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# Current Evidence Regarding the Safety and Effectiveness of Early Weightbearing and Accelerated Rehabilitation Following Patellar Instability Surgery: A Scoping Review

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## Abstract

Postoperative rehabilitation following patellar instability surgery, particularly medial patellofemoral ligament reconstruction (MPFLR) with or without tibial tubercle osteotomy (TTO), remains highly variable. Increasing interest in accelerated rehabilitation strategies raises the question of whether earlier functional recovery can be promoted without compromising stability and safety. A scoping review was conducted in accordance with the PRISMA extension for Scoping Reviews (ScR) guidelines. PubMed, Embase, and Cochrane Library databases were searched from January 2010 to September 2026 using prespecified, database-specific search strings. Studies evaluating early or accelerated postoperative weightbearing, range of motion (ROM), or activity following MPFLR and/or TTO were included. Early or accelerated rehabilitation was defined as the advancement of at least one of four domains, relative to a conventional protocol: weightbearing, ROM, the discontinuation of bracing, or strengthening and return to activity.

Two independent reviewers screened articles and extracted data on study characteristics, rehabilitation protocols, and clinical outcomes, with disagreements resolved by consensus. The search identified 252 records, 175 of which remained after duplicates were removed and were screened. Six studies comprising 474 patients met inclusion criteria. Accelerated rehabilitation protocols commonly involved early ROM progression, immediate or early weightbearing as tolerated, and the reduced use of postoperative bracing. Across studies, early rehabilitation was not associated with increased rates of recurrent patellar instability, graft failure, or major complications. Several studies reported earlier return to activity and improved short-term functional outcomes compared with more restrictive protocols, while long-term patient-reported outcomes were comparable between rehabilitation strategies. Current evidence suggests that early weightbearing and accelerated rehabilitation following patellar instability surgery appear feasible in appropriately selected patients and were not associated with increased rates of recurrent instability, graft failure, or major complications in the included studies. Since the evidence base is small, heterogeneous, and predominantly non-randomized and because no formal quality appraisal was performed, these findings should be regarded as preliminary and hypothesis-generating rather than as evidence of equivalence or superiority. Further high-quality comparative studies are needed to establish optimal rehabilitation parameters.

**Categories:** Sports Medicine, Orthopedics
**Keywords:** knee range of motion (rom), knee rehabilitation, medial patellofemoral ligament reconstruction, patellar instability, scoping review, tibial tubercle osteotomy

## Introduction And Background

Patellar instability is a relatively common issue faced by physically active pediatric and adolescent patients, accounting for about 2%-3% of pediatric knee injuries. The incidence of first-time patellar dislocation is anywhere between 23 and 108 children/adolescents per 100,000 annually [1,2]. The reported risk of recurrent instability after a first-time lateral patellar dislocation varies widely and depends on age, skeletal maturity, and anatomic risk factors, such that a single pooled figure may be misleading. In unselected cohorts managed nonoperatively, reported recurrence rates range from approximately 15% to 35% [3,4]. The risk is higher in the young, athletic population, which is the focus of this review: Patients younger than 25 years of age with trochlear dysplasia have a reported 60%-70% risk of recurrence within five years, and in children and adolescents, the predicted risk of recurrence rises to approximately 75% in the presence of any three and 88% in the presence of all four of the following factors: trochlear dysplasia, skeletal immaturity, a Caton-Deschamps index greater than 1.45, and a history of contralateral patellar dislocation [5,6]. Many patients who sustain recurrent instability ultimately undergo surgical stabilization, most commonly medial patellofemoral ligament reconstruction (MPFLR).

The medial patellofemoral ligament (MPFL) prevents the lateral translation of the patella through approximately the first 20-30 degrees of knee flexion and is often injured in first-time lateral patellar

dislocations. MPFLR aims to restore this function, most often using a tendon graft secured to the patella and to the medial femoral condyle. Because the graft, its fixation, and the healing osteotomy site are all vulnerable during the early postoperative period, conventional protocols have restricted weightbearing, limited knee flexion, and required a brace or immobilizer for several weeks after surgery [7]. Once patients undergo MPFLR, they are expected to adhere to postsurgical rehabilitation protocols over the course of the next several months. Such protocols involve alterations to weightbearing status, knee bracing, strengthening and neuromuscular coordination with physical therapy, and home exercise programs [7,8]. However, the literature has revealed notable variation between different postoperative rehabilitation protocols after MPFLR, with no definitive or unified consensus on the optimal postoperative rehabilitation program.

Moreover, with increasing pressure for young athletes to return to sport participation, the question of whether accelerated rehabilitation and earlier weightbearing after surgery lead to similar outcomes compared to more conservative weightbearing protocols becomes apparent. Therefore, this review aims to synthesize the available literature on early weightbearing and activity in patients status post MPFLR in order to determine whether returning to activity earlier leads to different outcomes compared to more conservative weightbearing standards. Throughout this manuscript, the terms "early" and "accelerated" rehabilitation refer to a protocol in which at least one postoperative milestone, including weightbearing, knee range of motion (ROM), the discontinuation of bracing, or the initiation of strengthening and return to activity, is advanced relative to conventional protocols.

This article was previously presented as a poster presentation at the Pediatric Research in Sports Medicine (PRiSM) 13th Annual Meeting on 29-31 January 2026, and as a podium presentation at the 34th Annual G. Wilbur Westin Lectureship Academic Day on 3 April 2026.

# Review

## Materials and methods

*Search Strategy*

This scoping review was conducted and reported in accordance with the PRISMA extension for Scoping Reviews (ScR) guidelines. All primary study designs were eligible, including randomized and non-randomized clinical studies. This review protocol was not registered. However, the review question, eligibility criteria, search terms, and data-extraction fields were agreed upon in writing by both reviewers before screening began, and none of these elements were altered post hoc. The PubMed, Cochrane Library, and Embase databases were examined from January 2010 to 1 September 2026. The following combination of search terms were applied equally to each database: (Medial Patellofemoral Ligament Reconstruction) AND (Early Weightbearing); (Medial Patellofemoral Ligament Reconstruction) AND (Early Rehabilitation); (Medial Patellofemoral Ligament Reconstruction) AND (Early Activity); (Patellar Realignment Surgery) AND (Early Rehabilitation); (Patellar Realignment Surgery) AND (Early Weightbearing); (Patellar Realignment Surgery) AND (Early Activity); (Tibial Tubercle Osteotomy) AND (Early Weightbearing); (Tibial Tubercle Osteotomy) AND (Early Rehabilitation); (Tibial Tubercle Osteotomy) AND (Early Activity).

Search terms were entered as unquoted phrases in each database's search field so that each database's automatic term-mapping function expanded the entered phrases to its own controlled vocabulary, including Medical Subject Headings (MeSH) in PubMed and Emtree headings in Embase, in addition to searching free-text fields. No filters for language, publication type, article type, age, sex, or study design were applied within any database; the publication window of 1 January 2010 to 1 September 2026 and the requirement for an English-language full text were applied manually during screening, as were all other eligibility criteria. The nine term pairings listed in the previous paragraph are logically equivalent to the single Boolean expression (Medial Patellofemoral Ligament Reconstruction OR Patellar Realignment Surgery OR Tibial Tubercle Osteotomy) AND (Early Weightbearing OR Early Rehabilitation OR Early Activity), which reproduces the entire search in one step and was the form used in PubMed. Table *1* shows the complete strategy executed in each database, the limits applied, the date each database was last searched, and the number of records retrieved from each database.

| Database (interface) | Search strategy as executed | Limits applied | Date last searched | Records retrieved |
|---|---|---|---|---|
| PubMed/MEDLINE (NLM interface) | Single combined Boolean string entered in the basic search field: (Medial Patellofemoral Ligament Reconstruction OR Patellar Realignment Surgery OR Tibial Tubercle Osteotomy) AND (Early Weightbearing OR Early Rehabilitation OR Early Activity). Automatic term mapping was left enabled (PubMed default), so entered phrases were expanded to MeSH terms and free-text variants. For example, PubMed translates (Medial Patellofemoral Ligament Reconstruction) AND (Early Weightbearing) as ("medial"[All Fields] OR "medialisation"[All Fields] OR "medialization"[All Fields]) AND "patellofemoral"[All Fields] AND ("ligaments"[MeSH Terms] OR "ligament"[All Fields]) AND ("plastic surgery procedures"[MeSH Terms] OR "reconstruction"[All Fields]) AND ("early"[All Fields] AND ("weight bearing"[MeSH Terms] OR "weight bearing"[All Fields] OR "weightbearing"[All Fields])) | None. No language, species, article type, age, or date filters were applied within the database; the language and date restrictions were applied manually at screening | 31 August 2026 | 109 |
| Embase (Elsevier) | The nine term pairings entered separately with Emtree mapping enabled, searching Emtree headings together with title, abstract, and author keywords. One hundred ninety-seven raw records across the nine searches; 133 unique after within-database de-duplication. Trial-registry records were not retrieved | None applied within the database | 31 August 2026 | 133 |
| Cochrane Library (Wiley; CDSR and CENTRAL) | The nine term pairings entered separately in the Cochrane Library search interface. Twenty-nine raw records across the nine searches; 10 unique after within-database de-duplication, of which two were retrieved by neither PubMed nor Embase | None applied within the database | 1 September 2026 | 10 |
| Total | Sum of unique records retrieved from the three databases, before cross-database de-duplication | - | - | 252 |

**TABLE 1: Database-Specific Search Strategies as Executed**

Records retrieved are counts after de-duplication within each database and before de-duplication across databases; 77 duplicates were subsequently removed, leaving 175 unique records for screening

MeSH, Medical Subject Headings; CDSR, Cochrane Database of Systematic Reviews; CENTRAL, Cochrane Central Register of Controlled Trials; MEDLINE, Medical Literature Analysis and Retrieval System Online; NLM, National Library of Medicine

PubMed and Embase were searched on 31 August 2026 and the Cochrane Library on 1 September 2026. The final search date for this review is therefore 1 September 2026, and all counts reported in Figure *1* reflect this search. In addition to the electronic database searches, the reference lists of all included studies and of relevant narrative and systematic reviews identified during screening were manually screened by both reviewers for further eligible reports; no additional studies were identified by this process.

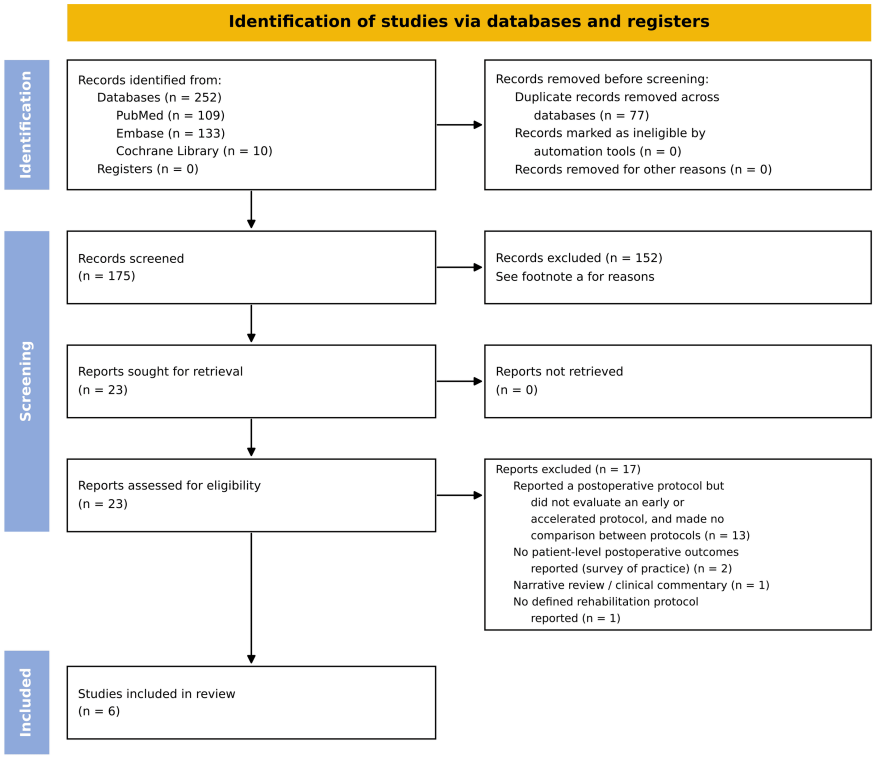



**FIGURE 1: PRISMA Flow Diagram Outlining Study Selection**

Counts derive from the search (final search date: 1 September 2026). Reasons for exclusion at title and abstract screening are itemized in footnote "a" of the figure; reasons for exclusion at full-text review are given in the figure itself

MPFLR, medial patellofemoral ligament reconstruction; TTO, tibial tubercle osteotomy

Trial-registry records describing ongoing or unpublished studies were not eligible for inclusion. Such records were excluded at the search stage in Embase and at screening for records retrieved through the Cochrane Central Register of Controlled Trials. No other gray-literature sources, conference proceedings, or dissertations were searched, and this is acknowledged as a limitation.

*Definition of Early or Accelerated Rehabilitation*

Because the term "accelerated" is used inconsistently in the rehabilitation literature and no validated threshold exists, an operational definition was set before the screening. A protocol was classified as early or accelerated if it advanced at least one of the following four domains relative to the study's own comparator group or, in single-arm studies, relative to the conventional protocol described by the study authors: (1) weightbearing, immediate or early (within two weeks of surgery) weightbearing as tolerated; (2) range of motion, the initiation of active or active-assisted knee flexion within two weeks of surgery or the attainment of at least 90 degrees of flexion by four weeks; (3) immobilization, the omission of a postoperative brace or immobilizer or its discontinuation before six weeks; and (4) strengthening and activity, such as the initiation of a structured quadriceps and lower-limb strengthening program within two weeks of surgery or clearance for sports earlier than the timeline specified for the comparator or for the conventional protocol described by the study authors. Return-to-sport guidance after MPFL surgery is predominantly time-based and has not been uniformly defined, so no single published threshold was available to serve as a fixed reference point [7,8]. At least one domain had to be met for a study to be included.

*Selection Criteria*

The initial screening of titles and abstracts was performed by two independent reviewers, who are the two lead authors of this manuscript. Both reviewers then assessed the full text of every record advanced to eligibility assessment. Disagreements at both the title-and-abstract and full-text stages were resolved by direct discussion between the two reviewers until consensus was reached. Consensus was achieved for all disputed records, so a third reviewer was not necessary. Studies examining accelerated weightbearing and/or activity levels in patients who underwent patellar realignment surgery were considered. Studies were included if they involved the following patellar realignment surgeries: MPFLR, tibial tubercle osteotomy (TTO), or both MPFLR and TTO. In addition, studies were required to report on postoperative rehabilitation protocols including weightbearing, range of motion (ROM), and activity levels in order to be included. Articles were excluded if they met any of the following criteria: (1) the study population did not undergo MPFLR and/or TTO performed for patellar instability or patellar realignment; (2) publication before 1 January 2010 or after 1 September 2026; (3) conference abstracts or meeting presentations without an accompanying full manuscript; (4) not available in English; (5) being narrative reviews, systematic reviews, meta-analyses, editorials, consensus statements, expert-opinion pieces, or surgical technique notes; (6) cadaveric, animal, in vitro, biomechanical, economic, or computational modelling studies without postoperative clinical outcomes; (7) trial-registry records or study protocols without reported results; (8) no defined postoperative rehabilitation protocol described or assessed; (9) no postoperative clinical, functional, or complication outcomes reported; or (10) the study described a postoperative rehabilitation protocol but neither evaluated an early or accelerated protocol as defined above nor compared two protocols.

*Data Extraction and Analysis*

The main findings of each article were recorded and synthesized for the review. The reviewers documented the following: the number of patients, types of surgical interventions, groups of comparison, rehabilitation protocol details, and primary outcomes. Study design, the presence or absence of a comparator group, the duration of follow-up, rates of recurrent instability and complications, and time to return to activity or sport were also recorded where reported. Data were extracted independently by both reviewers into a shared standardized extraction sheet and were then cross-checked; any discrepancy was resolved by returning to the source article and reaching consensus. Findings were synthesized narratively. No meta-analysis or other quantitative pooling was performed, because the included studies were clinically and methodologically heterogeneous with respect to surgical procedure, comparator, rehabilitation protocol, outcome instruments, and the duration of follow-up; pooled estimates would therefore not have been interpretable. Given the nature of this scoping review, a risk of bias assessment was not conducted. Consistent with PRISMA-ScR and Joanna Briggs Institute guidance, the purpose of a scoping review is to map the extent, range, and nature of the available evidence rather than to grade its strength. Because this review nonetheless summarizes outcomes related to the safety and effectiveness of accelerated protocols, the absence of a formal quality assessment is explicitly acknowledged as a principal limitation of the present work (see Limitations), and all statements regarding safety and effectiveness are framed as descriptive observations as opposed to evidence of comparative efficacy. To allow readers to weigh the strength of the underlying evidence, the design of each included study and the presence or absence of a comparator group are reported in Table *2*.

| Study | Surgery type | Groups of comparison | Number of patients | Type of accelerated protocol | Main findings |
|---|---|---|---|---|---|
| Magnussen et al., 2022 [9] (retrospective cohort) | MPFLR | Yes: restricted versus accelerated rehabilitation | 123 | Lack of brace use and immediate weightbearing after surgery | The lack of a knee brace after MPFLR is not associated with adverse outcomes compared to traditional knee brace use |
| Zhang et al., 2024 [10] (prospective RCT) | MPFLR with TTO | Yes: conservative versus accelerated rehabilitation | 50 | Early initiation of weightbearing, ROM, and strengthening exercises | Earlier ROM, weightbearing, and activity levels in patients who underwent MPFLR are associated with better functional outcomes and fewer complications |
| Rahnel et al., 2024 [11] (prospective single-arm) | TTO with most patients also receiving MPFLR | No: all patients had an active rehabilitation program | 80 | Immediate WBAT; hip and quadriceps strengthening without knee immobilization | Early rehabilitation, weightbearing, and activity appear safe and effective in patients who underwent distal TTO with or without MPFLR. A lack of knee bracing after surgery is not associated with adverse outcomes |
| Xing et al., 2022 [12] (retrospective cohort) | MPFLR | Yes: active versus traditional exercise groups | 31 | Initiation of knee flexion five days after surgery and faster incremental knee ROM increases | The earlier initiation of brace removal, ROM, and knee exercises after MPFLR are associated with improved functional outcomes |
| Song et al., 2025 [13] (retrospective cohort) | MPFLR | Yes: all arthroscopic versus traditional MPFLR. Rehabilitation protocols were the same between groups | 140 | Traditional protocol for everyone but the all-arthroscopic MPFLR was associated with faster time to baseline activity and exercise compared to traditional MPFLR (Note: this study compares surgical technique, not two rehabilitation protocols; both groups followed the same protocol. It is therefore discussed separately from the studies that directly evaluate rehabilitation protocols; see Discussion) | All-arthroscopic MPFLR patients may be able to begin earlier postoperative pain management, functional rehabilitation, and return to activities compared to traditional MPFLR |
| Morgan et al., 2022 [14] (retrospective single-arm) | TTO with some patients receiving MPFLR | No: all patients had an accelerated rehabilitation protocol | 50 | Early initiation of ROM, strengthening exercise, and return to activity | An accelerated rehabilitation protocol is associated with satisfactory outcomes after TTO, with lower complication rates than traditional protocols |

**TABLE 2: Patient Characteristics and Summary of Each Study**

Study design and the presence or absence of a comparator group are stated for each study. Two studies [11,14] were single-arm and had no comparator group, and only one study [10] was randomized

ROM, range of motion; MPFLR, medial patellofemoral ligament reconstruction; TTO, tibial tubercle osteotomy; WBAT, weightbearing as tolerated; RCT, randomized controlled trial

## Results

The search identified 252 records (PubMed, n = 109; Embase, n = 133; Cochrane Library, n = 10). After the

removal of 77 duplicate records, 175 records underwent title and abstract screening, of which 152 were excluded for the following reasons: the study population did not undergo MPFLR and/or TTO for patellar instability or realignment (n = 58); being narrative review, systematic review, meta-analysis, consensus statement, editorial, or surgical technique note (n = 27); published before January 2010 (n = 21); MPFLR and/or TTO study with no early or accelerated component to the protocol and no comparison between protocols (n = 16); cadaveric, animal, in vitro, biomechanical, economic, or modelling study without clinical outcomes (n = 11); not available in English (n = 9); conference abstract without an accompanying full manuscript (n = 6); and trial-registry record or study protocol without reported results (n = 4). All 23 records advanced to eligibility assessment were retrieved and reviewed in full text. Seventeen reports were excluded at this stage: 13 reported a postoperative rehabilitation protocol but did not evaluate an early or accelerated protocol as defined above and made no comparison between protocols; two reported no patient-level postoperative outcomes, being surveys of surgeon practice or institutional guidelines; one was identified at full text as a narrative review; and one reported no defined postoperative rehabilitation protocol. The manual reference list screening of the included studies and of relevant reviews did not identify additional eligible reports. A total of six articles encompassing 474 patients met selection criteria (Figure *1*). The included studies comprised one prospective randomized controlled trial, three comparative cohort studies with a control or alternative-treatment group, and two single-arm cohort studies without a comparator group [9-14]. Table *2* demonstrates a summary of each study, including the number of participants, surgical procedure performed, groups of comparison, and main outcomes. Table *3* highlights the specific accelerated rehabilitation protocol assessed by each study.

| Study | ROM | Weightbearing | Strengthening exercise |
|---|---|---|---|
| Magnussen et al., 2022 [9] | No limitation: no brace use | Immediate WBAT after surgery | No difference between groups: not specified |
| Zhang et al., 2024 [10] | Weeks 0-2, 0°-45°; weeks 2-4, 45°-90°; weeks 4-6, 90°-120°; week 6 to six months, 120° to full | Weeks 1-3, partial weightbearing; week 3+, full weightbearing | One day to two weeks, quadriceps strengthening, ankle exercises, and neuromuscular electrical stimulation; weeks 2-4, knee-focused muscle training; weeks 4-6, wall climbing exercises and air cycling; week 6 to three months, half-squats, balance feedback, and neuromuscular electrical stimulation |
| Rahnel et al., 2024 [11] | No limitation: no brace use | Immediate WBAT after surgery (crutch use for those unable to WBAT) | Weeks 0-2, supine knee end-range extension, isometric supine knee extension, and seated active knee flexion; weeks 2-4, exercises from weeks 0 to 2 plus supine straight-leg raise, seated knee extension stretch, and seated active knee extension; weeks 4-6, exercises from weeks 0 to 4 plus seated active knee end ROM flexion and supine active knee flexion; weeks 6+, exercises from weeks 0 to 6 plus knee hyperextension and chair-assisted mini-squat exercises |
| Xing et al., 2022 [12] | Day 5 to two weeks, 0°-90°; weeks 2-4, 90°-120°; weeks 4+, 120° full (as tolerated) | No difference between groups: partial WBAT at two weeks and full WBAT at four weeks | No difference between groups: ankle pump, straight leg, half squat, and patella shifting exercises |
| Song et al., 2025 [13] | Week 0-4, 0°-90°; weeks 4-6, 90°-120°; weeks 6-8, 120° to full | Partial WBAT after four weeks and full WBAT at eight weeks | Not specified |
| Morgan et al., 2022 [14] | Weeks 0-2, 0°-30°; weeks 2-3, 0°-70°; weeks 4-5+, 70° to full (hinged-knee brace removed) | Weeks 0-2, no weightbearing; weeks 2-3, crutch-assisted weightbearing; weeks 3+, full WBAT | Weeks 0-2, straight-leg raises, quadriceps isometric contraction with electrical stimulation, and knee ROM exercises without a brace; weeks 3-10, quadriceps strengthening; gait training; stationary bike; closed-chain strengthening (four weeks); open-chain strengthening (eight weeks); balance and pool running; and advanced proprioception, endurance training, isometric exercise, and isokinetic exercise (weeks 8-9); weeks 11-16, return to light sports (running); weeks 16-22, noncontact sports |

**TABLE 3: Accelerated Rehabilitation Protocol Details by Study**

No two included studies used an identical rehabilitation protocol. Protocols differ in the timing of weightbearing progression, the rate of ROM advancement, the use and duration of bracing, and the timing of strengthening

ROM, range of motion; WBAT, weightbearing as tolerated

## Discussion

This scoping review suggests that early or accelerated rehabilitation following MPFL reconstruction, with or without TTO, may be feasible in appropriately selected patients and that within the six included studies, it was not associated with increased rates of recurrent instability, graft failure, or major complications. The findings show similarities in both subjective and objective outcomes between accelerated and traditional rehabilitation programs and are consistent across diverse clinical settings and surgical techniques, including all-arthroscopic MPFLR, which may inherently support faster functional recovery due to less soft-tissue disruption.

*Discussion of Findings by Study*

Magnussen et al. (2022) utilized an accelerated protocol after MPFLR, which involved no postoperative bracing or weightbearing restrictions. Patient-reported outcomes were similar between groups, and recurrent dislocations occurred only in the restrictive rehabilitation group [9].

Song et al. (2025) compared all-arthroscopic MPFLR with traditional MPFLR, both using the same accelerated rehabilitation protocol for weightbearing and ROM. The authors reveal that an all-arthroscopic MPFLR had improved early postoperative pain scores, as well as earlier return to baseline activity compared to traditional MPFLR. These findings suggest that patients undergoing an all-arthroscopic technique may be able to tolerate a more accelerated rehabilitation program than what is traditionally performed [13].

Xing et al. (2022) compared an accelerated protocol for MPFLR that allowed for faster increases in knee ROM with standard protocols. The study found increased quadriceps strength, functional scores, and subjective symptom scores by six months without increased instability or reoperation rates in the accelerated group [12].

Morgan et al. (2022) focused on adolescents undergoing MPFLR ± TTO and used a protocol that allowed earlier weightbearing, knee ROM, and the initiation of physical strengthening exercises [14]. The recurrence rate of patellar instability was low (2.6%), with over 90% of patients returning to sport. While about 10% of patients developed arthrofibrosis requiring intervention, the rate of knee ROM deficits after ligament reconstruction seems to range from 0% to 20% in the literature [14,15].

Rahnel et al. (2024) evaluated a rapid rehabilitation program that involved immediate weightbearing as tolerated, no postoperative brace, and an aggressive knee-strengthening program. No significant differences in patellar stability or complication rates were noted between groups, although patients in the rapid-rehab group did resume sporting activities, on average, about one-and-a-half months earlier [11].

Zhang et al. (2024) used a standardized early rehabilitation protocol post-MPFLR with structured timelines for weightbearing, ROM, and knee-strengthening exercises. Most patients reached full ROM by eight weeks and returned to sports by six months. Complications were minimal, and patient-reported satisfaction was high [10].

*Comparison Between Studies and Explanation of Findings*

In the case of three studies (Zhang et al., 2024 [10]; Xing et al., 2022 [12]; and Morgan et al., 2022 [14]), accelerated protocols may even be associated with superior recovery outcomes. Studies utilizing an accelerated rehabilitation program in patients status post anterior cruciate ligament reconstruction have also shown favorable results, including superior ROM, pain level, muscle strength, and function outcomes [16-18]. These observations may be, in part, due to the fact that the lack of knee extension and flexion is associated with decreases in mobility and may even lead to persistent knee arthrofibrosis [19]. Early exercise may help strengthen the knee, improve neuromuscular coordination, and reduce postoperative effusion, which can prevent arthrofibrosis and decrease pain level [7]. Additionally, early rehabilitation has been seen to counter the effects of early arthritis and can preserve the function of the quadriceps through prompt neuromuscular reeducation [18,20].

However, if an exercise program becomes too aggressive, this may negatively impact the healing of the tendon-bone contact area, as well as adjacent soft tissues [7,21]. Thus, an optimal balance is needed between early mobilization and the protection of healing soft tissue and bone structures. Some authors have suggested that around two to four weeks after surgery is optimal for the initiation of knee exercises and strengthening, although more recent studies are necessary to solidify this claim [22]. It must be emphasized that no consensus definition of "accelerated" weightbearing or rehabilitation currently exists, and the term is applied inconsistently across the literature. The operational definition used in this review was therefore deliberately domain-based rather than anchored to a single time point, and establishing a consensus, time-anchored definition of accelerated rehabilitation after patellar stabilization surgery is an important priority for future work.

Furthermore, studies such as those by Magnussen et al. (2022) [9] and Song et al. (2025) [13] dispel concerns that early weightbearing or the removal of bracing increases the risk of graft failure or recurrent instability [23]. The biomechanical rationale supports this approach, as modern MPFL grafts have failure loads well above the stresses encountered during early rehabilitation [24].

*Interpretation of Studies Comparing Surgical Technique*

The study by Song et al. (2025) differs from the other included studies in that its comparison is between two surgical techniques, all-arthroscopic and traditional MPFLR, rather than between two rehabilitation protocols; both groups followed the same postoperative protocol [13]. The study nonetheless met the prespecified eligibility criteria, because it reported a defined postoperative rehabilitation protocol covering weightbearing, ROM, and activity progression and because it reported the time at which patients were able to resume daily living and low-intensity exercise, which is one of the outcomes this review set out to map. It does not, however, contribute direct evidence on accelerated versus restrictive rehabilitation, and it should not be read as such. Its contribution is complementary: it indicates that the index surgical procedure itself influences how rapidly a patient can tolerate progression through a given protocol, with the all-arthroscopic group requiring less opioid analgesia, reporting lower pain scores during functional rehabilitation, and

resuming daily living and low-intensity exercise approximately half a week earlier than the traditional group. For these reasons, the study by Song et al. [13] is discussed separately from the studies that directly compare rehabilitation protocols [9-12,14] and does not contribute to the observations regarding accelerated versus traditional rehabilitation summarized above.

*Heterogeneity and Its Effect on Interpretability*

The evidence identified by this review is heterogeneous in three respects, each of which limits the strength of the inferences that can be drawn. First, the surgical procedures differ: Two studies examined isolated MPFLR [9,12], one examined MPFLR with TTO [10], two examined TTO with or without concomitant MPFLR [11,14], and one compared two MPFLR techniques [13]. Because a TTO creates a healing osteotomy that must resist bending and shear forces during weightbearing whereas an isolated soft-tissue reconstruction does not, the risk profile of immediate weightbearing is not the same across these procedures, and protocols cannot be assumed to be interchangeable between them. Second, the rehabilitation protocols themselves differ substantially, as shown in Table *3*: No two included studies used an identical protocol, and interventions labeled "accelerated" ranged from immediate, unrestricted weightbearing with no brace [9,11] to partial weightbearing beginning in week 1 with full weightbearing at week 3 [10], while the initiation of knee flexion ranged from postoperative day 5 [12] to week 4 [13]. Third, the study designs differ: Only one study was randomized [10], two had no comparator group at all [11,14], and follow-up duration ranged from approximately six to 24 months. Single-arm studies can show that an accelerated protocol was followed by acceptable outcomes, but they cannot establish that those outcomes were better than, or even equivalent to, what a restrictive protocol would have produced in comparable patients. Taken together, this heterogeneity means that the consistency observed across studies is better understood as a convergence of broadly similar signals than as a replication of a single, well-defined intervention. It precludes quantitative pooling, precludes any recommendation of a specific protocol, and is the principal reason the conclusions of this review are framed as descriptive rather than comparative.

*Limitations*

Limitations of this study include the small number of studies included. This highlights the need for additional research, particularly randomized clinical trials, that can assess early ROM, weightbearing, and strengthening exercise protocols in patients undergoing MPFLR. Furthermore, some of these studies (Rahnel et al., 2024 [11]; Morgan et al., 2022 [14]) do not compare their accelerated protocol with a control group. Finally, there is substantial heterogeneity between studies, with some focusing on MPFLRs and others involving both MPFLRs and TTOs. Future studies should stratify results between the different types of patellar instability surgeries to have more specific conclusions.

Several additional limitations warrant emphasis. Only six studies, comprising 474 patients in total, met eligibility criteria, and only one of these was a randomized controlled trial [10]; the remainder were retrospective or single-arm cohort studies, which are susceptible to selection bias, confounding by indication, and incomplete follow-up. Heterogeneity in both the surgical procedures performed and the rehabilitation protocols used, detailed above, further limits interpretation. Outcome instruments were not standardized across studies, and follow-up duration varied from approximately six to 24 months, so the durability of any early functional advantage cannot be assessed, and long-term equivalence cannot be established. One included study compared surgical techniques rather than rehabilitation protocols and therefore contributes only indirect evidence [13]. Consistent with scoping review methodology, no formal risk-of-bias or methodological quality assessment was performed; because this review nonetheless summarizes safety- and effectiveness-related outcomes, readers should treat the findings as a map of the available evidence rather than as an appraisal of its strength, and the absence of quality appraisal is a principal limitation of this work. Finally, the review protocol was not prospectively registered, the search was restricted to three databases with eligibility to English-language full-text publications, and trial-registry records describing ongoing or unpublished studies were not eligible, such that relevant unpublished or non-English data may have been missed. For all these reasons, the present findings are descriptive and hypothesis-generating and should not be interpreted as demonstrating the comparative safety or efficacy of accelerated rehabilitation.

*Strengths*

The review has several methodological strengths. The search was re-executed in full and is reported as executed: the strategy entered in each database, the limits applied, the date each was last searched, the records retrieved from each, and the automatic term-mapping translation that determined the retrieved set. A reader can therefore reconstruct the record set rather than approximate it. Because no consensus definition of accelerated rehabilitation exists, an operational definition was set before screening across four domains with explicit time thresholds and applied unchanged throughout, which makes the basis for each inclusion decision auditable and offers a candidate definition for later work. Screening and data extraction were independent and in duplicate, with disagreements resolved by consensus and all eligibility criteria agreed in writing before screening began. Table *3* reports the weightbearing, range of motion, and strengthening schedule of each included study week by week rather than describing protocols by label alone,

which is the level of detail needed to apply or compare a protocol in practice. The included studies also span both isolated soft-tissue reconstruction and tibial tubercle osteotomy, so the map covers the procedures actually used for patellar instability rather than a single one.

## Conclusions

Within the small and heterogeneous body of evidence identified by this review, early rehabilitation protocols were associated with earlier return to activity and, in several studies, with better short-term functional outcomes, without an observed increase in recurrent instability or major complications. The available data are not sufficient to establish long-term equivalence between accelerated and traditional protocols. These findings provide preliminary support for individualized, less restrictive rehabilitation strategies after patellar instability surgery, but they should be regarded as hypothesis-generating rather than as definitive clinical guidance. Future studies should focus on large, randomized controlled trials with procedure-specific stratification for a more definitive outcomes analysis and standardization of accelerated rehabilitation protocols.

## Additional Information

### Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

**Concept and design:** Artin T. Allahverdian, Kristen Combs

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