53 CHAPTER

Medial Patellofemoral Ligament Reconstruction

Hany Elrashidy, Joseph Carney, Najeeb Khan, and Donald C. Fithian

DEFINITION

- Stability of the patellofemoral joint (PFJ) is multifactorial as it depends on limb alignment, interaction of the surrounding muscles, the osseous architecture of the patella and the trochlea, and the integrity of the medial soft tissue constraints of which the medial patellofemoral ligament (MPFL) is the main component.
- Of the many factors contributing to PFJ stability, the MPFL is the primary ligamentous restraint against lateral patellar displacement, with the MPFL reported to provide between 50% and 60% of the medial soft tissue resistance to lateral dislocation of the patella.[4,21]
- Consequently, patellar dislocation often results in injury to the medial retinacular ligaments, including the MPFL, leading to increased lateral patellar mobility.
- Competency of the MPFL is both necessary and sufficient to restore lateral patellar mobility to a normal range; consequently, surgical treatment should aim for restoration of a functional MPFL.

ANATOMY

- The MPFL is an extra-articular ligament that lies in layer 2, between the medial retinaculum superficially and the joint capsule on its deep surface. The vastus medialis obliquus (VMO) tendon lies superficially anteriorly and inserts onto the anterior third of the MPFL.
- In a cadaveric study, the MPFL was moderately or well developed in 17 of 20 (85%) specimens and poorly developed in 3 of 20 (15%).[20]
- The MPFL is approximately 58 mm in length, with a width and thickness of 12 mm and 0.44 mm, respectively, at its midpoint.[20]
- The MPFL fans out anteriorly, inserting on the proximal two-thirds of the patella.
- The femoral attachment of the MPFL is posterosuperior to the medial femoral epicondyle and just distal to the adductor tubercle with the knee fully extended. The center of the anterior edge of the femoral attachment is located 9.5 mm proximal and 5.0 mm posterior to the center of the medial femoral epicondyle (**FIG 1**).[20]
  - In children with open physes, the femoral attachment of the MPFL has been reported to be 6.4 mm (2.9 to 8.5 mm) distal to the femoral physis.[15]

PATHOGENESIS

- Patellar dislocations typically occur when the foot is planted, the knee is partially flexed, and the body pivots abruptly, resulting in internal rotation of the femur. Patients may or may not have sustained a direct blow.
- Patients may report that something "popped out" medially, as the uncovered medial femoral condyle becomes prominent.
- The knee usually gives way secondary to pain inhibition of the quadriceps and disruption of the mechanical advantage of the extensor mechanism, and the patient falls down.
- If the knee remains flexed, the patella may remain dislocated over the lateral femoral condyle.
- The history of injury may be unclear, especially if the patella rapidly and spontaneously reduced.
- In one cohort of 189 patients, 61% of first-time dislocations occurred during sports activity.[3]
- Individuals with trochlear dysplasia are typically more vulnerable to patella dislocation as the PFJ geometry is less suited to resist lateral translation of the patella, thereby shifting even more responsibility on the MPFL to restrain the patella.
- Individuals with patella alta are also more vulnerable to patella dislocation as the degree of flexion at which the patella engages in the trochlea is higher than that in a normal knee. This reduced ability of PFJ geometry to resist lateral translation in the partially flexed knee shifts even more load onto the MPFL to restrain the patella.

NATURAL HISTORY

- Fithian et al[10] reported a 17% incidence of redislocation in a cohort of first-time dislocators followed over 2 to 5 years.

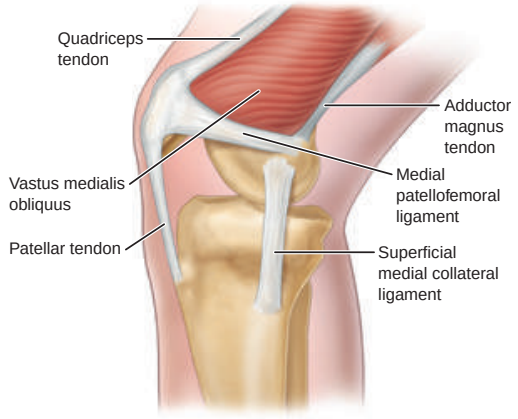


FIG 1 ● Schematic diagram of the medial knee. The MPFL arises between the adductor tubercle and medial epicondyle then runs forward just deep to the distal VMO to attach to the superior two-thirds of the medial patellar margin.

- On the other hand, patients presenting with recurrent patellar instability are much more likely to continue experiencing additional dislocations than patients who present with their first dislocation.
  - The risk of a repeat dislocation in patients presenting with a history of prior patellar dislocation is about 50% over a 2- to 5-year period.[10]
- The strongest risk factor for recurrent patellar instability is a history of prior patellar subluxation or dislocation.[10]
  - Other risk factors include female gender and younger age (younger than 18 years old).[10,16]
  - In one study, girls with open tibial apophyses had the worst prognosis for instability.[10,16]
- It is unclear whether patellar dislocation leads to premature arthritis.
  - Crosby and Insall[5] reported that degenerative changes were uncommon after patellar dislocation.
  - In a more recent study, however, the incidence of degenerative changes was significantly higher at 6- to 26-year follow-up in first-time dislocators treated nonoperatively.[12]

PATIENT HISTORY AND PHYSICAL FINDINGS

- The patient should be asked about mechanical symptoms such as locking or catching. Osteochondral loose bodies off the medial patellar facet or lateral trochlea (kissing lesion), impaction fracture of the lateral femoral condyle, or avulsion fragments off the medial patella may occur after patellar dislocation.
- Physical examination should include the following:
  - Lateral–medial patellar translation. Increased laxity is signified by more than two quadrants of translation, 10 mm or more of lateral translation, or the absence of an end point.
  - Apprehension sign. Inability to fully translate the patella laterally because of patient guarding may lead to a false-negative result.
  - J sign. The patella abruptly translates laterally as the knee is fully extended, moving in an upside-down "J"pattern.
  - Checkrein sign. A positive test (no end point) signifies MPFL laxity (analogous to a Lachman test).
  - Patellar facet palpation. Tenderness may indicate an osteochondral or avulsion injury.
  - Medial retinacular palpation. Tenderness may indicate retinacular injury. A palpable defect may be felt in the retinaculum or near the VMO.
  - Effusion. A tense effusion or hemarthrosis on aspiration after acute dislocation should raise suspicion for an osteochondral fracture. Magnetic resonance imaging (MRI) or arthroscopy should be considered.
- A comprehensive physical examination of the knee is vital to evaluate for associated injuries such as cruciate or collateral ligament disruption.

IMAGING AND OTHER DIAGNOSTIC STUDIES

- Recommended plain radiographs include a standing anteroposterior view, a true lateral view with the knee flexed 30 degrees, and a standard axial patellar view at 30 or 45 degrees flexion.
- On the lateral radiograph, patellar height is measured according to the method of Caton and Deschamps (ie, the ratio between the distance from the lower edge of the patellar articular surface to the upper edge of the tibial plateau and the length of the patellar articular surface).[3]
  - A ratio of 1.2 or greater indicates patella alta, which predisposes to patellar instability due to late engagement of the patella in the trochlea as the knee flexes.
  - If present, a tibial tubercle osteotomy and distalization should be considered.
- Trochlear morphology can be assessed on a true lateral radiograph (the posterior borders of both femoral condyles are strictly superimposed).
  - Trochlear dysplasia is evident when the floor of the trochlea crosses the anterior border of both femoral condyles (crossing sign)[6] (**FIG 2A**).
  - Alternatively, the positive trochlear prominence (ie, the sagittal distance between the trochlear groove and the anterior femoral cortex) on the lateral view has been shown to correlate well with trochlear dysplasia[6,7] (**FIG 2B**). A trochlear groove prominence of 3 mm indicates trochlear dysplasia (**FIG 2C**).
- The axial patellar view may demonstrate lateral patellar subluxation or even frank dislocation. It may demonstrate medial patellar avulsion fractures, although these can be missed on plain x-rays.
- Stress radiography has been advocated to demonstrate abnormal patellar mobility.
  - With the knee flexed to 30 degrees, an axial patellar view is taken with a laterally directed force applied to the medial side of the patella.
  - Measurements are made on both the symptomatic and asymptomatic knees.
  - A side-to-side increase of 3.7 mm or more of lateral translation on the symptomatic versus asymptomatic side is considered abnormal.[27]
- MRI identifies osteochondral injuries on the patella and femur as well as loose bodies that may be missed on plain radiographs.
  - A tense effusion should be aspirated. Presence of gross hemarthrosis on joint aspiration is an indication for MRI to assess for osteochondral fracture and loose body.
- The TT–TG offset is the transverse distance between the anterior tibial tuberosity (TT) and the center of the trochlear groove (TG).[6]
  - It can be measured on axial computed tomography (CT) or MRI (**FIG 2D**), although some argue that these imaging modalities are not interchangeable as MRI has been reported to underestimate the TT–TG offset when compared with CT.[2]
  - Lateral offset of 20 mm or more should be corrected with medialization of the tibial tubercle.
- MRI is also useful in identifying the location and degree of medial soft tissue injury preoperatively and has been reported to be even more accurate than arthroscopy in identifying MPFL injuries.[1]
  - MPFL injuries occur commonly in the form of tears near the femoral attachment or avulsions off the femur but may also occur as midsubstance tears or avulsions off the patella (**FIG 2E,F**). Injuries to multiple sites in the medial ligamentous complex occur.[7]

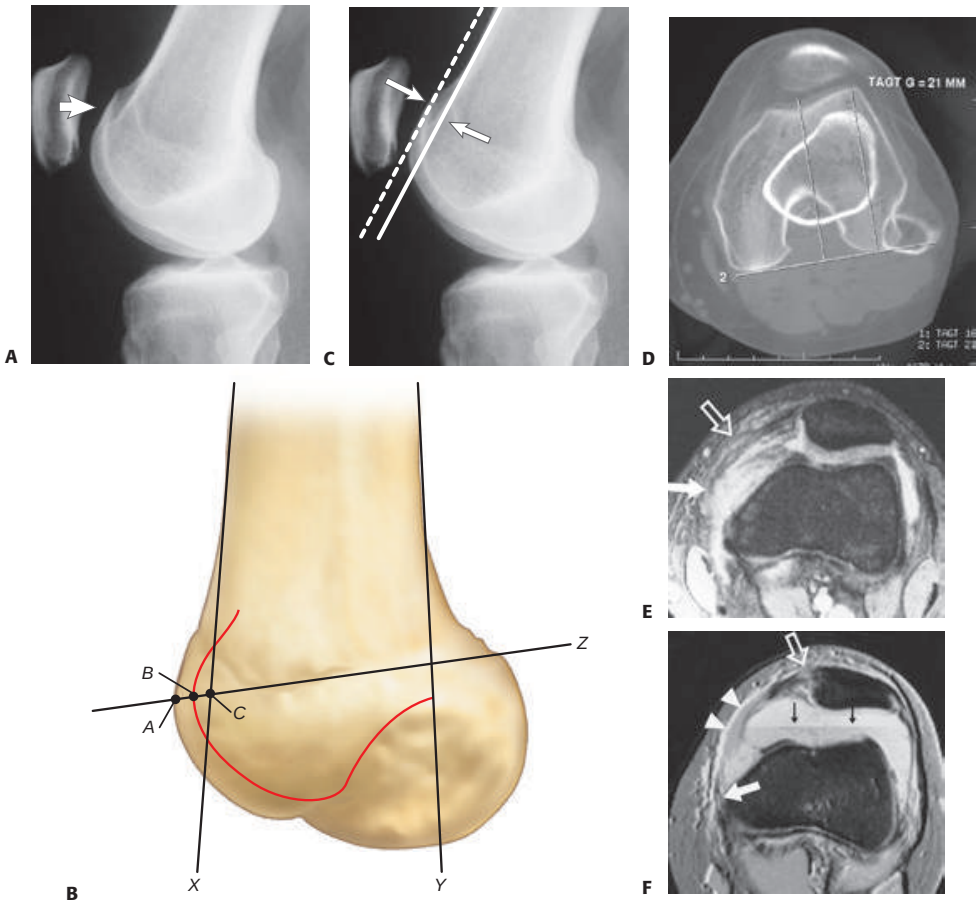


FIG 2 ● **A.** On a true lateral radiograph, trochlear dysplasia is evident when the floor of the trochlea crosses the anterior borders of both femoral condyles (ie, the "crossing" sign). **B.** Measurement of the trochlear prominence on the lateral view according to Dejour et al[6] *X* and *Y* are lines tangential to the anterior and posterior cortices of the distal femoral metaphysis, respectively. Line *Z* crosses the most prominent point of the line of the trochlear groove (point *B*) and the upper aspect of the posterior border of the condyles. Line *Z* crosses the anterior aspect of the lateral condyle (point *A*) and line *X* (point *C*). The distance *BC* (in mm) is the trochlear prominence. **C.** Lateral radiograph demonstrating a knee with positive trochlear prominence. Note that the floor of the trochlea lies anterior to the line tangential to the anterior cortex of the distal femur. **D.** Measurement of the tibial tuberosity–trochlear groove (TT–TG) offset, the transverse distance between the apex of the anterior tibial tuberosity and the center of the trochlear groove. Measurements are made on superimposed axial CT or MRI images. **E,F.** MPFL injury appearance on MRI. **E.** Transverse gradient echo image of the knee obtained at the level of the insertion of the adductor magnus tendon 3 weeks after lateral patellar dislocation demonstrates a complete tear of the femoral origin of the MPFL, with MPFL fibers retracted anteriorly (*solid arrow*). Partial injury, with surrounding edema, to the midsubstance of the patellar retinaculum (*open arrow*) also is seen. **F.** Transverse gradient echo image of the knee in a different patient 2 days after lateral patellar dislocation showing partial injury to the femoral origin of the MPFL. The MPFL fibers (*solid white arrow*) are wavy and show longitudinal split, and there is extensive surrounding edema. A complete tear (*open arrow*) is seen in the patellar insertion of the medial patellar retinaculum. A large joint effusion with layering (*black arrows*) is present, consistent with hemarthrosis. Note also the inferior fibers of the VMO (*arrowheads*).

DIFFERENTIAL DIAGNOSIS

- Ligament/capsular injury (anterior cruciate ligament, posterior cruciate ligament, medial collateral ligament, lateral collateral ligament, posterolateral corner)
- Osteochondral injury
- Medial patellar dislocation
- Extensor mechanism disruption
- Meniscal tear
- Patellofemoral osteoarthritis
- Contusion

NONOPERATIVE MANAGEMENT

- Nonoperative treatment is typically indicated for acute, first-time dislocators without associated osteochondral fracture or loose bodies.
  - Recent randomized prospective studies comparing treatment for initial patellar instability with and without surgery found a redislocation rate of 29% in the nonoperative group (vs. 0% in the operative group) but minimal difference in clinical or subjective outcomes.[25]

- Although there is evidence suggesting that immobilization after patellar dislocation can lower the risk of redislocation, patients often do not accept prolonged cast or splint immobilization.[11] As a result, nonoperative management relies on brace protection in the initial 6 to 8 weeks as the focus turns to progressive restoration of motion and functional rehabilitation.
  - After an acute dislocation, patients are initially placed into a knee immobilizer for comfort and allowed to be weight bearing as tolerated.
  - As soon as comfort allows, passive range of motion (ROM) and resisted closed-chain and isometric exercises in a patellar stabilization brace are initiated.
  - Patients are allowed to return to all functional activity including sports upon resolution of any effusion, attainment of full ROM, and a return of at least 80% of quadriceps strength compared to the uninjured extremity.
  - Patients are encouraged to continue wearing the patellar stabilization brace during participation in pivoting sports and activities.

SURGICAL MANAGEMENT

- An associated osteochondral fracture and loose body occurs in 3% to 4% of first-time dislocators and may necessitate acute surgical treatment.
  - Decision making in the presence of an osteochondral injury is guided by several factors, including the following:
    - The presence or absence of mechanical symptoms
    - The size and location of the donor fragment
    - The presence of adequate subchondral bone, an important factor when considering fragment repair
  - For smaller, pure chondral injuries with no associated mechanical symptoms, nonoperative treatment for first-time dislocators is appropriate.
  - In the presence of mechanical symptoms, surgery may be indicated and may include the following:
    - Loose body removal if the fragment is small and/or purely cartilaginous
    - Osteochondral fixation for larger fragments with an intact bony subchondral bed
  - In this case, MPFL reconstruction may be performed after addressing the osteochondral injury. In cases of osteochondral fixation, ensure optimal biomechanical strength and fixation to support the early motion necessary after MPFL reconstruction.
- Surgical management is indicated for patients with at least two documented patellar instability events and a confirmatory physical examination demonstrating excessive lateral patellar laxity.
  - For these recurrent dislocators, MPFL reconstruction is the current procedure of choice.

Preoperative Planning

- Plain radiographs should be reviewed for the presence of trochlear dysplasia (ie, crossing sign and trochlear prominence of 3 mm or more), avulsion fractures, patella alta, and loose bodies.
  - If patella alta is present (ie, Caton-Deschamps ratio of 1.2 or greater), then distalization of the tibial tubercle should be considered.
- MRI and CT scan are helpful in the preoperative workup and for preoperative planning of any associated procedures.
  - CT imaging can further identify and characterize avulsion or osteochondral fractures and loose bodies.
  - The use of axial MRI has been shown to more accurately classify trochlear groove anatomy (vs. axial radiographs or CT) when assessing trochlear dysplasia.[22]
  - Axial CT or MRI sequences are used to measure the TT–TG offset. Offset of 20 mm or more should be treated with medialization of the tibial tubercle.
- Examination under anesthesia should confirm excessive lateral patellar mobility.
  - The patella should displace more than 10 mm laterally from the centered position with the knee flexed 30 degrees, and there should be a soft or no end point with the knee extended.

Positioning

- The patient is positioned supine. A small bump may be placed under the hip to prevent external rotation. A sterile bump may also be placed under the knee to maintain slight flexion.
- Knee arthroscopy may be performed prior to MPFL reconstruction for both diagnostic and/or therapeutic purposes, including the following:
  - Subjective mechanical symptoms or joint effusion
  - MRI or CT evidence of osteochondral injury amenable to fixation
  - To assess patellofemoral tracking (from both anteromedial and superolateral portals) as well as to evaluate and stage any chondral injury, treat meniscal tears, and other associated intra-articular pathology
- As discussed earlier, in the presence of an osteochondral fracture amenable to fixation, arthroscopic or open reduction and fixation is performed prior to MPFL reconstruction.

Approach

- The surgical approach is discussed later (under Medial Patellofemoral Ligament Reconstruction section). The incisions may vary slightly, depending on whether associated procedures such as tibial tubercle osteotomy are to be performed.

Diagnostic Arthroscopy

- Standard anterolateral and anteromedial portals are used.
- A superolateral portal is used to facilitate viewing of the patellar articular surface as well as passive patellar tracking and mobility.
- Articular cartilage lesions are addressed.
  - Specifically, the patellofemoral compartment is assessed for the severity of articular cartilage injury and the presence of degenerative changes.
  - Unstable cartilage flaps are treated with débridement and/or chondroplasty.
- Loose bodies are removed and osteochondral injuries addressed as discussed earlier.

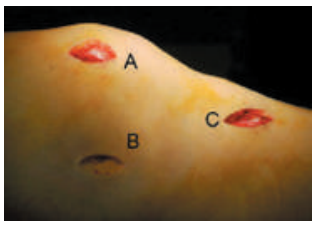
Medial Imbrication (ie, Medial Reefing or Plication)

- Traditionally, primary plication (tightening) of injured medial soft tissue structures was advocated to improve stability of the patellofemoral articulation (including medial retinacular tissue and MPFL).[13]
- Medial imbrication involves isolating the injured or compromised medial retinacular/MPFL tissue and placing sequential sutures to tighten this tissue and restore stability. This is typically performed with 2-0 nonabsorbable suture and can be done via an arthroscopic or mini-open technique.[13]
- Recent literature has found the MPFL to be the key restraint to lateral patellar translation; MPFL reconstruction may be a more anatomic and more effective procedure to correct recurrent patellofemoral instability.[13]
- Lateral retinacular release is almost never indicated as an isolated procedure as it is a key component of both lateral and medial stability. Isolated or overzealous lateral release can lead to medial instability and patellofemoral destabilization, especially in patients with soft tissue laxity. It is best reserved as an additional technique to recenter patellas that do not center easily.[17]

Medial Patellofemoral Ligament Reconstruction

Semitendinosus Tendon Graft Harvest and Preparation

- The sartorial fascia is exposed through a 2- to 3-cm skin incision made 2 cm medial and distal to the medial border of the tibial tubercle (**TECH FIG 1**).
- The sartorial fascia is incised in line with the palpable gracilis tendon.
  - Avoid making this incision too deep to avoid injury to the underlying superficial medial collateral ligament.
- Identify and isolate both the gracilis (proximal) and semitendinosus (distal) tendons from their deep aspect, that is, from within the bursal layer.
- Apply tension to the semitendinosus while freeing it from the crural fascia at the posteromedial corner with tissue scissors.



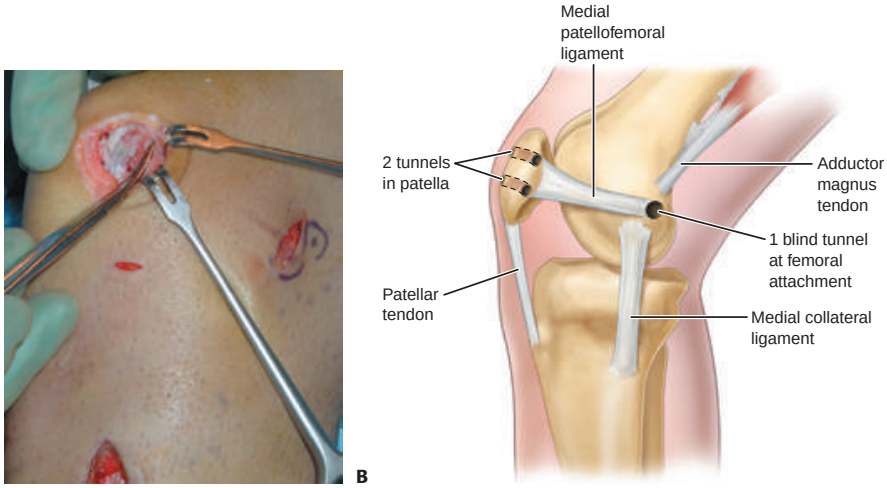
TECH FIG 1 ● Incisions used for MPFL reconstruction at the left knee. (*A*) Over the medial patella. (*B*) Over the femoral origin of the MPFL, which lies between the adductor tubercle and the medial epicondyle. (*C*) Over the pes anserinus, which is used to harvest the semitendinosus graft.

- Place stay sutures of no. 0 or 1 absorbable on a tapered needle, and then divide the tendon from the tibial insertion.
- Once all tendinous slips have been freed, harvest the semitendinosus tendon using a closed (preferred) or open tendon stripper.
- Baseball stitches are placed on both free ends for later graft passage through the two patellar tunnels. The remaining free ends are discarded after graft fixation.
- The graft is prepared on the back table by first sizing the graft to 240 mm then folding it in half, leaving a doubled graft of 120 mm. The excess is removed.
- A pullout suture of no. 5 polyester is placed through the loop to be used for pulling the doubled graft into the blind femoral tunnel.
- A baseball stitch 25 mm in length is placed in the looped end of the graft.

Patellar Tunnel Placement

- A longitudinal incision the length of the patella is made at the junction of the medial and middle thirds of the patella (in line with the medial border of the patellar tendon at the distal patellar pole).
- The medial 8 to 10 mm of the patella is exposed by subperiosteal dissection with a no. 15 scalpel.
- The dissection extends medially and dorsally around the patella through layers 1 (longitudinal retinaculum) and 2 (native MPFL), stopping after the transverse fibers of the native MPFL have been cut. The capsule (layer 3) is left intact (**TECH FIG 2A**).
- A 4.5-mm drill hole is placed on the medial side of the upper pole of the patella adjacent to the articular margin (**TECH FIG 2B**).
  - A corresponding drill hole is placed on the anterior surface of the patella approximately 8 mm from the medial border (this point corresponds to the lateral edge of the original retinacular dissection).
  - The two drill holes are connected with a curved curette.

TECHNIQUES



TECH FIG 2 ● **A.** Exposure of the medial patella of the right knee. The medial 8 to 10 mm of the patella is exposed by subperiosteal dissection. The native MPFL is dissected off the medial border of the patella, leaving the capsule (layer 3) intact. **B.** Schematic diagram of the medial knee demonstrating the locations of the two patellar tunnels and the blind femoral tunnel, reproducing the anatomic femoral origin and patellar insertion of the native MPFL.

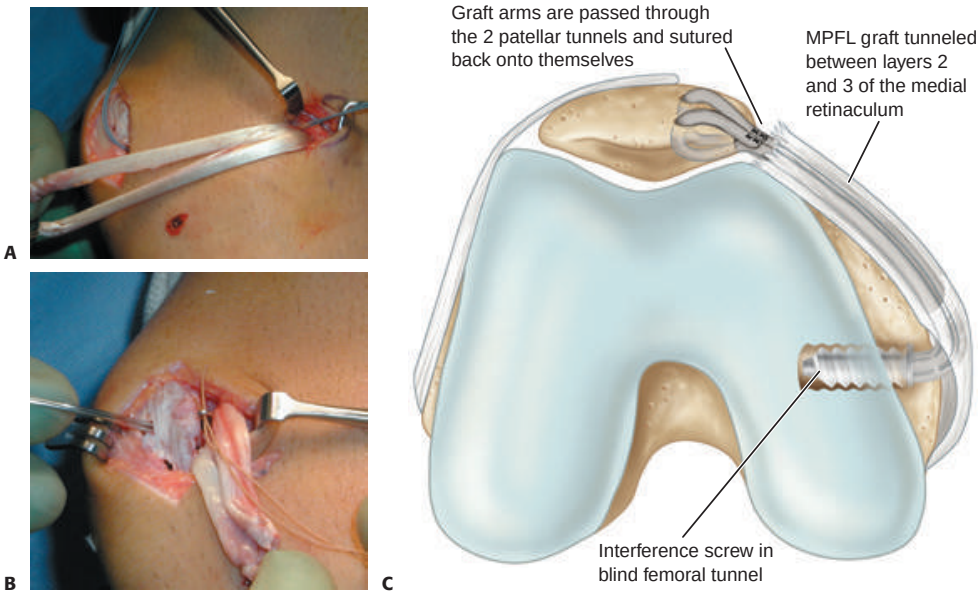
- A second 4.5-mm drill hole is placed on the medial side of the patella at a point two-thirds down the length of the patella.
  - Again, a corresponding drill hole is placed on the anterior surface of the patella about 8 mm from the medial border, and the two holes are connected with a curved curette.
- If the semitendinosus graft is more than 4.5 mm in diameter, the drill holes are enlarged slightly to facilitate graft passage.
- It is important to avoid placing the distal patellar tunnel distal to the native insertion of the MPFL to avoid constraining the distal pole of the patella.

Femoral Tunnel Placement and Checking Isometry

- A skin incision is made just anterior to the palpable ridge connecting the medial femoral epicondyle and the adductor tubercle (see **TECH FIGS 1** and **2**).
  - The knee is flexed slightly to facilitate palpation of this landmark (flexion moves the hamstrings posteriorly away from the medial epicondyle).
  - If the patient is obese and the landmarks are difficult to palpate, a small skin incision is made and palpation is done through the wound to identify the ridge.
- The graft may be placed between layers 1 and 2 or between layers 2 and 3 (joint capsule) (ie, it may lie superficial or deep to the native MPFL).
  - Placing the graft between layers 2 and 3 is preferred because blind dissection superficial to the native MPFL may disrupt the insertion of the VMO into the anterior portion of the MPFL; in addition, by placing the graft deep to the native MPFL, the latter may be repaired to the graft during wound closure.
  - The graft should not be placed deep to the capsule because it should remain extra-articular to avoid graft abrasion and facilitate complete healing.
- Using a long, curved clamp, the selected interval is developed (again, preferably between layers 2 and 3) from the patellar incision anteriorly to the medial femoral epicondyle posteriorly.
- With the tip of the clamp overlying the ridge between the medial epicondyle and adductor tubercle, layers 1 and 2 are incised using a no. 15 blade.
- The tip of a Beath pin is placed at a point 9 mm proximal and 5 mm posterior to the medial epicondyle; the pin is then passed toward the lateral side of the femur. Accuracy of pin placement should be confirmed by fluoroscopic imaging.[24]
- A loop of no. 5 braided polyethylene suture is passed through the Beath pin, through the dissected retinacular tunnel, then through one of the patellar tunnels.
- The knee is taken through the ROM to evaluate isometry.
  - If lengthening occurs in flexion, a second Beath pin is placed more distally toward the medial epicondyle. The first pin is left in place to facilitate repositioning while drilling the second Beath pin. The loop of no. 5 suture is passed through the second Beath pin, and the knee is put through ROM again. If isometry is acceptable, then the first Beath pin is removed.
  - If lengthening occurs in extension, a second Beath pin is placed more proximally toward the adductor tubercle. Again, the first pin is left in place to facilitate repositioning while drilling the second Beath pin. The loop of no. 5 suture is passed through the second Beath pin and the knee put through ROM again. If isometry is acceptable, then the first Beath pin is removed.
- Once the femoral pin site is accepted, a blind tunnel is reamed into the femur the size of the doubled graft. For a semitendinosus graft, this usually is 6 to 7 mm in diameter.
- The femur is reamed to a depth of at least 20 mm, with a preferred depth of 25 mm.

Graft Passage and Fixation

- No. 5 suture is passed through the Beath pin on the looped end of the graft, and the pin then is advanced out the lateral femoral cortex to pass the graft into the femoral tunnel.
- Fixation to the femur may be achieved reliably with a 20-mm interference screw.
- The looped isometry suture, if left in place in the retinacular tunnel, may be used to pass the free ends of the graft through the retinacular interval created previously (**TECH FIG 3A,B**).
- The free graft arms are passed individually through their respective patellar tunnels using double 22-gauge stainless steel wire or a curved suture passer.
- The graft arms enter the medial border of the patella and exit anteriorly (**TECH FIG 3C**).
- The free graft arms are then doubled back and sutured on themselves just medial to the patella using two figure-8 mattress sutures of no. 2 nonabsorbable suture on a tapered needle.
- Patellar mobility is checked after the first suture is placed. There should be a good end point, or checkrein, with the knee in full extension and at 30 degrees of flexion, full knee ROM, and 7 to 9 mm of lateral patellar displacement from the centered position at 30 degrees of flexion.
- Excess graft is sharply removed.
- The native MPFL is sutured to the graft, and then the retinaculum is closed over the graft.
- The wounds are closed in standard fashion.



TECH FIG 3 ● **A.** The synthetic isometry suture is in place. After correct placement of the femoral attachment site is confirmed using the isometry suture, the semitendinosus graft has been fixed to the femur using an interference screw. **B.** The isometry suture is used to shuttle the graft anteriorly out the medial patellar incision. The graft will then be fixed to the two patellar tunnels. **C.** Schematic diagram demonstrating fixation of the graft posteriorly into a blind femoral tunnel and anteriorly to two patellar tunnels. At the patella, each limb of the graft enters into respective medial drill hole, exits the anterior drill hole, then is sutured back to itself medial to the patella.

PEARLS AND PITFALLS

Indications	■ Perform examination under anesthesia to confirm excessive lateral patellar mobility. ■ Perform arthroscopy to stage articular cartilage lesions and rule out preexisting arthritis, a contraindication to MPFL reconstruction.
Femoral tunnel placement	■ This is one of the most critical steps in the operation. ■ Adjust the tunnel placement to ensure appropriate graft behavior during flexion and extension, recreating isometry. ■ Check for accurate tunnel placement using fluoroscopy.[24]
Setting MPFL graft length without tension	■ Center the patella in the patellar groove and ensure that the MPFL graft is lax throughout an ROM, becoming tight only when the patella is displaced laterally from its centered position. ■ The patella should enter the trochlea from the lateral side as the knee is flexed. ■ The graft should not be tensioned as it serves as a checkrein. It should be set to a length that allows no excessive slack and no tension.
Overtightened graft resulting in excessive medial constraint	■ If the patella enters the trochlea from the medial side as the knee is flexed or if there is less than 5 mm of lateral patellar glide with gentle manual force at 30 degrees of knee flexion, then the graft is overtensioned. The sutures should be removed and the graft length set again.
Breakage of patellar bone bridge	■ May occur during preparation of the two patellar tunnels or during passage of an oversized graft through a tight patellar tunnel. ■ If this occurs, then drill a second exit hole more laterally on the anterior patellar surface or drill the tunnel transversely across the patella, exiting at the lateral patellar margin. ■ The graft can be secured by tying the sutures over a button or suturing the end of the graft to the soft tissues on the lateral patellar border. ■ Drilling a tunnel across the patella carries a risk of patellar fracture.

POSTOPERATIVE CARE

- Weight bearing as tolerated is allowed immediately postoperatively in a drop-lock or knee extension brace.
  - Bracing may be continued for up to 6 weeks during ambulation to prevent falls until quadriceps control is restored.
- After the soft tissue procedure, passive ROM and resisted closed-chain exercises are started as soon as possible to restore ROM and quadriceps control.
- If a tibial tubercle osteotomy is performed, passive ROM using heel slides is begun postoperatively. No active extension is allowed for the first 6 weeks postoperatively. At that time, full active ROM is begun, followed by closed-chain resistance exercises at 3 months postoperatively.
- Patients are allowed to return to stressful activities, including sports, when they attain full ROM and have regained at least 80% of their quadriceps strength compared to the noninjured limb.
- If at least 90 degrees of flexion is not achieved by 6 postoperative weeks, then the intensity of the therapy program must be increased; manipulation under anesthesia (MUA) may be needed between 9 and 12 weeks postoperatively if stiffness does not resolve with therapy alone.

OUTCOMES

- In a series of 92 knees treated with MPFL reconstruction, Fithian and Gupta[9] reported only 7 failures or reoperations (7.6%) and only one case of frank patellar redislocation (1.1%). Most of the reoperations were for stiffness and were treated successfully with MUA.
- Schöttle et al[23] reported 86% good and excellent results at 47 months after MPFL reconstruction using semitendinosus autograft. In their series of 15 MPFL reconstructions, there was one case of bilateral recurrent instability.
- Steiner et al, [26] in a series of 34 patients treated with MPFL reconstruction using a variety of graft sources, reported 91.1% good and excellent results at 66 months and no recurrent dislocations.
- In a series by both Schöttle et al[23] and Steiner et al,[26] the presence of trochlear dysplasia did not affect the outcome of MPFL reconstruction.
- Nomura and Inoue[19] reported on 12 knees after hybrid MPFL reconstruction using semitendinosus graft at a minimum of 3 years follow-up. There were 83% good and excellent results and no cases of recurrent patellar subluxation or dislocation.

COMPLICATIONS

- Stiffness
- Redislocation
- Excessive medial patellar constraint resulting in a painful, overconstrained patella[8,14, 17,18]
- Patellar fracture
- Symptomatic hardware

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