Patella Footprint Technique—A Surgical Method for Medial Patellofemoral Ligament Reconstruction

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Abstract: Recurrent patella instability is a common condition that may potentiate substantial knee dysfunction resulting in loss of time from work and sports. There are numerous factors that contribute to recurrent patella instability including tearing of the medial patellofemoral ligament (MPFL), shallow trochlea, valgus alignment, externally rotated tibia tubercle, ligamentous laxity, elevated Q angle, and increased tibial tuberosity trochlear groove distance. Reconstruction of the MPFL has been shown to restore patella stability where concomitant pathology is within acceptable limits. Major complications include recurrence from inadequate MPFL reconstruction or failure to address other pathology, patella femoral pain from over constrained MPFL or unaddressed cartilage defects to the patella femoral compartment, or patella fracture. This technique provides a reproducible method of restoring patella stability through MPFL reconstruction while minimizing stress risers in the patella by using suture anchor fixation that creates a ligamentous footprint instead of tendon healing into a socket on the patella.

The vast majority of patella dislocations occur laterally, implicating injury to the medial patellofemoral ligament (MPFL), which is the primary passive restraint to lateral translation of the patella. Recurrent patellar dislocation is frequently observed among young, active patients with a greater predilection for females. Identifying patient-specific risk factors such as presence of genu valgum, large Q angle, ligamentous laxity, trauma, or patella alta is crucial as patients with at least 2 dislocations have a 50% recurrence rate.

Surgical reconstruction of the MPFL has become increasingly common with the development of various surgical techniques showing satisfactory short- and midterm outcomes. Although the goal of surgical intervention is to provide a functional anatomic reconstruction in conjunction with appropriate graft tensioning and secure fixation to prevent nonphysiological patellofemoral loads, ambiguity as to the ideal method still exists. Postoperative complications can largely be attributed to technical inaccuracy, with stiffness reported in up to 4.6% of patients and patella fractures reported in 3.5% of patients undergoing surgical management. Therefore, we present a surgical technique for MPFL reconstruction using suture anchor fixation that creates a ligamentous footprint along the medial patella (Video 1).

Surgical Technique

Step 1: Patient Preparation and Diagnostic Arthroscopy

The patient is placed in the supine position. The skin incisions and anatomical landmarks are shown in Figure 1. After the induction of general anesthesia, the patient is examined for range of motion and the presence of 4-quadrant translation with minimal force applied. After the examination under anesthesia, the patient is prepped and draped in a sterile fashion. Using standard anterolateral and anteromedial portals, diagnostic arthroscopy of the affected knee is performed. In the presence of chondromalacia of the patellofemoral articulation, chondroplasty is performed (Video 1).
Step 2: Graft Harvesting and Preparation

A longitudinal incision is made over the pes anserinus, and dissection carried out down to the level of the sartorial fascia. The sartorial fascia is identified and incised proximal to and in line with the gracilis tendon. The gracilis tendon is bluntly dissected off of the sartorial fascia, and brought out of the wound using a hemostat (Fig 2).

The open hamstring stripping device (Stryker Orthopedics, Mahwah, NJ) is used to harvest a gracilis tendon autograft, maintaining the distal attachment during the harvesting process. Once harvested, the gracilis tendon is detached sharply at its insertion taking care to avoid damage to the semitendinosus. The muscle belly is removed from the tendon using a periosteal elevator, and a whip stitch is applied to the distal end of the tendon using a No. 2 orthocord suture (DePuy Mitek, Warsaw, IN). Place the graft in a moist lap sponge while attention is now turned to the placement of suture anchors in the patella.

Step 3: Medial Patella Dissection With Suture Anchor Placement and Bone Debridement

Next, a longitudinal incision is made over the medial border of the patella, and dissection is carried out down to the level of the capsule. A longitudinal arthrotomy is performed just medial to the patella tendon. The proximal third of the medial aspect of the patella is debrided with a rongeur down to a base of bleeding bone, creating a footprint for graft insertion. Two GRYPHON suture anchors (DePuy Mitek) are paced in the medial aspect of the patella: the first at the juncture of the proximal and middle thirds, and the second 5 mm to 1 cm proximal to the first (Fig 3).

Step 4: Soft Tissue Tunneling

Using the adductor tubercle and the medial femoral epicondyle as anatomical reference points, a blunt instrument is used to develop an intra-articular, extrasynovial plane for tunneling toward the anatomic insertion of the medial patellofemoral ligament on the femur (Fig 4).
Step 5: Femoral Tunnel Formation, Graft Preparation, and Femoral Graft Fixation

An incision is made over the site of anatomic origin of the MPFL on the femur. A guidewire is placed to approximately 30 mm of depth at the anatomic insertion of the MPFL on the femur, which can be identified in the saddle area proximal-posterior to the medial epicondyle and distal-anterior to the adductor tubercle. The femur is drilled and the drill hole is tapped. One end of the whip stitch applied to the tendon autograft is loaded through a 7 mm × 23 mm MILAGRO interference screw (DePuy Mitek) with the assistance of the CHIA PERCPASSER suture passer (DePuy Mitek). The tendon is pushed into the drill hole with a pickup or freer, and the screw is advanced until flush with the cortex of the femur (Fig 5). A free needle is used to sew the unused end of the suture through the graft, and it is tied to the end that was previously passed through the suture anchor.

Step 6: Deliver Graft Through Soft Tissue Tunnel and Tension Graft

The graft is passed through the intra-articular, extrasynovial plane using a hemostat (Fig 6). With the knee held in 45° of flexion, the graft is marked where it aligns with the more distal suture anchor, and then from there the distance between the 2 suture anchors is marked off on the graft.

Step 7: Secure Distal and Then Proximal End of the Graft to the Patella

A free needle is used to whip stitch the graft to the appropriate suture anchor at each level. The unused end is pulled to take up slack, bringing the graft down to the bone and anchor. The knots are subsequently tied, starting with the distal anchor and the excess graft is cut off (Fig 7).

Step 8: Evaluate Graft Tensioning

The knee is taken through range of motion to confirm that the graft is not over tensioned. Translation is confirmed to be less than 2 quadrants.

Step 9: Wound Closure

The capsule is repaired in a pants-over-vest fashion with a No. 2 orthocord (DePuy Mitek), and the skin is closed with a subcuticular vicryl suture followed by a running monocryl.

Rehabilitation Protocol

Postoperatively, the patient is weight bearing as tolerated with the brace in 0° to 30° of flexion for the first week, progressing to 60° of flexion by week 2 and 90° of flexion by week 4. With the assistance of a physiotherapist the patient is to work on strengthening of the quadriceps, especially the vastus medialis oblique muscle for the first 6 weeks. At more than 6 weeks postoperatively, if patients have achieved near full range of motion and can maintain a strong quadriceps contraction, discontinuation of the brace is acceptable. Table 1 highlights the pearls and pitfalls of this technique.

Discussion

Before patella engagement with the trochlea, the MPFL acts a vital checkrein during the first 30° of flexion allowing for smooth knee motion. In patients with recurrent patella dislocation, rupture of the MPFL is often observed leading to abnormal biomechanical patellofemoral pressure, pain, and early onset arthritis.
Although no gold standard currently exists for MPFL reconstruction, various techniques have been described employing different methods of graft fixation and tensioning. Despite showing satisfactory outcomes, with a complication rate reported at 26.1%, continual development of new techniques to minimize potentially devastating complications and optimize outcomes is essential. Therefore, we presented a technique for MPFL reconstruction that uses 2 suture anchors along the patella for graft fixation to provide a biomechanical favorable construct. Table 2 outlines the advantages and disadvantages of our described technique.

Restoration of the fan-like native MPFL is challenging. In an anatomical study of 12 cadaver specimens, Kang et al. described the presence of 2 functional bundles along the patella insertion in the native MPFL. Although single- and double-bundle MPFL techniques have both been shown to adequately restore knee stability, outcomes have been better for double bundle reconstructions. Double-bundle techniques replicate the fan-like dynamics of the native MPFL, whereas single-bundle techniques can lead to unbalanced loading of the patella. By using 2 suture anchors in the patella, the technique that we describe here uses the MPFL footprint in a single-bundle setting to restore the native MPFL anatomy and patella stability. In addition, by submerging the tail of the gracilis graft with the interference screw at the femoral footprint we ensure a secure fixation.

Formation of a stress riser in the patella can result in a catastrophic complication after MPFL reconstruction. Techniques that use large-diameter, transverse, or long oblique patella bone tunneling are associated with an increased risk of patellar fracture. Such tunnels are often associated with screw fixation. In a comparison study between interference screw and suture anchor medial patella fixation, Russ et al. showed that despite interference screws exhibiting a significantly stronger fixation, suture anchor fixation was still adequate.

**Fig 5.** (A) With the patient supine and the left knee flexed to 45° of flexion, an incision is made over the saddle area proximal-posterior to the medial epicondyle and distal-anterior to the adductor tubercle on the femur. A guidewire is placed to approximately 30 mm of depth, the femur is drilled, and the drill hole is taped. One end of the whip stitch applied to the gracilis tendon autograft is loaded through a 7 mm × 23 mm interference screw (DePuy Mitek) and the tendon is dunked into the drill hole. (B) The screw is advanced until flush with the cortex of the femur.

**Fig 6.** The patient is in the supine position, the left knee flexed to 45°, when the graft is passed from the femoral fixed side through the intra-articular, extrasynovial plane using a hemostat and exiting out the opening at the medial border of the patella. Once the graft is passed, with the knee held in 45° of flexion, the graft is marked where it aligns with the more distal suture anchor, and then from there the distance between the 2 suture anchors is marked off on the graft. Arrows denote the location of 2 suture anchors.

**Fig 7.** The patient is supine with the knee in 45° of flexion and a free needle is used to whip stitch the graft to the appropriate suture anchor at each level. The unused end is pulled to take up slack, bringing the graft down to the bone and anchor. The knots are subsequently tied, starting with the distal anchor and then the proximal anchor, and the excess graft is cut off. The blue star denotes excess graft.
Furthermore, in a study evaluating patients with patella suture anchor fixation at mid-term follow-up (34.5 months; range, 24-50 months), Song et al. showed significant improvements in pre- to post-operative clinical scores (Kurjala 52 to 90.9 and Lysholm 49.2 to 90.9, respectively) without report of patellar fracture or dislocation. Comparatively, Schiphouwer et al. used a 2-transverse-tunnel MPFL reconstruction with absorbable sutures on the patella and adductor sling on the femur in 179 patients (192 knees) with a median follow-up of 9 months (range, 1-67 months) with a 3.6% prevalence of patella fracture. Thus, the aforementioned study highlights the associated risk increase seen with transverse patella tunneling.

This highlights the importance of understanding the consequences of technical implant selection and fixation on potential complications or failures. The technique described here provides an easy to replicate anatomical reconstruction with suture anchor patellar fixation. Future studies are warranted comparing the outcomes between different fixation options, as well as exploring long-term outcomes.

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