Systematic Review

Does Operative Treatment of First-Time Patellar Dislocations Lead to Increased Patellofemoral Stability? A Systematic Review of Overlapping Meta-analyses

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Purpose: To conduct a systematic review of meta-analyses comparing nonoperative and operative treatment of patellar dislocations to elucidate the cause of the variation and to determine which meta-analysis provides the current best available evidence. **Methods:** A systematic review of the literature to identify meta-analyses was performed. Data were extracted for patient outcomes and recurrent dislocations. Meta-analysis quality was assessed using the Oxman-Guyatt and Quality of Reporting of Meta-analyses systems. The Jadad algorithm was then applied to determine which meta-analysis provided the highest level of evidence. **Results:** Four meta-analyses met the eligibility criteria: 1 Level I evidence, 2 Level II evidence, and 1 Level III evidence. A total of 1,984 patients were included (997 underwent surgery whereas 987 underwent conservative treatment). Three meta-analyses found a lower subsequent patellar dislocation rate in patients managed operatively compared with nonoperatively, whereas one did not find a difference in recurrent dislocation rates between the operative and nonoperative groups. When the results of all the studies were combined, the overall redislocation rate was 29.4% and the rate of recurrent instability episodes was 32.8%. Patients treated operatively had a 24.0% rate of repeat patellar dislocation and a 32.7% rate of recurrent patellar instability, whereas patients treated nonoperatively had a 34.6% rate of repeat patellar dislocation and a 33.0% rate of recurrent instability. In addition, 1 meta-analysis found a significantly higher rate of patellofemoral osteoarthritis in the operative group. No differences in functional outcomes scores were seen between treatments. Two meta-analyses had low Oxman-Guyatt scores (<4), indicative of major flaws. **Conclusions:** According to the best available evidence, operative treatment of acute patellar dislocations may result in a lower rate of recurrent dislocations than nonoperative treatment but does not improve functional outcome scores. **Level of Evidence:** Level III, systematic review of Level I, II, and II studies.

Patellar dislocations account for roughly 2% to 3% of all knee injuries and are cited as the second most common cause of traumatic hemarthrosis of the knee.[1] The injuries often result from a traumatic injury but can sometimes be the result of hyperlaxity. Patients who sustain a patellar dislocation often rupture the medial patellofemoral ligament (MPFL) because the distance the patella travels when it dislocates laterally often exceeds the distance the MPFL can stretch before rupture.[2]

Many studies have sought to find the most effective treatment for first-time patellar dislocations. These treatments include conservative therapy, knee arthroscopy, and surgical reconstruction of the MPFL with or without fixation of an osteochondral fragment.[3] Several studies have attempted to determine

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whether surgical treatment is more effective than conservative treatment for first-time patellar dislocations. Buchner et al.[3] compared 126 patients at a mean of 8.1 years after primary patellar dislocation who underwent surgical versus nonsurgical treatment, and they found no difference between redislocation and reoperation rates, functional and subjective outcomes, and level of activity. Similarly, Nikku et al.[4] compared operative and nonoperative treatment of primary patellar dislocations in 127 patients at a mean of 7 years' follow-up and found no significant differences between treatment groups. However, Bitar et al.[5] did find better outcomes at a minimum of 2 years' follow-up in patients treated operatively versus those treated nonoperatively for primary patellar dislocations. Other studies have also supported operative treatment.[6,7]

Hence the purpose of this study was to perform a systematic review of overlapping meta-analyses comparing operative and nonoperative treatment of primary patellar dislocations to determine the cause of discordance and to determine which studies provide the best available evidence on this subject. The purposes of this study were (1) to conduct a systematic review of meta-analyses comparing operative and nonoperative treatment of primary patellar dislocations, (2) to provide an analytic framework for interpreting the presently discordant best available evidence to develop treatment recommendations, and (3) to identify gaps in the literature that require continued investigation. We hypothesized that operative treatment for primary patellar dislocations would provide lower rerupture rates than nonoperative treatment.

Methods

A systematic review of the literature was performed using the Medline database, Cochrane Database of Systematic Reviews, Scopus database, and Embase database. The following search terms were used: "patella" and "dislocation." Study type limits were set to meta-analysis or systematic review in the English language, with broad search query terms used to include all possibly applicable studies. Each article was cross-referenced to ensure inclusion of all relevant articles.

The abstracts were then reviewed by 3 authors (B.J.E., R.M., E.T.S.). Similar to prior systematic reviews of overlapping meta-analyses, the inclusion criteria were (1) meta-analyses that compared nonoperative and operative treatment of first-time patellar dislocations and (2) English language. The exclusion criteria were (1) meta-analyses that evaluated treatment of recurrent patellar dislocations; (2) meta-analyses without clinical outcome data; (3) systematic reviews that did not pool data or perform a meta-analysis; (4) narrative reviews or those without an organized and reported search algorithm; and (5) cadaveric, animal, and other laboratory studies. After obtaining full articles for the studies that met both the inclusion and exclusion criteria, the references were manually reviewed to ensure no studies were missed. The tables of contents for the past 2 years of the *Journal of Bone and Joint Surgery*, the *American Journal of Sports Medicine*, *Clinical Orthopaedics and Related Research*, and *Arthroscopy* were manually searched as well for any additional studies. A PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram shows our study selection algorithm (Fig 1).

The following data were extracted from each included study: primary author, journal of publication, year of publication, conflicts of interest, levels of evidence included, number and publication dates of primary studies included, inclusion and exclusion criteria, performance of heterogeneity analytics, sample size, patient demographic data, follow-up period, blinding protocols, type of surgical treatment, type of conservative treatment, and range of motion. Standardized knee outcome scores extracted included the Tegner score, Lysholm score, Kujala score, Knee Injury Osteoarthritis and Outcome Score, and visual analog scale (VAS) score. Outcome measures assessed included recurrent patellar dislocations, instability episodes, patient satisfaction, apprehension, complications, and further surgical procedures. Finally, each meta-analysis was screened to determine the methodologic characteristics including the rationale for repeating the meta-analysis, the number of "possible" previous meta-analyses cited relative to the number the study "actually" cited, the databases used in the literature search algorithm, and the conclusions of the meta-analysis as to whether operative or nonoperative treatment provided superior clinical outcomes.

The Quality of Reporting of Meta-analyses (QUOROM) system was used to determine the methodologic quality of the studies.[8] The QUOROM scoring system is an 18-category scoring system that scores a study based on the quality of its reporting and methodology. There were 18 possible points; 1 point was awarded in each category if the study met over half of the criteria given in that category. Meta-analysis quality was also graded using the Oxman-Guyatt quality-appraisal tool.[9] Finally, if the study recorded biases within the reviewed literature, these were recorded.

To interpret discordant meta-analyses, the Jadad decision algorithm was used.[10] The sources of discordance include differences in the clinical question, inclusion and exclusion criteria, data extraction, quality assessment, data pooling, and statistical analysis.[10] Scoring was performed based on assessment of randomization, randomization methodology,

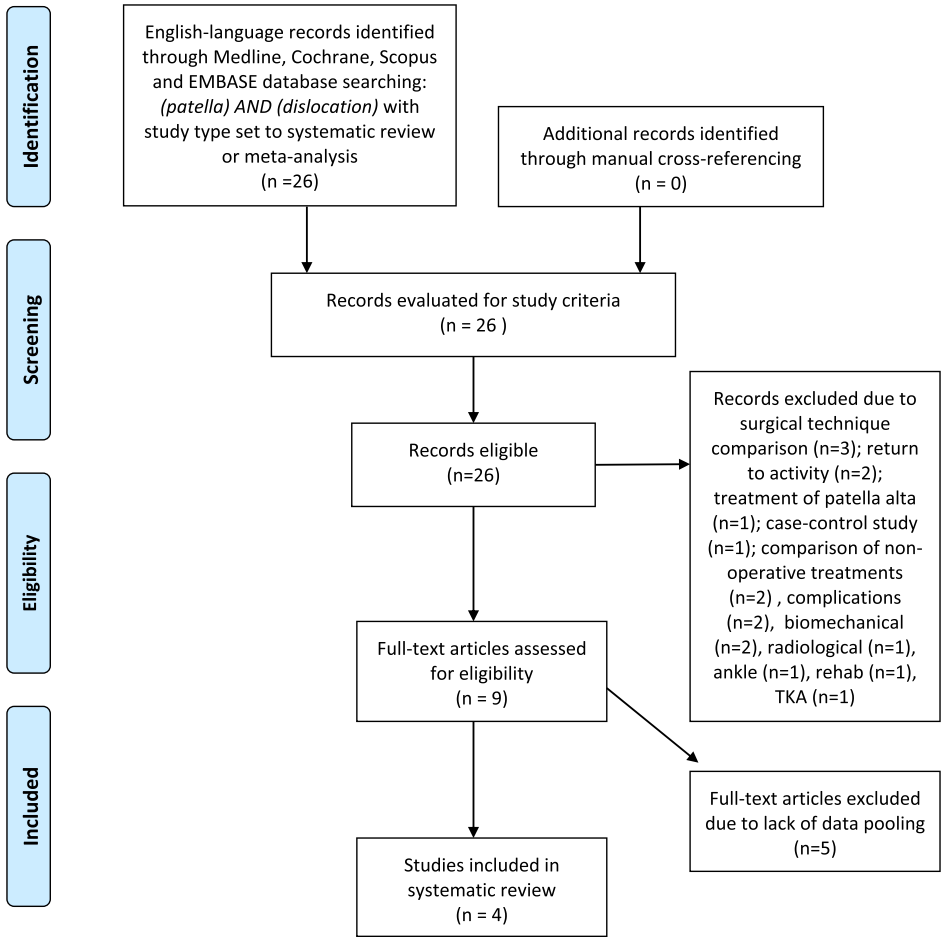

Fig 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) flow sheet.

double-blinding, withdrawals or dropouts, and allocation concealment. It was independently applied by 3 of the study authors (B.J.E., R.M., B.S.), and their results were compared most robustly to determine which of the included meta-analyses provided the current best available evidence for treatment recommendations. All statistical analyses were performed using Excel X (Microsoft, Redmond, WA).

Results

The initial search found 26 abstracts, of which 4 studies were included after application of our study selection algorithm (Fig 1).[11-14] These studies were published between 2011 and 2014, with all 4 performing a meta-analysis. One study reported a conflict of interest,[11] whereas 3 did not. The number of primary studies included in each meta-analysis ranged from 5 studies[11] to 11 studies,[14] and the number of patients analyzed ranged from 339 patients[11] to 702 patients,[14] with an average of 485 patients per study. Of these patients included, 997 underwent surgery whereas 987 underwent conservative treatment. The gender and age breakdowns were reported in 3 of the studies[11,13,14] and were not found to have affected outcomes. The follow-up period ranged from 2 to 14 years.[12,13] When the results of all studies were combined, the overall redislocation rate was 29.4% and the rate of recurrent instability episodes was 32.8%. Patients treated operatively had a 24.0% rate of repeat patellar dislocation and a 32.7% rate of recurrent patellar instability, whereas patients treated nonoperatively had a 34.6% rate of repeat patellar dislocation and a 33.0% rate of recurrent instability.

Authors' Assessment of Prior Meta-analysis Literature

Authors of 3 of the 4 meta-analyses cited all of the previously published meta-analyses[11,12,14] (1 of these 3 had no prior studies available to cite[14]) (Table 1), with only 1 study failing to cite all previous studies.[13] Of the 3 studies that performed a literature search after at least 1 prior meta-analysis had been published, the rationale for repeating the study was provided in all 3 possible instances.[11-13] The reasons given for repeating the meta-analysis included

Table 1. Number of Prior Systematic Reviews or Meta-analyses Actually Cited Compared With Maximum Number That Could Possibly Have Been Cited and Authors' Rationale for Repeating Systematic Review

Author	Date of Publication	Date of Last Literature Search	No. of Systematic Reviews or Meta-analyses Possible to Cite	No. of Systematic Reviews or Meta-analyses Cited	Rationale for Repeating Meta-analysis as Abstracted From Manuscript
Smith et al.[14]	January 14, 2011	September 1, 2010	0	0	NA
Hing et al.[11]	January 2012	August 16, 2010	1	1	"A meta-analysis including five randomized and six non-randomized controlled trials assessing surgical to non-surgical interventions for patients following patellar dislocation reported. . . statistically significant differences between interventions for outcomes including: frequency of recurrent dislocation, development of osteoarthritis and Hughston VAS patellofemoral score. The differences in findings with respect to recurrent dislocation may be attributed to the inclusion of non-randomized trials which were excluded in this Cochrane review, in addition to difference in statistical and methodological analysis methods and overall eligibility criteria."
Zheng et al.[12]	January 4, 2014	May 2013	2	2	"The findings of earlier meta-analysis indicated that surgical management was associated with a significantly lower incidence of patellar redislocation but a higher risk of patellofemoral osteoarthritis, while the strength of evidence could be weaken due to the limitation of mixed population analyzed together. . . . Later, Hing et al. published another meta-analysis and concluded that there was insufficient evidence to confirm any significant difference in outcome between surgical or non-surgical strategies. Furthermore, the latest search date was October 2010, and the limited number of trials was identified. Since then, several comparative trials for the treatment of primary patellar dislocation have been published and that allowed to update meta-analysis possible."
Cheng et al.[13]	March 18, 2014	December 2013	3	1	"The meta-analysis including 11 publications (only five RCTs) indicated lower redislocation rates, but higher rates of patellofemoral osteoarthritis after operative treatment. The author of that analysis considered that this finding should be interpreted with great caution, since the inclusion of too many non-RCTs is the weakness of that study. Therefore, it is necessary to conduct a meta-analysis including only RCTs to compare the clinical outcomes of patients managed operatively compared to nonoperatively following a patellar dislocation."

NA, not applicable; RCT, randomized controlled trial; VAS, visual analog scale.

reporting of controversial results and conclusions,[12] varying inclusion criteria,[11-13] and performance of a repeat analysis to include the most recent studies (Table 1).[12]

Search Methodology

Every study included in this review queried Medline, Embase, and The Cochrane Library as part of the literature search; however, there was significant variability in the other databases queried, with only 2 studies using the Cumulative Index to Nursing and Allied Health Literature and The Allied and Complementary Medicine Database[11,14] (Table 2). A total of 14 prospective comparative studies were included in the various meta-analyses. One meta-analysis cited 11 of these studies,[14] one meta-analyses cited 9 of these studies,[12] one meta-analysis cited 7 of these studies,[13] and one meta-analysis cited 5 of these studies[11] (Table 3).

Table 2. Search Methodology Used by Each Included Study

Author	PubMed/Medline	Embase	The Cochrane Library	CINAHL	AMED	Other	No. of Primary Studies	Primary Studies That Included Only RCTs
Smith et al.[14]	+	+	+	+	+	+	11	−
Hing et al.[11]	+	+	+	+	+	+	5	+
Zheng et al.[12]	+	+	+	−	−	−	9	−
Cheng et al.[13]	+	+	+	−	−	−	7	+

NOTE. The study by Hing et al. included "quasi-RCT" in which randomization was performed by odd versus even birthdates, which is not completely random.

AMED, The Allied and Complementary Medicine Database; CINAHL, Cumulative Index to Nursing and Allied Health Literature; Embase, Excerpta Medica Database; Medline, Medical Literature Analysis and Retrieval System Online; RCT, randomized controlled trial.

Outcome Measures

In the 4 included studies, there was significant variability in the clinical outcomes assessed by each meta-analysis (Table 4). All 4 studies used 4 or more clinical outcome scores.[11-14] One study reported on knee function and knee range of motion.[11] All 4 studies reported on recurrent patellar dislocations, but only one reported on the frequency of a positive apprehension test after treatment.[14] Every study reported on subsequent operative intervention, whereas only 2 reported on the development of patellofemoral osteoarthritis.[12,14] All 4 studies reported on the Hughston VAS score, with an aggregate average of 84.2 in the operative group and 90 in the nonoperative group. Three studies reported on the Tegner score, with an aggregate average of 4.7 in the operative group and 5.2 in the nonoperative group.[11-13] Two studies reported on the Kujala score, with an aggregate average of 87 in the operative group and 82 in the nonoperative group.[11,13]

Study Results

There was significant variability in the conclusions of each of the 4 meta-analyses. Cheng et al.[13] concluded that operative treatment led to a lower rate of recurrent patellar dislocation and subsequent surgery compared with nonoperative treatment whereas patients in the nonoperative treatment group had higher Tegner and Hughston VAS scores. Similarly, Smith et al.[14] found a significantly lower rate of recurrent patellar dislocation in the operatively treated group compared with the nonoperatively treated group but found a higher rate of patellofemoral osteoarthritis in the operative group. However, they found no difference in recurrent instability or Tegner, Lysholm, or VAS scores. Likewise, Zheng et al.[12] found a lower rate of recurrent dislocations in the operative group compared with the nonoperative group but found no difference in reoperation rates, Tegner scores, or Kujala scores between groups. Conversely, Hing et al.[11] reported no significant difference in recurrent dislocation rates and found no difference in the need for subsequent surgery or Tegner scores between the operative and nonoperative groups.

Table 3. Primary Studies Included in Meta-analysis

Primary Study	Smith et al.[14]	Hing et al.[11]	Zheng et al.[12]	Cheng et al.[13]
Apostolovic et al.,[15] 2011	−	−	+	−
Arnbjornsson et al.,[16] 1992	+	−	−	−
Bitar et al.,[5] 2012	−	−	+	+
Buchner et al.,[3] 2005	+	−	−	−
Camanho et al.,[17] 2009	+	+	+	+
Cash and Hughston[18] 1988	+	−	−	−
Christiansen et al.,[19] 2008	+	+	+	+
Marcacci et al.,[20] 1995	+	−	−	−
Nikku et al.,[21] 1997	+	+	+	+
Palmu et al.,[22] 2008	+	+	+	+
Petri et al.,[23] 2013	−	−	+	+
Savarese and Lunghi[24] 1990	+	−	−	−
Sillanpaa et al.,[25] 2008	+	−	+	+
Sillanpaa et al.,[26] 2009	+	+	+	−

Study Quality and Validity

QUORUM scores, which can reach a maximum of 18, were calculated for each study, with 3 studies scoring 15[12-14] and 1 study scoring 16.[11] The mean was 15.75, and the median was 15. The Oxman-Guyatt scores varied from two[13,14] to five[11] (Table 5). The mean score was 3.25, and the median score was 3. Two of the four studies had an Oxman-Guyatt score of less than 4 ($\leq$3),[13,14] which is indicative of "major flaws" in the methodology of the study (Table 6).

Heterogeneity Assessment

All 4 studies reported a heterogeneity analysis.[11-14] Two of the four studies performed subgroup and/or sensitivity analyses to assess the influence of parameters such as frequency of recurrent dislocation and frequency at which patients reported no pain, as well as several others (Table 6).[11,14]

Application of Jadad Decision Algorithm

To determine which of the 4 included meta-analyses provided the best available evidence, the Jadad

Table 4. Outcomes Assessed for and Reported by Each Included Study

	Smith et al.[14]	Hing et al.[11]	Zheng et al.[12]	Cheng et al.[13]
Clinical indices				
Lysholm knee score	+	+	−	−
KOOS knee score	−	+	−	−
Tegner activity score	+	+	+	+
VAS pain score	+	+	+	−
Hughston VAS patellofemoral score	+	+	+	+
Regaining preinjury activity level	+	+	+	−
Patient-reported outcomes of activity level	−	+	−	−
Kujala patellofemoral disorder score	−	+	+	+
Frequency of patients reporting no pain	+	−	−	−
Patient satisfaction (excellent or good subjective opinion)	+	+	+	+
Knee function				
Performance testing (1-leg hop distance, squat downs, and so on)	−	+	−	−
Knee ROM	−	+	−	−
Patellar stability				
Recurrent patellar dislocation	+	+	+	+
Recurrent instability or subluxation (non-dislocation)	+	+	−	+
Frequency of positive apprehension test between groups	+	−	−	−
Complications				
Requirement for subsequent operative intervention (reoperation rate)	+	+	+	+
Development of patellofemoral OA (radiographic examination)	+	−	+	−
Adverse effects (e.g., infection)	+	+	−	−

KOOS, Knee Injury and Osteoarthritis Outcome Score; OA, osteoarthritis; ROM, range of motion; VAS, visual analog scale.

decision algorithm was used by the 3 lead authors (B.J.E., R.M., B.S.) independently. This led to the determination that 2 of the 4 included studies provided the highest level of currently available evidence.[11,12] The study by Hing et al.[11] showed no major differences between groups but did show higher patient satisfaction scores in the nonoperative treatment group versus fewer symptoms of patellar instability in the group that was treated operatively. Similarly, the other study, by Zheng et al.,[12] showed a lower chance of recurrent patellar dislocation in patients treated operatively but no differences between groups in further surgery or subjective patient outcomes. Of the total number of patients, 42% were in the 2 higher-level studies whereas 58% were in the lower-level studies.

Discussion

Patellar dislocations are a common orthopaedic problem and are the second leading cause of traumatic hemarthrosis of the knee in younger patients.[1,5,7] Multiple trials and meta-analyses have been conducted to study this problem, so the main aims of this systematic review of overlapping meta-analyses were to determine the cause of discordance among the various meta-analyses and to determine which studies provided the current best available evidence on treatment of primary patellar dislocations. Our hypothesis was confirmed in that operative treatment of primary patellar dislocation resulted in a lower rate of recurrent dislocations than nonoperative treatment. However, a caveat to this finding is that this lower rerupture rate occurred in the setting of higher knee scores in the nonoperative group compared with the operative group.

There were 4 total studies included in this review, 2 of which had an Oxman-Guyatt score of 4 or more with QUOROM scores of at least 15.[11,12] Both of the other studies included had Oxman-Guyatt scores of less than 4, indicating major flaws with the studies.[13,14] The first of the 2 high-level studies was a Level II meta-analysis by Hing et al.,[11] earning a QUOROM score of 16 and Oxman-Guyatt score of 5. The study found no significant difference in recurrent patellar dislocations at either 2, 5, to 7 years' follow-up between operative and nonoperative treatment of primary patellar dislocations. The study also found no difference in Kujala scores or rate of subsequent surgical procedures between groups. The authors did find better patient satisfaction in the nonoperative group and fewer patient-reported patellar instability symptoms in the operative group. The second study was a Level II meta-analysis by Zheng et al.[12] that received a QUOROM score of 15 and Oxman-Guyatt score of 4. This study found a significantly higher rate of recurrent patellar dislocations in the nonoperative group compared with the operative group. However, it found no difference in rates of subsequent surgery and subjective patient outcomes between groups. These 2 studies were also determined by the Jadad algorithm to have the highest level of evidence.

No study found nonoperative treatment to be superior to operative intervention regarding rates of recurrent patellar dislocations or subsequent surgical

Table 5. Comparisons Performed by Each Meta-analysis and Quality Scores for Each Meta-analysis

Author	Frequency of Recurrent Dislocation (OR/RR)	Frequency of Recurrent Instability/ Subluxation (OR/RR)	Frequency of Subsequent Surgery Required (OR/RR)	Frequency of Patients Reporting No Pain (OR)	Patient Satisfaction (Excellent/ Good) (OR/RR)	Regained Activity to Pre-Dislocation Level (OR)	Positive Apprehension Test (OR)	Grade 1 or More Severe PFJT OA (OR)	Kujala Score: Knee Function (MD)	Kujala Score: Subjective Assessment of Symptoms (OR)	Hughston VAS (MD)	Tegner Score (MD)	Lysholm Score (MD)	VAS Pain Score (SMD/MD)	QUOROM Score	Oxman-Guyatt Score
Smith et al.[14]	+ (OR)	+ (OR)	+ (OR)	+	+ (OR)	+	+	+	+	–	+	+	+	+ (SMD)	15	2
Hing et al.[11]	+ (RR)	+ (RR)	+ (RR)	–	+ (RR)	–	–	–	+	–	+	+	–	+ (MD)	16	5
Zheng et al.[12]	+ (OR)	–	+ (OR)	–	+ (OR)	+	–	+	+	+	+	+	–	+ (MD)	15	4
Cheng et al.[13]	+ (RR)	+ (RR)	+ (RR)	–	+ (RR)	–	–	–	+	–	+	+	–	–	15	2

NOTE. All 4 studies performed data pooling.

MD, mean difference; OR, odds ratio; PFJT OA, patellofemoral joint osteoarthritis; QUOROM, Quality of Reporting of Meta-analyses; RR, relative risk; SMD, standardized mean difference; VAS, visual analog scale.

procedures. However, some studies did find better subjective outcome scores in the nonoperative group,[13] and one study found an increased risk of patellofemoral osteoarthritis in the operative group.[14]

Despite the fact that 3 of the studies found a lower rate of recurrent patellar dislocations with operative treatment, the study with the highest overall QUOROM and Oxman-Guyatt scores found no significant difference. This discordance among studies calls for further investigation into this subject. There are also many factors that affect the decision of whether to treat a primary patellar dislocation operatively or nonoperatively. These include the tibial tuberosity–trochlear groove distance, quadriceps angle, and quality of the MPFL and medial retinaculum, as well as several physical examination findings, such as a positive apprehension test and patellar tilt.[27] With this multitude of factors that contribute to the decision-making process, it is unlikely that one treatment would become the standard of care for all first-time patellar dislocations. Rather, the goal of future research should be to provide insight into the benefits and pitfalls with each treatment modality. Furthermore, future research should examine the development of patellofemoral osteoarthritis after operative versus nonoperative treatment because one study found an increase with operative intervention[14] whereas other studies in the literature have not found operative treatment of a patellar dislocation to significantly increase a patient's risk of patellofemoral arthritis.[28]

Limitations

The strengths of this review lie in the number of validated independent quality-assessment tools implemented by 3 authors with agreement and the validated quality-assessment tools used to assess each study.[8,9] However, there are also several limitations because this study is subject to all limitations of the 4 included studies. These include reporting bias, lack of standardization of surgical procedures and rehabilitation protocols, and patients who were lost to follow-up, as well as lack of preoperative data such as functional level. Because some of the included meta-analyses included studies that were not completely randomized, there is a potential bias as to how treatment decisions were made regarding which patients underwent operative versus nonoperative treatment.

Conclusions

According to the best available evidence, operative treatment for acute patellar dislocations may result in a lower rate of recurrent dislocations than nonoperative treatment but does not affect functional outcome scores.

Table 6. Heterogeneity or Subgroup Analyses of Primary Studies

	Smith et al.[14]	Hing et al.[11]	Zheng et al.[12]	Cheng et al.[13]
Statistical heterogeneity analysis	+	+	+	+
Subgroup or sensitivity analysis				
Frequency of recurrent dislocation (after primary *v* recurrent dislocation)	+	−	−	−
Risk ratio of recurrent dislocation (minimum 2-yr *v* 5- to 7-yr follow-up periods)	−	+	−	−
Risk ratio of recurrent subluxation (minimum 2-yr *v* 5- to 7-yr follow-up periods)	−	+	−	−
Risk ratio of any episode of instability (minimum 2-yr *v* 5- to 7-yr follow-up periods)	−	+	−	−
Frequency with which patients reported no pain (after primary *v* recurrent dislocation)	+	−	−	−
Patient satisfaction (excellent/good) (after primary *v* recurrent dislocation)	+	−	−	−
Grade 1 or more severe PFJT OA (after primary *v* recurrent dislocation)	+	−	−	−
Mean difference in Hughston VAS patellofemoral score (minimum 2-yr follow-up period)	−	+	−	−
Mean difference in Tegner score (minimum 2-yr follow-up period)	−	+	−	−
Mean difference in KOOS (minimum 2-yr follow-up period)	−	0	−	−
Mean difference in knee pain (minimum 2-yr follow-up period)	−	+	−	−
Risk ratio of patient satisfaction (minimum 2-yr follow-up period)	−	+	−	−
Mean difference in Kujala patellofemoral disorder score (minimum 2-yr *v* 5- to 7-yr follow-up periods)	−	+	−	−
Complications (after recurrent dislocation)	0	−	−	−
Risk ratio of patients who underwent subsequent surgery (minimum 5- to 7-yr follow-up)	−	0	−	−

NOTE. A plus sign indicates formal sensitivity or subgroup analysis was performed; a minus sign indicates formal sensitivity or subgroup analysis was not performed; and a zero indicates descriptive data were provided or discussed but no analysis was performed.

KOOS, Knee Injury and Osteoarthritis Outcome Score, PFJT OA, patellofemoral joint osteoarthritis; VAS, visual analog scale.

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