

Medial Patellofemoral Ligament Reconstruction and Lateral Retinacular Lengthening from a Lateral Approach



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Abstract: The medial patellofemoral ligament (MPFL) is frequently torn and attenuated in patients with acute or chronic patellar instability. The mainstay for surgical treatment has become MPFL reconstruction to reestablish the checkrein to lateral patellar translation. The authors describe a technique for MPFL reconstruction with concomitant lateral retinacular lengthening with a gracilis allograft and adjustable loop cortical femoral fixation performed chiefly from a lateral parapatellar approach. This technique allows for reliable retensioning of the medial and lateral patellar soft tissues while avoiding complications associated with techniques that use interference screw fixation. Successful execution of this procedure provides a strong MPFL construct that allows patients to undergo early aggressive rehabilitation and return to activities.

Lateral patellar instability can range from asymptomatic subluxation and patholaxity to acute lateral patellar dislocation. Rates of patellar dislocation have been calculated to be between 2 to 43 per 100,000 person-years, in the general and higher-risk adolescent populations, respectively.¹⁻³ Unfortunately, non-operative treatment modalities are not effective in some patients, especially for patients with chronic instability due to underlying pathoanatomy. Surgical reconstruction of the medial soft tissue structures, most notably via medial patellofemoral ligament (MPFL) reconstruction, has become the gold standard treatment option for lateral instability. However, because the patella is tensioned into the trochlea from both medial and lateral structures, a

medial reconstruction alone ignores any lateral pathology. Lateral retinacular lengthening (LRL) has been described to address concomitant lateral tightness in lateral patellar instability, and when used in conjunction with medial reconstruction, it allows the surgeon to effectively rebalance the patellofemoral forces.⁴ An arthroscopic lateral release can also loosen tight lateral structures; however, LRL has gained interest recently because of its ability to perform a more precise lengthening of the lateral structures and avoid medial instability.⁵ Furthermore, LRL was shown to be the preferred technique to address tight lateral tissues by the International Patellofemoral Study Group.⁶ The purpose of this Technical Note is to describe a reproducible method for MPFL reconstruction and lateral retinacular lengthening done chiefly from a lateral parapatellar approach in which adjustable loop cortical fixation is used for femoral fixation as opposed to an interference screw.

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Indications

Soft tissue retensioning and augmentation via MPFL reconstruction and LRL can be performed in virtually every case of lateral patellar instability. The principle decision is whether to perform this in isolation or in addition to another procedure. Given that most surgical patellar instability is due to some form of pathoanatomy (trochlear dysplasia, patella alta, genu valgum, femoral anteversion, etc.), a determination will need to be made whether the underlying pathoanatomy needs to be



Fig 1. Left leg of a patient positioned supine on a regular operating room table. Concomitant arthroscopy can be performed on an as-needed basis. A laterally-based incision approximately the length of the patella (5-6 cm) is marked out just medial to the lateral border of the patella. (black arrow = lateral border of the patella, red arrow = inferior pole of the patella)

corrected. For cases in which the underlying pathoanatomy is mild to moderate, an isolated MPFL reconstruction and LRL can be performed.⁷ When the underlying problem becomes more severe, this soft tissue rebalancing is done in addition to a corrective procedure (e.g., trochleoplasty for high-grade trochlear dysplasia or distalizing tibial tubercle osteotomy for severe patella alta). To be clear, in almost all cases of patellar instability, the core problem is not an inherently weak MPFL. Thus MPFL reconstruction should be

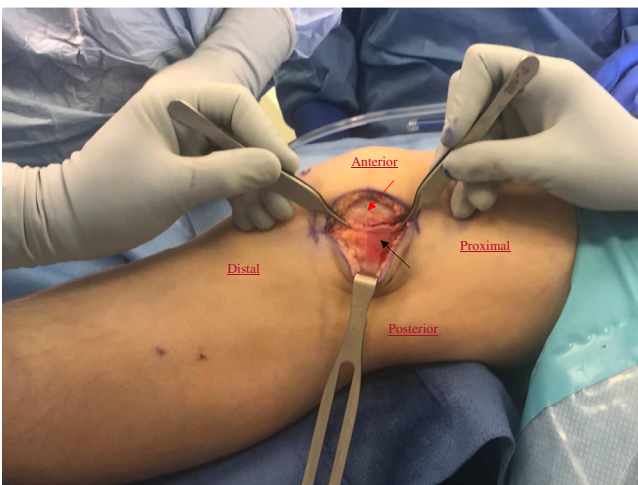


Fig 2. Lengthening of the lateral retinaculum is performed first through the laterally-based incision. With the patient supine and the knee flexed over a radiolucent triangle, the superficial layer (black arrow) is dissected off the lateral border of the patella (red arrow) while the deep layer is left attached to the patella. The deep layer is incised and freed from the anterior aspect of the iliotibial band.

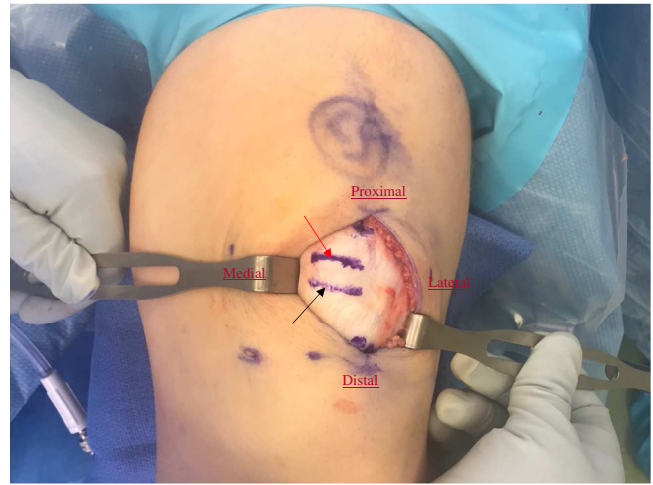


Fig 3. With the patient supine and the knee in slight flexion over a radiolucent triangle, the medial side of the patella is exposed for preparation of patella sockets for the medial patellofemoral ligament graft. The midpoint of the proximal to distal aspect of the patella is marked with a surgical marking pen (black arrow). Next, a position halfway between the midpoint and the proximal pole is marked (red arrow). This will be where the two limbs of the graft will be anchored.

viewed as a compensatory procedure that strengthens the native MPFL to resist the underlying pathology that has created the instability. Although a discussion of

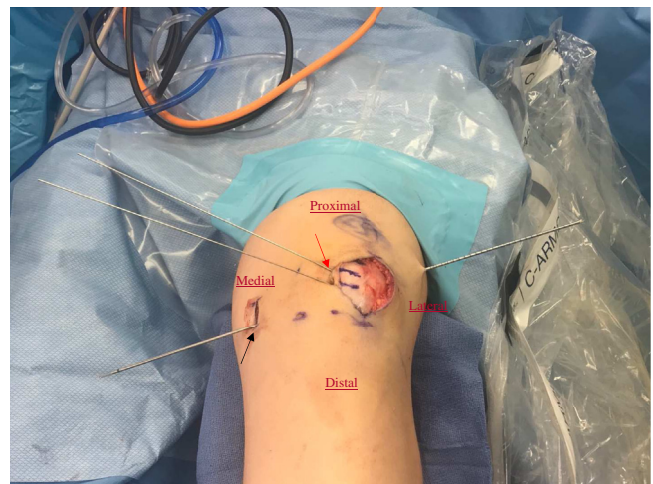


Fig 4. After medial patella exposure, two 0.45 K-wires are placed in the upper half of the patella, one at the midpoint between the inferior and superior aspect of the patella and one halfway between the midpoint and superior extent of the patella (red arrows). Fluoroscopy is used to confirm correct placement in the cancellous portion of the patella avoiding the articular cartilage or the anterior cortex (Fig 5). A Beath pin is then placed under fluoroscopic guidance at the femoral insertion of the medial patellofemoral ligament through a 2-cm incision over the medial distal femur (black arrows). The knee is positioned in approximately 45 degrees of flexion on the radiolucent triangle during guidewire and Beath pin placement for easy of lateral fluoroscopy and ease of access.

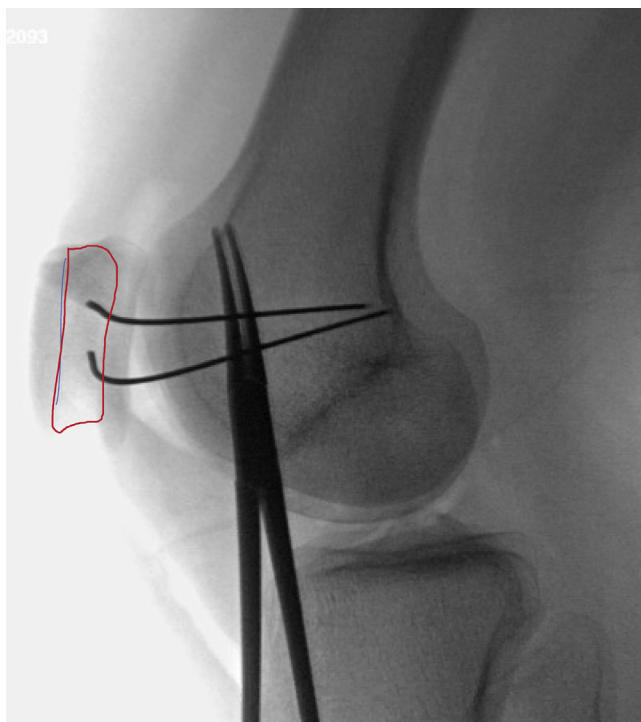


Fig 5. Lateral knee fluoroscopic image showing ideal placement of guidewires within the cancellous portion of the patella (red outline). Imaging is used before drilling sockets and graft fixation to avoid malposition and minimize the risk of patella fracture.

what constitutes high-grade pathoanatomy is beyond the scope of this Technical Note, this is a critical point to understand and take into consideration when indicating someone for patellar stabilization surgery. The technique described below involves a “V”-shaped MPFL graft with two points of fixation on the patella and one point of fixation on the femur using an adjustable loop cortical button. This allows for precise titration of graft length on the femoral side while avoiding some of the complications related to interference screw fixation such as overtensioning, graft damage, and screw backing out with loss of tension and prominent hardware.

Surgical Technique

A complete demonstration of the surgical technique described in this section can be viewed in the [Video 1](#). Before prep and drape, an adductor canal block is preferred as an adjunct to general anesthesia for post-operative pain control. The patient is positioned supine with a thigh-high tourniquet and subsequent draping well proximal to the operative knee in the standard fashion. The limb is exsanguinated with an Esmarch, and the tourniquet is inflated. An incision that is approximately the length of the patella (usually 5-6 cm) is made just medial to the lateral border the patella, and dissection is carried down to the lateral retinaculum

([Fig 1](#)). The incision is placed as such because the patella is typically translated slightly lateral in the setting of recurrent patellar instability. Once the surgery is complete, the patella will be more medial, and the incision will now be on the lateral border of the patella. The retinaculum is subsequently opened in a Z-lengthening fashion by elevating the superficial layers of the retinaculum from the lateral patella posteriorly until the longitudinal fibers of the iliotibial (IT) band are visualized. The retinacular lengthening proceeds proximally from the inferior aspect of the vastus lateralis tendon down the proximal tibia between the tibial tubercle and Gerdy’s tubercle. The deep layer of the retinaculum is incised just anterior to the IT band from the vastus lateralis tendon to the proximal tibia between Gerdy’s tubercle and the tibial tubercle ([Fig 2](#)). The two layers will be closed back to each other in a lengthened fashion at the end of the case.

Through this same lateral incision, the medial patella is exposed by elevating a fasciocutaneous flap over the anterior patella. The superior and inferior borders of the patella are marked, as are the sites for patellar graft placement. The inferior limb of the graft will be placed at the superior-to-inferior midpoint of the patella, and the superior limb will be placed halfway between the midpoint and the superior border of the patella ([Fig 3](#)). The medial retinacular structures are incised, typically with electrocautery, to expose the medial patella. Two

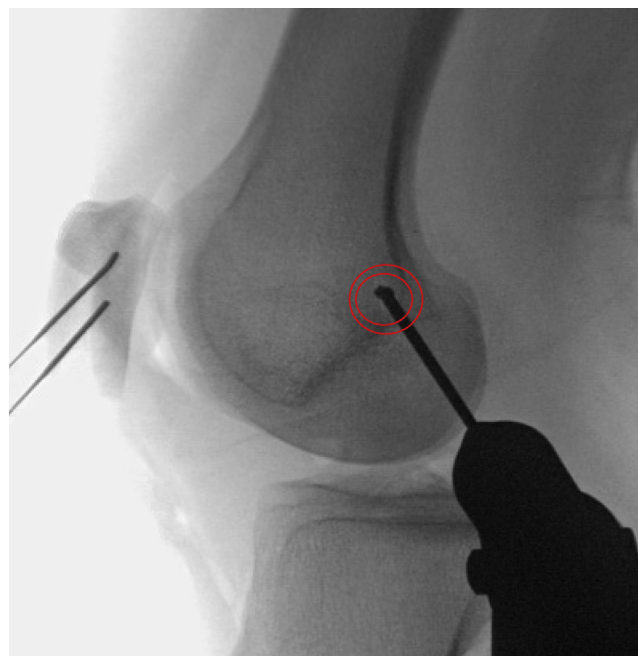


Fig 6. Lateral knee fluoroscopic image showing proper placement of the MPFL femoral insertion guide pin at Shuttle’s area (red circle). Once accurate placement is confirmed with imaging the guidewire is advanced in an anterior and proximal direction and out the lateral femoral cortex and skin on the lateral thigh ([Fig 4](#)).

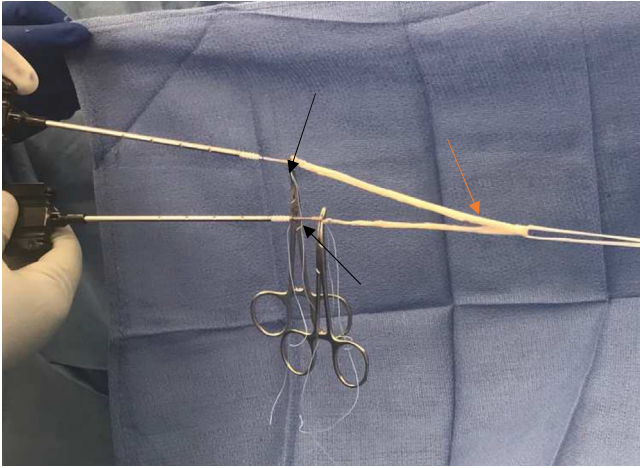


Fig 7. MPFL reconstruction construct consisting of a folded gracilis allograft fashioned with 3.5-mm biocomposite Swivelock anchors on each free end (black arrows) and a Tight Rope RT at the midportion of the graft (red arrow).

0.45 Kirshner wires are placed in the patella just anterior to the articular cartilage at these two points (Fig 4). To avoid postoperative patellar fracture or violation of the patellar chondral surfaces, the pins should be placed in the central cancellous bone and avoid either anterior or posterior cortex. Appropriate pin placement is confirmed with a lateral fluoroscopic view (Fig 5). A radiolucent tibial triangle is used to steady the extremity for reliable imaging. Keeping the fluoroscope in position, the femoral insertion of the MPFL, Schottle's point, is determined with a perfect lateral view. A small, 2- to 2.5-cm incision is made here, and a 3.5-mm spade-tipped Beath pin (Arthrex, Naples,



Fig 8. The graft is anchored into the patella via suture anchors (black arrows) then passed through layers 2 and 3 on the medial aspect of the knee and out the medial incision (red arrow). After drilling of the femoral tunnel, the graft is passed through the femoral tunnel aided by a Beath pin (Fig 9).

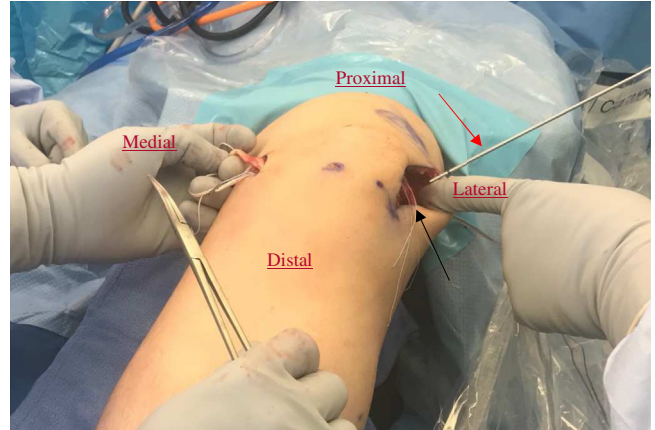


Fig 9. The Beath pin (red arrow) is pulled through the femur to shuttle the passing sutures of the cortical button. The passing sutures can be easily retrieved in the lateral incisions (black arrow).

FL) is placed. Optionally, once the Beath pin is placed in the femur but before it is driven through the far cortex, the reamer for the femoral tunnel can be placed over the Beath pin and onto the medial femur. A fluoroscopic picture can be taken here to confirm that the subsequent tunnel will be created in the desired location (Fig 6). The Beath pin is then drilled through the lateral cortex of the femur and through the skin of the lateral thigh.

A gracilis allograft is routinely used as the MPFL reconstruction graft. Most gracilis grafts are between 200 to 220 mm. If a graft is longer than 220 mm, it can be trimmed to ensure it doesn't bottom out in the femoral tunnel, although this would be exceedingly rare with this technique. Each free end is bulletized as needed and reinforced with 2-0 FiberWire (Arthrex). A TightRope RT (Arthrex) is then loaded on the graft by placing the graft through the interlocking adjustable loop (Fig 7). The graft is sized to ensure that it will easily fit in a 4.5-mm tunnel.

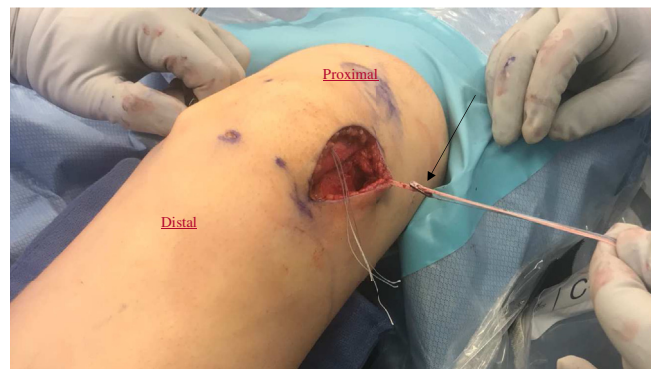


Fig 10. After passing the graft through the femoral tunnel (Fig 9), the button (black arrow) is easily visualized through the laterally based incision. This allows seating of the button onto the lateral femoral cortex under direct visualization.

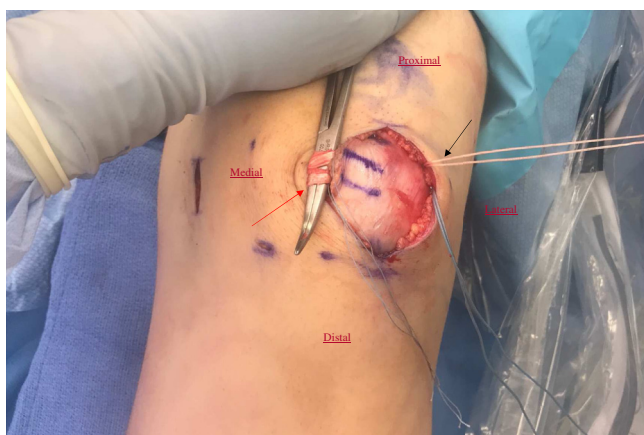


Fig 11. The graft is tensioned with the knee in 45° of flexion by progressively tightening the adjustable loop of the TightRope (black arrow). Once the graft enters the femoral tunnel, a curved clamp is placed under the graft at the patellar insertion during final tensioning to prevent overtensioning the graft (red arrow). The adjustable loop is tightened until the patella has approximately a quadrant and a half of lateral patellar translation in full extension with neutral patellar tilt. It is important to make sure that the patella is seated in the trochlear groove and that it has a neutral position during graft tensioning. This also prevents overtensioning.

The patellar sockets are created with a 3.5-mm cannulated drill over the k-wires, and both limbs of the graft are secured with 3.5-mm biocomposite Swivelock suture anchors (Arthrex) (Fig 8). Using Metzenbaum scissors, the layer deep to the medial retinaculum is developed down to the femoral insertion of the MPFL. A shuttle suture is used to bring the graft and Tightrope construct down to and out of the femoral incision. To double-check appropriate femoral tunnel position, the graft is wrapped around the Beath pin that is still in place in the femur. The knee is fully flexed, and the graft is checked to see if it loosens, tightens, or stays isometric. Ideally, the graft loosens slightly in flexion and at worst, it stays the same. If the graft tightens, the Beath pin placement should be changed. Once this double-check is complete, the femoral tunnel can be drilled. Although the tunnel size can be adjusted to accommodate the size of the graft, we routinely drill a 4.5-mm tunnel, and we also penetrate the far cortex with the drill. Penetrating the far cortex allows for the Tightrope button to pass easier through the femoral tunnel and also obviates the risk of the graft bottoming out in the femoral tunnel. In the rare cases that the doubled over diameter of the gracilis allograft is larger than 4.5 mm, we elect to thin the graft to fit the tunnel as opposed to using a larger drill. This allows for the operating room staff to always open the same equipment and maximize efficiency of the operation.

After femoral tunnel completion, the passing and tensioning sutures from the Tightrope are loaded

through the eyelet of the Beath pin, and these are passed through the femoral tunnel and out of the skin of the lateral thigh (Fig 9). Next, taking further advantage of the lateral incision, the sutures are retrieved and brought out through the lateral incision. At this point, the Tightrope button is passed through the femoral tunnel, and it is flipped and seated under direct visualization on the lateral femur (Fig 10). If needed, soft tissue surrounding the tunnel aperture can be removed to help visualize and seat the button. With the knee in approximately 45° of flexion, typically achieved by using the radiolucent tibial triangle, the adjustable loop of the TightRope is progressively tightened until the graft enters the femoral tunnel. A curved clamp is placed under the graft on the medial patella during final tensioning (Fig 11). This prevents inadvertent overtensioning of the graft. In addition, the patella is held firmly in the trochlear groove and with neutral tilt to further minimize the risk of overtensioning. The adjustable loop is shortened until the patella has approximately a quadrant and a half of lateral patellar translation in full extension with neutral tilt. Knee range of motion is re-examined to ensure that there is full flexion.

After the wounds are irrigated, the knee is flexed to 70°, and the retinaculum is closed in a lengthened fashion with 0 Vicryl suture (Ethicon, Inc., Somerville, NJ) in a pants-over-vest fashion. The superficial layer of the retinaculum is pulled up and sutured in place in relaxed tension wherever it comes to lie (Fig 12). This allows for an anatomic restoration of lateral-sided tension and to avoid iatrogenic medial instability. The dermal and subcuticular layers of both incisions are closed with absorbable sutures, a soft dressing is applied, and the tourniquet is released.

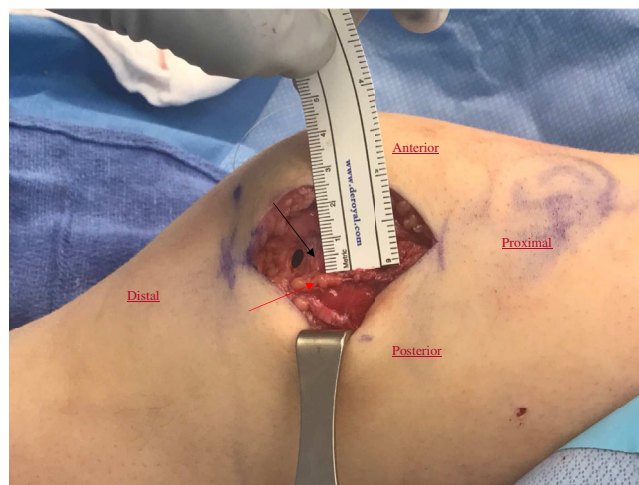


Fig 12. After satisfactory placement and securing of the MPFL graft, the lateral retinaculum is closed in the lengthened position. With the knee in 70° of flexion, the superficial layer of retinaculum (red arrow) is pulled up and sutured in place to the deep layer (black arrow) in relaxed tension wherever it comes to lie. The amount of lengthening can be measured and recorded.

Table 1. Advantages and Disadvantages**Advantages**

- An anatomic reconstruction is performed that best recreates normal anatomy.
- Allograft choice eliminates donor site morbidity and reduces tourniquet time.
- Open lateral lengthening allows for improved measurement of lateral sided tension compared to an arthroscopic release.
- Laterally based incision allows for easily visualization of the femoral tunnel and button manipulation.
- Femoral fixation with cortical button decreases risk of graft damage, loosening, and migration seen with interference screw fixation.
- Femoral fixation with cortical button has superior biomechanical strength compared to interference screw
- Adjustable loop button allows for re-tensioning of the graft if unsatisfied after preliminary tension and stability assessment.

Disadvantages

- Intraoperative fluoroscopy is required to facilitate anatomic positioning of the graft.
- Creation of patellar bone tunnels carries low risk of patella fracture.
- Lateral lengthening adds additional time and dissection compared with MPFL reconstruction alone.
- Adjustable loop button can be overtightened which requires removal of button and attaching a new one.

MPFL, Medial patellofemoral ligament.

Postoperative Management

After surgery the patient can weight-bear as tolerated with crutches for comfort and begin full range of motion as tolerated. No brace is used. Physical therapy commences within 1 to 2 weeks after surgery, with an early focus on range of motion, swelling reduction, and isometric strengthening. Progressive strengthening can begin shortly thereafter with impact activities including light jogging potentially starting around 6 to 8 weeks. Full return to sport can occur within 3 months pending progress with physical rehabilitation.

Discussion

Lateral patellar instability is a common orthopaedic condition that is caused by a variety of pathoanatomy. In patients who sustain a patellar dislocation, the MPFL is disrupted 94% to 100% of the time.⁸ Reconstruction of

the MPFL is commonly performed to help stabilize the patella and create a stronger soft tissue restraint to lateral translation than the native MPFL. This is done in isolation as a compensatory procedure when underlying pathoanatomy is less severe or as a concomitant procedure when performing osseous corrective procedures such as a tibial tubercle osteotomy, femoral osteotomy, and trochleoplasty when pathoanatomy is more severe.⁹ Clinical outcomes with modern MPFL reconstruction in isolation have been favorable. Schneider et al.¹⁰ recently performed a systematic review and meta-analysis looking at outcomes of isolated MPFL reconstruction with up to 5-year follow-up and found a pooled risk of recurrent instability after surgery to be only 1.2%. They also found that athletes with instability treated with MPFL reconstruction returned to their preinjury sports level 84.1% of the time. Mochizuki et al.¹¹ recently reported excellent

Table 2. Pearls and Pitfalls**Pearls**

- Make lateral incision just medial to the lateral border of the patella. The patella is typically translated laterally and therefore after reconstruction and tensioning of the MPFL the incision will lie on the lateral border of the patella. Slight medialization of the incision further facilitates easier access to the medial side of the patella for tunnel and graft placement.
- Use fluoroscopy after placement of patella guide pins to ensure trajectory within the cancellous portion of the patella to minimize risk of fracture.
- When reaming the femoral tunnel, the 4.5 mm drill can be advanced through the lateral femoral cortex to allow easier passage and visualization of the cortical button.
- After fixing the graft to the patella but prior to passing the graft through the femur, wrap graft around Beath pin and fully flex the knee. If the femoral tunnel is appropriate the graft will remain with the same tension or loosen slightly. If the graft tightens, the Beath pin should be adjusted.
- Ensure cortical button is fully seated on the lateral femoral cortex prior to shortening the adjustable loop.
- To minimize overtensioning of the graft, place a curved clamp under the graft at the level of the patella and hold the patella at neutral tilt while tensioning. Once the graft tightens over the clamp, stop tensioning and check patella translation in full extension. Retension as needed.

Pitfalls

- Carry the lateral lengthening posteriorly through the contributions of the iliotibial band and incise the deep layer of the retinaculum just anterior to the longitudinal fibers of the iliotibial band. This should create a deep flap that is roughly 3 cm. Failure to do so may result in a deep flap that is too short and unable to be covered at time of closure
- Violation or significant compromise of the anterior cortex of the patella with sockets can increase the risk of patella fracture.
- While it is almost impossible to have a gracilis allograft that is too long for this technique, always premeasure the graft to ensure that it is between 200-220 mm long. If a longer tendon than a gracilis is used, make sure it is cut down prior to graft placement
- Before final tensioning of the graft, manually stretch the graft with a curved clamp at the level of the patella to remove any graft-adjustable loop foldover in the femoral tunnel.

MPFL, Medial patellofemoral ligament.

outcomes of MPFL reconstruction using an adjustable cortical fixation system similar to our technique. They reported no complications (re-dislocation, patella fracture, infection, and joint contracture) and significantly improved patient-reported outcome scores at mean follow-up of 33 months. Advantages and potential disadvantages of our technique are described in [Table 1](#). With attention to certain details associated with this procedure ([Table 2](#)), this technique can provide a consistent method for rebalancing the soft tissues stabilizing the patella by reconstructing the MPFL and addressing concomitant lateral tightness with lateral retinacular lengthening through a laterally-based incision.

The routine incorporation of a lateral soft tissue procedure may be looked at by some as unnecessary but critical review of magnetic resonance images of patients with recurrent patellar instability will consistently show increased lateral patellar tilt and translation. While this is typically attributed to medial soft tissue laxity, the lateral structures have reflexively tightened. The lateral retinacular tightness can be treated with either lateral retinaculum release (LRR) or LRL. Although an arthroscopic LRR is commonly performed, it is not without complications. LRR has been shown to lead to increased lateral pain, postoperative hemarthrosis, and medial patellar instability.⁶ Complications occur most commonly after overaggressive surgical release leading to muscle atrophy, loss of soft tissue restraint, and medial instability.¹² Comparatively, LRL reduces lateral-sided tension without losing soft tissue integrity, thus reducing the risk of medial patellar instability.¹³ Studies have also demonstrated improved outcomes with LRL compared with LRR. Two prospective randomized studies comparing LRR to LRL demonstrated better functional knee outcomes and return to sport with LRL.^{14,15} Since incorporating this as a routine part of our patellar stabilization surgical protocol, we have performed over 200 LRLs in conjunction with MPFL reconstruction, and we have achieved a minimum lengthening of 1 cm every time.

Another unique advantage of this technique is that femoral fixation is achieved with a cortical button that avoids graft damage, screw back out and is biomechanically stronger than an interference screw.¹⁶ Golant et al.¹⁷ first described the use of suspensory fixation for an MPFL reconstruction, but this hybrid construct also used interference screw fixation on the femur, which seems to obviate the benefits of the button. Interference screw graft fixation, when used for MPFL reconstruction, can cause overtensioning, undertensioning, graft damage, screw migration, and screw prominence. With an adjustable loop cortical button system, we have the advantage of minimizing or eliminating these potential interference screw-related complications, without sacrificing the adequate strength necessary to reconstruct the MPFL.¹⁸ This system is further advantaged with the lateral

incision because it allows the button to be secured on the lateral femur under direct visualization and negate the risks of deployment on the iliotibial band or incomplete passage through the distal femur. In the rare event in which the adjustable loop is overtensioned, this can be easily corrected by cutting the button from the adjustable loop under direct visualization through the lateral incision or the anchors in the patella can be partially backed out, the tension adjusted and the anchors reinserted. Either of these measures will cause little to no graft damage. To our knowledge suspensory MPFL reconstruction is described in only two prior Technical Note which both address only the medial parapatellar tissue.^{19,20} Although medial suspensory graft fixation reconstructs the MPFL, it does not allow for precise tensioning from both the medial and lateral sides of the patella.

Conclusion

This MPFL reconstruction technique allows for systematic patellar tensioning by reconstructing the medial patellar checkrein while simultaneously adjusting for lateral tightness, all through a laterally based incision. The biomechanical strength and reliability of this construct allows for an aggressive rehabilitation and early return to activity while avoiding pitfalls and complications associated with other techniques that use femoral interference screw fixation.

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