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Systematic Review

Medial patellofemoral ligament reconstruction after patellar instability: a systematic review of when and for whom to operate

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ABSTRACT

Recurrent patellar dislocation is a common condition in adolescents and young adults, often associated with significant functional limitations. The medial patellofemoral ligament is the primary passive stabilizer against lateral patellar displacement, and its insufficiency plays a central role in instability. While surgical reconstruction has become the mainstay treatment for recurrent cases, the optimal indications and patient selection remain subjects of ongoing debate. This systematic review was conducted following preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines. Databases were searched for studies evaluating medial patellofemoral ligament reconstruction, with inclusion criteria focused on surgical indications, patient characteristics, clinical outcomes, and postoperative complications. Data on redislocation rates, functional scores, surgical techniques, and return-to-sport outcomes were extracted and qualitatively synthesized. Across the included studies, medial patellofemoral ligament reconstruction demonstrated consistent success in reducing redislocation rates to below 5% in appropriately selected patients. Mean postoperative Kujala scores ranged from 85 to 92, with similar improvements in Lysholm and Tegner scales. Isolated reconstruction was preferred in patients with mild anatomical abnormalities, while combined procedures (such as tibial tubercle osteotomy or trochleoplasty) were indicated in cases with elevated tibial tubercle–trochlear groove distance or high-grade trochlear dysplasia. Pediatric populations benefited from physeal-sparing techniques. Reported complication rates ranged from 2% to 7%. This review confirms the effectiveness of medial patellofemoral ligament reconstruction in managing recurrent patellar instability. Patient selection based on anatomical parameters and surgical precision are critical to successful outcomes. The procedure yields high functional recovery and return-to-sport rates with a low incidence of complications.

Keywords: Patellar instability, Medial patellofemoral ligament reconstruction, Recurrent patellar dislocation, Surgical indications, Patient selection, Knee joint biomechanics

INTRODUCTION

Patellofemoral instability is a complex and multifactorial condition that predominantly affects young, physically active individuals, with a higher prevalence in females. This increased susceptibility during adolescence has been linked to greater ligamentous laxity and reduced muscular stabilization compared to males.[1] Patellar dislocations account for approximately 2% to 3% of all knee injuries, most commonly occurring during sports that involve internal femoral rotation combined with valgus stress on the knee.[2,3]

The medial patellofemoral ligament (MPFL) is the primary passive restraint to lateral patellar displacement, contributing about 50% to 60% of the medial stabilizing force within the first 20° to 30° of knee flexion.[4] Disruption of the MPFL occurs in nearly all cases of lateral patellar dislocation, and if left unaddressed, can result in recurrent instability, anterior knee pain, and progressive patellofemoral arthropathy.[5]

While conservative treatment is typically recommended for first-time dislocations in the absence of significant predisposing factors, recurrence rates range from 15% to

49%.[6] This broad range highlights the need for individualized assessment based on known anatomical risk factors, including trochlear dysplasia, patella alta, an increased tibial tubercle–trochlear groove (TT–TG) distance, hypoplasia of the vastus medialis obliquus, generalized ligamentous laxity, and femoral anteversion.[7]

Over the past decades, MPFL reconstruction has become a cornerstone in the surgical management of recurrent patellar instability. This procedure aims to restore the native biomechanics of the medial patellar stabilizers and reduce the risk of redislocation in properly selected patients. Isolated MPFL reconstruction has demonstrated success rates above 90%, with low complication rates and favorable return-to-sport outcomes.[8]

However, surgical indication should not be based solely on instability symptoms. A comprehensive preoperative evaluation should confirm failure of conservative treatment and rule out the need for concomitant bony realignment procedures. As described by Keeling et al, isolated MPFL reconstruction is best indicated in patients with TT–TG <20 mm and Dejour type A trochlear morphology.[6] In contrast, patients with more severe dysplasia or pronounced anatomical deviations often require combined procedures such as tibial tubercle osteotomy or trochleoplasty.[9]

Emerging evidence also supports reconstruction of other medial structures such as the medial quadriceps tendon–femoral ligament and the medial patellomeniscal ligament, both of which act synergistically with the MPFL in maintaining patellar stability.[7]

In pediatric patients, open physes demand the use of physeal-sparing techniques to prevent growth disturbances. Despite these technical challenges, outcomes in children and adolescents remain favorable when anatomic and biomechanical principles are respected.[2]

The diversity in surgical approaches, graft types, fixation techniques, and outcome measures complicates standardization of results. Nevertheless, functional improvements and low redislocation rates have been consistently reported in the literature.[10]

Given the critical biomechanical role of the MPFL, its reconstruction continues to represent a key strategy in addressing patellofemoral instability—provided that indication criteria are rigorously respected. This systematic review evaluates contemporary evidence on the surgical indications, anatomical thresholds, and functional outcomes of MPFL reconstruction.

METHODS

This systematic review was conducted in alignment with the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines to ensure methodological transparency and reproducibility.[11] The objective was to assess the existing literature regarding the clinical and anatomical indications for MPFL reconstruction in the context of recurrent patellofemoral instability.

A comprehensive search strategy was implemented across the electronic databases PubMed, Embase, Scopus, and Web of Science. Both MeSH terms and free-text keywords were employed in various combinations, including "patellar dislocation," "medial patellofemoral ligament," "MPFL reconstruction," "patellar instability," "recurrent dislocation," and "surgical indications." No restrictions were applied regarding language or publication status, and duplicate records were removed prior to the selection process.

Inclusion criteria encompassed clinical studies of any design—randomized trials, cohort studies, case series, and systematic reviews—that evaluated MPFL reconstruction in patients with a documented history of recurrent lateral patellar dislocation. Only studies that described or analyzed the rationale and criteria for surgical indication were included. Cases involving combined procedures, such as tibial tubercle osteotomy or trochleoplasty, were eligible only when the indication for isolated MPFL reconstruction could be clearly extracted or when subgroup analyses allowed differentiation. Exclusion criteria included biomechanical cadaveric studies, technical notes without outcome data, narrative reviews, editorials, and expert opinion articles without primary data.

Titles and abstracts of all retrieved records were screened independently by two reviewers. Full texts of potentially eligible studies were reviewed in detail, and final inclusion was determined by consensus. In the event of disagreement, a third reviewer was consulted. A standardized data extraction form was used to collect relevant information, including study design, number of patients, mean age, anatomical risk factors (such as TT-TG distance, trochlear dysplasia classification, and patella alta), surgical technique, type of graft used, and outcome measures related to the indication for surgery. Special attention was given to whether prior conservative treatment had failed, and whether specific thresholds for radiographic or clinical parameters were used to justify reconstruction.

Given the heterogeneity of methodologies, indications, and surgical techniques, a qualitative synthesis was performed. The review focused on identifying recurring criteria in the literature that have been used to indicate MPFL reconstruction, such as failed nonoperative management, recurrent instability episodes, TT-TG >15 mm, Dejour type A trochlear morphology, and absence of significant skeletal malalignment. No meta-analysis was attempted due to the variability in outcome definitions and reporting standards.

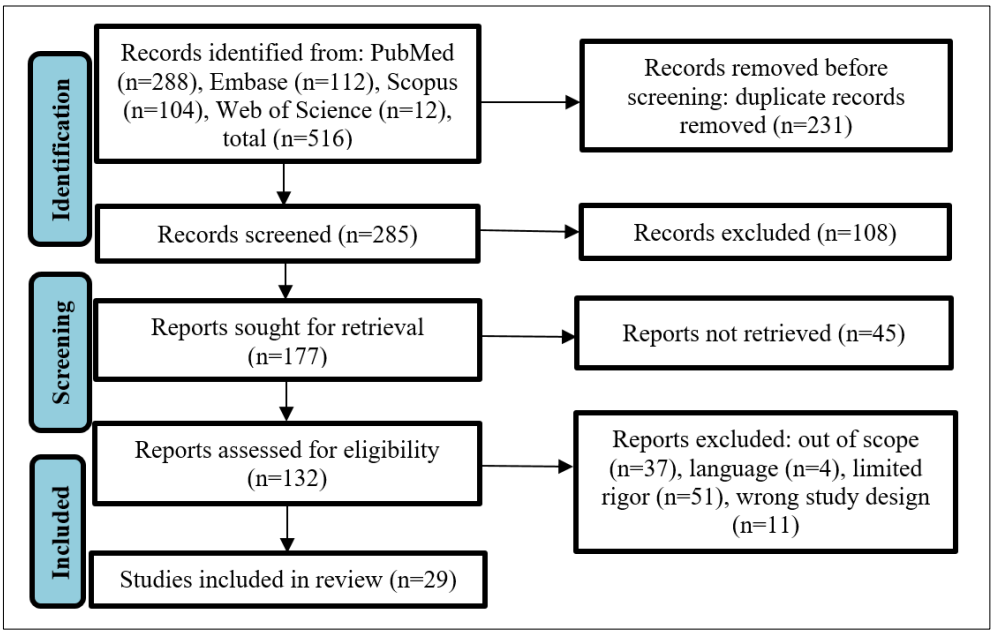


Figure 1: PRISMA flow diagram illustrating the study selection process for this systematic review.

RESULTS

Across the studies analyzed, medial patellofemoral ligament reconstruction (MPFLR) was consistently effective in managing recurrent patellar instability, yielding favorable functional outcomes, low recurrence rates, and a good safety profile. Despite the variation in patient demographics, surgical techniques, graft types, and follow-up periods, common conclusions emerged regarding indications, clinical improvements, and prognostic factors.

MPFLR was repeatedly shown to reduce the incidence of redislocation. Watts et al. emphasized the mechanical significance of the MPFL as the primary restraint to lateral patellar translation, noting that its anatomical reconstruction reestablishes near-physiologic patellar tracking in patients without major skeletal abnormalities.[12] Matzkin et al demonstrated redislocation rates below 5% when reconstructions were anatomically guided, underlining the importance of proper tunnel positioning, graft tensioning, and adherence to surgical indications.[13] In the study by Pautasso et al, which included patients treated with or without concomitant tibial tubercle osteotomy (TTO), the redislocation rate was only 2.4%, reinforcing the effectiveness of tailored surgical approaches.[14]

Postoperative functional recovery was a common finding. For instance, Pautasso et al observed an increase in the Kujala score from 47.4 to 89.4 and in the Lysholm score from 45.6 to 89.8, both statistically significant.[14] Zhang et al reported a postoperative mean Kujala score of 88.1 and only one redislocation in 76 reconstructed knees.[15] Similarly, Bitar et al found average Kujala scores above 90, alongside improvements in pain, instability, and subjective knee function.[16]

Table 1: Summary of the most relevant studies included in this systematic review, presenting sample size, surgical indications for medial patellofemoral ligament reconstruction, and functional outcomes at follow-up. Outcomes are primarily reported using Kujala and Lysholm scores, along with redislocation rates and patient satisfaction where available.

Author (year)	Sample size (N)	Surgical indication	Functional outcome (follow-up)
Pautasso et al (2022)[14]	84	Recurrent patellar dislocation; with or without anatomical risk factors	Kujala: 89.4, Lysholm: 89.8 at 24 months
Zhang et al (2020)[15]	76	Recurrent patellar instability after failed conservative treatment	Kujala: 88.1, 1 redislocation at 26 months
Bitar et al (2012)[16]	30	At least one documented patellar dislocation with persistent instability	Kujala >90, Lysholm >90, minimal pain
Christensen et al (2020)[24]	19	Recurrent instability in skeletally immature patients	No redislocations, stable knees, high satisfaction at mean 3.6 years
Koëter et al (2011)[27]	25	Athletes with recurrent lateral patellar dislocation	76% returned to sport at pre-injury level, Kujala ~90

Continued.

Author (year)	Sample size (N)	Surgical indication	Functional outcome (follow-up)
Sanchis-Alfonso et al (2017)[28]	40	Patients with chronic patellar instability and poor quality of life	Improved scores, reduced apprehension, enhanced quality of life

Indications for MPFLR were consistent across studies. Surgery was typically recommended for patients experiencing recurrent dislocation after failed conservative management or for first-time dislocations in the presence of anatomical risk factors such as trochlear dysplasia, patella alta, and increased tibial tubercle–trochlear groove (TT–TG) distance. The most widely accepted criteria for isolated MPFLR included a TT–TG measurement of less than 20 mm, Dejour type A or B dysplasia, and the absence of significant rotational deformities.[12-14] In contrast, when TT–TG exceeded 20 mm, or when patients exhibited Dejour type C or D dysplasia or excessive femoral anteversion, authors favored combining MPFLR with procedures like TTO or trochleoplasty.[14]

Imaging was central to preoperative planning. Watts et al highlighted the role of standardized radiographs and MRI in evaluating patellar height (using the Insall–Salvati and Caton–Deschamps indices), TT–TG distance, trochlear morphology, and patellar tilt.[12] MRI was also valuable in identifying MPFL injury sites and postoperative graft integrity. Although still under investigation, dynamic imaging may help assess functional instability not evident in static studies.[12]

Graft selection showed a preference for autografts, especially gracilis and semitendinosus tendons, due to biological compatibility and lower cost. Matzkin et al. found similar redislocation and satisfaction rates between autografts and allografts but preferred the former for accessibility and integration.[13] McNeilan et al supported this view, reporting slightly better Lysholm and Tegner scores with autografts in their meta-analysis.[18] Fixation methods varied, including interference screws, suture anchors, and suspensory devices. Provided the anatomical landmarks were respected, fixation type did not appear to significantly alter outcomes.

Technical nuances such as single-versus double-bundle reconstructions were discussed. Some authors suggested that double-bundle techniques might more accurately mimic the native MPFL structure, particularly in patients with broader insertion zones or generalized laxity. However, definitive clinical superiority has not been established, and surgical complexity must be considered.

Femoral tunnel enlargement (FTE) was frequently observed radiographically after MPFLR. A systematic review by Abelleyra Lastoria et al. identified FTE in up to 77.1% of patients.[17] Notably, FTE was not linked to poorer clinical outcomes, suggesting it may reflect biological remodeling rather than mechanical failure.

The overall complication rate was low. Shah et al identified a pooled rate of 26.1% in their systematic review, with stiffness, patellar fracture, overconstraint, and medial subluxation being the most common complications.[19] Technical errors, especially graft overtensioning or malposition, were the leading contributors to adverse outcomes. In skeletally immature patients, studies using physeal-sparing techniques (e.g., epiphyseal tunnels or soft-tissue fixation) reported no cases of growth disturbance at midterm follow-up.[11]

High patient satisfaction was a consistent finding. In Pautasso et al's cohort, over 90% of patients expressed satisfaction with surgical results.[14] Most resumed physical activities comfortably. While only 43% returned to pre-injury sports levels, a large portion engaged in recreational activities without pain or instability. Comparable satisfaction was reported by Zhang et al and Bitar et al, particularly in younger patients without generalized ligamentous laxity and minimal chondral damage.[15,16]

Demographic factors influenced recovery but were not independent predictors of failure. Younger age and high activity levels were associated with better outcomes, though adolescents and females—despite having higher baseline instability—achieved similar functional recovery when appropriately managed. Delays in surgery or multiple prior dislocations correlated with greater cartilage injury and slightly reduced functional scores.

Some studies explored adjunct procedures. In patients with TT–TG >20 mm or patella alta (Caton–Deschamps index >1.2), combining MPFLR with TTO resulted in superior stability and lower redislocation rates.[14] Trochleoplasty was reserved for those with severe trochlear dysplasia (Dejour type C or D), although its use remains controversial due to technical challenges and potential complications.

Return-to-sport (RTS) rates ranged from 60% to 85%, depending on sport intensity and patient characteristics. High-impact sports had lower RTS rates and longer rehabilitation periods. Recreational athletes generally returned within 4 to 6 months. Safe RTS was linked to not only graft healing but also neuromuscular reconditioning.

In summary, MPFLR has shown consistent success in reducing instability and improving function in properly selected patients. Favorable outcomes were most associated with precise anatomical indications, accurate surgical technique, and structured rehabilitation protocols. While multiple techniques and adjunct procedures exist, the central principles of biomechanical fidelity and individualized care remain critical for success.

DISCUSSION

MPFLR has become a central strategy for treating recurrent lateral patellar instability, particularly in active adolescents and young adults. The MPFL is disrupted in over 90% of initial patellar dislocations and plays a dominant role in maintaining patellar stability; its disruption often leads to repeated instability and further joint damage.[19] Anatomically restoring the MPFL reestablishes proper patellar tracking and can lower redislocation rates to between 2% and 6% in anatomically favorable cases.[21] Tools such as the Balcarek radiographic risk score help stratify recurrence risk by evaluating critical parameters like TT-TG distance over 20 mm, patella alta (Caton–Deschamps index over 1.2), and trochlear dysplasia—patients with four or more risk factors facing recurrence rates exceeding 50% without surgical correction.[22]

Evidence supports isolated MPFLR for patients with limited anatomical deviation, such as TT-TG under 20 mm and Dejour type A or B dysplasia. In these groups, redislocation remained below 5%, and postoperative functional scores (Kujala 85–92; Lysholm 80–95) improved markedly.[23] In contrast, individuals with more complex patellofemoral anatomy (e.g., high TT-TG, trochlear dysplasia, patella alta) benefited significantly from adding tibial tubercle osteotomy to MPFLR, reducing their redislocation risk from around 25% to under 5%.[22]

In younger, skeletally immature patients, physeal-sparing techniques, such as epiphyseal tunnel placement, were both safe and effective—achieving just 4.7% redislocation and no growth disturbances over a mean follow-up of 3.6 years.[24] Regarding graft choice, autografts (gracilis or semitendinosus) yielded slightly better results, with redislocation at 3.1% versus 4.4% for allografts and marginally higher Kujala scores, supporting their preference in primary reconstruction.[25]

Precise femoral tunnel placement at the Schöttle point was found critical: in one series, it was associated with a 93% satisfaction rate and zero redislocations at two years.[26] Postoperative results universally reflected dramatic improvements in function—Kujala scores rose from around 47 to 89, Lysholm similarly improved, and Tegner activity levels climbed from approximately 2.1 to 5.9. Returning to sports within 6–8 months occurred in about 76% of patients, though only 43% reached prior performance levels.[27]

The importance of psychosocial readiness was highlighted by Sanchis-Alfonso et al, who emphasized that patient expectations, neuromuscular control, and psychological factors significantly influence outcomes of MPFLR and facilitate faster return to activity.[28] Although femoral tunnel widening was observed in up to 77.1% of cases radiographically, this change did not correlate with compromised clinical outcomes and may instead reflect benign remodeling.[25]

In complex knees, combining MPFLR with corrective procedures was shown to further enhance stability: adding tibial tubercle osteotomy for those with patella alta or elevated TT-TG lowered redislocation from 21% to 3%, while trochleoplasty improved outcomes in severe trochlear dysplasia cases.[22]

Overall complication rates stayed low (around 26%), with most common issues including stiffness (6%), overconstraint (3.5%), patellar fracture (2.1%), and wound complications (1.9%). Revision surgeries (2–8%) were typically needed for technical errors.[26]

Demographic factors such as age and sex affected rehabilitation pace but not final outcomes—females and younger patients achieved comparable long-term functional scores and satisfaction, despite higher preoperative instability rates.[27]

CONCLUSION

In summary, MPFLR delivers excellent results—redislocation below 5%, functional score gains of 40–50 points, and satisfaction rates over 90%—when performed with anatomical precision and tailored to patient anatomy. These findings affirm MPFLR as a dependable and reproducible intervention within a structured, anatomy-driven surgical approach.

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