QUALITY IN SPORT
eISSN 2450-3118 · Open Access · Peer-reviewed
apcz.umk.pl/QS Nicolaus Copernicus University in Toruń

MILLER, Leon, MAJEWSKA, Aleksandra, MICHALSKA, Wiktoria, GAWEŁ, Karolina, DEDIO, Emilia, KOZIK, Aleksandra, MATERA, Weronika, DZIUBA, Klaudia, AUGUSTYNOWICZ, Gabriela and PODLASIEWICZ, Wiktoria. Combined Trochleoplasty, Tibial Tuberosity Transfer, and Medial Patellofemoral Ligament Reconstruction in Recurrent Patellar Instability: Indications, Surgical Strategy, and Outcomes – A Narrative Review. Quality in Sport. 2026;72:74862. https://doi.org/10.12775/QS.2026.72.74862

ARTICLE TIMELINE
Received: 01.08.2026. Revised: 18.08.2026. Accepted: 07.09.2026. Published: 15.09.2026.

The journal has been awarded 20 points in the parametric evaluation by the Polish Ministry of Higher Education and Science (Annex to the announcement of 05.01.2024, No. 32553). Unique Journal Identifier: 201398. Scientific disciplines assigned: Economics and Finance (Field of Social Sciences); Management and Quality Sciences (Field of Social Sciences).
Punkty Ministerialne z 2019 – aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398. Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych). © The Authors 2026.

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Combined Trochleoplasty, Tibial Tuberosity Transfer, and Medial Patellofemoral Ligament Reconstruction in Recurrent Patellar Instability: Indications, Surgical Strategy, and Outcomes – A Narrative Review

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Abstract

Background. Recurrent patellar instability is a multifactorial condition associated with trochlear dysplasia, abnormal extensor mechanism alignment, and medial patellofemoral ligament (MPFL) insufficiency. Isolated procedures may not address all anatomical abnormalities, leading to persistent instability. Therefore, combined procedures such as trochleoplasty, tibial tuberosity transfer (TTO), and MPFL reconstruction are increasingly used.

Aim. To evaluate the evidence on indications, biomechanical rationale, and outcomes of combined trochleoplasty, TTO, and MPFL reconstruction in recurrent patellar instability.

Material and methods. A narrative review of PubMed-indexed literature was conducted, including clinical studies, systematic reviews, and biomechanical analyses. Data were synthesized qualitatively due to heterogeneity in patient populations, surgical techniques, and outcomes.

Results. Combined procedures are associated with low redislocation rates and generally favorable functional outcomes in selected patients. MPFL reconstruction restores medial soft-tissue restraint, TTO improves patellar tracking, and trochleoplasty enhances osseous containment in high-grade trochlear dysplasia. Combined approaches appear more reliable than isolated procedures in patients with multiple anatomical risk factors. However, functional outcomes and return to sport remain variable, influenced by cartilage status and chronicity of instability.

Conclusions. Combined surgery is a logical and effective strategy for complex recurrent patellar instability when based on careful anatomical assessment. Success depends on appropriate patient selection rather than routine use. Further prospective studies are needed to refine indications and optimize surgical strategies.

Key words: patellar instability, MPFL reconstruction, tibial tuberosity transfer, trochleoplasty, patellofemoral joint, combined surgery.

1. Introduction

Recurrent patellar instability remains a challenging clinical problem, particularly in young and active patients. While a single dislocation may be managed non-operatively, recurrence is common and often reflects underlying anatomical abnormalities rather than isolated soft tissue injury. Over the past decades, it has become increasingly clear that patellar instability is not a uniform entity but rather the result of a combination of factors, including trochlear dysplasia, lateralization of the tibial tuberosity, patella alta, and insufficiency of the medial patellofemoral ligament (MPFL).

Among these, trochlear dysplasia is considered one of the most important predisposing factors, especially in patients with high-grade deformities. In such cases, the native bony anatomy provides limited containment for the patella during early flexion. At the same time, an increased tibial tuberosity–trochlear groove (TT–TG) distance contributes to lateral maltracking, while disruption or elongation of the MPFL reduces the primary soft tissue restraint against lateral displacement. These abnormalities frequently coexist, which may explain why isolated surgical procedures do not always provide reliable long-term stability.

MPFL reconstruction has become a widely adopted technique and is often considered the cornerstone of surgical treatment. However, there is growing recognition that restoring the ligament alone may be insufficient in the presence of significant bony malalignment or dysplasia. Similarly, procedures such as tibial tuberosity transfer (TTT) or trochleoplasty address specific anatomical components but do not correct the full spectrum of instability when used in isolation. As a result, attention has shifted toward combined surgical strategies that aim to correct both soft tissue and osseous contributors in a single setting (Dennis et al., 2022).

Despite increasing use of combined procedures, including trochleoplasty, TTT, and MPFL reconstruction, indications remain somewhat heterogeneous, and surgical decision-making is still largely based on individual surgeon experience. The available literature is composed mainly of retrospective case series with varying inclusion criteria and outcome measures, which makes direct comparison difficult. Nevertheless, several studies suggest that addressing multiple pathological factors simultaneously may reduce the risk of recurrent instability in carefully selected patients.

The aim of this narrative review is to summarize current evidence on the role of combined trochleoplasty, tibial tuberosity transfer, and MPFL reconstruction in the management of recurrent patellar instability, with particular focus on indications, surgical rationale, and reported clinical outcomes.

2. Methodology

2.1. Study Design

This study was designed as a narrative review aiming to provide a clinically oriented synthesis of the current literature on combined trochleoplasty, tibial tuberosity transfer (TTT), and medial patellofemoral ligament (MPFL) reconstruction in the management of recurrent patellar instability.

A narrative approach was chosen to allow integration of heterogeneous evidence, including surgical techniques, indications, and outcome data, which are not easily comparable across studies. The focus was placed on clinically relevant aspects of decision-making rather than on quantitative pooling of results.

2.2. Data Sources and Search strategies

A comprehensive literature search was conducted using electronic databases, including PubMed, Scopus, Web of Science, and Google Scholar. The search strategy included combinations of the following keywords and Medical Subject Headings (MeSH) terms:

("patellar instability" OR "recurrent patellar dislocation" OR "patellofemoral instability")
AND
("trochleoplasty" OR "trochlear dysplasia surgery")
AND
("tibial tubercle osteotomy" OR "tibial tuberosity transfer" OR "TTO" OR "TTT")
AND
("MPFL reconstruction" OR "medial patellofemoral ligament reconstruction")).

Reference lists of relevant articles were also manually screened to identify additional studies that were not captured in the initial database search.

2.3. Limitations of Methodology

This review is subject to limitations inherent to its narrative design. Study selection was not based on a predefined systematic protocol, which may introduce a degree of subjectivity. However, a structured search strategy and manual reference screening were used to ensure that the most relevant literature was included.

3. Pathoanatomy and Need for Combined Correction

Recurrent patellar instability is best understood as a multifactorial disorder rather than the result of a single injured structure. Although disruption of the medial patellofemoral ligament (MPFL) is commonly observed following a primary dislocation, recurrent instability typically reflects the combined effect of soft-tissue insufficiency, abnormal trochlear morphology, altered extensor mechanism alignment, and delayed patellar engagement during early flexion (Dejour et al., 1994; Wolfe et al., 2025).

Trochlear dysplasia is widely regarded as one of the most important predisposing factors, particularly in patients with high-grade deformities. A shallow or even convex trochlear groove limits osseous containment of the patella during early flexion, when stability depends heavily on soft-tissue restraints. In this setting, even a well-performed MPFL reconstruction may be exposed to abnormal loads if the underlying bony anatomy is not addressed (Dejour et al., 1994; Vogel et al., 2019).

In addition to trochlear morphology, the alignment of the extensor mechanism plays a key role. An increased tibial tubercle–trochlear groove (TT–TG) distance shifts the vector of quadriceps force laterally, promoting maltracking and increasing the risk of recurrent dislocation. Similarly, patella alta delays engagement of the patella within the trochlear groove, prolonging the period during which the patella is vulnerable to lateral translation. These factors frequently coexist and may amplify each other's effects on patellar stability (Grimm et al., 2018; Ricciuti et al., 2024).

The relative contribution of these factors varies throughout the range of motion. In early flexion, stability depends primarily on the MPFL and trochlear morphology, whereas at higher degrees of flexion, osseous congruence and alignment become more dominant. This dynamic interaction helps explain why isolated correction of a single abnormality may fail to restore normal patellofemoral biomechanics in patients with complex instability patterns (Wolfe et al., 2021).

From a clinical perspective, accurate identification of the dominant anatomical contributors is essential. Modern imaging, including MRI and CT, allows detailed assessment of trochlear shape, TT–TG distance, patellar height, and rotational alignment. These parameters guide surgical planning and support an individualized, anatomy-driven approach rather than a standardized operative strategy (Ricciuti et al., 2024; Dejour, 2025).

The rationale for combined surgical correction follows directly from this pathoanatomical framework. MPFL reconstruction restores medial soft-tissue restraint, tibial tubercle osteotomy or transfer corrects the lateralized force vector and improves patellar tracking, and trochleoplasty addresses deficient osseous containment in cases of high-grade dysplasia. When multiple abnormalities are present, addressing only one component may leave residual mechanisms of instability uncorrected. Conversely, a tailored combination of procedures allows for restoration of more physiological patellofemoral biomechanics (Vogel et al., 2019; Grimm et al., 2018).

Importantly, combined surgery is not required in all patients. In cases where instability is primarily due to soft-tissue insufficiency without significant bony abnormalities, isolated MPFL reconstruction may be sufficient. However, in patients with high-grade trochlear dysplasia, increased TT–TG distance, or patella alta, failure to address these structural factors may compromise surgical outcomes and increase the risk of persistent instability (Wolfe et al., 2021; Dejour, 2025).

Taken together, current evidence supports a shift toward an anatomy-based, individualized treatment strategy. Recognizing the interplay between soft tissue, osseous morphology, and alignment is essential for understanding why combined procedures are increasingly used in the management of recurrent patellar instability.

4. MPFL Reconstruction in the Context of Combined Surgery

Reconstruction of the medial patellofemoral ligament (MPFL) has become a central element in the surgical management of recurrent patellar instability. As the primary passive restraint to lateral patellar translation in early knee flexion, the MPFL plays a key role in maintaining stability before the patella engages fully within the trochlear groove. Consequently, restoration of this structure is considered essential in most operative strategies addressing recurrent instability (Amis et al., 2003; Wolfe et al., 2021; Dejour, 2025).

In patients without significant bony abnormalities, isolated MPFL reconstruction has been shown to provide reliable stabilization and satisfactory functional outcomes. However, its effectiveness is closely linked to underlying anatomy. When major structural risk factors such as high-grade trochlear dysplasia, increased TT–TG distance, or patella alta are present, reconstruction of the ligament alone may not adequately restore normal patellofemoral biomechanics (Grimm et al., 2018; Ricciuti et al., 2024).

One of the key limitations of isolated MPFL reconstruction in this setting is that it does not correct abnormal force vectors or deficient osseous containment. As a result, the reconstructed ligament may be subjected to increased mechanical stress, particularly during early flexion when trochlear guidance is insufficient. This can lead to persistent maltracking, residual apprehension, or even failure of the reconstruction despite technically appropriate graft placement and tensioning (Vogel et al., 2019; Su et al., 2021).

For this reason, MPFL reconstruction is increasingly performed as part of a combined surgical approach in patients with complex or recurrent instability. Within this context, the role of the MPFL is not to compensate for uncorrected anatomical abnormalities, but rather to restore physiological medial restraint once underlying structural factors have been addressed. When combined with procedures such as tibial tubercle osteotomy or trochleoplasty, MPFL reconstruction contributes to a more balanced and stable patellofemoral joint by complementing corrections in alignment and bony morphology (Grimm et al., 2018; Vogel et al., 2019).

The concept of combined surgery also has implications for surgical planning and technique. Graft placement, tensioning, and fixation must be carefully adjusted in relation to concomitant procedures to avoid overconstraint or altered patellofemoral contact mechanics. In particular, excessive tensioning of the graft in the setting of corrected alignment may lead to medial overload, pain, or restricted range of motion, highlighting the importance of intraoperative assessment and individualized adjustment (Schöttle et al., 2007; Wolfe et al., 2025).

Clinical outcomes further support the use of MPFL reconstruction within combined procedures. Studies evaluating MPFL reconstruction in conjunction with tibial tubercle osteotomy or trochleoplasty have reported low rates of redislocation and generally favorable functional outcomes in appropriately selected patients. At the same time, comparative data suggest that similar results can be achieved with isolated MPFL reconstruction in patients without significant anatomical abnormalities, reinforcing the importance of careful patient selection (Su et al., 2021; Meng et al., 2024).

Overall, MPFL reconstruction should be viewed as a necessary but not always sufficient component of surgical treatment for recurrent patellar instability. Its role within combined procedures is to restore soft-tissue restraint as part of a comprehensive correction strategy, rather than to compensate for persistent anatomical risk factors.

5. Tibial Tuberosity Transfer (TTO) in the Context of Combined Surgery

Tibial tuberosity transfer (TTO), also referred to as tibial tubercle osteotomy, is a well-established procedure aimed at correcting abnormal alignment of the extensor mechanism in patients with patellar instability. By modifying the position of the tibial tubercle, TTO directly influences the direction and magnitude of the quadriceps force vector, thereby improving patellar tracking and reducing lateralizing forces acting on the patella (Grimm et al., 2018).

The most common indication for TTO in the setting of recurrent patellar instability is an increased tibial tubercle–trochlear groove (TT–TG) distance, which reflects lateralization of the extensor mechanism. In such cases, medialization of the tibial tubercle can reduce

lateral translation forces and facilitate more central patellar tracking. In addition, distalization may be performed in patients with patella alta to promote earlier engagement of the patella within the trochlear groove, while anteriorization or anteromedialization may be considered to decrease patellofemoral joint contact pressure in selected cases (Fulkerson, 1983; Grimm et al., 2018; Ricciuti et al., 2024).

Importantly, TTO does not directly address soft-tissue insufficiency or trochlear dysplasia. As a result, its role is primarily complementary when used in combination with other stabilizing procedures. In patients with combined anatomical risk factors, particularly those with both increased TT–TG distance and MPFL insufficiency, TTO is frequently performed alongside MPFL reconstruction to address both the abnormal force vector and the lack of medial restraint (Su et al., 2021; Meng et al., 2024).

Clinical outcomes support this combined approach in appropriately selected patients. Studies evaluating MPFL reconstruction combined with TTO have reported low rates of redislocation and generally favorable functional outcomes, suggesting that correction of both alignment and soft-tissue stability provides a more robust solution than isolated procedures in patients with maltracking (Su et al., 2021). At the same time, evidence indicates that outcomes may be comparable to isolated MPFL reconstruction in patients without significant malalignment, underscoring the importance of careful patient selection (Meng et al., 2024).

Within the broader context of combined surgery, TTO serves to normalize patellar tracking and reduce pathological loading conditions that may otherwise compromise the durability of soft-tissue reconstruction. In cases where trochlear dysplasia is also present, TTO may be combined with both MPFL reconstruction and trochleoplasty to address alignment, restraint, and osseous containment simultaneously. This approach is particularly relevant in patients with complex instability patterns, where multiple anatomical abnormalities interact to produce recurrent dislocation (Vogel et al., 2019).

From a technical perspective, the extent and direction of tubercle transfer must be tailored to the individual patient. Overcorrection may lead to medial overloading or altered patellofemoral kinematics, while undercorrection may fail to resolve maltracking. This

highlights the importance of preoperative planning based on imaging parameters such as TT–TG distance, patellar height indices, and clinical assessment of tracking patterns (Grimm et al., 2018).

Although TTO is generally effective, it is associated with procedure-specific risks, including nonunion, tibial fracture, hardware irritation, and the potential need for secondary procedures for implant removal. These considerations further support a selective, indication-based approach rather than routine use in all patients with recurrent patellar instability (Grimm et al., 2018).

Overall, TTO plays a key role within combined surgical strategies by correcting abnormal alignment and improving patellar tracking. However, its benefits are most pronounced when used in patients with clearly defined malalignment, and it should be integrated into a broader, anatomy-driven treatment plan rather than applied as a standalone solution.

6. Trochleoplasty in the Context of Combined Surgery

Trochleoplasty is the only surgical procedure that directly addresses trochlear dysplasia, making it a key option in patients with recurrent patellar instability associated with high-grade morphological abnormalities. In contrast to soft-tissue reconstruction or alignment procedures, trochleoplasty aims to reshape the femoral trochlea to improve patellar engagement and restore osseous containment during early knee flexion (Vogel et al., 2019; Ricciuti et al., 2024).

The indication for trochleoplasty is typically limited to patients with severe trochlear dysplasia, particularly Dejour types B–D, in whom the native groove fails to provide sufficient stability even at low degrees of flexion. In such cases, the patella may remain laterally unstable despite intact or reconstructed soft-tissue restraints, highlighting the limitations of isolated MPFL reconstruction when the underlying bony anatomy is unfavorable (Dejour et al., 1994; Dejour, 2025).

From a biomechanical perspective, trochleoplasty reduces the reliance on soft-tissue stabilizers by restoring a more congruent trochlear groove. This is particularly relevant in early flexion, when the patella transitions into the trochlea and is most vulnerable to lateral

displacement. By improving osseous guidance, trochleoplasty helps normalize patellar tracking and reduces the mechanical demands placed on reconstructed ligaments (Vogel et al., 2019).

In clinical practice, trochleoplasty is rarely performed as an isolated procedure in patients with recurrent instability. Instead, it is typically combined with MPFL reconstruction to restore medial restraint and, when indicated, with tibial tubercle osteotomy to correct alignment abnormalities. This combined approach allows for simultaneous correction of bony morphology, soft-tissue insufficiency, and abnormal force vectors, which is particularly important in patients with complex or long-standing instability (Nelitz et al., 2013; Vogel et al., 2019).

Clinical outcomes following trochleoplasty, particularly when combined with other stabilizing procedures, are generally favorable in carefully selected patients. Studies report low rates of recurrent instability and improvements in functional scores. However, interpretation of these results is complicated by heterogeneity in patient selection, surgical techniques, and outcome measures across studies. In addition, most available data are derived from retrospective series, limiting the strength of conclusions (Ricciuti et al., 2024).

Concerns regarding trochleoplasty primarily relate to its technical complexity and potential complications. These include cartilage injury, postoperative stiffness, persistent anterior knee pain, and the possible development of patellofemoral osteoarthritis over time. While some studies have reported radiographic progression of degenerative changes, the clinical relevance of these findings remains uncertain, as functional outcomes do not always correlate with imaging findings (Kreutzer et al., 2025; Pineda et al., 2026).

Given these considerations, trochleoplasty should be reserved for patients in whom trochlear dysplasia represents a major driver of instability. Overuse in patients with mild anatomical abnormalities may expose them to unnecessary surgical risk without clear benefit. Conversely, failure to address high-grade dysplasia may compromise the effectiveness of other procedures and lead to persistent instability.

In the context of combined surgery, trochleoplasty plays a central role in restoring structural stability. When appropriately indicated and integrated with soft-tissue and alignment procedures, it contributes to a more comprehensive correction of the underlying pathomechanics of recurrent patellar instability.

7. Rationale for Combined Procedures

The increasing use of combined surgical procedures in the treatment of recurrent patellar instability reflects a shift toward a more comprehensive, anatomy-driven approach. Rather than addressing a single pathological feature, combined strategies aim to correct the multiple interacting factors that contribute to instability in complex cases. This approach is based on the recognition that patellar instability rarely results from an isolated abnormality, but instead arises from the interplay between soft-tissue insufficiency, abnormal alignment, and deficient osseous containment (Dejour et al., 1994; Wolfe et al., 2021).

Each of the principal procedures targets a specific component of this multifactorial pathology. MPFL reconstruction restores medial soft-tissue restraint, particularly in early flexion. Tibial tuberosity transfer corrects the lateralized force vector of the extensor mechanism and improves patellar tracking, while trochleoplasty addresses deficient bony morphology in patients with high-grade trochlear dysplasia (Dean et al., 2016; Grimm et al., 2018; Vogel et al., 2019).

When these abnormalities coexist, performing a single procedure may leave residual mechanisms of instability uncorrected (Dean et al., 2016; Floyd et al., 2022). For instance, isolated MPFL reconstruction may not provide durable stability in the presence of severe trochlear dysplasia, while tibial tubercle osteotomy alone does not compensate for deficient soft-tissue restraint. Similarly, trochleoplasty without addressing malalignment or ligament insufficiency may fail to restore normal patellofemoral mechanics. This highlights the importance of a combined approach in selected patients (Dejour, 2025).

The rationale for combining procedures therefore lies in restoring a more physiological balance between static and dynamic stabilizers of the patellofemoral joint. By

simultaneously addressing soft tissue, alignment, and osseous morphology, combined surgery aims to normalize patellar tracking and reduce abnormal loading patterns across the full range of motion. This integrated correction may also decrease mechanical stress on individual reconstructions, potentially improving durability and long-term stability (Grimm et al., 2018; Ricciuti et al., 2024).

Clinical studies support the use of combined procedures in patients with multiple anatomical risk factors. Combined MPFL reconstruction and tibial tubercle osteotomy have been associated with low redislocation rates and improved functional outcomes in appropriately selected patients. Similarly, the addition of trochleoplasty in cases of high-grade dysplasia appears to enhance stability by improving osseous containment, particularly in early flexion (Su et al., 2021; Vogel et al., 2019). However, the benefits of combined surgery are closely linked to appropriate indication, and similar outcomes may be achieved with isolated procedures in patients without significant structural abnormalities.

A key element of this strategy is therefore patient selection. Combined procedures are most appropriate in patients with clearly defined anatomical risk factors, such as high-grade trochlear dysplasia, increased TT–TG distance, or patella alta, particularly when these abnormalities coexist. In contrast, routine use of combined surgery in low-risk patients may expose individuals to unnecessary surgical morbidity without additional benefit. This reinforces the importance of individualized, anatomy-based decision-making (Dejour et al., 1994; Ricciuti et al., 2024).

While current findings support the use of combined procedures in selected patients, available evidence is largely based on retrospective series with heterogeneous indications and outcome measures. Therefore, results should be interpreted in the context of these limitations.

In summary, combined surgical approaches represent a logical extension of the multifactorial understanding of patellar instability. When applied selectively, they allow for a more complete correction of the underlying pathomechanics and may improve the likelihood of durable stability and satisfactory functional outcomes.

8. Clinical Outcomes

Clinical outcomes following surgical treatment of recurrent patellar instability are typically assessed using a combination of objective and patient-reported measures, including redislocation rates, functional scores such as the Kujala and IKDC scores, return to sport, and patient satisfaction. Across the literature, combined procedures involving MPFL reconstruction, tibial tuberosity transfer, and/or trochleoplasty generally demonstrate favorable stability outcomes in appropriately selected patients.

One of the most consistent findings is a reduction in redislocation rates when multiple anatomical risk factors are addressed simultaneously. Studies evaluating combined MPFL reconstruction and tibial tubercle osteotomy report low recurrence rates, often below 5–10%, particularly in patients with increased TT–TG distance or patella alta (Su et al., 2021; Meng et al., 2024). Similarly, the addition of trochleoplasty in patients with high-grade trochlear dysplasia has been associated with improved stability, with many series reporting minimal or no recurrent dislocations at mid-term follow-up (Vogel et al., 2019).

Functional outcomes, most commonly assessed using the Kujala score, also tend to improve following combined procedures. Patients frequently report significant increases in functional scores postoperatively, reflecting improved stability, reduced apprehension, and better overall knee function. However, the magnitude of improvement varies across studies and appears to be influenced by preoperative factors such as cartilage damage, chronicity of instability, and baseline functional status (Grimm et al., 2018; Ricciuti et al., 2024).

Return to sport is another important outcome, particularly in younger and athletic populations. While many patients are able to return to previous levels of activity following combined reconstruction, the reported rates are variable. Factors such as the extent of surgical intervention, rehabilitation protocols, and the presence of concomitant cartilage lesions may influence the ability to resume high-level sports. In general, combined procedures do not appear to significantly delay return to activity compared to isolated reconstruction, although data remain limited (Wolfe et al., 2021).

An important consideration when interpreting outcomes is the comparison between isolated and combined procedures. Several studies suggest that similar functional and stability outcomes can be achieved with isolated MPFL reconstruction in patients without significant anatomical abnormalities. In contrast, in patients with clear structural risk factors, combined procedures appear to provide more reliable stabilization. This highlights that improved outcomes are not necessarily a result of performing more extensive surgery, but rather of selecting the appropriate procedure based on individual anatomy (Su et al., 2021; Meng et al., 2024).

Despite generally favorable results, outcome reporting across studies is heterogeneous. Differences in patient selection, surgical technique, outcome measures, and follow-up duration limit direct comparison between studies. In addition, many studies are retrospective in nature and involve relatively small cohorts, which may influence the generalizability of results.

While current findings support the effectiveness of combined procedures in improving patellar stability and functional outcomes, available evidence is largely based on retrospective series with heterogeneous indications and outcome measures. Therefore, results should be interpreted in the context of these limitations.

Overall, the literature suggests that combined surgical approaches can achieve good clinical outcomes in patients with complex patellar instability, particularly when treatment is tailored to the underlying anatomical abnormalities. The key determinant of success appears to be appropriate patient selection rather than the routine use of multiple procedures.

9. Conclusion

The present review highlights the importance of an anatomy-driven approach in the surgical management of recurrent patellar instability. The available literature consistently suggests that instability is rarely attributable to a single pathological factor, but rather reflects the combined effect of soft-tissue insufficiency, malalignment, and abnormal trochlear morphology. As a result, surgical strategies that address multiple contributing

factors appear to provide more reliable stability in patients with complex anatomical abnormalities.

A key finding across the reviewed studies is that combined procedures—particularly those incorporating MPFL reconstruction with tibial tuberosity transfer and/or trochleoplasty—are associated with low redislocation rates and generally favorable functional outcomes in appropriately selected patients. These findings support the concept that restoring both static and dynamic stabilizers of the patellofemoral joint may improve biomechanical conditions and reduce the likelihood of recurrent instability. At the same time, the observed improvements in functional scores such as the Kujala score suggest that patients also benefit from reduced apprehension and improved confidence in daily and sporting activities.

However, an important nuance emerges when comparing combined and isolated procedures. Several studies indicate that isolated MPFL reconstruction can achieve similarly favorable outcomes in patients without significant anatomical risk factors. This suggests that the benefit of combined procedures is not universal, but rather dependent on the presence and severity of underlying structural abnormalities. In this context, performing additional procedures in low-risk patients may not provide meaningful clinical benefit and may unnecessarily increase surgical morbidity.

The central clinical implication of these findings is that surgical decision-making should be individualized rather than standardized. Parameters such as TT–TG distance, patellar height, trochlear morphology, and clinical tracking patterns should guide the choice of procedure. In patients with high-grade trochlear dysplasia, significant malalignment, or multiple coexisting risk factors, combined procedures appear justified and may improve the likelihood of durable stability. Conversely, in patients with isolated soft-tissue insufficiency, less invasive approaches may be sufficient.

Another important consideration is the distinction between stability and overall functional outcome. While combined procedures are effective in reducing redislocation rates, improvements in patient-reported outcomes are more variable. Factors such as pre-existing cartilage damage, chronicity of instability, and postoperative rehabilitation play a

significant role in determining final functional results. This suggests that achieving mechanical stability alone may not be sufficient to guarantee optimal patient satisfaction, and highlights the importance of comprehensive patient evaluation and counseling.

The potential risks associated with combined procedures must also be considered. While complication rates are generally acceptable, the addition of multiple surgical steps increases operative complexity and may expose patients to procedure-specific risks such as stiffness, hardware-related problems, or overconstraint. This further reinforces the need for careful patient selection and precise surgical planning.

While current findings support the use of combined procedures in selected patients, available evidence is largely based on retrospective series with heterogeneous indications and outcome measures. Therefore, results should be interpreted in the context of these limitations. In particular, variability in surgical techniques, outcome reporting, and follow-up duration makes direct comparison across studies challenging.

Future research should focus on prospective, comparative studies evaluating isolated versus combined procedures in clearly defined patient populations. Standardization of outcome measures and longer-term follow-up will be essential to better understand not only recurrence rates but also functional outcomes and the potential development of patellofemoral osteoarthritis. In addition, further work is needed to refine surgical indications and develop validated decision-making algorithms that can guide individualized treatment strategies.

In summary, the current literature supports a shift toward a tailored, anatomy-based approach in the management of recurrent patellar instability. Combined surgical procedures offer a logical and often effective solution in patients with complex anatomical abnormalities, but their success depends primarily on appropriate indication rather than routine application.

Disclosure
Supplementary Materials. Not applicable.

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Funding

This research received no external funding.

Institutional Review Board Statement

Ethical review and approval were not required for this study, as it is a systematic review based exclusively on previously published data.

Informed Consent Statement

Not applicable.

Data Availability Statement

No new data were created or analyzed in this study. Data sharing is not applicable to this article.

Conflicts of Interest

The authors declare no conflict of interest.

Declaration of the Use of Generative AI and AI-Assisted Technologies

During the preparation of this manuscript, the authors used ChatGPT (OpenAI) for language editing and stylistic improvement. After using this tool/service, the author(s) have reviewed and edited the content as needed and accept full responsibility for the substantive content of the publication.

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