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Operative Techniques in

Sports Medicine

Medial Patellofemoral Ligament Repair

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Medial patellofemoral ligament repair (MPFL) represents an alternative method of medial soft tissue management in patients with lateral patellar instability. MPFL repair is best indicated in patients with isolated patellar- or femoral-based avulsions, which can be identified on preoperative MRI. MPFL repair technique utilizes small incisions over the site of injury, where sutures anchors are used to repair the residual stump to its anatomic insertion site. Medial reefing, otherwise known as imbrication, is a technique to tighten the medial soft tissues, and is most commonly used as an adjunct to other realignment procedures when mild residual instability remains. Overall, we recommend a systematic and multifactorial approach to patellar instability, with decisions regarding medial soft tissue management based on the MPFL injury pattern on MRI.

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Introduction

The medial patellofemoral ligament (MPFL) is the primary soft-tissue restraint to lateral patellar translation.[1,2] In an acute lateral dislocation of the patella, the MPFL is injured in approximately 100% of cases.[3] It is important to consider that while the MPFL is commonly injured, there are myriad pathologic conditions that contribute to patellar instability and that must be considered in operative management.[4] However, operative management of patellar instability typically includes restoration of the MPFL with either repair or reconstruction, with or without other associated procedures.

Understanding the location of MPFL injury is an important factor in determining appropriate treatment. Ruptures can occur at the femoral attachment, patellar attachment, or intrasubstance region. Rupture at the femoral attachment occurs more commonly in older patients, while patellar-based ruptures are more common in younger patients.[5] Furthermore, multiple studies have demonstrated that skeletally-immature patients are significantly more likely to suffer a patellar-based rupture following acute dislocation.[6,7] The location of the injury plays a role in determining appropriate surgical treatment, as patellar and femoral attachment ruptures have more favorable outcomes with repair as compared to intrasubstance tears. Thus, a preoperative MRI is useful to localize the rupture site and assess for other associated injuries.[8]

Medial Patellofemoral Ligament Repair: Technique and Outcomes

There is currently no consensus regarding the most appropriate treatment for patients with recurrent patellar instability and normal bony anatomy. While MPFL reconstruction is commonly performed with excellent results and low risk of recurrent instability, complications such as femoral tunnel widening, patella fracture, stiffness, wound complications, and pain have been reported in up to 26% of cases.[9] MPFL repair offers an alternative method to address patellar instability with promising results in carefully selected patients. MPFL repair decreases the risk of nonanatomic graft placement and eliminates the need for large drill holes, thus decreasing the risks of tunnel enlargement and patella fracture. MPFL repair is best performed in younger patients with an isolated femoral- or patellar-based avulsion injury, particularly in the acute setting. When the MPFL cannot be identified on MRI, or when the injury occurs at the midsubstance or at multiple sites, MPFL reconstruction is recommended.[10]

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The appropriate skin incision for MPFL repair depends on the location of the tear, with patellar-based lesions requiring an incision along the medial edge of the patella, and femoral lesions requiring an incision over the adductor tubercle. Dissection is then performed to identify the MPFL between layers 2 and 3, with care taken to isolate the torn edge. An Allis clamp is placed at the torn edge of the ligament. The anatomic insertion site at either the patella or femur is then identified and prepared with a bur. Two suture anchors are then placed at the prepared insertion site. The knee is flexed to 30° and the surgeon centralizes the patella in the trochlear groove to determine appropriate tensioning. Repair is then performed with suture at the desired tension. The knee is then taken through range of motion and appropriate patellar glide and tilt is confirmed on clinical examination.[10] Similarly, an examination should be compared after repair for lateral patellar translation, demonstrating a firm endpoint and 1-2 quadrants of translation.

Multiple studies have demonstrated favorable results of MPFL repair in appropriately indicated patients. Pandya et al described a cohort of 16 pediatric and adolescent patients who underwent MPFL repair and reported no cases of recurrent instability at a mean of 1.5 years postoperatively. When compared to a historical cohort of patients who had undergone MPFL reconstruction, the authors noted a lower incidence of recurrent instability and complications in the repair group as compared to the reconstruction group.[11] Camp et al described a cohort of 29 knees in 27 patients who underwent an MPFL repair for recurrent patellar instability. The authors reported a recurrence rate of 28% (8/29 knees); however, only 59% of their patients underwent MRI preoperatively, and 7 of the 29 knees were noted at the time of surgery to have midsubstance tears. These patients underwent reefing of the medial soft tissues without the use of suture anchors. The authors also noted that nonanatomic suture anchor placement for femoral-based avulsions significantly correlated with risk of recurrent instability, with 80% (4/5) of nonanatomic repairs experiencing repeat dislocations, and 0% (0/7) of anatomic repairs suffering a repeat dislocation event. Thus, their results emphasize the importance of preoperative planning with MRI and anatomic anchor placement in MPFL repair.[12]

Dragoo et al reported a cohort study of 24 of our patients with recurrent patellar dislocations who underwent surgical treatment based on a multifactorial algorithmic approach. Patients were examined clinically for patellar tilt to determine whether a lateral lengthening procedure was required to restore neutral tilt. All patients underwent a preoperative MRI to localize the site of MPFL injury and to determine the tibial tubercle-trochlear groove (TT-TG) distance. Those patients with a TT-TG distance greater than 20 mm underwent a tibial tubercle osteotomy (TTO) in addition to a medial soft tissue procedure. MPFL reconstruction was performed in patients with a poorly visualized MPFL on MRI or with a mid-substance or multifocal tear. In this cohort, 16 patients underwent MPFL repair, 8 underwent MPFL reconstruction, 21 underwent an additional lateral retinacular lengthening, and 3 underwent a TTO. Recurrent instability and patient-reported outcome scores were reported at a minimum of 2 years postoperatively with a mean follow-up of 51 months. There was one postoperative recurrent dislocation in the MPFL repair cohort, representing a failure rate of 4%. However, this patient had a TT-TG distance of 26 mm but declined TTO, a scenario that departs from our treatment algorithm. There were no recurrent dislocations in the MPFL reconstruction cohort. There were no significant differences in outcomes scores between the 2 groups, and no other surgical complications were noted in either group (Table 1). This study indicates that using an algorithmic approach as illustrated in Figure 1, MPFL repair can provide similar results to MPFL reconstruction in appropriately indicated patients.[10]

Medial Patellofemoral Reefing: Technique and Outcomes

Medial patellofemoral reefing, also described as imbrication or plication, is a proximal patellar realignment procedure that serves to effectively tighten the medial soft tissue structures. MPFL reconstruction is the preferred procedure when no other realignment procedures are required, as the native soft tissue is often attenuated and unreliable in the setting of chronic patellar instability. Indeed, studies demonstrate that in patients with high-grade trochlear dysplasia, those who underwent isolated MPFL imbrication had significantly worse outcomes than those who underwent MPFL reconstruction.[13] However, patients undergoing distal realignment procedures, femoral osteotomy, or trochleoplasty, medial reefing may be an adequate supplementary procedure to manage the medial soft tissues. If the patella remains dislocatable following osteotomy to correct anatomic alignment, then a reconstruction of the MPFL is indicated; however, if mild residual lateral instability remains, medial reefing may be appropriate. Medial reefing can be performed with or without lateral retinacular lengthening to restore appropriate patellar tracking and stability. Multiple techniques have been described, including open, arthroscopically assisted, and all arthroscopic methods.[14]

Because medial reefing is typically performed in conjunction with other open procedures, the open technique commonly utilizes existing incisions. If an appropriate incision is not available, a 4-5 cm incision is made at the medial border of the patella. Dissection is performed down to the medial retinacular tissue and MPFL, which are identified and tagged with suture. Imbrication is then performed by suturing a cuff of tissue at the medial border of the patella over the adjacent soft tissues in a pants-over-vest fashion. The patella must be carefully centered in the trochlear groove during tensioning to avoid over-constraint.[14]

Miller et al described an arthroscopically-assisted technique for medial reefing. The procedure begins with an examination under anesthesia, with a focus on assessment of patellar tilt as well as medial and lateral glide. Next, standard diagnostic arthroscopy is performed. During arthroscopy,

Table 1 Outcomes Scores for Patients Undergoing Operative Intervention for Recurrent Lateral Patellar Instability

Patient Number	KOOS Symptoms	KOOS Pain	KOOS ADL	KOOS Sport	KOOS QOL	Lysholm Total	VR12PCS	VR12MCS	Tegner
MPFL Repair Patients[α]									
4	82.1	91.7	97.1	95.0	31.2	90.0	42.6	62.4	3.0
5	50.0	75.0	69.1	25.0	31.2	41.0	27.1	51.4	2.0
6	78.5	94.4	100.0	75.0	62.5	95.0	56.8	57.9	7.0
8	42.8	63.8	69.1	45.0	12.5	39.0	29.5	51.1	1.0
9	82.1	72.2	95.5	60.0	50.0	82.0	44.4	54.0	5.0
10	92.9	100.0	100.0	75.0	81.2	89.0	53.5	55.2	3.0
11	85.7	100.0	100.0	95.0	93.8	100.0	42.1	58.3	7.0
12	78.5	75.0	82.3	50.0	43.7	64.0	48.3	48.4	3.0
13	89.3	91.7	94.1	65.0	68.8	87.0	57.4	37.1	3.0
14	57.1	55.5	82.3	20.0	31.2	57.0	48.9	57.3	3.0
15	75.0	83.3	94.1	80.0	62.5	70.0	58.1	30.4	1.0
18	78.5	80.5	97.0	75.0	56.2	79.0	58.0	50.6	8.0
19	85.7	94.4	95.5	85.0	56.2	82.0	51.5	52.9	3.0
21	85.7	94.4	95.6	85.0	56.2	82.0	51.5	52.9	3.0
23	89.2	97.2	95.5	80.0	68.7	84.0	55.2	55.1	3.0
24	82.1	80.5	79.4	60.0	50.0	6.0	43.8	29.5	2.0
Average	**77.2**	**84.4**	**90.4**	**66.9**	**53.5**	**71.7**	**48.0**	**50.3**	**3.6**
MPFL Reconstruction Patients									
1	50.0	61.1	67.6	25.0	12.5	46.0	29.7	58.2	2.0
2	60.7	83.3	91.1	40.0	31.2	60.0	44.8	60.3	3.0
3	100.0	100.0	100.0	90.0	75.0	95.0	54.2	56.0	3.0
7	42.8	63.8	69.1	45.0	12.5	39.0	29.5	51.1	1.0
16	32.1	27.8	23.5	0.0	12.5	20.0	15.6	54.6	1.0
17	85.7	94.4	97.0	90.0	87.5	91.0	52.3	55.5	3.0
20	64.2	88.8	91.1	70.0	75.0	87.0	50.4	52.8	3.0
22	82.1	77.7	97.0	35.0	62.5	80.0	38.0	56.8	2.0
Average	**64.7**	**74.6**	**79.6**	**49.4**	**46.1**	**64.8**	**39.3**	**55.7**	**2.3**
***P*-Value**	**0.12**	**0.20**	**0.15**	**0.13**	**0.50**	**0.54**	**0.08**	**0.14**	**0.11**
Difference Between Repair and Reconstruction									

[α]Outcomes scores for the MPFL repair and reconstruction cohorts. Four subsets of the Knee Injury and Osteoarthritis Outcome Score (KOOS), Lysholm, Veterans RAND 12-Item Health Survey For Physical (VR-12 PCS) and Mental (VR-12 MCS) Health, and Tegner scores were used. Patient 21 was originally a repair patient but was revised to reconstruction. Outcome scores for her were obtained only after her reconstruction. ADL, activities of daily living; MPFL, medial patellofemoral ligament; QOL, quality of life.

the knee should be brought through passive flexion and extension to visualize patellar tracking in the trochlear groove. Additionally, the patella and trochlea are examined for chrondral lesions, which should be addressed appropriately as needed. Under arthroscopic visualization with the knee in 20° of flexion, #2 Vicryl sutures are then passed percutaneously through the medial retinaculum using a king needle. The needle enters along the medial edge of the patella and exits the capsule approximately 25 mm posteromedially. Additional sutures are placed 1 cm apart to the level of the inferior pole of the patella, using an average of 4 sutures. The authors place a cannula in the anteromedial portal to protect the suture loops from being cut. They subsequently use a radiofrequency device to cut the medial capsule from superior to inferior between the loops of suture. Next, the authors make a 2 cm incision along Langer's lines at the medial aspect of the patella between the superior and inferior pole. Blunt dissection is performed down to the level of the deep fascia. The suture ends are identified under the skin and passed into the incision. Separate 0-PDS sutures are then placed in the medial and lateral edges of the capsule. The 2 free ends of the lateral capsular suture are placed on a king needle and passed under the medial limb and out through the skin. Using the PDS sutures to pull in a "pants over vest" fashion with the medial limb over the lateral limb, the surgeon ties the vicryl sutures through the incision. Stability and tracking are then reexamined arthroscopically and clinically to assess outcome. The authors reported a series of 24 patients and 25 knees treated with this

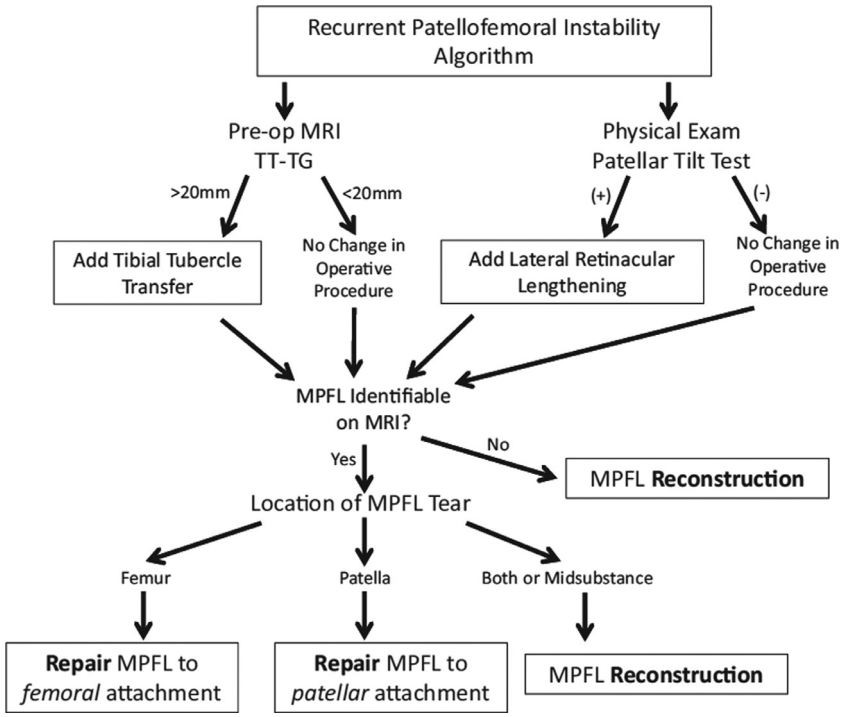

Figure 1 Algorithm for treatment of recurrent patellofemoral instability. MPFL, medial patellofemoral ligament; MRI, magnetic resonance imaging; TT-TG, tibial tubercle–trochlear groove distance.

procedure, with significant improvement in Lysholm and Tegner scores and no instances of recurrent instability at an average of 60 months postoperatively.[15]

Cerciello et al subsequently described an all-arthroscopic technique for medial reefing. The procedure begins with an examination under anesthesia and diagnostic arthroscopy as previously described. The author recommends a gentle shaving of the medial retinaculum to facilitate healing. Sutures are then passed percutaneously using a spinal needle. The most distal needle is passed first and should be located at the distal third of the patella, just off the medial edge. The authors pass a #1 PDS suture through the spinal needle and retrieve it through a posterior access portal. Two more sutures are passed proximally with approximately 1.5 cm between sutures. The 2 edges of each suture are then retrieved from the posterior portal. The authors recommend tying the sutures with the knee at 60-70° of flexion, taking care to avoid over-tensioning. Patellar tracking is again assessed under arthroscopic visualization. The authors reported on 30 patients who underwent medial reefing using this technique. They noted no episodes of recurrent instability or other postoperative complication. However, at 120 months postoperatively, only 61% of patients were very satisfied with their outcome, with 25% of patients satisfied, and 14% unsatisfied with their result.[16]

The same authors also performed a systematic review of the literature describing medial retinaculum reefing procedures for patellar instability. They identified 17 relevant studies, 9 of which were retrospective. The techniques used varied from open, arthroscopically-assisted, or all arthroscopic, and other procedures such as lateral release and TTO were also performed in some studies. Overall, the average recurrent instability rate across all studies was 6.1%, with a range of 0%-31%. There were no other major complications reported in any study. However, most of the studies included represented small series with low levels of evidence, with a heterogeneous patient population and variable surgical technique. Thus, it is difficult to draw conclusions from the current literature regarding the efficacy of reefing procedures.[17] In general, medial reefing is mostly recommended as an adjunct in the setting of mild residual instability at the time of other realignment procedures.[14,18]

Conclusion

Medial patellofemoral ligament tears occur in nearly all cases of lateral patellar instability. Both MPFL repair and medial reefing are soft tissue procedures aimed at restoring the medial soft tissue restraint at the patellofemoral articulation. Preoperative MRI is paramount to identify the location of the MPFL rupture, as patellar- or femoral-based avulsions are best indicated for MPFL repair. In the case of an MPFL that is not visible on MRI or a midsubstance tear, MPFL reconstruction is a more appropriate treatment. Medial reefing describes a variety of surgical techniques aimed at tightening the medial soft tissues to center the patella in the trochlear groove. These procedures are most commonly performed in conjunction with other realignment procedures. Overall, medial soft tissue procedures are recommended as part of a multifactorial algorithmic approach to determine the appropriate operative management of patellofemoral instability.

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