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SYSTEMATIC REVIEWS

# Combined medial patellofemoral ligament and medial patellotibial ligament reconstruction in recurrent patellar instability: A systematic review and meta-analysis

Ahmad Abbaszadeh, Mohsen Saeedi, Amir Human Hoveidaei, Haleh Dadgostar, Saeed Razi, Mohammad Razi

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**Ahmad Abbaszadeh, Mohsen Saeedi,** Department of Orthopedic, Emam Khomeini Teaching Hospital, Ahvaz Jundishapur University of Medical Sciences, Ahvaz 6135715794, Iran

**Amir Human Hoveidaei,** Sports Medicine Research Center, Tehran University of Medical Sciences, Tehran 14395-578, Iran

**Haleh Dadgostar,** Department of Sports and Exercise Medicine, School of Medicine, Rasool Akram Medical Complex, Iran University of Medical Sciences, Tehran 1445613131, Iran

**Saeed Razi,** Bone and Joint Reconstruction Research Center, Department of Orthopedics, School of Medicine, Iran University of Medical Sciences, Tehran 1545913487, Iran

**Mohammad Razi,** Department of Orthopedic Surgery, Rasoul Akram Hospital, Iran University of Medical Sciences, Tehran 1445613131, Iran

**Corresponding author:** Mohammad Razi, MD, President, Professor, Surgeon, Department of Orthopedic Surgery, Rasoul Akram Hospital, Iran University of Medical Sciences, Department of Orthopedic Surgery, Rasoul Akram Hospital, Iran University of Medical Sciences, Shahid Hemmat Highway, Tehran 1445613131, Iran. mrazi@razimd.info

## Abstract

***BACKGROUND***

The medial patellofemoral ligament (MPFL), along with the medial patellotibial ligament (MPTL) and medial patellomeniscal ligament, aid in the stabilization of the patellofemoral joint. Although the MPFL is the primary stabilizer and the MPTL is a secondary limiter, this ligament is critical in maintaining joint stability. There have been few studies on the combined MPFL and MPTL reconstruction and its benefits.

***AIM***

To look into the outcomes of combined MPFL and MPTL reconstruction in frequent patellar instability.

***METHODS***

By May 8, 2022, four electronic databases were searched: Medline (PubMed), Scopus, Web of Science, and Google Scholar. General keywords such as "patellar instability," "patellar dislocation," "MPFL," "medial patellofemoral ligament,"

"MPTL," and "medial patellotibial ligament" were co-searched to increase the sensitivity of the search.

*RESULTS*

The pooled effects of combined MPFL and MPTL reconstruction for Kujala score (12-mo follow-up) and Kujala score (24-mo follow-up) were positive and incremental, according to the findings of this meta-analysis. The mean difference between the Cincinnati scores was also positive, but not statistically significant. The combination of the two surgeries reduces pain. According to cumulative meta-analysis, the trend of pain reduction in various studies is declining over time.

*CONCLUSION*

The combined MPFL and MPTL reconstruction has good clinical results in knee function and, in addition to providing good control to maintain patellofemoral joint balance, the patient's pain level decreases over time, making it a valid surgical method for patella stabilization.

**Key Words:** Medial patellofemoral ligament reconstruction; Medial patellotibial ligament; patella dislocation; Patella instability



**Core Tip:** In patellar instability, combined medial patellofemoral ligament and medial patellotibial ligament reconstruction is associated with good clinical outcomes and can be considered a standard treatment in patellar instability treatment guidelines.

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## INTRODUCTION

The patella is a vital component of the knee joint that includes the extensor mechanism. The main stabilizing ligamentous structure, the medial patellofemoral ligament (MPFL), allows the patella to stabilize in conjunction with the medial patellotibial ligament (MPTL) and medial patellomeniscal ligament (MPML). During knee movements, the MPFL is important in maintaining the patella's stability and position and is thought to be the primary internal stabilizing ligament[1,2]. Although the MPFL ligament is the primary stabilizer, the MPTL and MPML ligaments also play an important role in maintaining joint stability, particularly in the final stages of stretching from 26 degrees in extension and 46 to 90 degrees in flexion[3].

Recurrent patella dislocation is associated with patella alta, a large Q angle, a hypoplastic lateral femoral condyle, and congenital ligament laxity[2,4,5]. According to a review of the literature, most patients with non-surgical treatments experience frequent instability in the injured knee and reduced activity level[6]. A large number of surgical methods for treating patellofemoral instability have been described in various studies, but the best method is still controversial[7,8].

MPFL reconstruction is widely recognized as an important component of the current treatment for recurrent patellar instability. This method can be used alone or in conjunction with bone methods such as tibial tuberosity distalization or trochleoplasty in the case of patella alta or high-grade trochlear dysplasia[9]. Another surgical method is a combined MPFL and MPTL reconstruction, which has yielded positive results in clinical trials. In a cohort study conducted by Hetsroni, the effect of combined surgery (MPFL and MPTL) was investigated during 73 mo on the patients. Their findings showed that combined surgery in young patients improved knee function better than MPFL surgery alone and maintained patella-femoral balance with more degrees of flexion, even though they did not return to pre-injury levels of activity[10,11]. Hence, according to role of MPTL reconstruction in combination of MPFL reconstruction in treatment of patella instability and the fact that many studies have not been done in this field, the present study was performed with the purpose of studying the combined MPFL and MPTL reconstruction in recurrent patellar instability.

## MATERIALS AND METHODS

### Search strategy

To find relevant studies, a comprehensive literature search for English-language observational studies was performed in Medline (PubMed), Scopus, Web of Science and Google Scholar. In order to maximize the sensitivity of the search, general keywords such as "patellar instability", “patellar dislocation”, “MPFL”, “medial patellofemoral ligament”, “MPTL”, and “medial patellotibial ligament” were co-searched (Supplementary material). The results of searches were refined through checking for and removing duplicate papers.

### Study selection

In keeping with standard meta-analysis techniques and PRISMA guidelines[12], we included studies published to May 8, 2022. Studies were independently selected for inclusion and only the original papers were included in the review. Two investigators independently applied the inclusion and exclusion criteria, which had questions about the main methodological aspects of descriptive studies, such as the sampling method, measurement of variables, objectives, and statistical analysis.

To be included in this study, inclusion criteria were: (1) Studies that used both MPFL and MPTL methods simultaneously for recurrent patellar instability; and (2) Primary studies. And Exclusion criteria were: (1) Not primary studies as well as those with only poster presentation; (2) Duplicated publication (we included just one); and (3) Studies that used only one of two methods, MPFL or MPTL for recurrent patellar instability. Figure 1 shows the PRISMA flow diagram.

### Screening and data extraction

All publications were reviewed independently by two researchers (Mohsen Saeedi and Ahmad Abbaszadeh). In case of discrepancies between investigators regarding inclusion criteria, it was resolved by the third author (Haleh Dadgostar). After the final evaluation, the selected publications were briefed by the name of first author, date of publication, country, sample size, study design, age average, Extension, Flexion, International knee Documentation Committee score, visual analogue scale (VAS), Patellar tilt, Patellar shift, Insall–Salvati ratio, Modified Insall–Salvati ratio, Caton–Deschamps Index, Tibial tuberosity-trochlear groove (TT–TG) distance, Kujala score, Cincinnati, Lysholm, range of motion (ROM) in degrees and Congruence angle. All the extracted data were then entered into Excel software.

### Quality assessment of studies

In this study, due to the small number of studies in this field, publication bias was not investigated.

### Statistical analysis

The "metan" command was used to apply a fixed or random effects model based on the results of Cochran's $Q$ test or a large Higgins and Thompson's $I^2$ value. Standardized mean difference (SMD) estimated by Hedges' g based on sample size, mean, and standard deviation before and after intervention. Forest plots were used to describe the results graphically. In addition, the "metacum" command was used for cumulative meta-analysis to determine the trend of the Kujala score. Stata software (version 14) was used for all statistical analyses.

## RESULTS

Five studies with a sample size of 148 knees after surgery were included in the systematic review and meta-analysis after reviewing and evaluating collected papers. These papers were published between 2013 and 2020. The highest average age was in the Maffulli study, which was 26.5 + 10.7 years. These studies were conducted in five countries. Only one study used Extension, Flexion, Caton-Deschamps Index, Tegner score, Patellar Shift, and Modified Insall-Salvati Ratio to assess the effect of combined medial patellofemoral and patellotibial ligament reconstruction. TT–TG distance and congruence angle were reported in two studies, but in one study, the value before surgery was the only one available. ROM and Lysholm were also reported in two studies, but the follow-up period was 12 mo in one study and 24 mo in another study. In two studies, the Insall–Salvati ratio was reported, but in one of them, the standard deviation was not reported. By the way, the average of VAS, patellar tilt angle, and Cincinnati were reported in two studies with a follow-up period of 24 mo. The Kujala score was also reported with a follow-up period of 12 mo in two studies and a follow-up period of 24 mo in four studies. More details about the studies are given in Tables 1-4.

### The effects of combined medial patellofemoral and patellotibial ligament reconstruction on different outcomes

According to these studies, the pooled effects of combined medial patellofemoral and patellotibial ligament reconstruction changes for Kujala score (12 mo and 24 mo follow-up) were positive and

**Table 1 Description of eligible studies evaluating combined medial patellofemoral and patellotibial ligament reconstruction in recurrent patellar dislocation regarding international knee documentation committee score, Extension and flexion degrees, and visual analogue scale**

| ID | Ref. | Year[1] | Type of study | Country | N | Mean age | Male/female | IKDC score | | | Extension, degree | | | Flexion, degree | | | VAS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Preop[2] | 12 mo[3] | 24 mo[4] | Preop | 12 mo[3] | 24 mo[4] | Preop | 12 mo[3] | 24 mo[4] | Preop | 12 mo[3] | 24 mo[4] |
| 1 | Maffulli *et al*[24] | 2020 | Prospective cohort | Italy | 34 | 26.5 ± 10.7 | 27:7 | | | | | | | | | | | | |
| 2 | Yang *et al*[15] | 2019 | Prospective | China | 58 | 22.6 ± 4.9 | 25:23 | 51.9 ± 13.8 | 80 ± 19.2 | 85 ± 13.9 | 2 ± 3 | 2 ± 4 | 3 ± 4 | 143 ± 7 | 141 ± 8 | 142 ± 7 | 58 ± 11 | 12 ± 5 | 11 ± 4 |
| 3 | Hetsroni *et al*[10] | 2019 | - | Israel | 20 | 18 ± 2 | 6:14 | | | 75.7 ± 18.1 | | | | | | | | | |
| 4 | Sadigursky *et al* [19] | 2017 | Case series | Brazil | 7 | 11.28 ± 1.49 | 4:3 | | | | | | | | | | | | |
| 5 | Sobhy *et al*[22] | 2013 | Prospective | Egypt | 29 | 20.1 ± 3 | 21:8 | | | | | | | | | | 63 ± 13 | | 18 ± 9.7 |

[1]Year of publication.
[2]Preoperative.
[3]12-mo follow-up.
[4]24 & > 24 -mo follow-up.
IKDC: International knee documentation committee; VAS: Visual analogue scale.

incremental (SMD = 3.64; 95%CI: -0.38 to 7.65 and SMD = 3.53; 95%CI: 2.03 to 3.03, respectively), but they were significant only for the 24 mo follow-up. The mean difference for Cincinnati was also positive but not statistically significant (SMD = 7.74; 95%CI: -2.95 to 18.44 and SMD = 3.75; 95%CI: 0-7.5, respectively). SMD for VAS was -4.76 mm and significant 95%CI: -6.5 to -30.03, which means that the combined effect of the two treatments can reduce the amount of pain (Figure 2). Also, according to the cumulative meta-analysis, the rate of pain reduction in different studies is decreasing over time (a decrease in the SMD value from 8.17 to 2.04).

## DISCUSSION

Patellar instability is one of the most common causes of knee injury and anterior knee pain, and it is associated with frequent dislocation, which prevents most patients from returning to sports and physical activities[13,14]. The main finding of this systematic review was that the combined surgical method of MPFL and MPTL reconstruction has good clinical outcomes in terms of knee function, and that patients' pain levels decrease over time, in addition to good control of patellofemoral balance. Although MPFL surgery alone was popular in the past, studies have shown that this treatment method was ineffective in some patellar conditions such as patella alta, and reconstruction of this ligament with the MPFL method alone increased the level of knee function but was ineffective when compared to the

**Table 2 Description of eligible studies evaluating combined medial patellofemoral and patellotibial ligament reconstruction in recurrent patellar dislocation regarding Caton–Deschamps Index, Tibial tuberosity-trochlear groove distance, Kujala score, and Cincinnati**

| ID | Ref. | Year[1] | Type of study | Country | N | Mean age | Male/female | Caton–deschamps index | | | TT–TG distance, mm | | | Kujala score | | | Cincinnati | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Preop[2] | 12 mo[3] | 24 mo[4] | Preop | 12 mo[3] | 24 mo[4] | Preop | 12 mo[3] | 24 mo[4] | Preop | 12 mo[3] | 24 mo[4] |
| 1 | Maffulli *et al*[24] | 2020 | Prospective cohort | Italy | 34 | 26.5 ± 10.7 | 21:8 | | | | | | | 47 ± 17 | | 82 ± 17[5] | 51 ± 22 | | 90 ± 19 |
| 2 | Yang *et al*[15] | 2019 | Prospective | China | 58 | 22.6 ± 4.9 | 21:8 | 1.41 ± 0.21 | 1.32 ± 0.17 | 1.31 ± 0.17 | 21.5 ± 0.6 | 20.2 ± 1.5 | 19.9 ± 1.7 | 55.1 ± 15.2 | 82.6 ± 14.9 | 89.5 ± 10.2 | | | |
| 3 | Hetsroni *et al*[10] | 2019 | - | Israel | 20 | 18 ± 2 | 21:8 | | | | | | | 54.9 ± 15.2 | | 86.4 ± 12.5[6] | | | |
| 4 | Sadigursky *et al* [19] | 2017 | Case series | Brazil | 7 | 11.28 ± 1.49 | 21:8 | | | | | | | 42.57 ± 8.9 | 88.57 ± 5.09 | | | | |
| 5 | Sobhy *et al*[22] | 2013 | Prospective | Egypt | 29 | 20.1 ± 3 | 21:8 | | | | | | | 36.6 ± 6 | | 90.6 ± 7 | 50 ± 7.1 | | 88 ± 6 |

[1]Year of publication.
[2]Preoperative.
[3]12-mo follow-up.
[4]24 & > 24-mo follow-up.
[5]Postoperative (the mean follow-up was 43 ± 17).
[6]Postoperative (the mean follow-up was 43 ± 17).

combined method[15]. According to the findings of a study conducted by Ambra *et al*[16], the MPFL method alone was ineffective in treating patellar instability.

The combined reconstruction (MPFL, MPTL) is typically used in patients who have at least two lateral patella dislocations, a delta patella, an increased TT-TG distance greater than 20 mm, an Insall-salvative-index greater than 1.2, multiple ligament damage, and an unstable joint[17]. The studies revealed that, while the MPFL ligament acts as the primary internal stabilizer of the patella, the MPTL is also required as a secondary lateral stabilizer to maintain patella stability and improve knee function, emphasizing the practical importance of combined surgery (MPFL, MPTL)[18].

In the current study, the Kujala score improved significantly after 12 and 24 mo of follow-up. After combined MPFL and MPTL reconstruction, the patients' performance level improved and their knee pain decreased.

According to the studies reviewed, the SMD for VAS was -4.76 mm, which was statistically significant. It demonstrates that combining MPFL and MPTL reconstruction can reduce pain. Furthermore, according to a meta-analysis, the rate of pain reduction in various studies is decreasing over time. (SMD decreased from 8.17 to 2.04). This study found that combining MPFL and MPTL reconstruction can reduce knee pain over time while also increasing knee stability and function. Perhaps it is due to the method's anatomical and biomechanical similarities with the normal knee. Then, it may

**Table 3 Description of eligible studies evaluating combined medial patellofemoral and patellotibial ligament reconstruction in recurrent patellar dislocation regarding Lysholm, range of motion, congruence angle, tegner score**

| ID | Ref. | Year[1] | Type of study | Country | N | Mean age | Male/female | Lysholm | | | ROM, degree | | | Congruence angle | | | Tegner score | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Preop[2] | 12 mo[3] | 24 mo[4] | Preop | 12 mo[3] | 24 mo[4] | Preop | 12 mo[3] | 24 mo[4] | Preop | 12 mo[3] | 24 mo[4] |
| 1 | Maffulli *et al*[24] | 2020 | prospective cohort | Italy | 34 | 26.5 ± 10.7 | 21:8 | | | | | | | | | | | | |
| 2 | Yang *et al*[15] | 2019 | prospective | China | 58 | 22.6 ± 4.9 | 21:8 | | | | | | | | | | | | |
| 3 | Hetsroni *et al*[10] | 2019 | - | Israel | 20 | 18 ± 2 | 21:8 | | | | | | | | | | 4 ± 3 | | 4.8 ± 2.4[5] |
| 4 | Sadigursky *et al* [19] | 2017 | case series | Brazil | 7 | 11.28 ± 1.49 | 21:8 | 33.71 ± 9.6 | 87.71 ± 5.70 | | 117.85 ± 8.09 | 148.57 ± 3.77 | | | | | | | |
| 5 | Sobhy *et al*[22] | 2013 | prospective | Egypt | 29 | 20.1 ± 3 | 21:8 | 51.9 ± 4.7 | | 89.5 ± 5.6 | 112.1 ± 7.1 | | 136.7 ± 8.5 | 11.93±1.85 | | -6.48 ± 3.8 | | | |

[1]Year of publication.
[2]Preoperative.
[3]12-mo follow-up.
[4]24 & > 24-mo follow-up.
[5]Postoperative (the mean follow-up was 43 ± 17).
ROM: Range of motion.

be an effective method of treating recurrent Patella instability.

Yang *et al*[15] discovered that normalizing the size and height of the patella, as well as decreasing its slope, can lead to increased tendon stability and pain reduction over time. Moreover, studies show that combining MPFL and MPTL reconstruction reduces the need for procedures like Tibial Tuberosity Osteotomy (TTO) and surgical complications in comparison to MPFL Reconstruction on its own[14]. Another study found that combined reconstruction can stabilize the patella even in the presence of other factors when treating patellar instability in children with TT-TG>15 mm. In other words, the children's performance and range of motion improved, as measured by the Kujala and Lysholm scores[19].

Furthermore, patellar tilt angle was measured in two studies over a period of 24 mo. This angle decreased after surgery, but it was not statistically significant, which could be attributed to the small sample size in the studies examined. Over the last few years, there has been an increase in interest in the combined reconstruction of MPFI and MPTL in the management of recurrent patella instability. It could be because new histological, anatomical, and biomechanical studies have revealed that the MPTL is a true ligament that is important for patellofemoral stability[4,20].

In patients with moderate dysplasia, combined reconstruction of MPFL and MPTL may reduce the need for both bony procedures such as TTO and trochleoplasty[21]. Furthermore, it may improve outcomes when compared to MPFL reconstruction alone[1,20,22,23].

**Table 4 Description of eligible studies evaluating combined medial patellofemoral and patellotibial ligament reconstruction in recurrent patellar dislocation regarding patellar tilt angle, patellar shift, insall–salvati ratio, and modified insall–salvati ratio**

| ID | Ref. | Year[1] | Type of study | Country | N | Mean age | Male/female | Patellar tilt angle | | | Patellar shift, mm | | | Insall–Salvati ratio | | | Modified Insall–Salvati ratio | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Preop[2] | 12 mo[3] | 24 mo[4] | Preop | 12 mo[3] | 24 mo[4] | Preop | 12 mo[3] | 24 mo[4] | Preop | 12 mo[3] | 24 mo[4] |
| 1 | Maffulli *et al*[24] | 2020 | Prospective cohort | Italy | 34 | 26.5 ± 10.7 | 21:8 | | | | | | | 1.1 | | 1.1 | | | |
| 2 | Yang *et al*[15] | 2019 | Prospective | China | 58 | 22.6 ± 4.9 | 21:8 | 19.1 ± 7.2 | 11.5 ± 5.6 | 11.3 ± 5.2 | 6.2 ± 2.1 | 1.2 ± 0.6 | 1.1 ± 0.7 | 1.49 ± 0.22 | 1.39 ± 0.23 | 1.37 ± 0.19 | 2.25 ± 0.18 | 1.95 ± 0.22 | 1.95 ± 0.25 |
| 3 | Hetsroni *et al*[10] | 2019 | - | Israel | 20 | 18 ± 2 | 21:8 | | | | | | | | | | | | |
| 4 | Sadigursky *et al* [19] | 2017 | Case series | Brazil | 7 | 11.28 ± 1.49 | 21:8 | | | | | | | | | | | | |
| 5 | Sobhy *et al*[22] | 2013 | Prospective | Egypt | 29 | 20.1 ± 3 | 21:8 | 10.9 ± 1.7 | | 2.45 ± 2.2 | | | | | | | | | |

[1]Year of publication.
[2]Preoperative.
[3]12-mo follow-up.
[4]24 & > 24-mo follow-up.

Therefore, combined MPFI and MPTI reconstruction is a safe method for management of recurrent Patella Dislocation and in the future, it may become a part of the algorithms used for the treatment of recurrent Patella instability. However, based on some previous studies, the conclusion stating that the combined procedure would be beneficial has to be made with caution.

The study's limitations included a small number of studies and a lack of randomized controlled trials. There are no randomized controlled trials that compare this method to other surgical treatments, and no article included a control group. The current study's strength is the use of precise inclusion and exclusion criteria, as well as the use of meta-analysis, which made our study more reliable.

## CONCLUSION

The current meta-analysis review study found that combining MPTL and MPFL is a safe method with favorable clinical results in patellar dislocation and instability, with fewer complications and the possibility of patellar recurrence or subluxation. There is a need for clinical trial studies with a control group and long-term follow-ups to know the desired results of the surgery, as well as comparing this method with the MPFL method alone, due to a lack of studies and samples in the research conducted in this field.

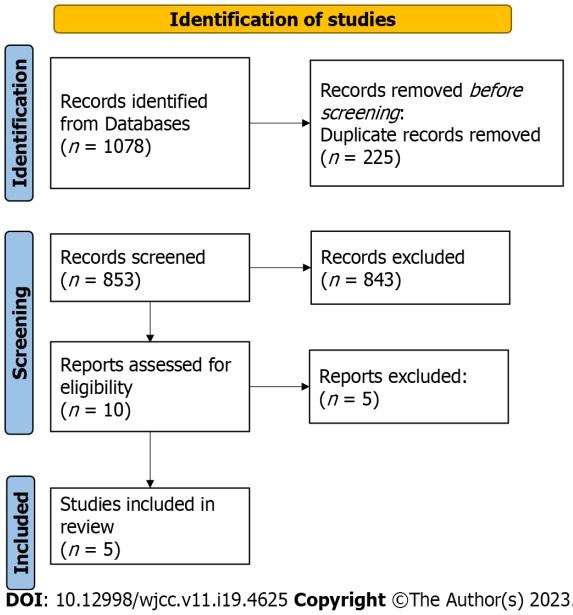


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**Figure 1 Flow diagram.** Flow diagram of the study selection process and including publications for the Combined medial patellofemoral ligament and medial patellotibial ligament reconstruction in recurrent patellar instability.

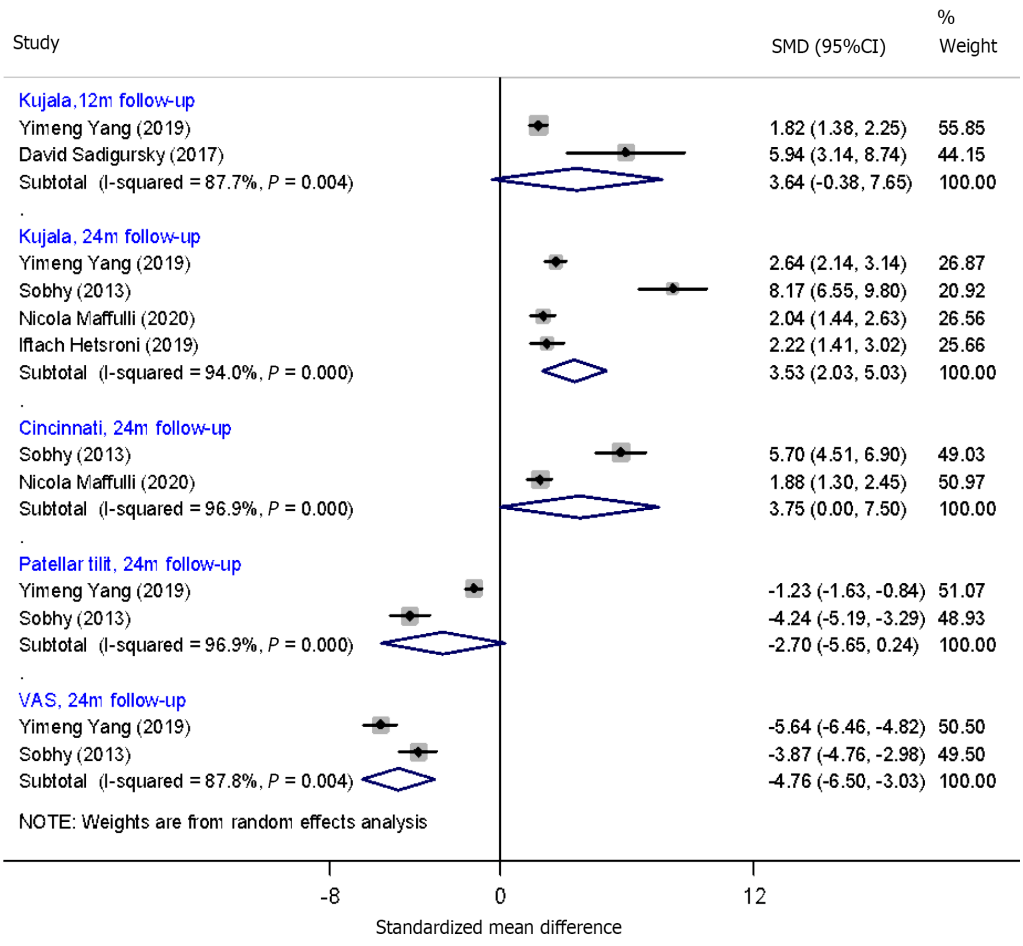


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**Figure 2 The pooled effects of combined medial patellofemoral and patellotibial ligament reconstruction.** SMD: Standardized mean difference.

## ARTICLE HIGHLIGHTS

### *Research background*

The patellofemoral joint stability is aided by the medial patellofemoral ligament (MPFL), along with the medial patellotibial ligament (MPTL) and medial patellomeniscal ligament (MPML). While the MPFL is the primary stabilizer, the MPTL plays a critical role as a secondary limiter. However, there are limited studies on the combined reconstruction of MPFL and MPTL and its advantages.

### *Research motivation*

Different studies on the results of patellar instability management are published with no certain consensus. So, it was necessary to do an analysis to clarify the role of combined reconstruction of MPFL and MPTL in patellar instability management.

### *Research objectives*

To find out the efficacy of combined reconstruction of MPFL and MPTL.

### *Research methods*

Several databases were searched to obtain eligible randomized controlled trials. Outcomes were mechanical ventilation time, length of intensive care unit stay, and duration of postoperative hospitalization.

### *Research results*

Combined MPFL and MPTL reconstruction led to positive outcomes in Kujala scores at 12 and 24-mo follow-ups. The surgeries reduced pain, but the trend of pain reduction decreased over time according to cumulative meta-analysis.

### *Research conclusions*

Combined MPFL and MPTL reconstruction is a safe method with favorable clinical results in patellar dislocation and instability.

### *Research perspectives*

Our conclusion needs further confirmation through the conduct of additional high-quality studies.

## FOOTNOTES

**Author contributions:** Razi M, Hoveidaei AH, and Dadgostar H contributed to conception and design of the study and made critical revisions related to important intellectual content of the manuscript; Abbaszadeh A, Saeedi M, and Razi S drafted the article and performed acquisition of data and analysis and interpretation of data; all authors approved of the final version of the article to be published.

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**Country/Territory of origin:** Iran

**ORCID number:** Amir Human Hoveidaei 0000-0003-4607-354X; Mohammad Razi 0000-0003-0273-5599.

**Corresponding Author's Membership in Professional Societies:** Iranian Orthopedic Association, President; Iranian Society of Knee Surgery, Arthroscopy, and Sports Traumatology, Past President; Asian Federation of Sports Medicine, Past President.

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