

# The Role of Medial Patellofemoral Ligament Repair and Imbrication

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## Abstract

Repair, reefing, and advancement of the medial patellofemoral ligament (MPFL) and medial retinacular structures can be performed as an isolated procedure or in conjunction with distal realignment procedures for patients with patellar instability. Although various operative techniques have been described, understanding the appropriate clinical indications and MPFL injury patterns ultimately determines the success or failure of the procedure.

MPFL repair is best indicated in the acute setting, particularly if there is a patella- or femoral-based avulsion. If MPFL repair is being considered, and there is no evidence of avulsion on plain radiographs, magnetic resonance imaging can be used to examine the pattern and extent of the MPFL injury.

In cases of chronic patellar instability, medial retinacular reefing or imbrication is best considered in conjunction with other procedures that address common pathology associated with chronic instability. These procedures include distal realignment, trochleoplasty, and distal femoral osteotomy.

The medial patellofemoral ligament (MPFL) is the primary soft-tissue restraint to lateral patellar translation.<sup>1</sup> In cases of first-time acute lateral patellar dislocation, injury to the MPFL is described as the essential lesion, occurring in almost 100% of cases.<sup>2-4</sup> Because of the relatively high frequency of recurrent instability after first-time acute lateral patellar dislocation,<sup>5-7</sup> much research has been focused on MPFL repair and

reconstruction.<sup>8-11</sup> Although the clinical results of isolated MPFL repair are highly variable, this variability is likely secondary to relatively inconsistent clinical indications for repair, with repair described for patients with acute as well as chronic or recurrent instability.<sup>10-13</sup> From these early successes and failures, much has been learned about the appropriate indications for MPFL repair as well as medial retinacular “reefing” or imbrication in the chronic setting.

## Relevant Anatomy

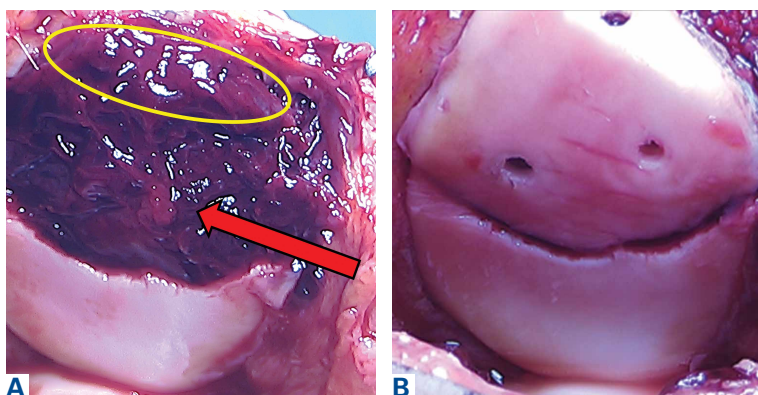
The MPFL is an extracapsular thickening of the medial retinacular structures and can be most consistently identified just distal to the vastus medialis obliquus, running within layer 2 of the medial side of the knee (using the often-referenced layer system popularized by Warren and Marshall<sup>14</sup>). The MPFL origin on the medial aspect of the femur falls within a well-defined saddle between the adductor tubercle and the medial epicondyle.<sup>15</sup> From this relatively narrow origin, the MPFL broadens before attaching to the proximal one-third of the medial aspect of the patella.

Over the past 2 decades, the osseous anatomy surrounding the femoral origin of the MPFL has been of much interest in large part because of the increasing popularity of MPFL reconstruction. Although useful for MPFL reconstruction, the vast amount

## Take-Home Points

- MPFL repair has the best results with isolated ligament avulsions in first-time dislocations. This can be demonstrated on MRI and verified at the time of arthroscopy.
- Recurrent dislocations, even if acute, have a higher failure rate with MPFL repair. In this setting, MPFL reconstruction provides more consistent outcomes.
- In cases of chronic lateral patellar dislocation, imbrication may be enough when other associated procedures have sufficiently stabilized the patella without the need for a strong soft-tissue checkrein.
- Femoral-sided repairs are more challenging due to the need to optimize the insertion point on the femur, as small changes in positioning can cause increased stress on the repaired tissue and lead to failure.
- If a repair is to have a chance to work, it must be performed at the site of the tear. Thus, preoperative planning and intraoperative inspection is important to precisely identify the site, which can involve intrasubstance and multifocal injuries as well as the femoral and patellar complex attachments.

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**Figure 1.** Medial parapatellar arthrotomy in the left knee after first-time patellar dislocation with stump of medial patellofemoral ligament at patellar insertion (yellow circle) and large medial patellar facet osteochondral defect (red arrow) (A) before and (B) after fixation.

of literature and our improved understanding of this anatomical region can be extrapolated to MPFL repair. The radiographic landmarks described by Schöttle and colleagues<sup>16</sup> have advanced our knowledge of the femoral origin of the MPFL, with fluoroscopic guidance allowing for more limited dissection and increased accuracy of repair for femoral-sided MPFL injuries.

### Location of MPFL Injury

Understanding and appreciating the specific location of the MPFL injury are paramount to successful MPFL repair. Unfortunately, the location and pattern of MPFL injury cannot be consistently predicted. Although early surgical dissections described femoral-sided injuries as the most common injury site,<sup>4</sup> more recent studies using magnetic resonance imaging (MRI) have described a more even distribution of MPFL injury patterns, which include patella-based ruptures, femoral-based ruptures, intrasubstance ruptures, and multifocal injuries.<sup>17</sup> In addition, age and skeletal maturity likely play a role in the MPFL injury location, as skeletally immature patients more often have patella-based ruptures.<sup>2,18,19</sup> In acute MPFL repair, MRI appears to be the most accurate imaging modality for determining the patella- or femoral-based injuries most amenable to repair and for identifying clinically significant osteochondral lesions, which are not uncommon after first-time patellar dislocation.<sup>20,21</sup>

### Medial Reefing, Imbrication, and Advancement

Medial reefing, imbrication, and advancement, collectively referred to as proximal realignment procedures, describe a variety of techniques that

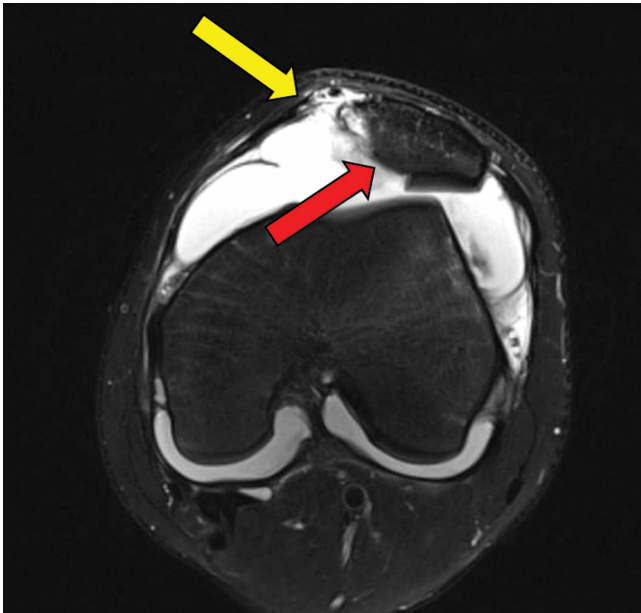
essentially shorten or tighten the medial retinacular structures.<sup>22-24</sup> Although the terms cover a variety of similar surgical techniques and are often used interchangeably in the literature, *imbrication*, or overlapping of adjacent edges, is the single most accurate term used to define this spectrum of procedures. These procedures historically were performed in the setting of chronic or recurrent patellar instability, with the primary goal being to imbricate the attenuated medial retinaculum, which includes the MPFL. However, the procedure has had good clinical outcomes when performed in isolation for patients with normal bony anatomy.<sup>25</sup> Such anatomy is rare in chronic or recurrent dislocators, and these proximal soft-tissue procedures are often combined with other osseous realignment procedures, including distal realignment, trochleoplasty, and distal femoral osteotomy.<sup>26</sup>

### Discussion

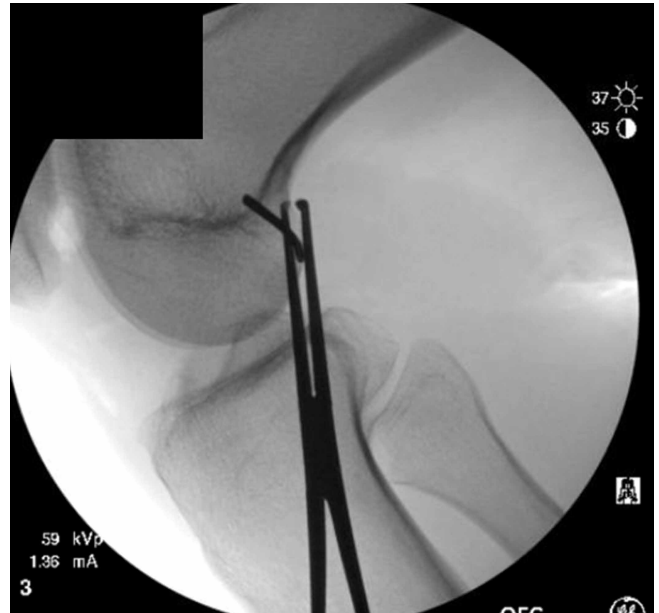
#### MPFL Repair: Indications and Surgical Technique

Although optimal management of first-time patellar dislocation continues to be a topic for debate, the frequency of recurrent instability,<sup>7,27</sup> particularly in young patients, has led some to advocate early surgical management.<sup>9,28</sup> A clear indication for early operative intervention is the presence of a large osteochondral lesion that can undergo fixation or is causing persistent mechanical symptoms with recurrent effusion (**Figures 1A, 1B**). Although large osteochondral lesions may be visible on plain radiographs, MRI can be considered because of the relatively high incidence of osteochondral lesions in this population.<sup>21</sup> In addition, MRI best determines the location and the extent of MPFL injury when early surgical intervention is being considered after discussion with the patient, or in cases of a concomitant osteochondral lesion.<sup>20</sup> MPFL repair is best indicated in a young patient with a first-time patellar dislocation and a patella- or femoral-based bony avulsion or isolated patella- or femoral-based rupture (**Figure 2**). However, in a patient with a multifocal intrasubstance ligamentous injury, and in a high-level athlete being considered for surgery, MPFL reconstruction may provide more reliable outcomes.<sup>11,29</sup>

Numerous open and arthroscopic MPFL repair techniques have been described.<sup>10,30-33</sup> Nevertheless, comparative studies are limited, and the greatest debate about MPFL repair continues to be appropriate indications. Arthroscopic MPFL repair can be technically demanding and can fully visualize only patella-based injuries. In addition,



**Figure 2.** Axial T2-weighted magnetic resonance imaging of the left knee with avulsion of patellar insertion of medial patellofemoral ligament (yellow arrow) and large medial patellar facet osteochondral lesion (red arrow) after first-time lateral patellar dislocation.



**Figure 3.** Perfect lateral radiograph of the knee and intraoperative fluoroscopic localization of Schöttle point with radiopaque marker before anchor placement for femoral-sided medial patellofemoral ligament repair.

all-arthroscopic repair techniques may place suture material in the joint, which causes concern regarding suture irritation. As a result, the majority of MPFL repair techniques described in the literature use an open approach, which typically includes a 4-cm to 5-cm longitudinal incision along the medial aspect of the patella. Sharp dissection is carried down through the medial retinaculum to the underlying joint capsule. The plane between the medial retinaculum and the underlying joint capsule is bluntly developed posteriorly until the medial epicondyle and the adductor tubercle are palpated. For a patella-based rupture, the MPFL is defined within layer 2, and 2 suture anchors are placed within the superior third of the patella. Although there are other patellar fixation methods, suture anchors provide adequate fixation with minimal risk of iatrogenic patellar fracture. With anchors in place, horizontal mattress sutures are placed in the stump of the MPFL. For femoral-based ruptures, the same surgical exposure is used to identify the MPFL. However, depending on the size of the incision and the mobility of the tissue, a second incision can be made posterior and parallel to the first—best achieved using a spinal needle to fluoroscopically localize Schöttle's point.<sup>16</sup> An incision is made in line with the spinal needle, and dissection is continued down to the previously developed extracapsular plane. Under fluoroscopic guidance

(**Figure 3**), 1 or 2 suture anchors are placed at Schöttle point, and horizontal mattress sutures are placed through the avulsed MPFL femoral origin. During intraoperative assessment, if there is any concern the MPFL injury is multifocal or intra-substance, then MPFL reconstruction, as opposed to repair, should be considered.

#### **MPFL Imbrication: Indications and Surgical Technique**

MPFL reconstruction is the technique of choice in recurrent patellofemoral instability when no other procedures are required. When combined with distal realignment procedures, distal femoral osteotomy, open patellofemoral cartilage resurfacing procedures, or trochleoplasty, MPFL imbrication can be considered in place of MPFL reconstruction. Recurrent patellofemoral instability is influenced by various factors, including static soft-tissue restraints, dynamic muscle action, and bony anatomy, only one of which is directly addressed with MPFL imbrication. Relying on native tissues without a graft increases the risk for recurrent instability because of concern that the already attenuated native tissues will stretch out further, particularly in the presence of hyperlaxity. Although the significance of trochlear dysplasia in patellofemoral instability was first noted by Dejour and colleagues,<sup>34</sup> the presence of trochlear dysplasia has been shown to negatively influence

outcomes of isolated MPFL imbrication.<sup>35</sup> Because of the relative frequency of trochlear dysplasia and axial or coronal plane malalignment in patients with chronic or recurrent patellar instability, MPFL imbrication typically is not performed on its own, and it is best used in conjunction with a distal realignment procedure or distal femoral osteotomy. MPFL reconstruction should be performed instead of MPFL imbrication in patients with severe trochlear dysplasia, in patients with hyperlaxity signs, and in young patients who participate in cutting or pivoting sports.

When distal realignment procedures are performed for axial alignment, or distal femoral osteotomy is performed for severe genu valgum, patellofemoral laxity is tested after the bony correction is completed. If the patella is still dislocatable, MPFL reconstruction provides the most predictable outcome. If laxity is increased, but the patella remains in the trochlea, typically MPFL imbrication is adequate.

Similar to MPFL repair, both open and arthroscopic techniques have been described in the literature.<sup>36-38</sup> As MPFL imbrication is most commonly performed in conjunction with large open procedures, this procedure can often be incorporated with other open incisions. In addition, open MPFL imbrication allows for precise control and tensioning of the medial retinacular structures, which is not always easily achieved by arthroscopic methods.

If a separate incision is required, a 4-cm to 5-cm longitudinal incision is made along the medial border of the patella, just as described for MPFL repair. The medial retinacular tissue, including the MPFL, is identified and isolated extracapsularly. Imbrication can be performed with sutures only (using a cuff of tissue along the medial border of the patella and placing pants-over-vest sutures in the adjacent tissue) or with sutures and anchors (more similar to MPFL repair described earlier). In either scenario, adequately tensioning the MPFL and associated medial retinaculum is essential in order to restore the checkrein function of the attenuated MPFL. Although typically described in the setting of MPFL reconstruction, the MPFL can easily be over-tensioned during MPFL imbrication. This potential pitfall can be avoided by recognizing that forces over 2 N will over-tension medial structures and thereby increase contact pressures at the medial patellar facet.<sup>39</sup> The complication can easily be prevented simply by placing the knee in 30° flexion and centering the patella in the trochlear groove while performing the MPFL imbrication.

### Conclusion

Careful patient selection is the most important element for successful MPFL repair or imbrication. MPFL repair is most reliably used in patients with clear patella- or femoral-sided avulsions and in patients with a first-time patellar dislocation and a clear surgical indication, such as a large osteochondral fragment. Proximal realignment procedures, which include MPFL reefing, imbrication, and advancement, typically are not performed in isolation, as other osseous procedures are often needed concomitantly in order to preserve the checkrein effect provided by proximal realignment procedures. As is the case with MPFL reconstruction, understanding the relevant anatomy and avoiding over-tensioning of the medial structures during MPFL repair or proximal realignment procedures are crucial.

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