Technical Note

Concomitant Patellar Tendon Reconstruction With Hamstring Autografts and Medial Patellofemoral Ligament Reconstruction With Quadriceps Autograft in the Setting of Severe Patellar Tendinopathy With Recurrent Lateral Patellar Instability

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Abstract: Chronic injuries to the extensor mechanism present unique challenges to physicians because of their complex nature and the need for a multifactorial treatment approach. When conservative treatment is unsuccessful in the setting of patellar tendinopathy, surgical intervention may be required to improve symptoms. For patients with concomitant lateral patellar instability, surgical treatment is also indicated to prevent future dislocations and worsening patellofemoral symptoms. Current literature presents numerous patellar tendon and medial patellofemoral ligament arthroscopic and open reconstruction techniques with varying short- and long-term outcomes. Known risk factors must be considered preoperatively when addressing patellofemoral pathology. The purpose of this Technical Note is to describe a technically challenging procedure to treat concomitant severe patellar tendinopathy with concurrent lateral patellar instability.

Injury to the extensor mechanism of the knee is common.[1,2] Severe patellar tendinopathy results from the overuse and gradual degeneration of the patellar tendon fibers, frequently located posterior/posteromedially at the inferior pole of the patella and observed at greater rates in patients younger than 40 years of age, and severe cases may require surgical treatment.[2,3] Primary lateral patellar dislocations have a relatively low incidence of recurrent instability, with recurrent dislocation observed near 17%.[4] If re-dislocation occurs, there is an exponential increase (50%) for additional dislocations.[1]

Numerous surgical techniques are described for these conditions in isolation.[2,5-7] In the setting of severe patellar tendinopathy, open or arthroscopic debridement and reconstruction of the patellar tendon with hamstring autografts are described.[8] In the case of recurrent patellar instability, medial patellofemoral ligament (MPFL) reconstruction with quadriceps or hamstring autograft has been reported as having postoperative success. We describe a patellar tendon reconstruction with hamstring autografts and MPFL reconstruction with quadriceps tendon autograft in the setting of severe patellar tendinopathy with chronic recurrent patellofemoral instability.

Surgical Technique

A detailed video of the assessment, hamstrings and quadriceps autograft harvest, patellar tendon reconstruction, and MPFL reconstruction is shown in Video 1. The step-by-step guide and surgical pearls are included in Table 1.

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Table 1. Step-by-Step Guide and Surgical Pearls for Concomitant Patellar Tendon Reconstruction With Hamstring Autografts and Medial Patellofemoral Ligament Reconstruction With Quadriceps Autograft in the Setting of Severe Patellar Tendinopathy With Recurrent Patellar Instability.

Step-by-Step Guide	Pearls
A central anterior incision is made from the proximal to the superior pole of the patella to over the tibial tubercle.	The incision should start 6 cm proximal to the superior pole of the patella and completely expose the extensor mechanism distally.
The central portion of the partial-thickness quadriceps tendon is harvested for the MPFL autograft.	The partial-thickness graft should be 8 cm long by 1 cm wide and remain attached to the superior pole of the patella.
The pes anserine bursa is identified and the gracilis and semitendinosus tendons are harvested and left attached to their tibial insertions.	Adhesions present on the tendons are removed with an elevator and scissors, and an open hamstring harvester is used to carefully harvest the grafts top avoid graft amputation and ensure adequate length.
A tibial tunnel is drilled lateral to medial under the tibial tubercle. A 4.5-mm EndoButton reamer is used to overreamed and a passing stitch is placed.	The tibial tunnel should be drilled 1 cm distal to the tibial patellar tendon attachment. The longer of the 2 tendons should be passed laterally.
Two suture anchors are placed medial and lateral to the tibial tubercle.	Place each suture anchor at the tunnel aperture at each side of the tibial tunnel and the grafts are fixed distally.
The patellar tunnel is drilled at the midpoint of the patella laterally to medially and overreamed with a 4.5-mm Endobutton reamer.	The patellar tunnel should be placed central to the anterior and posterior margins of the patella to avoid iatrogenic fracture.
Two suture anchors are first placed into the adductor tubercle and then another is placed 6 mm distal at the anatomic attachment site of the MPFL.	Identification of the adductor magnus tendon is used to localize the adductor tubercle. A channel is created under the medial retinaculum that matches the width of the MPFL graft to allow future passing.
Anteromedial and anterolateral parapatellar portal are made and intra-articular assessment occurs.	A chondroplasty of articular surface chondromalacia promotes optimal patellar tracking and symptomatic reduction.
The autografts are now passed through a tunnel in the patella with the semitendinosus graft lateral to medial and the gracilis graft is passed from medial to lateral.	The grafts are properly tensioned so that the patellar height is restored.
A vertical incision central in the patellar tendon is made beginning at the proximal aspect of the tendon and pathologic tissues are removed.	Confirmation of preoperative indications are made, and careful attention is taken to completely remove the degenerative tissue.
The hamstring autografts for the patellar tendon are now sewn to each other at the apertures of the patellar tunnel.	The knee is brought to different degrees of flexion to confirm the tensioning. Any extra graft is passed distally and sewn into the other limb of the previously passed graft distally.
A suture anchor is placed superomedial on the patella and the MPFL graft is fixed. The MPFL graft is now passed through the previously created medial channel and fixed the knee in 45° of flexion and the patella is positioned central within the trochlear groove	The arthroscope is reinserted into the joint confirming the patella is seated in the center of the trochlear groove with the knee in flexion and extension.
The patellar tendon vertical incision is closed along with deep and superficial tissues.	Layered closure prevents postoperative edema and reduces overall donor-site morbidity.

MPFL, medial patellofemoral ligament.

Patient Evaluation

Chronic lateral patellar instability and severe patellar tendinopathy require clinical evaluation and diagnostic imaging to properly assess and optimize postoperative outcomes. Conservative measures including bracing, taping, and physical therapy may be indicated in acute settings. Magnetic resonance imaging can be useful for assessing degenerative changes in ligaments and tendons (Figs 1 and 2) and provide a comprehensive understanding of bony anatomy and alignment. When prolonged symptoms become functionally limiting, surgical reconstruction of the patellar tendon and MPFL is indicated.

Anesthesia and Positioning

The patient is placed supine on the operating table and induced under general anesthesia. An examination under anesthesia is performed to confirm the clinical findings. A high-thigh tourniquet is placed on the surgical leg. The surgical leg is placed in an extremity holder (Mizho OSI, Union City, CA) and the patient is administered perioperative cefazolin for prophylaxis against infection.

Hamstring Graft Harvest

An anterior incision is made from 6 cm proximal to the superior pole of the patella to the tibial tubercle, exposing the extensor mechanism (Fig 3). Dissection is carried distal to the pes anserine bursa. Both the gracilis and semitendinosus grafts are exposed, tendon adhesions are removed with an elevator and scissors, and an open hamstring harvester is used to harvest the grafts. Both tendons are left attached to their tibial insertions (Fig 4).

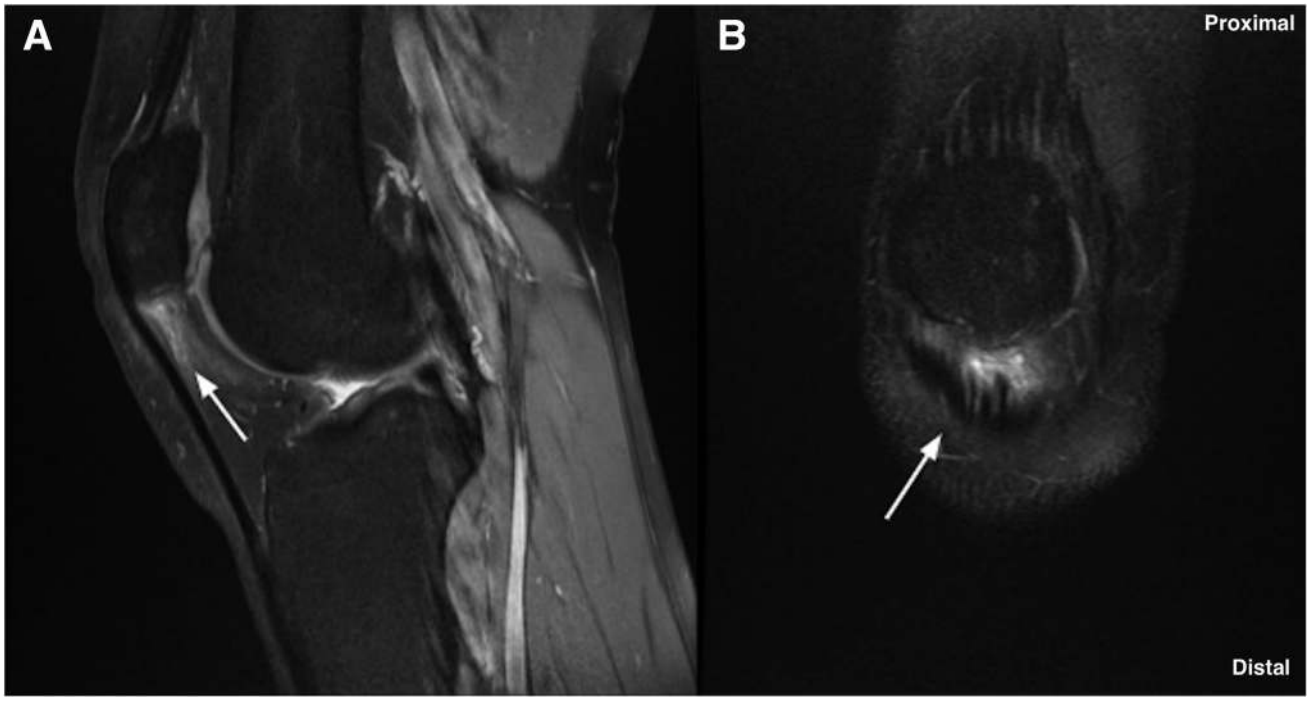

Fig 1. Preoperative magnetic resonance imaging (MRI) of a sagittal (A) and coronal (B) view of the right knee. An MRI scan should be performed to assess the severity and location of separation of the patellar tendon (white arrow) from the distal pole of the patella to ensure complete debridement of the degenerative tissue intraoperatively.

Patellar Tendon Reconstruction Site Preparation

Exposure continues to the medial and lateral aspects of the tibial tubercle. A Beath pin is drilled horizontally across the tibial tubercle using an ACL guide (Arthrex, Naples, FL), 1 cm distal to the patellar tendon attachment (Fig 5). The guide pin is then overreamed with a 4.5-mm EndoButton reamer (Smith & Nephew, London, England). The longer of

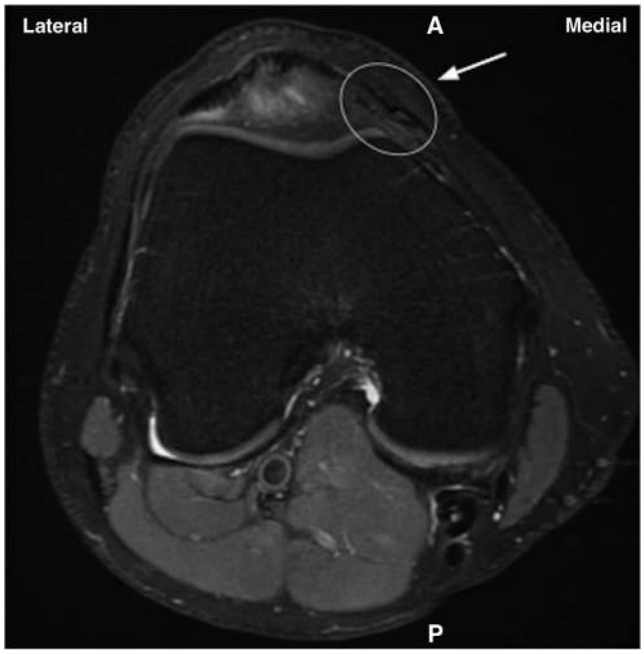

Fig 2. Preoperative magnetic resonance imaging scan of an axial view of the right knee. The medial patellofemoral ligament tear (white arrow) is visualized. (A, anterior; P, posterior.)

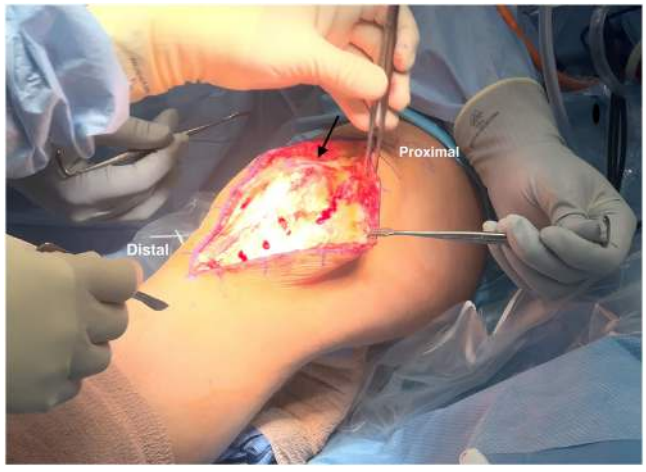

Fig 3. Right knee anterior midline approach for the patellar tendon reconstruction and concomitant medial patellofemoral ligament (MPFL) reconstruction, with the patient in supine position. The incision begins 6 cm proximal to the superior pole of the patella (black arrow) to the tibial tubercle, completely exposing the extensor mechanism. Dissection can be continued distally and medially to expose the adductor magnus tendon to locate the adductor tubercle to localize the MPFL attachment.

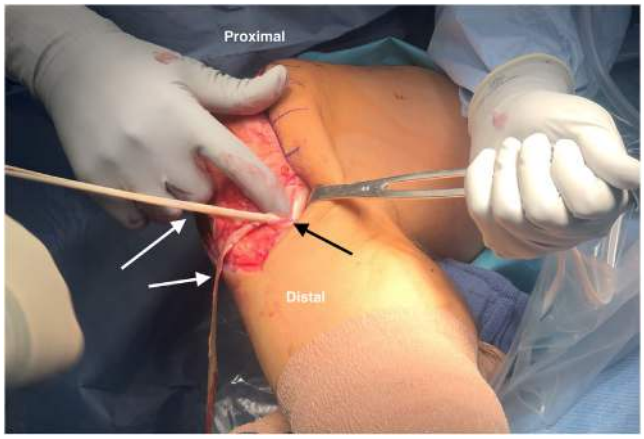

Fig 4. Right knee anterior midline approach with the patient in supine position. The pes anserine bursa is isolated (black arrow) and both the gracilis and semitendinosus grafts are exposed (white arrows), tendon adhesions are removed with a Cobb elevator and scissors, and an open hamstring harvester is used. Both the gracilis and semitendinosus are left attached to their tibial insertions before fixation medial and lateral to establish the margins of the patellar tendon reconstruction.

the 2 hamstring grafts (usually the semitendinosus graft) is passed from medial to lateral through the tunnel. Two Q-FIX anchors (Smith & Nephew) are placed at each tunnel aperture, medial and lateral to the tibial tubercle. The gracilis and semitendinosus grafts are fixed to the medial Q-FIX, whereas only the semitendinosus graft is fixed at the lateral Q-FIX (Fig 6).

For the patellar tunnel, spinal needles are placed at the proximal and distal ends of the patella and the midpoint is identified. The medial and lateral aspects at the midpoint of the patella are exposed, and an ACL guide (Arthrex) is used to drill a Beath pin horizontally across the patella. This is then overreamed with a 4.5-mm EndoButton reamer (Smith & Nephew) (Fig 7).

Fig 5. Right knee anterior midline approach with the patient in supine position. The medial and lateral aspects of the tibial tubercle are exposed and a Beath pin is drilled horizontally across the tibial tubercle using an anterior cruciate ligament guide. The pin is aimed 1 cm distal and transversely to the patellar tendon attachment (black arrow).

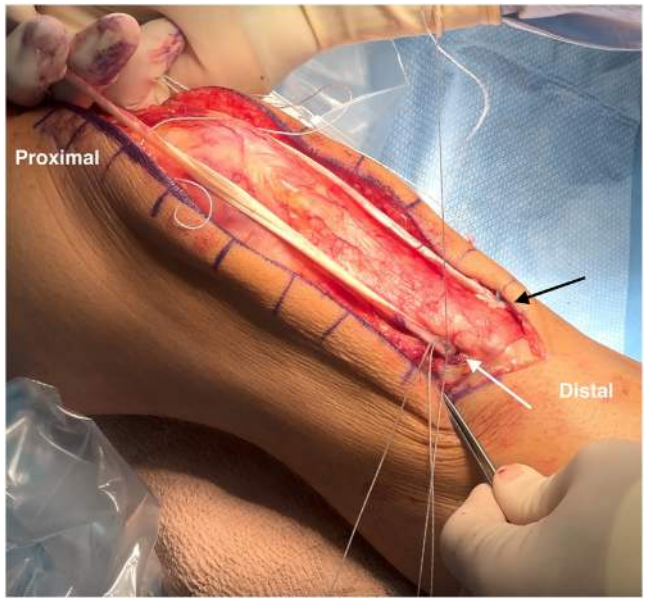

Fig 6. Right knee anterior midline approach with the patient in supine position. The semitendinosus graft is passed from medial to lateral through the tunnel and 2 Q-FIX anchors are placed at each tunnel aperture, medial and lateral to the tibial tubercle. The gracilis and semitendinosus grafts are fixated to the medial Q-FIX (black arrow), while only the semitendinosus graft is fixated at the lateral Q-FIX (white arrow) and are brought proximally before being routed through the patella.

MPFL Site Preparation

A spinal needle is placed at the superior pole of the patella and an 8 × 1-cm partial-thickness strip of the quadriceps tendon is harvested for the MPFL graft

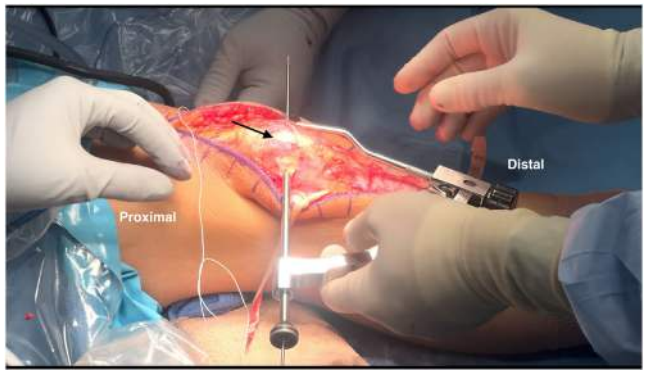

Fig 7. Right knee anterior midline approach with the patient in supine position. For the patellar tendon tunnel, the midpoint of the patella (black arrow) is identified, and a guide pin is drilled through transversely. The pin is then overreamed with a 4.5-mm EndoButton reamer. Both hamstring autografts are passed in their respective directions with a Hewson passer.

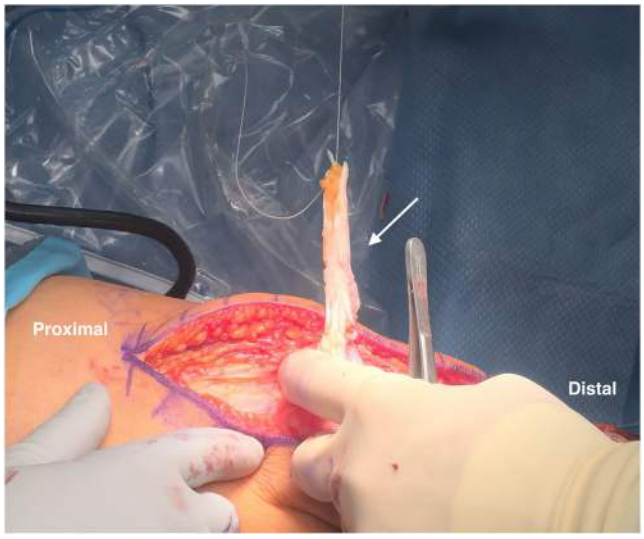

Fig 8. Right knee anterior midline approach with the patient in supine position. A spinal needle is placed at the superior pole of the patella and an 8 × 1-cm long partial-thickness strip of the quadriceps tendon is harvested for the MPFL graft (white arrow).

(Fig 8). The quadriceps tendon should be left attached to the patella. Dissection continues medially to expose the adductor magnus tendon, which is used to localize the adductor tubercle. A channel is created under the medial retinaculum that matches the width of the MPFL graft to allow future graft passing. A Q-FIX anchor (Smith & Nephew) is first placed into the adductor tubercle and then another is placed 6 mm distal to the first to reconstitute the normal attachment site of the MPFL (Fig 9).

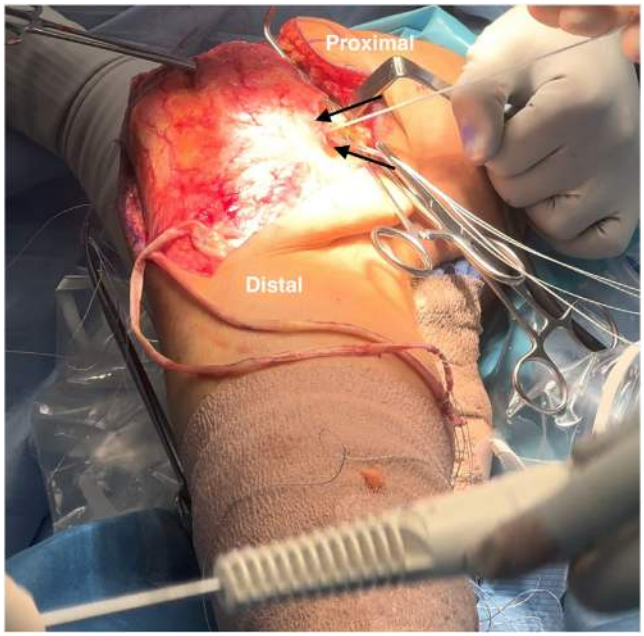

Fig 9. Right knee anterior midline approach with the patient in supine position. Isolation of the adductor magnus tendon is used to localize the adductor tubercle and then the medial epicondyle. A channel is created under the medial retinaculum that matches the width of the medial patellofemoral ligament graft to allow future passing. A Q-FIX anchor (is first placed into the adductor tubercle and then another is placed 6 mm distal to the first to reconstitute the normal attachment site of the medial patellofemoral ligament (black arrows).

Arthroscopy

Anteromedial and anterolateral parapatellar portals are made, the camera is inserted into the joint, and the joint is insufflated with normal saline. Assessment of the suprapatellar pouch, medial and lateral gutters, and intraarticular compartment follows.

Open Patellar Tendon Debridement and Patella Graft Passage

A vertical incision is made at the proximal central aspect of the tendon. Confirmation is made that >60% of the patellar tendon is detached proximally, in agreement with our previous clinical indications, and the pathologic portion is debrided (Fig 10). A rongeur is used at the inferior pole of the patella due to the excessive scar tissue present.

Attention is now brought to the gracilis and semitendinosus grafts, which are then passed under the superficial tissues to the patellar tendon tunnel. Both grafts are passed through the patellar tunnel, the semitendinosus graft is passed from lateral to medial and the gracilis graft is passed from medial to lateral. The grafts are tensioned so that the patellar height is restored.

Graft Fixation and Closure

A Q-FIX (Smith & Nephew) is placed in the patella superomedially and the MPFL graft is fixed at this location. The hamstring autografts for the patellar tendon are now sewn to each other at the apertures of the patellar tunnel, and the knee is brought to different degrees of flexion to confirm the proper tensioning and positioning for the patellar tendon reconstruction. Any extra graft is passed distally and sewn into the other limb of the previously passed graft (Fig 11). The MPFL graft is then passed through the previously created medial channel and fixed to the femur at the proximal and distal femoral Q-FIX anchors (Smith & Nephew) with the knee in 45° of flexion and the patella is positioned in the center of the trochlear groove (Fig 12). The arthroscope was reinserted into the joint after tying the first suture to confirm the patella is well-seated in the center of the trochlear groove with the knee in flexion and extension and that there is 1 quadrant of lateral translation in extension.

The site of the patellar tendon defect is closed with 0 VICRYL (Ethicon Inc., Raritan, NJ). Deep and

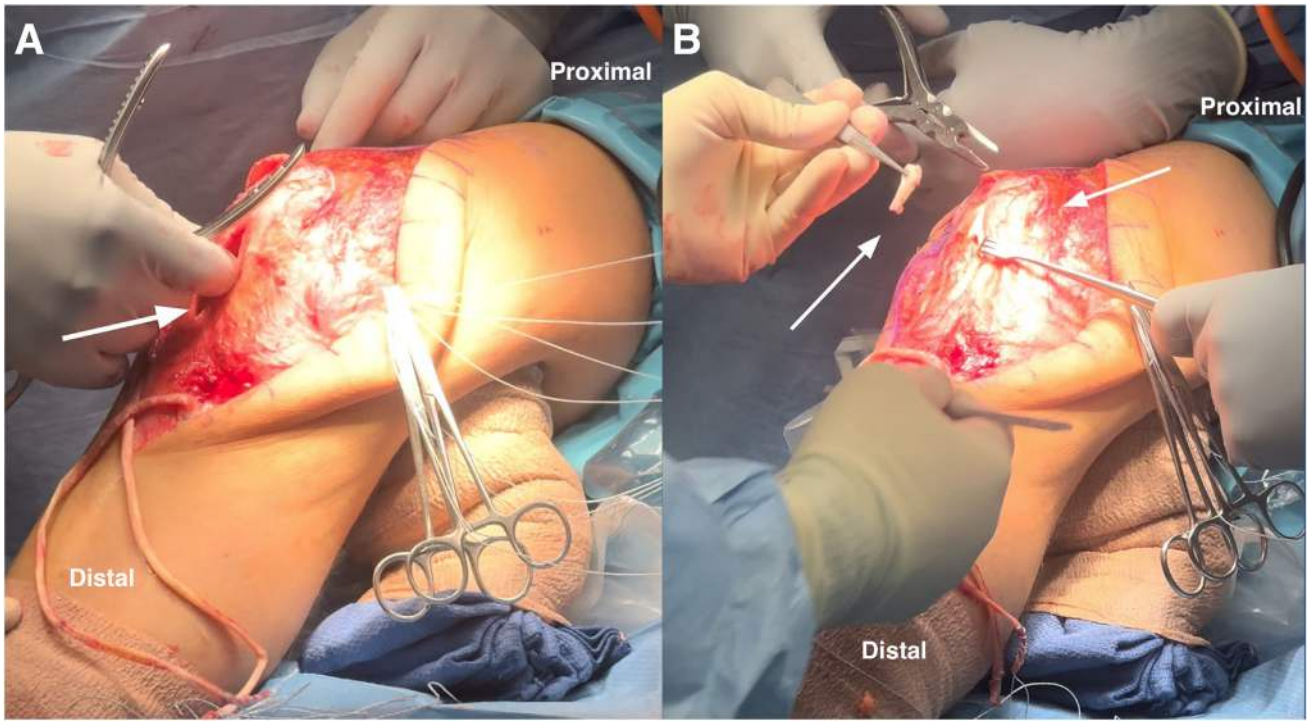

Fig 10. Right knee anterior midline approach with the patient in supine position. The patellar tendinopathy is addressed with a vertical incision made at the central aspect of the tendon (A), and the pathologic portion is identified and debrided (white arrow) (B). A rongeur is used at the inferior pole of the patella to remove excessive scarring. In agreement with our previous clinical indications, confirmation of the radiograph assessment >60% of the patellar tendon is detached.

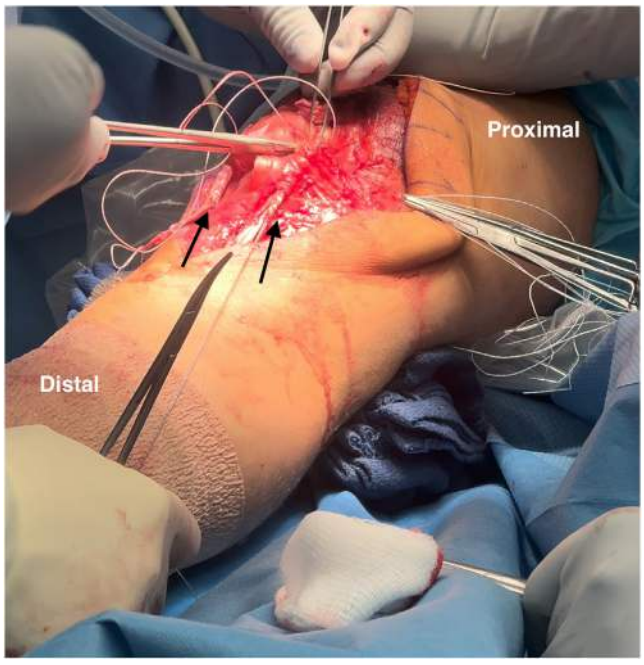

Fig 11. Right knee anterior midline approach with the patient in supine position. The hamstring autografts for the patellar tendon are passed proximally through the patella and sewn to each other at the apertures of the patellar tunnel (black arrows). Proper tension is ensured through a series of different knee flexion angles to confirm positioning for the reconstruction. Excess graft is passed distally and sewn over the proximally run graft.

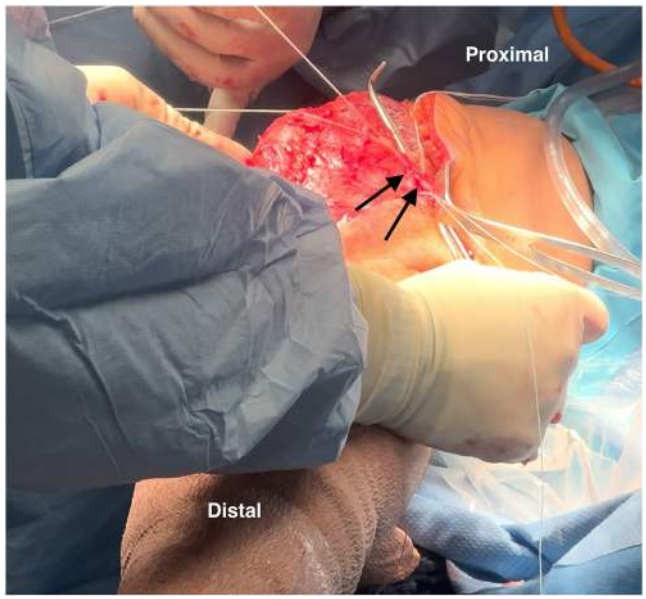

Fig 12. Right knee anterior midline approach with the patient in supine position. The medial patellofemoral graft is passed through the tunnel created inferior to the medial retinaculum and fixed to the femur at the proximal and distal femoral Q-FIX anchors (black arrows). The knee is placed in 45° of flexion and the patella is distracted 4 to 5 mm laterally to avoid overmedialization before the fixation of both anchors. Tension is assessed and neutral placement of the patella is confirmed.

Table 2. Advantages and Disadvantages of a Concomitant Patellar Tendon Reconstruction with Hamstring Autografts and Medial Patellofemoral Ligament Reconstruction With Quadriceps Autograft in the Setting of Severe Patellar Tendinopathy With Recurrent Patellar Instability

Advantages	Disadvantages
Use of autografts optimize outcomes when compared with allograft reconstructions and is more cost effective.	Risk of morbidity at graft donor sites and larger incision required to harvest quadriceps tendon autograft.
Allows for correction of lateral patellar instability while removing and augmenting pathologic tissue of the patellar tendon.	Risk of over- and undertensioning grafts that contribute to altered position of the patella in the trochlea while limiting range of motion.
Removal of degenerative tissue promotes overall healing and reduce overall pain.	Full reconstruction increases risk of patellar fracture and iatrogenic surgical injury
Rerouting the quadriceps tendon while attached to the patella creates a robust construct that allows for precise position and reduces risk of reconstruction failure.	Concomitant patellar tendon reconstruction increases risk of convergence of suture anchor and tunnels within the patella.
Using excess hamstring autografts that are sutured back on to the passed grafts in the patella reinforce the reconstruction.	

superficial tissues are closed with 0 and 2-0 VICRYL, and a knee immobilizer is applied in full extension.

Postoperative Protocol

Physical therapy starts on postoperative day 1, with a focus on quadriceps activation, edema control, and knee motion. Postoperatively, the patient is non−-weight-bearing on the lower extremity for 6 weeks. Flexion is limited to 90° for 2 weeks and increased as tolerated. Baseline anteroposterior and lateral knee radiographs are obtained postoperative day 1.

Discussion

In isolation, patellar tendon and MPFL reconstructions have reported promising outcomes. Systematic reviews by Schneider et al.[9] and Migliorini et al.[10] reported excellent subjective and clinical outcomes for patients who underwent MPFL reconstruction for recurrent patellofemoral instability. Postoperatively, 84.1% of patients returned to sport, recurrent instability after surgery ranged from 1.8% to 3.2%, and risk of reoperation ranged from 1.4% to 3.1%. Improvements in Lysholm and Tegner pain scores were also reported. A more recent systematic review reported isolated patellar tendon reconstructions using hamstring autografts in the setting of chronic patellar tendon ruptures.[11] Of the patients included (n = 71), 70.6% reported "normal" or "nearly normal" function of their postoperative IKDC, with 88.2% observing no function range of motion limitation.[11] Previous literature has reported long-term positive outcomes for debridement and patellar tendon reconstruction in the setting of severe patellar tendinopathy.[12]

With this in mind, it is essential to use existing knowledge of anatomic variations that factor into patellofemoral instability and the development of chronic injury pathologies in order to reproduce/improve observed outcomes from isolated patellar tendon and MPFL reconstructions in a combined procedure. The advantages and disadvantages of this technique are listed in Table 2.

Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: R.F.L. reports consulting or advisory and funding grants from Ossur; consulting or advisory, funding grants, and travel reimbursement from Smith & Nephew; consulting or advisory with Responsive Arthroscopy; funding grants from the Arthroscopy Association of North America and American Orthopaedic Society for Sports Medicine; speaking and lecture fees from Foundation Medical, LLC; and a patent with royalties paid to Ossur. All other authors (E.P.S., L.V.T., D.R.L., M.T.R., R.C.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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