Hanypsiak, Makenna Wilbrett, USA

**Summary** Substitution of Medial Congruent Polyethylene did not result in improved final range of motion in our patients.

**Data**

**Purpose** Patient satisfaction in total knee arthroplasty is directly associated with range of motion. Our purpose was to evaluate the effect of substitution of a less constrained polyethylene on final range of motion in patients undergoing total knee arthroplasty.

**Hypothesis** The utilization of Medial congruent polyethylene would lead to improved range of motion at the time of discharge from physical therapy. Study design: Cohort study (prognosis); Level of evidence: 2.

**Methods** The authors reviewed a consecutive series of 69 total knee arthroplasties that were performed by the same surgeon. An Ultracongruent Polyethylene was utilized on 33 knees and a Medial congruent on 36 knees. The utilization of the medial polyethylene component represented a running change in the lead authors’ practices. An independent physical therapist, blinded to the choice of implants, measured Maximum Flexion at the time of discharge from physical therapy. Maximum Flexion was recorded and analyzed between the groups utilizing a t-test. A power analysis conducted prior to data collection indicated the study was adequately powered. A difference of 10 degrees of flexion was set as our minimum clinically significant difference.

**Results** 33 patients had a TKA with an Ultracongruent Polyethylene (UCP). 36 patients had a TKA with a Medial Congruent Polyethylene (MCP). Patients undergoing TKA with UCP averaged 114.3 degrees of flexion (Range = 80 – 130) at the time of discharge from physical therapy. Patients undergoing TKA with MCP averaged 114.8 degrees of flexion. (Range = 75 - 130). There was no statistically significant difference between groups (p=0.42). Three patients in each group required manipulation under anesthesia at 3 months from the index procedure. With these 6 patients excluded, patients with UCP averaged 117.1 degrees of flexion and patients with MCP averaged 117.7 degrees of flexion.
Conclusion Utilization of a less constrained polyethylene did not lead to improvement in range of motion. Our results did not correlate with industry sponsored white papers. The difference in our study is likely multifactorial, but may have been affected by the pandemic altering patients willingness to attend outpatient therapy. Keywords: Case series with retrospective collection of data; knee; arthroplasty; polyethylene; flexion; range of motion.

Summary Pediatric patients with the lowest activity level, according to the HSS Pedi-FABS, report the lowest PROMIS® Global Health scores and the highest Fatigue and Pain Interference scores.

Data Background The benefits of regular physical activity on general health is well established. Organizations such as the World Health Organization and The American College of Sports Medicine has stated that regular physical activity provides many health benefits, however this has mainly been studied in an adult population. Very little information exists on how activity levels can affect a child’s overall health. This study aims to evaluate the association of a validated activity scale, the HSS Pedi-FABS, with global health scores in a pediatric population.

Methods A retrospective review of youth athletes age 6 to 19 presenting for evaluation at a single pediatric sports medicine clinic between April 2016 and July 2020 was performed. Participants were included if they completed a pre-visit intake questionnaire, the HSS Pedi-FABS, and the PROMIS® Pediatric Global Health 7 (PGH7) with Fatigue (PGHF) and Pain Interference (PGHPI) components as part of standard of care treatment. Patient demographics, sport, level of competition, frequency of sport participation, HSS Pedi-FABS Quartiles, PROMIS® PGH T-scores and HSS Pedi-FABS scores were compared utilizing a Kruskal-Wallis test followed by the Dwass, Steel, and Critchlow-Flinger method for multiple comparisons. Spearman’s Correlations were calculated to evaluate HSS Pedi-FABS score association with patient reported participation in sport (level, hours, weeks) and PROMIS® PGH T-scores.

Results 1049 sports medicine patients (mean age 14.7 ± 2.4 years; 52.1% females) reported participating in sports for 9.3 ± 7.0 hours per week during 30.6 ± 15.9 weeks per year; 52.1% females) reported participating in sports for 9.3 ± 7.0 hours per week during 30.6 ± 15.9 weeks per year. The mean PGH7 score was 50.9 ± 8.6, while PGHF was 51.1 ± 6.9. All three PGH components correlated significantly with the HSS Pedi-FABS, report the lowest PROMIS® Global Health scores and the highest Fatigue and Pain Interference scores. This association suggests that higher childhood and adolescent activity levels are associated with improved global health scores and may serve as a basis for future research supporting public health initiatives promoting increased physical activity for pediatric wellbeing.

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Results 1049 sports medicine patients (mean age 14.7 ± 2.4 years; 52.1% females) reported participating in sports for 9.3 ± 7.0 hours per week during 30.6 ± 15.9 weeks per year. The mean PGH7 score was 50.9 ± 8.6, while PGHF was 51.1 ± 6.9. All three PGH components correlated significantly with the HSS Pedi-FABS, report the lowest PROMIS® Global Health scores and the highest Fatigue and Pain Interference scores. This association suggests that higher childhood and adolescent activity levels are associated with improved global health scores and may serve as a basis for future research supporting public health initiatives promoting increased physical activity for pediatric wellbeing.

Introduction The role of the medial collateral ligament (MCL) and the posterior oblique ligament (POL) in restraining valgus and anteromedial rotation has been extensively studied. However, the individual role of each part of these broad structures have not been evaluated yet. Thus, the goal of the present study was to investigate the role of the individual fiber region of the MCL and POL. It was hypothesized that each MCL and POL fiber region have similar roles in restraining medial knee laxity.

Methods Eight fresh-frozen cadaveric knee specimens were mounted onto a six degree of freedom robotic testing setup (KUKA KR60/3) with a force-moment sensor(ATI-Theta FT-sensor; Schunk). The knees were aligned according to the coordinate system of Grood and Sunray and the following simulated clinical laxity tests were performed at 0/30/60/90° knee flexion: (1) 134N anterior tibial translation (ATT) performed at 5Nm external tibial rotation (ER) to simulate anteromedial rotatory knee instability (AMRI), (2) internal tibial rotation, and (3) 10Nm valgus rotation. These simulated laxity tests were applied to the intact knee and after sequentially resecting the (1) anterior-, (2) middle-, and (3) posterior portion of the MCL and the (1) central- and (2) capsular arm of the POL. Therefore, the femoral and tibial insertion site of the MCL was divided into 3 parts from anterior to posterior and each portion was longitudinally resected. Similarly, the POL was divided macroscopically into the central and capsular arm and was also resected. The contribution of each portion was recorded using a position controlled setup and was presented as percentage from the total MCL and POL contribution, respectively. A 2-way repeated measure ANOVA with post-hoc Bonferroni correction was performed.

Results The anterior portion of the MCL was the major reenrer (more than 50% of the whole MCL) at 30–90° knee flexion (p<0.01) in restraining AMRI, which was the highest at 90° knee flexion (63.1% of the whole MCL and 23.2 ±9.8% total). The middle portion also had a significant
contribution, but never exceeded 30% contribution of the whole MCL. The central arm of the POL primarily contributed in restraining internal tibial rotation at 0 and 30° knee flexion, presenting 72% (0°) and 92% (30°) of the POL, which showed a 46±13.1% and 30.4±17.7% overall contribution in restraining internal rotation. The MCL only showed a relevant contribution at 30° (21.7±11.9), with the posterior portion contributing for 55.8%. All parts of the MCL had a similar contribution in restraining valgus rotation at 0 and 30°, with the middle part as highest contributor (38.4 and 42.1%). At higher flexion angles the anterior portion of the MCL was the major restraint (p < 0.01). Only the central arm of the POL showed a statistically significant (p < 0.05) contribution in restraining valgus rotation at early flexion angles (0–30°).

Conclusion Contrary to our hypothesis, each of the MCL/POL portions had individual contribution in restraining medial knee laxity, where the anterior portion was the major restraint to AMRI at high flexion angles and the posterior portion and the central arm of the POL were the major restraint to internal rotation at early flexion angles. Reconstructing only one part of the MCL may not be sufficient in restoring the entire medial knee kinematic.

Results 475 subjects (HT=252, QT=223) were included. The risk of graft failure at 2 years was 9.4% for QT and 11.1% for HT (p= .46). Respectively, the risk of revision ACLR was 2.3% and 1.6% (p= .66), the risk of re-operation due to cyclops was 5.0% and 2.4% (p= .13), and the risk of re-operation due to meniscal injury was 4.3% and 7.1% (p= .16). The risk of re-operation due to any reason was 20.5% and 23.6% (p= .37). At 1 year follow-up A-P laxity was 1.4 mm for QT and 1.5 mm for HT (p= .35), and the proportion of patients with a positive pivot-shift was 29% for both groups.

Conclusion QT and HT yield similar rates of graft failure, revision ACLR and re-operation at two years follow-up after ACLR. Graft failure was found in 9–11%. QT showed a non-statistically trend of higher risk for re-operation due to cyclops, and HT a non-statistically trend of higher risk for re-operation due to meniscal injury.

Summary Computational models can be used to quantifying heightened ACL force and unique kinematic patterns in targeted, high risk male and female athletes presenting with geometric risk factors for ACL injury.

Data Background A recent prospective clinical study of 88 ACL-injured and 88 uninjured matched-control subjects (61 female pairs and 27 male pairs) has shown that increased sagittal slope of the lateral tibial cartilage in females and decreased posterior wedge angle of the lateral meniscus in males are risk factors for noncontact ACL rupture. Unfortunately, little is known about how the contacting articular and meniscal geometries impact ACL loading and tibiofemoral kinematics in individuals at elevated risk of ACL injury.

Purpose To develop a framework to quantify ACL loads and tibiofemoral kinematics in male and female subjects exhibiting risk factors for non-contact ACL rupture.

Materials/Methods This was a registry study with review of medical records. Our study cohort consist of patients with primary ACLR using either QT or HT performed at Copenhagen University Hospital Hvidovre from January 2015 to December 2018. The cohort was identified from the Danish Knee Ligament Reconstruction Registry and linked to the Danish National Patient Registry to identify all hospital contacts post-ACLR. The outcome variables were graft failure (re-rupture or >3 mm side difference in A-P laxity), revision ACLR, re-operation due to cyclops, re-operation due to meniscal injury and re-operation due to any reason. Also, A-P laxity and pivot-shift were assessed at 1 year. Using Kaplan-Meier estimates, the rates of events were evaluated at 2 years and comparison performed with Cox regression analysis.
were predicted in response to a simulated clinical pivot shift maneuver. The simulated pivot shift consisted of serially applied compression (100 N), valgus (8 Nm), internal rotation (2 Nm), and anterior (30 N) loads with the knee held at 15° of flexion.

**Results** ACL force predictions for the female and male case knee models exceeded their matched controls by 61 N and 41 N, respectively (Fig. 2). For the female case, ACL force was 19 N greater than the matched control with applied compression, then rapidly increased and was 65 N greater than the matched control with the addition of valgus torque. Compared to the uninjured control, the female case knee model exhibited greater anterior tibial translation and internal tibial rotation (ITR) with compression and valgus. In the case and control male knee models, addition of internal rotation torque increased ACL force to 45 and 44 N, respectively. The male case knee model exhibited increased ITR with internal rotation torque. Adding the anterior force led to the largest difference in ACL force (41 N) between the male case and control knee models.

**Discussion and Conclusion** This work provides proof-of-concept data supporting the ability of computational models to quantify heightened ACL force and unique kinematics patterns in targeted, high risk male and female athletes presenting with geometric risk factors for injury. A key strength of this integrated clinical and computational framework presented is the ability to establish a direct mechanical link between geometric risk factors for injury and knee kinematics and ACL force.

**Conclusion** Following transtibial repair for posterior meniscal root repairs, the LMPRTs had a higher frequency of healing, whereas MMPRTs continued to extrude, despite surgical intervention. The study also confirmed that MMPRTs and LMPRTs differ in demography and associated injuries.

**Materials and Methods** A prospective randomized study was conducted during September 2016 and June 2018 to evaluate ACL reconstructions using double and single beam ACL reconstruction surgical techniques in a group of 72 previously healthy, active patients with acute injury to the ACL with a similar injury mechanism in all cases. This study was reviewed and accepted by the research and ethics committee of the Christus Muguerza del Parque Hospital. An ACL injury was documented using the IKDC and Tegner Lysholm clinical scales, measurement equipment such as KT1000 and the Pivot-Shift Meter application (PSM) before the operation, complemented with an imaging study, magnetic resonance (MRI), all lesions were evaluated with these instruments just before and after the operation and as a follow-up at 2, 4, 6, 12 months and 2 years. Before surgery, a blind envelope was opened to decide which surgical technique to use.

**Results** 72 patients were randomized, distributing 36 patients in each group. The double-bundle group had a less repeated ACL tear, fewer meniscal injuries, and better Lysholm and IKDC scores. This technique also had a better measurement on the KT-1000 and a more stable knee with the PSM.

**Conclusion** After a follow-up of more than two years, it was found that the double-bundle (DB) ACL group had significantly better results than the group that underwent the single-bundle (SB) surgical technique. The double-bundle technique is better in a short and medium-term follow-up (two years), since the recovery of patients is better using this technique, the results in clinical scales are better, the patients present less difference in anteroposterior displacement in millimeters using the KT-1000 relative to your healthy knee and a downgrade.
using PSM. Patients can return to their pre-injury activities faster using the double beam technique. Level of Evidence: Case - Control Study

**Summary**
The rotational stability of the knee can be accurately measured using a mobile phone application.

**Data**
PSM: Pivot Shift Meter Cellphone Application for Classifying ACL Injuries

**Hypothesis**
The rotational stability of the knee can be accurately measured using a mobile phone application.

**Materials and Methods**
A technological application named Pivot Shift Meter (PSM) was designed to provide a dynamic evaluation of rotational stability of the knee, measured in rad/s (angular velocity) through the gyroscope integrated in a mobile phone. The evaluation of 52 young, healthy subjects was obtained by 5 different medical practitioners. The time and maximum velocity reached of each maneuver was used in intraclass correlation coefficient (ICC) study to find the differences between the practitioner’s maneuvers. The correlation study variables were maneuver time and amplitude of maximum speed. Then the data obtained with the PSM was analyzed to create a classification of injury degree, using an already established classification named as the “Del Parque” Classification obtained through the KT1000.

**Results**
The ICC study results in terms of time and maximum velocity reached give an average result of 94% and of 66%, respectively, from an interobserver correlation. These results demonstrated that a quantitative analysis of the maneuver can be carried out through the application. From these correlation results, the samples were grouped into classes determined by the femur. A precise measurement of pivot shift could give an advantage in determining the rotational instability of both ACL bundles.

**Conclusions**
In the present study PSM was able to precisely measure rotational instability, providing quantitative dynamic diagnostic information that the gold standard arthrometer cannot offer. Digital arthrometry seems to be the way to develop methods for the precise and numerical evaluation of rotational instability, with all the advantages that an early diagnosis and classification prior to any surgical treatment can provide. Level of Evidence: Case - Control Study

**Introduction**

The pivot shift test is key to define therapeutic paths. But this test cannot be numerically measured, and the gold standard KT-1000 test can only measure the anterior translation of the tibia over the femur. A precise measurement of pivot shift could give an advantage in determining the rotational instability of both ACL bundles.

**Materials and Methods**
A technological application named Pivot Shift Meter (PSM) was designed to provide a dynamic evaluation of rotational stability of the knee, measured in rad/s (angular velocity) through the gyroscope integrated in a mobile phone. The evaluation of 52 young, healthy subjects was obtained by 5 different medical practitioners. The time and maximum velocity reached of each maneuver was used in intraclass correlation coefficient (ICC) study to find the differences between the practitioner’s maneuvers. The correlation study variables were maneuver time and amplitude of maximum speed. Then the data obtained with the PSM was analyzed to create a classification of injury degree, using an already established classification named as the “Del Parque” Classification obtained through the KT1000.

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**Summary**

Sport injuries during lockdown were more frequent than before lockdown and happened mostly indoors during intensive aerobics and power exercise.

**Data**

**Introduction and Objective**

COVID-19 lockdown orders were imposed on the entire Israeli population from 20March to 12May-2020. These had a major impact on sport activities. During this period, an abnormally high number of patients with indoor sport injuries arrived for orthopedic consultation. The purpose of this study was to characterize the modifications in physical activities (PA) that occurred during the lockdown, identify the related sport injuries, and to investigate lockdown-related risk factors associated with these injuries.

**Methods**

This was a cross-sectional observational study targeting the physically active Israeli population. During the last 2 weeks of the lockdown, an anonymous web-based survey was shared through social media using the “Snowball Sampling” method. Informed consent was waived by the ethics committee. Data collected included demographics, type/frequency of physical activity (PA) before/during lockdown, and incidence and characteristics of sports injuries. The sport injuries were self-reported. The severity of the injuries was determined according to the need of the patient to seek professional medical consultation or treatment during the lockdown since going out was prohibited excluding urgent medical treatment.

**Results**

415 individuals responded to the survey (205:210 female:male, age, mean±SD=38±15 years, range=11–75). Of the responders, 91% reported to be physically active twice a week or more before the lockdown, of which 82% reported that they remained at the same frequency of activity during the lockdown. However, the type of PA was modified relative to before the lockdown – PA at pools and gyms decreased to 10%, and group PA or those that required bikes/treadmills decreased to 50%. In contrast, individual activities near or at home, including running and power exercise with machines, were unchanged. Moreover, PA practiced at home with digital media such as aerobics and power exercises increased by 20%. Indeed, 77% of responders that practiced in groups before the lockdown were practicing alone during the lockdown (p<0.001 by McNemar). Sport injuries were reported by 108 of 415 (26%) of the respondents and occurred mostly indoors during intensive aerobics (38%) and power exercise (43%). The anatomical location of the majority of the injuries was the knees/ankles (57%), lower back (25%), and shoulders (16%). The male:female injury ratio was 1.6:1 (66:42) (p=0.011 by Chi-Square contingency). This is lower than the 3:1 ratio reported in the...
literature prior to the lockdown. Twenty-nine of 415 injured (7\%) sought medical treatment despite the lockdown, attesting to the severity of their injury, of which 16 visits were to orthopedic clinic or emergency room (3.8\%). Since this occurred during the 2-month lockdown, it extrapolates to a 23\% potential annual incidence that is twice as much as the previously reported annual sport injury incidence of 3–13\% outside of the lockdown period.

**Conclusions** The sharp increase in incidence of injury and difference in gender-related injury ratio during the lockdown point to the need for additional public health evaluation of measures necessary for injury prevention during this period of imposed restrictions.

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### 20492 OSTOTOMIES ABOUT THE KNEE CAN SAFELY BE PERFORMED IN AN AMBULATORY SETTING

Michael Doran, Anthony Essifi, 1Eoghan T Hurley, 1David Bloom, 1Amit K Manjunath, 1Eric Jason Strauss, 1Laith M Jazrawi, 1Michael J Alaia. 1USA; 2Ireland

**Summary** Osteotomies about the knee performed in an ambulatory setting were safe, with no difference in readmission, reoperation, and post-operative complications compared to those performed at an inpatient hospital.

**Data**

- **Purpose** The purpose of this study was to assess the rate of inpatient conversions, hospital readmissions, reoperations, and complications with tibial tubercle osteotomies (TTO), high tibial osteotomies (HTO), and distal femoral osteotomies (DFO) operations performed at our ambulatory surgery center compared to our inpatient hospital setting.

- **Methods** A retrospective review of patients receiving a TTO, HTO or DFO at our institution between June 2011 and October 2019 was performed. All patients included had one of the three procedures done at either our inpatient hospital or our ambulatory surgical center (ASC) and had a minimum follow-up of 90 days. Complications, including re-admission and re-operation were compared between the two groups using either the Fisher’s exact test and independent samples t-test, where applicable, and a p-value of < 0.05 was considered to be statistically significant.

- **Results** The study included 497 patients undergoing osteotomies (180 ASC and 317 hospital) with no patients lost to follow-up in the 90-day post-operative period. No patients operated on at an ASC required transfer to inpatient setting. There were no differences in re-admission or re-operation rates amongst the two groups (3.3\% vs 4.4\%, p = 0.6508). Additionally, there were no significant differences in complication rates between those who had surgery in the ASC or hospital for TTOs (3.8\% vs 5.1\%, p = 0.7885), HTOs (2.7\% vs 3.6\%, p = 1.0), or DFOs TTOs (0\% vs 5.5\%, p = 1.0). Complications including surgical site infection and arthrofibrosis were not significantly different in the two cohorts, (1.1\% vs. 2.5\%, p = 0.341 and 0.6\% vs 0.9\%, p = 1.000, respectively).

- **Conclusions** Osteotomies about the knee performed in an ambulatory setting were safe, with no difference in readmission, reoperation, and post-operative complications compared to those performed at an inpatient hospital. Additionally, no patient required conversion from an outpatient to an inpatient setting.

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**20435 CAN PRE-OPERATIVE MRI ACCURATELY PREDICT HAMSTRING AUTOGRF DIAETR IN ANTERIOR-CRUCIATE LIGAMENT RECONSTRUCTION?**

1Thomas J Kremen, 1Michael Tan Arnold, 2Ignacio Garcia-Mansilla, 1Myra Trivellas, 1Thomas J Kremen. 1USA; 2Argentina

**Summary** Preoperative MRI can be used to predict quadrupled hamstring autograft diameter used in ACL reconstruction.

**Data**

- **Background** Quadrupled hamstring tendon autograft (HTA) is the most common graft choice for ACL reconstruction (ACLR) worldwide. HTAs with diameter <8 mm used for ACLR have been associated with increased failure rates. Accurate estimates of HTA diameter pre-operatively would help guide optimal ACLR graft selection and patient counseling.

- **Purpose/Hypothesis** We aimed to estimate intra-operative HTA diameter based upon pre-operative MRI measurements of potential autograft tendon sources. We hypothesized that pre-operative MRI measurements of potential autograft sources could be used to accurately predict which patients will have grafts > or = 8 mm.

- **Methods** Patients with a history of ACLR with HTA and pre-operative 3-Tesla (3T) MRI performed at our institution were included in this retrospective evaluation. Intra-operative HTA diameter was recorded from each patient’s operative report. Two independent blinded reviewers measured multiple tendon parameters on each patient’s preoperative MRI including semitendinosus (ST) cross-sectional area (CSA), gracilis (G) CSA, patellar tendon (PT) length, PT width, PT thickness, and quadriceps (Q) thickness. CSA was calculated for ST and G using the elliptical region of interest tool on the corresponding proton density-weighted axial image of the knee. The axial slice positioned at the widest portion of the femoral condyle was used for CSA measurements. Bivariate analysis was performed using height, weight, BMI, age, ST CSA, GT CSA, PT length, PT width, PT thickness, and Q thickness as predictors of intra-operative HTA diameter > or = 8 mm. The three best predictors were combined into a weighted, additive logistic regression model to determine a threshold score. Reliability statistics between both image readers for all MRI measurements were measured using coefficient of variation.

**Results** Application of our inclusion criteria resulted in a total of 53 patients who underwent ACLR with HTA. Height, weight, PT length, PT thickness, ST CSA, and GT CSA were found to be significant predictors for having intra-operative HTA > or = 8 mm in diameter. PT length, PT thickness, and GT CSA were the strongest predictors and these parameters were combined into an additive logistic regression model where logit score = [-23.24 + (1.68 * PT length) + (20.104 * PT thickness) + (147.7 * GT CSA)]. If the logit score is >0.237 in our data set, the HT graft diameter is predicted to be > or = 8 mm with 87.4% accuracy. Application of a logit function calculation to the logit score can then be used to calculate the probability that the intra-operative HTA is > or = 8 mm in diameter. PT length, PT thickness, and GT CSA had coefficient of variance between image readers of 2.0\%, 10.9\%, and 13.8\%, respectively.

**Conclusion** Preoperative MRI measurements of PT length, PT thickness and GT CSA can be used to predict quadrupled intra-operative HTA diameter > or = 8 mm with a high degree of accuracy and this approach can help guide preoperative planning and ACLR graft selection.
**20456**  
**ARTHROSCOPIC PICATION OF THE RADIAL COMPONENT OF THE LATERAL COLLATERAL LIGAMENT FOR SYMPTOMATIC MINOR INSTABILITY OF THE LATERAL ELBOW (SMILE)**

1Paolo Angelo Arrigoni, 2Davide Cucchi, 1Alessandra Menon, 1Carlo Eugenio Zaolino, 1Alberto Aliprandi, 1Francesco Luceri, 1Pietro S Randelli. 1Italy, 2Germany

10.1136/jisakos-2021-congress.289

**Summary** Minor instability is a possible aetiology of lateral elbow pain and arthroscopic plication of the radial component of the lateral collateral ligament produces subjective satisfaction and positive clinical results at 2-year median follow-up.

**Data**

**Background** Minor instability has been proposed as a possible aetiology of lateral elbow pain. This study presents the results of the arthroscopic plication of the radial component of the lateral collateral ligament (R-LCL) to reduce minor instability of the lateral elbow.

**Methods** Twenty-seven patients with recalcitrant lateral epicondylitis who had failed conservative therapy and who had no previous trauma or overt instability, were included. R-LCL plication was performed in the presence of at least one sign of lateral ligamentous patholaxity and one intra-articular abnormal finding. Single-assessment numeric evaluation (SANE), Oxford Elbow Score (OES), quick-DASH (Disabilities of the Arm, Shoulder, Hand), patient satisfaction and post-operative range of motion were evaluated. The Shapiro-Wilk normality test was used to evaluate the normal distribution of the sample. Differences between pre- and post-operative SANE score were analysed with an unpaired Wilcoxon matched-pairs signed rank test.

**Results** SANE improved from a median of 30 [2–40] points pre-operatively to 90 [80–100] at final follow-up (p < 0.0001), and 96.3% patients obtained good or excellent subjective results. Post-operative median quickDASH was 9.1 [0–25] points and OES 42 [34–48]. Median post-operative flexion was 145° and extension was 0°. Post-operative flexion was restrained in seven patients and extension in eight patients; 59% of patients reached full ROM at final follow-up.

**Conclusions** R-LCL plication produces subjective satisfaction and positive clinical results in patients presenting with a symptomatic minor instability of the lateral elbow (SMILE) at 2-year median follow-up. A slight limitation in range of motion is a possible undesired consequence of this intervention.

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**21013**  
**ADDITIONAL INFERIOR EXTENSOR RETINACULUM AUGMENTATION AFTER ALL-INSIDE ARTHROSCOPIC ANTERIOR TALOFIBULAR LIGAMENT REPAIR FOR CHRONIC ANKLE INSTABILITY IS NOT NECESSARY**

Sung Hyun Lee, Bong Jun Jang. Republic of Korea

10.1136/jisakos-2021-congress.290

**Summary** Additional inferior extensor retinaculum augmentation after arthroscopic anterior talofibular ligament repair did not guarantee better clinical outcomes.

**Data**

**Background** Although several arthroscopic surgical techniques for the treatment of chronic ankle lateral instability (CAI) have been introduced recently, the effect of inferior extensor retinaculum (IER) augmentation remains unclear. Purpose The purpose of this study was to compare the clinical outcomes after arthroscopic anterior talofibular ligament (ATFL) repair according to whether additional IER augmentation was performed or not.

**Study Design** Cohort study

**Level of evidence:** 3. Methods Between 2016 and 2018, we performed a retrospective review of consecutive patients who underwent arthroscopic ATFL repair surgery for CAI. The mean age of the patients was 35.2 years (range, 19–51 years), and the mean follow-up period was 32.6 months (range, 24–48 months). Patients were divided into two groups according to the surgical technique used for CAI: Arthroscopic ATFL repair (group A, n = 37), and arthroscopic ATFL repair with additional IER augmentation (group R, n = 45). The Pain Visual Analog Scale, American Orthopedic Foot and Ankle Society (AOFAS) score, Foot and Ankle Outcome score (FAOS), and the Karlsson Ankle Functional Score were measured as subjective outcomes, and posturographic analysis was performed using a Tetrax device as an objective outcome. Radiologic outcomes were performed preoperatively and at 2 years postoperatively using stress radiographs and axial view MRI.

**Results** A total of consecutive 101 patients, 19 (18.5%) patients were excluded base on exclusion criteria, and 82 patients were evaluated. We identified a total of six re-tears (7.3%) based on postoperative MRI evaluation. All patients who had ATFL re-tear on MRI (8.1% 3/37) in group A, and 6.7% 3/45 in group R) demonstrated recurrent CAI with functional discomfort and anterior displacement > 3 mm compared to the intact contralateral ankle. All clinical scores and posturographic results were improved after surgery in both groups (P < 0.001). However, there were no significant differences in the clinical results and radiologic findings between the two groups.

**Conclusion** The clinical and radiologic outcomes of patients with CAI improved after all-inside arthroscopic ATFL repair. However, additional IER augmentation after arthroscopic ATFL repair did not guarantee better clinical outcomes.

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**21015**  
**PREDISPOURING FACTORS FOR POSTTRAUMATIC OSTEARTHROSIS OF ANKLE JOINT: UNDER 50 YEARS OLD PATIENTS WITH MINIMUM FOLLOW UP OF 5 YEARS**

Sung Hyun Lee, Bong Jun Jang. Republic of Korea

10.1136/jisakos-2021-congress.291

**Summary** Surgeons should be aware that accurate reduction should be considered in ankle fracture patient with large PM fracture, especially when patients were obese or severe initial injury such as fracture dislocation.

**Data**

**Aims** This study aimed to identify the risk factors for posttraumatic osteoarthritis (OA) after surgery with ankle fractures in young and middle-aged patients. Furthermore, the rate of posttraumatic OA and clinical outcomes were evaluated.

**Patients and Methods** We performed a retrospective review between 2005 and 2014 of consecutive patients who underwent operation with ankle fractures and available at minimum 5 years of follow up. Patients aged over 50 years were excluded to minimize the selection bias related to primary ankle OA. Patients were sorted into 2 groups according to the
presence of OA more than Kellgren-Lawrence classification grade 3 at last follow up. Statistical binary logistic regression analyses were performed including age at surgery, sex, diabetes, smoking, body mass index (BMI), AO/OTA classification, associated fracture of the posterior malleolus (PM), joint congruency, associated deltoid ligament injury, and syndesmotic injury. The functional outcomes were assessed with the Foot and Ankle Outcome Score.

Results In total, 332 patients who met the study inclusion criteria underwent analysis. The overall rate of posttraumatic arthritic change was 27.7% (non-arthritis group: 240 patients, arthritis group: 92). It was significantly affected by the BMI (p = 0.011; adjusted odds ratio (OR) = 30, 6.56), fracture dislocation injury (p = 0.024, adjusted OR 4.06), PM fracture (p = 0.031, adjusted OR > 25% of articular surface, 5.72), and postoperative articular incongruence (p = 0.034, adjusted OR 7.21). The mean scores in the group with arthritis were significantly lower than those in the group without arthritis (p < 0.05).

Conclusion Obesity, fracture dislocation injury, concomitant large PM fracture and its malreduction were significant risk factors for postoperative OA after surgery with ankle fractures. Surgeons should be aware that accurate reduction should be considered in ankle fracture patient with large PM fracture, especially when patients were obese or severe initial injury such as fracture dislocation.

### 20402 URINARY TRACT INFECTIONS DIAGNOSED WITHIN TWO WEEKS PRIOR TO SHOULDER ARTHROPLASTY ARE ASSOCIATED WITH INCREASED POSTOPERATIVE INFECTION RATES

Brian C Werner, Jourdan Michael Cancienne, Brian C Werner. USA

Summary Patients diagnosed with a UTI within 2 weeks prior to shoulder arthroplasty may be at an increased risk of postoperative PJI.

Data

Background While literature describing the increased risk of postoperative infection for patients undergoing lower extremity arthroplasty with a preoperative urinary tract infection (UTI) is inconclusive, this relationship has yet to be adequately studied for shoulder arthroplasty. The goals of the present study were to (1) examine the association between preoperative UTIs and their timing with periprosthetic joint infection (PJI) following shoulder arthroplasty, and (2) if an antibiotic prescription mitigates this risk.

Methods Patients undergoing primary shoulder arthroplasty diagnosed with a UTI in the preoperative period were identified in an insurance database and separated into mutually exclusive groups based on one-week intervals up to six weeks prior to surgery. Patients in each study cohort who received a preoperative antibiotic prescription for the UTI were then identified and compared to those without antibiotic prescriptions. A matched control cohort without a preoperative UTI was created for comparison. The incidence of PJI within two years following shoulder arthroplasty was then assessed for each cohort and compared using a logistic regression analysis.

Results Compared with matched controls, patients with a UTI diagnosed within 1 week prior to shoulder arthroplasty (OR, 2.73; 95% CI 1.67–4.46; P < 0.001) and within 1 to 2 weeks preoperatively (OR, 1.77; 95% CI 1.24–2.52; P = 0.002) experienced significantly higher rates of PJI within 2 years postoperatively. There were no significant differences in the incidence of PJI between patients diagnosed with a UTI greater than 2 weeks prior to surgery and matched controls (P > 0.05). No significant differences were observed across all cohorts when comparing the incidence of PJI in patients who received an antibiotic prescriptions for a diagnosis of UTI and those who did not.

Conclusions Patients diagnosed with a UTI within 2 weeks prior to shoulder arthroplasty may be at an increased risk of postoperative PJI. Antibiotic prescriptions do not appear to mitigate this increased risk.
UNDERSTANDING THE REASONS WHY PATIENTS DO NOT ACHIEVE AN ACCEPTABLE SYMPTOM STATE AFTER REVERSE SHOULDER ARTHROPLASTY

Brian C Werner, Evan Lederman, Reuben Gobeze, Patrick J Denard. USA

Summary At least one quarter of patients do not achieve a PASS after RSA

Data

Background The patient acceptable symptom state (PASS) was developed to improve the subjective interpretation of patient reported outcomes (PROs) and the minimum score necessary for the patient to “feel good”. The purpose of this study was to compare individual responses on PROs between patients achieving or failing to meet a PASS after reverse shoulder arthroplasty (RSA).

Methods A retrospective review of multi-center prospectively maintained database of RSAs between 2015 and 2018 was conducted. All primary RSAs with minimum 2 year follow-up were included. Patients undergoing revision arthroplasty or arthroplasty for fracture were excluded. Patients were stratified into two groups by whether they achieved or failed to meet PASS scores at a minimum of two years of 76 for the ASES score or 75.5 for the SANE score. The primary goals of the study were to compare outcomes, range of motion (ROM) and individual ASES and WOOS survey responses for patients above and below the PASS score.

Results 87 patients were included. Using the ASES cutoff for PASS, 23% failed to meet a PASS while 45% failed to meet a PASS defined by the SANE. The most notable difference between patients above and below ASES PASS was a significant difference in VAS pain scores (3.1 vs 0.3; p < 0.001). Overall, ROM was similar between patients above and below the ASES PASS, with slight, but statistically improved rotational motion in those achieving an ASES PASS (ER 14 degrees improved, p = 0.005, IR 10 degrees improved, p = 0.011). Similarly, patients failing to meet the SANE PASS had twice as high VAS pain scores (1.9 vs 0.8; p = 0.017). Patients failing to meet the ASES PASS had almost universally statistically higher rates of reporting “very difficult” or “unable to do” for pain, ADL and work/sports questions on the ASES and globally more symptoms on every domain of questions for the WOOS. Similarly, for the PASS defined by SANE, patients reported higher levels of pain and dysfunction on nearly every question and domain of the ASES and WOOS.

Conclusions At least one quarter of patients do not achieve a PASS after RSA. Pain appears to be the primary driver for this finding, while ROM is very similar between patients achieving or failing to meet a PASS regardless of PRO used to define the PASS. Patients who fail to achieve PASS after RSA report doing poorly in all domains of their outcome.
SEGMENTAL LABRAL RECONSTRUCTION WITH A POLYURETHANE SCAFFOLD: ASSESSMENT OF FEMORO-ACETABULAR CONTACT MECHANICS

Bruno Capurro, Marc Tey, Francisco Reina, Anna Carrera, Mauricio Gidi, Joan C Monllau. Spain

Summary Femoro-acetabular contact mechanics significantly worsened after segmental labrectomy. Reconstruction with a synthetic polyurethane scaffold reversed the loss in contact area and reduced both contact pressure and peak force caused by partial labrectomy. Contact area and peak force were normalized and the labral seal was re-established in the majority of cases.

Background The acetabular labrum plays a major role in hip joint mechanics and restoration of labral function and is considered key for success in hip preservation surgery. The purpose of this study was to evaluate the effects of segmental labrectomy and defect reconstruction with a synthetic polyurethane scaffold (PS).

Methods A cadaveric biomechanical study was performed using 10 hips from 5 fresh-frozen pelvises with an intact acetabular labrum without osteoarthritis. Using an intra-articular pressure measurement system (Tekscan), contact area (CA), contact pressure (CP) and peak force (PF) were assessed for the following conditions: (1) Intact labrum; (b) Anterosuperior partial labrectomy; (c) Reconstruction with PS. All specimens were analyzed for each condition in 4 positions: 90° flexion, 90° flexion plus internal rotation, 90° flexion plus external rotation, and 20° extension and with a labral seal test. The relative change from the intact condition (value = 1) was determined for all conditions and positions.

Results When compared to the intact labrum, segmental labrectomy resulted in a significant decrease in CA (p<0.001) and a significant increase in PF (p<0.001) in all positions. CP (p<0.001) increased significantly in all positions except in extension (p=0.48). Following labrectomy, scaffold reconstruction of the segmental defect resulted in a significant increase in contact area as well as a significant decrease in contact pressure and peak force across all positions (p<0.05). In comparison to the intact labrum, scaffold reconstruction restored CA and PF to normal in all positions (p>0.05) whereas contact pressure was significantly decreased compared to labrectomy (p<0.05) but did not return to normal values (p>0.05). The labral seal was lost in all specimens following partial labrectomy and was restored in 80% of the specimens after scaffold labrum reconstruction.

Conclusions Femoro-acetabular contact mechanics significantly worsened after segmental labrectomy. Reconstruction with a synthetic polyurethane scaffold reversed the loss in contact area and reduced both contact pressure and peak force caused by partial labrectomy. Contact area and peak force were normalized and the labral seal was re-established in the majority of cases.

AXIAL LOAD INDUCES HIGH DISTRACTION FORCES ON THE POSTERIOR MENISCAL ROOTS

Elmar Herbst, Sophia Ellermann, Andre Frank, Jens Wemers, Christoph Domnick, Michael J Raschke, Johannes Glaabrenner, Christoph Kittl, Mirco Herbst. Germany

Summary Following posterior meniscal root repair, axial load should be avoided in order to reduce distraction forces on the repair while passive flexion-extension exercises do not seem to affect the distraction forces.

Data Introduction Complete healing following posterior meniscal root (PMR) repair has been observed in only 50–60%. One reason for these low healing rates might be excess loading during the early postoperative phase. Thus, the purpose of this study was to determine the distraction forces on the PMR in the native knee and following transosseous PMR repair in various tibiofemoral loading conditions throughout the range of motion. It was hypothesized, that with increasing axial load and flexion angle, the distraction forces on the PMR will increase continuously.

Methods 8 fresh-frozen human cadaveric knees (mean age 76.7) were mounted in a custom-made kinematics rig. The tibia and femur of the knee were extended with a 12 mm steel nail to a length of 37cm and 46cm, respectively, in order to simulate the average length of the lower extremity in Caucasians. The distal end of the tibial nail, representing the ankle joint, was either not loaded or loaded with 200N and 400N to simulate passive mobilization, toe touch and partial weightbearing. A transosseous PMR repair was performed with a No.2 FiberWire (Arthrex Inc., Naples). The sutures were shuttled through a 2.4 mm tibial bone tunnel and tied over a force sensor mounted on the anterior tibia with a pretension of 2N. After measuring the native distraction forces throughout a flexion-extension cycle, the PMR and the ACL were detached sequentially. For the posterior lateral meniscal root (PLMR) an additional non-anatomic repair close to the insertion of the ACL was performed as some studies suggested a transtibial repair through the ACL tunnel. A repeated-measures ANOVA was used for data analysis (p<0.05).

Results For both menisci a significant overall effect of the state of the knee (native, ACL deficient, root repair) as well as the flexion angle was observed (p<0.01). Furthermore, axial loading of 200N and 400N resulted in a significant increase of distraction forces on both menisci throughout the range of motion (p<0.01). Interestingly, distraction forces following posterior lateral as well as medial meniscal root (PMMR) repair were not significantly affected by flexion angle when no axial load was applied (NS). With axial loading of 200N and 400N, the distraction forces on the PLMR will increase continuously at flexion angles between 15° and 90° compared to full extension (up to 15.9N; p<0.01). Similar results have been observed in ACL deficient knees. Furthermore, no significant differences were observed when comparing anatomic and non-anatomic PLMR repairs (NS). On the medial side, distraction forces were highest (up to 7.0N) at 0°–30° and decreased significantly towards 90° of flexion with 200N and 400N axial load (p<0.01).

Conclusion Data of the study suggests, that following PMR repair, axial load should be avoided in order to reduce distraction forces on the repair. Furthermore, it is shown, that passive flexion-extension exercises can be performed without significantly affecting the forces on the repair. With axial loading, the forces on the PLMR increased continuously with higher knee flexion, while on the PMMR the distraction forces were highest at full extension.
Abstracts

20603 ISOLATED MCL RECONSTRUCTION MIGHT NOT BE SUFFICIENT IN CASES WITH A HIGH-GRADE ANTEROMEDIAL ROTATORY KNEE INSTABILITY

Elmar Herbst, Christian Peez, Lena Haferkemper, Jens Wemmers, Johannes Gläßbrenner, Thorben Briese, Michael J Raschke, Christoph Kittl. Germany
10.1136/jisakos-2021-congress.298

Summary
Anteromedial rotatory knee instability cannot be fully restored with an sMCL reconstruction. Even the anteromedial reconstruction with a Semitendinosus-tendon graft did not restore knee kinematics entirely.

Data
Introduction
Recently, rotatory knee instabilities have gained increasing interest. While the lateral side of the knee has extensively been investigated, little is known about anteromedial rotatory knee instabilities (AMRI). Thus, the purpose of this study was to biomechanically investigate knee kinematics in response to external loads in knees with simulated high-grade anteromedial injuries and reconstructions. It was hypothesized, that in cases of a high-grade anteromedial injury an isolated reconstruction of the superficial medial collateral ligament (sMCL) might not fully restore knee kinematics.

Methods
12 fresh-frozen human cadaveric knees were used for this study. Knees were mounted onto a 6 degrees of freedom robotic testing system (KUKA KR 60–3). Knee kinematics were recorded with a force/moment sensor (ATI Theta FT-sensor; Schunk). The following loads were applied: (1) 134N anterior tibial translation (ATT) performed at 5Nm external tibial rotation (ER), (2) 5Nm ER, (3) 5Nm internal tibial rotation (IR), and (4) 10Nm valgus rotation. These loading conditions were tested in the native knee and in the following knee states: (1) sMCL and deep MCL (dMCL) resection, (2) sMCL reconstruction, (3) posterior oblique ligament (POL) resection, (4) POL reconstruction, (5) anteromedial capsule and retinaculum (AM) resection, and (6) AM reconstruction. The order of antero- and posteromedial cutting and reconstructions was randomized. A repeated-measures ANOVA with a post-hoc Bonferroni correction was performed (p < 0.05).

Results
ATT performed in ER significantly increased after removal of the sMCL and the underlying dMCL at 0°, 30°, 60°, and 90° (p < 0.015). Even though sMCL reconstruction was able to reduce ATT in ER, there was a persistent difference to native knee kinematics at all flexion angles (p < 0.05). Despite a lack of statistical significance, removal of the AM resulted in increased ATT, which could not be restored by an AM reconstruction (p < 0.05). Similarly, isolated ER was significantly increased by removing the sMCL and dMCL at all flexion angles (p < 0.001). sMCL reconstruction decreased isolated ER to values not significantly different to the native knee at 0° and 30° (NS). However, at higher flexion angles sMCL reconstruction was not able to restore ER (p < 0.001). With AM resection, ER was not statistically significant but clinically relevant increased by >5° compared to the native knee. This could not be restored to normal when performing an AM reconstruction. IR was restored with a POL reconstruction at 0°. At 30° and higher flexion angles, IR was significantly higher compared to the native knee (p < 0.05). Valgus rotation was significantly increased with MCL deficiency (p < 0.001) and could be restored at 0° and 30° with sMCL reconstruction.

Conclusion
Data of this study indicate, that with an isolated sMCL reconstruction, AMRI cannot be fully restored. Even the anteromedial reconstruction with a Semitendinosus-tendon graft did not restore knee kinematics entirely. Thus, when facing high-grade AMRI, surgeons should be aware, that current techniques might not be sufficient to treat these entities. From an anatomical perspective, one could speculate, that one explanation of these findings is the fact, that current techniques do not mimic the broad shape of the sMCL.

20316 HISTOLOGICAL CHANGES DURING HEALING WITH AUTOLOGOUS FASCIA LATA GRAFT AFTER SUPERIOR CAPSULE RECONSTRUCTION FOR THE IRREPARABLE SUPRASPINATUS TEAR IN A RABBIT MODEL

Akihiko Hasegawa, Teruhisa Mihata, Yasuo Itami, Kunimoto Fukushima, Masashi Neo. Japan
10.1136/jisakos-2021-congress.299

Summary
Superior capsule reconstruction (SCR) using fascia lata autograft regenerated fibrocartilaginous insertion at both the greater tuberosity and superior glenoid. The mid-substance of the grafted fascia gradually remodeled into tendon/ligament-like tissue. These results suggest that the fascia lata autograft has the capacity for graft-to-bone healing and remodeling after SCR.

Data
Background
Superior capsule reconstruction (SCR) has been developed to improve shoulder function and relieve pain in the treatment of irreparable rotator cuff tears. Previous studies have reported that graft healing can enhance favorable outcomes after SCR. On the other hand, the graft tear leads to less desirable outcomes and sometimes requires additional surgeries. However, the healing process underlying this remains unclear. In this study, we aimed to investigate histological changes occurring during the healing process associated with autologous fascia lata graft after SCR in vivo. We hypothesized that (1) autologous fascia lata graft can regenerate fibrocartilaginous insertion into both the greater tuberosity and superior glenoid and (2) the mid-substance of the grafted fascia gradually remodels into tendon/ligament-like tissue after SCR.

Methods
Irreparable supraspinatus tears were created in 24 mature Japanese white rabbits (age, 6 months; mean weight, 3.2 kg). Four weeks after creating the defects, the right shoulders were subjected to SCR using autologous fascia lata grafts. The left shoulders were left untreated. Samples from the shoulders were harvested at 4, 8, 12, and 16 weeks after surgery to perform histological examinations and immunohistochemistry.

Results
Macroscopically, we did not observe graft tear after SCR in our experiments. Histologically, chondrocyte-like cells gradually increased and the extracellular matrices around those cells contained glycosaminoglycan at the fascia-bone junction after SCR. The unmineralized fibrocartilage, mineralized fibrocartilage, and tidemark were observed at 16 weeks after SCR. The distribution of type II collagen presented a pattern similar to that of a normal tendon and ligament insertion. In the mid-substance of the grafted fascia, disorganized collagen fibers were observed 4 weeks after SCR. At 12 and 16 weeks after surgery, the arrangement of cells and the orientation of collagen fibers were found to be parallel to the long axis. These results suggest that the mid-substance of the grafted fascia gradually remodeled into tendon/ligament-like tissue. Regarding the vascularity, blood vessels were observed in the...
mid-substance of the grafted fascia lata at all postoperative time points.

Conclusions SCR using fascia lata autograft regenerated fibrocartilaginous insertion at both the greater tuberosity and superior glenoid. The mid-substance of the grafted fascia gradually remodeled into tendon/ligament-like tissue. These results suggest that the fascia lata autograft has the capacity for graft-to-bone healing and remodeling after SCR.

Summary Early, 3 month patient reported VAS, mHHS, and HOS-SSS scores substantially predict reoperation risk at mid-term follow-up.

Data Introduction Hip arthroscopy is commonly performed with established safety and efficacy. However, follow-up protocols after arthroscopy are yet to be standardized. Given the financial, logistical, and recent pandemic-related considerations of medical travel, it would be of utility to identify both low- and high-risk patients in order to tailor timing of in-person and electronic clinic visits. The purpose of this multicenter study was to use early postoperative outcomes to predict mid-term outcomes and reoperation rates following hip arthroscopy.

Methods Prospectively collected data for primary hip arthroscopies at two high-volume centers 2008–2014 were analyzed using Visual Analog Scale (VAS), modified Harris Hip Score (mHHS), and Hip Outcome Score-Sports Specific Subscale (HOS-SSS) and their associated published Minimum Clinically Important Difference (MCID, VAS: 2.0, mHHS: 13.0, HOS-SSS: 28.0). Outcomes from 3 month follow-up were evaluated for their prognostic value for mid-term outcomes and revision rates.

Results 1,100 patients (348 M, 608 F, age: 37.1±13.8 years) undergoing hip arthroscopy were followed for a mean of 3.6±1.6 years (range: 2.0–8.6). At 3 months following surgery, patients experienced statistically significant (p<0.001) improvements in all outcome scores, with 69% achieving MCID for VAS, 96% for mHHS, and 94% for HOS-SSS. At final follow-up, 145 (13%) patients had undergone reoperation, with 66 (6%) proceeding to total hip arthroplasty. Early outcomes were found to be highly significant in predicting reoperation, with each single digit point decrease in 3 month VAS (HR: 1.17, p<0.001) and increase in mHHS (HR: 0.98, p<0.001) and HOS-SSS (HR: 0.99, p<0.01) decreasing reoperation risk by 17%, 2%, and 1%, respectively.

Discussion and Conclusion Prognosticating recovery is of substantial clinical utility following hip arthroscopy. Early, 3 month patient reported VAS, mHHS, and HOS-SSS scores substantially predict reoperation risk at mid-term follow-up.

Summary Long-term function of TKA following proximal tibial osteotomy (PTO) is excellent, with patients demonstrating comparable outcome scores and equivalent knee preference between TKA following PTO and contralateral knees which underwent index TKA without prior PTO.

Data Introduction Proximal tibial osteotomy (PTO) is a well-established extra-articular technique for the treatment of varus deformity and medial compartment osteoarthritis. However, the utility of non-arthroplasty interventions must be weighed against their potential effects on subsequent total knee arthroplasty (TKA). The purpose of this study was to robustly evaluate the long-term effect of PTO on subsequent TKA by employing paired outcomes in patients with bilateral TKAs following unilateral osteotomy.

Methods All patients undergoing unilateral PTO performed between 1980–2007 with subsequent bilateral TKAs at a single institution were reviewed. Knee Society scores (KSS), Forgotten Joint Score 12 (FJS-12), subjective knee preference, and revision rates were compared between the PTO-TKA side and contralateral TKA-only side.

Results We evaluated 140 TKAs performed in 70 patients (21 F, 39 M) who underwent unilateral PTO with subsequent conversion to bilateral primary TKA (16 simultaneous, 54 staged). Mean age at the time of PTO was 50±7 years, with patients converting to TKA at a mean of 14±7 years following ipsilateral PTO. Patients were followed for a mean of 25±7 years (Range: 6–40). PTOs demonstrated similar KSS (41±16) compared to their contralateral side (KSS: 39±16, p=0.67) immediately prior to arthroplasty. Patients had significant post-TKA improvements in KSS (p<0.001), with no significant difference in scores at 2 years of follow-up when comparing their knees in a pairwise fashion (p=0.38). Revision rates were similar (p=0.76), with 5 PTO-TKA knees (7%) and 4 control TKA-only knees (6%) undergoing revision at a mean of 5 years postoperatively. At the time of final follow-up, PTO-TKA knees demonstrated similar KSS (73±6) and FJS-12 scores (72±26) compared to the contralateral TKA-only side (KSS: 69±13, p=0.09; FJS-12: 70±28, p=0.73). When queried, 19% of patients preferred their PTO-TKA knee, 19% preferred the contralateral knee, and 63% stated their knees were equivalent. Tegner activity score at final follow-up was 2.5±1.4.

Conclusion PTO demonstrates satisfactory durability, with a mean of 14 years between PTO and conversion to TKA. Long-term function of TKA following PTO is excellent, with patients demonstrating comparable outcome scores and equivalent knee preference between PTO-TKA and TKA-only knees.
20512  EFFICACY AND SAFETY OF INTRAVENOUS FERRIC CARBOXYMALTOSE IN PATIENTS WITH POSTOPERATIVE ANEMIA FOLLOWING SAME-DAY BILATERAL TOTAL KNEE ARTHROPLASTY: A RANDOMIZED CONTROLLED TRIAL

Man-Soo Kim, Yong Gyu Sung, Dong-Chul Park, Jae Jung Kim, Yong In. Republic of Korea

Introduction The purpose of this study was to discover whether pain sensitivity was associated with postoperative pain and patient-reported outcome measures (PROMs) after total knee arthroplasty (TKA).

Methods Pain sensitivity was evaluated preoperatively using a pain sensitivity questionnaire (PSQ). Resting, walking, nighttime, and average pain visual analog scale (VAS) were measured before surgery and 6 weeks, 3 months, 6 months, and 1 year after surgery. PROMs were also evaluated by the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score and patient satisfaction. The association between PSQ score and WOMAC total score, and pain sensitivity (mild, moderate, and total score) were assessed at each stage.

Results There were 59 patients with a high PSQ score (≥5.2) and 53 with a low PSQ score (<5.2). Up to 1 year postoperatively, the group with high PSQ scores had higher resting, walking, nighttime, and average pain VAS scores than the group with low scores (all p < 0.05). Worse preoperative pain, function, and WOMAC total scores continued till 1 year after surgery in the high-scoring PSQ group compared to the low-scoring group (all p < 0.05). The group with low PSQ scores were more satisfied with surgery than those with high scores (p=0.027). There was a positive correlation between preoperative PSQ score and pain VAS average score at all time points (all p<0.05). A relationship between the PSQ score and WOMAC total score was also observed (all p<0.05).

Conclusion Pain sensitivity is a factor that is related to persistent postoperative pain and inferior PROM in patients undergoing primary TKAs.

21111  INVOLVEMENT OF KAPLAN FIBERS AND Ilio-Tibial Band in the Control of Anterolateral Rotational Knee Instability

Thomas Neri,1 Antonio Klasan,2 Sven Edward Putnis,1 Florian Bergandi,1 Alexandre Goimard,1 Remi Philippot,1 France; 2Austria; 3UK

Introduction The purpose of this study was to discover whether the involvement of the ITB, PFK and DFK in the control of rotational instability in ACL deficient knees.

Materials and Methods This was a biomechanical study including 11 cadaveric knees. Using a 3D optoelectronic system (Motion Analysis®), full knee kinematics (0 to 90°) in Internal Rotation (IR) set at 5 Nm) as well as antero-posterior translations at 30 and 90° of flexion (AP30, AP90) were analysed. Sequential sections were performed. After the analysis of the kinematics of the intact knee, sections of the ACL, the Kaplan Fibers and the ITB were performed successively. The sections of PKF and DKF were randomised.

Results The combined section of PKF and DKF resulted in a significant increase in IR (p<0.05), starting at 30° of flexion. DKF section resulted in a greater increase in IR than PKF section (p<0.05). There was a significant increase in IR laxity after the ITB section over the entire kinematic profile (p<0.05). The respective or combined PKF and DKF sections
had no influence on AP30 and AP90 translation (p>0.05), while the ITB section increased the AP laxity at 30 and 90° of flexion (p<0.05).

Conclusion This study confirms that ITB is a major stabilizer of tibial IR in an ACL deficient knee. KF, especially DKF, reinforces this anti-rotational action. By establishing a connection with the distal femur, they appear to reinforce the action of the ITB. This additional rotational laxity associated with combined ACL, ITB and/or KF injuries suggests that their diagnosis should be included in the treatment algorithm by combining an extra-articular procedure with intra-articular reconstruction.

Summary Tissue-Engineered Augmentation of A Rotator Cuff Tendon Using A Novel Bio-Inductive Biocomposite Scaffold

Data Introduction Surgical repair of torn rotator cuff tendons has been associated with a high degree of re-tears. Recent studies have shown that augmenting the repair through the induction of new host tissue can prevent gapping or re-tears by increasing the thickness of the tendon. This study investigated the ability of a novel, bio-inductive, biocomposite (high porosity collagen with PLLA microfilaments) scaffold to support the rapid proliferation, maturation, and remodeling of new host tissue in an animal model of rotator cuff tendon repair. The bio-inductive scaffold was hypothesized to rapidly increase the thickness of the repaired tendon through the addition of functional host tissue.

Methods The porosity of the bio-inductive, biocomposite (collagen-PLLA) scaffold (BioBrace, Biorez Inc.) was measured using mercury porosimetry. Arthroscopic surgical technique of an augmented rotator cuff repair was evaluated using human cadaveric shoulders. Following Institutional Animal Care and Use Committee approval, a mid-portion detachment of the biceps at the inferior surfaces of the scaffold was also observed on the superior and inferior surfaces of the scaffold which added to the overall thickness of the healing tendon. By 12 weeks there was maturation and remodeling of the fibrovascular connective tissue within the scaffold as well as on its inferior and superior surfaces. Scattered foreign body giant cells (arrows) were observed at both 6 and 12 weeks and were associated with the PLLA fibers. Mechanical testing: The ultimate tensile strength (UTS) of the repaired IST construct significantly increased between 0 (1163 + 303N) and 6 weeks (1740 + 338N) (p=0.01), and 6 (1740 + 338N) and 12 weeks (2463 +484N) (p=0.01). There was no significant difference in UTS between repaired (2463 + 484N) and contralateral control tendons (2707 + 605N) at 12 weeks (p=0.35).

Discussion The collagen-PLLA biocomposite scaffold increased the thickness of a repaired rotator cuff tendon through the rapid induction of host-generated dense, regularly-oriented connective tissue. The new host tissue demonstrated functional remodeling over time resulting in a repair that was as strong as the unoperated control by 12 weeks. SIGNIFICANCE/CLINICAL RELEVANCE: Healing of rotator cuff repairs has been a challenging clinical problem. In addition, functional outcomes are improved with integrity of the rotator cuff after repair. This study shows that a biocomposite scaffold induced a proliferative healing response that improved the thickness of the repair tissue, and was as strong as controls. This has strong potential as an adjunct for rotator cuff repair.

Summary Opening wedge high tibial osteotomy restores native leg length, particularly in patients with large preoperative varus deformity.

Data Purpose Recently published meta-analyses reported that opening wedge high tibial osteotomy (OWHTO) significantly increases leg length and thus, closing wedge HTO should be preferred in patients with unilateral medial compartment knee osteoarthritis (OA) to prevent leg length discrepancy, in particular if large correction is necessary as the amount of correction and leg length increase after OWHTO are significantly correlated. Yet, theoretical considerations suggest that patients with unilateral medial compartment OA present with a shortened involved lower extremity due to the medial compartment height loss and subsequent varus deformity. This study aimed therefore to assess the pre- and postoperative leg length of the involved lower extremity in patients submitted to OWHTO and compare it to the unaffected contralateral side. It was hypothesized that patients present with decreased preoperative length of the involved leg when compared to the contralateral side and that OWHTO would subsequently restore native leg length.

Methods Sixty-seven patients that underwent OWHTO for unilateral medial compartment knee osteoarthritis that received pre- and postoperative full leg length assessment were included in this retrospective study. Patients that presented with varus or valgus deformity (>3°) of the contralateral side were excluded. A musculoskeletal radiologist assessed imaging for the mechanical axis, full leg and tibial length of the
involved and contralateral lower extremity. Statistical analysis determined the pre- and postoperative leg length discrepancy and the influence of the mechanical axis.

**Results**
The majority of patients (62.7%) presented with a decreased length of the involved leg with a mean preoperative mechanical axis of 5.0 ± 2.9°. Length discrepancy averaged −2.2 ± 5.8 mm indicating a shortened involved extremity (p = 0.003). OWHTO significantly increased the mean lengths of the tibia and lower limb by 3.6 ± 2.9 mm and 4.4 ± 4.7 mm (p < 0.001), leading to a postoperative tibial and full leg length discrepancy of 2.8 ± 4.3 mm and 2.2 ± 7.3 mm (p < 0.001 and p = 0.017, respectively). Preoperative leg length discrepancy was significantly correlated with the preoperative mechanical axis of the involved limb (r = 0.292, p = 0.016) and the amount of correction was significantly associated with leg lengthening after OWHTO (r = 0.319, p = 0.009). Patients with a varus deformity of ≥6.5° (n = 14) presented with a preoperative length discrepancy of −4.5 ± 1.6 mm (p < 0.001) that was reduced to 1.8 ± 3.5 mm (p = 0.08).

**Conclusion**
Patients submitted to OWHTO present with preoperative length discrepancy that is directly associated with the varus deformity of the involved extremity. As OWHTO significantly increases leg length, particularly patients with large varus deformity may benefit from native leg length restoration.

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**20474**

**INCIDENCE AND COMPLICATIONS OF PRIMARY AND REVISION SHOULDER ARTHROPLASTY FROM 2010–2018**

Christopher L Mccrum, Jacob Thomas Wood, Michael Khazzam, Senthil Sambandam, USA

10.1136/jisakos-2021-congress.308

**Summary**
Using the most recent available data on primary and revision total shoulder arthroplasty, we found that both of the procedures are safe, with infrequent complications. Revision surgery does come with a more frequent incidence of complications, while this population is on average older.

**Data**

**Introduction**
Total shoulder arthroplasty (TSA) is an increasingly common procedure that improves shoulder pain and function for the arthritic shoulder. Due to the increasing frequency of this procedure, the need and frequency of revision total shoulder arthroplasty (RevTSA) is also increasing. Our aim is to report the rate of complications for primary and revision shoulder arthroplasty.

**Methods**
We conducted a retrospective review of a large commercial insurance database (PearlDiver, USA) between the years 2010–2018. PearlDiver is a publicly available database that captures data on demographics and complications for patients with claims for TSA and RevTSA. Patients who underwent TSA or RevTSA were identified using Common Procedural Terminology (CPT) codes and the appropriate International Classification of Diseases (ICD) codes. Odds ratios were calculated to compare complication rates between primary and revision procedures.

**Results**
A total of 102,698 patients underwent primary total shoulder arthroplasty between 2010–2018. Data for revision arthroplasty was available 2013–2018, and a total of 4551 had RevTSA, with 1945 having either glenoid or humeral revision and 2891 patients having revision of both components. Of TSA patients, 58% were female and 42% were male, while RevTSA patients consisted of 54% female and 46% male patients. On average, RevTSA patients were older than primary TSA patients (p = 0.0172). Odds of surgery intercepts linear mixed-effects models compared pressure and contact area measurements among the 4 experimental conditions.

**Results**
The meniscal deficient state demonstrated significantly higher mean contact pressure than all other testing conditions (p < 0.001 for all comparisons) and significantly smaller total contact area compared to all other testing conditions (p < 0.001 for all comparisons). There were no significant differences in mean contact pressure or total contact area between the intact, transplant, or transplant with tunnel groups. There were no significant differences in any outcome measure across all comparisons in the lateral compartment and no significant differences in center of pressure and relative pressure distribution across testing conditions.

**Conclusion**
Segmental medial meniscus allograft transplantation restored the medial compartment mean contact pressure and mean contact area to values measured in the intact medial compartment. Clinical Relevance: Segmental medial meniscus transplantation may provide an alternative to full meniscal transplantation by addressing only the deficient portion of the meniscus with transplanted tissue. Additional work is required to validate long-term fixation strength and biologic integration.
Cannabis use is associated with fewer postoperative opioids and fewer thromboembolic complications following shoulder arthroscopy

Christopher L Mccrum. USA

Summary Patients using cannabis use fewer opioids following shoulder arthroscopy. Additionally, cannabis use is not a risk for postoperative complications, and cannabis users have a lower risk of CVA, PE, and DVT. However, cannabis use is associated with a higher 30-day cost after these procedures.

Data

Introduction Self reported cannabis use is rapidly increasing in North America, particularly following legalization in several states in the United States and Canada, with use rates approaching those of tobacco. Despite the increasing frequency of use among patients, there is a paucity of data on the influence of cannabis on shoulder arthroscopy, particularly with regard to complications. Furthermore, the relationship between cannabis use and postoperative opioid use remains poorly understood in this population. We hypothesized that complication rates, postoperative opioid use, and cost does not differ between patients with and without cannabis use.

Methods Data was collected from a large commercial insurance database (PearlDiver, USA) between the years 2010–2019. Patients who underwent shoulder arthroscopy with reported cannabis use were identified using Common Procedural Terminology (CPT) codes and the appropriate International Classification of Diseases (ICD) codes. This group was then matched by age, procedure, gender, Charleston Comorbidity Index (CCI), Elixhauser Comorbidity Index (ECI), obesity, tobacco use, diabetes to a group of similar patients without self-reported cannabis use. Opioid use over the episode of care, evaluated by morphine milligram equivalents (MME), and 30-day cost were compared between groups using unequal variance t-test. Complication rates between groups were examined using odd’s ratio (OR).

Results A total of 5174 patients (67% male and 33% female) were included in the cannabis use and no cannabis use groups, respectively. Patients with reported cannabis use received significantly fewer postoperative opioids on average (1877 ± 2971 MME) than those without cannabis use (2363 ± 4584 MME) (p<0.001). Cannabis use patients had significantly fewer total cerebrovascular accidents (CVA) (OR=0.3635, p<0.001), deep vein thrombosis (DVT) (OR=0.6460, p<0.001), and pulmonary emboli (OR=0.3488, p<0.001). Furthermore, cannabis users experienced significantly fewer DVT at 30 days (OR=0.5815, p=0.023) and 90 days (OR=0.6600, p=0.024) and PE at 30 days (OR=0.3990, p=0.014) and 90 days (OR=0.3426, p=0.002). There were no significant differences in wound complications, dehiscence, surgical site infections, mechanical complications, nerve injury, sepsis, transfusions, pneumonia, cardiac arrest, hematoma, or myocardial infarction between groups. Patients who use cannabis have a significantly higher 30-day cost after shoulder arthroscopy ($2004.78 ± $2970.66) than those who do not report use ($1704.67 ± 2334.78) (p<0.001).

Conclusion Patients using cannabis use fewer opioids following shoulder arthroscopy. Additionally, cannabis use is not a risk for postoperative complications, and cannabis users have a lower risk of CVA, PE, and DVT. However, cannabis use is associated with a higher 30-day cost after these procedures.
had full financial and opioid use data for analysis. Prescription opioid use was not significantly different over the episode of care in patients with reported cannabis use (1840 ± 2743 MME) than those without reported cannabis use (2129 ± 3383 MME) (p = 0.3848). Additionally, episode of care reimbursement cost following hip arthroscopy did not differ significantly between patients with cannabis use ($2957 ± $4428) and those without reported cannabis use ($2651 ± $3762) (p = 0.0956).

Conclusion Following hip arthroscopy, patients with reported cannabis use did not have significantly different postoperative opioid use or cost of hip arthroscopy episode of care compared with patients without reported cannabis use.

**20963**

4DCT ANALYSIS OF CADAVERIC KNEES TO DETERMINE ISOMETRIC GRAFT POSITIONS IN ACL RECONSTRUCTION – A NOVEL TECHNIQUE

Justin Wong, Matthias Lu, Bronwyn Anderson, Justin Wong, Australia

**Summary** Using 4DCT to determine tunnel positions that will result in the least graft anisometry

**Data**

**Introduction** Tunnel position in anterior cruciate ligament (ACL) reconstruction is critically important for successful surgery as it determines the orientation of the graft and its degree of anisometry. If the length of the graft changes significantly over the range of movement of the knee, the risk of graft failure is increased. Previous cadaveric studies have investigated the anisometry of ACL grafts by reconstructing the ACL with various tunnel positions and measuring graft length changes during knee movement. This is limited by the number of tunnels that can be made in any given specimen. Using a 4D CT scan, hundreds of virtual femoral and tibial points can be generated to create thousands of virtual grafts. The aim of this project is to calculate the change in length between multiple virtual graft attachment points on the femur and tibia during knee movement and to define a safe zone for ACL graft placement that minimises graft anisometry.

**Methods** 6 fresh-frozen cadaveric knees were chosen. Knees were only included in the study if they had no surgical scars or deformities, and were stable on clinical testing of the cruciate and collateral ligaments. An arthroscopic examination was performed to evaluate the chondral surfaces and integrity of the ACL. Tantalum markers, used as reference points, were implanted into the femur and tibia. The knees were then attached to a machine that moved the joints through a range from 0–90 degrees, whilst the 4DCT scan was performed. The 4DCT takes multiple scans per second and was therefore able to capture the knees at several points during the range of movement. Using the DICOM data, virtual points were created in and around the femoral and tibial ACL footprints. The coordinates of these points were extrapolated for each position of the knee recorded by the 4DCT. The distance from each femoral point to every tibial point was then calculated, and from this the variability of the length of the virtual graft during the range of movement was derived. The graft length variability was then plotted for each femoral and tibial virtual point and then overlaid onto the specimen’s CT scan. The grid by Bernard and Hertel was drawn over the plot to describe the positions of the femoral and tibial points.

**Results** The femoral points resulting in the least graft anisometry had an average depth of 30% in the shallow-deep direction and 10% in the high-low direction, according to Bernard-Hertel. On the tibial side, points within the ACL footprint did not affect the length variability of the graft by more than 5 mm.

**Conclusion** The degree of graft anisometry is more dependent on the position of the femoral tunnel than the tibial tunnel. The least anisometric femoral points are mostly outside of the ACL footprint. Small changes in the position of the femoral tunnel can result in large changes in graft length variability. Siting the femoral tunnel deeper and more superior on the lateral wall results in a more isometric graft. Tibial tunnels placed more anteriorly also improves graft isometry.

**20947**

COMPARATIVE ASSESSMENT BETWEEN PHYSICAL EXAMINATION AND STRESS RADIOGRAPHY IN MULTIGAMENTARY KNEE INJURIES

José Leonardo Rocha de Faria, Igor Pedrinha, José Leonardo Rocha de Faria, Marcos Castro Moreira, Douglas M Pavia, Rodrigo S Pires E Albuquerque, Marcelo Mendarino, Alan P Mozella. Brazil

**Summary** Stress radiography is a useful and inexpensive tool, already widely used in the evaluation of knee ligament injuries. This study demonstrates the importance of performing this exam in patients with multi-ligaments injuries of the knee, as the physical exam is examiner dependent.

**Data**

**Introduction** This study aims to assess the reliability of the physical examination in the presence of stress radiography in multigamentary knee injuries. Stress radiography is a useful and inexpensive tool, already widely used in the evaluation of knee ligament injuries and the physical examination in this context can be complex and challenging.

**Hypothesis** In the face of injury to multiple knee ligaments, physical examination can be confusing and not always reliable. In this context, we assume that the radiograph with stress would present a certain disagreement with the examination of surgeons alone.

**Materials and Methods** 22 patients were summoned, physical examination performed by two surgeons on their knees alone without any imaging exam or prior knowledge of the diagnosis and then twelve radiographs with anterior, medial, lateral and posterior stress by manual force and their objective parameters evaluated and compared.

**Results** It was found that there is significant agreement in the surgical diagnosis of medial, lateral and posterior injury for surgeon 1 in relation to surgeon 2. In general, the agreement was of good degree. There was no significant agreement for the anterior cruciate ligament injury (p = 0.51). In 40.9% of the patients analyzed, there was agreement between the examiners of the diagnosis of the lesions as a whole and of this percentage, 55.5% correlated with the result of the radiography with stress.

**Conclusions** The physical examination shows great interobserver disagreement and a certain disagreement with the stress radiography, showing low accuracy in this context of
multiligament injuries, being imperative the use of the greatest number of different ways to better characterize the diagnosis and treatment schedule, such as radiography with stress, nuclear magnetic resonance and/or arthroscopy.

LABRAL PRESERVING HIP ARTHROSCOPY AND BONE MARROW ASPIRATE INJECTION FOR PATIENTS WITH SYMPTOMATIC LABRAL TEARS AND EARLY DEGENERATIVE CHANGES

Summary Labral preserving hip arthroscopy with bone marrow aspirate injection results in statistically and clinically significant improvement in patient-reported outcomes scores for patients with symptomatic labral tears and early radiographic degenerative changes at short term follow-up.

Data
Purpose The treatment of labral tears of the hip in the setting of early radiographic degenerative changes is challenging, with multiple studies showing higher failure rates in this group. This study aims to define the clinical effect of intraarticular injection of iliac crest-derived bone marrow aspirate concentrate (BMAC) at the time of labral-preserving hip arthroscopy in patients with symptomatic labral tears and early radiographic degenerative changes.

Methods A retrospective review of a prospectively collected hip registry database was performed. Patients with a symptomatic labral tear, Tönnis grade 1–2 degenerative changes who underwent labral-preserving hip arthroscopy and BMAC were included and were age- and sex-matched to patients without arthritis who underwent hip arthroscopy without BMAC. Demographic information, patient-reported outcomes measures (PROMs), procedures performed, and failure were evaluated. PROMs collected preoperatively and 6-months, 1-year, and 2-years postoperatively included Modified Harris Hip Score (mHHS), Hip Outcomes Score Activities of Daily Living (HOS ADL), Hip Outcomes Score Sport (HOS Sport), International Hip Outcomes Tool 33 (iHOT-33).

Results 35 patients underwent labral-preserving hip arthroscopy with BMAC and were matched with 35 control patients without arthritis. There was no difference in the mean age at time of surgery (p=0.75), gender (p=0.66) or BMI (p=0.10) of the BMAC group (48.5 ± 11.6 years; 68.6% female; 25.3 ± 4.1 kg/m2) compared to the control group (47.9 ± 11.4 years; 68.6% female; 23.1 ± 5.3 kg/m2). The BMAC group was comprised of 31 patients (86.6%) Tönnis grade 1 and 4 (11.4%) grade 2, whereas 35 (100.0%) were Tönnis grade 0 was comprised of 31 patients (86.6%) Tönnis grade 1 and 4 (11.4%) grade 2, whereas 35 (100.0%) were Tönnis grade 0.

Discussion and Conclusion Labral preserving hip arthroscopy with bone marrow aspirate injection results in statistically and clinically significant improvement in patient-reported outcomes scores for patients with symptomatic labral tears and early radiographic degenerative changes at short term follow-up. Although the proportion of failures requiring total hip arthroplasty is comparable in both groups, the time to conversion is earlier in the BMAC group. Level of Evidence: Level IV

LATERAL EXTRA-ARTICULAR TENODESIS PROVIDES SUPRAPHYSIOLOGICAL RESTRAINT TO INTERNAL TIBIAL ROTATION
1Ronak M Patel, 1Andrew D Pearle, 1Carl W Imhauser, 1Zahab Ahsan, 2Niv Marom, 1Hamid Jahandar, 1Erim Berube, 1Thomas Fraychineaud, 2Zaid Zayad, 1Thomas L Wickiewicz, 1Danyal H Nawabi. USA; 2Israel

Summary LET creates a supraphysiologic restraint to internal tibial rotation compared to the native lateral tissues.

Data
Background Lateral extra-articular tenodesis (LET) reduces ACL graft failure rates two years after surgery when performed as an adjunct to ACL reconstruction (ACLR). Interestingly, previous biomechanical studies have shown that LET may reduce tibial rotation beyond that of the intact knee, while others found no such kinematic overconstraint. Parameters of ligament engagement have proven useful in characterizing the biomechanical function of the ACL and the anterolateral ligament; however, they have not been used to describe the biomechanics of LET.

Purpose To compare engagement parameters (engagement point, in-situ stiffness, and tissue force at peak applied load) of an LET-reconstructed knee compared to the native lateral tissues in response to an internal rotation torque at 0°, 30°, 60°, and 90° of knee flexion.

Methods Seven cadaveric knees (mean age: 39 ± 12; range: 28–54; 4 male) were mounted to a robotic manipulator. The robot applied an internal rotation torque of 5 Nm while monitoring the resulting internal tibial rotation (ITR) (in degrees). Each knee was tested following a bone-patellar tendon-bone ACL reconstruction with intact lateral tissues (consisting of the anterolateral ligament and Kaplan fibers) and after sectioning these tissues and performing LET (modified Lemaire technique). Resultant forces carried by the native lateral tissues and the LET were determined via superposition. The parameters of engagement were determined for both the native lateral tissues and the LET and compared via two-way repeated measures ANOVA (p < 0.05).

Results At full extension, both the LET-reconstructed and native lateral tissues did not engage. At 30°, 60°, and 90° knee flexion, the native lateral tissues engaged with greater ITR than the LET-reconstructed lateral tissues. Specifically, the native lateral tissues engaged with 8° (p < 0.001), 13° (p < 0.001), and 14° (p < 0.001) greater ITR than the LET-reconstructed lateral tissues at 30°, 60°, and 90° knee flexion, respectively. At 30° of flexion, the LET-reconstructed lateral tissues engaged with 9° (p < 0.001) and 10° (p < 0.001) greater ITR than at 60° and 90° knee flexion. Across all three tested knee flexion angles (30°, 60°, and 90°), the LET-reconstructed lateral tissues had greater in situ stiffness than the native lateral tissues. Compared to the native lateral tissues, the LET carried 29 N greater force on average at the peak applied internal rotation torque at 30° of flexion (p = 0.006).

Discussion and Conclusion LET creates a supraphysiologic restraint to ITR compared to the native lateral tissues. Specifically, LET engaged with less internal rotation at all flexion angles tested but full extension. The LET also carried greater
force at the peak applied load and had a greater in situ stiffness at 30° of flexion than the native lateral tissues. Discrepancies between previous biomechanical studies may arise from variations in one or more of these modifiable surgical parameters. Clinical Relevance: The engagement point of an LET is surgically modifiable by altering the flexion angle or degree of tibial rotation at which the tenodesis is fixed. Parameters of engagement may be used to inform clinical decision-making to tune LET to achieve the desired level of restraint to internal tibial rotation towards improved clinical outcomes.

Abstracts

20376 CLINICAL OUTCOMES OF ARTHROSCOPIC PARTIAL MENISECTOMY AND DEBRIDEMENT COMBINED WITH INTRAOSSEOUS BIOPLASTY USING BONE MARROW ASPIRATE CONTRATE AND DEMINERALIZED BONE IN PATIENTS WITH MODERATE TO SEVERE OSTEOARTHRITIS AND BONE MARROW EDEMA

Rajit Saluja, Anand Prakash Saluja, Akshay Prakash Saluja. USA

Summary Treatment of subchondral bone marrow edema lesions with bone marrow aspirate concentrate improves the pain and clinical outcome of patients with moderate to severe osteoarthritis undergoing arthroscopic partial meniscectomy and debridement at a minimum follow-up of one year.

Data Bone marrow edema (BME) is an MRI finding of hyperintense signal on a fluid sensitive, fat suppressed background and is a cause of significant knee pain. BME may be seen in acute trauma, avascular necrosis, insufficiency fracture and in osteoarthritis (OA). Patients with OA who have BME have more pain and are more likely to progress to Total Knee Arthroplasty (TKA). BME lesions have high bone turnover and have the potential to heal but, if untreated, may collapse. Treatment of bone marrow lesions with injection of bone marrow concentrate (BMC) and demineralized bone matrix, known as intraosseous bioplasty (IOBP), has shown good short-term success in some studies. Furthermore, arthroscopic meniscectomy and debridement has not been shown to provide successful lasting pain relief in patients with moderate to severe OA. The aim of this study was to evaluate the benefits of combined IOBP of BME lesions with arthroscopic meniscectomy and debridement in patients with moderate to severe OA.

Methods We prospectively followed 22 patients with moderate to severe OA who had BME lesions on MRI Scans and had failed conservative treatment with anti-inflammatory, cortisone and/or hyaluronic injections. The patients had bone marrow aspiration from the Posterior Superior Iliac Spine and underwent arthroscopic partial meniscectomy, chondral debridement, and treatment of BME with IOBP with the addition of intraarticular BMC injection. The mean patient age was 60.5 (range 41–75). The mean follow-up was 14.6 months (range 12–21) and assessed with VAS and WOMAC scores at 6 weeks, 3 months, 6 months and 1 year. Rescue injections were also tracked. The need for additional surgeries was also followed.

Results The mean preoperative surgery VAS score was 7.6 (range 2–10). The mean VAS score at 6 weeks was 4.6 (range 0–8), at 3 months was 3.0 (range 0–7), at 6 months was 1.5 (range 0–6), and at 1 year was 1.1 (range 0–8). The mean preoperative WOMAC score was 72.5 (range 42–96). The mean WOMAC score at 6 weeks was 41 (range 5–71), at 3 months was 24.5 (range 0–72), at 6 months was 12.9 (range 0–48) and at 1 year was 12.2 (range 0–78). 5 patients required an injection during the first year and only 2 of the injections were intraarticular and the remaining 3 were either at the IT Band or Pes Tendon insertions. None of the patients have required any additional surgical procedures on the same knee. Compared to the preoperative values, the VAS score 6 months postoperative from surgery decreased from 7.6 to 1.5 (P<0.00001), and the WOMAC score decreased from 72.5 to 12.9 (P<0.00001). Compared to the preoperative values, the VAS score 1-year postoperative surgery decreased from 7.6 to 1.1 (P<0.00001), and the WOMAC score decreased from

20697 COMPARISON OF ONE STAGE VERSUS TWO STAGE REVISIONS FOR INFECTED TOTAL KNEES

Gerhard E Maale, Aniruth Srinivasaraghavan, Nicole Kennard, Arianna Mixon, Daniel Mohammad, Gerhard E Maale. USA

10.1136/jisakos-2021-congress.315

Summary We explore whether single-stage revisions of infected total knees result provides comparable or possibly better patient outcomes to those reported for two-stage revisions.

Data Background The efficacy of one stage knee limb salvage procedures over the two-stage alternative is still under contention. The conventional treatment for periprosthetic joint infections (PJI) of the knee is the two-stage revision requiring the use of an antibiotic loaded spacer followed by a delayed exchange. Our question is whether single-stage revisions of infected total knees result provides comparable or possibly better patient outcomes to those reported for two-stage revisions.

Methods We retrospectively reviewed 385 cases of one-stage revisions of knees between 2005–2018. Patient comorbidities, which included both local and systemic compromises, were reviewed for all patients using McPherson’s classification system for PJIs and patients were subsequently staged. All patients in our cohort presented with PJI of the knee and subsequently underwent a one stage revision using dual setup with radical debridement, definitive knee reconstruction with antibiotic loaded cement and implantation of antibiotic loaded calcium sulfate hemihydrate pellets. Successful treatment was defined as a knee joint without recurrence of infection, for a minimum of 2 years, and limb preservation.

Results The patients in this cohort had a mean follow-up of 60 months (range: 24 months–14 years) and mean patient age of 61 years old, consisting of 199 males and 186 females. Almost all of the patients were classified as Cierny-Mader type IV BLS borderline C- host or McPherson type III-C- III. Fifty-five out of the 385 patients required flaps; 2 local flaps and 53 free muscle flaps. Fifty-three patients had some form of recurrence. Of the 53 patients that recurred, 25 required an amputation. All patients who had a recurrence of infection presented with draining sinus tracts with dislocations and wound healing problems being a major contributing factor.

Conclusion A one-stage treatment of the knee is more cost-effective and is not associated with some of the physically debilitating complications seen in patients treated with two-stage revision. Based on our findings, one-stage revision of PJIs demonstrates at least as good an infection eradication rate as two-stage revision: 86% compared to 85%. With added advancements to antibiotic delivery mechanisms, we believe that the one stage treatment for total knees will be a more popular treatment option for patients with PJI.
72.5 to 12.2 (P<0.00001). Two patients increased in both their VAS and WOMAC scores between 6 months postoperative surgery and 1-year postoperative surgery. One of those two patients increased her WOMAC score but also has significant lumbar radiculopathy.

**Discussion and Conclusion** Typically, patients with moderate to severe osteoarthritis who undergo arthroscopic meniscectomy and debridement have been shown in literature to have poor outcomes. The treatment of BME with IOBP at the time of arthroscopic meniscectomy and debridement in our study has provided good pain relief at a minimum follow-up of 1 year. The addition of Intraosseous Bioplasty with Bone Marrow Aspirate Concentrate in the treatment of the Bone marrow Edema lesions may be the contributing factor for the improved results in our study. It’s possible the intraarticular injection of Bone Marrow Aspirate at the time of the procedure may also be providing some added benefit.

**Summary** Particulated juvenile allograft cartilage demonstrates overall good clinical results at long term follow up (6–8 years)

**Data**

**Background** Patients with symptomatic osteochondral lesions of the talus can have serious impairments in their activities of daily living and occupations. The role of particulated juvenile allograft articular cartilage (DeNovo NT®) implantation is not well elucidated in reference to long-term patient outcomes.

**Methods** A total of thirteen patients with difficult to treat osteochondral lesions of the talus underwent arthroscopic assisted implantation of DeNovo NT® graft into defects from 2010–2012 by the same surgeon. Difficult lesions were defined as having some combination of the following: (1) lesions size of 1.07cm² or greater, (2) corner/shoulder lesions, (3) patients who failed microfracture, (4) patient age over 40, or (5) patient BMI>25 kg/m². Patients were evaluated using physical examination, patient interviews, and pre and postoperative outcome score measures. Patients had follow-up at 2 years, 4 years, and between 6–9 years at their most recent follow-up. Differences in functional outcome scores were compared before and after surgery.

**Results** Patients (Age: 46.5±11.8years; Sex: 8 Male/5 Female; Body Mass Index: 28.5 ±6.1kg/m²) had on average, most recent follow-up of 8.0 years (range 72–113 months). Average VAS pain score decreased for patients by 3.9 points, 95% CI [2.18, 5.60], when compared to preoperative assessment. FAAM ADL and Sports scores also showed improvement from 46.5 to 80.9, 95% CI [21.35, 47.43] and from 18.8 to 57.9, 95% CI [21.05, 57.10], respectively. SF-36 physical component scores showed significant improvement by an average of 45.5 points, 95% CI [32.42, 58.50]. AOFAS scores improved from 55.2 to 80.3, 95% CI [12.459, 37.741].

**Conclusion** The use of arthroscopic assisted DeNovo NT® implantation of talar osteochondral lesions provides satisfactory outcomes for difficult to treat lesions. These results demonstrate clinically positive long-term outcomes for a cohort of patients followed over the course of 6–9 years.

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**20773**

**LONG-TERM OUTCOME MEASURES FOLLOWING PARTICULATED JUVENILE ALLOGRAFT CARTILAGE IMPLANTATION FOR TREATMENT OF DIFFICULT OSTEÖCHONDRAL LESIONS OF THE TALUS**

Cary Chapman, Joseph Manzi, Mathew Hamula, Dinesh Dhanaraj. USA

10.1136/jisakos-2021-congress.317

**Summary** Particulated juvenile allograft articular cartilage demonstrates overall good clinical results at long term follow up (6–8 years)

**Data**

**Background** Patients with symptomatic osteochondral lesions of the talus can have serious impairments in their activities of daily living and occupations. The role of particulated juvenile allograft articular cartilage (DeNovo NT®) implantation is not well elucidated in reference to long-term patient outcomes.

**Methods** A total of thirteen patients with difficult to treat osteochondral lesions of the talus underwent arthroscopic assisted implantation of DeNovo NT® graft into defects from 2010–2012 by the same surgeon. Difficult lesions were defined as having some combination of the following: (1) lesions size of 1.07cm² or greater, (2) corner/shoulder lesions, (3) patients who failed microfracture, (4) patient age over 40, or (5) patient BMI>25 kg/m². Patients were evaluated using physical examination, patient interviews, and pre and postoperative outcome score measures. Patients had follow-up at 2 years, 4 years, and between 6–9 years at their most recent follow-up. Differences in functional outcome scores were compared before and after surgery.

**Results** Patients (Age: 46.5±11.8years; Sex: 8 Male/5 Female; Body Mass Index: 28.5 ±6.1kg/m²) had on average, most recent follow-up of 8.0 years (range 72–113 months). Average VAS pain score decreased for patients by 3.9 points, 95% CI [2.18, 5.60], when compared to preoperative assessment. FAAM ADL and Sports scores also showed improvement from 46.5 to 80.9, 95% CI [21.35, 47.43] and from 18.8 to 57.9, 95% CI [21.05, 57.10], respectively. SF-36 physical component scores showed significant improvement by an average of 45.5 points, 95% CI [32.42, 58.50]. AOFAS scores improved from 55.2 to 80.3, 95% CI [12.459, 37.741].

**Conclusion** The use of arthroscopic assisted DeNovo NT® implantation of talar osteochondral lesions provides satisfactory outcomes for difficult to treat lesions. These results demonstrate clinically positive long-term outcomes for a cohort of patients followed over the course of 6–9 years.

**21186**

**PREOPERATIVE COMPUTERIZED TOMOGRAPHY PREDICTS CORACOID GRAFT SIZE AND RESTORATION OF THE GLENOID TRACK IN PATIENTS UNDERGOING LATARJET PROCEDURES**

Brian M Godshaw, Jonathan D Hughes, Stephanie Boden, Albert Lin, Bryson P Lesniak. USA

10.1136/jisakos-2021-congress.318

**Summary** Preoperative CT measurements of the coracoid can predict Latarjet coracoid graft width and size of reconstructed glenoid.

**Data**

**Introduction** Shoulder instability often results in both humeral and glenoid lesions. The Latarjet is a commonly used procedure to address glenoid bone loss but does not specifically address humeral lesions. Further, the concept of the glenoid track has been described to predict which humeral lesions contribute to shoulder instability. The purpose of this study was to determine if preoperative computerized tomography (CT) imaging can predict coracoid graft size and conversion of off-track to on-track Hill-Sachs lesions in patients undergoing Latarjet procedures. We hypothesized that coracoid graft size, and therefore amount of glenoid reconstruction, could be accurately predicted based off preoperative CT imaging.

**Methods** Patients who underwent Latarjet procedure at a single institution from 2012–2020 were evaluated. Inclusion criteria consisted of pre- and post-operative advanced imaging (CT or magnetic resonance imaging, MRI). Patient information was obtained via chart review. Preoperative CT scans were reviewed to determine glenoid bone loss, via best-fit circle method, and the Hill-Sachs interval. Off versus on track was then determined. Additionally, the preoperative CTs were used to measure coracoid dimensions including its total length, height, and depth/thickness. Postoperative CT or MRIs were then reviewed to measure the height and width of the graft, as well as the new glenoid diameter. Using the dimension of the previously measured Hill-Sachs interval, new on vs off track status was calculated.

**Results** Fourteen patients met the inclusion criteria. The average Hill-Sachs interval was 20.9±6.0 mm with an average glenoid track of 18.9±2.5 mm. Overall, 8 patients had off-track lesions. The average glenoid bone loss was 23.9±0.8%. The harvested coracoid graft was 65.±9.5% of the length and 102.1±17.2% of the depth of the preoperative measurements. The predicted new glenoid diameter was 35.1±3.8 mm and reconstructed 99.1±7.7% of the predicted diameter, or 34.7±4.0 mm. Patients who underwent Latarjet procedure at a single institution from 2012–2020 were evaluated. Inclusion criteria consisted of pre- and post-operative advanced imaging (CT or magnetic resonance imaging, MRI). Patient information was obtained via chart review. Preoperative CT scans were reviewed to determine glenoid bone loss, via best-fit circle method, and the Hill-Sachs interval. Off versus on track was then determined. Additionally, the preoperative CTs were used to measure coracoid dimensions including its total length, height, and depth/thickness. Postoperative CT or MRIs were then reviewed to measure the height and width of the graft, as well as the new glenoid diameter. Using the dimension of the previously measured Hill-Sachs interval, new on vs off track status was calculated.

**Conclusion** This study shows that preoperative CT measurements of the coracoid can predict Latarjet coracoid graft width, and to a lesser extent, graft length. When factoring in preoperative measurements of the glenoid, one can estimate the amount of glenoid that can be reconstructed with a Latarjet, as the glenoid bony diameter was restored to 99.1% of the preoperatively calculated size. By performing these measurements, one can predict whether an off-track Hill-Sachs can be converted to on-track, further enhancing shoulder stability.
Summary Of the variables we evaluated, fracture morphology was identified as the only significant risk factor for the development of postoperative complications in patients treated with open reduction and internal fixation in midshaft clavicle fractures.

Data

Introduction Complications can occur following clavicle fracture fixation including symptomatic hardware, nonunion, and infection. Identifying predictors of postoperative complications could potentially identify patients better served with a trial of nonoperative management. In this study demographics, injury pattern, and surgical technique were used to identify predictors of postoperative complications. We hypothesized that increased comorbidities (e.g. smoking, diabetes), segmental fracture patterns, and superior plating would lead to higher complication risks.

Methods We retrospectively reviewed all adult patients at a single tertiary trauma center who underwent open reduction and internal fixation of midshaft clavicle fractures performed by orthopaedic trauma and sports medicine surgeons between 2007 and 2019. Demographic information, injury characteristics, surgical technique, postoperative complications including reoperation, and follow-up were recorded. Postoperative complications were separated into major complications that required reoperation and minor complications that did not require reoperation. The study utilized chi-square statistics and analysis of variance between subjects to identify predictors of all, major, and minor postoperative complications with significance set at p<0.05.

Results There were 354 patients (288 males, 66 females) with an average age of 38.0 ± 14.6 years and BMI of 26.3 ± 5.2. The average follow-up was 3.0 ± 7.5 months. There were 116 smokers (32.8%) and 14 diabetics (4.0%). Occupation was documented in 285 patients (80.5%), with 93 of those patients (32.6%) working in manual labor. There were 157 transverse fractures (44.4%), 147 oblique fractures (41.5%), and 50 Z-type fractures (14.1%). Average time from injury to surgery was 5.4 days (range 0–44 days) with 219 patients (61.9%) treated inpatient and 135 patients (38.1%) treated outpatient. There were 144 patients (40.7%) who had superior plating, 134 patients (37.9%) who had anterior plating, and 76 patients (21.4%) who had dual plating. Overall, postoperative complications occurred in 58 patients (16.4%). Of those complications, there were 44 minor complications (12.4%) and 14 major complications (4.0%). Of the major complications the most common causes were non-union (n=5), symptomatic hardware (n=4), and infection (n=3). Of the minor complications the most common causes were sensory deficits (n=25), superficial wound infections that resolved with observation or antibiotics (n=11), and delayed union that resolved with bone stimulator (n=3). The only significant predictor for postoperative complications was fracture pattern for all complications (p=0.03) and major complications (p=0.002). Complications occurred more frequently in transverse and Z-type fractures than oblique fractures.

Discussion Fracture pattern was the only predictor identified for the development of postoperative complications. While the overall risk of major complication was low, transverse and Z-type fracture patterns may be more problematic. Non-unions occurred exclusively in transverse clavicle fractures, possibly due to the reduced bony surface area in contact. Symptomatic hardware occurred mostly with Z-type fractures which may be secondary to longer plates for segmental fixation that can be a source of irritation.

abstracts

21206 PERFORMING A CONCOMITANT TIBIAL TUBERCLE OSTEOTOMY DURING PRIMARY MEDIAL PATELLOFEMORAL LIGAMENT RECONSTRUCTION DOES NOT LEAD TO INCREASED POST-OPERATIVE COMPLICATION RATES

Adam Money, Seth L Sherman, Kurali Varsnneya, Andrew Gudeman, Kevin G Shea. USA

Summary Concomitant TTO does not lead to increased post-operative complications following primary MPFLR; however, its performance may lead to increased healthcare resource utilization through 2-years of follow-up.

Data

Purpose There remains controversy regarding the addition of tibial tubercle osteotomy (TTO) to medial patellofemoral reconstruction (MPFLR) in the setting of patella instability surgery. Our purpose was to evaluate the impact of performing a concomitant tibial tubercle osteotomy (TTO) with a medial patellofemoral ligament reconstruction (MPFLR) on post-operative complications, re-operations and costs up to two years following primary surgery. Our hypothesis was that concomitant TTO will not influence complication rates but will reduce re-operation rates at the expense of increased cost as compared to isolated MPFLR.

Methods We queried the MarketScan database in order to identify patients who underwent primary MPFLR from 2007–2015. Patients were stratified into cohorts based on concomitant TTO performed on the same day as index MPFLR. To minimize the effect of potential confounding on the direct comparison of patients undergoing the two procedures, a propensity-score match (PSM) was utilized. A greedy nearest-neighbor algorithm was employed to match patient cohorts with a 7:1 MPFLR to MPFLR + TTO ratio. Reoperations, complications, and costs were followed for two years post-index procedure. Patients without laterality codes were excluded. Results were analyzed statistically.

Results This study identified 968 patients who underwent primary MPFLR. Patients were stratified into two groups: (1) MPFLR only or (2) MPFLR + TTO. After matching the cohorts, mean age, sex distribution, and rates of baseline diabetes, hyperlipidemia, hypertension, tobacco use, and obesity were similar. Patients in the two cohorts experienced similar rates of post-operative complications (MPFLR + TTO: 9.9%, MPFLR: 8.7%, p = 0.6694). Rates of dislocation (MPFLR + TTO: 5.8%, MPFLR: 4.3%, p = 0.4434), stiffness (MPFLR + TTO: 0.8%, MPFLR: 2.5%, p = 0.2538), infection (MPFLR + TTO: 0.8%, MPFLR: 0.6%, p = 0.7559), and wound complication (MPFLR + TTO: 0.8% vs MPFLR: 0.8%, p = 1.000) were similarly low. Performing a concomitant TTO increased revision surgery for instability (revision MPFLR) rates (6.6% vs 11.1%, p = 0.1327); however, this
DO ISOLATED GREATER TUBEROSITY FRACTURES BEHAVE LIKE ROTATOR CUFF TEARS WHEN FIXED ARTHROSCOPICALLY? A MATCHED COHORT ANALYSIS

Joseph J Ruzbarsky, Dylan R Rakowski, Thomas Woolson, Marilee P Horan, Peter J Millett. USA

Summary Isolated greater tuberosity fractures show significantly improved patient reported outcomes to the same degree as acute rotator cuff tears when fixed arthroscopically and these results suggest that linked, double row repairs can result in rotator cuff tendon to bone healing which may be equivalent to bone-to-bone healing.

Data

Background Isolated greater tuberosity (GT) fractures are a bony avulsion of the rotator cuff. A majority of these fractures can be managed non-operatively, but fractures with significant displacement can result in chronic pain, impingement, weakness, and shoulder dysfunction if not managed surgically. In the evolution of GT fracture fixation, double row fixation has been utilized to improve initial repair strength and restore normal anatomy, but the outcomes of these fractures relative to those with acute rotator cuff tears remains largely unknown.

Purpose To evaluate and compare patient reported outcomes following isolated GT fracture fixation to acute rotator cuff repair (RCR) at a minimum of 2 years.

Methods Patients who underwent isolated GT fracture fixation were compared in a 1-to-3 fashion with patients who underwent arthroscopic RCR for an acute rotator cuff tear by a single surgeon between January 2006 and July 2018. Data were prospectively collected and retrospectively reviewed. Patient reported outcomes (PROs) were compared pre- and post-operatively as well as between groups (ASES, SF-12 PCS, SANE, QuickDASH, and satisfaction). Reoperation rates were analyzed.

Results A total of 56 patients, 15 isolated GT fracture fixation patients with a mean age of 48.3 years old and 41 acute RCR patients with a mean age of 57.2 years old were evaluated (p=0.038). ASES scores significantly improved from 43.6 to 91.3 (p=0.005) in the isolated GT fracture fixation group and from 51.4 to 95.2 (p<0.001) in acute RCR group. At final follow-up, mean QuickDASH scores were 10.6 and 7.9 (p=0.633) and SANE scores were 90.6 and 87.3 (p=0.846) for the GT and acute RCR groups, respectively. The median satisfaction for both groups was 10/10. Additional comparison of patients who underwent double row repair for an acute rotator cuff tear or isolated GT fracture revealed no significant difference in outcomes (p>0.185). There were no revisions in the GT fracture fixation group and one patient in the acute RCR group had recurrent shoulder pain and subsequently underwent revision surgery.

Conclusions Concomitant TTO does not lead to increased post-operative complications following primary MPFLR; however, its performance may lead to increased healthcare resource utilization through 2-years of follow-up. Further research should investigate the impact of a concomitant TTO and MPFLR on long-term MPFL stability and failure rates.

RISK FACTORS FOR EARLY CONVERSION TO HIP ARTHROPLASTY FOLLOWING HIP ARTHROSCOPY: A MATCHED COHORT ANALYSIS

Joseph J Ruzbarsky, Max Seiter, Rui Soares, Lauren Pierpoint, Karen K Briggs, Marc J Philippon. USA

Summary Patients with bipolar chondral lesions seen at the time of hip arthroscopy are at increased risk for conversion to total hip arthroplasty within two years.

Data

Background Surgical indications for hip arthroscopy continue to evolve in an effort to optimize long term survivorship and durability. Radiographic joint space narrowing less than 2 mm is a well-established risk factor for conversion to total hip arthroplasty (THA) after hip arthroscopy; however, it is unclear why some patients convert early to THA compared to others. The purpose of this study was to determine which factors differentiate those patients who convert to THA within 2 years of hip arthroscopy compared to those who convert later than 2 years.

Methods Included in this study were patients who underwent conversion to THA within two years of primary hip arthroscopy from a prospectively-collected patient registry from 2007 to 2017. Patients who underwent early conversions to arthroplasty were matched 1:1 with patients who converted after two years, based upon age and gender. Preoperatively outcome scores were collected including Short Form-12, modified Harris Hip Score, and Hip Outcome Score. Additionally, variables from the preoperative radiographic evaluation, surgical findings, and procedures performed were also compared.

Results Forty-nine patients were included in the early conversion group and were matched with forty-nine patients in the later conversion group. Patients with lateral center edge angle of less than 25° were more likely to be in the early failure group [OR: 3.9; 95%CI: 1.01 to 15]. Patients with unipolar chondral defects on either the femoral (p = 0.128) or acetabular side (p = 0.656) were not at increased odds for early conversion compared to later conversion; however, those with bipolar chondral lesions at the time of surgery had increased odds of early conversions [OR: 3.3; 95%CI: 1.4 to 8] (p=0.01). Neither microfracture treatment (p = 0.666), labral reconstruction (p = 0.07), labral debridement (p = 0.298), preoperative intraarticular injection (p = 0.598), nor preoperative patient reported outcome measures were associated with early conversion.

Conclusions Patients with low lateral center edge angles or bipolar chondral lesions seen at the time of hip arthroscopy are at increased risk for conversion to total hip arthroplasty within two years. Imaging modalities to more reliably and
accurately predict these intraoperative findings are necessary to prevent unsuccessful surgeries.

**20916 MIDTERM OUTCOMES AFTER ARTHROSCOPIC HIP CAPSULAR RECONSTRUCTION USING Iliotibial BAND ALLOGRAFT**

Joseph J Ruzbarsky, Max Seiter, Rui Soares, Lauren Pierpoint, Karen K Briggs, Marc J Philippon. USA

10.1136/jisakos-2021-congress.323

Summary Capsular reconstruction with ITB allograft shows acceptable success at midterm follow-up.

Data

**Purpose** The purpose of this study was to describe patient outcomes 3–5 years after arthroscopic hip capsular reconstruction.

**Methods** Patients were included in this study if they underwent an arthroscopic hip capsular reconstruction using an ITB allograft by the senior surgeon from 2007 to 2016, and >18 years of age at the time of surgery with minimum 3–5 year follow up. Patients were excluded if they had previous severe less than 18 or greater than 50 years at the time of surgery, advanced osteoarthritis (Tonnis grade 3), significant acetabular dysplasia (LCEA < 20 degrees), history of open hip surgery, avascular necrosis, Legg-Calve-Perthes disease or refused to participate. Clinical outcomes including the Hip Outcome Score (HOS)-(Activity of Daily Living (ADL) and Sport), modified Harris Hip Score (mHHS), SF-12, Western Ontario & McMaster Universities Osteoarthritis Index (WOMAC), and Vai Hip Score (VHS) were collected, in addition to failure rate (conversion to total hip arthroplasty (THA), or revision hip arthroplasty), and patient satisfaction (1–10).

**Results** Thirty-nine patients met the inclusion criteria. Average age of the cohort was 32 ± 10 years, with 6 males and 33 females. Six patients (15%) converted to total hip arthroplasty at an average of 2.1 years (range 7 months – 6 years) following capsular reconstruction. There were 5 females and 1 male with an average age of 33 years at time of arthroscopy. Five of the patients had 3 prior hip arthroscopies and 1 patient had 5 previous. Four female patients (10%) required revision hip arthroscopy for adhesions. In patients who did not undergo subsequent surgery, mean follow-up time was 4 ± 0.7 years (range 3 to 5.5 years). All outcome scores showed significant improvement. MCID was met for HOS-ADL in 90% of patients, for HOS Sport in 90% of patients and for mHHS in 86% of patients.

**Conclusion** Capsular reconstruction with ITB allograft shows acceptable success at midterm follow-up. Most patients had numerous previous surgery; however, 75% did not require additional surgery and 90% had meaningful improvements in outcome scores. Failure was associated with a higher number of previous surgeries.

**20732 ENDOSCOPIC ILIOTIBIAL BAND RELEASE DURING HIP ARTHROSCOPY FOR FEMOROACETABULAR IMPINGEMENT SYNDROME AND EXTERNAL SNAPPING HIP HAD BETTER PATIENT-REPORTED OUTCOMES: A RETROSPECTIVE COMPARATIVE STUDY**

Chunbao Li, Shaoxing Zhang. China

10.1136/jisakos-2021-congress.325

Summary Compare the patient-reported outcomes (PROs) in patients with femoroacetabular impingement (FAI) syndrome and external snapping hip (ESH) treated with hip arthroscopy with or without endoscopic iliotibial band (ITB) release.

Data

**Purpose** To compare patient-reported outcomes (PROs) in patients with femoroacetabular impingement (FAI) syndrome and external snapping hip (ESH) treated with hip arthroscopy with or without endoscopic iliotibial band (ITB) release.

**Methods** Retrospective review case series with both FAI syndrome and ESH who underwent surgical treatment under same indications. According to the primary operation that determined by patients themselves, the patients undergoing
ITB release during hip arthroscopy for FAI syndrome were enrolled in ITB-R group, the patients undergoing hip arthroscopy without ITB release were enrolled in Non-ITB-R group. Patients with dysplasia, severe osteoarthritis, revision and bilateral surgery were excluded. Patient-reported outcomes (PROs) including international Hip Outcome Tool (iHOT-33), modified Harris Hip Score (mHHS), visual analog scale for pain (VAS-pain) and VAS-satisfaction, and the rates of achieving minimal clinically important difference (MCID), patient acceptable symptomatic state (PASS) and substantial clinical benefit (SCB) for the PROs at 2 years postoperatively were comparative analyzed.

Results The prevalence of ESH in FAI syndrome patients who underwent hip arthroscopy in our institution was 4.9% (30 of 612 hips). The mean age at the time of surgery was 33.1 ± 6.9 years (range, 22-48 years). After exclusion, 16 patients (16 hips) were enrolled into ITB-R group and 11 patients (11 hips) enrolled into Non-ITB-R group. PROs including iHOT-33, mHHS, VAS-pain and VAS-satisfaction in patients in ITB-R group were better than that in Non-ITB-R group at two years postoperatively (P=0.013, 0.016, 0.002 and 0.005, respectively). The rates of achieving PASS for mHHS, PASS for VAS-pain and SCB for iHOT-33 of patients in ITB-R group were better than that in Non-ITB-R group at two years (P=0.013, 0.016, 0.002 and 0.005, respectively). The rates of achieving PASS for mHHS, PASS for VAS-pain and SCB for iHOT-33 of patients in ITB-R group were better than that in Non-ITB-R group at two years (P=0.013, 0.016, 0.002 and 0.005, respectively). The rates of achieving PASS for mHHS, PASS for VAS-pain and SCB for iHOT-33 of patients in ITB-R group were better than that in Non-ITB-R group at two years (P=0.013, 0.016, 0.002 and 0.005, respectively). The rates of achieving PASS for mHHS, PASS for VAS-pain and SCB for iHOT-33 of patients in ITB-R group were better than that in Non-ITB-R group at two years (P=0.013, 0.016, 0.002 and 0.005, respectively). The rates of achieving PASS for mHHS, PASS for VAS-pain and SCB for iHOT-33 of patients in ITB-R group were better than that in Non-ITB-R group at two years (P=0.013, 0.016, 0.002 and 0.005, respectively).

Conclusions Patients with both FAI syndrome and ESH undergoing ITB release during hip arthroscopy had better PROs than those undergoing hip arthroscopy without ITB release.

Summary The use of Quadriceps tendon autograft in isolated, primary anterior cruciate ligament reconstruction leads to equal clinical, functional and patient-reported outcomes but to less donor site morbidity when compared to hamstring tendon autografts.

Data Objectives To compare clinical and functional outcomes of patients after primary anterior cruciate ligament reconstruction (ACLR) using quadriceps tendon- (QT-A) and hamstring tendon (HT-A) autograft with a minimum follow-up (FU) of 5 years.

Methods Between 2010 - 2014, all patients undergoing ACLR (QT: 119, HT: 511) were recorded in a prospectively administered database. All patients with primary, isolated QT-A ACLR and without any concomitant injuries or high grade of osteoarthritis were extracted from the database and matched to patients treated with HT-A. Re-rupture rates, anterior-posterior (ap) knee laxity, single-leg-hop test (SLHT) performance, distal thigh circumference (DTC) and patient reported outcome measurements (PROMs) were recorded. Between-group comparisons were performed using chi-square-, independent-samples T- or Mann-Whitney-U tests.

Results 45 QT-A patients were matched to 45 HT-A patients (n=90). The mean FU was 78.9±13.6 months. 18 patients (20.0%/QT: N=8, 17.8%; HT: n=10, 22.2%; p=.60) sustained a graft rupture and 17 subjects (18.9%/QT: N=9, 20.0%; HT: n=8, 17.8%; p=.79) suffered a contralateral ACL injury. In high active patients (Tegner-activity-level=7) the rerupture rate increased to 37.5% (HT-A) and 22.2% (QT-A; p=.32). No statistical between-group differences were found in ap knee laxity side-to-side (SSD) measurements (QT-A: 1.9±1.2 mm, HT-A: 2.1±1.5 mm; p=.60), subjective IKDC- (QT: 93.8±6.8, HT: 91.2±7.8, p=.17), Lysholm- (QT: 91.9±7.2, HT: 91.5±7.7, p=.75) or any of the five subscales of the KOOS score (all p>.05). Furthermore, Tegner-activity-level (QT: 6.1±5.2, HT: 6.2, p=.62), VAS for pain (QT: 0.5 ±0.9, HT: 0.6±1.0, p=.64), Shelbourne-Trumper-Scoring (QT: 96.5±5.6, HT: 95.2±8.2, p=.50), Patient-and-Observer-Scar-Assessment-Scale (POSAS) (QT: 9.4±3.2, HT: 10.7±4.9, p=.24), SSD-DTC (QT: 0.5±0.5, HT: 0.5±0.6, p=.97), return to sports rates (QT-A: 82.1%, HT-A: 86.7%) and SLHT (QT: 95.9±3.8, HT-A: 93.7±7.0%) did not differ between groups. Length of skin incision (HT-A: 3.1 ±0.6cm, QT-A: 1.8 ±0.6cm; p<.001) was significantly longer and donor site morbidity (HT-A n=14, 46.7%; QT n=3, 11.5%; p=.008) significantly lower in the QT-A group.

Conclusion Patient-reported outcome measures, knee laxity, functional testing results and re-rupture rates are similar between patients treated with QT- and HT- autografts. However, patients with QT-autograft have smaller tibial skin incisions and lower postoperative donor site morbidity.
Methods Sixty-five consecutive patients who underwent ASCR using the minimally invasively harvested AFL between 2015 and 2021 by the same surgical team were retrospectively reviewed. Patients who had less than 6 months of FU, suffered subsequent injuries to either of the lower limbs or had died, were excluded. The functional outcome of the harvested and contralateral thighs was evaluated using the WOMAC score. Patient satisfaction was evaluated using the Patient Scar Assessment Questionnaire (PSAQ), and a subjective dichotomous questionnaire. Pain was assessed using the Visual Analogue Scale (VAS). The paired samples T-test was used to compare outcome and satisfaction scores. Pearson’s chi-square test was used to compare the categorical variables, and Pearson’s correlation and linear regression were used to analyze the continuous variables. Statistical significance level was set at p<.05.

Results Fifty-four patients met the inclusion criteria, 1 was lost to FU. 53 patients were enrolled (34% male, 66% female; average age, 65.5 ± 7.16 years). The mean FU was 38.3 ± 18.9 months, and 75% of the patients had more than 21.5 months of FU (percentile, 25). The mean WOMAC Score significantly differed by 1% between the harvested and unharvested thighs (p<.001). The mean PSAQ score in the harvested thigh significantly differed by 5% from the minimum PSAQ value (p<.001). 30.2% of the patients reported residual thigh symptoms. 92.5% of the patients considered that the thigh symptoms were compensated by the shoulder outcome and would agree to undergo the same procedure again. The female gender correlated with a lower WOMAC score of the surgery.

Conclusion At a mid-term FU, the minimally invasive AFL harvesting technique does not produce significant functional or subjective morbidity and the residual thigh symptoms are compensated by the shoulder outcome. DSM does not seem to be a valid argument against the use of AFL in ASCR.

Abstracts

LOW POSSIBILITY OF DEVELOPING DEGENERATIVE CHANGES AFTER ARTHROSCOPIC REMPLISSAGE AUGMENTING THE CLASSIC BANKART REPAIR.

PROBABILITY AFTER 10 YEARS FOLLOW UP

Prodromos Natsaridis, Emmanuel V Brilakis, Stefania Kokkineli, Emmanuel M Antonogiannakis. Greece

Summary A long term follow up (10 years) after an arthroscopic Remplissage technique augmenting the classic Bankart repair.

Data Introduction Purpose Arthroscopic Remplissage is a surgical technique augmenting the classic Bankart repair for the management of recurrent anterior shoulder dislocations. It is a non-anatomical technique of filling the Hill Sachs lesion by folding the infraspinatus tendon and the posterior capsule. The long-term results of this procedure are well documented as far as the efficacy is concerned. However, concerns have been expressed related to the development of arthritis. The purpose of this study is to record the degenerative changes in the shoulder joint after 10 years of follow-up and the presence of osteoarthritis.

Materials and Methods Thirty-two (32) patients were included in the study where they underwent surgery between January 2010 and December 2012. The surgery was performed by the same team and a single surgeon with the arthroscopic Remplissage technique augmenting the Bankart repair for anterior shoulder dislocation. It is about 26 men and 6 women with an average age of 31 years (from 18–63). This is a retrospective study where patients underwent imaging radiographs preoperatively and after long term follow up in the operated but also in the healthy shoulder. Patients were evaluated using the modified Samilson-Priesto classification for osteoarthritis according to Allain. The average follow-up was 120 months (88–160 months).

Results According to the Samilson- Priesto classification 21 patients presented with type 1, 9 patients with type 2 and 2 patients with type 3 arthritis. No one of the patients had arthritis clinically. Most of them had stage 1–2 type of osteoarthritis. Compared to the other hand of each patient, there was no difference with no statistically significant difference. (p>0.05) Few patients (6%) had developed stage 3 (only 2 of 32). Nevertheless some anatomical abnormalities were observed. Like subchondral cysts, calcified tendonitis or mild irregularities inferiorly to the glenohumeral joint without any so significant clinically difference in the last decade of follow up.

Conclusions Patients treated with the Remplissage technique for anterior shoulder dislocations after a decade of follow-up have no significant osteoarthritis development of the operated shoulder except for some anatomical lesions due to the nature of the surgery.
using five different definitions for LTF as the dependent variable: (1) LTF - missing all endpoint data at two-years; (2) Early LTF - LTF within one-year post-operative; (3) Late LTF - complete data through one-year after which they were LTF; (4) Clinical LTF - patients unwilling to visit the surgical office for clinical assessment and thus missing primary outcome data, and; (5) Missing Any Data - patients who miss any study visit throughout the trial. Eight predictors, including sex, age, smoking status, employment status, body mass index, pre-injury level of sport participation, delayed mobilization post-operatively, and distance from the patients’ primary residence and the clinical site were included in the analysis, along with clinical site.

Results Six-hundred and eighteen patients from the Stability 1 Study were included in this analysis (mean age = 18.9 years, 51.5% female). The LTF rate was 8.9%. Smokers (odds ratio [OR] = 2.61, 95% confidence interval [CI]: 1.15 to 5.96) and those employed part-time (OR = 2.33, 95%CI: 1.06 to 5.12) had significantly greater odds of LTF than other patients. No clinically meaningful predictors were identified for missing the in-person clinical exam at any visit or LTF after the first post-operative year. Clinical site was the single biggest predictor of missing outcomes at any visit.

Conclusions Smoking and part-time employment status were significant predictors of LTF, and part-time employment was significantly associated with early LTF. While we cannot accurately predict who will be LTF, investigators should be aware of these factors so they can identify high-risk patients and focus retention strategies accordingly, particularly on sites with inadequate resources.

Summary T1rho and T2 relaxation times are similar between patients undergoing ACLR and ACLR + LET at two-years post-operative.

Data Introduction The addition of a lateral extra-articular tenodesis (LET) to hamstring tendon autograft anterior cruciate ligament reconstruction (ACLR) has been demonstrated to reduce failure rates in the first two years post-operative. However, concern over lateral compartment over constraint and the subsequent potential risk of post-traumatic osteoarthritis (OA) development remains due to the historic experience of LET being performed in isolation in ACL deficient knees.

Purpose The purpose of this study was to evaluate whether augmentation of ACLR with a LET affects articular cartilage quality on magnetic resonance imaging (MRI) two years post-operatively in a young, active population.

Methods Patients included in this analysis were participants in the Stability 1 Study, a multi-center, international, pragmatic randomized controlled trial comparing hamstring tendon autograft ACLR alone to ACLR + LET. A consecutive sub-group of patients at the Fowler Kennedy Sports Medicine Clinic with healthy contralateral knees underwent bilateral 3T MRI at two-years post-surgery. The primary outcome was T1rho and T2 relaxation times, determined using quantitative MRI (qMRI) pulse sequences consisting of a Sagittal Multi-Echo Spin Echo T2 Mapping sequence, and a 16-shot Gradient Echo T1rho Mapping sequence. Articular cartilage was manually segmented on three consecutive load-bearing slices, and values were averaged for three regions on the tibia and five regions on the femur in both the medial and lateral compartments. Independent t-tests were used to compare relaxation times between groups for each compartment. An effect size (Cohen’s d) was calculated to estimate the magnitude of the standardized difference between groups for each compartment =(<0.2 = trivial, 0.2 to 0.5 = small, 0.5 to 0.8 = moderate, >0.8 = large).

Results Ninety-seven participants (47 ACLR, 50 ACLR+LET) with a mean age of 18.9 years (59.8% female, 58/97) underwent MRI 2-years post-operative (range = 20 to 36 months). Eighty-seven scans were available for analysis however, two were excluded due to significant movement artefact. Means and standard errors (SE) were calculated for T1rho and T2 relaxation times (ms) for each compartment. There was no difference in relaxation times for any of the regions in the medial compartment. T1rho relaxation times were significantly lower for the ACLR+LET group in the PL tibia (ACLR+LET = 39.7 ± 0.7, ACLR = 42.0 ± 0.6, p = 0.02), T2 relaxation times were significantly higher for the ACLR + LET group in the central (CL) tibia (ACLR+LET = 39.0 ± 0.3, ACL = 37.9 ± 0.4, p =0.04) and posterolateral (PL) femur (ACLR+LET = 46.3 ± 0.7, ACLR = 44.0 ± 0.6, p = 0.01). Effect sizes ranged from trivial (0.0) to moderate (0.56) for each compartment.

Conclusions T1rho and T2 relaxation times were relatively similar between groups. T1rho favoured ACLR + LET in the PL tibia and T2 favoured ACLR alone in the CL tibia and PL femur. Differences were small to moderate in magnitude indicating that further research, including long-term follow-up, is required to better understand the clinical significance of these findings.

Summary This study provides fundamental knowledge of the native behavior of the sMCL, dMCL and POL and their response to externally applied loads. Hence, current medial collateral ligament (MCL) reconstruction techniques differ fundamentally in attachment points, number of bundles and the tensioning protocol. The purpose was to define the length change patterns of the anterior and posterior fibers of the superficial MCL,
The relative contributions of the anterior cruciate ligament, anterolateral ligament, Kaplan fibres and the lateral meniscus to knee stability

1 Lukas Willinger, 2 Kiron K Arthwal, 2 Andy Williams, 2 Andrew A Amsi. 1 Germany; 2 UK

Summary This study investigates the relative contributions of the anterior cruciate ligament (ACL), anterolateral ligament and adjacent capsule, Kaplan fibres and posterior root of lateral meniscus to translational and rotatory stability of the knee.

Data

Introduction Tears of the anterior cruciate ligament (ACL) are often accompanied by injuries to the anterolateral complex (Kaplan fibres (KF), anterolateral capsule including the anterolateral ligament (C/ALL)), plus posterior lateral meniscus root (PLMR) tear. These concomitant injuries have been separately associated with increased anterolateral instability, but their relative contributions to stability remain unknown. The aim was to investigate the relative contributions of the ACL, C/ALL, KF and PLMR to translational and rotatory stability of the knee. It was hypothesized that the KF are the primary restraint against tibial internal rotation.

Methods Ten fresh-frozen human cadaveric knees (aged 56 ± 4 years) were tested in a 6-degrees of freedom robot system (Stäubli TX90). Initially, the robot found the passive path by neutralizing loads/torques in each knee. Then, 90° anterior/posterior force, 5Nm internal/external and 8Nm valgus/varus torques were applied in 0°, 30°, 60° and 90° and the kinematics were recorded. The kinematics were replayed after sequentially cutting the ACL, C/ALL, KF and the PLMR (order varied) and the respective load/torque drop was measured. The decrease of load/torque reflected the respective contribution of the cut structure to restrain knee laxity. One-way analysis of variance (ANOVA) with repeated measures were used to find significance in the contribution of the anatomical structures across the cutting stages separately for each load/torque and flexion angle.

Results The ACL was the primary restraint for anterior translation and accounted for 71 ± 11% in 0° and 64 ± 8% in 30° knee flexion (p < 0.0001). Internal rotation was mainly constrained by the KF with growing contribution from lower to higher flexion, reaching: 44 ± 23% at 90° (p < 0.01) and followed by C/ALL: 14 ± 13% at 90° (p < 0.05). The ACL was a restraint of internal rotation in 0° knee flexion: 16 ± 13% (p < 0.05), but insignificant in higher flexion. The PLMR was not a significant restraint of internal rotation or anterior translation. However, cutting the PLMR resulted in a considerable torque decrease for valgus: 33 ± 17% at 90° (p < 0.0001), but was insignificant in resisting external rotation: max 5 ± 6% at 30° and posterior draw: 11 ± 9% at 30°.

Conclusion The Kaplan fibres were a significant restraint against tibial internal rotation, especially in higher (60° and 90°) knee flexion, and the ACL to anterior draw across 0° to 90°, as hypothesised. The C/ALL complex contributed 10% to 14% resistance to internal rotation from 30° - 90° knee flexion. The PLMR resisted neither internal rotation nor anterior translation significantly, but had a large effect in valgus rotation. The findings with clinical implications are: (1) The KF on the lateral femoral condyle and shaft are a strong restraint of internal rotation (along with overlying ITB), and (2) The PLMR provided negligible resistance to anterolateral knee laxity within normal laxity limits (ACL intact/reconstructed).
Methods Data from 69 patients (43 males/26 females, median age 27 - percentile 25–75: 20–37), were retrospectively extracted from their medical records. All had a primary or secondary ACL deficiency as confirmed by MRI and clinical examination with a bilateral weightbearing radiograph of the knees at 15°-20° flexion available. Meniscal status was assessed on MRI images by a radiologist and an independent orthopaedic surgeon. ATT and posterior tibial slope (PTS) were measured on the lateral monopodal weightbearing radiographs for both affected and contralateral healthy side. Paired t-test was used to compare affected/healthy knees. Independent t-tests were used to compare primary/secondary ACL deficiencies, time from injury (TFI) (=4 years/> 4 years) and meniscal versus no meniscal tear.

Results ATT of the affected side was significantly greater than the contralateral side (6.2±4.4 mm vs. 3.5±2.8 mm; p<0.01). There was moderate correlation between ATT and PTS in both the affected and healthy knees (r=0.43, p<0.01 and r=0.41, p<0.01). SSD-ATT was greater in secondary ACL deficiencies (4.7±3.8 vs. 1.9±3.2 mm; p<0.01), patients with a TFI greater than 4 years (4.2±3.8 vs. 2.0±3.0 mm; p<0.01) and with at least one meniscal tear (3.9±3.8 vs. 0.7±2.2 mm; p<0.01). Linear regression showed that, in primary ACL deficiencies, SSD-ATT was expected to increase (+ 2.7 mm) only if both a meniscal tear and a TFI > 4 years were present. In secondary ACL deficiencies, SSD-ATT was mainly influenced by the presence of meniscal tears regardless of the TFI. Conclusion SSD-ATT was significantly greater in secondary ACL deficiencies, patients with a TFI greater than 4 years and with at least one meniscal tear. These results confirm that SSD-ATT is a time-and meniscal-dependent parameter, supporting the concept of gradual sagittal decompensation in ACL-deficient knees and point out the importance of the menisci as a secondary restraint of the knee. Monopodal weightbearing radiographs may offer an easy and objective method for the follow up of ACL injured patients to identify early signs of soft tissue decomposition under loading conditions. Level of Evidence: Level III Key words: Anterior Tibial Translation, weightbearing radiographs; ACL deficiency; knee sagittal decompensation

Summary Level II cohort study of consecutive patients managed with or without bone marrow aspiration concentrate augmentation (BMAC) during ACL reconstruction. At 6 months follow-up, BMAC did not improve graft maturation as seen on magnetic resonance imaging, and did not show differences for functional outcomes at 6 months, 12, and 30-month follow-up.

Data Background There is ambiguous recent evidence regarding the use of healing adjuvants during anterior cruciate ligament reconstructions (ACL-R) procedures. Bone marrow aspiration concentrate (BMAC) has been proposed as a safe and potentially healing stimulation aid in animal models; however, clinical evidence is still scarce and controversial regarding imaging and functional results.

Purpose Evaluate the imaging and functional outcomes of BMAC augmentation in ACL-R.

Methods Cohort nonrandomized study in patients treated for primary ACL rupture using an autologous hamstring graft. Patients with multiligamentary knee injuries and revision surgeries were excluded. Two study groups were analyzed: Intervention (BMAC) and Control. Both groups were compared for operative times, graft maturation (magnetic resonance at 6 months from surgery), and functional outcomes (isokinetic tests at 6 months from surgery, and KOOS, IKDC, Lysholm, and Tegner at 0, 6, 12, and 30 months). BMAC was obtained from the intercondylar femoral notch during the reconstruction procedure.

Results Forty-nine patients were selected (30 Intervention/19 Control). Both groups were comparable for age (p=0.845), sex (p=0.711), body mass index (p=0.121), and all pre-operative functional scores, except for a higher KOOS (Function in sport and recreation) in the Control group (p=0.035). Two (6.7%) and two (10.5%) patients from Intervention and Control group, respectively, lost follow-up at 30 months from surgery (p=0.548). Operative times: The Intervention group showed significantly higher operative times than the Control group [63 minutes (48–90)/50 minutes (38–72); p<0.001]. Graft maturation: No differences regarding graft maturation were observed for tunnel integration (p=0.498; p=0.954) and graft ligamentization (p=0.382) between groups. Isokinetic tests: No differences between groups in muscle deficit at 6 months, for both extensor [36% (11–68)/32% (15–73); p=0.339] and flexor muscles [15% (2–46)/14% (7–34); p=0.875]. Functional scores: No differences at 6, 12, and 30 months from surgery between groups. Both groups showed significant improvements between baseline and 6 months (p<0.001), and between 6 and 12 months (p<0.001).

Conclusion BMAC did not improve ACL-R graft maturation and isokinetic tests at 6 months of follow-up, nor functional outcomes at 6, 12, and 30 months from surgery compared to a Control group; however, it increased operative time.
modulates the healing process by decreasing the gene expression of inflammatory, muscle atrophy, and reparative markers.

Methods Experimental in vivo study in twenty C57BL6 male mice (age 3–4 months). A complete mid-section in the right quadriceps was done on all animals and then randomly assigned to two intervention groups: ASCD Group (n=10): ASCD (1mg) administered 14 days from the muscle injury, and Control Group (n=10): No intervention. All left quadriceps were left without injury nor intervention and were considered as a third study group: Healthy muscle group (n=20). Molecular evaluations were blinded and included mRNA expression (qRT-PCR) of the following markers: Inflammatory (TNF-a, FASL, ANX), muscle atrophy (ACT3, TGF-a, and MSTM), and reparative (extracellular matrix (MMP3 and Col6a5) and myogenic (IGFBP-2, CDKN2-a, CDK-1, APOE, KRT-8, KRT-18, FGF-1, FGF-6, Kd67, VEGF-a, VEGF-b, and Myog)). Evaluations were performed at 21 and 28 days after the muscle section to assess the time frame progression of the molecular changes. Statistical analysis included the Kruskal-Wallis, ANOVA, and Bonferroni tests (p<0.05). The minimum necessary animals were considered for 80% of statistical power.

Results Inflammatory: Control Group showed significantly more TNF-a and FASL than the ASCD group (p<0.05). The ASCD Group did not differ from the Healthy Group for any factor (p>0.05). Muscle atrophy: ASCD Group showed significantly less TGF-a, ACT3, and MSTM expression than the Healthy Group (p<0.05). Reparative (extracellular matrix): Control Group showed significantly more MMP3 and COL6A5 expression than the Healthy Group (p<0.05). Reparative (myogenic): Control Group showed significantly more IGFBP, CDKN2a, APOE, KRT-8, KRT-18, Ki67, and Myog than the Healthy Group (p<0.05). The ASCD group showed significantly more IGFBP and KRT-8 expression than the Healthy Group only on day 28 (p=0.014).

Conclusion In this animal model, the local administration of ASCD after a muscle injury modulated the normal healing process by decreasing the expression of inflammatory, atrophic, and reparative extracellular matrix and myogenic markers.

**21124 LOWER EXTREMITY INJURY RATES ON ARTIFICIAL TURF AND NATURAL GRASS PLAYING SURFACES: A SYSTEMATIC REVIEW**

Heath Patrick Gould, Stephen J Lostetter, Eric R Samuelson, Gregory P Guyton. USA

10.1136/jisakos-2021-congress.336

Summary In a systematic review, the rates of overall injury and knee injury appear to be similar between artificial turf and natural grass playing surfaces, though artificial turf may be associated with a higher rate of foot & ankle injuries compared to natural grass.

Data

Introduction Artificial turf (AT) playing surfaces have emerged as a common alternative to natural grass (NG) at all levels of athletic competition from youth to professional. While several prior articles have compared the lower extremity injury rates on AT and NG, the heterogeneity of these studies in terms of design and methodology has led to widely variable results. The purpose of this systematic review was to determine whether any definitive conclusions can be drawn with regard to the risk of lower extremity injury on AT and NG playing surfaces.

Methods A systematic review of the English-language literature was performed according to the PRISMA guidelines. All included studies presented a direct comparison of injury rates on AT versus NG playing surfaces. No restrictions were made with regard to sport, level of competition, level of evidence, or year of publication. Studies that examined only head injury rates (e.g. concussions) without any comparison of overall injury rates or lower extremity injury rates were excluded. Systematic reviews and meta-analyses were also excluded. The following data elements were extracted from each article: publication year, study design, level of evidence, industry funding, cohort selection process (ad-hoc vs. systematic), sport, level of competition, number of athletic seasons, injury setting, AT type, overall injury rate, knee rate, and foot & ankle injury rate. AT types were classified into Old Generation (1st or 2nd generation) or New Generation (3rd generation or higher).

Results 53 articles ranging in publication year from 1972 to 2020 met inclusion criteria. 31 articles compared overall injury rates (indiscriminate of anatomic location) on AT versus NG. Roughly one-half of these studies (51.6%) found no significant difference between NG and AT, while one-third (35.5%) found a higher overall injury rate on AT and just 4 studies (12.9%) found a higher overall injury rate on NG. Similarly, of the 26 articles comparing knee injury rates, 14 studies (53.8%) reported no significant difference between AT and NG, 8 studies (30.8%) reported a higher injury rate on AT, and 4 studies (15.4%) reported a higher injury rate on NG. With regard to foot & ankle injuries, however, a majority of articles (14/24, 58.3%) reported a higher injury rate on AT. Comparatively few articles (3/24, 12.5%) reported a higher foot & ankle injury rate on NG, while the remaining articles (7/24, 29.2%) reported no difference in foot & ankle injury rate between AT and NG. Moreover, this trend toward a higher foot & ankle injury rate on AT persisted when New Generation and Old Generation playing surfaces were analyzed separately. Further analysis of the 3 articles reporting a higher foot & ankle injury rate on NG also revealed that 2 of these studies (66.7%) utilized ad-hoc cohort selection and received industry funding from an AT manufacturing company.

Conclusions The present study is a systematic review of 53 articles in the English-language literature that compared injury rates on AT and NG. Our findings suggest that the rates of overall injury and knee injury are similar between these two playing surfaces, though AT may be associated with a higher rate of foot & ankle injuries compared to NG.

21140 THE TOP 100 MOST IMPACTFUL ARTICLES ON THE MEDIAL ULNAR COLLATERAL LIGAMENT: AN ALTMETRIC ANALYSIS OF ONLINE MEDIA

Heath Patrick Gould, Kunal M Kirloskar, Matthew Cvijlette, William Rate, Andrew Cohen, Brett Haislip, Blake M Bodendorfer, Heath Patrick Gould. USA

10.1136/jisakos-2021-congress.337

Summary The top 100 most impactful MUCL articles in online media were substantially different from the most-cited MUCL articles.

Data

Introduction The medial ulnar collateral ligament (MUCL) is a commonly injured ligament in athletes who compete in sports.
Biomechanical analysis of kicking action in football aids in performance assessment and identifying the proportion of injury risk among players in a team. The information obtained can be used to formulate injury prevention training programs and also equips the coaches and sports physicians to understand the mechanism of injury occurrence.

**Data**

**Introduction**

Kicking in football is an essential, common, and distinctive part of a players activity. During an average 90-minute game, a player has 51 contacts with the ball, 26 with the foot. An analysis of injury risk while playing football indicated that kicking accounted for 51% of potential actions that could lead to injury. Approximately 60%–80% of severe injuries to football players occur in the lower extremities, most commonly at the knee (29%) and ankle (19%). Kicking is the most reproducible action in football which can be studied in lab environments. We aimed to analyse the biomechanical factors that contribute to better kick performance and identify injury risk in Indian league level football players.

**Materials and Methods**

25 professional Male Football players participated in this descriptive cross-sectional study. Five successful instep kicks were performed against a goalpost placed 11m from the football. 35 retroreflective markers were affixed over the player’s skin on anatomical landmarks. The instep kick was captured using sixteen 3D VICON motion capture cameras (250 fps), two 2D Bonita cameras (125 and 250 fps), AMTI force plates and ball velocity using Radar speed gun (Ball catch). The data was analysed using VICON Nexus software version 2.7 and key biomechanical parameters were quantified and compared with the existing literature. Descriptive statistics were done using R software version 4.0.1.

**Results**

Players had a mean age of 18.8 ± 0.96 years with professional training of 6.72 ± 3.17 years. The study group consisted of 36% Midfielders, 16% goalkeepers, 36% defenders and 12% strikers. The mean hip shoulder separation angle measured 20.33 ± 6.15° which was found to be significantly lower (p<0.05). The peak trunk rotation velocity and peak hip flexion velocity of 437.95 ± 118.37°/s and 565.86 ± 129.81°/s respectively was noted to be similar to the values in literature with positive correlation to ball velocity. Supporting leg knee flexion at ball contact was 43.75 ± 9.18°. The ankle plantarflexion at ball impact measured 33.97 ± 11.05° which was found to be significantly higher than the reference values (3.44 ± 0.61N/Kg BW). The mean duration of the kick cycle was significantly lower especially the followthrough phase amounting to 0.062 ± 0.01s.

**Conclusion**

Peak Hip Flexion velocity, Trunk Rotation Velocity and Ankle Plantarflexion correlate with better kick performance. Greater ankle range of motion at ball impact predisposes to a higher incidence of Anterior Ankle Impingement syndrome. Higher Ground Reaction Forces and Shorter Follow-Through Phase imply that the players are prone to deceleration injuries of the lower back, knee and ankle. These findings will aid in the strategic planning of injury prevention programs and refine kicking technique thus optimising performance.
Summary Intra-articular gadolinium for magnetic resonance arthrogram administered concurrently with a diagnostic intra-articular anesthetic injection can result in a false negative response to the diagnostic injection, but is not a negative predictor of short-term surgical outcomes after hip arthroscopy.

Data

Introduction Magnetic resonance arthrography (MRA) with intra-articular gadolinium and diagnostic intra-articular anesthetic injections (DIAI) are important tools in the evaluation of young patients with hip pathology and are often performed concurrently. However, some authors have questioned whether concurrent gadolinium administration can lead to false negative DIAI due to post-arthrography pain.

Methods Patients receiving a series of two diagnostic intra-articular hip injections with anesthetic, the first with gadolinium for concurrent MRA and the second without gadolinium, were retrospectively identified. Pain response to diagnostic injection, injectate volume, local anesthetic volume, inclusion of corticosteroids, and method of injection were compared between injections. False negative injection was defined as <50% pain relief with concurrent gadolinium, but > or =50% pain relief with subsequent anesthetic injection without gadolinium. False negative injections in patients that ultimately underwent primary hip arthroscopy were identified from this cohort and matched in a 3:1 ratio to a control cohort to compare post-operative single assessment numerical evaluation (SANE) scores.

Results Forty-three patients underwent a series of anesthetic injections with and without gadolinium and met inclusion and exclusion criteria. Pain response was significantly different in injections performed with and without gadolinium (18% vs. 81%; p<0.001). There were significant differences in total injectate volume, local anesthetic volume, corticosteroid use, and method of injection between injections, but these variables were not correlated with pain response based on Spearman’s correlation tests. Fifteen patients had false negative responses to injection with gadolinium and were matched in a 3:1 ratio to a control cohort. There was no difference in post-operative SANE scores between the gadolinium-sensitive and control groups (81.6 vs. 80.0, p>0.05) collected at an average one year post-operatively.

Conclusion Concurrent administration of intra-articular gadolinium with DIAI may result in a false negative response to anesthetic. Additionally, in patients with initial false negative DIAI with gadolinium followed by response to a second injection without gadolinium, short-term post-operative outcomes after hip arthroscopy are similar to a matched cohort.

Introduction Recurrent shoulder instability is frequently associated with glenohumeral bone loss. Recently there has been a surge of interest in arthroscopically performed bone block procedures. The aim of this systematic review was to determine the clinical and radiological outcomes of arthroscopic glenoid bone block stabilisation for recurrent anterior dislocation.

Methods This systematic review was performed in accordance with PRISMA guidelines. The search strategy was applied to MEDLINE and Embase databases on 20th July 2020. Studies reporting either clinical or radiological outcomes following arthroscopic bone block stabilisation for recurrent anterior dislocation were included. Primary outcomes were function and instability scores. Secondary outcomes included recurrent instability, graft union and resorption rates, return to activity/sports, and complications. Pooled analysis was performed when an outcome was uniformly reported by more than one study. Critical appraisal of studies was conducted using the Methodological Index for Non-Randomized Studies (MINORS) tool.

Results Application of the search strategy resulted in the inclusion of 15 eligible studies; 12 used iliac crest bone graft while 3 used distal tibial allograft. The overall population comprised 265 patients (mean age range, 25.5–37.5 years; 79% of participants were men). All post-operative outcome scores were significantly improved, and the overall rate of recurrent instability was low (weighted mean 6.6%, range 0–18.2%) at mean follow up of 30.4 months. The Rowe score was the most frequently reported outcome measure, improving on average by 33.9 points at final follow-up, exceeding the minimal clinically important difference (MCID) threshold. Graft union rates ranged between 92–100% in 8 out of 10 studies at mean follow up range 6–78.7 months but two reported lower rates ranging from 58.3–84% for autografts and 37.5% for allografts. Graft resorption rates averaged between 10–16% for autografts and 32% for allografts. Hardware-related complications occurred in 2% with the most frequent being screw breakage or symmetric mechanical irritation.

Conclusion Arthroscopic bone block stabilisation is associated with high rates of graft union, significant improvements in the WOSI, Rowe, Constant and SSV scores (exceeding MCID thresholds where known), and a low rate of complications. Longer follow-up of these patients and future experimental studies are required to further examine the effects of graft type and fixation methods.

Summary Arthroscopic bone block stabilisation is associated with high rates of graft union, significant improvements in the WOSI, Rowe, Constant and SSV scores (exceeding MCID thresholds where known), and a low rate of complications.

Data

Introduction Patellofemoral pain or instability (PFI) is often caused by femoral or tibial malalignment. Despite normal torsion
measurements (CT/MRI) in femur/tibia there are symptomatic patients with clinical high external rotation of the tibia (ROM shifted to external rotation). An intraarticular malrotation of the knee may be the cause for chronic patellar maltracking or patellofemoral instability in these situations. The influence of the intraarticular rotation of the knee has not been considered and described in the literature yet. The aim of this study was to detect and quantify a possible intraarticular malrotation of the knee in symptomatic patients.

**Materials and Methods**

100 patients with patellofemoral pain, instability or a suspected malalignment of the lower extremity that had been examined for torsional abnormalities via MRI were included in a retrospective study between November 2017 and May 2020. The torsion of the femur and tibia were measured using the method of Strecker and Waidelich. The intraarticular rotation (IAR) of the knee was measured in full extension; therefore the angle between the posterior femur condylar axis (PFCA) and the proximal posterior tibia plateau axis (PTPA) was analyzed. Supplementary measurements were made using the following levels and values: (1) femur transsepticondylar axis (FTEA); (2) the tibial plateau ellipses axis (TPEA; axis through the center of two ellipses on the medial and lateral tibial plateau below meniscal level) (3) tibial tuberosity trochlea groove distance (TT-TG) and (4) tibial tuberosity posterior cruciate ligament distance (TT-PCL). In Long leg x-rays ("knee forward") measurements of the mechanical Femur-Tibia-Axis (mFTA), mechanical Medial- Proximal-Tibia-Angle (mMPTA) and Joint-Line-Convergence-Angle (JLCA) were performed.

**Results**

In 200 analyzed legs of 100 patients (mean age 23.5 ± 8.6 years) the intraarticular rotation of the knee was +5.4 ± 5.2° (range -7.7 to +16.4°) external rotation (PFCA to PTPA). The mean femoral torsion was -29.5 ± 10.7° (-74.9 to -0.8°) internal torsion, mean tibial torsion +36.9 ± 8.4° (+9.7 to +62.3°) external torsion. The additional measurement from FTEA to PTEA showed an intrarticular rotation of +4.7 ± 5.2° (-8.0 to 16.6°) external rotation. Mean TT-TG was 16.3 ± 4.0 mm (6.8 bis 30.1 mm) and mean TT-PCL 21.6 ± 3.4 mm (10.6 to 32.6 mm). The leg axis analysis showed the following results: mFTA: 0.9 ± 3.0° (-7.1 to 11.5°) valgus; mL DFA: 86.2 ± 2.1° (80.2 to 91.4°); mMPTA: 87.6 ± 2.5° (82.2 to 96.6°); JLCA: 0.5 ± 1.3° (-4.6 to 4.3°) medial convergence.

**Conclusion**

This study group is a population with expected normal torsion or intraarticular rotation. Therefore, normal values for rotation of the knee cannot be defined in this study. However, the range of 24.1° of intraarticular knee rotation may have a decisive influence on the rotational alignment of the lower extremity and on the patellofemoral joint causing PFI or maltracking. This has not been described and sufficiently taken into account in the analysis of patellofemoral disorders yet. Additional studies are necessary to define the normal value and range of intraarticular rotation (IAR) in healthy patients.

**Summary**

Genetics contribute substantially to the etiology of ATR with an estimated heritability of the liability to ATR of approximately 50%.

**Data**

Objective: The etiology of Achilles tendon rupture (ATR) is complex and not fully understood. The aims of the study were (1) to calculate the concordance rate for monozygotic twins and same-sex dizygotic twins and (2) to estimate the heritability of ATR.

Methods The study was performed as a registry study using the Danish Twin Registry and the Danish National Patient Registry. Twins registered with ATR were retrieved and the probandwise concordances for monozygotic and dizygotic twins were calculated. Additionally, using structural equation analyses the heritability of ATR was estimated.

Results The study sample consisted of 85,534 twins born from 1870–1996. Of these, 572 (0.67%) were registered with ATR in the period from 1994 to 2014. The concordance rate was 0.081 (95% CI 0.018–0.154) for MZ twins and 0.043 (95% CI 0.014–0.095) for SSDZ twins. The heritability of ATR was 47% (95% CI 31–62%).

Conclusion This study found that genetics contribute substantially to the etiology of ATR with an estimated heritability of the liability to ATR of approximately 50%. The finding generates the hypothesis that genetics play a role in the pathological changes that occur in the Achilles tendon before a rupture. The risk of ATR for a twin within a 20 year period, if the co-twin had had an ATR, was 8% for MZ twins and 4% for SSDZ twins which may be clinically relevant.
Results The mean follow-up was 55.0 months (range, 24–119 months). Compared with preoperative assessment, all functional scores significantly improved (P< .001). At the final follow-up, a significant ROM loss (>15°) of external rotation (ER) at the side (ER0) was found in 12 patients, among whom 8 patients had significant ROM loss of ER at 90° of abduction as well. Further, 12 patients with decreased ER had significantly higher signal intensity of cartilage on the anterior, middle, and posterior humeral head (anteroP, P = .002; middle, P <.001; posterior, P <.001) than 9 patients with normal ER. The ratio of the width of the remplissage anchor to the humeral head (w:d ratio) was significantly greater (P = .031) in the decreased ER group than in the normal ER group. Correlation analysis showed that signal intensity on the posterior humeral head and ER0 loss (deltaER0) had a significantly positive correlation (r = 0.516; P = .034), while the w:d ratio and deltaER0 had a significantly positive correlation (r = 0.519; P = .039).

Conclusion At a minimum of 2 years of follow-up, patients who underwent BR showed significant clinical improvement compared with preoperative assessment, except for limitations in ER. The glenohumeral cartilage degeneration (higher signal intensity) after BR had a significantly positive correlation with the postoperative ER loss, which was found to be associated with a relatively medial placement of the remplissage anchor. Keywords: shoulder instability; arthroscopy; Bankart repair; remplissage; articular cartilage

Summary This study identified asymmetry in axial plane rotator cuff muscle fatty infiltration in B2 and B3-type glenoids compared to concentrically worn glenoids, with relatively more fatty infiltration of the infraspinatus and teres minor compared to the subscapularis in glenoids with posterior wear pattern.

Purpose The purpose of this study was to use MRI to assess the association of rotator cuff muscle fatty infiltration and glenoid morphology in primary glenohumeral osteoarthritis.

Background Rotator cuff atrophy evaluated with computed tomography (CT) scans has been associated with asymmetric glenoid wear and humeral head subluxation in glenohumeral osteoarthritis (GHOA). Magnetic resonance imaging (MRI) has increased sensitivity for identifying rotator cuff pathology compared to CT and has not been used to investigate this relationship.

Methods 132 shoulders from 129 patients with primary GHOA were retrospectively reviewed and basic demographic information was collected. All MRIs were obtained as part of preoperative evaluation prior to total shoulder arthroplasty and were reviewed to assess glenoid morphology and rotator cuff pathology. All patients had intact rotator cuff tendons. Glenoid morphology was assigned using the modified-Walch classification system (types A1, A2, B1, B2, B3, C, and D) and rotator cuff fatty infiltration was assigned using Goutallier scores.

Results 46 (35%) of the shoulders had posterior wear patterns (23 type B2s, 23 type B3s). Both the infraspinatus and teres minor independently had significantly more fatty infiltration in B2 and B3 type glenoids compared to type A glenoids (p <.001). There was a greater imbalance in posterior rotator cuff muscle fatty infiltration in B2 and B3 type glenoids compared to type A glenoids (p <.001); however, there was no difference in axial plane Goutallier scores between B2 and B3 glenoids (p = 1.00). There was an increased amount of fatty infiltration in the infraspinatus among B2 and B3-type glenoids compared to type A glenoids on multivariate analysis controlling for age and gender (Odds ratios of 71.7 [95% CI 8.2 to 629.0, p <.001] for B2 glenoids and 64.5 [95% CI 5.8 to 717.9, p <.001] for B3 glenoids). Males were also found to have increased likelihood of having B2 or B3-type glenoids compared to type A glenoids in the same multivariate analysis (Odds ratios of 4.5 [95% CI 1.1 to 18.1, p = 0.034] for B2 glenoids and 12.2 [95% CI 2.4 to 61.7, p = 0.0025] for B3 glenoids).

Conclusions These results identify significant asymmetry in axial plane rotator cuff muscle fatty infiltration in B2 and B3-type glenoids compared to concentrically worn glenoids, with relatively more fatty infiltration of the infraspinatus and teres minor compared to the subscapularis in glenoids with posterior wear pattern.
A labral repair was performed in 78.9% and 76% of the BD and control groups, respectively, all patients underwent capsular closure as part of routine hip arthroscopy. A cam decompression was performed in 97.4% of the BD patients and 99.0% of the control patients. At mean follow-up of 9.6 years (range, 8.2–11.6 years) on average there was significant improvement in all patient-reported outcomes scores in both groups (P<0.001). There were no significant differences between pre and post-operative scores or rates of achieving MCID between BD and control groups. Two hips (5.2%) underwent revision surgery in the BD group and 10 hips (10.4%) in the control group, of these one patient in the BD group underwent THA and one patient who underwent bilateral hip arthroscopies in the control group underwent bilateral hip resurfacing.

**Conclusion** Durable outcomes (>9 years) with low revision rates can be expected after isolated hip arthroscopy that includes cam resection, labral refixation and capsular closure in BD patients with equivalent outcomes to a FAI cohort with normal coverage parameters.

**20389** ARTHROSCOPIC LATARJET PROCEDURE FOR RECURRENCE OF ANTERIOR SHOULDER INSTABILITY AFTER FAILED ARTHROSCOPIC BANKART REPAIR

1Manuel Olmos, 2Mikaili Chell, 3Jakub Stefaniasz, 4David J Saltkin, 5Patrick Gendre, 2Gilles Cloizeux, 1Pascal Boileau. 1Argentina; 2France; 3Poland; 4Canada

Summary Revision Arthroscopic Latarjet is an efficient and safe procedure with high rate of return to sport and low complication rate.

**Data**

**Background** Recurrent anterior instability after arthroscopic Bankart repair (ABR) it’s a concern and often related to gle- noid bone loss. Results of arthroscopic Latarjet in this setting has never been published.

**Purpose** To assess clinical and radiological outcomes after revision arthroscopic Latarjet procedure for recurrence of anterior instability after failed arthroscopic Bankart repair. Study design: Case series; Level of evidence, 4.

**Methods** We included all patients undergoing revision of failed Bankart repair with arthroscopic Latarjet. Recurrence, complications and return to sport were assessed. Forty-eight consecutive patients (38 males; mean age 30 years ±9.4, 17–55) were followed for a mean 73 months (±40, 26–150). All patients had recurrent shoulder dislocation (31 cases) or subluxation (17 cases) and apprehension before revision surgery. ISIS score was 5.2 points (±1.9, 1–9). 32 patients had hyperlaxity and 44 were involved in sport practice. Recurrent instability occurred in average 29 months (±35, 3–166) after ABR, whereas revision surgery was performed 59 months (±62, 8–303) after failed ABR. All patients had a Hill-Sachs lesion and 41% had glenoid bone defect > 20% on preoperative imaging studies or during arthroscopy. Button fixation was performed in 36 patients while 12 patients underwent single screw fixation. An associated capsulolabral repair was performed in all, and an additional Hill-Sachs remplissage only in four patients.

**Results** At final follow-up, no recurrence was observed; 10 patients (21%) had persistent anterior apprehension. Two complications (one temporary musculocutaneous nerve palsy and one infection) were addressed and one reoperation was performed. Mean Walch-Duplay and ROWE score were 80 (±16, 45–100) and 82 (±16, 45–100), respectively. Mean subjective shoulder value (SSV) for daily living (SSVdaily) was 91 (±11, 40–100) while for sport (SSVsport) was 86% (±14, 40–100). Visual analogue scale (VAS) for pain was 1.1 ± 2. No significant difference was observed in terms of range of motion before revision surgery and at last follow-up. Return to sports was achieved in 98% of cases, but only 19 patients practiced high risk sports. 55% returned to competition level (11/20). Return to sport was faster in those patients practicing sports without risk (5.4 ± 1.5 months vs. 6.7 ± 2 months, P = 0.018). Bone block healed in 88% of cases. Flush positioning was observed in 83% of cases and subequatorial in 44 patients. Single screw fixation technique group had higher incidence of bone block nonunion (33% vs 6%, P = .028) and lateralized bone block (33% vs 6%, P < .001). Bone block migrated in 6 patients before 9 months post-operative. Arthritic changes (Samilson 1, 2 and 3) were observed in 15 patients (31%) but no patient developed osteoarthritis with joint line narrowing (Samilson 4). Overall, 47 patients (98%) were satisfied or very satisfied with the procedure. Persistent anterior apprehension was associated to a lower level of SSVsport (p = 0.038) and bone block nonunion/migration (p = 0.012).

**Conclusion** Arthroscopic Latarjet is an efficient and safe procedure for failed ABR, with high rate of return to sport and patients’ satisfaction. The arthroscopic nature of the technique offers the possibility to control bone block position and simultaneously address other associated lesions (labrum detachment, engaging hill-sachs lesion, cuff or biceps tendon lesion).

**20712** PREDICTING SUBJECTIVE FAILURE OF ACL RECONSTRUCTION: A MACHINE LEARNING ANALYSIS OF THE NORWEGIAN KNEE LIGAMENT REGISTER AND PATIENT REPORTED OUTCOMES

1R Kyle Martin, 1Solveig Wastvedt, 1Ayoosh Pareek, 2Andreas Persson, 2Havard Visnes, 1Anne Marie Fenstad, 1Gilbert Moatshe, 2Julian Wolfson, 2Lars Engebretsen, 1USA; 2Norway

Summary This machine learning analysis of a national knee ligament register can predict a patient’s risk of subjective failure of ACL reconstruction (KOOS QoL <44). The resulting algorithm supports the creation of an easy-to-use calculator for point-of-care risk stratification which can be used to guide surgical discussions with patients and quantify their specific risk of failure.

**Data**

**Background** Measurement of patient reported outcome measures following anterior cruciate ligament (ACL) reconstruction enable the recognition of patients who have experienced an inferior outcome but who have not undergone subsequent revision surgery. While we can identify these patients based on their post-operative scores, the ability to accurately predict the risk of a poor subjective outcome pre-operatively remains challenging. Our hypothesis was that machine learning analysis has the potential to improve our predictive capability. We applied machine learning analysis of primary ACL reconstructions to the Norwegian Knee Ligament Register (NKLR) with the purpose of: (1) identifying the most important risk factors associated with experiencing a subjective failure of ACL reconstruction.
reconstruction and (2) developing a clinically meaningful calculator for predicting the risk of an inferior outcome.

Methods Machine learning analysis was performed on the NKLR dataset. The primary outcome measure was subjective failure of ACL reconstruction, defined as a Knee Injury and Osteoarthritis Outcome Score (KOOS) Quality of Life (QoL) subscale score less than 44 at two-years post-operatively. Data was split randomly into training (75%) and test (25%) sets. Four machine learning models were tested: Lasso logistic regression, random forest (RF), generalized additive model, and gradient boosted regression (GBM). Calibration and area under the curve (AUC) were calculated for all four models.

Results In total, 20,818 patients met the inclusion criteria and complete follow-up KOOS data was available for 11,630 patients at two-years (56%). Of these, subjective failure was reported by 2,556 patients (22%). All models except the RF were well calibrated and the GAM exhibited the best performance (AUC 0.68; 95% CI 0.64–0.71). Inverse-probability weighted analysis suggested there were no significant differences between those with complete KOOS data and those with missing data. In total, six pre-operative variables were required for outcome prediction and an in-clinic calculator was developed which can estimate the risk of experiencing a subjective failure of primary ACL reconstruction (https://swastvedt.shinyapps.io/calculator_koosqol/). While the overall risk of subjective failure was 22%, this calculator can quantify risk at a patient-specific level.

Conclusions Machine learning analysis of a national knee ligament register can predict the risk of a patient experiencing an inferior outcome and subjective failure after primary ACL reconstruction with moderate accuracy. This algorithm supports the creation of an in-clinic calculator for point-of-care risk stratification prior to surgery based on the input of six readily available factors. Interestingly, all predictors of subjective failure were patient-related and non-modifiable by the surgeon nor affected by surgical technique.

#### 20514 MANAGEMENT OF IRREPARABLE ROTATOR CUFF TEARS: SUPERIOR CAPSULAR RECONSTRUCTION VS. MARGINAL CONVERGENCE

Neel K Patel, Nyaluma N Wagala, Christopher John Como, Bryson P Lesniak, Albert Lin. USA

10.1136/jisakos-2021-congress.348

Summary Based on the findings of this study, the clinical outcomes following MC and SCR may be equivalent despite their varying cost and operative time. However, further studies with long-term outcomes are needed to determine if there are certain indications for which one treatment results in better outcomes.

Data

Introduction Irreparable rotator cuff tears can be challenging to manage in younger patients with minimal glenohumeral arthritis who are not well indicated for reverse total shoulder replacement. Treatment options in this patient population are usually marginal convergence (MC) and superior capsular reconstruction (SCR). Both of these treatment options have demonstrated good short-term outcomes but have vastly different associated costs and operative times. Thus, the purpose of this study was to compare range of motion (ROM), patient reported outcomes, and re-operation rates following MC and SCR. We hypothesized that SCR would outperform MC regarding functional and subjective outcomes as well as re-operation rates.

Methods Forty-four patients with irreparable rotator cuff tears that underwent either MC (28 patients, 28 shoulders) or SCR (16 patients, 16 shoulders) performed by 2 surgeons from 2014–2019 at a single academic center were retrospectively reviewed. All patients included in the study had failed conservative or prior surgical management, and demonstrated no or mild glenohumeral arthritis, Hamada grade 1 or 2 rotator cuff arthropathy, Goutallier grade 3 or 4 fatty infiltration of the involved muscles, and had an intact subscapularis or repairable subscapularis tear. All patients had a minimum of 1 year follow-up. Active forward flexion (FF) and external rotation (ER) range of motion, Visual Analogue Scale (VAS) for pain, reoperation rate, and rate of conversion to reverse total shoulder arthroplasty were evaluated. For statistical analysis, t-tests and Chi-Squared tests were used to determine differences within and between groups (*p < 0.05).

Results Average follow-up was 31.5 months for the MC group and 17.8 months for the SCR group. There were no significant differences in baseline characteristics of the patients in either group with regard to the mean age at the time of surgery, gender, body mass index, pre-operative FF and ER, and pre-operative VAS. There was no significant improvement in post-operative FF or ER in either group. Both the MC and SCR group had significant improvements in VAS for pain from an average of 7.3 pre-operatively to 2.5 post-operative for the MC group (p < 0.01) and from 7.3 pre-operatively to 1 post-operatively for the SCR group (p < 0.01). There were no significant differences in the post-operative FF or ER, change in FF or ER, post-operative VAS, or change in VAS between the two treatment groups. The overall rate of reoperation and rate of conversion to arthroplasty was not significantly different between the MR and SCR groups.

Discussion Both MC and SCR were effective in improving VAS for pain, but did not consistently result in significant improvement in ROM. This finding is contrary to previous studies that have shown significant improvements in ROM following both treatments individually. Overall, there were no significant differences between the treatment methods, which could be a result of the fact that the number of patients in each group of this study is relatively small. Additional patient reported outcome measures need to obtained with longer term follow-up in order to determine more subtle differences between the treatment options.

#### 20585 IS PLATELET-RICH PLASMA INJECTION MORE EFFECTIVE THAN STEROID INJECTION IN THE TREATMENT OF CHRONIC LATERAL EPICONDYLITIS IN ACHIEVING LONG-TERM RELIEF?

Prasad Soraganvi, Raghavendra Raju. India

10.1136/jisakos-2021-congress.349

Summary Purpose of this study is to compare the longerterm functional outcome of lateral epicondylitis treated with PRP and steroid injection.
Data

Background Autologous injection of platelet rich plasma (PRP) stimulates healing process in degenerated tendons. In recent times Steroid injection and PRP are used extensively for treatment of lateral epicondylitis. The purpose of this study is to compare the longterm functional outcome of lateral epicondylitis treated with PRP and steroid injection.

Methodology Clinically diagnosed lateral epicondylitis patients who failed conservative medical therapy were included in the study. Patients with previous surgery, vascular disease, neuropathy related to elbow pain were excluded from study. In this prospective double-blind study 140 patients included were divided randomly into two groups. Patients in group-A received PRP injection and in group-B received steroid injection. Steroid group (n=70) and PRP group (n=63). Data were collected before procedure, at 4, 8, 12 weeks, 1 year and 2 years after procedure. The main outcome measures were visual analogue score, Mayo elbow performance score, DASH score and hand grip strength. Among 70 patients in group B, 7 patients were missed for followup, hence not included in final outcome.

Results Successful treatment was defined as more than a 25% reduction in visual analogue score or DASH score and more than 75 score in Mayo elbow performance score. We observed that 35 of the 70 patients (50%) in corticosteroid group and 47 of the 63 patients (75%) in PRP group were successful, which was significantly different (p<.001), according to DASH score 37 of the 70 patients (53%) and 47 of the 63 patients (75%) in the PRP group were successful which was also significantly different (P <.005), Mayo elbow performance score was successful in 36 of the 70 patients (51%) in corticosteroid group and 49 of the 63 patients (78%) in PRP group. The improvement in hand grip strength of hand from 24.7kg (mean) 26kg in corticosteroid group and 23.3kg (mean) to 32.9 kg (mean) in PRP group.

Conclusion PRP injection for chronic lateral epicondylitis reduces pain, improve functionality and hand grip strength when compared to steroid injection and beneficial effects last long.

Methods Patients with the clinical diagnosis of chronic plantar fasciitis after failed conservative treatment and plantar fascia thickness more than 4 mm were included in the study. Patients with bilateral plantar fasciitis, vascular insufficiency or neuropathy, hypothyroidism and diabetics were excluded from the study. In this prospective double-blind study 80 patients included were divided randomly into two groups. Patients in group-A received PRP injection and in group-B received steroid injection. Patients were assessed with visual analog scale (VAS) and American Orthopedic Foot and Ankle Society (AOFAS) score. Assessment was done before injection, at 4 weeks, 3 months and at 6 months follow-up. Plantar fascia thickness was assessed before the intervention and six months after treatment.

Results Mean VAS in group-A and group-B decreased from 7.3 and 7.41 before injection to 1.41 and 2.9 at final follow-up, respectively. Mean AOFAS score in group-A improved from 56 to 92.03 and in group-B improved from 55.6 to 76.67 at 6 months follow-up. The improvement observed in VAS and AOFAS was statistically significant. At the end of six months follow-up, plantar fascia thickness reduced in both groups (5.86 mm to 3.35 mm in group-A & 5.6 to 3.8 in group-B) and the difference was statistically significant.

Conclusions Local injection of platelet-rich plasma is effective in reducing symptoms and plantar fascia thickness in chronic plantar fasciitis.

Summary PRP injection is more effective in reducing thickened plantar fascia and symptoms than steroid injection.

Data Background/Objective chronic Plantar fasciitis is characterized by pain in the heel, which aggravates on weight bearing after prolonged rest and thickened plantar fascia (>4 mm). Many studies show that steroid injection provides pain relief in the short term, but relief is not long lasting. Recent literature shows autologous platelet-rich plasma (PRP) injection promotes healing, resulting in better pain relief as well as reduction in plantar fascia thickness. This study was undertaken to compare the effects of local injection of Platelet Rich Plasma and Corticosteroid in the treatment of chronic plantar fasciitis.

Conclusions PRP injection for retrocalcaneal bursitis reduces pain, improve functionality compared to steroid injection and beneficial effects last long.
Summary AUTOLOGOUS MICRO-FRAGMENTED ADIPOSE TISSUE TO TREAT ADVANCED SYMPTOMATIC KNEE OSTEOARTHRITIS: Outcomes and prognosticators from a large case series with minimal 12 months follow-up.

Data
Purpose Autologous micro-fragmented adipose tissue (MFAT) for treating symptomatic knee osteoarthritis (OA) is gaining interest although supportive data on clinical safety and efficacy are lacking. The study primarily aimed to evaluate (1) the short-term clinical effect, (2) the therapeutic response rate (TRR), and (3) the therapeutic safety of a single intra-articular autologous MFAT injection for symptomatic knee OA. Secondly, patient- and pathology-related parameters were investigated to optimize patient selection in future clinical practice.

Methods Sixty-four subjects (37 unilateral, 27 bilateral) with mild-severe knee OA were enrolled in a single-centre trial. After liposuction, the adipose tissue was mechanically processed with the Lipogem device, which eventually produced 8–10cc MFAT. Subjects were clinically assessed by means of the KOOS, NRS, UCLA and EQ-5D at baseline and 1, 3, 6 and 12 months after injection. Adverse events were recorded. The TRR was defined according to the OMERACT-OARSI criteria and baseline MRI was scored following the MOAKS classification.

Results The TRR of the index knee was 64% at 3 months and 45% at 12 months after injection. Therapy responders at 12 months improved with 28.3±11.4 on KOOS pain, while non-responders lost 2.1±11.2 points. All clinical scores, except the UCLA, improved significantly at follow-up compared to baseline (p<0.05). In the bilateral cohort, no difference in baseline scores or TRR was found between the index knee and contralateral knee (n.s.). Numerous BML were negatively correlated with the TRR at 12 months (p=0.003). A post-injection inflammatory reaction was reported in 79% knees and resolved spontaneously within 16.6±13.5 days after MFAT administration without affecting the 12 month clinical outcome.

Conclusion The study demonstrated an early clinical improvement but a mediocre response rate of 45% at 12 months after a single intra-articular injection with autologous MFAT. Assessment of bone marrow lesions on MRI can be helpful to increase the therapeutic responsiveness of MFAT up to 70% at 12 months. In comparison to repetitive injection therapies increase the therapeutic responsiveness of MFAT up to 70% at 12 months. In comparison to repetitive injection therapies, repetitive injection therapies might become a relevant alternative in well-selected patients with symptomatic knee OA.

Summary Improving abduction ROM during functional tasks following RSA may be necessary for optimizing outcomes.

Data
Introduction Reverse shoulder arthroplasty (RSA) is a common procedure used to restore function in patients with rotator cuff arthropathy. Few studies have examined shoulder motion after RSA while performing functional activities, and all of them report maximum or end range-of-motion (ROM) without continuous kinematic data. The study aimed to present a comprehensive description of functional motions in RSA patients, determine the repeatability of motion between and within subjects, and examine correlations between motion and patient-reported outcomes (PROs). It was hypothesized that increased range-of-motion would correlate with better patient-reported outcome scores.

Methods Twenty-six patients received RSA Each subject completed 5 shoulder motions for at least 3 repetitions each: abduction, hand-to-head, hand-to-back, internal/external shoulder rotation with the arm in 90° abduction, and circumduction. Reflective markers placed on the torso, shoulder and humerus were tracked using conventional motion capture and used to calculate shoulder abduction, plane of elevation, and internal/external rotation for each motion. Total ROM, maximum/minimum ROM, and continuous kinematic waveforms were calculated, and correlations between motion and implant characteristics as well as PROs of ASES, Constant-Murley Score (CMS), VAS, and Brophy scores were determined.

Results The largest component of motion during each motion was: 102.8 ± 24.9° of abduction during the abduction motion, 112.7 ± 62.4° of shoulder rotation during the hand-to-head motion, 73.2 ± 25.6° of internal/external shoulder rotation during the rotation motion, and 107.7 ± 29.2° in plane of elevation during the hand-to-back motion. During circumduction, the shoulder moved through 101.0 ± 13.6° of abduction, 101.5 ± 21.9° of plane of elevation, and 112.4 ± 17.0° of rotation. Greater abduction was associated with increased CMS during abduction (r = .467, p = .038) and hand-to-back motions (r = .436, p = .043). Greater abduction during hand-to-back motion also correlated with better ASES scores (r = .573, p = .008). Increased humeral retroversion was associated with lower abduction (r = -.47, p = .042), higher plane of elevation (r = -.496, p = .031), and more shoulder rotation (r = -.469, p = .043) during circumduction. Humeral retroversion also was correlated with more abduction during hand-to-head motion (r = -.512, p = .025). No correlations between ROM and tilt, lateralization, or eccentricity of the implant were found.

Discussion Increased abduction ROM during the tasks of abduction and hand-to-back motion was associated with better PROs. The functional movements showed greater shoulder rotation ROM in the hand-to-head compared to hand-to-back motion, while the opposite trend was seen for plane of elevation indicating different strategies are used in these functional movements. Additionally, circumduction is a complex cross adduction motion that has not previously been described and was shown to have a correlation with humeral retroversion for all measured motions. This indicates that humeral retroversion may be an important factor that determines ROM for various movements.

Conclusions Improving abduction during functional tasks following RSA may be necessary for optimizing outcomes. Humeral retroversion may be important for determining total ROM for complex functional motions.
THE HIGHER RATE OF INJURY FOLLOWING THE COVID-19 LOCKDOWN PERIOD IN ELITE PROFESSIONAL FOOTBALLERS HIGHLIGHTS THE IMPORTANCE OF PRE-SEASON TRAINING

Albert Tang, John Ranson, Neil Jain. UK
10.1136/jisakos-2021-congress.354

Summary We highlight the benefits of a formal preseason in professional football in terms of there being a lower injury rate at the start of the season following a formal preseason.

Data

Background The ‘preseason’ is an established period of the professional football season for players to gain fitness and has been demonstrated to subsequently improve player performance following the start of the season. Although players are at greater risk of injury in the preseason period, it is questioned whether a preseason subsequently decreases the risk of injury in the start of the formal season itself. Due to the established nature of the preseason no studies have previously reviewed the effect of the preseason on injury rates in the subsequent season. Our aim was to report the injury rate from post-lockdown professional football games (no preseason programme - NPP) and compare to the start of the season (following a preseason programme - FPP). This would then provide a comparison between the two groups and a determination of the potential beneficial effect of a formal preseason on the injury rates at the start of the formal season.

Methods We compared the injuries sustained across 4 European Professional Football Leagues (Premier League, Serie A, Bundesliga, La Liga) from the first 2 games for each team at the start of the 2019–20 season (FPP group) and from the first 2 games for each team after the re-start of football following lockdown (NPP group). We recorded the frequency, injuries per game, contact and soft tissue injuries. An injury was recorded if the player was deemed unable to continue play.

Results In total 156 games were reviewed, 78 in the FPP group and 78 in the NPP group. A total of 10 injuries were observed in the FPP group, 0.13 per game, compared to 30 injuries in the NPP group, 0.39 per game (p=0.001). The ratio of contact to soft tissue injuries was the same for both groups (1:4). There was no significant difference in the length of downtime between the leagues stopping and restarting (92–103 days) and no correlation between injury rate and length of downtime.

Conclusions Injuries in elite professional football were more common in the first 2 games following the restart after lockdown than in the first 2 games of the 2019/20 season. We believe this is due to the beneficial effect of a normal preseason being absent for the restart. We highlight the importance of preseason in reducing injury rates amongst professional footballers.

NEUTROPHIL TO LYMPHOCYTE RATIO AS PREDICTOR OF PERIPROSTHETIC JOINT INFECTION IN PATIENTS WITH SECONDARY SURGERY AFTER TOTAL KNEE ARTHROPLASTY

Mary Rose Casas Gonzales, Antonio Nicolas Tanchuling, Henry Calleja. Philippines
10.1136/jisakos-2021-congress.355

Summary In the recent years, neutrophil to lymphocyte ratio (NLR) has emerged in orthopedics as a marker to indicate subclinical inflammation. With NLR being significantly related to periprosthetic joint infection, this readily available low cost marker may be maximized by initiating early diagnosis, that may contribute to timely treatment and reduction of morbidity and mortality.

Data

Background Knee arthroplasty is a highly effective surgical procedure that significantly improves patient quality of life by providing symptom relief, restoration of limb or joint function, improved mobility and independence. Periprosthetic joint infection (PJI) remains one of its most serious complications. In the recent years, neutrophil to lymphocyte ratio (NLR) has emerged in the field of orthopedics as a marker to indicate subclinical inflammation in patients with septic arthritis.

Purpose The aim of the study is to determine relationship of NLR to presence or absence of PJI in patients who underwent secondary surgery after total knee arthroplasty (TKA). Methodology This is a cross sectional study utilizing chart review. A list of all patients who underwent knee arthroplasty procedures was made and those who underwent secondary knee procedures were identified. These patients were classified as infected and non-infected based on intraoperative cultures from the prosthesis knee joint. Relationship of NLR with PJI was analyzed using chi square as univariate analysis with odds ratio (OR) as outcome.

Results A total of 685 knee arthroplasty cases were performed. Twelve were excluded from the study and analysis was conducted on 673 knees. There were 642 knees that underwent primary TKA and 31 were subjected to secondary knee arthroplasty procedures. PJI was noted in 16 knees (2.49%) based on positive intraoperative culture. When the cut off value of NLR was taken as 2.708 with a sensitivity of 87.5% (64–96.5, 95%CI) and specificity of 80% (54.8–93, 95%CI), there was a significant relationship of NLR and PJI with a p value of 0.0003 with OR of 28 (3.99–196, CI95%).

Conclusion With NLR being significantly related to PJI, this readily available low cost marker may be maximized by initiating early diagnosis, that may contribute to timely treatment and reduction of morbidity and mortality.

RETURN TO ELITE SPORT AFTER ACL RECONSTRUCTION IN 376 'PROFESSIONAL' ATHLETES

Kyle Borque, Mary Jones, Ganesh Balendra, Lukas Willinger, Vitor Hugo Pinheiro, Andy Williams. USA, UK, Australia, Germany
10.1136/jisakos-2021-congress.356

Summary High rates of return to play are possible with ACLR in elite athletes to the same or higher level but recurrent effusions and further interventions prolong RTP time, and using the AMB femoral tunnel position and adding LET reduces graft re-rupture rates.

Data

Background Following ACL reconstruction (ACLR), main concerns of athletes are whether they will be able to return to their sport and how quickly, and the risk of needing revision. We report the return to play (RTP) rates and times in elite sports and the factors affecting them, and graft failure rates.
Computational Simulation of MPFL Reconstruction Stabilizing the Patella During a Pivot Landing

Travis Jones, Jeffrey Watts, Lutul D Farrow, Travis Jones, John Elias. USA

Abstracts

Methods A consecutive series of primary ACLR in elite athletes (defined as playing professional sport or top-level amateur sport) between January 2005 and June 2018 were retrospectively reviewed. Academy footballers (<17 years) and rugby players (<18 years), those with other knee ligament surgery, or with less than 2 years follow up were excluded. Variables including age, surgical technique, concomitant injuries and subsequent interventions were analysed for their effect on RTP rates, time to return and re-rupture. RTP was defined as the time between ACLR and first professional game.

Results 376 athletes were included with 24 (6.4%) of these receiving bilateral ACLRs. 229 were footballers, 115 rugby players and 56 other sports. Mean age at operation was 23.1 years. 88% of footballers and 90.4% of rugby ACLRs were male compared to 37.5% in the other sports group. 71.3% of knees had new meniscal damage. 17.4% of rugby players also had ICRS grade 3/4 chondral lesions compared to 10.5% in footballers and 5.4% in other sports. 58% of ACLR were performed using hamstring (HS) autografts, 41.8% had patellar tendon (PT) autografts and one case, at the player’s insistence, had an allograft. The operative technique evolved: between 2010 and 2013 (114 knees) the femoral tunnel was drilled in the “anatomic” central femoral footprint position rather than the anteromedial bundle (AMB) position (286 knees). 68.9% had a lateral extra-articular tenodesis (LET) in the last 3 years of the study compared to 23% of knees overall. Rugby (91.3%) had the lowest RTP rate compared to football (95.6%) and other sports (98.2%). Footballers aged under 25 years had a significantly higher RTP rate compared to the older group (99.3% vs 90.2, p=0.001) whereas in rugby and other sports RTP was greater in the older age group (92.9% vs 90.4% and 100% vs 97.5% respectively). The mean RTP time was fastest for rugby players (9.5 months vs 10.5 in football and 10.7 in other sports) and was longer in athletes receiving PT grafts (10.9 vs 9.8), those with concomitant meniscal injuries (10.5 vs 9.6), post-operative recurrent effusions (11.1vs 10.0) and those undergoing further surgery before RTP (12.8 vs 9.6). Re-rupture occurred in 6 (5 football, 1 rugby) cases prior to RTP and only one, a footballer, failed to RTP following revision ACLR. LET and AMB femoral tunnel position did not affect RTP but did reduce re-rupture rates (4.4% vs 8.8% and 6.6% vs 10.5% respectively).

Conclusion Between 91–98% of elite athletes in a wide range of sports will return to professional sport with the time to RTP being affected by several factors. Recurrent effusions and further interventions prolonged RTP time. Using the AMB femoral tunnel position and adding LET reduces graft re-rupture.

Discussion The results show the interaction of MPFL graft tension and patellar tracking for effective stabilization of the patella. For knee squatting, the passive resistance from an MPFL graft and the articular constraints of the trochlear groove can stabilize the patella. For a more dynamic activity including higher muscle forces and tibial external rotation, MPFL reconstruction does not sufficiently stabilize the patella for all knees. Computational simulation of knee function has the potential to identify the characteristics of knees that cannot be sufficiently stabilized with MPFL reconstruction.

Acknowledgement Department of Defense, Peer Reviewed Medical Research Program Discovery Award W81XWH2010040.
BIOMECHANICAL ASSESSMENT OF KNEE LAXITY FOLLOWING A NOVEL POSTEROLATERAL CORNER RECONSTRUCTION TECHNIQUE

1Thiago Vivacqua, 1Samira Vakili, 1Ryan Willing, 1Gilbert Moatshe, 1Ryan M Degen, 1Alan Getgood. 2Canada; 1Norway

10.1136/jisakos-2021-congress.358

Summary In a cadaveric biomechanics study, we found that a ‘modified LaPrade’ posterolateral corner reconstruction technique using a single semitendinosus autograft restored varus and external rotation laxity similarly to the ‘original LaPrade’ anatomic technique.

Data

Background A number of different techniques to restore knee stability after posterolateral corner (PLC) injury have been described. The anatomic PLC reconstruction originally described by LaPrade used two separate allografts, focusing on the reconstruction of the fibular collateral ligament (FCL), popliteofibular ligament (PFL), and the popliteus tendon (PT), to adequately control coronal and rotational laxity. Access to allograft tissue continues to be a significant limitation of this technique which lead to the development of a modified anatomic approach by Wood et al. utilizing a single autologous semitendinosus graft fixed on the tibia with an adjustable loop to enable differential tensioning of the FCL and PFL/PT components.

Purpose The objective of this study was to compare the ‘modified LaPrade’ technique to the ‘original LaPrade’ anatomic reconstruction in terms of varus and external rotation laxity.

Hypothesis Both techniques will restore varus and external rotation laxity following a simulated complete PLC injury.

Study Design: Controlled laboratory study

Methods Eight fresh-frozen cadaveric shoulders (mean age, 53.4 ± 14.2 years) were tested using a dynamic shoulder simulator. Each specimen underwent the following 5 conditions: (1) intact, (2) irreparable posterosuperior rotator cuff tear (psRCT), (3) V-shaped LHBT reconstruction, (4) box-shaped LHBT reconstruction, and (5) single-stranded LHBT reconstruction. MAA, ghST, cDF and sCP were assessed in each tested condition.

Results Each of the 3 LHBT techniques for reconstruction of the superior capsule on shoulder kinematics, along with different fixation constructs in a dynamic biomechanical model. The authors hypothesized that each of the 3 proposed fixation techniques would restore native joint kinematics, including glenohumeral superior translation (ghST), maximum abduction angle (MAA), maximum cumulative deltoid force (cDF), and subacromial contact pressure (sCP). Study Design: Controlled laboratory study.

Methods Eight fresh-frozen cadaveric shoulders (mean age, 53.4 ± 14.2 years) were tested using a dynamic shoulder simulator. Each specimen underwent the following 5 conditions: (1) intact, (2) irreparable posterosuperior rotator cuff tear (psRCT), (3) V-shaped LHBT reconstruction, (4) box-shaped LHBT reconstruction, and (5) single-stranded LHBT reconstruction. MAA, ghST, cDF and sCP were assessed in each tested condition.

Results Each of the 3 LHBT techniques for reconstruction of the superior capsule significantly increased MAA while significantly decreasing ghST and cDF compared with the psRCT (P < .001 and P < .001, respectively). Additionally, the V-shaped and box-shaped techniques significantly decreased sCP (P = .009 and P = .016, respectively) compared with the psRCT. The V-shaped technique further showed a significantly increased MAA (P < .001, respectively) and decreased cDF (P = .042 and P = .039, respectively) when compared with the box-shaped and single-stranded techniques, as well as a significantly decreased ghST (P = .027) when compared with the box-shaped technique.

Conclusion In a dynamic biomechanical cadaveric model, using the LHBT for reconstruction of the superior capsule improved shoulder function by preventing superior humeral migration, decreasing deltoid forces and subacromial contact pressure.

BIOMECHANICAL ASSESSMENT OF KNEE LAXITY FOLLOWING A NOVEL POSTEROLATERAL CORNER RECONSTRUCTION TECHNIQUE

1Daniel P Berthold, 1Andreas B Imhoff, 2Augustus D Mazzocca, 1Knut Beitzel, 1Lucas Nawid Muech, 1Felix Dyma, 1Bastian Scheiderer, 1Ellho Obopile, 1Michael R Krifte, 4Giuseppe Milano, 2Ryan M Bell, 1Andreas Voss. 1Germany; 2USA; 3Austria; 4Italy

10.1136/jisakos-2021-congress.359

Summary In a dynamic biomechanical cadaver model, using the long head of the biceps tendon for reconstruction of the superior capsule improves shoulder function by preventing superior humeral migration, decreasing deltoid forces and subacromial contact pressure.

Data

Background In the past decade, superior capsular reconstruction has emerged as a potential surgical approach in young patients with irreparable posterosuperior rotator cuff tears (RCT) and absence of severe degenerative changes. Recently, the use of locally available and biological viable autografts, such as the long head of the biceps tendon (LHBT) for SCR has emerged, with promising early results.

Purpose/Hypothesis The purpose of this study was to investigate the effect of using the LHBT for reconstruction of the superior capsule on shoulder kinematics, along with different fixation constructs in a dynamic biomechanical model. The authors hypothesized that each of the 3 proposed fixation techniques would restore native joint kinematics, including glenohumeral superior translation (ghST), maximum abduction angle (MAA), maximum cumulative deltoid force (cDF), and subacromial peak contact pressure (sCP). Study Design: Controlled laboratory study.

Methods Eight fresh-frozen cadaveric shoulders (mean age, 53.4 ± 14.2 years) were tested using a dynamic shoulder simulator. Each specimen underwent the following 5 conditions: (1) intact, (2) irreparable posterosuperior rotator cuff tear (psRCT), (3) V-shaped LHBT reconstruction, (4) box-shaped LHBT reconstruction, and (5) single-stranded LHBT reconstruction. MAA, ghST, cDF and sCP were assessed in each tested condition.

Results Each of the 3 LHBT techniques for reconstruction of the superior capsule significantly increased MAA while significantly decreasing ghST and cDF compared with the psRCT (P < .001 and P < .001, respectively). Additionally, the V-shaped and box-shaped techniques significantly decreased sCP (P = .009 and P = .016, respectively) compared with the psRCT. The V-shaped technique further showed a significantly increased MAA (P < .001, respectively) and decreased cDF (P = .042 and P = .039, respectively) when compared with the box-shaped and single-stranded techniques, as well as a significantly decreased ghST (P = .027) when compared with the box-shaped technique.
psRCTs could potentially be delayed. Clinical Relevance: Using a biologically viable and locally available LHBT autograft is a cost-effective, potentially time-saving, and technically feasible alternative for reconstruction of the superior capsule, which may result in favorable outcomes in irreparable psRCTs. Moreover, each of the 3 techniques restored native shoulder biomechanics, which may help improve shoulder function by preventing superior humeral head migration and the development of rotator cuff tear arthropathy in young patients with irreparable rotator cuff tears.

**Summary**

In a dynamic biomechanical shoulder model, isolated non-retracted RCT, located lateral to the rotator cable, can be sufficiently compensated by the remaining intact cuff.

**Data**

Background Complex interactions between dynamic and static stabilizers of the shoulder girdle are critical to produce a biomechanically complex system, allowing for sufficient range of motion in multiple planes. As such, detailed knowledge on the biomechanical consequences of non-retracted, isolated, and massive and retracted posterosuperior rotator cuff tears (RCT) in the glenohumeral joint is needed.

Purpose The purpose of the study was to assess the biomechanical consequences of isolated, massive, non-retracted RCT (according to Patte I) and irreparable, retracted posterosuperior RCT (Patte III) on the glenohumeral joint using a validated, dynamic shoulder testing system.

Study Design: Controlled Laboratory Study Methods Eight fresh-frozen cadaveric shoulders were tested using a dynamic shoulder simulator. Each shoulder was tested in the following conditions: (1) Intact state; (2) Isolated non-retracted supraspinatus tendon (SSP) defect; (3) Isolated non-retracted subscapularis tendon (SSC) defect; (4) Isolated non-retracted infraspinatus tendon (ISP) defect; (5) Massive non-retracted RCT involving all three tendons; (6) Irreparable, retracted posterosuperior RCT. Four parameters were measured in each cadaveric shoulder for each testing condition: (1) maximum glenohumeral abduction angle (degrees), (2) glenohumeral superior translation (%), (3) subacromial peak contact pressure (MPa), and (4) cumulative deltoid force (N).

Results The SSP, SSC and ISP simulated defects showed a significant increase in total deltoid force, respectively (P = 0.012; P = 0.007; P = 0.001). Compared to the intact state, the massive RCT showed a significant decrease in glenohumeral abduction angle (P < 0.001) and a significant increase in total deltoid force (P < 0.001). The irreparable, retracted posterosuperior RCT showed a significant decrease in glenohumeral abduction angle, significant increase of total deltoid force, subacromial peak contact pressure, and glenohumeral superior translation (P > 0.001, respectively) compared to the intact state.

**Conclusion**

In a dynamic biomechanical shoulder model, isolated non-retracted RCT, located lateral to the rotator cable, can be sufficiently compensated by the remaining intact cuff. However, in irreparable, massively retracted posterosuperior RCT located medial to the rotator cable, devastating effects on the glenohumeral joint can be expected. Along with increased maximum deltoid forces, increased subacromial peak contact pressure, decreased shoulder function can be expected. As such, surgery should be highly recommended for patients with retracted tears involving the cuff located medial to the rotator cable to improve shoulder function and reduce painful direct bone-to-bone contact. Key Terms Rotator Cuff Tears; Posterosuperior Rotator Cuff Tears; Biomechanics; Dynamic Shoulder Simulator; Superior Capsule, Rotator Cable
was 256. Overall, WOSI scores remained the same or improved from 2 to 10 years postoperatively. Three patients had postoperative complications including a traumatic subluxation, continued instability, and a traumatic dislocation; two of which required revision surgery (9.5% failure rate).

**Conclusion** Arthroscopic repairs of 270° labral tears involving the anterior, inferior and posterior labrum have high satisfactory clinical outcomes at 10 years, with complication and relocation rates similar to those at 2 years. Key Terms: 270° labrum, labral repair, outcomes, shoulder, instability; dislocation. What is known about the subject: Clinical outcomes at short- and mid-term follow-up after arthroscopic repair of 270° labral tears are excellent with high rates of return-to-sport. However, high complication rates have been reported in up to 30% of cases. What this study adds to existing knowledge: The data from this study shows excellent long-term outcomes following arthroscopic repair of 270° labral repairs, with few cases of recurrent instability or revision surgery. As a result, the presented data suggests that repairs of extensile labral tears are effective in restoring and maintaining mechanical stability of the glenohumeral joint long-term, thus avoiding future interventions addressing re-instability.

**Summary** During ACL reconstruction, high volume surgeons more commonly place the femoral tunnel in an anatomic position compared to low volume surgeons.

**Data**

**Background** Placement of the femoral and tibial tunnels in the anatomic footprint during anterior cruciate ligament reconstruction (ACLR) is paramount for restoring rotatory knee stability. Recent studies have looked at surgeon volume and its outcomes on procedures such as total knee arthroplasty and infection rates, but very few studies have specifically examined tunnel placement after ACLR based on surgeon volume.

**Purpose** To compare the placement of femoral and tibial tunnels during ACLR between high volume and low volume surgeons. It was hypothesized that high volume surgeons would have more anatomic tunnel placement compared to low volume surgeons.

**Methods** A retrospective review was conducted of all ACLR performed between 2015 and 2019 at an integrated health care system consisting of both academic and community hospitals with 68 orthopedic surgeons. Surgeon volume was categorized as less than 12 ACLRs per year (low volume) and 12 or more ACLRs per year (high volume). Femoral tunnel placement for each patient was determined using a strict lateral radiograph (less than 6 mm of offset between the posterior halves of the medial and lateral condyles) taken after the primary ACLR using the quadrant method. The center of the femoral tunnel was measured in relation to the posterior-anterior (PA) and proximal-distal (PD) dimensions (normal center of anatomic footprint: PA 25% and PD 29%). Tibial tunnel placement for each patient was determined on the same lateral radiographs by measuring the mid-sagittal tibial diameter and the center of the tibial attachment area of the ACL from the anterior tibial margin (normal center of anatomic footprint: 43%). Each lateral radiograph was reviewed by 1 of 3 blinded reviewers.

**Results** A total of 4500 patients were reviewed, of which 688 patients had adequate postoperative radiographs and were included in the final analysis. There were 254 patients in the low volume group and 434 patients in the high volume group. Low volume surgeons performed a mean of 4 ACLRs per year, whereas surgeons in the high volume group performed a mean of 36 ACLRs per year. In the PA dimension, the low volume group had statistically significant more anterior femoral tunnel placement compared with the high volume group (31% ± 10% vs. 28% ± 9%, p<0.01). In the PD dimension, the low volume group had statistically significant more proximal femoral tunnel placement compared to the high volume group (32% ± 9% vs 35% ± 9%, p<0.01). For the tibial tunnel, the low volume group had statistically significant more posterior tibial tunnel placement compared to the high volume group (40% ± 9% vs 38% ± 6%, p<0.01).

**Conclusion** Low volume surgeons placed their femoral tunnels statistically significantly more anterior and proximal (high) during ACLR, as well as statistically significantly placed their tibial tunnels more posterior, compared to high volume surgeons. Prior research has indicated anatomic placement of the femoral and tibial tunnels during ACLR leads to improved rotatory knee stability. The findings of this study demonstrate the importance of surgical volume and experience during ACLR, and ACLR should be preferentially pursued in high volume centers.

**Summary** Role of PRF membrane in chondral defects of patella

**Data** Chondral defects are seen in 34%–62% of knee arthroscopies, while full-thickness focal lesions with an area of at least 1–2 cm in patients younger than 40 year. A recent systematic review of microfracture concluded that early treatment of chondral defects with microfracture is associated with positive clinical and histologic outcomes. The biggest drawback of marrow-stimulating techniques is that the newly formed fibro-cartilage, a form of Type I cartilage, has less mechanical stress resistance than native cartilage, the number of stem cells procured is also low. Hence to overcome the issues of microfracture, We incorporated PRF membrane in it to enhances regeneration of soft tissues and bone as it contains meshed fibrin matrix, platelet incorporation, leukocytes, circulating stem cells, cytokines and various growth factors which allow optimal healing, angiogenesis, low costs, and complete immune-biocompatibility. It also present antinociceptive effects through, anti-inflammatory cytokines, and opioid peptides.

**Methodology** In this comparative study, 30 patients with full thickness chondral defect of patella with age from 18–40 yrs Patients divided in groups, Group 1 Chondral defect of patella .with arthroscopic debridement along with micro fractures.
Group Chondral defect of patella with arthroscopic debridement along with micro fractures + PRF membrane.

**Results** After a baseline pre-operative evaluation, patients were assessed at two weeks, six weeks, and three months, 6 months,12 months with clinical, radiological, and biological evaluation. The assessment included evidence of infection and local pain graded by the visual analogue scale Mean (VAS) Score has decreased Group 1 from (8.3 to 3.2) vs Group 2 the mean of (8.9 to 2.4) no significant difference was seen with in groups after 12 months Kujala Score in Group 1 improved from (33.93 to 76.4) Vs Group 2 (32.4 to 90.27) Shows significant difference among groups after 12 months P<0.05 We independently assessed each WOMAC dimension, specifically pain, stiffness, and functional capacity. Most patients Group 1 (67.7%) vs Group 2(80.7%) reported mild pain while walking on flat terrain, Group 1 (26.0%)Vs Group 2 (15.3%) reported moderate pain while using stairs, and Group 1 (6.3%) Vs Group 2(3.9%) reported moderate pain while sitting. Regarding return to sport, 70% of our patients in Group 2 as compare to group 1 - 56% reported returning to sport at a level equal to their preinjury level. Healing evaluation with MRI Scanning Analysis of each category included in the MOCART score showed that nearly 67% of patients had a complete hypertrophic repair of the defect in Group 2 as compare to Group 1 with 54%. Furthermore, 77% of patients had a defect filling greater than 50%, in group 2 vs group 1- 64%. We evaluated the biologic response with IL-6 and TNF-a. In group 2 there is significant decrease in Inflammatory biomarkers as compare to group 1 P<0.01.

**Conclusion** Hence it can be concluded that PRF showed good osseous integration and excellent filling of the chondral surface, as evidenced. PRF is a good alternative to treat patellar chondral defects, especially among young patients.

**Abstracts**

**THE KNEE JOINT MENISCUS IS A SHOCK ABSORBER**

Andreas M Seitz, Daniela Warnecke, Jonas Schwer, Anita Ignatius, Lutz Dürselen. Germany

10.1136/jisakos-2021-congress.364

**Summary** This complementary in-vitro biomechanical shock absorption study used a customized setup to apply both realistic impact loads and sinusoidal loading to fourteen porcine knee joints at five different meniscus states and revealed a significant contribution of the menisci to the shock absorption of the knee joint.

**Data** “The shock absorbing truth about meniscus” by Andrews et al. (2011) initiated a controversial discussion about the assumption, that the meniscus acts as a shock absorber inside the knee joint. Although there is evidence in literature indicating the shock absorbing potential of meniscus tissue, there is no publication objectively corroborating this assumption/hypothesis. Therefore, the aim of this biomechanical in-vitro investigation was to enlighten the question whether the meniscus acts as a shock absorber in the knee joint or not. The soft tissue of fourteen porcine knee joints were removed leaving the capsuloligamentous structures intact. The joints were consecutively mounted in 45° neutral knee flexion in a validated drop tower setup. Six joints were exposed to an impact load of 3.5J. Then the loss factor (??), which is used to interpret the damping behavior of the meniscus within the knee joint under impact loads was calculated. Then, the setup was modified in a way to allow for application of sinusoidal loads by integrating the setup frame into a fatigue testing machine. Subsequently, the eight remaining knee joints were exposed to a dynamic mechanical analysis (DMA) applying 10 frequencies from 0.1Hz to 10Hz at a static load of 1210N and a superimposed sinusoidal load of 910N (2.12xBW). The force (F) and deformation (l) were continuously recorded at a sampling rate of 1kHz and the damping factor tand was calculated. For both experiments four different meniscus states (intact, medial posterior root avulsion, medial meniscectomy, complete bilateral meniscectomy) were used to investigate the shock absorbing contribution of the meniscus. Non-parametric analyses were used to determine statistical differences, while p=0.05 was considered significant. During the drop tower experiments the intact state possessed a loss factor of ?? = 0.1. Except for the root avulsion state (~15%, p=0.12) the loss factor decreased significantly (p<0.046) by a maximum of ~68% for the total meniscectomy state (p=0.028) when compared to the intact state. Sinusoidal DMA testing revealed, that knees with an intact meniscus had the highest damping factors, ranging from .10 to .15. Any surgical manipulation lowered the damping factor: Medial meniscectomy resulted in a reduction of 24%, while the resection of both menisci lowered tand by 18% compared to the intact state. The results of this biomechanical study shows that the damping factor, and thus the shock absorbing ability of a knee joint is lower the more meniscal tissue is resected. Therefore, we can conclude that the meniscus significantly contributes to the shock absorption of the knee joint not only during impact loads but also during sinusoidal loads representing activities of daily living. The findings may have an impact on the rehabilitation of young, meniscectomized patients who want to return to sports. Consequently, such patients are exposed to critical loads at the articular cartilage, especially when performing sports with recurring impact loads transmitted through the knee joint surfaces.

**SUPERIOR OUTCOMES WITH ROUTINE CAPSULAR REPAIR IN HIP ARTHROSCOPY**

Austin M Looney, Spencer M Comfort, Patrick T Connolly, Julia E McCann, Andrew Curley, William F Postma. USA

10.1136/jisakos-2021-congress.365

**Summary** Routine capsular repair with hip arthroscopy results in superior outcomes.

**Data**

**Background** In hip arthroscopy, a capsulotomy is created to improve visualization and allow instrumentation of the joint. Traditionally the defect was left unrepaired; however, increasing evidence suggests that this may contribute to persistent pain and iatrogenic capsular instability. Nevertheless, the clinical benefit of performing routine capsular repair remains controversial.

**Methods** A systematic review and meta-analysis was conducted according to PRISMA guidelines. The terms “hip,” “arthroscopy,” “capsule,” “capsular,” “repair,” and “closure” were used to query OvidMedline, EMBASE, CENTRAL (Cochrane Central Register of Controlled Trials), CINAHL (Cumulative Index to Nursing and Allied Health Literature), SPORTDiscus, and PubMed. Articles with PROs stratified by capsular management were included. Multivariate mixed effects metaregression models were implemented with study-level random effects.
and fixed effects moderators for capsular closure vs non-repair, and controlling for surgical indication and preoperative PROs. Effect of repair on both postoperative score and change were evaluated for Harris Hip Score (HHS)/modified HHS (mHHS), Hip Outcome Score-Activities of Daily Living (HOS-ADL), and HOS-Sport Specific Subscale (HOS-SSS), with a supplemental analysis of additional outcomes. Results Out of 432 initial articles, 36 were eligible for analysis, with results for 5132 hip arthroscopies. The capsule was repaired in 3427 arthroscopies and unrepaired in 1705. Capsular repair was associated with significantly higher postoperative HHS/mHHS (2.011; SE, 0.743; 95% CI, 0.534 to 3.467; \( P = .007 \)), HOS-ADL (3.635; SE, 0.873; 95% CI, 1.923 to 5.346; \( P < .001 \)), and HOS-SSS (4.137; SE, 1.205; 95% CI, 1.775–6.499; \( P < .001 \)), as well as significantly improvement in HHS/mHHS (2.571; SE, 0.878; 95% CI, 0.849–4.292; \( P = .003 \)), HOS-ADL (3.315; SE, 1.131; 95% CI, 1.099–5.531; \( P = .003 \)), and HOS-SSS (3.605; SE, 1.689; 95% CI, 0.295–6.915; \( P = .033 \)). Conclusion This meta-analysis is the largest to date evaluating the impact of capsular management on PROs and demonstrates significantly higher mean postoperative scores and significantly superior improvement with repair, controlling for effects of preoperative score and indication. The true magnitude of the benefit of capsular repair may be clarified by large, prospective, randomized studies using PROs specifically targeted and validated for hip arthroscopy/preservation.

**20406** LATERAL ELBOW LAXITY IS AFFECTED BY THE INTEGRITY OF THE RADIAL LATERAL COLLATERAL COMPLEX. A CADAVERIC MODEL WITH SEQUENTIAL RELEASES AND VARUS LOAD SIMULATING EVERYDAY ACTIVITIES

Davide Cucchi, Pietro S Randelli, Paolo Angelo Anigoni, Francesco Luceri, Alessandra Menon, Carlo Eugenio Zacchino, Andrea Zapparella, Michele Catapano, Mattia Radici, Nicola Migliaccio, Dario Polli. Germany; Italy

Summary The radial lateral collateral complex is confirmed as an important static lateral stabilizer, supporting a pathological model based on its insufficiency and culminating with a symptomatic minor instability of the lateral elbow.

Data Background An elongation of the radial lateral collateral complex (R-LCL) can provoke a symptomatic minor instability of the lateral elbow (SMILE) leading to lateral elbow pain. Biomechanical models investigated the effects of elongation, partial or complete lesions of the R-LCL on lateral elbow stability are lacking. To evaluate how partial and complete R-LCL release affect the radiocapitellar joint stability in a setting of controlled varus load and progressive soft tissue release.

Methods Ten fresh-frozen specimens were obtained and mounted on a custom-made support to control elbow flexion/extension and allow controlled varus load. Stress tests were performed on all intact specimens under gravity load alone, 0.5 kg load applied to the hand and 1 kg load applied to the hand. After load application, anteroposterior radiographs were obtained. The following release sequence was applied to all specimens: release of the anterior half of the common extensor origin; pie crusting of the R-LCL; R-LCL release. After each release, stress tests and radiographs were performed. The varus joint angulation of the elbow (a), was measured by two examiners as main outcome parameter.

**Results** Significant changes in a from the initial condition occurred after each release and a significant effect of varus load on a was documented for all release steps. A significant effect of the releases on a could be documented for all identical varus load conditions. A linear regression model to describe the effect of varus load on a was generated.

**Conclusions** Varus loads simulating everyday activities produce changes in a in the intact specimen, which are linearly dependent on the applied moment and persist also after releasing the lateral stabilizing structures. With progressive load, a pie crusting of the R-LCL is the minimal procedure able to provoke a significant change in a and a complete R-LCL release produces additional increase in a in all testing conditions.

**20302 PLATELET-RICH PLASMA INJECTION REDUCES TEAR SIZE IN PARTIAL SUPRASPINATUS TENDON TEARS COMPARED TO CONVENTIONAL STEROID INJECTION**

Danaihep Limskul, Thanathep Tangpawong, Tiporn Vitoonpong, Phark Thanghraisan, Marvin Thepsoparn, Somsk Kuptnitratuk, Thun Ithipanichpong, Danaihep Limskul, Achitpol Thongkim, Nunphung Numkarunarunrote, Chindarat Ratanakornphan, Aticha Aryachaipanich, Thailand

Summary While both the PRP and the steroids can help improve functional scores, PRP injection can reduce tear size in partial supraspinatus tendon tear.

Data Objectives Corticosteroid (CS) injection is commonly used in partial-thickness rotator cuff tears to decrease pain. However, unwanted side effects, such as tendon rupture, could result. Alternatively, platelet-rich plasma (PRP) injection is frequently used to treat tendinopathies because it enhances healing. This study compared the differences in tear size and functional scores between intralesional PRP and subacromial CS injections.

Methods Patients with symptomatic partial-thickness tears of the supraspinatus tendon who underwent conservative treatment for more than 3 months were enrolled. All patients underwent magnetic resonance imaging (MRI) to confirm the diagnosis. Fourteen and 15 patients received intralesional PRP and subacromial CS injections, respectively. Tears were measured in the coronal and sagittal planes. The patients underwent another MRI 6 months after the injection. Tear size was compared between the two MRI results. The American Shoulder and Elbow Surgeons Shoulder score and the Constant-Murley score were also obtained.

**Results** The demographic data were similar between the two groups. In the coronal plane, PRP and CS showed significant tear size reductions of 3.39 mm and 1.10 mm, respectively. In the sagittal plane, PRP and CS showed tear size reductions of 2.97 mm and 0.76 mm, respectively. Functional scores improved 6 months after injection in both groups, but PRP showed better functional scores than CS.

**Conclusion** Intralesional PRP injection can reduce the tear size in partial-thickness tears of the supraspinatus tendon. Subacromial steroid injection did not affect the tear size. While CS improved functional scores compared to baseline, PRP resulted in better improvement at 6 months post-injection.
VARIATIONS IN BRANCHING OF POPLITEAL ARTERY AND ITS CLINICAL INTEREST

Paloma Aragonés, Miguel Ángel Heman-Prado, Sara Quinones, Yolanda Guindal Pérez, Ana María Valverde Villar, Irene Espina Flores, Jose R Sanudo. Spain

10.1136/jisakos-2021-congress.368

Summary Anatomical variations of the popliteal artery and its terminal branches must be known and identified by knee surgeons to avoid iatrogenic vascular injuries during routine surgical procedures.

Data Background The frequency of appearance of anatomical variability in the terminal division of the popliteal artery (PA) is different according to the type of sample used, and ranges from 2% to 21%. The PA locates 1.01 cm behind the lateral meniscus, which makes it vulnerable during surgical procedures. Iatrogenic injury to the PA or its terminal branches increases if anatomical variables are present. Our aim is to review and describe variations in branching of the PA in a cadaveric sample and determine the risk of iatrogenic injuries to these vessels during routine knee surgery procedures.

Methods A sample consisting of 260 popliteal regions, corresponding to 130 corpuses (66 women, 64 men), have been dissected. Multivariate analysis was carried out. A review of the current literature was done, and the different branching patterns of the popliteal artery were rearranged in a new easier and useful classification.

Results The terminal division of the PA was classified as follows: Pattern 1: the PA was divided into the anterior tibial (ATA) and posterior tibial arteries (PTA) at the level or distal to the lower border of the popliteal muscle (PM) (94.7%). Pattern 2: the PA bifurcated into the ATA and PTA, proximal to the lower border of the PM (3.3%). In this pattern, 3 different possibilities of bifurcation and travel of the vessels where found, and they where named as 2.a, 2.b, and 2.c. Pattern 3: the PA divides at the same level into the ATA, PTA and PEA (2%). No significant differences between gender and side of the limb were found regarding the pattern of terminal division of the PA.

Discussion Some anatomical variables are particularly vulnerable during surgical procedures around the knee, such as the ATA in pattern 2b in sutures of the lateral meniscus, posterior cruciate ligament reconstructions, proximal tibial osteotomies or total knee arthroplasties. The incidence of the pattern 2b ranges from 0%–2.4% in the current literature performed with cadaveric simples. In these cases, the ATA runs through the anterior surface of the PM, just behind the posterior cortex of the proximal tibial surface, and 1 mm posterior to the joint capsule behind the posterior horn of the lateral meniscus. Knowing the vulnerability of the ATA in several surgical procedures around the knee if this pattern is present, knee surgeons should recognize the vessels and their pathways when studying the MRI of their patients.

Conclusions We propose a classification that encloses only three easily identifiable groups. This will allow clinicians to know about these variables and avoid injuries during surgical procedures as lateral meniscus repair. This is particularly relevant in the case of the pattern described as 2b.

Conflict of interests The authors declare that they have no conflict of interests.

Funding The authors received no financial support for the research, authorship, and/or publication of this article.

VALIDITY OF A NOVEL SENSOR-BASED APPLICATION FOR HOME-BASED REHABILITATION FOLLOWING ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

Natalie Mengis, Jules-Nikolaus Rippke, Sebastian Schmidt, Mahli Zecher, Caroline Schmidt-Lucke, Andre Ellermann, Christian Sobau. Germany

10.1136/jisakos-2021-congress.369

Summary Telerehabilitation might be an intriguing option to improve and monitor early rehabilitation of anterior cruciate ligament reconstruction (ACLR).

Data Background Telerehabilitation might be an intriguing option to improve and monitor early rehabilitation of anterior cruciate ligament reconstruction (ACLR). Despite its self-evident potential, data on validity and safety are scarce.

Objectives To assess the validity of a novel sensor-based application as an objective quantitative measurement tool on knee function during rehabilitation post ACLR in the ongoing ARCUS trial (DRKS 000024359) with regards to an international accepted measurement tool.

Design and Methods Prospective, longitudinal, randomized, single-centre clinical trial in patients with ACLR reconstruction less than 6 months after injury. Validation of combined measures: coordination, strength and agility tests, as well as range of motion (ROM), assessed with a sensor-based application (Orthelligent, OPED) at 3 (primary endpoint), 6 and 12 months, and with regards to the subjective International Knee Documentation Committee (sIKDC) score, Tegner, Lysholm, and Functional Movement Screen. Further, safety and risk evaluation were conducted. To identify independent determinants of sIKDC, multivariate linear regression analysis for various sensor data of different pre-defined exercises was performed.

Results From July 2019 to December 2020, 67 patients planned for primary ACLR (70.1% male, age 25 years [21–32], IKDC 47 [30–59], Tegner 6 [4–7], Lysholm 56 [42–72]) were included. At three months, significant correlations were detected for active and passive ROM (r=0.460, p=0.0004, y=52.52+0.58*x and r=0.358, p=0.025, y=93.34+0.41*x respectively) regarding the subjective IKDC. Further, significant correlations were found for strength and agility via the vertical jump test (r=0.426, p=0.011, y=41.99+2.78*x) and side-hop test (r=0.367, p=0.042, y=3.66+0.58*x), as well as for coordination via the Y-Balance test (r=0.579, p=0.0001, y=32.04+1.08*x). Regarding the secondary endpoint at six months, strong correlation was detected for side hop (r=0.539 (p=0.004), y=−40.32+1.12*x), vertical jump (r=0.444, p=0.018, y=−1.492+3.95*x) and Y-Balance (r=0.499 (p=0.008), y=25.27+0.95*x). Vertical jump (β=0.39, T=2.4) and passive ROM (β=0.35, T=2.2) were independent predictors of the sIKDC score at 3 months (p=0.003) and the side-hop test (β=0.45, T=2.4) of the sIKDC at 6 months (p=0.02). Moreover no adverse events related to the use of the sensor-based application were reported.

Conclusion For the first time we were able to demonstrate validation of a digital sensor-based application to objectively quantify knee function. This will have further implications for clinical and therapeutic decision-making, quality control of rehabilitation measures, and offers great opportunities in developing further scientific research questions.
COMPLICATIONS OF ELBOW ARTHROSCOPY: A META-ANALYSIS

Abdulaziz F Ahmed, 1Pieter D’Hooghe, 1Khalid Alkhelaifi, 2Bashir Zikria. 1Qatar; 2USA

10.1136/jisakos-2021-congress.370

Summary This meta-analysis reviewed the post-operative complications of elbow arthroscopy.

Data

Introduction Elbow arthroscopy has been popularized during the past 3 decades. It was initially utilized as a diagnostic tool and later on, it became an effective tool for the treatment of elbow pathologies. However, elbow arthroscopy is technically demanding, therefore it is liable to complications even when implemented by experienced surgeons. Therefore, the objective of this meta-analysis was to evaluate the rate of complications of elbow arthroscopy in the literature.

Methods PubMed, Web of Science, and Embase were searched in February 2021. Eligibility criteria included clinical studies reporting postoperative complications following elbow arthroscopy. Excluded articles were abstracts, case reports, reviews, non-clinical studies, imaging studies, technique studies, and those not reporting postoperative complications. The baseline data items that were collected included: the authors’ surnames, study year, level of evidence, age, number of elbows operated, diagnosis, procedure position, and follow-up time points. The primary outcome was the total complication rate for all studies. We further subdivided complications to entail all potential complication rates individually. The statistical analysis entailed pooling the total complication rates by dividing the total complications by the overall sample size. Each individual complication was calculated by dividing the number of events of an individual complication divided by the number of patients at risk. For each individual complication, we only pooled patients in studies that reported that specific complication to avoid underestimating or overestimating individual complications.

Results A total of 95 studies were included with 14,213 patients. The majority were case series with a level of evidence of IV. The age was variable across studies. Twelve studies reported complications in pediatric patients with a mean age ranging from 4–16 years. Whereas the rest of the studies reported outcomes on patients’ mean ages 20–80. The main diagnoses for elbow arthroscopy were osteochondritis dissecans, primary osteoarthritis, post-traumatic stiffness/arthritis, and loose bodies. Not all studies reported patient position during the procedure, however, the most common position reported was the lateral position. The mean follow-up was variable across studies ranging from 1 month to up to 13 years. The total complication rate was 8% (1136/14,213). Nerve injury was the most common complication with a rate of 1.95% of which most were transient. Ulnar nerve dysfunction was the most common nerve injury, with a rate of 1.95%. The second most injured nerve was the radial nerve (0.73%) followed by the lateral antebrachial cutaneous nerve (0.26%). The posterior interosseous and the median nerves had a similar injury rate of 0.17%. The least injured nerve was the medial antebrachial cutaneous nerve (0.09%). In terms of infection, the superficial infection rate was 1.89% and the deep infection rate was 0.36%. Wound healing complications such as drainage or dehiscence were reported in 0.81%. Stiffness was found to be prevalent in 1.79% of patients, and instability in 1.36%. Complex regional pain syndrome was reported in five patients. The all-cause revision rate due to failure of arthroscopy was 1.9%.

Conclusion This study highlights that elbow arthroscopy is a relatively safe procedure with low complication rates. However, surgeons must be conscious of its complications, and counsel patients accordingly.

LEVEL OF CONFIDENCE OF RANDOMIZED CONTROLLED TRIALS IN ARTHROSCOPY AND SPORTS MEDICINE – A SPIN BASED ASSESSMENT

Girinivasan Chellamuthu, Sathish Muthu. India

10.1136/jisakos-2021-congress.371

Summary We have performed an analysis of spin in the abstracts of RCTs published in top 5 journals of Arthroscopy and Sports Medicine using the LOC tool designed by Orthopaedic Research Group and found that only 50 percent of RCTs have high LOC

Data

Purpose Over the years pioneering works on the quality appraisal of RCTs have recognized and addressed most of the issues that affect the RCT quality but some issues are still to be sorted out. One such potential issue that hides in plain sight of the readers is the ‘Writers’ bias’ or the so-called “Spin” in research articles. Spin, particularly in the abstracts, is a potential source of deception to the readers. Grading of studies based on spin will help readers to choose good articles. The main purpose of this study is to grade the RCTs of arthroscopy and sports medicine based on spin in their abstracts, analyze the prevalence of spin and the usefulness of this grading, and explore methods to prevent spin.

Methods 230 recent RCTs from the top 5 arthroscopy and sports medicine journals were selected. Baseline data of the articles were collected. Consort Adherence Score (CAS) based on the adherence of the abstracts of the RCTs to Consort checklist was calculated. The abstracts of the RCTs were graded using the Level Of Confidence (LOC) grading tool developed by the Orthopaedic Research Group. The association of spin grade with other characteristics of the articles was analyzed.

Results The median CAS for the included studies was 9 (IQR 8–10). It was found that only 49.6% (n=124) articles had high LOC with no or one non-critical spin in abstract. 20.8% (n=52) had Moderate LOC with more than one non-critical spin. 19.6% (n=49) had at least one critical spin and 10% (n=25) had more than one critical flaw making their results have Low and Critically Low LOC respectively. Of the ten variables analyzed in multivariate regression analysis, it was found that CAS was the only significant factor (β=0.152, p=0.037) that determines the level of confidence in the abstract of RCTs.

Conclusion Spin is prevalent in abstracts of sports medicine and arthroscopy journals with 50.4% having some form of spin. LOC tool is the first of its kind grading tool for spin. Grading the LOC of the RCTs based on spin is the necessity of the day for the readers. Only 49.6% of the RCTs had high LOC. Upon exhaustive analysis of factors associated with spin, only the Consort Adherence Score had a significant correlation. Thus objective structuring of the abstracts will help eliminate spin in the future.
Anterior Deltoïd Muscle Reflection in a Deltopectoral Approach is Safe and Does Not Influence the Outcome of Reversed Shoulder Arthroplasty

Bart-Jan Jd Veen, Esther J Smits, Andrew Ker, Brandon Ziegenfuss, Ashish Gupta, Kenneth Cubbas

Summary
No difference in shoulder function after 24 months for patients receiving an RSA with or without reflection of the anterior deltoid muscle.

Data
Introduction
The deltopectoral approach is well accepted for shoulder arthroplasty procedures. The extended deltopectoral approach with detachment of the anterior deltoid from the clavicle allows increased joint exposure and can protect the anterior deltoid from traction injury. The efficacy of this extended approach has been demonstrated in anatomical total shoulder replacement surgery. However, this has not been shown in reverse shoulder arthroplasty (RSA). The primary aim of this study was to evaluate safety of the extended deltopectoral approach in RSA. The secondary aim was to evaluate the performance of the deltoid reflection approach in terms of functional and radiological outcomes up to 24 months post-surgery.

Methods
A prospective non-randomized comparative study was performed between January 2012 and October 2020 including 77 patients in the deltoid reflection group and 73 patients in the comparative group. Based on the intra-operative evaluation on avoiding injury on the deltoid muscle, the deltoid muscle was either reflected from the distal clavicle or preserved. The occurrence of any complication observed was recorded at each postop visit. Additionally, patients were followed up for at least 24 months for evaluation of their shoulder function and ultrasound evaluation in the deltoid reflection group. Functional outcome measures included the Oxford Shoulder Score (OSS), Disabilities of the Arm, Shoulder and Hand (DASH) score, American Shoulder Elbow Society Score (ASES), pain intensity (VAS 0–100), range of motion (forward flexion (FF), abduction (AD), internal rotation (IR) and external rotation (ER)).

Results
There were no significant differences in the rate of complications between the two groups (13.8% in the deltoid reflection group and 13.8% in the comparative group, p=0.327). Ultrasound evaluation of the anterior deltoid muscle was available in 57 (76%) patients and no proximal detachment was observed. Small focal delhiscence was observed in five (7%) patients and one patient showed a seroma. In addition, there were no significant differences in functional outcome measures both pre-operatively and at 24 months post-operation between the groups. Mean VAS pain score at 24 months was similar (11.0 (SD 18.5) deltoid reflection vs 12.4 (SD 18.1) comparative group). Deltoid reflection (p=0.102), age (p=0.806), sex (p=0.916), glenoid graft (p=0.106), prosthesis manufacturer (p=0.340) and pre-op VAS score (p=0.308) were not of influence.

Discussion
Results of this study show an extended deltopectoral approach for RSA, with selected reflection of the anterior deltoid muscle improving exposure and preventing anterior deltoid muscle injury followed by re-attachment, is safe. Patients with the anterior deltoid muscle reflected in RSA surgery had similar functional scores pre-op and at 24 months compared to a control group. Multiple regression analyses indicated that only prior surgery affected VAS pain score at 24 months. Furthermore, ultrasound evaluation showed intact reattachments.

Tranexamic Acid Administration in Arthroscopic Surgery is a Safe Adjunct to Decrease Postoperative Pain and Swelling: A Systematic Review & Meta-Analysis

Conor Jones, Kyle Goldstein, Jeffrey Kay, Jason J Shin, Darren L de. Canada

Summary
This is a systematic review and meta-analysis of the effects of tranexamic acid (TXA) in arthroscopic surgery that suggests TXA improves pain scores and visual clarity/technical ease, and also decreases drainage output, need for joint aspiration, and incidence of hemarthrosis, without an increase in complications.

Data
Background
Tranexamic acid (TXA) has been used effectively to decrease blood loss in many fields of surgery. Guidelines for use in arthroscopic surgery are limited to date.

Purpose
To systematically screen the literature in an effort to critically examine the effect of TXA in patients undergoing arthroscopic surgery, specifically pertaining to pain, blood loss, length of surgery, and both major and minor complications.

Study Design: Systematic Review and Meta-Analysis

Methods
In accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) and Revised Assessment of Multiple Systematic Reviews (R-AMSTAR) guidelines, three databases (MEDLINE, EMBASE, and Cochrane) were searched April 2020 and screened in duplicate using inclusion and exclusion criteria for studies on the given subject. Study findings were reviewed, and meta-analysis was then performed on sufficiently congruent data using a random-effects model.

Results
There were seven eligible randomized controlled trials, with 724 total patients, undergoing ACL reconstruction (4 studies, 537 patients), meniscectomy (1 study, 45 patients), femoroacetabular impingement (1 study, 70 patients), or rotator cuff repair (1 study, 72 patients). The mean age throughout the included studies was 33.9 years, with a mean of 27.7% female patients. There was a 1% drop out rate at 3 months postoperatively. There were significantly lower VAS scores at 2 weeks postoperatively in the TXA groups (Mean difference: −1.65, 95% CI = −3.41 to 0.10, P=0.06, I 2 =79%). Furthermore, there was a significant decrease in the number of patients requiring joint aspiration in the TXA groups (Risk Ratio= 0.27, 95% CI= 0.12 to 0.56, I 2 =0%, p=0.0006). The drainage output in TXA groups was also significantly decreased (Mean difference: −61.14ml, 95% CI= −104.43 to −17.85, I 2 =94%, p=0.006). Furthermore, there was a statistically significant decrease in hemarthrosis grade (Coupens & Yates) at 2 weeks postoperatively (Mean difference: −0.76, 95% CI= −0.97 to −0.54, I 2 =0%,
p<0.0001). Finally, there was no significant difference in operating time, across all studies (Mean difference: 0.53, 95% CI = −3.43 to 4.50, I 2 =57%, p<0.79). The use of TXA showed no increased incidence of deep vein thrombosis, infection, arthrofibrosis, or other major complications or adverse reactions between the TXA and control groups.

Conclusions This systematic review and meta-analysis of RCTs found that the use of TXA significantly improves pain scores up to 6 weeks postoperatively, decreases drainage output, decreases the need for joint aspirations, decreases incidence of hemarthrosis, increases visual clarity and technical ease, and has no increased incidence of other complications, at no loss to operative time. These findings indicate that TXA may be a useful adjunct in arthroscopic surgery, which can be confirmed by larger studies with a wider variety of patients.

**Summary** A modified suture bridge technique for tibial eminence fracture fixation provides stable fixation and maintains fracture reduction allowing for early post-operative rehabilitation.

**Data**

**Background** Surgical management with anatomic reduction and rigid fragment fixation is often required for displaced tibial eminence fractures. Early rehabilitation while avoiding post-operative fracture migration is important for successful functional outcomes.

**Purpose** To determine differences in stiffness, cyclic elongation, and fragment displacement in type III tibial eminence fractures for various suture configurations. It was hypothesized that a modified suture bridge technique would exhibit higher stiffness, less cyclic elongation, and less fracture displacement compared to a suture sling technique.

**Methods** Twenty-nine fresh frozen porcine knees were dissected with the exception of the ACL to form a femur-ACL-tibia complex (FATC). A 2 cm × 2 cm × 0.5 cm type III tibial eminence fracture was created using an oscillating bone saw. For the modified suture bridge technique, individual sutures were passed through each ACL bundle with suture ends passing through one lateral tunnel and two medial tunnels. For the suture sling technique, one suture was passed through and looped around the ACL prior to passing the ends through one lateral and one medial tunnel. #2 braided suture and #2 suture tape were utilized and secured with a button fixation device on the anteromedial tibia. Four configurations were used: bridge technique with suture tape (n=7), sling technique with suture tape (n=7), bridge technique with braided suture (n=7), and sling technique with braided suture (n=8). Each specimen was loaded onto a materials testing machine with the ACL in vertical alignment and the following loads were applied consecutively: (1) 2N preload, (2) 30 N loads for preconditioning, and (3) 500 cycles of cyclical loading from 2–50 N. An optical tracking system (DMAS, Spica Technology Corporation, Kihei, HI; 0.01 mm accuracy) was used to measure the 3D motion of the fracture fragment relative to the tibia. Linear region stiffness and cyclic elongation were calculated at the last completed cycle. Kruskal-Wallis test with post-hoc analysis was performed to evaluate differences in structural properties among configurations. Significance was set at p < 0.05.

**Results** Bridge-tape (42.4 ± 1.0 N/mm) and sling-tape (42.6 ± 3.9 N/mm) exhibited significantly higher stiffness with a 29% and 30% difference compared to sling-braded (31.5 ± 8.2 N/mm), respectively (both p < 0.05). Both bridge-tape (2.0 ± 0.3 mm) and bridge-braded (2.3 ± 1.0 mm) resulted in significantly less elongation with >70% difference when compared to sling-tape (5.5 ± 1.0 mm) and sling-braded (4.9 ± 1.4 mm) (all p < 0.05). Regarding fracture motion, bridge-tape (1.8 ± 1.0 mm) resulted in 118% and 119% less vertical displacement compared to sling-tape (7.0 ± 2.2 mm) and sling-braded (7.1 ± 2.5 mm), respectively (both p < 0.05). Additionally, bridge-braded (0.2 ± 0.6 mm) resulted in 189% less vertical displacement compared to both sling techniques (both p < 0.05).

**Conclusion** Compared to suture sling, modified suture bridge exhibited significantly higher stiffness, less elongation, and less fracture displacement. Modified suture bridge is a stable fixation technique that may facilitate early progressive rehabilitation while preserving fracture reduction.

**Summary** This study assesses a series of patients who presented with recurrent instability after failed patellofemoral instability surgery and reports on their demographics, radiographic findings, patient reported outcomes, return to sport rate and recurrent instability events after undergoing revision surgery.

**Data**

**Introduction** Recurrent patellar instability is a complex problem that affects primarily adolescent patients. Current recommendations regarding the optimal timing and scope of surgical intervention are evolving. It is essential to identify whether a patient is experiencing pain, instability or a combination of both, as the best treatment for these pathologies varies significantly. It is not currently understood which subgroup of first time dislocators should be managed operatively as well as which subset of recurrent dislocators require concomitant bony realignment procedures, tibial tubercle osteotomies (TTO), in addition to a soft tissue stabilization, medial patellofemoral ligament (MPFL) reconstruction. If the patient’s complete pathology is not addressed at their index procedure, there is a high risk of recurrent instability necessitating revision surgery. This study assesses a series of patients who presented with recurrent instability after failed patellofemoral instability surgery.

**Methods** Patients who underwent any prior procedure for patellar instability that experienced recurrent patellar instability requiring additional surgical intervention from March 2014 to July 2019 were identified from an institutional patellofemoral registry. Prior procedures included MPFL reconstructions, tibial tubercle transfer, lateral release, imbrication/plication,
and loose body removal. Baseline demographic, radiographic, and knee-specific PROMs were collected prior to surgery. Follow-up data included the KOOS QOL, Pedi-Fabs, IKDC, KOOS-PS, and Kujala patient reported outcome measures (PROMs) which were collected at 1- and >/= 2-years postoperatively. Additionally, return to sport (RTS) rates and recurrent instability events were collected.

Results This study cohort included 71 knees (67 patients) of which 79% were female. The average patient age was 25.0 years ±8.4 and the average BMI was 25.9±5.9. Previous surgical procedures included 29 (41%) of patients MPFL reconstructions, 16 (23%) tibial tubercle transfers, 25 (35%) lateral releases, 21 (30%) imbrication/refiging/plication procedures, and 13 (18%) loose body removals. Revision procedures consisted of 39 MPFL+TTOs, one MPFL+TTO+distal femoral osteotomy, 23 isolated MPFL reconstructions, and eight isolated TTOs. After their revision procedure, 81% of patients were able to return to sport. Of those that returned to sport, 92% returned at the same or a higher level. One patient (2%) reported a recurrent subluxation event and no patients (0%) reported a recurrent dislocation event following their revision procedure. Significant improvement from baseline scores (0-15 years follow-up were found in the KOOS-QOL (19.0 vs 54.1, p<0.001), IKDC (38.4 vs 69.2, p<0.001), KOOS-PS (40.1 vs 18.7, p<0.001), and Kujala (50.8 vs 80.0, p<0.001). No differences were observed for Pedi-FABS. Additionally, no statistically significant differences were observed between 1- and 2-year follow-up for all PROMs. The mean TT-TG was 17.0 ± 5.1 with 31% (n=21) of patients having a TT-TG greater than 20 mm. The mean CDI was 1.11 ± 0.19, 14% (n=10) patients had a CDI >=1.3 and 8% (n=6) had CDI <= 0.8. The mean PTI was 48.2% ± 18.3%. Trochlear dysplasia, defined as a TDI < 3 mm, was present in 73% (n=52) of patients. The measure of extensor mechanism containment, TT-LTR within 1 mm, found to be predictive of recurrent instability, was found in 11% of patients (n=8). PT-LTR, a measurement of lateral patellar tracking, was mean 6.2 ± 7.3.

Discussion and Conclusion Recurrent patellofemoral instability is a complex problem and the ideal surgical intervention as well as optimal surgical timing is not yet well defined. This study demonstrates that patients who underwent revision surgical stabilization procedures for failed patellofemoral instability surgery were both able to return to sport and benefit from improved subjective outcomes with low recurrent instability at short term follow-up. Continued data collection is currently underway to determine if these results will be sustained long term.

20787 HOW LOW CAN YOU GO? A BIOMECHANICAL STUDY ANALYZING CORACOID STABILITY AFTER CORACOPLASTY

Lucas F Heilmann, Julia Sußek, Michael J Raschke, Andre Frank, Jens Werners, Philipp Michel, Felix Dyma, Benedikt Schliemann, J Christoph Kathagen. Germany

Summary The goal of this biomechanical study was to determine the maximum amount of the coracoid that can be resected during arthroscopic coracoplasty without leading to coracoid fracture or avulsion of the conjoint tendon during simulated activities of daily living.

Data

Background Arthroscopic coracoplasty is a commonly performed procedure in orthopedic surgery for patients affected by subcoracoid impingement. To date, there is no consensus on how much of the coracoid can be resected with the shaver without compromising its stability. This biomechanical study aimed to determine the maximum amount of the coracoid that can be resected during arthroscopic coracoplasty without leading to coracoid fracture or avulsion of the conjoint tendon during simulated activities of daily living.

Methods A biomechanical cadaver study was performed with 24 shoulders (15 male, 9 female). Specimen were randomized into three treatment groups with similar distribution based on age, gender, and bone mineral density: group (A): native coracoid; group (B): 3 mm coracoplasty; group (C): 5 mm coracoplasty. Coracoid anatomic measurements were documented before and after coracoplasty. The scapula was potted, and a traction force was applied through the conjoint tendon. The stiffness and load-to-failure (LTF) were determined for each specimen.

Results The mean coracoid thickness in group (A) was 7.2 mm, 7.68 mm in group (B), and 7.81 mm in group (C). The mean LTF was 428 N (± 127 SD) in group (A), 284 N (± 77 SD) in group (B), and 159 N (± 87 SD) in group (C). Group (B) showed a significantly lower LTF in comparison with group (A) (p=0.016), as did group (C) (p<0.001). The stiffness of specimens between group A and group B showed no significant difference postoperatively (p=0.777), whereas the difference between group A and group C was significant (p=0.003). Postoperative coracoids with a thickness of 5 mm or greater were able to withstand activities of daily living.

Conclusion Depending on the amount of bone resected, arthroscopic coracoplasty can weaken the coracoid in a potentially clinically relevant manner. A 3 mm coracoplasty did not weaken the coracoid significantly in most patients. The critical value of 5 mm of coracoid thickness should be preserved to ensure its stability. In correspondence with the findings of this study, careful preoperative planning should be used to measure the maximum reasonable amount of coracoplasty to be performed.

21022 NON-ANATOMIC FEMORAL TUNNEL POSITION IN ACL-R INCREASES RISK FOR FUTURE MENISCUS TEARS

Alexandra Santina Gabrielli, Benjamin Todd Raines, Jonathan D Hughes, Jonathan Dalton, Cameron Crasto, Volker Musahl, Bryson P Lesniak. USA

Summary Femoral tunnel position has an impact on post-operative meniscal tear risk after ACL-R and an anatomic femoral tunnel position has protective effect on post-operative survival of menisci.

Data

Background Surgical technique accounts for 30–50% of failed ACL reconstruction (ACL-R) procedures, with femoral tunnel malposition being responsible for the majority of cases. A paucity of data still exists, however, regarding whether femoral tunnel positioning contributes to subsequent meniscal tears after ACL-R.

Purpose The objective of this study was to determine if a relationship exists between the position of femoral tunnel in ACL-R and subsequent meniscus tears.
COVID MORTALITY AMONG NECK OF FEMUR FRACTURES DURING THE PANDEMIC 2019

Aashish Raghu, Anas Hassan, Nicholas Roeck, Mohamed Antar. UK

Summary To review 30 day mortality rate, mortality related to covid infected neck of femur fracture patients, if we are following NICE guidelines for management of neck of femur fracture patients during the pandemic

Data Covid-19 has had a profound impact on the NHS. In addition, Hip fractures still form a significant proportion of admissions during the national lockdown period in 2020. Since 2007 the NHFD has reported a progressive improvement in 30 day mortality after hip fracture and this trend continues with just 6.1% dying in 2018, against 6.9% in 2017. (1) Covid-19 has increased the mortality especially in elderly population who commonly present with fragility hip fractures. (2) Various early studies show increased mortality in patients with hip fracture with concurrent covid-19 infection. National Institute of Clinical Excellence (NICE) clinical guidance (CG124) states that patients should have definitive surgery on the day of, or the day after diagnosis, along with other criteria, aiming to reduce mortality and morbidity.

Objectives To review the 30 day mortality rate (30 days from fracture diagnosis) in patients with NOFs and PPs during the pandemic. •To determine mortality in NOF patients with concurrent covid-19 infection. •To assess if we are following the NICE guidelines of time to surgery for NOF patients during the covidpandemic.

Study Design & Methods Retrospective study of all patients with NOFs and peri-prosthetic hip and knee fractures admitted during the period of 01/03/2019 to 24/05/2019 and 01/03/2020 to 24/05/2020. •Data collection using eTrauma, ICE and PACS.

Results Admissions- (1) There were 86 NOFs in 2019 and 8 PPs in 2019 (94 patients). (2) There were 95 NOFs in 2020 and 9 PP in 2020 (104 patients). •Deaths- (1) There were 3 NOF and 1 PP deaths in 2019 (4.25%). (2) There were 18NOF deaths and 0 PP deathsin 2020 (17.3%). •Covid status- (1) Among the 95 NOFs in 2020, 15 were covid positive, of which 7 died. (2) Among the 9 PPs in 2020, there were 2 were covid positive, of which none died. (38.8% of deaths in 2020 were covid positive) •Time to surgery for all patients (in 2019 and 2020) was <24 hours.

Conclusions Mortality rate in 2019 was 4.25% which increased to 17.3% in 2020 which is opposite to the recent yearly decreasing NHFD trend (6.8% prior to pandemic) but similar to NW study (32.8%). •Of the 2020 deaths, 38.8% were covid-19 positive which is similar to the recent UK study of 16,749 patients admitted to hospital with COVID-19 reports a mortality rate of 31%. (9) •Time to surgery was <24 hours in both 2019 and 2020 showing that we are following NICE guideline.

20483 HIGH RATE OF INITIALLY OVERLOOKED KAPLAN FIBER COMPLEX INJURIES IN PATIENTS WITH ISOLATED ANTERIOR CRUCIATE LIGAMENT INJURY

1Ryan M Bell, 1Robert A Ansorea, 1Cory M Edgar, 2Daniel P Berthold, 1Lukas Willinger, 1Matthew R Levasseur, 1Daniel Marrero, 2Lukas Nawid Muench, 2Andreas B Imhoff, 2Elmar Herbst, 1Mark P Cote. 1USA; 2Germany

Summary To retrospectively determine the rate of initially overlooked Kaplan Fiber Complex injuries in isolated primary ACL-deficient knees on routine MRI.

Data Background Injuries to the Kaplan fibers complex (KFC) are not routinely assessed in the anterior cruciate ligament (ACL)-deficient knee using preoperative magnetic resonance imaging (MRI). As injuries to the KFC lead to anterolateral rotatory instability (ALRI) in the ACL-deficient knee, preoperative detection of these injuries on MRI may help surgeons to individualize treatment and improve outcomes along with reduction of failure rates.

Purpose To retrospectively determine the rate of initially overlooked Kaplan Fiber Complex injuries in isolated primary ACL-deficient knees on routine MRI.

Methods Patients who underwent isolated ACL reconstruction between 08/2013 and 12/2019 were identified. Preoperative knee MRIs (minimum 1.5 T) were reviewed and injuries to proximal and distal Kaplan fibers (KFs) were recorded by 3 independent reviewers. KF length and distance to nearby anatomic landmarks (lateral joint line and lateral femoral epicondyle) were measured. Additional radiological findings including
bleeding, lateral femoral notch sign, and bone marrow edema (BME) were identified to detect correlations with KFC injury. **Results** The intact KFC could reliably be identified by all three reviewers (85.9% agreement; Kappa 0.71). Fifty-three–Fifty-six% of the patients with initially diagnosed isolated ACL-ruptures showed initially overlooked injuries to the KFC. Injuries to the distal KFs were more frequent (48.1%, 53.8% and 43.3% for Reviewer 1, 2, and 3, respectively) than injuries to the proximal KFs (35.6%, 47.1%, and 45.2%) for Reviewer 1, 2 and 3, respectively. Bleeding in the lateral suprapatellar region was associated with KFC injuries (p=0.023). Additionally, there was a positive correlation between distal KFs injuries and lateral tibial plateau BME (p=0.035). No associations were found with lateral femoral notch sign or other patterns of BME, including pivot-shift BME. **Conclusion** KF integrity and injury can be reliably detected on routine knee MRI. Fifty-three–Fifty-six% of the patients presenting with initially diagnosed isolated ACL ruptures had concomitant injuries to the KFC. This is of clinical relevance, as current routine MRI diagnostic may come along with a high number of occult or hidden KFC injuries. As injuries to the KFC contribute to persistent ALRI, which may influence ACL failure or reoperation rates, significant improvements in pre-operative diagnostic are required, in order to determine the exact injury pattern and to assist in surgical decision-making.

**20713** **COMPARISON OF THE SINGLE ASSESSMENT NUMERIC EVALUATION (SANE) SCORE TO THE SHORT VERSION OF THE INTERNATIONAL HIP OUTCOME TOOL (iHOT-12) FOR ASSESSMENT OF HIP CONDITIONS**
Brandon Barnds, Atlee Witt, Alexandra Orahovats, Kenneth J Hunt, James W Genuario, Theodore F Schlegel. USA
10.1136/jisakos-2021-congress.380

**Summary** The hip Single Assessment Numeric Evaluation (SANE) is an effective and efficient patient-reported outcome (PRO) to assess hip function when compared to the iHOT-12 PRO in an orthopaedic sports medicine subspecialty clinic. **Data** **Objectives** Patient-reported outcome (PRO) measures are increasingly important and valuable tools in orthopaedics to objectively assess patient outcomes and guide decision-making. Though the Single Assessment Numeric Evaluation (SANE) scale has been validated for use with shoulder, knee, and foot injuries, it has yet to be heavily utilized for hip injuries. Our objective is to compare the hip SANE PRO to the previously validated iHOT-12 PRO at our orthopaedic sports medicine clinic. **Methods** We retrospectively reviewed a prospectively collected database of consecutive patients presenting to an orthopaedic sports medicine clinic with a primary complaint of “hip pain” from September 2020 to January 2021. Inclusion criteria was any patient presenting to clinic with a self-reported primary complaint of hip pain. The database consists of prospectively recorded iHOT-12 and hip SANE PRO measures collected via a secure software platform. Age and sex were also recorded. Data was analyzed from both new patients and the first episode of relevant data obtained from returning patients undergoing nonoperative treatment. The original 33-question iHOT score measures health-related quality of life (QOL) and changes after treatment in young, active patients with hip disorders. This was later shortened to a 12-question PRO that accounts for 95% variation of the original version while achieving equivalent sensitivity to change. The SANE score was developed as a brief and efficient tool to subjectively assess the impact of a patient’s condition as well as improvement following orthopaedic treatment. In this study, the SANE score was administered as follows: “If 100% is perfectly normal, what percent of normal is your hip today?” This question was modeled off previously validated shoulder, knee, and foot SANE questionnaires. **Results** A total of 460 patients met the study inclusion criteria, of which 282 were new to clinic and 178 were return patients. The mean age was 47.83 (SD ± 16.94, range 13.02 to 87.36) of which 303 patients were female and 157 patients were male. The diagnoses of these patients presenting with a primary complaint of hip pain included conditions such as femoroacetabular impingement of the hip, lumbar radiculopathy, dysplasia, or labral tearing. The mean SANE and iHOT-12 scores for all patients were 47 and 48.38, respectively. The Pearson correlation coefficient between these two PRO measures was \( r = 0.700 \) (\( P = <0.005 \)) for all patients representing a high correlation, of which \( r = 0.674 \) (\( P = <0.005 \)) for new patients and \( r = 0.741 \) (\( P = <0.005 \)) for return patients. These correlation values were analyzed separately, representing a moderate and high correlation for new and return patients, respectively. **Conclusion** In conclusion, this study uses a large dataset to demonstrate that the hip SANE score correlates well with the iHOT-12 score in hip patients presenting to an orthopaedic subspecialty clinic with a primary complaint of hip pain. This supports the use of the hip SANE score for a patient-reported outcome measure in this population. The SANE score may be a useful and efficient PRO measure to inform treatment decision-making and monitor outcomes following treatment of hip conditions.

**20749** **PROMIS VALIDATION IN HIP ARTHROSCOPY: A SHIFT TOWARDS REDUCING SURVEY BURDEN**
Erik Gefach, Vehniah K Tjong, Michael Terry, Ryan S Sellely, Daniel Johnson, Richard W Nicollay, Gregory Versteeg, Mark Andrew Plantz, Peter Swiatek, Eric Sanders, Bejan Alvandi. USA
10.1136/jisakos-2021-congress.381

**Summary** PROMIS scores correlate strongly with traditional legacy measures which can help reduce survey fatigue and possibly improve quality. **Data** **Introduction** The Patient Reported Outcomes Measurement Information System (PROMIS) was developed to provide measures of patient-reported symptoms and healthcare outcomes across a variety of conditions in an easily accessible manner. The purpose of this study was to validate PROMIS against traditional legacy measures in patients undergoing hip arthroscopy for femoral acetabular impingement (FAI). **Methods** Outcome measures collected pre- and post-operatively included PROMIS pain interference (PI) and physical function (PF), mHHS, HOS (Activities of Daily Living (ADL) and Sport subscales), NAHS, and Visual Analog Pain Scale (VAS). Pearson’s correlation coefficients were calculated between each outcome measure.
Results Strong correlations were observed between the PROMIS PF T-Score and the mHHS ($r=0.64-0.83$, $p<0.0001$), HOS-ADL ($r=0.54-0.81$, $p<0.0001$), HOS-Sport ($r=0.55-0.74$, $p<0.0001$) and NAHS scores ($r=0.61-0.78$, $p<0.0001$). PROMIS CAT PI T-Score and VAS also demonstrated a strong correlation ($r=0.64-0.80$, $p<0.0001$).

Discussion PROMIS PF scores correlate strongly with mHHS, HOS-ADL, HOS-Sport and NAHS scores at all time points. Likewise, PROMIS PI scores correlate strongly with VAS pain scores. On average patients completing PROMIS need to fill out only 4 or 5 questions. This study supports the use of PROMIS as an efficient, valid outcome tool for patients with FAI undergoing hip arthroscopy.

Summary The present study was conducted to compare the clinical and radiographic outcomes of reverse total shoulder arthroplasty (RTSA) in a senior athletic and non-athletic population.

Results 61 patients (f:36; m:25; mean age 75.9 years) were available for follow-up survey (Follow-up: 47.1 months). 34 patients were assigned to the athletic group and 27 patients to the non-athletic group. The overall rate of return to sport was 78%. The athletic group demonstrated superior clinical results and patient-rated-outcomes (PROs) with CS 68.6 (SD: 10.4), ASES 87.0 (SD: 10.4), SST 9.1 (SD: 2.0) and VAS 0.1 (SD: 0.3) compared to the non-athletic group (CS 55.2 (SD: 17.2), ASES 71.5 (SD: 21.3), SST 6.8 (SD: 2.9) and VAS 2.2 (SD:2.1)), respectively ($p<.05$). Incomplete radiolucency around the humeral component was found significantly more frequent in the athletic group compared to the non-athletic group ($P=0.019$), whereas the occurrence of complete radiolucent

lines around the implant components demonstrated no statistical difference between the two groups ($P=0.382$). Incomplete radiolucency around the glenoid component was observed in patient (3%) of the athletic group, and patients (11%) of the non-athletic group ($P=0.2$). There was no loosening and/or migration of the glenoid component. Scapular notching was observed in 18 patients (53%) of the athletic group and 12 patients (44%) of the non-athletic group ($P=0.51$).

Conclusion At mid-term follow-up, the athletic population demonstrated significantly better clinical results following RTSA without a higher rate of radiographic changes when compared to non-athletic patients. However, incomplete radiolucency around the humeral component was observed significantly more often in the athletic group, which may affect long-term implant survivorship.

Summary The objective of this study was to compare patient rated outcome measurements (PROMs) and joint stability via ultrasound in patients following conservative or surgical treatment after simple elbow dislocation.

Results 44 patients (26 women, 18 men) with an average age of 41.5 ± 15.3 years were clinically and sonographically assessed. The mean follow-up period was 65.5 ± 30.4 months (range 26 - 123). 21 patients were treated conservatively (CT group) in accordance with a standardized protocol and 23 patients (ST group) received surgical treatment. No statistically significant difference was found between the conservative group and the surgical group concerning ROM, the ESAS (CT group: 99.4 ± 1.5 points; ST group: 99.8 ± 0.3 points), MEPS (CT group: 97.3 ± 6.8 points; ST group: 98.7 ± 3.3 points) and Quick DASH (CT group: 7.8 ± 10.4 points; ST group: 6.3 ± 7.9 points) ($p>0.05$). Two patients (9.5%) reported severe subjective instability of the treated elbow (both CT group).

No statistically significant difference was found in sonographic measurements comparing the two groups and the two groups to their respective unaffected side ($p>0.05$).
Conclusion Patients with conservatively, as well as surgically treated simple elbow dislocations can achieve high patient satisfaction and good to excellent clinical results. Even though ultrasound evaluation showed no significant differences in joint gapping between groups, nearly 10% of the conservative treated patients complained about severe subjective instability. Thus, especially for high demanding patients, individual conditions should be considered and discussed regarding primary surgical approach.

Data

Background Coronal and sagittal malalignment of the knee are well-recognized intrinsic risk factors for failure after anterior cruciate ligament reconstruction (ACLR). However, the influence of the axial malalignment, particularly the tibiofemoral rotational malalignment, on ACLR graft survival is still unknown. The aim of this pilot study was therefore to evaluate whether increased tibiofemoral rotational malalignment is associated with ACLR graft failure.

Methods In this review of prospectively collected data, we analyzed data from 20 patients who underwent revision or primary ACLR with a minimum of 2 years follow-up between June 2018 and January 2019. Ten patients who required revision of ACLR due to graft failure (ACLR revision group) were compared to a matched-control group of patients who underwent primary ACLR and had no evidence of graft failure (primary ACLR group). The patients were matched by age, gender, body mass index (BMI), presence of medial and/or lateral meniscus tear, and posterior tibial slope. Axial malalignment was assessed on magnetic resonance imaging (MRI) through the tibiofemoral rotation angle and the tibial tuberosity-trochlear groove (TT-TG) distance by two independent examiners. Tibiofemoral rotation angle was measured using the angle between the posterior condylar lines of the distal femur and the proximal tibia. TT-TG distance was calculated according to established landmarks. Data were analyzed using descriptive statistics, Shapiro-Wilk test of normality, independent t test or Mann-Whitney U test, as appropriate.

Results Overall, the mean age was 30.1 ± 8.0 years, and the mean BMI was 24.96 ± 3.01 kg/m². Medial and lateral posterior tibial slope were 9.6° ± 2.6° and 10° ± 3°, respectively. The mean tibiofemoral rotation angle was significantly higher in the ACLR revision group (7.1° ± 2.9°) compared to the primary ACLR group (3.8o ± 2.7°), (p= 0.02). However, TT-TG distance was similar between the groups (revision ACLR: 12.7 ± 4 vs primary ACLR: 13.4 ± 3.7 mm; p= 0.66).

Conclusion Our matched-control study demonstrated that patients who required revision of ACLR due to graft failure have a higher tibiofemoral rotation angle than patients with no evidence of ACLR graft failure. We believe that increased knee rotational malalignment provides more stress on the ACLR graft and therefore might jeopardize the success of ACLR.
correlation between LCL-CPN distance distally and knee flexion angle ($r=0.41, p=0.008$).

**Conclusions** Distance from the LCL fibular insertion to the CPN is modified by knee flexion angle, being greater at 90° than at 0° of knee flexion. When performing a posterolateral corner reconstruction, at 90° of knee flexion angle, an anatomically positioned 6 mm fibular tunnel is safe without a common peroneal nerve neurolysis.

**20401 HIGHER SURVIVAL RATE OF TOTAL KNEE ARTHROPLASTY AFTER HIGH TIBIAL OSTEOTOMY COMPARED WITH UNICOMPARTMENTAL KNEE ARTHROPLASTY; A STUDY OF A NATIONWIDE COHORT DATA IN KOREA**

Sun-Ho Lee, Jong-Keun Seon, Eun-Kyoo Song. Republic of Korea

**Summary** Orthopedic surgeons should be aware of the risk of a relatively low survival rate in TKA after UKA compared to TKA after HTO.

**Background** Although some studies reported that survival rates of TKA after HTO or UKA is not as good as those of primary TKA, it is still controversial issue regarding survival rate of them. This study was to evaluate the revision rates of TKA after HTO and UKA compared with those of primary TKA and compare survival rate and perioperative complication between TKA after HTO and UKA using propensity score matching analysis.

**Methods** List of patients with primary TKA, TKA after UKA or TKA after HTO were obtained from Korean National Health Insurance database for 684,767 TKAs performed from January 1, 2007 to May 31, 2019. Among them, 608,871 cases of the primary TKA due to degenerative OA (Group A), 2,757 TKAs after HTO (Group B), and 1584 TKAs after UKA (Group C). Revision rates were compared between groups with use of log-rank tests and were presented as Kaplan-Meier curves. The adjusted hazard ratio (HR) and 95% confidence interval (CI) of Group B and C compared with reference group (Group A) were calculated for revision rate using a multivariable Cox proportional hazard regression model. 1356 of matched patients were assigned to each group B and C on the basis of propensity score for comparing revision rates until 8 years after TKA and perioperative complication between TKA after HTO and UKA.

**Results** The overall revision rate was 1.41% in Group A, 1.74% in Group B, and 3.79% in Group C. The revision rate until 8 years after TKA was significantly higher in Group B or C than in Group A ($p<0.001$). The multivariable regression analysis revealed that HR for revision compared with Group A rate was significantly higher in Group B and C (1.51 in Group B and 3.97 in Group C). The result of comparison using PSM between TKA after HTO and UKA, TKA after HTO showed lower risk of revision than TKA after UKA (HR: 0.11 at 4 years and 0.22 at 8 years). However, there were no statistical differences in perioperative complication between two groups except incidence of DVT and surgical site infection.

**Conclusions** Patients with TKA after UKA or HTO showed significantly higher risk of revision than primary TKA. While TKA after HTO showed lower risk of revision than TKA after UKA, there were no differences in perioperative complications between TKA after UKA or HTO. Thus, surgeons must be aware of the risk relatively low survival rate in TKA after UKA or HTO, especially in TKA after UKA.

**21014 POSTOPERATIVE COMPLICATIONS OF INTRAOPERATIVE PLATELET RICH PLASMA IN HIP ARTHROSCOPY**

Kunal Varshneya, Geoffrey D Abrams, Seth L Sherman, Marc R Safran. USA

**Summary** The use of platelet rich plasma during hip arthroscopy may lead to increased risk for postoperative complications, in particular heterotropic ossification.

**Data** Platelet-rich-plasma is becoming an increasingly popular tool orthopedic surgeons use intraoperatively to accelerate healing and recovery; however, little data exists regarding its safety profile in hip arthroscopy.

**Methods** We queried the MarketScan database to identify patients who underwent hip arthroscopy from 2007 to 2015. Patients were stratified into groups based on whether or not they received platelet rich plasma during their surgery. Complications, reoperations and costs for both groups were assessed for 90 days after surgery. Patients without laterality codes were excluded. A multivariate logistic regression analysis was used to control for confounding factors.

**Results** 35,263 patients met the inclusion criteria of this study, of which $n = 253 (0.7\%)$ received PRP at the time of surgery. Age and rates of diabetes, hypertension, hyperlipidemia, obesity, and tobacco use were similar between cohorts. However, there were significant differences in the comitant procedure distribution. Unadjusted composite complications rates were significantly different between the two cohorts (arthroscopy only 7.9%, arthroscopy + PRP 14.2%, $p = 0.0002$). Heterotopic ossification was the main driver of this difference, occurring more commonly in the PRP cohort (10.7% vs 5.7%, $p = 0.0006$). When stratifying by procedure type, intraoperative PRP was associated with higher complications in patients undergoing femoroplasty (25.0% vs 10.4%, $p < 0.0001$), labral repair (18.8% vs 9.2%, $p = 0.0002$), and acetabuloplasty (20.3% vs 10.8%, $p = 0.0009$). In multivariate regression analysis, after controlling for all other variables, PRP did lead to higher rates of postoperative complications after hip arthroscopy (ref: no PRP, OR 1.9, 95% CI 1.3–2.7, $p = 0.0003$).

**Conclusions** Patients receiving intraoperative PRP during hip arthroscopy may be at increased risk of developing a postoperative complication, particularly heterotropic ossification. Consideration should be made on which patients may benefit the most from PRP. Further studies should aim to elucidate whether or not a link exists between the biochemical process of heterotopic ossification and PRP.

**21010 RISK FACTORS FOR HIP FRACTURE AND DISLOCATION FOLLOWING ARTHROSCOPIC FEMOROACETABULAR IMPINGEMENT SURGERY**

Kunal Varshneya, Geoffrey D Abrams, Seth L Sherman, Marc R Safran. USA

**Summary** Although some studies reported that survival rates of TKA after HTO or UKA is not as good as those of primary TKA, it is still controversial issue regarding survival rate of them. This study was to evaluate the revision rates of TKA after HTO or UKA compared with those of primary TKA and compare survival rate and perioperative complication between TKA after HTO and UKA using propensity score matching analysis.

**Methods** List of patients with primary TKA, TKA after UKA or TKA after HTO were obtained from Korean National Health Insurance database for 684,767 TKAs performed from January 1, 2007 to May 31, 2019. Among them, 608,871 cases of the primary TKA due to degenerative OA (Group A), 2,757 TKAs after HTO (Group B), and 1584 TKAs after UKA (Group C). Revision rates were compared between groups with use of log-rank tests and were presented as Kaplan-Meier curves. The adjusted hazard ratio (HR) and 95% confidence interval (CI) of Group B and C compared with reference group (Group A) were calculated for revision rate using a multivariable Cox proportional hazard regression model. 1356 of matched patients were assigned to each group B and C on the basis of propensity score for comparing revision rates until 8 years after TKA and perioperative complication between TKA after HTO and UKA.

**Results** The overall revision rate was 1.41% in Group A, 1.74% in Group B, and 3.79% in Group C. The revision rate until 8 years after TKA was significantly higher in Group B or C than in Group A ($p<0.001$). The multivariable regression analysis revealed that HR for revision compared with Group A rate was significantly higher in Group B and C (1.51 in Group B and 3.97 in Group C). The result of comparison using PSM between TKA after HTO and UKA, TKA after HTO showed lower risk of revision than TKA after UKA (HR: 0.11 at 4 years and 0.22 at 8 years). However, there were no statistical differences in perioperative complication between two groups except incidence of DVT and surgical site infection.

**Conclusions** Patients with TKA after UKA or HTO showed significantly higher risk of revision than primary TKA. While TKA after HTO showed lower risk of revision than TKA after UKA, there were no differences in perioperative complications between TKA after UKA or HTO. Thus, surgeons must be aware of the risk relatively low survival rate in TKA after UKA or HTO, especially in TKA after UKA.
Summary Patient specific factors such as age, sex, and hypertension may impact the risk for hip fracture following femoroacetabular impingement surgery.

Data

Purpose To identify risk factors associated with hip fracture and dislocation following arthroscopic surgical management of femoroacetabular impingement (FAI).

Methods We queried the MarketScan database to identify patients who underwent FAI surgery from 2007 to 2016. Patients were stratified into 2 groups: (1) acetabuloplasty only or (2) femoroplasty only. Those underwent concomitant procedures were excluded. Reoperations, and postoperative surgical complications were followed for postoperatively for 180 days. Patients without laterality codes were excluded. A multivariate logistic regression analysis was used to control for covariates and identify independent risk factors for hip dislocation and fracture.

Results This study identified 13,809 patients (mean age, 36.3 ± 9 years) who underwent FAI surgery. Unadjusted postoperative complication rates were similar between the two cohorts (acetabuloplasty 17.1%, femoroplasty 19.9%, p = 0.0622). Rates of hip fracture (femoroplasty: 2.4% vs acetabuloplasty: 2.0%, p = 0.0302) and heterotopic ossification (femoroplasty: 11.3% vs acetabuloplasty: 8.8%, p < 0.0001) were higher in the femoroplasty only cohort. Combined acetabuloplasty and femoroplasty was associated with the highest postoperative complication burden of 21.6% (p < 0.0001). After multivariate regression, differences in age, sex, comorbid status, or procedure type did not influence odds in risk for postoperative hip dislocation. Adjusted data showed that neither femoroplasty nor acetabuloplasty influenced odds of hip fracture (p > 0.05). Patients who were aged under 20 years old were significantly less likely to fracture their hips postoperatively than patients aged 60+ years (OR 0.3, 95% CI 0.1–0.8). Hypertension was independently associated with increased odds of hip fracture (OR 1.7, 95% CI 1.2–3.5).

Conclusions Hip fractures and dislocations are uncommon but severe complications following femoral osteoplasty and acetabuloplasty. Older age, male sex, and hypertension all carry increased risk for a hip fracture following acetabuloplasty or femoroplasty. Patient and procedure specific factors that could be assessed with this database did not influence risk for hip dislocation.

20499 ALL-ARTHROSCOPIC MUSCLE ADVANCEMENT REPAIR TECHNIQUE FOR MASSIVE POSTERO-SUPERIOR ROTATOR CUFF TEARS

Andrew Kee, Jashint Maharaj, Bart-Jan Jd Veen, Kenneth Cutbush, Ashish Gupta. 1Australia; 2Netherlands

Summary All-Arthroscopic muscle advancement technique for massive cuff tears allows for tension-free repair and low retear rates

Data

Aim The purpose of this study was to present an all-arthroscopic muscle advancement technique to repair massive postero-superior rotator cuff tears and to examine functional and clinical outcomes.

Background Re-tear rates remain high following repair of massive rotator cuff tears. Retraction and delamination result in poor tendon quality and increased tension on the repair. These tears are often deemed irreparable due to a high failure rate. In this case, younger patients are often managed with tendon transfers or superior capsular reconstruction, whereas elderly patients are recommended reverse shoulder arthroplasty. This technique modified the open DeBeyre-Patte procedure and the arthroscopy-assisted muscle advancement procedure reported by Morihara et al. This all-arthroscopic technique of muscle advancement allows a tension-free tendon repair in massive retracted rotator cuff tears.

Methods Our technique involved sequential arthroscopic release of the supraspinatus and infraspinatus muscles. Muscle models of the scapula. Comparisons with methods utilizing the glenoid rim for bone loss estimations (best circle fit method and glenoid height/width method) were also investigated.

Methods 36 consecutive preoperative bilateral Computed Tomography (CT) scans of patients eligible for primary stabilization procedure were selected from our institutional surgical database (mean age 29 ± 9 years, 31 males and 5 females). Bilateral CT scan segmentation allowed for generation of 3D models of both scapulae. The Anatomical Concave Surface Area (ACSA) of the inferior glenoid was mapped using the diameter of the best-fit circle of the healthy glenoid using 3-Matic 13.0 software (Materialise, Leuven, Belgium). A ratio of the difference between surface areas of both glenoids (healthy and pathological) against the anatomical circular surface area of the healthy glenoid (ACSA method) was calculated to estimate bone loss. These results were compared with glenoid bone loss estimations obtained using the best circle fit and glenoid height/width methods. Inter- and intra-observer reliabilities were also calculated.

Results The average bone loss calculated using the ACSA, best circle fit and glenoid height/width methods were 9.4 ± 6.7%, 14.3 ± 6.8% and 17.6 ± 7.2% respectively. The ACSA method showed excellent inter-observer reliability with Intraclass Correlation Coefficient (ICC) of 0.95 compared to the best circle fit (ICC = 0.71) and glenoid height/width (ICC = 0.79) methods.

Conclusion This study showed that use of 3D anatomical concave surface area method to quantify instability-related glenoid bone loss is reliable and provides results that are less than methods utilizing the glenoid rim for bone loss estimations.
slides consisting of the release of the medial attachment to the scapula border and preservation of fascial attachments to rhomboids and deltoid to full muscle advancement were utilized in patients with irreparable postero-superior cuff tears depending on the extent of retraction and chronicity of the tear. Identification and preservation of the neurovascular pedicles (suprascapular nerve) to each muscle were performed. This allowed advancement of the tendon to its footprint, permitting tension free tendon repair. Tendon repair technique addressed the deep tendon layer with a Lasso loop, followed by a tied medial row taken to a knotless lateral row. 55 patients underwent this repair technique, with a mean follow up of 11 months (range 6–24 months). All patients had pre-operative Magnetic Resonance Imaging (MRI) scans confirming massive retracted rotator cuff tears to the rim of the glenoid (Patte Grade 3) and muscle fatty infiltration as classified by Goutallier et al. Follow-up MRI scans were performed to assess tendon healing. Clinical outcomes were evaluated comparing pre- and post-surgical Constant Murley scores and pain VAS.

Results MRI showed that 51 out of 55 (93%) repairs were healed, with a re-tear rate of 7%. The mean Constant Murley scores improved from 48 ± 16 pre-operatively to 80 ± 13 (p<0.05). VAS scores improved from a mean of 4 ± 2 pre-operatively to 1±2 post-operatively. 5 patients underwent further surgery: 2 patients to remove prominent hardware, 1 patient for release due to stiffness and 2 patients for reverse shoulder arthroplasty.

Conclusions In our series, the clinical outcomes of the all-artroscopic muscle advancement technique showed a low re-tear rate. Significant improvements in shoulder function and pain were noted. This technique is an alternative to non-anatomical procedures, such as superior capsular reconstruction and tendon transfers.

Summary Deterioration of JSW following MOWHTO was closely related to the undercorrection, and it affected clinical outcomes.

Data

Introduction There has been little data on the changes in joint space width (JSW), which could represent cartilage restoration, and factors affecting deterioration of JSW following medial opening-wedge high tibial osteotomy (MOWHTO). The purpose of this study was to evaluate the changes in JSW over time after MOWHTO and identify risk factors for deterioration of JSW using anteroposterior (AP) and Rosenberg views.

Methods We retrospectively analyzed changes in JSW of 104 MOWHTO patients whose preoperative osteoarthritis (OA) grade was K-L grade 3 or less on AP and Rosenberg views. Serial changes in JSW were assessed from preoperatively to at least 3 years postoperatively. Patients were divided into 2 groups according to JSW change patterns on each of AP and Rosenberg views: group 1 had either unchanged or increased JSW, and group 2 had decreased JSW. Clinical outcomes were compared using Western Ontario and McMaster Universities OA Index (WOMAC) score between groups. Multivariate logistic regression analysis was performed to identify risk factors for deterioration of JSW.

Results Our study population demonstrated increase in JSW overall by 0.5 mm and 0.8 mm on AP and Rosenberg views, respectively (p <0.05). Group 1 showed significant improvement based on patient reported outcomes (WOMAC) than group 2 (all p < 0.05). Undercorrection was an independent risk factor for failure to achieve maintained or increased JSW on both AP (OR: 6.274, 95% CI 1.870–21.051, p = 0.003) and Rosenberg (OR: 10.465, 95% CI 2.652–41.305, p = 0.001) views.

Conclusion JSW increased gradually and continuously on standing AP and Rosenberg views until postoperative 3 years after MOWHTO. Deterioration of JSW following MOWHTO was closely related to the undercorrection, and it affected clinical outcomes. Level of evidence: Level 3, Case control study.

Keywords: High Tibial Osteotomy, Medial Opening Wedge High Tibial Osteotomy, Joint Space Width, Cartilage thickness, Anteroposterior, Flexion, Undercorrection.

Summary This study looks to identify differences in outcomes following ACL reconstructions with regard to the patient’s sex.

Data

Introduction There is a paucity of information on the influence of patient sex on outcomes following ACL reconstructions (ACLR). Previous studies have demonstrated that females have worse outcomes with regards to instrumented laxity, revision rate, Lysholm score, Tegner activity score, and are less likely to return to sport. However, other measures have been shown to be similar between male and female patients. The purpose of this study was to perform a systematic review and meta-analysis comparing outcomes after ACL reconstructions with regard to sex.

Methods A systematic review and meta-analysis were conducted using PubMed, PubMed Central, Embase, Cochrane Library, and OVID (inception – April 2020) according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) guidelines. Outcomes including functional tests, re-rupture rates, re-operative rates, post-operative range of motion, post-operative stability, return-to-sport rates, and International Knee Documentation Committee (IKDC) scores were recorded and analyzed.

Results Studies that reported post-operative IKDC scores, re-rupture rates, and revisions rates were included in the meta-analysis. For IKDC scores, there were 7 studies included with 2022 males and 1402 females. We found that males had a statistically significant higher IKDC post-operative score (MD = 3.02; 95% CI [1.19, 4.84]; I² = 66%). Seven studies (14,543 males and 5,306 females) reported the rate of ACL revision. Our results show that there was no significant difference between males and females with regards to revisions (OR
A NOVEL OPERATIVE TECHNIQUE IN HARVESTING PERONEUS LONGUS TENDON FOR ARTHROSCOPIC RECONSTRUCTION IN COMBINED ANTERIOR AND POSTERIOR CRUCIATE LIGAMENT TEARS

Jhulia Nicholle Kawachi Cruz, Jason Paul Santiago, Raphael Coligado Jurilla, Patrick How.
Philippines

Summary Significant improvements in clinical functional outcome, and preservation of preoperative motor strength of the donor ankle suggest that donor ankle morbidity is prevented. Furthermore, significant improvements in clinical functional outcome and stability of the injured knee makes PLT a suitable graft for PCL in simultaneous ACL-PCL arthroscopic reconstruction.

Data Background Recent comparative studies suggest that the peroneus longus tendon (PLT) may be a good alternative autograft in anterior cruciate ligament (ACL) reconstruction in terms of strength, efficacy, and safety. However, the presence of several donor ankle morbidities observed postoperatively suggests a possible gap in the operative technique described in current literature. The aim of this study is to describe a surgical technique in harvesting the PLT for arthroscopic reconstruction of the posterior cruciate ligament (PCL) in patients with combined ACL-PCL tears, thereby decreasing, if not eliminating, the postoperative outcome of donor ankle weakness.

Methods In this case series, four patients diagnosed with combined ACL-PCL tears undergo simultaneous arthroscopic reconstruction of the ACL and PCL using the ipsilateral hamstring and peroneus longus tendon (PLT) as autografts respectively. After harvesting the PLT, the remaining distal stump of the tendon was sutured on to the peroneus brevis using simple interrupted technique. Functional Foot Index (FFI) was utilised to measure clinical functional outcome of the donor ankle, whereas Knee Injury and Osteoarthritis Outcome Score (KOOS) was utilized to measure clinical functional outcome of the injured knee. Manual Muscle Testing (MMT) was used to document motor strength of the donor ankle, and special tests of the knee were performed to assess stability of the injured knee.

Results With the longest follow-up period of 3 years, significant and continuous improvements were noted in clinical functional outcomes of the donor ankle and injured knee in all patients who underwent the surgical procedure. Physical examination findings reveal no weakness in first ray plantar-flexion and foot eversion of the donor ankle as early as 3 months in the postoperative period. Previously positive findings in the special tests performed on the knee, suggesting the presence of a multi-ligamentous injury, reveal negative findings immediately intraoperatively, as soon as the autografts are secured.

Conclusion Suturing the distal stump of the remaining PLT to peroneus brevis is a novel and crucial step in preventing donor ankle morbidity after harvesting the PLT for PCL reconstruction in combined ACL-PCL tears. Significant improvements in clinical functional outcome, and preservation of preoperative motor strength of the donor ankle suggest that donor ankle morbidity is prevented. Furthermore, significant improvements in clinical functional outcome and stability of the injured knee makes PLT a suitable graft for PCL in simultaneous ACL-PCL arthroscopic reconstruction.

A COMPARISON OF LOWER LIMB STRENGTH AND PLYOMETRIC ABILITY IN ATHLETES WHO UNDERWENT ACLR WITH LATERAL EXTRA-ARTICULAR Ilio-Tibial BAND TENDENOSIS WHEN COMPARED WITH ISOLATED ACL SURGERY. A BIOMECHANICAL STUDY

Bláithín Brady, Sarah Crosbie, Neil Welch, Mihai Vioreanu. Ireland

Summary A retrospective chart review of differences in maximal and reactive strength between injured and uninjured limbs of athletes who underwent isolated ACLR and those who underwent ACLR-LEAT.

Data Background Recently there has been a resurgence of interest in lateral, extra-articular ITB tenodesis (LEAT) to augment ACLR in an attempt to reduce the residual laxity that may be present post isolated ACLR and subsequently improve surgical outcomes. Adding a LEAT procedure to an isolated ACLR surgery adds to the surgical morbidity and raises the concern of decreasing maximal quadriceps strength and may lead to a significant reduction in lower limb reactive strength and hence plyometric ability ahead of returning to play (RTP).

Objectives The objective of our study was to identify differences in maximal quadriceps strength and reactive strength, with isokinetic and biomechanical 3D Laboratory testing at 6–8 months post-operatively, between athletes who undergo isolated ACLR and those who had ACLR-LEAT surgery.

Methods This is a single surgeon, retrospective chart review of 68 athletes, matched for gender, age and activity level, who underwent isolated ACLR or ACLR-LEAT. All athletes completed their isokinetic and 3D motion capture assessments between 6 and 8 months post-operatively in our Biomechanical Laboratory. Each athlete's isokinetic scores alongside their double leg drop jump (DLDJ) and bilateral single leg drop jump (SLDJ) results were documented and analysed.

References

= 0.85; 95% CI = [0.45, 1.60]; I²=94%). For the re-rupture rate, there were 7 studies with 19,370 males and 14,747 females. We found that males were significantly more likely to suffer a graft re-rupture than their female counterparts (OR=1.35; 95% CI = [1.22, 1.50], I² = 0%). Males also reported a 17% higher return-to-sport (RTS) rate than females (59.82% compared to 42.89%); however, no formal statistical analysis was able to be done due to the variability in reporting techniques between papers.

Conclusion To our knowledge, this is the most recent and comprehensive study focused on the role of a patient's sex on ACLR outcomes. Males and females showed similar outcomes with regards to rate of revision surgery. However, males were found to have higher post-operative IKDC scores and higher re-rupture rates. Males also showed almost a 17% higher incidence of returning to sport; however, the variability in reporting RTS rates following ACLR by sex prevents us from being able to perform a statistical analysis on these results. More studies are needed that focus directly on the effect of sex, combined with other co-variables such as age, graft used, or level of sport, to increase the breadth of knowledge on sex specific outcomes following ACL reconstructions.
Results There was no statistically significant difference between the two groups for maximal quadriceps strength (P = 0.86) or for LSI for either muscle group (P=0.95). Reactive strength was significantly higher for DLLD and bilateral SDLJ in the ACLR group (P = 0.018; P=0.009; P= 0.014).

Conclusions In our isokinetic and biomechanical analysis we observed no statistically significant difference in the maximal strength between uninjured and injured limbs for isolated ACLR athletes and ACLR-LEAT athletes. Between 6–8 months, reactive strength was significantly higher in the isolated ACLR athletes. This is of clinical relevance for surgical decision making regarding augmenting ACLR with LEAT, as well as, prescription of plyometric end stage rehabilitation and RTP timelines.

Summary We describe the first clinical results from the use of a continuous All-Inside meniscal repair device and show this to produce excellent early to mid-term results with high patient satisfaction and low meniscal re-tear rates.

Data

Introduction Meniscal tears remain common within sport and with the philosophy to ‘save the meniscus’, meniscal repair has become more common and is clearly preferred to meniscectomy. Many meniscal repair techniques exist. An Inside-Out technique was previously considered the gold standard although All-Inside techniques have gained popularity recently. Previous studies describe clinical outcomes following individual All-Inside sutures and while a laboratory study shows potential biomechanical advantages of a continuous All-Inside suture technique no studies exist that describe clinical results. Therefore, to our knowledge we present the first series of clinical results and outcomes following meniscal repair with a continuous All-Inside device.

Methods Over a 4-year period, 35 patients underwent arthroscopic meniscal repair using a continuous All-Inside meniscal device (CONMED Linvatec Sequent). This comprised of 28 males and 7 females. The mean age was 28 years (range 16 to 48 years) with a mean time from injury to surgery of 7 months (range 1 to 36 months). Each patient was followed up to a mean of 36 months (range 18 to 72 months). Patients were assessed for Tegner Score, IKDC Score, whether they had returned to sport, whether they had returned to the same level of sport and whether they had required further surgery on the knee, i.e. a further meniscal operation due to a failed repair. Concurrent surgery in the form of Anterior Cruciate Ligament Reconstruction (ACL-R) was also noted. The meniscus repaired (Medial or Lateral or Both) was recorded. All patients underwent standard physiotherapy protocol which was guided by a ‘safe zone’ range of motion determined by the intra-operative findings. All patients were permitted to weight bear from day 1 post-operatively.

Results The overall mean post-op Tegner score was 93.5 (range 69 to 100) and IKDC Score was 93.5 (range 74 to 100). A perfect (100 out of 100) Tegner score was observed in 47% of patients and a perfect (100 out of 100) IKDC score was observed in 41% of patients. Four patients (11.4%) required further surgery and were found to have a failed repair. One of these patients had a revision repair and remains asymptomatic. The other 3 required partial meniscectomy. This suggests an 88.6% survival rate or successful repair rate. When reviewing sub-groups of patients with concurrent ACL-R the highest mean post op Tegner and IKDC scores were observed in the group that underwent Medial Meniscal Repair with ACL-R (98 and 98.2). The lowest scores were observed in the Medial Meniscal Repair Group without ACL-R (83.2 and 87.8). Almost all patients (94.3%) were able to return to some form of sport with 88.2% returning to the same level of sport.

Discussion A continuous All-Inside Suture technique for meniscal repair has been suggested to have biomechanical benefit over an individual All-Inside technique. We have demonstrated excellent early to mid-term clinical results from the use of such a device and therefore our findings would support this suggested benefit. In particular we observed high rates of return to play and a low re-tear rate. We would advocate its use.
also demonstrated greater sensitivity and lower specificity in patients in the higher BMI groups but results were not statistically significant. Greater BMI, independently of age and gender, was significantly associated with positive findings of ACL (Anterior Drawer: Odds Ratio (OR) = 4.33–5.02, p < 0.008; Lachman: OR = 4.60–5.43, p < 0.006; Pivot-Shift: OR = 3.71–4.23, p < 0.026).

Conclusion Provocative tests for ACL tears are less sensitive but more specific in obese patients. Provocative tests for meniscal tears may be more sensitive and less specific in patients with greater BMI, particularly in the setting of a medial meniscal tear. The physician should take into consideration the impact of BMI on the accuracy of the physical examination of the knee to optimize treatment decision-making.

20719
ARE FEMORAL AND TIBIAL DEROTATION OSTEOTOMIES EFFECTIVE IN IMPROVING HIP AND KNEE PAIN AND FUNCTION?

Vitali Goriainov, Mohamed Zubair Farook, Rajiv Kaila, Tom CB Pollard, Antonio JMD Andrade, UK

10.1136/jisakos-2021-congress.397

Summary Femoral and tibial derotation osteotomies are effective interventions in management of relevant hip and knee symptoms resulting from rotational deformities.

Data

Introduction Rotational profile of femur and tibia significantly contribute to the kinematics of hip and knee joints. Femoral version abnormalities lead to impingement syndromes, hip articular damage and periarticular muscle imbalance, gait disturbances, as well as dysfunction of patello-femoral joint (PFJ). Although the role of tibial torsion derangements in PFJ dysfunction is evident, their contribution to hip symptoms, especially with certain activities, is less well understood. The treatment of femoral and tibial rotational deformities includes Proximal Femoral Derotation Osteotomy (PFDO) and Distal Tibial Derotation Osteotomy (DTDO), respectively. We aimed to determine the clinical effectiveness of these interventions in improving patients’ hip and knee symptoms.

Materials We performed a retrospective review of prospectively collected data in patients that underwent PFDO and DTDO between 2018–2020. PFDO was routinely stabilised using intramedullary nail (Metatan, S&N) and DTDO with tibial plate (EVOS, S&N). Pre-operative and interval post-operative functional outcomes were analysed and correlated. Functional outcomes included international hip outcome tool (iHOT12), hip and kneedeck score activities of daily living scale (HOS ADLS and KOSS ADLS, respectively) and sport scale (HOS SS and KOS SS, respectively), non-arthritic hip score (NAHS) and anterior knee pain or Kujala score (AKP). HOS and KOS scores included additional graphical scores.

Results We identified 22 patients that underwent PFDO (13 females) and 30 – DTDO (27 females). Average age was 24 years (17–38) and 26 years (18–44) in PFDO and DTDO cohorts, respectively. Average follow-up was 18 months (2–33). Statistical difference between pre-operative and post-operative scores was achieved at 18 and 12 months for PFDO and DTDO, respectively. To date, there were two non-unions in PFDO group, one treated with Exogen ultrasound device and one with exchange nailing. Three further PFDO required nail dynamization. There were no other significant post-operative complications. Pre-operative vs 18 months post-operative scores for PFDO were 33 vs 88 for iHOT 12; 55 vs 91 for HOS ADLS and 46 vs 92 for HOS ADLS graphical; 44 vs 86 for HOS SS and 39 vs 80 for HOS SS graphical; and 57 vs 89 for NAHS. Pre-operative vs 12 months post-operative scores for DTDO were 38 vs 97 for iHOT 12; 58 vs 94 for KOS ADLS and 61 vs 95 for KOS ADLS graphical; 52 vs 96 for KOS SS and 40 vs 96 for KOS SS graphical; and 58 vs 94 for AKP.

Conclusions Femoral and tibial rotational deformities are important to be recognised as contributing factors to hip and knee pain. Derotation osteotomies are effective interventions in management of relevant symptoms resulting from rotational deformities. Recovery is more rapid following tibial osteotomy, although the initial level of pre-operative function is higher in patients with tibial torsional abnormalities. Nevertheless, both osteotomies can lead to a functional recovery to near normal level at the maximum of 18 months.

20849
DOES MRI SCAN ENABLE OPTIMALLY INFORMED PRE-OPE RATIVE PLANNING IN HIP ARTHROSCOPY?

Vitali Goriainov, Fadi Hindi, Andrew Langdown, UK

10.1136/jisakos-2021-congress.398

Summary Examination under anaesthetic of hips with FAI is a reliable method of defining underlying pathomorphology.

Data

Introduction Femoro-acetabular impingement (FAI) is a dynamic phenomenon. The decisions on FAI management are guided by radiological findings, most prominently MRI scan. However, MRI is suboptimal in assessing the precise dynamic nature of FAI, bony pathomorphology (CAM/pincer lesions) and, infrequently, labral pathology. There is paucity of knowledge on how informed our pre-operative planning is when based purely on MRI findings. We additionally aimed to evaluate the value of anterior acetabular sector angle (AASA) as a measure of anterior acetabular coverage assessment.

Materials We performed a review of a single high-volume surgeon’s cohort of patients that underwent hip arthroscopy for FAI. Pre-operative MRI findings were analysed, and correlated with examination under anaesthetic (EUA) and intra-operative arthroscopic findings (benchmark). The parameters analysed included alpha-angles versus presence of CAM lesions, precise nature of labral lesions, presence of pincer lesions and their correlation to AASA. Alpha-angle >50 degrees and AASA >65 degrees were deemed pathological.

Results We reviewed 150 patients who underwent 150 hip arthroscopies. There were 78 females and 72 males, average age 38 years (53–18). Intra-operatively, pincer was present in 20% of patients, CAM in 26%, and mixed impingement in 54%. MRI scans correctly identified the presence of pincer in 36% of cases, CAM lesions in 44%, and precise labral abnormalities in 80%. Although there was a statistically significant difference in reported AASA values between pure CAM-type and impingements involving the presence of pincer lesions (57o vs 63o p < 0.05), this difference was absent between pure pincer and mixed impingement (62o vs 63o,
p=0.62). Pre-operative EUA accurately identified the presence of CAM lesions in 89% and pincer-type lesions in 77%.

Conclusions Ability to precisely establish pathology enables thorough pre-operative planning. MRI scans, even when reported by experienced MSK radiologists, frequently fail to identify the impingement pattern. Pathological threshold of AASA >65 degrees in MRI-based axial-plane evaluation of pincer-type pathomorphology was shown to be unreliable. Therefore, we advocate pre-operative EUA to enhance the understanding of pathology, treatment planning and, ultimately, the success of hip arthroscopy.

**Summary**

Proximal Femoral malrotation correction frequently successfully resolves hip impingement even in the presence of intra-articular CAM/pincer pathomorphology.

Data

Introduction It is recognised that hip impingement can be caused by intra-articular pathology (CAM/pincer) and/or a combined femoral/acetabular version abnormality. The latter is treated based on the severity of predominant component. Proximal Femoral (PF) malrotation treatment includes Proximal Femoral Derotation Osteotomy (PFDO). We aimed to determine PFDO clinical effectiveness in patients with hip symptoms.

Materials A review of patients undergoing PFDO between 2018–2020. Sub-trochanteric PFDO was routinely stabilised with IM nail (Metatan,SKN). We reviewed our management of femoral torsion and associated MRI-defined intra-articular pathomorphology: CAM/pincer ? labral tear and non-CAM/pincer-related labral tears. Combined femoral/acetabular version was assessed using McKibbin Index (MI) (normal ranges: MI=20–50°, acetabular version=10–25°, PF=10–25°). If presenting symptoms resolved, patients were discharged at 18months.

Results 22 patients underwent PFDO for hip pain. Average age=24years (17–38), average follow-up=20 months (3–36). Observed prevalence of version abnormalities in our cohort were: • MI o 8-Excessive retroversion (range -5–5°, median–3°), o 14-Excessive anteversion (51–67°,median–53°); • Acetabulum o 11-Relative retroversion (–2–9°, median–4°), o 11-Normal (11–23°, median–19°); • PF o 8-Relative retroversion (–8–5°, median–0°), o 14-Excessive anteversion (26–54°, median–34°). Overall, 12 patients settled post-PFDO and were discharged at 18 months follow-up. Of 10 patients with associated MRI-defined CAM/pincer pathomorphology • 4 had hip arthroscopy prior to PFDO (discharged) • 1 required hip arthroscopy post-PFDO • 5 – no hip arthroscopy required (discharged, 3– <18months follow-up).

Conclusion Patients with hip impingement present with high prevalence of rotational malalignment. Hip arthroscopy for intra-articular pathology prior to malrotation correction is likely to fail. Primary correction of malrotation is crucial and leads to symptom resolution in significant proportion of patients.

**Summary**

Correction of tibial malrotation is a viable treatment for hip impingement.

Data

Introduction Contribution of tibial malrotation to hip joint kinematics and impingement, especially with certain activities, is poorly understood. Tibial malrotation treatment includes Distal Tibial Derotation Osteotomy (DTDO). We aimed to determine DTDO clinical effectiveness in patients with hip symptoms.

Materials A review of patients undergoing DTDO between 2018–2020. DTDO was routinely stabilised with tibial plate (EVOS,SKN). We reviewed our management of tibial torsion and associated ipsilateral pathology: MRI-defined intra-articular pathomorphology (CAM/pincer) and non-CAM/pincer-related labral tears, as well as excessive combined femoral/acetabular version (McKibbin Index (MI) >50°). If presenting symptoms resolved, patients were discharged at 1year.

Results 27 patients underwent DTDO for hip pain, 3 – for hip and knee pain. Mean tibial torsion was 48.6° (41–63°). Average age=27years (18–44), average follow-up=20 months (3–36). Thirteen patients (43%) had a co-existent CAM/pincer and 7 (23%) – excessive MI (51–76°). Of 13 CAM/pincer patients post-DTDO: • 2 patients settled (discharged) • 4 had hip arthroscopy prior to DTDO - 1 settled post-DTDO (discharged) - 3 are persistently symptomatic <1yr follow-up, including 1 with excessive MI (51°) • 3 with persistent hip symptoms >1yr post-DTDO underwent and 1 awaits hip arthroscopy (all with normal MI) • 4 patients <1 yr post-DTDO are improving. Of 17 non-CAM/pincer patients: • 4 had labral tears - 2 settled post-DTDO (discharged) - 2 – clinically improving (<1yr follow-up) • 7 had excessive femoral/ acetabular version - 2 – discharged - 5 – under review (<1yr follow-up) • 6 others discharged • no direct hip interventions were required to date. Four patients required plate removal, no complications were identified.

Conclusion Patients with rotational malalignment frequently present with multi-level deformity and high prevalence of co-existent CAM/pincer. Hip arthroscopy for intra-articular pathology prior to malrotation correction is likely to fail. Malrotation correction should be prioritised. Significant proportion of symptomatic hip impingement patients (=45%) improve with tibial derotation.
hip joint. Compensatory movement patterns as a result of restriction of movement and pain in the hip seen in FAI have been demonstrated to increase forces on neighboring joints such as the knee and lumbar spine and are subsequently at risk for injury. Previous studies have demonstrated a high incidence of ACL reconstructions in athletic populations that have been retrospectively diagnosed with FAI. A population level analysis to evaluate the phenomenon of ACL reconstructions in patients with FAI, or the time course of ACL reconstruction relative to FAI surgery has not yet been investigated. This study sought to answer the following questions: (1) Do patients that undergo FAI-related hip arthroscopy have a higher incidence of ACL reconstruction? (2) Does ACL reconstruction tend to precede FAI-related arthroscopy?

Methods We assessed all patients who underwent hip arthroscopy identified using two FAI-related Current Procedural Terminology (CPT) codes between January 2011 and December 2016 by retrospective analysis of the IBM MarketScan Research databases (formerly Truven Health Analytics). Patients were excluded if they did not meet continuous insurance enrollment criteria for two years surrounding the period of interest. The primary outcome was ACL reconstruction as indicated by the corresponding CPT code at any period of time within the database limits (January 2006 – December 2016). We identified 18,649 individuals that underwent hip arthroscopy for FAI between the years of 2011–2016. During this same period, 122,651 patients were treated with an ACL reconstruction. A cohort of 139 unique patients was identified that underwent FAI-related arthroscopy and ACL reconstruction that met inclusion criteria.

Results The incidence of ACL reconstruction in patients with FAI-related arthroscopy was 0.0075, while the incidence of ACL reconstruction over the same time period in the MarketScan database was 0.0014 (p < 0.0001). The final cohort with both FAI-related arthroscopy and ACL reconstruction totaled 139 unique patients consisting of 87 women (63%) and 52 men (37%) (p < 0.01). The average age at FAI-related arthroscopy was 33.7 years (SD 13.2 years). On average, patients underwent ACL reconstruction 14 months before FAI-related arthroscopy (95% CI 8.6–18.7 months).

Conclusions Patients who underwent FAI-related arthroscopy were shown to have a significantly higher incidence of ACL reconstruction when compared to the general incidence of ACL reconstruction in this dataset. ACL reconstruction also occurs, on average, before FAI-related arthroscopy suggesting a potential causal or comorbid relationship that requires further investigation. Level of Evidence: Level II
functional meniscal replacements. The purpose of this study is to create a meniscus construct with micro-scale circumferential and radial fibres, inspired by native tissue architecture and using clinical grade materials. Secondly, we aim to seed the construct with a clinically relevant cell number and cell type for potential translation in one-stage treatment. In order to assess bio-compatibility, we compare the in vitro meniscus extracellular matrix formation in the construct.

Materials and Methods Scaffolds were made from medical-grade polycaprolactone (Corbion) using melt-electrowriting (MEW) technology. Two different architectures were deposited with a programmed inter fibre spacing of 225 μm or 160 μm. The ratio of circumferential: radial fibres was 14:2 or 12:4. Printability was assessed using scanning electron microscopy (SEM). The scaffolds were seeded with co-cultures of primary human osteoarthritic meniscus cells and bone marrow mesenchymal stromal cells (MSCs) in fibrin glue (3 donor combinations; 5 technical replicates). The constructs were compared to a CMI® that was reduced to the same form and size and 2 Fused Deposition Modelling constructs. Elastic properties were assessed under uniaxial confined compression. After 4 weeks of culture, proteoglycan and DNA content were quantified. Cell distribution throughout the scaffold was assessed at 3 locations and 2 orientations using Hematoxylin and Eosin (H&E) staining. Micro Computed Tomography (uCT) was used to assess construct dimensions.

Results After 28 days of co-culture, a basal level of proteoglycan production was observed in MEW scaffolds, the CMI®, and fibrin gel control, yet within the FDM scaffolds less proteoglycan production was observed. The MEW scaffolds showed a higher Young’s modulus compared to the CMI® scaffolds and a higher yield point compared to FDM scaffolds. During 28 days of culture the cell-seeded scaffolds increased in yield stress and ultimate strength. Histology indicated distribution of cells across the construct.

Conclusions This study shows feasibility of creating a wedge-shaped meniscus scaffold with MEW using medical-grade materials, and seeding the scaffold with a clinically-feasible cell number and -type for potential translation as a one-stage treatment.

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Methods Two novice sonographers, a medical student with no prior ultrasonographic experience and a junior orthopedic resident with limited shoulder ultrasonographic experience, completed a training phase with an experienced sonographer. The two novice sonographers subsequently performed standardized ultrasonographic measurements on patients, diagnosed with subacromial pain, recruited consecutively from an orthopedic outpatient clinic. The measurements were: supraspinatus tendon thickness, subacromial bursa thickness, acromio-humeral distance and an assessment of dynamic impingement (visual impingement of the supraspinatus tendon and the subacromial bursa between the humeral head and the anterolateral aspect of acromion). Intraclass correlation coefficients (ICC(2,1)), standard error of measurement (SEM), minimal detectable change (MDC), 95% Limits of Agreement (LOA) and Cohen’s unweighted kappa were used to evaluate reliability and agreement.

Results Twenty-eight patients (mean age: 52 years; mean BMI: 27.5) were included (28 symptomatic and 20 asymptomatic shoulders). ICC-values of supraspinatus tendon thickness ranged from 0.73 to 0.77 (SEM 0.4–0.5 mm; MDC 1.2–1.4 mm). Subacromial bursa thickness ICC ranged from 0.41 to 0.88 (SEM 0.2–0.4 mm; MDC 0.4–1.0 mm) and acromio-humeral distance ICC ranged from 0.68 to 0.72 (SEM 0.9 mm; MDC 2.5–2.6 mm). Kappa of mechanical impingement in symptomatic shoulders was 0.29 and was driven by a discrepancy of positive findings between the raters (43% vs 18%).

Conclusion Novice sonographers achieved good reliability for ultrasonographic measurements of supraspinatus tendon thickness and acromio-humeral distance. The reliability of subacromial bursa thickness ranged from fair to good, while the evaluation of mechanical impingement only resulted in fair reliability.

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THE QUEST FOR OPTIMAL FEMORAL ANTEVERSION ANGLE MEASUREMENTS: A COMPARATIVE ADVANCED 3D STUDY

Bert Van Fraeyenhove, Annemiek Van Haver, Jonas Grammens, Gino Mestach, Jeroen Verhaegen, Peter Verdonk. Belgium

Summary An advanced 3D analysis of femoral anteversion angle

Data

Introduction Femoral rotational alignment is expressed as femoral anteversion angle (FAVA). It is defined as the angle between the femoral neck axis (FNA) and posterior condylar line (PCL) in the axial plane. FAVA affects both hip and knee biomechanics and has important clinical implications in treatment of femoral fractures, derotational osteotomies and total hip arthroplasty design. In this study five different FAVA measurement methods were studied using advanced 3D imaging and compared to Murphy’s method.

Methods CT scans of 102 dry femur specimens were taken with subsequent density-based segmentation using the Mimics® software package to obtain 3D images. Murphy’s method and five different 3D measurement methods, to determine FAVA, were applied and compared. Murphy’s method was performed to the contours of the femoral 3D models by calculating the angle between the line formed by the femoral head center...
and the center of the base of the femoral neck and the condylar axis. In the first 3D measurement method, a best fit sphere was plotted on the femoral head. Next, an elliptical least-square fitting approach was applied to find the cross-sectional center of the femoral neck. The FNA connects those two center points. In method 2, a second sphere with the same center point as in method 1 was created to intersect the femoral neck by increasing the radius of the first sphere with 25%. Subsequently, a best fit arc and its center at intersection of the femoral neck were determined. The line connecting the centers of sphere and arc is called FNA. Method 3 is the same as method 2, except that the radius of the best fit sphere was increased with 40%. In method 4, the complete femoral neck surface was used, and the center of mass was calculated. The line defined by this point and the center of the best fit sphere through femoral head was used as FNA. To assess the robustness of method 4, it was repeated (method 5) with another selection of femoral neck surface points (same observer, 1 week later). This simulates a surgical navigation, defining femoral head and neck surface by means of a spatially tracked pointer device.

**Results** The mean FAVA (and SD) for the 102 specimens measured with Murphy’s method, 3D methods 1, 2, 3, 4 and 5 were respectively 8.12° (7.30°), 9.93° (8.24°), 9.53° (7.87°), 10.46° (7.83°), 13.21° (8.60°) and 8.21° (7.64°). A paired student t-test showed significant differences except for method 1 and 2 (p = 0.193). Those results differ from the reference FAVA range of 10–25° as found in literature. The presence of a CAM deformity resulted in an increased femoral anteverision, independent of the used measurement technique. In addition, the presence of a CAM deformity tends to underestimate the measured FAVA in method 2, as compared to method 3. Strong correlations between the different methods were observed above 7.5° of anteverision (Murphy’s method). Pearson correlation coefficients between Murphy’s method and method 2 decreased in the presence of a CAM deformity.

**Conclusion** Advanced 3D morphology analysis of FAVA revealed significant differences between methodologies and questions the validity of the current reference data. More research is needed to investigate the increase in FAVA in hips with a CAM deformity. We propose method 3 (sphere +40%) to measure the FAVA, since the presence of a CAM deformity does not influence the results as compared with method 2. In addition, advanced 3D imaging is considered more robust than surgical navigation-based methods. The definition of FNA by the center of mass of the femoral neck surface is not a solid method to apply in surgical navigation and is too difficult to standardize in clinical settings. These findings provide new insights into femoral anteverision and its variability and may have applications in the development of new image-based diagnostic strategies, hip implant design and positioning.

**Summary** The prevalence of Kaplan Fiber (KF) injuries was found to be similar to a smaller, underpowered series, but these injuries were not detected reliably among independent reviewers in the largest series to date of magnetic resonance imaging (MRI) examinations assessed.

**Data**

**Background** Residual rotatory knee laxity following ACL reconstruction portends suboptimal clinical outcomes. When found in conjunction with ACL tear, KF injuries may be evidence of high-grade rotatory knee laxity. Previous investigations have been underpowered to conclusively define the prevalence of KF injuries. The accurate identification of KF injuries is vital for devising an optimal surgical tactic that restores knee stability and minimizes the likelihood of clinical failure.

**Objectives** (1) To define the prevalence of KF injury in the setting of a complete ACL tear on MRI and (2) To examine the relationship between KF injuries and injuries to structures commonly found in conjunction with ACL tears.

**Methods** After institutional review board approval, a database of patients with a complete ACL tear confirmed on MRI within 90 days of injury was created. All MRI were read by two, fellowship-trained musculoskeletal radiologists. KF injury was evaluated using a previously described grading scheme: Grade 0, normal; Grade 1, periligamentous edema; Grade 2, partial tear; and Grade 3, complete tear. In instances where there was complete disagreement between reviewers regarding the presence of KF injury, MRI were read by a third reviewer. Using previously published KF injury prevalence rates among smaller series, an a priori sample size estimate determined that 120 MRI would be needed to yield an inter-rater reliability of 0.9 with 80% and an alpha level of 0.05. Weighted kappa of inter-rater agreement was determined for all MRI examinations. Wilcoxon’s Kruskal Wallis test was performed to assess for associations between KF injury and the use of magnetic resonance imaging (MRI) v. 3.0 T, patient age, patient gender, the presence of medial and/or lateral meniscal tears, and/or postero-lateral tibial bone bruise.

**Results** Between 2014 and 2020, 131 patients (94 males, 37 females) with a complete ACL tear underwent MRI examination within 3 months of injury. The mean age of the cohort was 27.8 ± 6.8 years. Sixty-five MRI (49.6%) were completed with a 1.5T magnet and sixty-six MRI (50.4%) with a 3T magnet. KF injuries were identified in 51 of 131 (38.9%) knees (Grade 1: 28 knees, Grade 2: 5 knees, and Grade 3: 5 knees.) Inter-rater agreement for KF for across all MRI was fair (kappa = 0.28) with forty-three MRI requiring third reviewer adjudication. There were no significant associations between KF injury and patient gender (P = 0.26), magnet strength (P = 0.98) medial meniscal tears (P = 0.45), lateral meniscal tears (P = 0.33), or the presence of a postero-lateral tibial bone bruise (P = 0.16).

**Conclusion** The prevalence of KF injuries was 38.9% of cases, which is comparable to previously described rates. The presence of KF injury was not associated with other injuries commonly observed in conjunction with ACL tear. However, KF injuries were not consistently detected among multiple, independent reviewers. An alternate diagnostic technique may be required to accurately assess for injury patterns suggestive of high-grade rotatory knee laxity in the setting of ACL tear.
CALCANEAL POSITIONING IN EQUINUS IMMobilization of the ankle joint. A COMPARISON OF COMMON ORTHOSES USED IN THE TREATMENT OF ACUTE ACHILLES TENDON RUPTURES

Rasmus Kramer Mikkelsen, Sanja Somodi, Per Hölmich, Kristoffer W Barfod. Denmark

Summary The aim of the study was to four different orthoses ability to place the foot in equinus using true lateral radiographs.

Data

Purpose Orthoses are an important part of both conservative and operative treatment of acute Achilles tendon rupture as they can be used to position the foot in equinus and protect the torn tendon from strain in the healing phase. The aim of the study was to test four different orthoses ability to position the foot in equinus.

Methods The study was performed as a cross-sectional study. 15 healthy study participants underwent radiographic examination with 11 true lateral radiographs of the right ankle and foot, one with the ankle joint in neutral position; one of a circular equinus cast (CEC); three of an adjustable equinus boot (AEB) with the foot in 30°, 15°, and 0° of plantar flexion, respectively; three of a fixed angle orthosis with 1°, 2°, and 3° plantar flexion with a plate (WWP); and three of a fixed angle orthosis with 1°, 2°, and 3° without plantar flexion (WWOP). The primary outcome was the Achilles Relief Distance (ARD). Secondary outcomes were the tibiocalcaneal angle (TCA), the tibiotalar angle (TTA), and the tibio-1st metatarsal angle (1MTP). All measurements were performed by a radiologist.

Results The mean (SD) ARD was 11 mm (7) in CEC, 23 mm (6) with 3 WWP, 11 mm (5) with 3 WWOP, and 15 mm (5) using AEB in 30° of plantarflexion. The mean (SD) TCA was 86° (7,8) in CEC, 76° (7,3) with 3 WWP, 90° (6,9) with 3 WWOP, and 84° (6,6) using the AEB in 30° of plantarflexion. CEC, AEB, and WWOP showed statistically significantly larger equinus than WWP.

Conclusion CEC, AEB, and WWOP produced significantly greater plantarflexion compared to WWP.

THE RISK OF IATROGENIC RADIAL NERVE AND/OR PROFUNDA BRACHII ARTERY INJURY IN HUMERAL PLATING USING A 4.5 MM NARROW DCP: A CADAVERIC STUDY

Supat Chirattikalwong, Chatwain Chuaychoosakorn, Supat Chirattikalwong, Wattle Wuttimanop, Tanarat Boonriong, Wachiraphan Painyjakup, Sitthiphong Suvarnaphisit. Thailand

Summary The 4th screw hole carries the highest risk of iatrogenic radial nerve and/or profunda brachii artery injury.

Data

Background Fixation of humeral shaft fractures with a plate and screws can endanger the radial nerve and/or profunda brachii artery if proper care is not taken. Although prior studies have looked at the risk of radial nerve injury using a 4.5 mm narrow locking compression plate (narrow LCP), no studies to our knowledge have studied this fixation with a 4.5 mm narrow dynamic compression plate (narrow DCP). The objectives is to evaluate the risk of iatrogenic radial nerve and/or profunda brachii artery in anterolateral humeral plating with the 4.5 mm narrow DCP.

Methods 18 humeri of 9 fresh-frozen cadavers were dissected with the anterolateral approach in the supine position with 45 degrees of arm abduction. A hypothetical fracture line was marked at the midpoint of each humerus. A precontoured ten-hole 4.5 mm narrow DCP was applied to the anterolateral surface of the humerus using the fracture line to position the center of the plate. Bicortical screws were inserted into all of the screw holes. After the fixation, the distance from each screw hole to the acromion process was measured for calculating the relative ratios with the entire humeral length. The cadaver was then turned over to the prone position with 45 degrees of arm abduction, and a triceps-splitting approach was done to expose the RNPBA. Screw holes that were in contact with or had penetrated the RNPBA were identified as dangerous screw holes.

Results The most dangerous screw hole was the 4th, for which all 18 screws had contacted or penetrated the nerve, followed by the 5th(12/18), the 3rd(8/18) and the 2nd(2/18). The relative distance ratios compared with the entire humeral length for the distances from the lateral epicondyle to the 2nd, 3rd, 4th and 5th screw holes were 0.64, 0.60, 0.56 and 0.52, respectively.

Conclusion In humeral shaft plating with the 4.5 mm narrow DCP using the anterolateral approach, the 4th screw hole carries the highest risk of iatrogenic radial nerve and/or profunda brachii artery injury. We recommend that only unicortical screw should be used for this hole. Level of evidence: IV; Cadaveric study

A NEW PROTOCOL FOR OBTAINING WHOLE LEG RADIOGRAPHS WITH EXCELLENT REPRODUCIBILITY

1Chien Nguyen, 2Nienke Van Egmond, 2Mario Hevesi, 1Harrie Weinans, 1Willem Paul Giels, 1Roel JH Custers. Netherlands; 2USA

Summary Whole Leg Radiograph guidelines provides excellent reproducible radiographs

Data

Background Whole Leg Radiographs (WLR) are the gold standard for diagnosing malalignment and for pre-operative osteotomy planning. Positioning can affect the reproducibility of the measured hip knee angle (HKA), resulting in insufficient diagnostics and preoperative plans. We developed an easy-to-use WLR protocol by standardizing patient positioning and focusing on reproducibility. This study aims on testing this reproducibility.

Methods This study enrolled 30 patients for a test-retest analysis. Each patient underwent two bilateral WLRs on the same day using the investigated positioning protocol. Three observers measured the HKA, mechanical medial proximal tibial angle (mMPTA), mechanical lateral distal femoral angle (mL DFA), and joint line convergence angle (JLCA) on the two radiographs. Twice each, with one week between.

Results The intra-observer and inter-observer reliabilities were excellent, with intraclass correlation coefficients (ICCs) between 0.990 and 0.996. The ICCs between the measured HKA (0.985), mMPTA (0.922), and mL DFA (0.903) on the two separate radiographs were excellent. The ICC between the JLCA measured on the first and second WLR was 0.999.
moderate with 0.632. The mean absolute error between the HKA, mMPTA, mLDFA, and JLCA measurements on the first and second WLR were respectively: 0.442°, 0.783°, 0.828°, and 0.794°.

Conclusion The investigated novel WLR positioning protocol produced excellent and reproducible HKA measurements, with clinically acceptable degrees of error. We recommend applying this easy-to-use protocol when obtaining WLRs for osteotomy planning.

THE OUTCOME OF NON-CIRCULAR (RECTANGLE, OVAL) FEMORAL TUNNEL ACL RECONSTRUCTION, DOES IT IMPROVE THE OUTCOME OF ACL RECONSTRUCTION SURGERY?

Joseph McCaughn, S Ali Ghasemi, Arthur R Bartolozzi. USA

10.1136/jisakos-2021-congress.410

Summary The non-circular femoral tunnel ACL reconstruction has some documented advantages when compared to the conventional round technique including early graft healing, decreased tunnel widening, and a smaller cross-sectional area, along with reasonable and comparable clinical outcomes making it a valuable option for primary or revision ACL reconstruction.

Data Purpose Anatomical studies have shown that the shape of the anterior cruciate ligament, specifically, its femoral attachment is a broad flat structure consisting of two bundles. Additionally, some studies have demonstrated that the conventional single round bundle ACL reconstruction does not adequately restore rotational stability and the rate of return to sport is not favorable. Recently some studies claimed the rectangular or oval femoral tunnel ACL reconstruction resembles more the shape of the native ACL and femoral attachment. This study is aimed to evaluate the use of non-circular femoral tunnel ACL reconstruction as it compares to the conventional round tunnel technique.

Methods An electronic search was performed using the PubMed and Scopus databases. All therapeutic trials written in English reporting the clinical outcomes of the non-round femoral tunnel were included. Data regarding kinematic tests as well as clinical scores were extracted and included pivot-shift test, Lachman test, KT-1000 measurements, Tegner Activity Scale, Lysholm score, IKDC subjective scale, and knee range of motion.

Results A total of 22 papers for the rectangle group (n = 1,314) met the inclusion criteria. With an average follow-up of 15.8 months (± 10.4 months), the mean reported Lysholm score was 97.8 (± 0.80) and the mean reported KT-1000 arthrometer measurement was 1.2 (± 1.9). When comparing the rectangle technique to the conventional round, no significant differences were seen regarding Lysholm score or KT-1000 arthrometer measurements at final follow-up. In the oval group, a total of 5 studies (n = 322) met the eligibility criteria. With an average follow-up of 20.2 months (± 13.7 months), the mean reported Lysholm score was 94.4 (± 2.0), the mean IKDC subjective was 90.4 (± 1.2), and the mean KT-1000 arthrometer measurement was 1.6 (± 0.4).

Conclusion The non-circular femoral tunnel ACL reconstruction has some documented advantages when compared to the conventional round technique including early graft healing, decreased tunnel widening, a smaller cross-sectional area, as well as reasonable and comparable clinical outcomes making it a valuable option for both primary or revision ACL reconstruction.

ASSESSING THE ROLE OF MOCART SCORE 1 AND 2.0 FOR PATIENTS AFTER AUTOLOGOUS MATRIX-INDUCED CHONDROGENESIS (AMIC) FOR OSTEOCHONDRAL LESIONS OF THE TALUS (OLT)

Fabio A Casari, Christoph Germann, Lizzy Weigelt, Stephan Hermann Wirth, Arnd Viehöfer, Jakob Ackermann. Switzerland

10.1136/jisakos-2021-congress.411

Summary Analyzing MOCART 1 and 2.0 for postoperative outcome evaluation of patients who underwent Autologous Matrix-Induced Chondrogenesis (AMIC) procedure

Data MRI imaging is the tool of choice for assessing articular surfaces after cartilage surgery. The MOCART score is a common tool for assessing regenerative cartilage tissue. The score was originally developed for use in the knee joint. Previous literature showed as a clear limitation with the lack of correlation of the score with clinical outcome after AMIC procedure for OLT. The aim of this study was to evaluate the now updated MOCART 2.0 score for use after AMIC procedure for OLT. This retrospective cohort study was approved by our ethics review board. Patients who underwent isolated AMIC for symptomatic focal OLT between October 2009 and August 2015, had postoperative follow-up MRI imaging with same day documentation of clinical scores (American Orthopaedic Foot and Ankle Society, AOFAS, and Tegner Score) were included. Patients with inflammatory arthritis and/or advanced osteoarthritides were excluded. Demographic, clinical, lesion-specific, and data regarding surgical procedure were documented. 35 patients could be included in the study. Mean: clinical and MRI follow-up was 4.5 ± 1.8 years, age was 34.4 ± 10.7 years and defect size was 0.9 ± 0.6 cm². Of the patients, 14 (40%) were female, 17 (48.6%) were smokers and 27 (77%) received a bone graft to fill the defect. The final AOFAS score was 92.63 ± 8.3 and the Tegner score was 5.1 ± 1.8 which significantly improved from 3.7 ± 2.0 (p=0.002). MOCART scores 1 Ø 64.7 ± 10.8 and 2.0 Ø 65.1 ± 13.9 correlated significantly with each other (r = 0.885; p < 0.001). Patients with shorter follow-up (<4.5 years) showed significantly better MOCART 1 scores (Ø 64.7 ± 10.8 vs. Ø 52.9 ± 16.6, p=0.02) and tended to have better MOCART 2.0 scores (Ø 69.4 ± 12.4 vs. Ø 60.6 ± 14.3, p=0.058).

However, analysis of MOCART 1 and 2.0 showed no correlation with clinical scores (AOFAS, Tegner). By implication, the MOCART score decreases over time. Neither the MOCART 1 nor 2.0 score can give us clinically relevant information, since the clinical outcome does not correlate with the radiological score. Thus, the MOCART 1 and 2.0 score does not play a relevant role in the treatment of symptomatic OLTs with AMIC procedure.
Summary Although often considered a low-impact form of physical activity, advanced biomechanical motion analysis indicates that rowing exercise may increase risk of hip impingement through elevated hip flexion paired with diminishing row technique when training to fatigue.

Data

Background Rowing ergometers have gained popularity for row training and as purportedly low-impact means of improving general fitness. However, previous studies have shown high rates of acute and overuse injuries of the hip and lumbar spine.

Purpose Utilize 3D motion capture paired with clinical and coaching assessments to (1) determine if ergometer-based rowing results in hip flexion (HF) and internal rotation (HIR) associated with elevated risk of hip injury; (2) determine the impact of fatigue on hip range of motion (ROM), pull force, and row form; and (3) characterize the prevalence of hip pain/disfunction in recreational rowers.

Methods Seventeen healthy amateur rowers (m=8, F=9; age=38±9.1 years, VO2max=44.4±7.8 ml·kg·min-1) volunteered to participate in this investigation. Following a standardized warmup, each subject performed a maximal effort 2000-meter row on an ergometer equipped with a load cell (Futek®) to record pull force. Kinematics were recorded using a 12-camera motion capture system (Vicon®). Data was recorded at the 200m, 600m, 1000m, 1400m, and 1800m distances. Risk thresholds were set at 90° of HF and 10° of HIR. Three professional rowing instructors (average 11.5 years rowing/coaching) evaluated row technique at the 200m and 1800m distances using a 1-5 rating scale (1, poor technique – 5, excellent technique) for the catch, drive, finish, and overall technique. Prior to beginning the bout, rowers completed an International Hip Outcome Tool (iHOT-12, VAS: 0 pain/disfunction – 100 no pain/no dysfunction) survey. A mixed-model ANOVA repeated on row distance followed by a Tukey post-hoc test for pairwise comparisons was used to compare biomechanical assessments during the bout. A Mann-Whitney test for non-parametric data was used to compare rowing form scores between the 200m and 1800m distances. Type-I error was set at α=0.05 for all analyses.

Results No effect of row distance was observed for either HF or HIR. For HF, the group significantly exceeded the 90° risk threshold throughout the 2000m row (p<0.001, 111.0±5.3°) with all participants above the threshold throughout the rowing bout. For HIR, the group did not differ from the 10° risk threshold. Following the 200m measurement (8.2 ±0.4 N/kg), peak force was observed to significantly decrease at the 600m (7.4±0.4 N/kg, p=0.004) and 1000m (7.5±0.4 N/kg, p=0.005) measurements followed by a subsequent increase at the 1800m measurement (8.4±0.5 N/kg) to a value similar to the 200m measurement. Rowing form decreased from the 200m to 1800m measurement (overall; 200m, 2.2±0.3 | 1800m, 1.9±0.2; p=0.012). The mean iHOT-12 score for the group was 89.5±7.6 with more than 50% of the participants reporting some degree of discomfort/disfunction (<100).

Conclusion While generally considered a low-impact exercise, recent studies have illuminated the risk of hip injury from rowing. Repetitive high degrees of hip flexion coupled with moderate pull forces and declining form with fatigue may place rowers at an increased risk of hip overuse injuries or FAI. Therefore, caution should be exercised when considering performing or prescribing repeated bouts of high intensity or fatiguing rowing. These findings may also assist in refining the concept of “low-impact” as it pertains to joint-specific injury risk.
MECHANICAL EVALUATION OF COMMERCIALLY AVAILABLE FIBRIN SEALANT ADHESIVES FOR CARTILAGE REPAIR

Anya Amirhekmat, Wendy E Brown, Kyriacos Athanasiou, Dean Wang. USA
10.1136/jisakos-2021-congress.414

Summary The analysis of the adhesive and frictional properties of commercially available fibrin sealant adhesives used in cartilage repair.

Data Fibrin sealant (glue) is a widely available product that uses fibrinogen and thrombin to create clots. Although it is frequently used for adjunct hemostasis, it is also commonly used as an adhesive for articular cartilage repair surgery, including for delaminated flaps, matrix autologous chondrocyte implantation (MACI), particulated articular cartilage techniques, and tissue engineered implants. However, the adhesive strength of commercially available fibrin sealants for cartilage repair surgery is unknown. The objective of this study was to measure the ex-vivo adhesive and frictional properties of Vistaseal (Ethicon) and Tisseel (Baxter) for articular cartilage repair. Juvenile bovine stifles explants were used to test the adhesive and tribological properties of the fibrin sealants. For uniaxial tension and lap shear testing, 5 mm-diameter osteochondral composites were used. The cartilage portion of the explant was the most superficial 2 mm of the removed cartilage. The subchondral bone portion of the explant was processed to match the size of the cartilage explant and to ensure the removal of the calcified cartilage zone. The cartilage and bone explants were glued together using 10 μL each of fibrin and thrombin (n=9/group). Cartilage annuli (4 mm-inner diameter) filled with either 60 mg minced cartilage and fibrin sealant (30 μL each of fibrin and thrombin), or fibrin sealant alone also underwent tribological testing. No significant differences were seen between Vistaseal and Tisseel in tensile modulus, tensile strength, interfacial shear modulus, interfacial shear strength, or coefficient of friction. While no differences in adhesive or tribological properties of Vistaseal and Tisseel were observed, the adhesive stiffness and strength of both sealants were 1,000x lower than the tensile properties of native bovine cartilage (Williamson, 2003). Additionally, the coefficient of friction for both minced cartilage plus fibrin and fibrin alone were 10x greater than intact native bovine cartilage (Link, 2020). The utility of fibrin sealants to effectively secure cartilage implants into the mechanically demanding joint environment should be further examined.

PREDICTORS OF OUTCOMES OF MICROFRACTURE FOR OSTEONECROTIC LESIONS OF THE TALUS

1John F Dankert, 2Yoshiharu Shimozono, 1John F Dankert, 1Timothy W Deyer, 1Nathanial P Mercer, 1John G Kennedy. 1USA; 2Japan
10.1136/jisakos-2021-congress.415

Summary This study sought to define the outcome predictors of microfracture for osteochondral lesions of the talus and identified lesion uncontainment and the existence of cysts as independent predictors of poor clinical outcomes following arthroscopic microfracture for smaller sized osteochondral lesions of the talus (<100 mm²).

CORRELATION BETWEEN SHOULDER FUNCTION AND RADIOLOGIC SEVERITY OF SUPRASPINATUS PATHOLOGY

Christopher T Eberlin, Stephen M Gillinov, Nathan Varady, Paul F Abraham, Michael Peter Kuchank, Christopher T Eberlin, Scott Martin. USA
10.1136/jisakos-2021-congress.416

Summary Radiologic severity of supraspinatus pathology was correlated with dynamic clinical function across the full range of pathology, revealing the functional importance of radiologic categories.

Data Introduction The purpose of this biomechanical study was to examine shoulder strength and function in patients presenting with presumptive supraspinatus pathology and to determine if these clinical parameters are correlated with radiologic severity.

Methods We prospectively enrolled 171 patients with suspected rotator cuff pathology disease and without apparent strength deficit on traditional rotator cuff physical examination (PE). This study evaluating dynamic strength testing was
strictly limited to patients with negative traditional, static PE tests. All patients underwent two bilateral shoulder strength tests using dynamometry; first, isometric strength was measured at 90 degrees of abduction and, second, isotonic strength was measured eccentrically from full abduction throughout the full range of motion until the arm was at the patient’s side. For both of these tests, the examiner placed the handheld dynamometer (Hoggan microFET® 3; Hoggan Scientific, LLC, Salt Lake City UT, USA) on the patient’s wrist, perpendicular to the arm, to measure the force applied along the arc. Absolute strength and symptomatic-to-asymptomatic arm (S/A) strength ratios were calculated. All patients were included in analyses of absolute strength measurements on strength testing. Patients then underwent shoulder MRI, classifying supraspinatus findings into one of seven ordinal categories. The primary outcome was the relationship between the radiologic severity of supraspinatus pathology on MRI and the degree of rotator cuff strength deficit upon exam. Results were analyzed for both isotonic and isometric function.

**Results** Increasing imaging severity was significantly associated with decreasing absolute strength during isotonic testing (P=0.036). Specifically, absolute strength measurements declined with increasingly severe imaging findings, from no tear [59.9 N], to tendinopathy [50.9 N], to fraying [48.2 N], to PTT [55.0 N], to high-grade PTT [48.9 N], to focal PTT/full thickness perforation [45.7 N], to FTT [44.2 N]. Similarly, increasing imaging severity was significantly associated with decreasing S/A strength ratios during isotonic testing (P=0.022). Isometric S/A strength ratios declined with increasingly severe imaging findings, from no tear [91.9%], to tendinopathy [70.8%], to fraying [66.1%], to PTT [76.2%], to high-grade PTT [75.7%], to focal PTT/full thickness perforation [65.2%], to FTT [63.3%]. In contrast to isotonic testing, increasing imaging severity was not significantly associated with decreased absolute strength measurements on isometric testing (P=0.12). Similar results were seen for isometric S/A ratio, as increasing imaging severity was not significantly associated with S/A strength ratio (P=0.085).

**Discussion** Radiologic severity of supraspinatus pathology was correlated with dynamic clinical function across the full range of pathology, revealing the fundamental importance of these frequently-used classifications. The lower discriminatory ability of isometric measurements and higher strength measurements on isometric assessment may be related to a greater role of compensatory musculature in static testing. These biomechanical results support the need for future work investigating the utility of dynamic rotator cuff physical examination maneuvers.

**Summary** Postoperative infection following intraarticular hip injection =3 months prior to hip arthroscopy is rare (<0.5%) and no more common than in patients who did not undergo preoperative injection.

**Data**

**Introduction** The purposes of this study were to assess the risk of infection associated with image-guided intraarticular injections prior to hip arthroscopy and compare that risk between US and FL-guidance.

**Methods** This was a retrospective cohort study of patients undergoing hip arthroscopy in a large commercial claims database (MarketScan) from 2007–2017. Patients were required to have 1-year of continuous enrollment prior to and 6-months after hip arthroscopy. For both the US and FL cohort, patients who underwent injection =3 months preoperatively and >3–12 months preoperatively were compared to those who did not undergo preoperative injection. The primary outcome of this study was surgical site infection within 6 months of surgery. Chi-squared or Fisher’s exact tests and multivariable logistic regressions were used to assess the association between preoperative hip injection and infection. Finally, we performed sensitivity analyses that did not exclude patients with an infection at time of hip arthroscopy.

**Results** We identified 17,093 hip arthroscopy patients (mean [SD] age 37.2 [14.0] years; 14,685 [85.9%] no injection control patients and 2,408 [14.1%] patients who underwent hip arthroscopy within 12-months of image-guided hip injection). In the FL cohort (n=1,219 [50.7%]), 673 (55.2%) patients underwent hip arthroscopy =3 months after hip injection, while 546 (44.8%) patients underwent hip arthroscopy >3–12 months following hip injection. Similarly, for the US cohort, 673 (56.6%) patients underwent hip arthroscopy =3 months after their hip injection, while 516 (43.4%) patients underwent hip arthroscopy >3–12 months following hip injection. Patients undergoing FL-guided (0.55%) and US-guided (0.58%) hip injection >3–12 months prior to hip arthroscopy had similar infection rates as those who did not undergo intraarticular injection in the 12 months prior to hip arthroscopy (0.50%, p=0.76 and p=0.75, respectively). Similarly, the infection rates for patients undergoing US-guided (0.45%) and FL-guided (0.45%) injections in the 3-months prior to arthroscopy were not significantly different from control patients who did not undergo preoperative hip injection (0.50%, p=1 for both). Results held in adjusted analysis controlling for age, sex, geography, year, smoking, and comorbidities. In reference to the no injection cohort, the adjusted odds ratio (95% CI) of postoperative infection for patients undergoing FL-guided injection =3 months and >3–12 months prior to hip arthroscopy were 0.90 (0.28–2.94, p=0.87) and 1.17 (0.36–3.84, p=0.80), respectively. For US-guided injection, the adjusted odds ratios at =3 months and >3–12 months were 0.89 (0.28–2.87, p=0.84) and 1.11 (0.34–3.60, p=0.86), respectively. Notably, infection rates in the arthroscopy =3 months cohort were substantially higher when including patients with an infection at the time of hip arthroscopy (FL 1.18%, US 0.74%).

**Discussion and Conclusion** Postoperative infection following intraarticular hip injection =3 months prior to hip arthroscopy is rare (<0.5%) and no more common than in patients who did not undergo preoperative injection. Moreover, there do not appear to be substantial differences in infection risk between imaging-modalities. Notably, postoperative infection rates were substantially higher in sensitivity analyses where we did not exclude patients who had an infection at the time of the hip injection/aspiration.
CHARACTERIZING THE INCIDENCE OF AVASCULAR NECROSIS AFTER CORTICOSTEROID INJECTIONS OF THE HIP

Christopher T Eberlin, Nathan Varady, Paul F Abraham, Ahab Chopra, Michael Peter Kucharik, Wendy Madelaine Meek, Christopher T Eberlin, David Frecco, Eric L Smith. USA

Summary
This study presents the first baseline reference data on the nationwide incidence of AVN after intraarticular CSI of the hip and reveals numerous factors independently associated with increased risk, including type of hip pathology and female sex.

Data
Introduction Corticosteroid injections (CSIs) are a cornerstone in the treatment of numerous hip joint disorders that have failed other forms of conservative management. Notably, recent reports have shown extremely high rates of avascular necrosis (AVN) after CSIs of the hip. However, these studies contained select patient populations, and the absolute incidence of AVN after CSI of the hip has not been defined. Furthermore, whether there are differences in risk of AVN after CSI between various underlying disease states or other patient factors is unknown. Therefore, the purposes of this study were to characterize the nationwide incidence of AVN after hip CSI and to identify risk factors associated with increased risk of AVN development.

Methods This retrospective cohort study identified all patients undergoing intraarticular CSIs of the hip in the MarketScan database from 2007–2017. Patient age, sex, geographic region, medical diagnoses, and surgeries were collected. The date and indication (osteoarthritis, unspecified pain, other derangements [labral injuries, loose-bodies, etc.]) for the patients’ first CSI were recorded. Cumulative incidence of new AVN was analyzed using Kaplan-Meier analyses censoring on database dropout or any hip surgery for a non-AVN indication. Cox-proportional hazard models were used for adjusted analyses including age, sex, region, year of first CSI, indication for first CSI, and number of subsequent CSIs. Patients with AVN at the time of first injection were excluded.

Results We identified 143,905 patients undergoing CSI of the hip (65.1% female; median [interquartile range] age 53.0 years [45.0–59.0 years]). The most common indications for CSIs were non-arthritis pain (64.8%) and osteoarthritis (32.3%). Across all patients, the one and two-year incidence of AVN was 1.8% (95% confidence interval [CI] 1.72%–1.88%) and 2.45% (95% CI 2.34%–2.55%), respectively. In adjusted analysis, age (hazard ratio [HR] 1.008 per additional year, 95% CI 1.004–1.013, p<0.001), female sex (HR 1.88, 95% CI 1.74–2.03, p<0.001), geographic region (p<0.001), number of additional CSIs (HR 1.08 per injection, 95% CI 1.06–1.1, p<0.001), and CSI indication (p<0.001) were associated with AVN risk. With respect to indication specifically, AVN rates were significantly higher for patients undergoing CSI for osteoarthritis than for joint derangements (HR 2.32, 95% CI 1.66–3.24, p<0.001) or non-arthritis pain (HR 1.71, 95% CI 1.58–1.86, p<0.001).

Discussion and Conclusion AVN is a relatively rare event after CSI of the hip, as the nationwide one- and two-year incidence of AVN after hip CSI is approximately 1.8% and 2.45%, respectively. Importantly, AVN incidence varies markedly between CSI indication, with significantly higher rates for those undergoing injection for osteoarthritis, even when controlling for patient factors. These results may suggest that AVN is often a function of the underlying disease and/or patient population. Future studies examining the risk of AVN after hip CSI should account for injection indication, and randomized controlled trials would be useful in determining whether CSIs themselves play a causal role in these findings.

ASSESSING RISK OF OSTEONECROSIS OF THE HIP FOLLOWING INTRAARTICULAR INJECTIONS: HYALURONIC ACID VERSUS CORTICOSTEROID

Christopher T Eberlin, Nathan Varady, Paul F Abraham, Michael Peter Kucharik, Christopher T Eberlin, David Frecco, Eric L Smith, Scott Martin. USA

Summary
In this study, we demonstrate that CSIs do not appear to uniquely increase the risk of osteonecrosis when assessed in reference to patients with similar stages of hip pathology.

Data
Introduction Intraarticular corticosteroid injections (CSI) are a key component in the conservative management of many painful hip conditions. Importantly, recent reports have raised questions about their safety, demonstrating one-year rates of osteonecrosis after CSI as high as 17%–27%. However, it is likely these results may have been related to the specific patient samples, and whether CSIs—as opposed to the underlying disease—may lead to osteonecrosis is unknown. Therefore, the purpose of this study was to assess the association between CSIs and osteonecrosis compared to a similar patient population undergoing non-CSI injections.

Methods This was a retrospective, propensity-matched cohort study of patients undergoing intraarticular hip injection in the MarketScan database from 2007–2017. Patients receiving hip CSI were matched to patients receiving hip hyaluronic acid (HA) injections based on age, sex, hip pathology (osteoarthritis [OA], unspecified pain, other), year, baseline time in database prior to CSI, follow-up time, and geographic region using propensity-scores. The patients’ first injections were identified and time to development of osteonecrosis was analyzed using Kaplan-Meier curves. Hazard ratios (HR) were estimated using Cox-proportional hazard models. Analyses were censored on loss to follow-up and hip surgery for a non-osteonecrosis indication. Patients with a history of osteonecrosis at the time of their first hip CSI or who received both types of injections were excluded.

Results This study included 1,650 patients undergoing intraarticular hip injections (825 HA, 825 CSI). All baseline factors were matched between groups, including mean (95% CI) age (52.9 [52.3–53.5] years vs. 53.1 [52.5–53.8] years, p=0.59), sex (55.5% female for both, p=1.0), and diagnosis (59.0% OA vs. 58.1% OA, p=0.75) (Table 1). Estimated cumulative one-year incidence of osteonecrosis was 2.6% (1.5%–4.2%) for patients receiving CSI and 2.7% (1.7%–4.2%) for patients receiving HA (p=0.82) (Figure 1). Similar results were seen across the entire study period (HR 1.07, 95% CI 0.60–1.91), and results persisted in a range of sensitivity analyses.

Discussion and Conclusion While chronic oral steroid use is well known to be associated with non-traumatic osteonecrosis of the femoral head, whether CSIs were associated with osteonecrosis was unclear. In this study, we demonstrate that CSIs do not appear to uniquely increase the risk of osteonecrosis.
when assessed in reference to patients with similar stages of hip pathology. Obtaining a proper control group can be challenging in non-randomized studies due to varying degrees of baseline disease; by leveraging HA injections and matching on patient factors, we were able to minimize the impact of residual confounding. Although this study cannot determine whether intraarticular injections themselves (regardless of drug) lead to osteonecrosis, these results suggest that rates of osteonecrosis after CSI may often be due in part to the natural course of the underlying disease.

**Summary**
In this study, we found no evidence that IUDs were associated with hip pain or surgery, which was in contrast to our hypothesis.

**Data**
**Introduction** The purpose of this study was to investigate the association between IUD usage and hip pain and surgery. We hypothesized that patients with IUDs would have higher rates of hip pain and surgery compared to patients with contraceptive implants.

**Methods** This was a retrospective cohort study of patients 18–44 years old using either IUDs or subdermal implants for contraception in a large commercial claims database (MarketScan) from 2012–2015. Contraceptive implants were chosen as the active comparator to IUDs given that they are another form of highly-effective, long-acting contraception that require a procedure to initiate. However, they are not local to the pelvic region (typically implanted in the arm), and therefore have no clear mechanism of causing hip pain. All patients had to =12 months of continuous enrollment both before and after contraceptive placement; patients with a history of hip pain or surgery were excluded. Baseline factors including age, region, year of insertion, and contraceptive history were collected. The primary outcome was new hip pain. Secondary outcomes included visiting an orthopaedic or sports medicine provider for a hip complaint, intraarticular hip injection, and arthroscopic hip surgery. Outcomes were analyzed with adjusted Cox-proportional hazard models. The date of contraceptive placement was considered the index date, and patients were then followed until the occurrence of each respective outcome, censoring on database drop out. Sensitivity analyses included additional censoring for contraceptive removal for non-musculoskeletal reasons, as well as comparing copper and hormonal IUDs.

**Results** We identified a total of 291,012 patients, 253,772 (87.2%) with IUDs and 37,240 (12.8%) with subdermal contraceptive implants. Implant patients were younger and more likely to live in the South and North Central United States, while IUD patients were common in the West. Additionally, implant became more common with time. Overall, 6108 (2.1%) patients experienced new hip pain in the follow-up period, 891 (0.3%) saw an orthopaedic surgeon or sports medicine specialist for that pain, 317 (0.1%) underwent intraarticular hip injection, and 91 (0.0%) underwent hip arthroscopy. In time-to-event analysis, IUDs (vs. implants) were not associated with increased risk of new hip pain diagnoses (hazard ratio [HR] 0.98, 95% CI 0.89–1.08, p=0.71). In contrast, both increasing age (p<0.001) and year (p=0.006) were associated with increased risk of new hip pain. Similar results were seen for the secondary outcomes, including risk of orthopaedic visits for hip complaints (HR 1.04, 95% CI 0.8–1.36, p=0.75), intraarticular injections of the hip (HR 1.03, 95% CI 0.64–1.66, p=0.89), and hip arthroscopy procedures (HR 1.13, 95% CI 0.54–2.35, p=0.74). Results held in all sensitivity analyses.

**Discussion and Conclusion** Identifying and ruling out non-musculoskeletal causes of patients’ symptoms is critical to avoiding unnecessary orthopaedic surgery. While there are many gynecologic pathologies that can occasionally present with symptoms consistent with musculoskeletal hip pain, whether contraceptive IUDs are associated with this clinical presentation was unknown. In this study, we found no evidence that IUDs were associated with hip pain or surgery, which was in contrast to our hypothesis.