The Outcomes of Isolated Lateral Release in Patellofemoral Instability: A Systematic Review and Meta-Analysis

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Abstract

There have been conflicting reports regarding the outcomes of lateral release when used in the management of patellofemoral instability. This systematic review and meta-analysis therefore aims to evaluate the outcomes of isolated lateral release in the management of patellofemoral instability. The review was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. All studies that reported the outcomes of isolated lateral release for recurrent patellofemoral dislocations were included. A total of 10 publications were included, with 204 knees. All studies consistently reported a decrease in the rates of patellofemoral dislocation (odds ratio [OR] $<$ 0.01; 95% confidence interval [CI]: $<$0.01–0.01) and an increase in the odds of having a good outcome (OR 0.01; 95% CI: $<$0.01–0.02) after lateral release. All studies also consistently reported a similar number of patients participating in sports postoperatively as compared with preinjury (OR 2.78; 95% CI: 0.53–14.68). A total of 28 (14.1%) out of 198 patients had postoperative dislocation. Of these patients, 15 required a secondary procedure for patellofemoral realignment; however, all patients who had their eventual outcomes reported still had a good outcome postoperatively. Isolated lateral release can lead to good short- to middle-term outcomes when used in the management of recurrent patellofemoral dislocations. The procedure can lead to a significantly decreased rate of recurrence of patellofemoral dislocations, a significantly increased rate of good outcomes, and a similar number of patients being able to participate in sports as compared with the number of patients participating in sports prior to having patellofemoral dislocations. An isolated lateral release could therefore potentially serve as a simple and relatively low-risk procedure that could be performed as a first-line surgical management in selected patients with patellofemoral instability, allowing them to possibly avoid a more complex and major operation. This is a Level IV study.

Keywords
- patellar instability
- patellofemoral instability
- lateral release

Patellofemoral instability is a common condition, affecting up to 49 people per 100,000.[1–6] One of the most common surgical procedures used in the management of patellofemoral instability is lateral release.[7,8] It can be performed either as an isolated procedure or in combination with other procedures.[7–9] Traditionally, lateral release has been performed concomitantly with other realignment procedures; however, isolated lateral release as a separate procedure for

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patellofemoral instability became popular after being first described by Merchant and Mercer in 1974.[8–10]

Over the years, however, there have been conflicting reports regarding the outcomes of lateral release when used in the management of patellofemoral instability.[7–9,11] Some authors have described good outcomes after isolated lateral release for patellofemoral instability, whereas others have shown inferior outcomes with longer follow-up or when compared with other procedures.[7–9,11] Due to these conflicting outcomes, many studies and authors have therefore been hesitant to perform lateral release as an isolated procedure and have often advocated its use together with other concomitant procedures.[7–9,11] Despite this, there is actually no systematic review or meta-analysis available that has attempted to pool together these apparently conflicting outcomes of isolated lateral release to determine whether the outcomes are indeed unsatisfactory.

This systematic review and meta-analysis therefore aims to evaluate the outcomes of isolated lateral release in the management of patellofemoral instability. The hypothesis was that lateral release would lead to a poor outcome when used in the management of patellofemoral instability and that patients would continue to have persistent recurrent dislocations even after the surgery.

Methods

Systematic Review

The systematic review was performed using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The search was conducted using PubMed, Medical Literature Analysis and Retrieval System Online (MEDLINE), Cumulative Index to Nursing and Allied Health Literature (CINAHL), and The Cochrane Library from inception through February 15, 2018. The keywords used were "lateral release" and "patella*," not "total knee."

All studies that reported the outcomes of isolated lateral release for recurrent patellofemoral dislocations or subluxations were included. Studies in which the patients did not have recurrent patellofemoral dislocations or subluxations, studies where the patellofemoral instability was not managed with lateral release, studies which performed concomitant procedures or where patients had prior surgical procedures related to patellofemoral instability, studies that did not report outcomes, studies where the outcomes cannot be extracted for patients with recurrent patellofemoral dislocation only, studies which included patients with complications only, nonhuman studies, studies with sample size less than 10, review articles, non-English articles, and articles with no full text available were excluded.

The articles were selected in two stages (►**Fig. 1**). First, the abstracts identified by the aforementioned searches were downloaded, and the list was screened using the inclusion and exclusion criteria. Second, the full texts of this short-listed list were downloaded and assessed for eligibility. The reference lists of the publications were then hand-searched for additional relevant studies. This process was repeated twice independently.

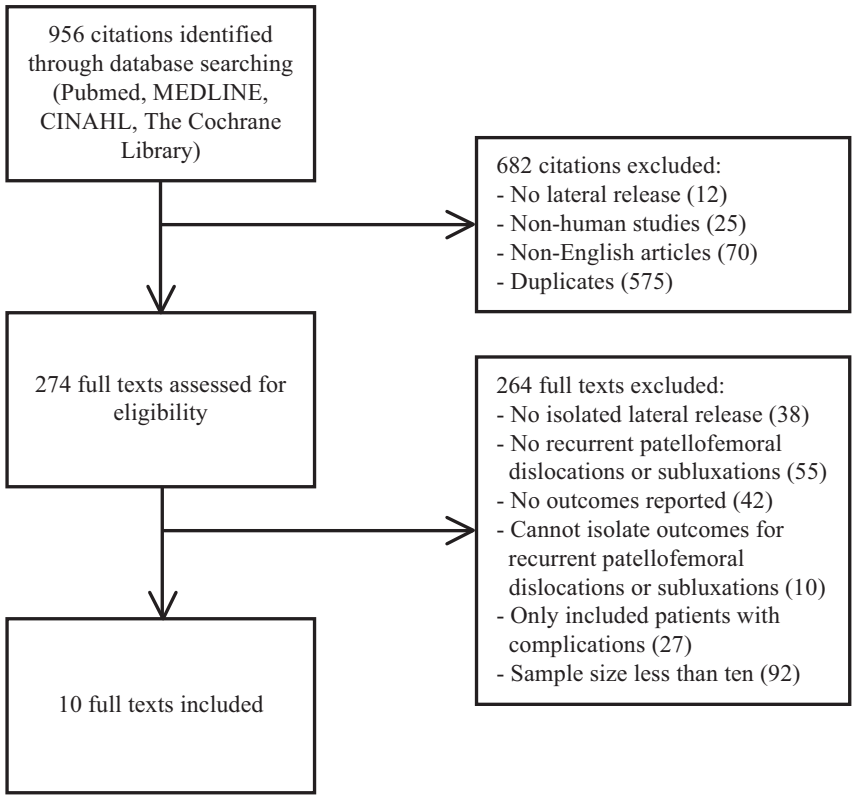

Fig. 1 Flow diagram of the review and selection of cases.

Data Abstraction

Each study's data were then retrieved individually. All clinical outcomes reported by three or more studies were included. These included the rates of recurrence of patellofemoral dislocation, the grading of the outcome, and the rates of return to sports. Patients were taken to have good outcomes if they were rated to be excellent, good, or improved in the original study and to have bad outcomes if they were rated to be fair, same, poor, or worse in the original study. The study design for each study was also analyzed. These included the patient demographics, the inclusion and exclusion criteria, and the surgical techniques used.

Data Analysis

The random effect model was used to analyze pooled estimates of pre- and postoperative differences for outcomes that were reported in three or more studies.[12] The random effect model assumes that the studies represented a random sample, with each study having its own underlying effect size. Under this model, it is assumed that there is a mean population effect size about which the study-specific effect varies. As the random effects model properly takes into account the interstudy heterogeneity such as differences in study design and definitions of outcomes, it provides a more conservative evaluation of the significance of the association than one based on fixed effects.[13] The pooled odds ratio or mean difference was then reported with the 95% confidence interval (CI). Forest plots were also provided.

Tests of heterogeneity were conducted while pooling the differences. This was performed with the Q-statistic that is distributed as a chi-square variate under the assumption of homogeneity of effect sizes. The extent of between-study heterogeneity was assessed with the I^2 statistic.[14,15] Meta-regression was not performed, as all outcomes analyzed were homogenous.

Funnel plots of the differences in pre- and postoperative outcomes were plotted against the CIs of each study. This was conducted together with the Egger's statistical tests to evaluate the possibility of publication bias for the outcomes analyzed.[16]

All statistical evaluations were made assuming a two-sided test at the 5% level of significance using Stata version 12 (Stata Corp, College Station, TX).

Results

A total of 10 publications were included in the review.[17–26] Collectively, these included a total of 179 patients with 206 knees. As the study population for the two articles published by Aglietti et al was similar, the total number of patients from the studies was only included once in the total sample size calculation. However, both studies were included in the review as different outcomes were reported in each study. When the same outcomes have been reported repeatedly, the results at the longest follow-up time point were used.[17,18]

The average age of the patients was 24.5 years (range: 10–54 years). The mean follow-up duration was 63.0 months (range: 13–120 months). The details of the patient demographics and follow-up duration for each study are detailed in ►**Table 1**. The inclusion and exclusion criteria for each study are detailed in ►**Table 2**.

Recurrence of Patellofemoral Dislocation

All studies included in the review reported the rates of recurrence of patellofemoral dislocation pre- and postoperatively.[17–26] The studies were homogenous ($p = 0.843$), with all studies consistently reporting a decrease in the rates of patellofemoral dislocation after lateral release (►**Fig. 2**).[17–26] A total of 28 (13.7%) out of

Table 1 Details of the studies included in the review

Author	Year	Level of evidence	Sample size (knees)	Age (years)			Gender		Follow-up (months)		
				Mean	Minimum	Maximum	Male	Female	Mean	Minimum	Maximum
Aglietti et al	1989	4	19	14	14	28	7	11	24	48	72
Aglietti et al	1994	3	20	NR	NR	NR	9	11	96	60	120
Chen and Ramanathan	1984	4	16	13	13	35	6[a]	9[a]	72	40	119
Dandy and Desai	1994	4	33	10	10	40	9	24	96	60	129
Metcalf	1982	4	14	12	12	48	NR	NR	49	40	58
Miller and Bartlett	1993	4	39	15	15	46	14	25	28	18	40
Roth et al	2013	4	33	11	11	18	3[a]	24[a]	54	36	72
Sherman et al	1987	4	18	13	13	54	NR	NR	28	24	36
Tecklenburg et al	2010	3	13	15	15	44	NR	NR	38	13	71
Woods et al	2006	4	20	15	15	40	6	14	27	24	43

Abbreviation: NR, not reported.
[a]Number of males and females are reported as per the number of patients and not as the per number of knees.

Table 2 Inclusion and exclusion criteria of the studies included in the review

Author	Year	Inclusion criteria	Exclusion criteria
Aglietti et al	1989	Recurrent patellar instability Failure of conservative management No prior surgery	None
Aglietti et al	1994	Two or more episodes of patellar dislocation Age of first dislocation $\geq$ 10 y	Chronic subluxation Congenital dislocation of the patella Patellofemoral arthritis
Chen and Ramanathan	1984	Recurrent dislocation	None
Dandy and Desai	1994	Three or more episodes of lateral patellar dislocation Failure of conservative management	Previous operation for patellofemoral instability Internal derangement of the knee Major trauma to the knee
Metcalf	1982	Recurrent patellar dislocation	Previous patellar alignment surgery
Miller and Bartlett	1993	Clear clinical history of recurrent patellar dislocation Patella dislocation under anesthesia Failure of conservative management Apprehension test positive on lateral displacement	Generalized ligamentous laxity Habitual dislocation of the patella Avulsion fracture of the patella Marked malalignment with Q angle $>$ 20 degrees Previous knee operation
Roth et al	2013	Recurrent patellar dislocation Positive apprehension test Positive J sign Normal tibial tubercle–trochlear groove distance Failure of conservative management	None
Sherman et al	1987	Recurrent patellar dislocation Failure of conservative management	Meniscal procedures Abrasion arthroplasty Acute patellar dislocations Other significant pathology Patellar compression Patellofemoral arthritis Previous operation
Tecklenburg et al	2010	Two or more episodes of patellar dislocation Tibial tubercle–trochlear groove distance $\leq$ 10 mm	No ligamentous or meniscal injury
Woods et al	2006	Recurrent patellar dislocation Failure of conservative management	Generalized joint laxity Congenital or fixed dislocation Previous knee operation

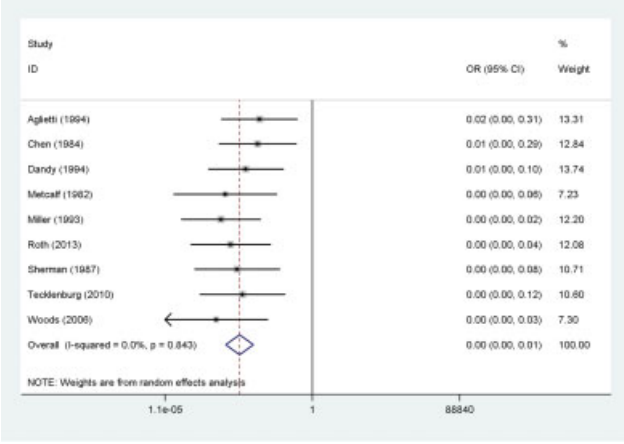

Fig. 2 Forest plot comparing pre- and postoperative rates of patellofemoral instability.

206 knees had postoperative dislocation. The odds of having patellofemoral dislocation postoperatively as compared with preoperatively was $<$ 0.01, and this was statistically significant with the 95% CI being <0.01–0.01 (►**Fig. 2**). No publication bias was identified ($p = 0.152$) (►**Fig. 3**).

Grading of Outcomes

Five studies reported the grading of outcomes.[17,19–22] Patients were taken to have good outcomes if they were rated to be excellent, good, or improved in the original study and to have bad outcomes if they were rated to be fair, same, poor or worse in the original study. When comparing good and bad outcomes, all studies consistently reported an improvement in outcomes postoperatively (►**Fig. 4**).[17,19–22] These studies were homogenous ($p = 0.916$). A total of 81 (79.4%) out of 102 patients were rated to have good outcomes postoperatively. The odds of

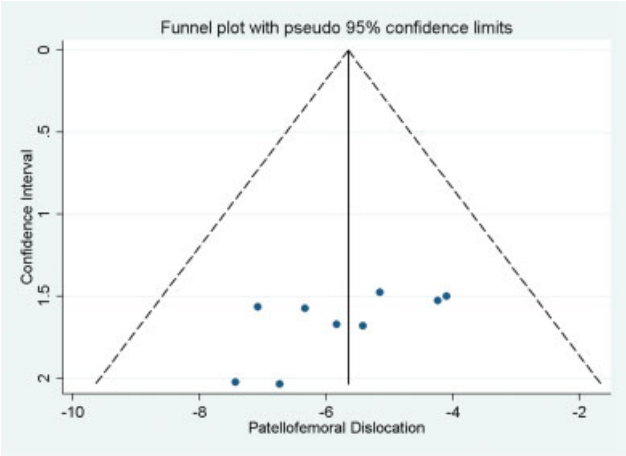

Fig. 3 Funnel plot for rates of patellofemoral dislocation.

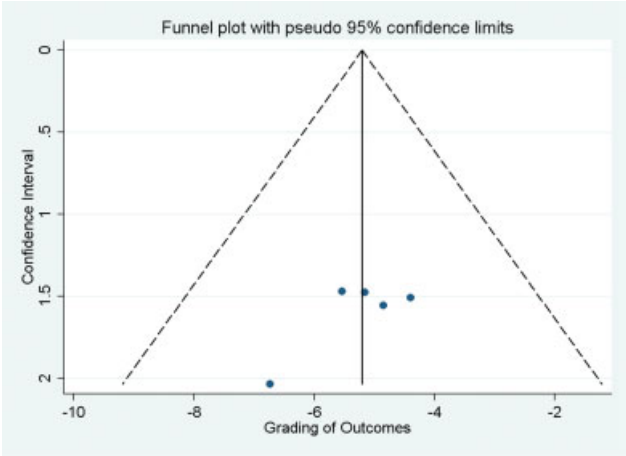

Fig. 5 Funnel plot for rates of bad versus good outcomes.

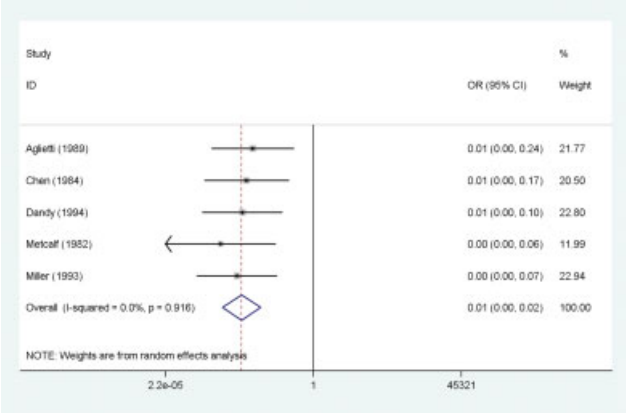

Fig. 4 Forest plot comparing pre- and postoperative rates of bad versus good outcomes.

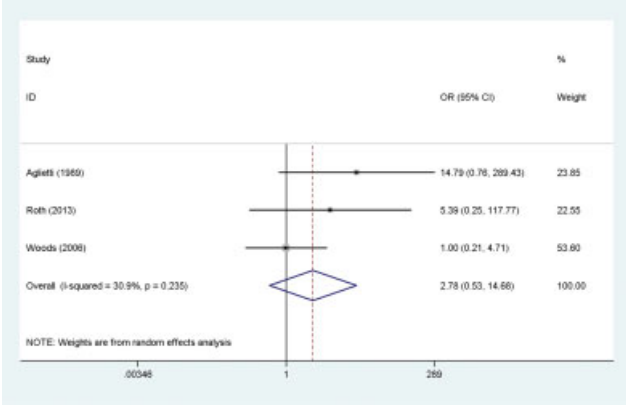

Fig. 6 Forest plot comparing pre- and postoperative rates of sports.

having a bad outcome postoperatively as compared with preoperatively was 0.01, and this was statistically significant with the 95% CI being <0.01 to 0.02 (►**Fig. 4**). No publication bias was identified ($p = 0.413$) (►**Fig. 5**).

Return to Sports

The rates of return to sports were reported pre- and postoperatively in three studies.[17,23,26] The studies were homogenous ($p = 0.235$), and all studies consistently reported a similar number of patients participating in sports postoperatively as compared with preinjury (►**Fig. 6**). A total of 41 (87.2%) out of 47 patients were participating in sports postoperatively, which was similar to 43 (91.5%) out of 47 patients participating in sports preinjury. The odds of not being able to return to sports postoperatively as compared with preinjury was 2.78; however, this was not statistically significant, with the 95% CI being 0.53 to 14.68 (►**Fig. 6**). No publication bias was identified ($p = 0.385$) (►**Fig. 7**).

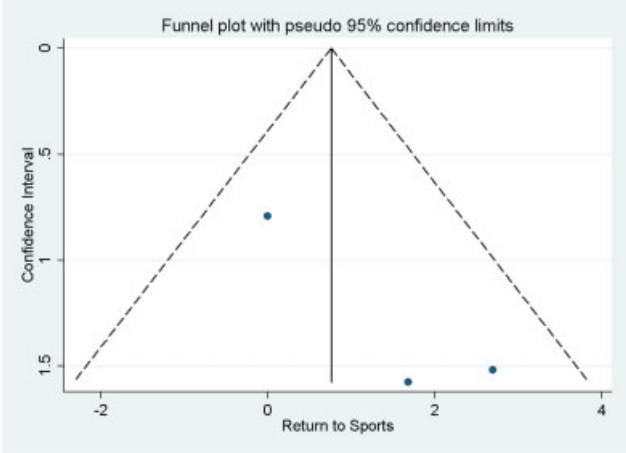

Fig. 7 Funnel plot for rates of return to sports.

Complications

The most common complication listed in the studies was that of the need for a second procedure for the management of the recurrent patellofemoral dislocation. Out of 190 knees, a total of 15 (7.9%) knees required a secondary procedure for recurrent patellofemoral dislocation.[19,20,22–24] The results by Metcalf were not included in the tabulation of the rates of complications as it was not possible to isolate the number of

patients with recurrent patellofemoral dislocation who had complications postoperatively.[21] Of the patients who required a secondary procedure, 12 patients were reported to have undergone a tibial tubercle transfer postoperatively. The eventual outcomes of five of these patients were reported, with two being free of symptoms eventually, one no longer having any dislocations, and two having an outcome that was rated as good eventually.[19,22,24] One other patient required a patellectomy for severe chondromalacia.[15] The subsequent surgical procedures and outcomes were not reported for the other patients.[20,23]

The second most common complication reported was postoperative hemarthrosis. Out of 190 knees, a total of 7 (3.7%) knees included in the review had postoperative hemarthrosis. One patient had reflex sympathetic dystrophy postoperatively.[20] No other complications were listed in all the studies included, including that of medial patellofemoral instability.

Discussion

The principal finding of the study is that isolated lateral release can lead to good outcomes when used in the management of recurrent patellofemoral dislocations. The procedure can lead to a significantly decreased rate of recurrence of patellofemoral dislocations, a significantly increased rate of good outcomes, and a similar number of patients being able to participate in sports as compared with the number of patients participating in sports prior to having patellofemoral dislocations.

This is in contrast to the current opinion that lateral release should be reserved as an adjunct procedure to other realignment procedures and should not be used in isolation.[7–9,11] One of the main reasons for the hesitancy in performing isolated lateral release stems from the perception that lateral release fairs inferiorly as compared with other procedures.[8,9,11] However, this review identified that the rate of recurrent patellofemoral dislocation after isolated lateral release postoperatively is 14.1%, which is comparable to the 1.2 to 10.5% rate of recurrence reported by other reviews for the realignment procedures.[27–29]

The other reason for the hesitancy in performing isolated lateral release is due to the fact that there were a few studies that were published in the 1980s to 1990s that showed that the outcomes of lateral release deteriorated over time.[17–19] The results of these studies at the longest follow-up were also included in this review, and pooling of the results still showed that the results were homogenous and that all studies consistently reported a decrease in the rates of recurrence of patellofemoral dislocation postoperatively (►**Fig. 2**).[17–19]

One of the possible reasons for these studies having more inferior results as compared with the other studies could be due to the fact that they included patients who had risk factors that were correlated with negative outcomes after lateral release. Indeed, several specific patient factors were identified to be negative predictors of outcomes in the long-term studies that reported a deterioration of outcomes with time.[17,20] These include the number of patellar dislocations, generalized ligamentous laxity, and subluxation with extension.[17,20] The study by Aglietti et al, one of the long-term studies that reported a deterioration of outcomes with time, included patients with a large number of dislocations and found that the preoperative number of dislocations, particularly if more than five, correlated negatively with the postoperative outcomes.[17] Similarly, another study, which also reported a deterioration of outcomes with time, also included patients with generalized ligamentous laxity and chronic subluxation with extension and found that these factors were correlated with poorer outcomes.[20] The inclusion of these patients could then therefore explain for the poorer outcomes in their studies as compared with the other studies.

The longest long-term study that has been published in the recent years is by Roth et al, which evaluated 33 knees from 27 patients at an average of 4.5 years (range: 3–6 years). The rate of recurrence in their study was 7.4%, and they attributed the recurrent dislocation in those two patients to poor patient selection, as the patients had hypoplasia of the femoral condyle and abnormality in the shape of the patella.[23] They then went on to conclude that arthroscopic lateral release could successfully treat recurrent patellofemoral instability in adolescents, improving their functional recovery and knee function.[23]

Indeed, many of the studies published have attributed their good outcomes after lateral release to good patient selection.[17,21–23,26] These include clear symptoms and signs of recurrent patellar dislocation, failure of conservative management, exclusion of other contributing risk factors for patellofemoral instability such as increased tibial tubercle–trochlear groove distance, valgus alignment, and generalized ligamentous laxity, as well as exclusion of other concomitant pathologies of the knee.[17–25] A thorough preoperative examination should therefore be performed prior to performing isolated lateral release, and any other concomitant risk factors of the patellofemoral joint should be considered for correction.[1,7,9,11]

The technique of lateral release has also been discussed by Woods et al to affect the outcomes of lateral release postoperatively.[26] Woods et al performed an arthroscopic release of the vastus lateralis with good outcomes.[26] They then argue that studies that performed a release of the vastus lateralis appear to have slightly better outcomes than those that did not.[26] While the other studies that performed a release of the vastus lateralis also appear to have good outcomes, no direct comparison studies have been performed thus far to validate or refute these hypotheses.[22]

Other studies also compared the rates of hemarthrosis after lateral release and correlated it with the use of electrocautery for the lateral release. Indeed, there was only one case of hemarthrosis among the three studies that had used electrocautery for the lateral release as compared with 15 cases of hemarthrosis among the four studies that had used the Smillie knife or blade for the lateral release.[19,20,22–26] However, similarly, future direct comparisons have to be performed to validate these observations.

There are no other major complications of lateral release noted from this review. Therefore, lateral release is indeed a smaller procedure, which can be performed in an outpatient setting, with lower risk of complications and faster rehabilitation. Multiple studies have also shown that even if the lateral release fail in the long term, the lateral release would not affect subsequent patellofemoral realignment procedures that could be performed and that these patients often still achieve a good outcome.[19,22,24] An isolated lateral release could therefore potentially serve as a simple and relatively low-risk procedure that could be performed as a first-line surgical management in selected patients with patellofemoral instability, allowing them to possibly avoid a more complex and major operation. Patients, however, would have to understand the risks of possibly needing a subsequent procedure in the long term.

Indeed, while this systematic review and meta-analysis is the first review to analyze the outcomes of isolated lateral release, the review faces several limitations. First, this review could not confidently analyze the long-term outcomes of lateral release. This is because there are only a limited number of old studies, which did not control for the preoperative patient factors, which have performed a long-term outcome analysis of lateral release.[17–19] The longest long-term study published recently analyzed the outcomes up to 6 years and found good outcomes after isolated lateral release.[23] Therefore, this review can only safely conclude that lateral release can produce good outcomes up to 6 years postoperatively. Further long-term studies, with specific inclusion and exclusion criteria, need to be performed to evaluate the long-term outcomes of lateral release confidently. Second, this review could not identify the potential moderators for the differences in the outcomes, as all the outcomes analyzed were homogenous. Therefore, no further comparisons can be made for the different preoperative risk factors for the patients as well as for the different surgical techniques. Future studies need to be conducted to validate or refute these observations of this review. Third, the inclusion of multiple retrospective studies could have introduced certain confounders that have not been controlled in the original studies. However, the review has attempted to minimize the risk of confounding by excluding studies that have included any other concomitant procedures. With that, all the parameters analyzed in the review were homogenous, and there was no publication bias identified. Lastly, the level of evidence of the review is limited by the presence of adequately powered studies in this literature. Through this systematic review and meta-analysis, it could then be recognized that this knowledge is still in its infancy, and further large-scale studies could be performed to confirm the outcomes proposed in the review. An isolated lateral release could therefore potentially serve as a simple and relatively low-risk procedure that could be performed as a first-line surgical management in selected patients with patellofemoral instability, allowing them to possibly avoid a more complex and major operation.

Conclusion

Isolated lateral release can lead to good short- to middle-term outcomes when used in the management of recurrent patellofemoral dislocations. The procedure can lead to a significantly decreased rate of recurrence of patellofemoral dislocations, a significantly increased rate of good outcomes, and a similar number of patients being able to participate in sports as compared with the number of patients participating in sports prior to having patellofemoral dislocations.

Conflict of Interest
None declared.

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