

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

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## 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 were the rate of recurrent dislocation of the patella and the Kujala score.

**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.

## What is already known

- ▶ Primary lateral patellar dislocation is a commonly encountered disorder that affects mainly young active adults and is associated with injury to the medial patellofemoral ligament (MPFL).
- ▶ There is controversy in literature about the superiority of early surgical intervention over conservative treatment of primary MPFL injuries.

## What are the new findings

- ▶ The surgical management of MPFL injuries in patients with primary patellar dislocation results in a significantly reduced rate of redislocation.
- ▶ The surgical group demonstrated significantly higher Kujala score.

## INTRODUCTION

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

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).



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**Table 1** Search terms

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

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

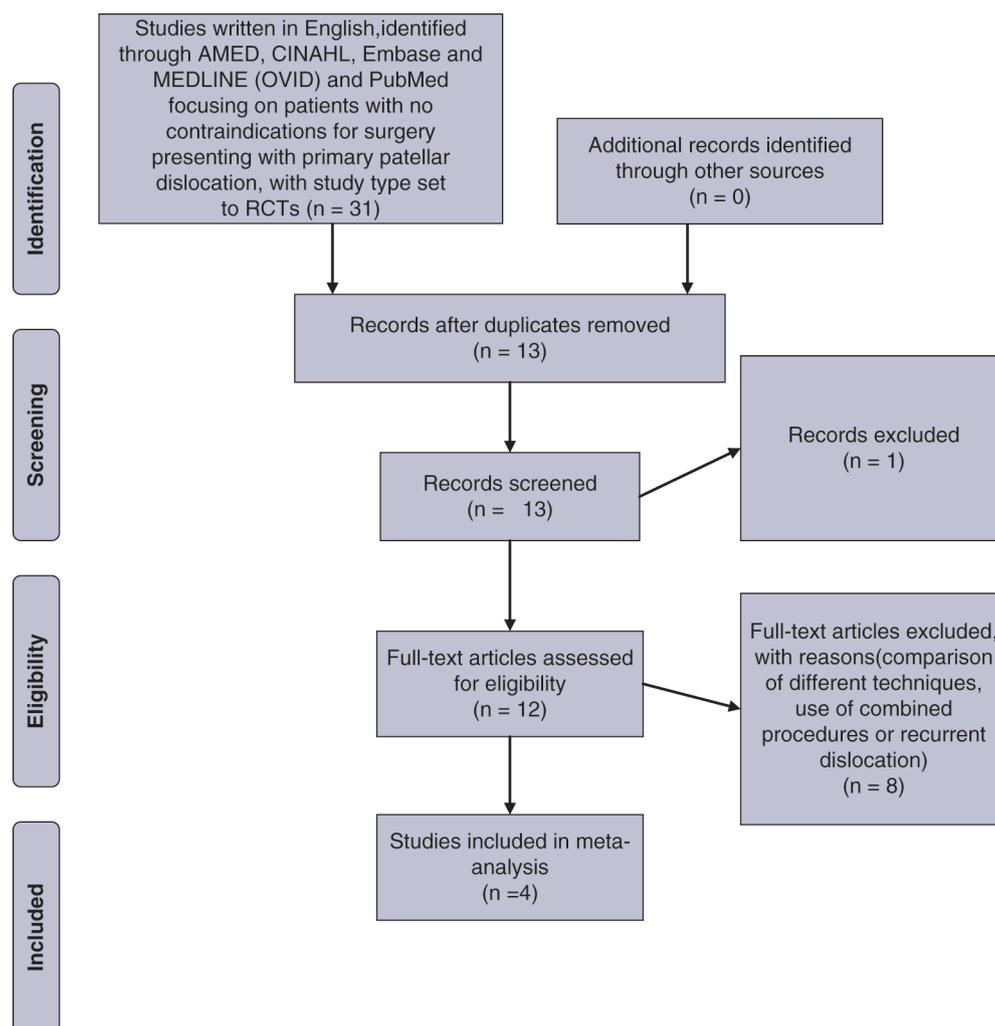
AMED, Allied and Complementary Medicine; CINAHL, Cumulative Index to Nursing and Allied Health Literature; MeSH, Medical Subject Headings; RCT, randomised controlled trials.

Persistent laxity of these structures following an initial dislocation has been implicated as one of the factors responsible for recurrent instability.<sup>4</sup>

Patellar instability has been traditionally managed non-operatively with immobilisation in a splint for a period, followed by physiotherapy, focusing on quadriceps strengthening exercises.<sup>5</sup> However, given that redislocation rates following non-operative treatment have been reported to be

as high as 40%–60%,<sup>6,7</sup> 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.



**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.

Table 2 Coleman methodology score

Components of the Coleman score	Individual components (score)	Bitar <i>et al</i>	Christiansen <i>et al</i>	Camanho <i>et al</i>	Petri <i>et al</i>
Study size (10)	>60 (10)		10		
	41–60 (7)	7			
	20–40 (4)			4	4
	<20, not stated (0)				
Mean duration of follow-up (5)	>24 (5)	5	5	5	5
	12–24 (2)				
	<12, not stated or unclear (0)				
Number of different surgical procedures included in each reported outcome (10)	One surgical procedure only (10)	10	10	10	10
	More than one surgical procedure but >90% undergoing one procedure (7)				
	Not stated, unclear or <90% undergoing one procedure (0)				
Type of study	Randomised control study (15)	15	15	15	15
	Prospective cohort study (10)				
	Retrospective study (0)				
Diagnostic certainty	In all (5)	5	5	5	5
	In >80%				
	In <80%				
Description of surgical procedure	Adequate (5)	5	5	5	5
	Fair (3)				
	Inadequate (0)				
Description of postoperative rehabilitation	Well described, >80% complying (10)	10	10	10	10
	Well described with 60%–80% complying (5)				
	Protocol reported or <60%–80% complying (0)				
Outcome measures	Outcome measures clearly defined (2)	2	2	2	2
	Timing of outcome assessment clearly stated (eg, at best outcome after surgery or at follow-up) (2)	2	2	2	2
	Use of outcome criteria that has reported good reliability (3)	3	3	3	3
	Use of outcome with good sensitivity (3)	3	3	3	3
Outcome assessment	Subject recruited (5)	5	5	5	5
	Investigator independent of surgeon (4)	4	4	4	4
	Written assessment (3)	3	3	3	3
	Completion of assessment by subjects themselves with minimal investigators assistance (3)				
Selection process	Selection criteria reported and unbiased (5)	5	5	5	5
	Recruitment rate reported: >80% or <80% (5)	5	5	5	5
	Eligible subjects not included in the study satisfactorily accounted for or 100% recruitment (5)	5			
Total		94	92	86	86

## MATERIALS AND METHODS

### Eligibility

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  $\pm$  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 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.<sup>8</sup> 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.<sup>9</sup>

## RESULTS

### Search strategy

A Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) compliant search was carried out as published in 2009.<sup>10</sup> 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

**Table 3** Demographic characteristics

	Surgical group	Conservative group	P value
Total number of patients	92	79	
Mean age, years (range)	19.15 (12–40)	18.48 (12–76)	>0.05*
Gender, no. (%)			
Male	48 (52.17)	40 (50.63)	>0.05†
Female	44 (47.83)	39 (49.37)	
Affected side, no. (%)			
Right	45 (48.91)	30 (37.97)	>0.05†
Left	47 (51.09)	49 (62.03)	
Mean follow-up, months (range)	27.28 (24–96)	24.46 (24–108)	

\*Tested for significance using Student's t-test.

†Tested for significance using  $\chi^2$  test.

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 by the Institutional Research Board and comparing conservative management with MPFL surgery for treating primary patellar dislocation.<sup>11–14</sup> References lists of the final studies were scanned for relevant studies that might have been missed during the primary search. Patients were divided into two groups: surgically treated group (92 patients) and conservatively treated group

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

	Surgical group	Conservative group	P value
Kujala score, mean (SD)	70.8 (2.5)	59.8 (8.5)	<0.001*
Redislocation rate, no (%)	6 (6.74)	22 (28.5)	<0.001†

\*Tested for significance using Student's t-test.

†Tested for significance using  $\chi^2$  test.

(79 patients). The performed surgical procedures included reconstruction and repair. The conservative management included muscle-strengthening exercises and proprioception.

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 disorders<sup>15</sup>) and the complication rate, which is associated with any surgical procedure.

The four studies were published between 2008 and 2013. Two were from Brazil,<sup>12 13</sup> one from Germany<sup>11</sup> and one from Denmark.<sup>14</sup> 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 40/39 in the conservative group).

In the surgical group, treatment involved either MPFL reconstruction (17 patients)<sup>12</sup> or repair (75 patients).<sup>11 13 14</sup> The four studies used different postoperative rehabilitation programmes. Petri *et al*<sup>11</sup> 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 al*<sup>14</sup> 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 al*<sup>12</sup> allowed their cohort of patients to fully weight bear directly after the surgery, while Camanho *et al*<sup>13</sup> did not state the weight bearing.

For non-operative management, all studies included muscle-strengthening exercises. Petri *et al*<sup>11</sup> used the same rehabilitation as their postoperative protocol. Camanho *et al*<sup>13</sup> allowed early full range of motion with their protocol focused mainly on lower limb muscle strengthening. Bitar *et al*<sup>12</sup> conversely kept their patients non-weight bearing for 3 weeks in full extension. Christiansen *et al*<sup>14</sup> 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 arthroscopy<sup>14</sup> 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 al*<sup>12</sup> 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 al*<sup>14</sup> reinserted and Camanho *et al*<sup>13</sup> sutured or reinserted the MPFL at the adductor tubercle with anchors. Petri *et al*<sup>11</sup> repaired only the ruptured soft tissues.

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.<sup>16</sup> Several reports have shown benefit following MPFL reconstruction in preventing redislocation and improving functional outcomes.<sup>17–20</sup> However, the results for MPFL repair have been inconsistent. Ahmad *et al*<sup>21</sup> 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)<sup>22</sup> and 28% (8/29),<sup>23</sup> 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.<sup>24 25</sup> Few studies have compared different surgical techniques, although it is suggested better outcomes are achieved when both bundles of the MPFL are reconstructed.<sup>26 27</sup> 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 *et al*,<sup>13</sup> they used a slip of paper, while a closed envelope technique was used by Petri *et al*, Sillanpää *et al* and Christiansen *et al*.<sup>11 14 28</sup> Bitar *et al*<sup>12</sup> 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.<sup>29</sup> 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<sup>30</sup> 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.<sup>30</sup>

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.<sup>29 30</sup>

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<sup>29</sup> 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,<sup>13</sup> which was included in our meta-analysis, and the study of Sillanpää *et al* undertaken in 2008,<sup>28</sup> which we have excluded in our analysis. Additionally, we included in our analysis more recent studies.<sup>29</sup> The authors recommended further prospective randomised studies. Cheng *et al* in their meta-analysis<sup>31</sup> 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<sup>32 33</sup> 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.<sup>28</sup> Our meta-analysis included only RCTs comparing MPFL surgery to non-operative treatment. Additionally, the study of Palmu *et al*,<sup>33</sup> which was included in their meta-analysis, was restricted only to those below 16 years of age, in contrast to this study which had no age limitations. The results of this study are also in agreement with the systematic review of three meta-analysis 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.<sup>34</sup> 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<sup>35</sup> 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. Conservatively 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-operative group. This is consistent with the study conducted by Ji *et al.*,<sup>36</sup> 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.<sup>36–38</sup> Their study showed that the mean Kujala score was  $80.19 \pm 5.07$  in the non-surgical treatment group and  $93.57 \pm 4.03$  in the surgical treatment group, which was statistically significant.

In one study,<sup>14</sup> patients in the conservative group underwent 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 quadriceps weakness<sup>39,40</sup> in addition to the period of immobilisation. However, there has been shown to be no difference in the quadriceps strength or electromyographic (EMG) quadriceps muscle activation between repair and reconstruction groups.<sup>41</sup>

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 improvements in redislocation rate and Kujala 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 mobilisation and non-weight-bearing status. This could have contributed 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.

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**Competing interests** None declared.

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