

Arthroscopic Transtibial Medial Meniscus Posterior Root Repair Using the “Meniscal Track” to Locate the Anatomical Footprint



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Abstract: The medial meniscus posterior root tears are a common problem in early elder patients. From a biomechanical study, the anatomical repair demonstrated a restored contact area and contact pressure than the nonanatomical repair. Nonanatomical repair of the medial meniscus posterior root resulted in decreased tibiofemoral contact area and increased contact pressure. Various surgical repair techniques were reported in the literature. However, there was no reported precise arthroscopic landmark to define the anatomical footprint of the posterior root attachment of the medial meniscus. We propose the “meniscal track”, an arthroscopic landmark to guide the location of the anatomical footprint of the medial meniscus posterior root attachment.

Introduction

The medial meniscus posterior root tear was a common knee problem in early elder patients. Many studies reported that arthroscopic meniscus posterior root repair showed superior functional and radiological outcomes, less osteoarthritic change, and less converted arthroplasty to conservative treatments and arthroscopic partial meniscectomy.¹⁻³ If there is no contraindication of surgery, such as advanced stage of osteoarthritic change, severe varus malalignment, and obesity, arthroscopic meniscus posterior root repair is a recommended treatment. Various surgical repair

techniques were reported in the literature.⁴⁻⁷ From a biomechanical study, the anatomical repair demonstrated a restored contact area and contact pressure than the nonanatomical repair.⁸ Even though the functional outcomes did not provide a statistically significant difference, the complete meniscal healing and correction of meniscal extrusion were higher in the anatomical repair.⁹

However, there was no reported precise arthroscopic landmark to define the anatomical footprint of the posterior root attachment of the medial meniscus. This technical note shows the arthroscopic landmark to guide the location of the anatomical footprint of the medial meniscus posterior root attachment called the “meniscal track”.

Surgical Technique (With Video Illustration)

Patient Positioning

After spinal anesthesia is done, the patient is positioned supine. When applying a valgus force, the lateral post controls hip rotation and helps the medial joint open. The foot is supported by distal support that keeps the knee flexed at 90°. To investigate intra-articular lesions, standard anterolateral, and anteromedial portals are established.

Superficial Medial Collateral Ligament Release

Following the identification of the medial meniscus posterior root tear, the superficial medial collateral ligament (MCL) is released to widen the medial joint

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space and avoid iatrogenic chondral injury. We use a needling approach to perform a percutaneous femoral-sided superficial MCL release.

Determine Anatomical Meniscus Posterior Root Attachment Using the “Meniscal Track”

The anatomical footprint of the medial meniscus posterior root is located anteromedially to the posterior cruciate ligament (PCL) and laterally to the demarcation line between the central and posterior areas of the medial tibial plateau¹⁰ (Fig 1). This demarcation line separates the more degenerative central part and the less degenerative posterior part of cartilage. The posterior rim of the medial tibial plateau, which the medial meniscus seats on, has a posterior downslope (Fig 2). That makes fewer compression loads on the posterior part than on the central part.

Arthroscopically Define the Anatomical Footprint

Arthroscopic examination defines a demarcation line that separates the different qualities of cartilage between the central part and posterior part of the medial tibial plateau. A "meniscal track" is the portion of the posterior cartilage where the meniscus is located. (Fig 3, A and B, Video 1) The cartilage over the footprint is removed to encourage meniscal healing.

Sewing the Meniscus Posterior Root

The Mini FirstPass suture passer (Smith & Nephew, Andover, MA) is used to pass a no. 2 FiberWire (Arthrex, Naples, FL) through the posterior part of medial meniscus posterior horn. (Fig 3C, Video 1) After that, a FiberTape (Arthrex) is passed through the center of the medial meniscus and more medially to the initial suture. (Fig 3D, Video 1) Another no. 2 FiberWire (Arthrex) is placed into the anterior part of the medial meniscus. (Fig 4A, Video 1) The most posterior suture is shuttled from the other end of the most anterior suture

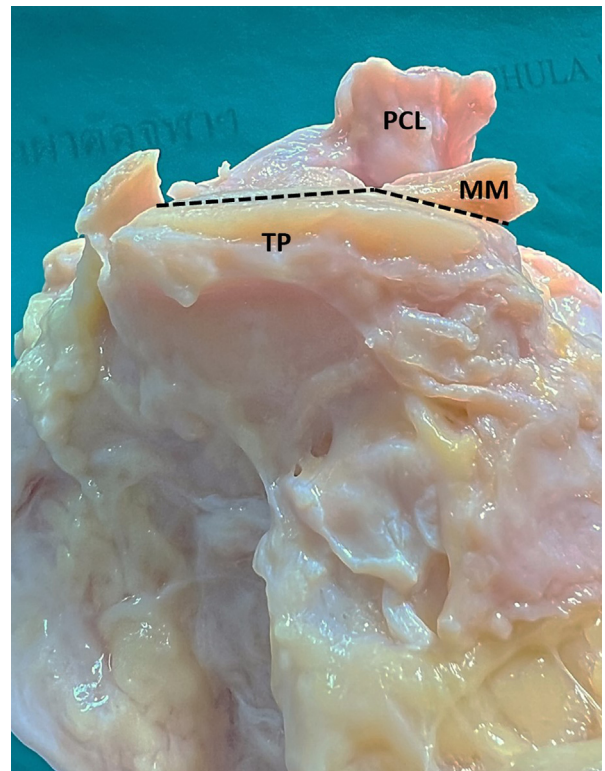


Fig 2. Right Thiel's embalmed cadaveric knee. Less compression loads are applied to this area due to the greater posterior slope of the posterior part of the medial tibial plateau on which the medial meniscus sits. That makes for fewer degenerative changes in the posterior chondral surface. MM, medial meniscus; PCL, posterior cruciate ligament; TP, tibial plateau.

through the posterior portion of the meniscus (Fig 4B, Video 1). Another end of the FiberTape (Arthrex) is placed over the vertical suture, and a shuttle suture is passed through the lateral portion of the meniscus.

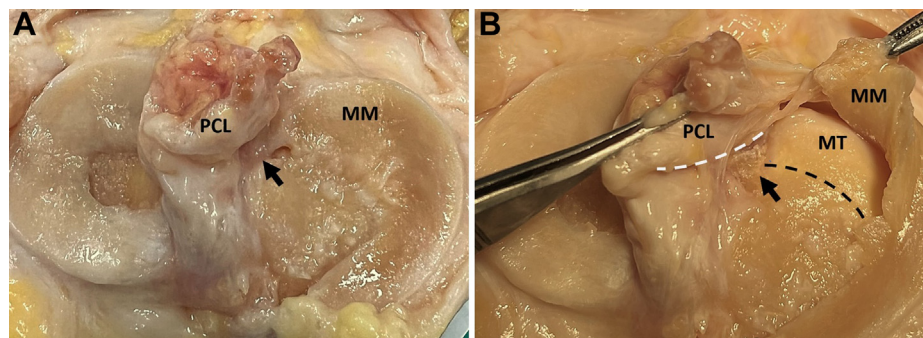
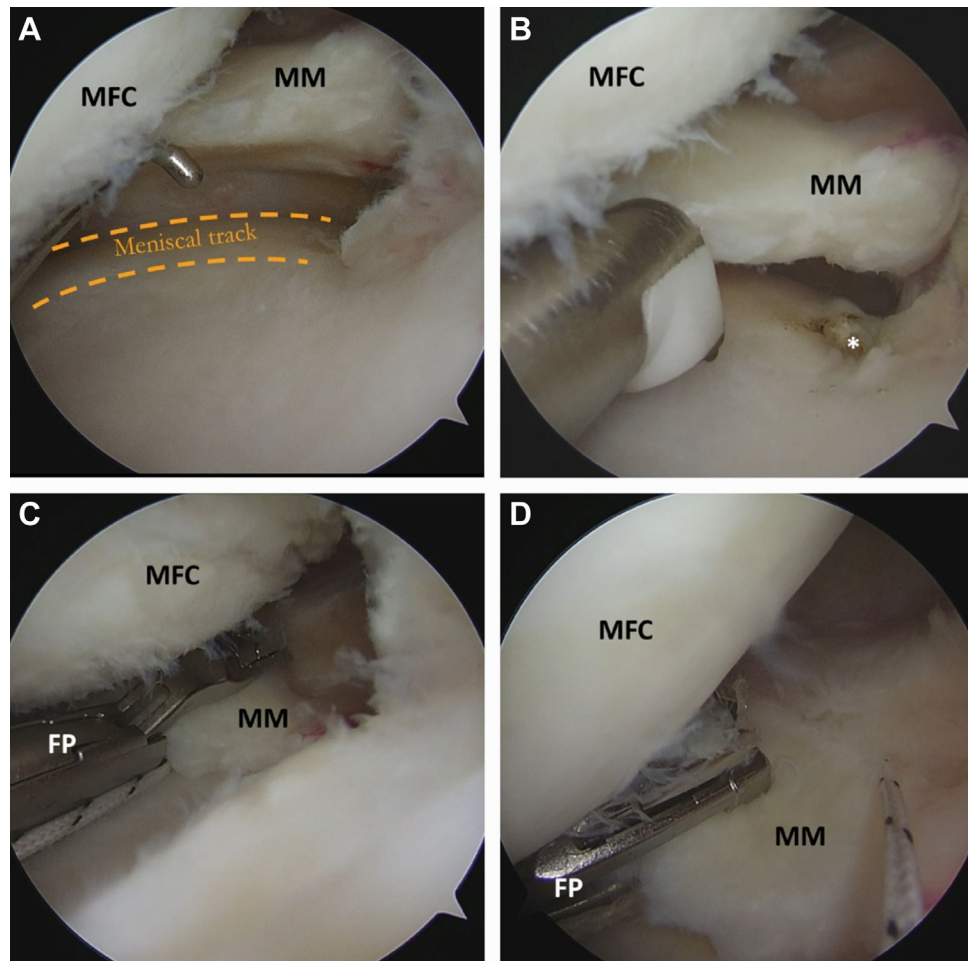


Fig 1. Right Thiel's embalmed cadaveric knee. (A) The posterior root attachment of the medial meniscus (arrow) locates anteromedially to PCL. (B) The demarcation line (black strip line) separates the posterior part of less degenerative cartilage and the central part of more degenerative cartilage. The footprint (arrow) is lateral to this demarcation line and anteromedial to PCL (white strip line). Both anatomical landmarks could guide the location of footprint in arthroscopic fields. MM, medial meniscus; MT, meniscal track; PCL, posterior cruciate ligament.

Fig 3. Picture of a patient who had left medial meniscus posterior root tear underwent arthroscopic repair in a supine position. Viewing from anterolateral portal. (A) Arthroscopic examination defines a demarcation line that separates the different qualities of cartilage between the central part and posterior part of the medial tibial plateau. A “meniscal track” is the portion of the posterior cartilage where the meniscus is located. (B) Identify medial meniscus posterior root footprint via arthroscopy. (C) Using a Mini FirstPass suture passer (Smith & Nephew, Andover, MA), insert a no. 2 FiberWire (Arthrex, Naples, FL) shuttle suture through the medial meniscus’ posterior part of the posterior horn. (D) Insert a FiberTape (Arthrex) through the center of the medial meniscus and more medially to the initial suture. An asterisk (*) denotes the medial meniscus posterior root footprint. FP, Mini FirstPass suture passer; MFC, medial femoral condyle; MM, medial meniscus.



Drilling Tibial Tunnel and Fixing with a Cortical Button

A meniscus root aiming device (Arthrex) is used to create a 4-mm-diameter tibial tunnel through the center of the footprint. (Fig 4C, Video 1) The sutures are all passed through the tunnel, and the tension is controlled and fixed with a cortical button (Arthrex) on the outside tibial cortex. (Fig 4D, Video 1) A compressive dressing is applied after the wound has closed.

Postoperative Care

The patient is ambulated with axillary crutches and non-weight bearing for 6 weeks. Progressive weight-bearing ambulation is allowed after 6 weeks. The patient is allowed 0 to 90° of knee flexion with a hinge knee brace, and the full range of motion is gradually encouraged after 6 weeks. The patient can return to normal activity after 3 months.

Discussion

The medial meniscus posterior root tears are a common problem in early elderly patients. These injuries

relate to a lower-energy mechanism, such as kneeling, squatting, slight knee twisting. The main problem is degenerative changes in the posterior root attachment of the medial meniscus.¹¹

The medial meniscus posterior root tears make several knee biomechanical alterations. The tibiofemoral contact area is less, which makes a higher articular contact pressure.⁸ The subchondral insufficiency fracture may be a result of the higher contact pressure of the medial femoral condyle.¹² From biomechanical studies, an anatomical repair can restore the tibiofemoral contact area and pressure.^{8,13} In many studies, anatomical repair resulted in superior functional outcomes, more complete meniscus repair, more correction of meniscus extrusion, and less osteoarthritic degeneration during the mid-term follow-up period.^{1,3,9,14}

From a biomechanical study by LaPrade et al., the anatomical repair demonstrated a restored contact area and contact pressure than the nonanatomical repair.⁸ Nonanatomical repair of the medial meniscus posterior root resulted in decreased tibiofemoral contact area and

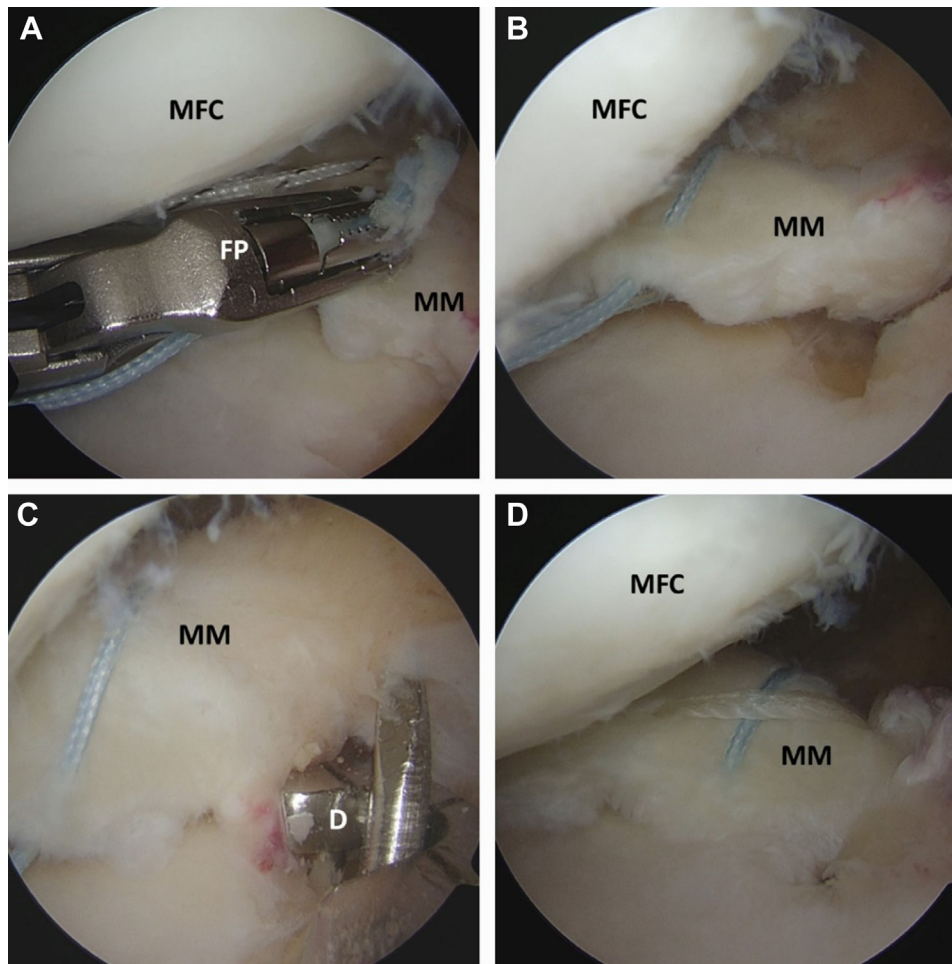


Fig 4. Picture of a patient who had left medial meniscus posterior root tear and underwent arthroscopic repair in a supine position. Viewing from anterolateral portal. (A) Insert another no. 2 Fiber-Wire (Arthrex, Naples, FL) through the medial meniscus' anterior part. (B) Use a posterior-most shuttle suture to thread the other end of the anteriormost suture through the posterior portion of the meniscus. (C) A meniscus root aiming device is used to create a 4-mm-diameter tibial tunnel through the bony center of the footprint. (D) Final repair construct. FP, Mini First-Pass suture passer; MFC, medial femoral condyle; MM, medial meniscus; D, 4-mm-diameter drill.

increased contact pressure.^{8,13} Even though the knee biomechanical changes were not restored, the non-anatomical repair still improved postoperative functional outcomes.⁹ However, the anatomical repair has more complete meniscal healing and better meniscal extrusion correction than the nonanatomical repair.⁹

A recent study defined a landmark of the anatomical footprint of the medial meniscus posterior root in an arthroscopic view.¹⁰ The anatomical insertion of the medial meniscus posterior root is located anteromedially to the PCL and laterally to the demarcation line between the medial tibial plateau's central and posterior parts (Fig 1). This line delineates the more degenerative central region of cartilage from the less degenerative posterior part. The medial tibial plateau's rear rim, on which the medial meniscus sits, has a posterior downslope (Fig 2). That makes for fewer compression loads on the posterior part than on the central part. This technical note presents the "meniscal track," an arthroscopic landmark to guide the location of the anatomical footprint of the medial meniscus posterior root attachment. It has the advantage of being a simple and reproducible technique to accurately find

the medial meniscus posterior root footprint using the PCL and the demarcation line of the meniscal track. However, there is the limitation that the meniscal track

Table 1. Pearls, Advantages, and Limitations of the Technique

Pearls	<ul style="list-style-type: none"> Release the superficial medial collateral ligament to widen the medial joint space enough to pass instruments, and to avoid iatrogenic chondral injuries. Create the bony crater over the footprint to promote the meniscal healing. Define the anatomical footprint anteromedially to posterior cruciate ligament and lateral to the demarcation line of meniscal track. Repair the meniscus posterior root with a Mason-Allen stitch to improve the strength of suture construct
Advantages	<ul style="list-style-type: none"> Restore the anatomical footprint. Restore normal contact area and contact pressure of the knee. Simple and reproducible
Limitations	<ul style="list-style-type: none"> The meniscal track may be difficult to locate in situations with advanced osteoarthritis of the knee.

may be difficult to locate in cases of advanced knee osteoarthritis.

In this technical note, we present arthroscopic trans-tibial medial meniscus posterior root repair using the meniscal track, and we prefer the Mason-Allen suture configuration in posterior meniscus root repair, because many studies have shown that it outperforms other suture configurations in terms of cyclic loading and load-to-failure testing.^{13,15,16} Advantages, limitations, and pearls of the technique are further described in Table 1.

In conclusion, this presented technique is a reproducible method and a safe surgical technique for locating the anatomical footprint of medial meniscus posterior root.

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