

# Arthroscopic Centralization of the Extruded Medial Meniscus



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**Abstract:** Tears of the posterior medial meniscus root commonly result in extrusion of the meniscus and disruption of tibiofemoral contact mechanics. Transtibial pull-through repair of the root often results in healing of the tear, but post-operative extrusion may persist. In this scenario, the meniscus is unlikely to be chondroprotective. Therefore, an additional centralization procedure is necessary to improve the extrusion. Biomechanical studies have demonstrated that centralization can improve meniscus mechanics and potentially reduce the risk of osteoarthritis. This Technical Note describes an arthroscopic technique for medial meniscus posterior root repair that combines transtibial pullout and centralization sutures.

In recent years, the treatment of meniscus root tears has received much attention, given the deleterious effects that these injuries pose to tibiofemoral mechanics.<sup>1,2</sup> Root disruption results in a loss of hoop strain resistance and increased articular cartilage contact pressure.<sup>3,4</sup> Krych and colleagues<sup>5,6</sup> reported that failure to recognize and repair posterior medial meniscus root tears (PMMRs) can result in rapid development of osteoarthritis in the medial compartment. Numerous studies have reported successful clinical outcomes and healing after transtibial pullout

repair of the posterior root.<sup>7-10</sup> However, meniscus extrusion remains problematic. Extrusion develops rather rapidly,<sup>11</sup> increases with age, body mass index (BMI), and varus alignment,<sup>12,13</sup> and can persist despite well-performed anatomic root repair.<sup>10,14,15</sup> Arthroscopic techniques have been developed to address this problem by centralizing the body of the meniscus to the tibial plateau,<sup>16,17</sup> with promising early results.<sup>18</sup> This Technical Note describes a technique for centralization of the medial meniscus, in conjunction with pull-through repair of the posterior meniscus root.

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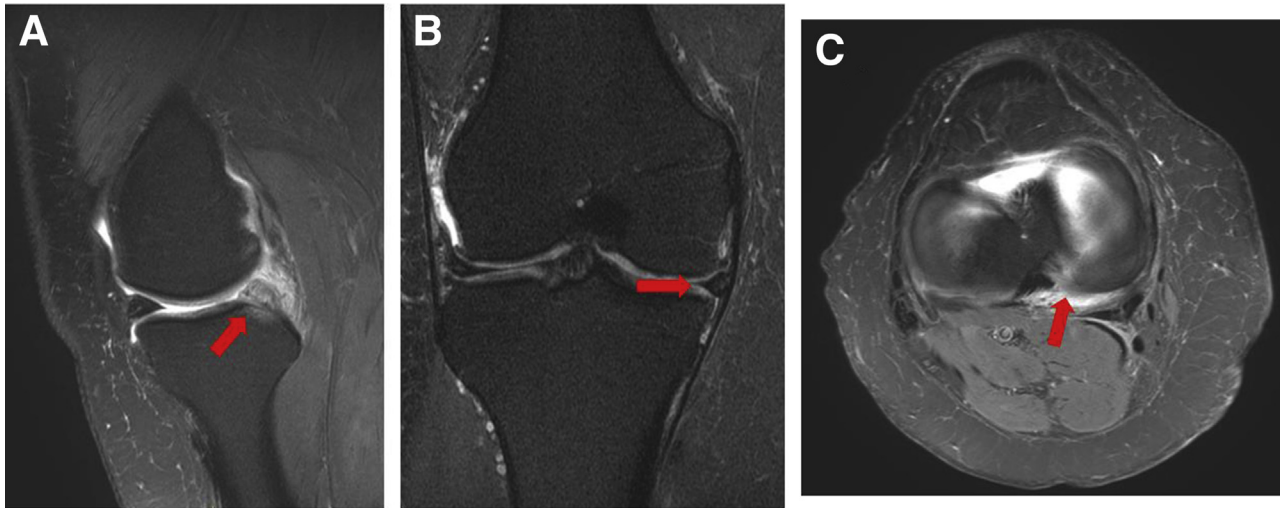
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## Surgical Technique

Before surgery, a thorough review of preoperative imaging is paramount to surgical planning. Fig 1 shows typical magnetic resonance imaging (MRI) images depicting a medial meniscus posterior root tear with associated extrusion. Equipment necessary to perform this surgery is listed in Table 1. Key steps, pearls, and pitfalls are summarized in Table 2. The Video details the technique, which is described below.

## Patient Positioning and Diagnostic Arthroscopy

Begin by performing an examination under anesthesia, evaluating the patient's Lachman, pivot shift, drawer test, dial test, and knee stability with varus and valgus stresses. Place the patient in a supine position, and prepared and drape the injured leg in the usual sterile manner. Perform a 3-portal diagnostic arthroscopy, evaluating for cartilage damage, loose bodies, and integrity of the cruciate ligaments and menisci.



**Fig 1.** (A) T2-weighted sagittal right knee magnetic resonance imaging (MRI) indicating medial meniscus (MM) posterior root tear with associated subchondral edema at the root footprint (arrow). (B) T2-weighted coronal MRI showing medial meniscus extrusion (arrow). (C) T2-weighted axial MRI showing MM posterior root tear (arrow).

### Medial Meniscus Centralization Preparation

Create an accessory anteromedial (AM) portal that is proximal and  $\sim 2$  cm more medial than the standard AM portal (Fig 2). The portal is just anterior to the medial collateral ligament (MCL) fibers. Enter the medial compartment while applying valgus force to open the medial compartment of the knee, having a low threshold to perform percutaneous MCL lengthening to improve exposure, and reduce risk to damage of iatrogenic cartilage damage. Through the accessory AM portal and anterolateral (AL) portal, use a curved Bankart elevator to release the meniscotibial (MT) ligaments along the periphery of the medial tibial plateau (Fig 3). Check the mobility of the medial meniscus, as

this should be increased once adequate MT ligament release is achieved.

### Medial Meniscus Centralization

Introduce the Knotless FiberTak curved drill guide (Arthrex, Naples, FL) through the accessory AM portal. Position the guide at the posteromedial aspect of the MM body just central to the peripheral rim of the tibial articular surface, and drill and deploy the FiberTak suture anchor (Fig 3). Retrieve only the white/blue repair FiberTak suture through the AL portal. Next, from the AL portal using a self-retrieving suture passer (Knee Scorpion; Arthrex), pass the white/blue repair suture through the meniscocapsular junction from inferior to superior, and back through the AL cannula. Use the Scorpion to pass a 0 FiberLink (Arthrex) suture through the meniscus in a mattress fashion and again retrieve that through the AL portal (Fig 4). Use this 0 FiberLink as a shuttle suture to then pass the white/blue repair suture back down and through the meniscocapsular junction in a mattress fashion (either vertical or horizontal). Shuttle the white/blue repair suture down to the anchor using the looped white/black shuttle suture from the anchor by pulling on the nonlooped black/white tape suture from the anchor. Finally, tension down the centralization suture to reduce the meniscus, using an arthroscopic knot pusher or a pusher-cutter device (Fig 5). The same steps are repeated 1 to 2 times, more anteriorly along the medial tibial rim.

Alternatively, sutures can be passed with a Micro SutureLasso, Straight (Arthrex), again introduced through the accessory AM portal. Pass the Micro SutureLasso from the periphery of the meniscocapsular junction, down over the articular surface, and retrieve it.

**Table 1.** Equipment Required for Medial Meniscus Posterior root Repair and Centralization

General
• Standard arthroscopy equipment
• Full-radius shaver (Stryker)
• Double-sided rasp (Linvatec, ConMed)
Meniscus centralization
• Knotless 1.8-mm FiberTak (Arthrex) with curved guide
• Scorpion (Arthrex) self-retrieving suture passer
• 0 FiberLink suture as a shuttle
• Knot pusher-cutter
• Micro Suture Lasso, Straight (Arthrex)
• Curved Bankart elevator and rasp
• Optional: PassPort cannula (Arthrex)
Posterior root repair
• Meniscus root repair tibial guide (Arthrex)
• 6.0-mm Flip Cutter (Arthrex)
• No. 2 FiberStick suture in sheath or a wire loop (Arthrex)
• Knee Scorpion self-retrieving suture passer (Arthrex)
• 0 FiberLink suture and 0 TigerLink suture (Arthrex)
• 4.75-mm Bio Composite SwiveLock anchor (Arthrex)

**Table 2.** Key Steps, Pearls, and Pitfalls**Key steps**

- Recognize tear pattern, evaluating particularly for meniscus extrusion. Medial meniscus (MM) root tears are commonly missed on magnetic resonance imaging.
- Use standard anteromedial (AM) and anterolateral (AL) portals and create an accessory AM portal proximal and 2 cm more medial than the standard AM portal.
- Be prepared to improve exposure to medial compartment through judicious percutaneous medial collateral ligament (MCL) lengthening.
- Elevate/release the meniscotibial (MT) ligament at the periphery of the tibial plateau (a curved Bankart elevator works best)
- Centralize the meniscus with 2 to 3 anchors starting at posteromedial corner and working anteriorly.
- Once centralization is complete, complete the posterior root transtibial pull-through repair.
- Transtibial passage of the posterior root cinch sutures (2 to 3 sutures) and reduction of the root to its anatomic footprint should also correct the extrusion.

**Pearls****Meniscus centralization**

- Fat pad debridement can enhance visualization as well as instrument access and passage.
- Improve exposure if needed with percutaneous MCL lengthening.
- Optimize proximal and medial position of the accessory AM portal.
- Ensure improved mobility of the meniscus after release of the MT ligament peripherally.
- Use PassPort cannula to assist with suture management and passage to avoid soft tissue entrapment.
- Use the Knee Scorpion vs the Micro SutureLasso for shuttling sutures.
- When using knotless sutures, tension with pusher/cutter through the accessory AM portal.

**Meniscus root repair**

- A variable-angle transtibial meniscal root drill guide (Arthrex) allows easy placement over the anatomic attachment site of the meniscal root.
- Transtibial drilling before meniscal root suturing avoids suture entanglement.
- A self-retrieving suture passer (Knee Scorpion; Arthrex) allows suturing through standard arthroscopy portals.

**Pitfalls**

- Inadequate exposure
- Iatrogenic cartilage injury
- Fixation failure if a patient is not able to follow the established rehabilitation protocol

Shuttle the white/blue repair Fibertak suture with the use of the Micro SutureLasso, and then repeat the steps previously mentioned for tensioning down the suture.

**Medial Meniscus Posterior Root Tear Preparation**

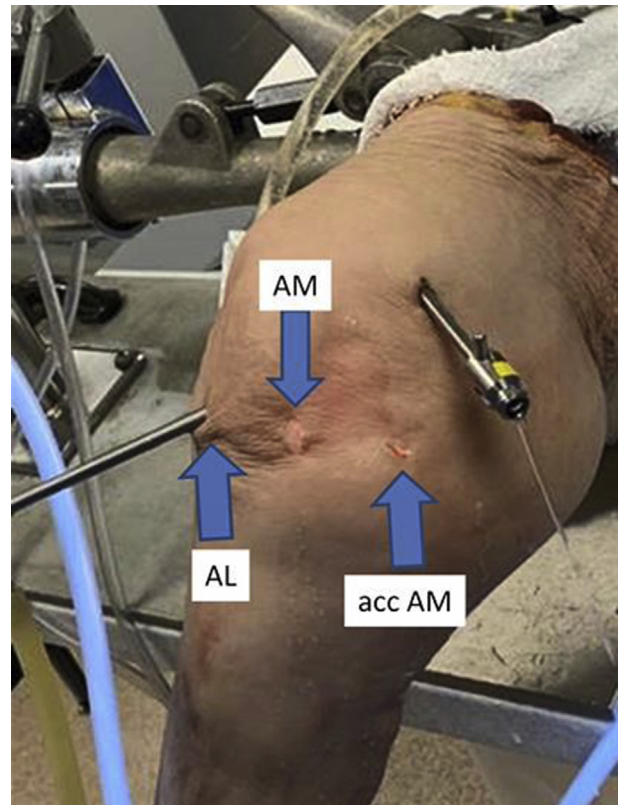
To improve visualization of the MM posterior root footprint, a small resection of the medial tibial spine and a small reverse notchplasty can be performed. Using a 3.5-mm full-radius shaver (Stryker, San Jose, CA) and a double-sided rasp (Linvatec, ConMed, Largo, FL), debride the edges of the posterior root tear until bleeding occurs, in an effort to enhance healing. We debride devascularized tissue at the edges of the tear to promote vascular infiltration. Also, use of a curved arthroscopic scissor can be helpful to release the

posterior capsular attachment of the root to improve overall mobility.

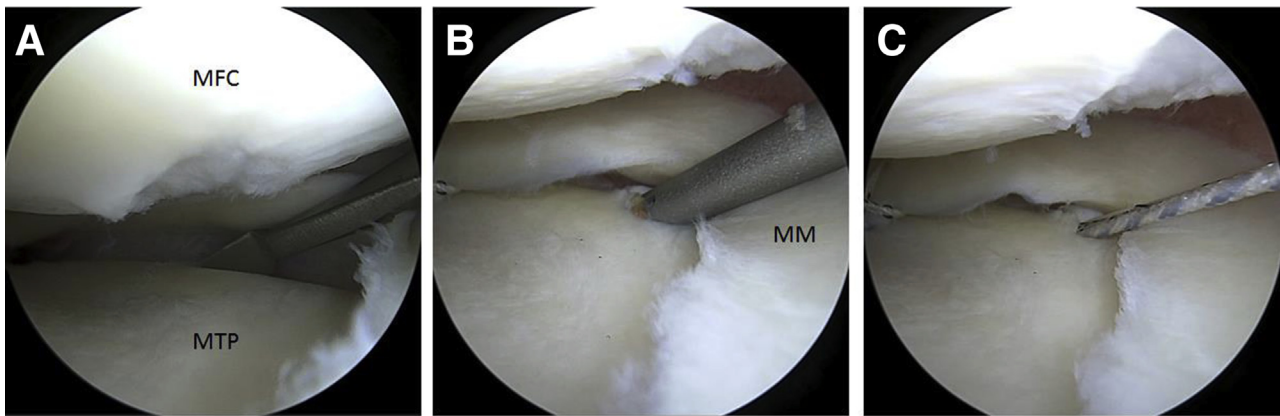
**Medial Meniscus Posterior Root Suture Passage**

Insert the Arthrex meniscus root repair tibial guide through the AM portal and hook the guide on the posterior aspect of the tibia, directly behind the root attachment site (Fig 6). Swivel the drill guide to the anteromedial face of the tibia. One can measure the distance from the posterior aspect of the tibial plateau to the anatomic footprint of the meniscal root, and adjust the guide to that distance for accurate drilling (Fig 5). Drill the 3.5-mm-diameter FlipCutter (Arthrex) pin through the tibia; it should exit at the anatomic footprint. Convert the FlipCutter to a 6.0-mm reamer, and retrodrill the tibia 10 mm. Advance the FlipCutter back into the joint, convert it back to a 3.5-mm-diameter pin, and remove it from the tibia.

Advance a no. 2 FiberStick shuttle suture in its red sheath (Arthrex) through the tibial tunnel and retrieve the shuttle suture through the AL portal. Through the AM portal, pass the loop end of a 0 FiberLink (Arthrex) through the meniscal root using a Knee Scorpion. Withdraw the suture from the portal and pass the free



**Fig 2.** Photograph of the portals used for the procedure on a right knee. Note the location of the accessory (acc) anteromedial (AM) portal slightly proximal and 2 cm more medial than the AM portal.



**Fig 3.** (A) Elevation/release of the MT ligament with Bankart elevator (right knee, viewing from AM portal). (B) FiberTak anchor drill guide (Arthrex) placed at the periphery of the MTP. (C) Deployed anchor with sutures exiting the accessory (acc) AM portal. Abbreviations: AM, anteromedial; MFC, medial femoral condyle; MM, medial meniscus; MTP, medial tibial plateau.

end through to loop to create a cinch-type suture. Repeat this step several millimeters lateral to the initial suture, using a 0 TigerLink (Arthrex) suture to aid in suture management. Shuttle these sutures back through the tibial tunnel with the FiberStick shuttle suture.

#### Fixation of Transtibial Posterior Root Sutures

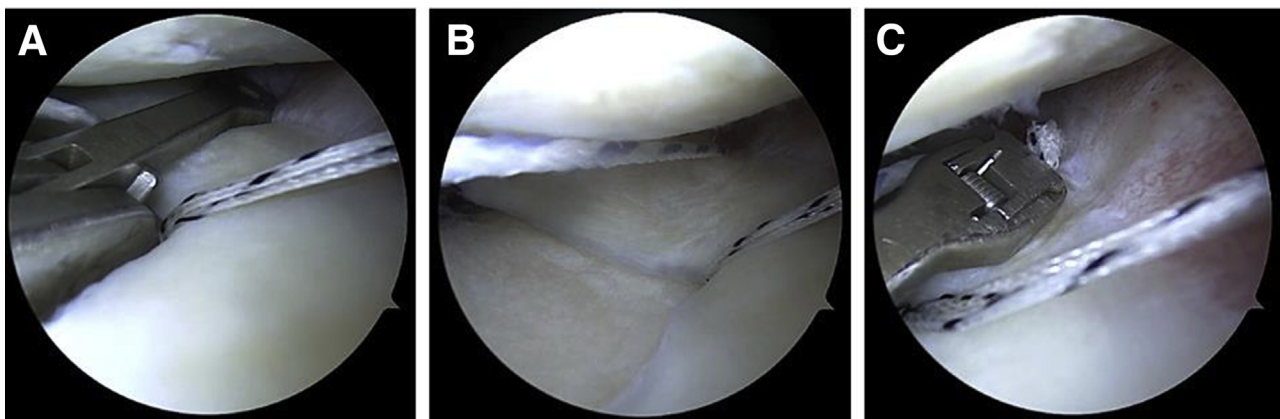
Attain tibial fixation with a 4.75-mm Bio Composite SwiveLock anchor (Arthrex). One centimeter distal to the transosseous FlipCutter hole in the anteromedial tibial, create the pilot hole for the SwiveLock using a 4.5-mm stepped drill to a depth of 20 mm. Tap the tibial cortex using a 4.5-mm tap. Cycle the knee from 0° to 90° 10 times to remove creep from the system, and pass the free ends of the cinch sutures into a SwiveLock anchor. Confirm that the meniscal root is well reduced with the knee in 90° flexion with applied tension and advance the SwiveLock anchor into the reamed, tapped tibial hole. [Fig 7](#) shows the final construct. Please see [Video 1](#) for the full arthroscopic technique.

#### Postoperative Rehabilitation

Depending on concomitant injuries and surgery, such as anterior cruciate ligament (ACL) reconstruction, rehabilitation may differ from patient to patient. Typically, we use a complex meniscus protocol for the first 6 weeks, with toe-touch weightbearing only. During this time, the patient can perform quad sets and straight leg raises. For the first 4 weeks, range of motion is limited to 90°. After 4 weeks, range of motion progresses as tolerated. At 6 weeks, the patient transitions to a more typical ACL rehabilitation protocol. However, jogging and impact activities are delayed until 4 to 6 months instead of the typical 3 months.

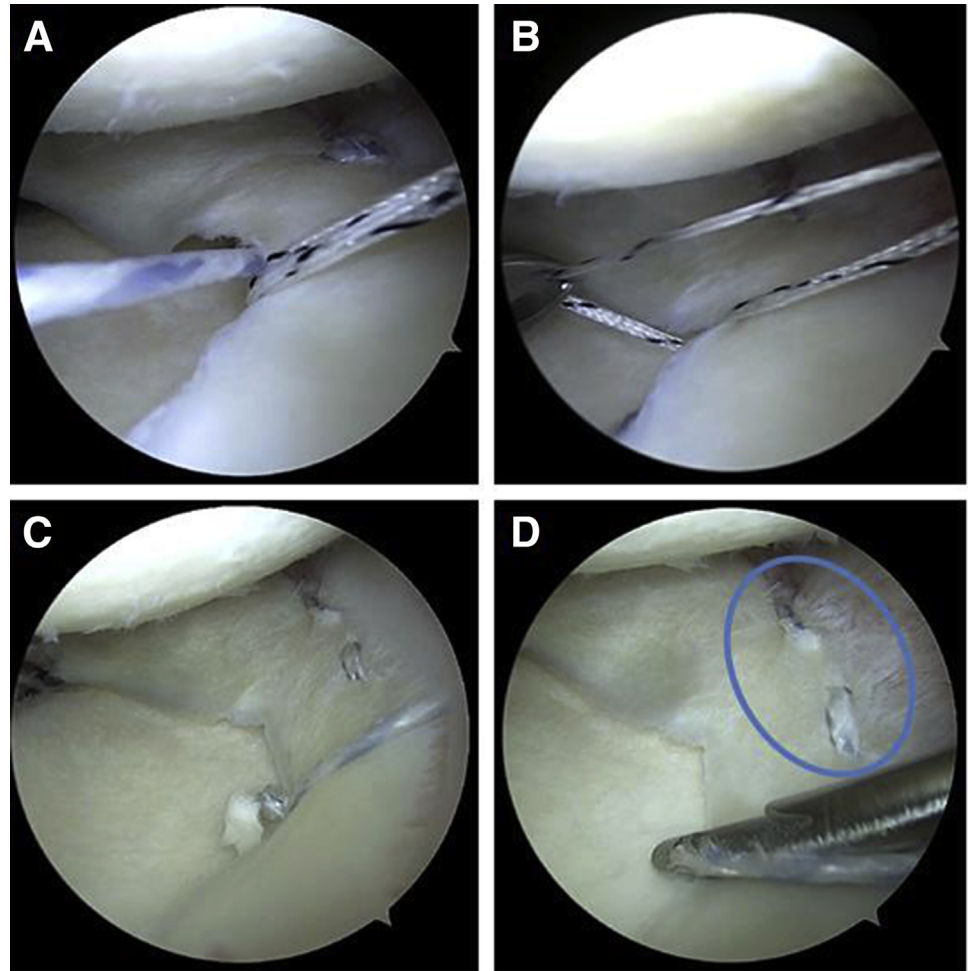
#### Discussion

Medial meniscus posterior root tears result in a loss of hoop strain resistance and increased articular cartilage contact pressure within the medial compartment,<sup>3,4</sup> leading to rapid progression of osteoarthritis within  $\geq 1$  year of injury.<sup>6</sup> It is thus important to restore the



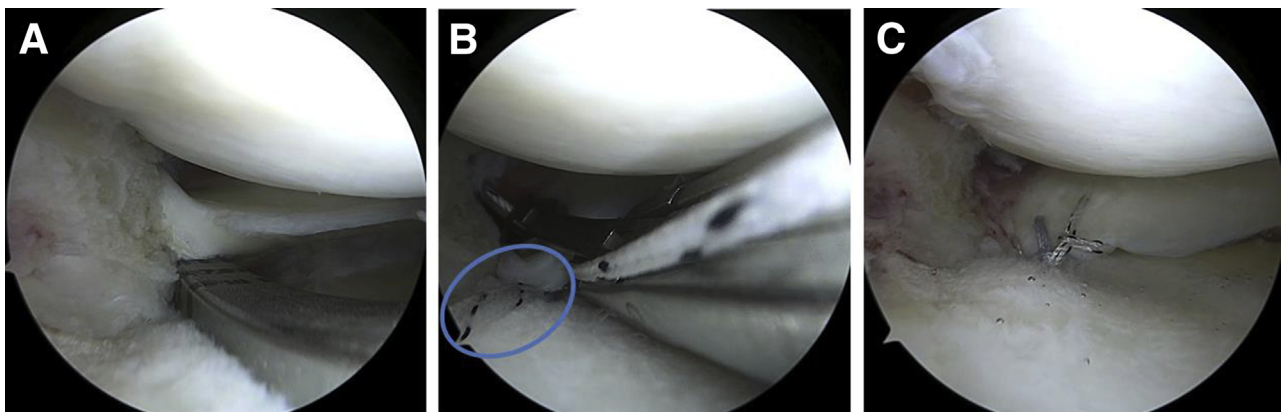
**Fig 4.** (A) Knee Scorpion (Arthrex) from the anterolateral (AL) portal piercing the meniscocapsular junction to pass the FiberTak blue repair suture. (B) FiberTak suture retrieved through AL portal. (C) Knee Scorpion passing the 0 FiberLink (Arthrex) shuttle suture in mattress fashion anterior to FiberTak suture to allow for second passage of repair suture to create horizontal mattress.

**Fig 5.** (A) FiberTak suture shuttled under the medial meniscus (MM) by the 0 FiberLink shuttle suture, and retrieved through the anterolateral (AL) portal. (B) Remaining 0 Fiberloop shuttle suture retrieved through AL portal. (C) FiberTak suture shuttled down to the anchor by pulling on the 0 Fiberloop shuttle suture through the accessory anteromedial (acc AM) portal. (D) FiberTak sutures tensioned down with arthroscopic knot pusher or pusher cutter (see position of sutures in meniscocapsular junction in the blue oval).

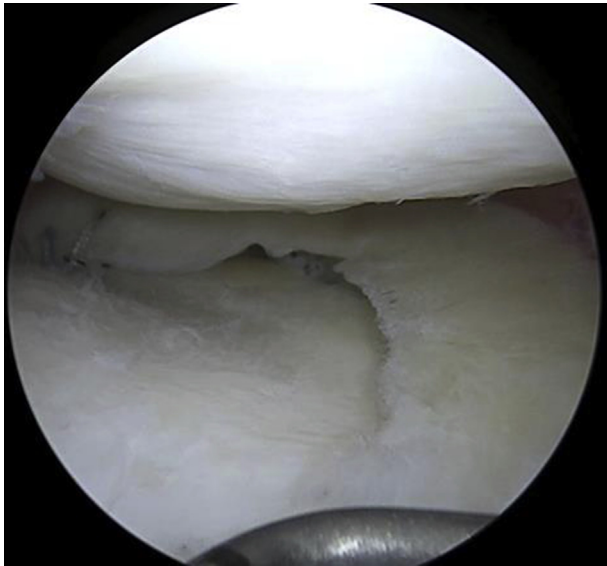


anatomy and function of the medial meniscus in these cases. However, even with well-executed anatomic repair of the posterior root, persistent meniscus extrusion may exist postoperatively.<sup>10,14,15</sup>

There are multiple theories as to why extrusion persists. There may be adhesion of the preoperatively extruded meniscus and adjacent capsule to the medial tibial plateau, distal to the medial edge. This would be



**Fig 6.** (A) Root guide (Arthrex) via anteromedial (AM) portal in position at the anatomic footprint of the medial meniscus (MM) posterior root (viewing from anterolateral [AL] portal). (B) Cinch suture passage with self-retrieving suture passer. Note the looped passing suture (circled) that was previously brought through the tibial tunnel and out the AL portal for later use. (C) Three cinch sutures delivered through the tibial tunnel and tensioned down to the posterior root footprint.



**Fig 7.** Final construct of right knee medial meniscus (MM) centralization and root repair. Note the improved meniscal extrusion.

somewhat analogous to anterior labral periosteal sleeve avulsion (ALPSA) lesion in the shoulder. Alternatively, a degenerative torn edge may not be able to hold the MM in the anatomically reduced position.

The purpose of meniscus centralization is to reduce the risk of postoperative extrusion. Koga et al.<sup>18</sup> reported good 2-year clinical and radiographic outcomes for the lateral meniscus and significantly reduced meniscus extrusion 3 months postoperatively on MRI that is maintained at 1 year postoperatively. The same group also previously described their centralization technique for the MM.<sup>16</sup> In the current Technical Note, we present our preferred technique for augmentation of a MM posterior root tear with centralization of the medial meniscus. Although long-term, large group studies are lacking, the centralization procedure has the theoretical benefit of restoring meniscus function after anatomic root repair. There is a theoretical risk of decreasing knee motion, but this not been borne out in the literature or in our experience thus far. It is a technically demanding procedure, but with a methodical approach and avoidance of pitfalls, we have anecdotally seen good short-term results in our patients.

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