Systematic review

Surgical treatment of medial patellofemoral ligament injuries achieves better outcomes than conservative management in patients with primary patellar dislocation: a meta-analysis

Amre Hussein,1 Asser A Sallam,2 Mohamed A Imam,3 Martyn Snow3

ABSTRACT

Importance Lateral patellar dislocation is a commonly encountered disorder that affects mainly young and active adults and is associated with potential long-term morbidity. Primary traumatic dislocations can result in injury to the medial patellofemoral ligament (MPFL).

There is controversy in literature about the superiority of early surgical intervention over conservative treatment of MPFL injuries.

Objective The aim of this project was to undertake a meta-analysis to evaluate the clinical outcomes of the surgical management of MPFL injuries compared with conservative treatment in patients with primary patellar dislocation.

Evidence review A systematic review of the English literature combining electronic databases Allied and Complementary Medicine (AMED), Cumulative Index to Nursing and Allied Health Literature (CINAHL), Embase and MEDLINE (Ovid) and PubMed and the reference lists of the final studies was performed during the last week of June 2017 using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Four eligible randomised controlled trials comparing MPFL repair/reconstruction to conservative management met our inclusion criteria. They were identified and critically appraised, and the results were quantitatively evaluated giving data of a total of 171 patients. They were divided into two groups: surgically treated group (92 patients) and conservatively treated group (79 patients). The performed surgical procedures included: reconstruction and repair of the MPFL. The conservative management group included mainly physiotherapy. The outcomes evaluated giving data of a total of 171 patients.

Findings Our analysis showed high statistical significance favouring the surgical management in reducing the redislocation rate (6.74%) in comparison with the conservative group (28.5%) (P<0.001). The surgical group also demonstrated significantly higher Kujala score (70.8) compared with the conservative group (59.8) (P<0.001).

Conclusions and relevance Contrary to the available current evidence in the literature, we report that the surgical management of MPFL injuries in patients with primary patellar dislocation results in a significantly reduced rate of redislocation when compared with non-operative management.

Level of evidence Meta-analysis, therapeutic type II.

INTRODUCTION

Patellofemoral instability affects mainly a young and active population and is responsible for 2%-3% of all knee injuries.1 It is commonly seen in general orthopaedic practice and often presents as a patellar dislocation.2 The patellar dislocation is estimated to affect approximately 77 per 100 000 populations.2

In the presence of an underlying anatomical or systemic pathology, a minor trauma can cause the patella to dislocate. In traumatic dislocations, the patient usually gives a history of trauma, followed by pain and swelling of the knee with subsequent difficulty in weight bearing. Most dislocations reduce spontaneously, either by the patients themselves or by attendants on site, leaving only a few patients presenting to the emergency department with either a persistent or irreducible dislocated patella. Acute examination is challenging due to pain and is often restricted to identifying a generally swollen and painful knee held in a fixed flexion position.

Primary patellar dislocation is usually associated with injury to the medial patellar restraints, osteochondral lesions and contusions of the medial patella and lateral femoral condyle. The medial patellar restraints include the medial patellofemoral ligament (MPFL), medial retinaculum and vastus medialis obliquus (VMO).
Persistent laxity of these structures following an initial dislocation has been implicated as one of the factors responsible for recurrent instability.4

Patellar instability has been traditionally managed non-operatively with immobilisation in a splint for a period, followed by physiotherapy, focusing on quadriceps strengthening exercises.5 However, given that redislocation rates following non-operative treatment have been reported to be as high as 40%–60%,6 7 there is increasing interest in early surgical management of primary patella dislocation.

Consequently, the purpose of our meta-analysis was to compare the outcome of isolated MPFL surgery (reconstruction/repair) with conservative management in primary (first time) patellar dislocation. We hypothesised that MPFL surgery for primary patellar dislocations would provide lower redislocation rate than non-operative treatment.

Table 1

<table>
<thead>
<tr>
<th>Search terms</th>
<th>AMED*</th>
<th>CINAHL</th>
<th>Embase</th>
<th>PubMed (title/abstract)</th>
<th>MEDLINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ‘Patella’ or ‘patellar’</td>
<td>936</td>
<td>2538</td>
<td>21 983</td>
<td>14 076</td>
<td>15 564</td>
</tr>
<tr>
<td>2 ‘Dislocation’ or ‘dislocations’</td>
<td>944</td>
<td>5402</td>
<td>68 370</td>
<td>35 117</td>
<td>48 592</td>
</tr>
<tr>
<td>3 ‘Mpfl’ or ‘medial patellofemoral ligament’</td>
<td>9</td>
<td>134</td>
<td>420</td>
<td>382</td>
<td>294</td>
</tr>
<tr>
<td>4 1 and 2 and 3</td>
<td>6</td>
<td>57</td>
<td>304</td>
<td>216</td>
<td>212</td>
</tr>
<tr>
<td>5 Limit to English</td>
<td>6</td>
<td>57</td>
<td>273</td>
<td>192</td>
<td>184</td>
</tr>
<tr>
<td>6 Limit to RCT</td>
<td>N/A</td>
<td>2</td>
<td>10</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Final</td>
<td>0*</td>
<td>2</td>
<td>10</td>
<td>10</td>
<td>9</td>
</tr>
</tbody>
</table>

* AMED did not have the option of RCT limitation; this was done manually and showed no RCTs.

AMED, Allied and Complementary Medicine; CINAHL, Cumulative Index to Nursing and Allied Health Literature; MeSH, Medical Subject Headings; RCT, randomised controlled trials.

Figure 1

Preferred Reporting Items for Systematic Reviews and Meta-analyses flow sheet. Studies written in English, identified through AMED, CINAHL, Embase and MEDLINE (Ovid) and PubMed focusing on patients with no contraindications for surgery presenting with primary patellar dislocation, with study type set to RCTs (n=31). AMED, Allied and Complementary Medicine; CINAHL, Cumulative Index to Nursing and Allied Health Literature; RCT, randomised controlled trials.
Systematic review

Multiple electronic databases were searched, and of the studies found, the references were screened for any missed studies. We searched the Allied and Complementary Medicine (AMED), Cumulative Index to Nursing and Allied Health Literature (CINAHL), Embase and MEDLINE (Ovid) and PubMed. The search was carried out in the last week of June 2017 for all studies up to and including that week.

Statistical analysis
Several variables were measured on a continuous scale, which were found to be normally distributed. Descriptive statistics were summarised with frequencies or means±SD. Student’s t-test was used to compare between both groups regarding the quantitative variables (Kujala score and age), while $\chi^2$ test was used to test the difference between both groups about to the qualitative variables (gender, affected side and redislocation rate). A P value <0.05 was considered to be statistically significant. All P values were two tailed.

The included articles were analysed for the quality of methodology by two independent observers using the Coleman methodology score.9 The categorical rating is considered to be excellent if the score was 85–100 points, good if it was 70–84 points, fair if it was 55–69 points and poor if it was $\leq$54 points.

RESULTS

Search strategy
A Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) compliant search was carried out as published in 2009.10 An electronic search was undertaken using preset search terms related to patellar dislocation and MPFL surgery according to predefined inclusion and exclusion criteria. This included the online databases: PubMed, EMBASE and the Cochrane Library from 1960 to the end of June 2017. Considering that different terms can be used to describe ‘primary
dislocation’ or the interventional procedures, the search was kept as broad and manageable as possible to identify all the relevant studies (table 1). The analysis of the results of each database revealed 31 studies (figure 1).

Selection process
The title and abstract of each study on our results list were reviewed as to their potential eligibility. Full-text papers of the relevant studies were ordered or downloaded and were reviewed against the eligibility criteria.

The inclusion criteria for the review were: studies written in English and focusing on patients with no contraindications for surgery presenting with primary patellar dislocation (reported by the patient or health professional). Only randomised controlled trials (RCT) that compared isolated MPFL repair/reconstruction to conservative management were included with no gender or age limitations. Complex injuries and previous ipsilateral knee surgeries were excluded, as well as studies with less than 2 years of follow-up. To the best of our knowledge, there is no consensus on the best non-operative method to manage these injuries, so the search was more pragmatic and included all non-operative protocols.

Critical appraisal
Eligible studies were critically appraised using the Critical Appraisal Skills Program checklist.

The final 31 studies were downloaded to Endnote and were cross-referenced, revealing 18 duplicates. The abstracts of the remaining 13 studies were then reviewed, and 9 irrelevant studies were identified and excluded (figure 1). Searching multiple databases revealed a total of four RCTs (171 patients) approved conservative databases revealed a total of four RCTs (171 patients) approved studies were identified and excluded (figure 1). The remaining 13 studies were then reviewed, and 9 irrelevant studies were excluded (figure 1). The remaining 13 studies were then reviewed, and 9 irrelevant studies were excluded. 

<table>
<thead>
<tr>
<th>Table 3 Demographic characteristics</th>
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<tr>
<td>Total number of patients</td>
</tr>
<tr>
<td>Mean age, years (range)</td>
</tr>
<tr>
<td>Gender, no. (%)</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Affected side, no. (%)</td>
</tr>
<tr>
<td>Right</td>
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<tr>
<td>Left</td>
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<tr>
<td>Mean follow-up, months (range)</td>
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</table>

*Tested for significance using Student’s t-test. †Tested for significance using χ² test.

The primary outcome was to assess the redislocation rate. The secondary outcomes included the Kujala score (developed to evaluate the subjective symptoms and functional outcomes in patients with patellofemoral disorders15) and the complication rate, which is associated with any surgical procedure.

The four studies were published between 2008 and 2013. Two were from Brazil,12,13 one from Germany11 and one from Denmark.14 All four were RCTs and were written in English. Selection criteria were clearly mentioned and were considered not biased in all studies by both the observers. The mean overall Coleman methodology score was excellent (88) (table 2). The total number of participants was 171, of which 88 were males and 83 were females with an age range from 12 years to 74 years. There were 92 patients who underwent surgical treatment, while 79 had non-surgical management. The follow-up ranged between 2 years and 7 years in both groups. Our analysis revealed no significant difference between the surgical and non-surgical group with regards to patients’ age, gender and affected side (table 3).

Both groups had a similar mean age (19.15 years in the surgical group and 18.48 years in the conservative group) with slight male predominance (M/F ratio 48/44 in the surgical group and 49/39 in the conservative group).

In the surgical group, treatment involved either MPFL reconstruction (17 patients)12 or repair (75 patients).11,13,14 The four studies used different postoperative rehabilitation programmes. Petri et al11 had a protocol of 0–30° of flexion in the first 3 weeks increasing to 0–90° for a further 3 weeks, before free mobilisation. Patients could fully weight bear directly postoperatively. Christiansen et al14 allowed full weight bearing immediately after surgery with a range of motion from 0° to 20° for the first 2 weeks, then free range of movement from week 2 to week 6. In the other two studies, patients were kept in immobilisers for 3 weeks with no clear range of movements documented. Bitar et al12 allowed their cohort of patients to fully weight bear directly after the surgery, while Camanho et al13 did not state the weight bearing.

For non-operative management, all studies included muscle-strengthening exercises. Petri et al11 used the same rehabilitation as their postoperative protocol. Camanho et al13 allowed early full range of motion with their protocol focused mainly on lower limb muscle strengthening. Bitar et al12 conversely kept their patients non-weight bearing for 3 weeks in full extension. Christiansen et al14 failed to include details of their conservative protocol. In addition to the strengthening exercises, all patients in both groups of the study of Christiansen et al had diagnostic arthroscopy14 to address any osteochondral lesions.

Within the surgical group, all authors started the procedure with a diagnostic arthroscopy to diagnose and treat any cartilage lesions and then performed either repair or reconstruction. Bitar et al12 reconstructed the MPFL with patellar tendon. The medial 1/3 of the patellar tendon was dissected and released distally up to the junction between the proximal and medial third of the patella. Stitches were then inserted between the periosteum of the patella and the patella tendon to safely rotate the graft. The graft was fastened with an absorbable interference screw in the medial femoral condyle, and then the distal edge of the vastus medialis muscle was sutured to the graft. Christiansen et al14 reinserted and Camanho et al13 sutured or reinserted the MPFL at the adductor tubercle with anchors. Petri et al11 repaired only the ruptured soft tissues.

Table 4 The mean Kujala score and the redislocation rate among the study groups at the final follow-up

<table>
<thead>
<tr>
<th></th>
<th>Surgical group</th>
<th>Conservative group</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kujala score, mean (SD)</td>
<td>70.8 (2.5)</td>
<td>59.8 (8.5)</td>
<td>&lt;0.001 *</td>
</tr>
<tr>
<td>Redislocation rate, no. (%)</td>
<td>6 (6.74)</td>
<td>22 (28.5)</td>
<td>&lt;0.001†</td>
</tr>
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</table>

*Tested for significance using Student’s t-test. †Tested for significance using χ² test.
The mean follow-up of patients treated conservatively was 24.46 (24–108) months with a redislocation rate of 28.5%. The mean Kujala score was 59.8. The mean follow-up in the surgically treated group was 27.28 (24–96) months with a redislocation rate of 6.74%. The mean Kujala score was 70.8.

The surgical group demonstrated a significantly (P<0.001) higher mean Kujala score compared with the conservative group and a significantly (P<0.001) lower redislocation rate (table 4).

**DISCUSSION**

This study has shown significant differences with regards to the redislocation rate and the clinical and functional outcomes when comparing MPFL reconstruction or repair to non-operative treatment in patients with primary patellar dislocation.

The MPFL is the primary static stabiliser preventing lateral patellar dislocation. Its injury is a common finding in primary patellar dislocation occurring in about 97% of cases. Several reports have shown benefit following MPFL reconstruction in preventing redislocation and improving functional outcomes. However, the results for MPFL repair have been inconsistent. Ahmad et al reported good results following early repair, although this study only included eight patients. In two larger cohort studies, the redislocation rate after repair was high at 46% (19/41) and 28% (8/29), respectively. These results are significantly higher than those reported in this study, which is likely due to the inclusion of individuals with chronic recurrent patellar instability instead of primary patellar dislocators.

Despite the variations in the surgical techniques for MPFL reconstruction, there is no consensus regarding the best surgical approach, choice of graft and fixation methods. Few studies have compared different surgical techniques, although it is suggested better outcomes are achieved when both bundles of the MPFL are reconstructed. Only one study within this review undertook MPFL reconstruction. Bitar et al contributed 32% of the study population and used a single bundle technique secured to the adductor tubercle.

All the studies were non-blind and used the draw method for randomisation. In the study of Camanho, they used a slip of paper, while a closed envelope technique was used by Petri et al, Sillanpää et al and Christiansen et al. Bitar et al did not mention how his ‘draw’ was undertaken. The rate of redislocation and the Kujala score was used as the main outcome measures in all the chosen four studies. Despite these RCTs including a surgical arm, which has increased inherent risk, none commented on the surgical complications incurred.

The included studies used different surgical and non-operative procedures, which made it hard to assess the comparative efficacy of each one. To the best of our knowledge, there is no consensus on the gold standard rehabilitation protocol to be used for non-operative management of primary patellar dislocations. During the acute phase, the immediate targets are to decrease inflammation, ease pain and discontinue activities that lead to excessive loads on the patellofemoral joint. Acute phase management usually follows the PRICE protocol: Protection of the joint, relative Rest, Ice, Compression and Elevation to control inflammation. Mäenpää and Lehto recommended that a stage of immobilisation could be beneficial. In their study of 100 primary dislocations, patients were categorised into three groups: plaster cast, posterior splint, and patellar bandage/brace. At long-term follow-up, fewer redislocations were observed in the posterior splint group and the cast group than in the patellar bandage group. The first two groups had a period of immobility, whereas the bandage group did not. The mechanism of benefit is thought to allow healing of the disrupted medial structures. The best outcomes were noted in the group initially treated with a posterior splint. The plaster cast group had a longer period of immobilisation, and the authors recommended limiting the period of immobilisation to 3 weeks to avoid muscle atrophy, knee joint stiffness and retropatellar crepitation.

Different rehabilitation protocols have been used in the analysed studies. Most of the protocols included an initial quadriceps strengthening during the acute phase. In the event of primary patella dislocation, these should be static exercises initiated during the period of immobilisation. Quadriceps electrical stimulation is an option for muscle re-education if the patient has difficulty activating the muscle secondary to pain. Therapy should also include a protocol for hamstring muscle stretching. Tight hamstring muscles functionally counteract their agonist group: the quadriceps.

In the current meta-analysis, we demonstrated high statistical significance (P<0.001) favouring the surgical management in reducing the redislocation rate. The surgical group demonstrated significantly higher Kujala score (70.76) compared with the conservative group (59.82) and a significantly (P<0.001) lower redislocation rate (6.74% vs 28.5%). There have been several previous reviews on this subject. Sillanpää and Mäenpää in their review suggested non-operative management for primary patellar dislocation in majority of the cases. Surgery should probably be considered for MPFL patellar or femoral attachment disruptions in cases with one or more dysplastic features, especially if patella is highly unstable after dislocation. Their study of Sillanpää and Mäenpää aimed to review the evidence concerning the aetiology, imaging and treatment options of patellar instability in order to put a treatment algorithm for that condition. They reported only two studies: the study of Camanho, which was included in our meta-analysis, and the study of Sillanpää et al undertaken in 2008, which we have excluded in our analysis. Additionally, we included in our analysis more recent studies. The authors recommended further prospective randomised studies. Cheng et al in their meta-analysis matched our findings. They demonstrated a lower rate of recurrent patellar dislocation events post-treatment in patients managed operatively compared with patients managed non-operatively. However, their analysis included non-MPFL surgery, including two RCTs in which a proportion of patients underwent only lateral release and another RCT in which a Roux-Goldthwaite distal realignment was performed in four patients. Our meta-analysis included only RCTs comparing MPFL surgery to non-operative treatment. Additionally, the study of Palmu et al, which was included in their meta-analysis, was restricted only to those below 16 years of age, in contrast to our study which had no age limitations. The results of this study are also in agreement with the systematic review of three meta-analyses undertaken by Erickson et al, who concluded that operative treatment for primary patellar dislocations may result in a lower rate of recurrent dislocations. They found that for patients treated surgically, there was a 24.0% rate of repeat patellar dislocation and a 32.7% rate in conservatively treated patients. However, in contradiction to our study, they found no effect on functional outcome scores. The authors in this study included a significant number of non-RCTs that may have affected their results and therefore is considered as weakness of that study.

Another review that builds on Erickson et al’s review confirmed that, specific to the paediatric population, surgical
treatment of first time patellar dislocation is associated with a significantly decreased rate of repeat dislocation. Conserva-
tively managed knees had a 31% rate of recurrent dislocation rate compared with 22% in surgical knees. Additionally, it 
was noted that surgical treatment is associated with clinically 
detectable improvement in sport and quality of life domains.

Most of our patient cohort used a repair of the MPFL and 
not a reconstruction that we fared better than the non-op-
erative group. This is consistent with the study conducted 
by Ji et al.,36 who performed an open repair of the MPFL 
based on their description to the MPFL injury pattern. They 
found that the femoral insertion of the MPFL is the main 
injury location in primary patellar dislocations and requires a 
‘single-point fixation’ repair. When approaching the patella, 
the MPFL becomes wider and attaches to the undersurface of 
the VMO.36–38 Their study showed that the mean Kujala 
score was 80.19±5.07 in the non-surgical treatment group 
and 93.57±4.03 in the surgical treatment group, which was 
statistically significant.

In one study,41 patients in the conservative group under-
went arthroscopy to identify and treat any intra-articular 
or cartilage pathology. The use of arthroscopy might have 
had a detrimental effect on the outcome in the non-operative 
group due to quadriceps inhibition and secondary quadri-
ceps weakness.39 40 in addition to the period of immobilisa-
tion. However, there has been shown to be no difference in 
the quadriceps strength or electromyographic (EMG) quadri-
ceps muscle activation between repair and reconstruction 
groups.41

The current study has some limitations. The Kujala score 
was originally developed to look at painful symptoms related to the 
patellofemoral joint pathology, yet it was used in these studies 
with correlation to instability. The minimum follow-up in both 
groups was 2 years, with only one study providing long-term 
follow-up up to 7 years. Thus, it is difficult to state the long-
term effect of surgery. Another limitation is the sole inclusion 
of literature published in the English language; consequently, 
relevant studies in other languages might have been omitted. 
Furthermore, an outcome comparison between surgical repair 
versus reconstruction was not included. It is still unclear if one is 
superior.

CONCLUSION
Meta-analysis of all available RCTs involving MPFL repair 
or reconstruction has shown statistically significant improve-
ments in redislocation rate and Kajula score when compared 
with non-operative treatment of primary MPFL injuries. 
Furthermore, non-operative management was not always 
well laid out and, in some instances, included frank mobilisa-
tion and non-weight-bearing status. This could have contrib-
uted to the poor results of the non-operative group. There 
was significant variability in both surgical and rehabilitation 
protocols. A well-designed multicentre RCT with clearly 
defined surgical and non-surgical protocols will address some 
of the inherent bias and heterogeneity within the current 
literature.

Contributors All authors have contributed to the design of the work, analysis 
and interpretation of data. All authors have contributed to drafting the work and revising 
it critically. All authors finally approved the version to be published. Questions 
related to the accuracy or integrity of any part of the work are appropriately 
investigated and resolved by all authors. 

Competing interests None declared.

Provenance and peer review Commissioned; externally peer reviewed.

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