Concomitant Medial and Lateral Meniscus Posterior Horn Root Repair With Anterior Cruciate Ligament Reconstruction Using Triangular Configuration of Transtibial Tunnel Technique

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Abstract: The simultaneous presence of posterior horn root tears in both the medial and lateral menisci along with an anterior cruciate ligament (ACL) rupture is uncommon. Literature is scarce that addresses the concurrent repair of medial and lateral meniscus root tears alongside ACL reconstruction. We discuss the management of concomitant medial meniscus posterior horn root tear, lateral meniscus posterior horn root tear, and ACL tear. Challenges may arise, including difficulty in accessing the medial meniscal root tear, confusion regarding the sequence of repair, and the risk of tunnel coalition within the tibial bone during each procedure. In response, we offer a detailed, step-by-step arthroscopic technique aimed at efficiently addressing these obstacles while saving time.

Lateral meniscus posterior horn root (LMPHR) tears are often traumatic and occur in 7% to 12% of the patients with anterior cruciate ligament (ACL) tears.[1] Medial meniscus posterior horn root (MMPHR) tears are mainly from chronic degeneration in middle-aged individuals and account for 10% to 28% of medial meniscus tears. Traumatic medial meniscus root tears are uncommon and seen usually with multiligament injuries.

Meniscus root tears refer to injuries at the points where the meniscus attaches to the tibia within approximately 1 cm from its insertion into the tibial plateau. These tears result in a loss of hoop stresses in the meniscus, leading to a gradual extrusion of the meniscus, reducing the contact area between the tibia and femur and increasing pressure on the hyaline cartilage in the knee.

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Research has indicated that meniscus root tears often are linked with significant knee laxity and may potentially influence the outcomes of ACL reconstructions. Hence, it is crucial to address these root tears during ACL reconstruction to safeguard the integrity of the ACL graft and optimize results.

Surgical Technique

Our surgical technique can be seen in Video 1.

Positioning

The patient is positioned supine with the operative leg hanging and the other leg in a stirrup leg holder. Using standard anteromedial and anterolateral portals, the surgeon performs a diagnostic arthroscopy. A diagnostic arthroscopy is done to confirm the presence of MMPHR tear, LMPHR tear, and ACL tear. Access to the medial compartment of the knee is improved by limited release of the medial collateral ligament by the pie-crusting technique. The knee is placed in nearly full extension, with a valgus force being applied to obtain maximum visibility and access for the MMPHR tear. For improved visualization and access to the lateral compartment of the knee, the operated limb is placed in the figure-of-4 position, with downward force applied at the level of the knee to open the lateral compartment.

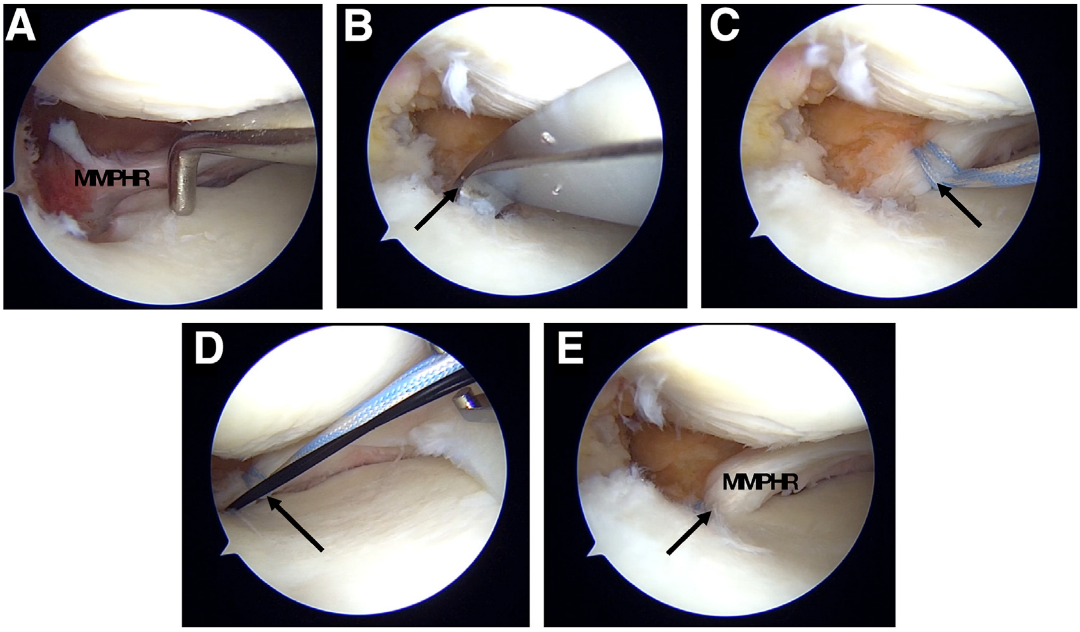

Fig 1. The patient is in supine position with the operative leg hanging and the other leg in stirrup leg holder. Medial meniscus posterior horn root (MMPHR) tear visualized from the anterolateral portal and working from anteromedial portal with knee in near extension with valgus stress. (A) MMPHR tear seen during diagnostic arthroscopy. (B) Preparation of the footprint of medial meniscus posterior root with microcurette. (C) Cinch knot tied in the MMPHR using FiberTape. (D) Retrieval of FiberTape suture using an ETHILON No. 1 suture (Ethicon) to shuttle the meniscus sutures into the tibial tunnel. (E) Anatomically reduced MMPHR

MMPHR Repair

While viewing from the anterolateral portal and working from the anteromedial portal, the MMPHR tear is visualized (Fig 1A). The surgeon prepares the medial meniscus posterior root tibial footprint with a microcurette (Fig 1B). High-strength tape (FiberTape; Arthrex, Naples, FL) is passed through the remnant of the medial meniscus root using antegrade suture passing device (FIRSTPASS MINI; Smith & Nephew, London, UK) (Fig 1C) using a cinch suture technique. This is followed by drilling with a 2.4-mm Beath pin using the dedicated low-profile meniscus root repair jig, set at an angle of 70° with the wire protected from migration using a microcurette. The MMPHR tunnel is placed relatively laterally on the anteromedial surface of tibia. The surgeon shuttles the FiberTape in the medial meniscus root through the transtibial tunnel with the help of an ETHILON no. 1 suture (Ethicon, Somerville, NJ) via a suture pullout technique (Fig 1D), which reduces the MMPHR anatomically (Fig 1E).

LMPHR Repair

The LMPHR tear is visualized from the anterolateral portal with instruments being passed from the anteromedial portal (Fig 2A). Arthrex FiberTape is passed through the remnant of the lateral meniscus root using

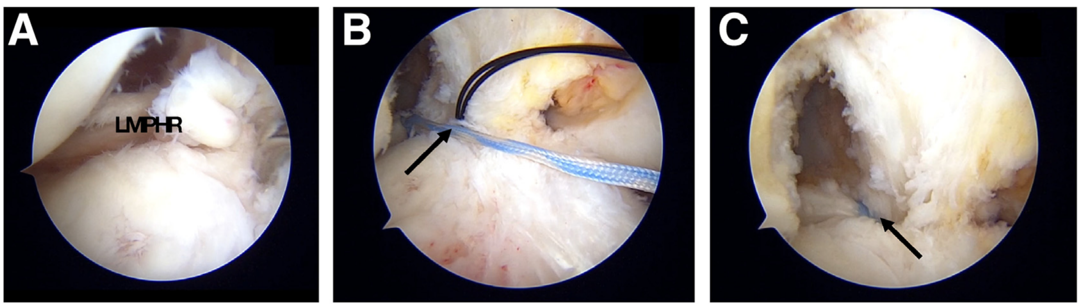

Fig 2. The patient is in supine position with the operative leg hanging and the opposite leg in a stirrup leg holder. Lateral meniscus posterior horn root (LMPHR) repair of the knee performed by visualizing from the anterolateral portal and working from the anteromedial portal. (A) LMPHR tear seen during diagnostic arthroscopy visualizing from the anterolateral portal. (B) Cinch-type suture taken with FiberTape in the LMPHR followed by pulling it out through the tibial tunnel using a shuttle suture. (C) Shows the lateral meniscus root reduced in anatomical position.

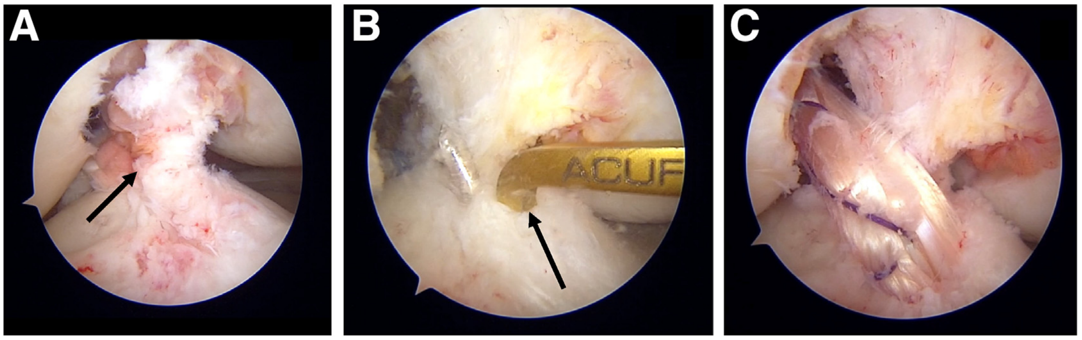

Fig 3. (A) A torn anterior cruciate ligament (ACL) through diagnostic arthroscopy. (B) The tibial tunnel being created with the help of an ACL tip aimer guide. (C) The stable and satisfactory reconstruction of the ACL.

an antegrade suture-passing device (FIRSTPASS MINI; Smith & Nephew) through the anteromedial portal (Fig 2B). This is to obtain the best trajectory for passage of the suture through a good meniscus tissue.

The sutures are then parked in the anteromedial portal. A 2.4-mm Beath pin is drilled using the dedicated low-profile meniscus root repair jig, setting it at an angle of 60° for the lateral meniscus root tunnel after preparing the footprint at the anatomical position with a microcurette. The sutures from the lateral meniscus root are shuttled into the reamed tunnel (Fig 2C). The LMPHR tunnel is placed relatively medially on the anteromedial surface of the tibia to get a pull of the meniscus in a mechanically superior direction. Precautions are taken to maintain sufficient bone bridge between the medial and lateral meniscus root tunnels.

ACL Reconstruction

The semitendinosus and gracilis are harvested and quadrupled to obtain an 8.5-mm diameter graft. After visualizing the ACL rupture (Fig 3A), the ACL remnant is shaved off. The femoral tunnel is drilled in a routine manner, and the ACL tibial tunnel guidewire is passed using an ACL tip aimer guide set at an angle of 50° (Fig 3B) with the external starting point in between the tunnels for LMPHR and MMPHR and slightly proximally. At this point, great care is taken while positioning the tibia tunnel to ensure sufficient bone bridge between the 3 tunnels on the anteromedial surface of the tibia. The ACL tunnel is situated proximally and most centrally of the 3 tunnels (Fig 4A).

Fixation of Root Repair and ACL Graft

The sutures from the medial meniscus root, as well as lateral meniscus root, are passed through a cortical button (ENDOBUTTON; Smith & Nephew) (Fig 4B), and they are tensioned individually and tied. The medial and lateral meniscus roots are tensioned at 30° of knee flexion with the knee in neutral rotation. This is followed by fixation of ACL on the tibial side in 10° of flexion in neutral rotation and posterior drawer force with an interference screw.

Postoperative Protocol

For initial rehabilitation, the patient needs to be kept non—weight-bearing for 6 weeks followed by full weight-bearing after 6 weeks. The knee range of movement is restricted to 90° for the initial 4 weeks, followed by a full range of motion after 4 weeks.

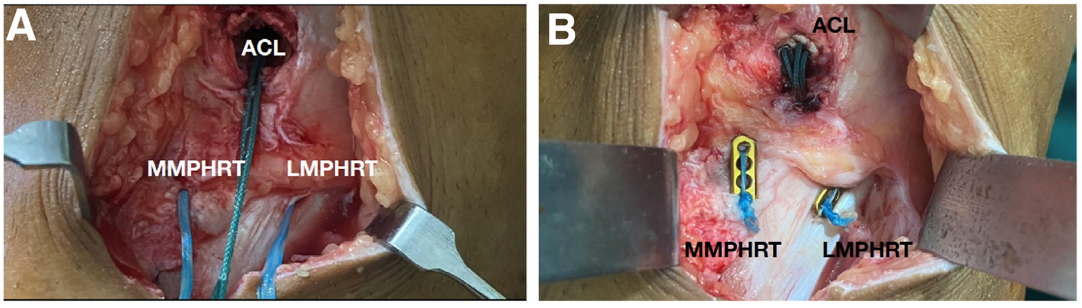

Fig 4. Outside picture showing arrangement of the root repair tunnels and ACL tibial tunnel. (A) Arrangement of the tunnels is in a triangular fashion with the apex formed by the ACL tunnel and the base by the tunnels of medial meniscus posterior horn root (MMPHR) and lateral meniscus posterior horn root (LMPHR), with the tunnel for the MMPHR being lateral. Note adequate bony bridge between the tunnels. (B) Sutures from the MMPHR and LMPHR fixed with cortical ENDOBUTTON and ACL fixed with aperture fixation with the interference screw. (LMPHRT, lateral meniscus posterior horn root tear; MMPHRT, medial meniscus posterior horn root tear.)

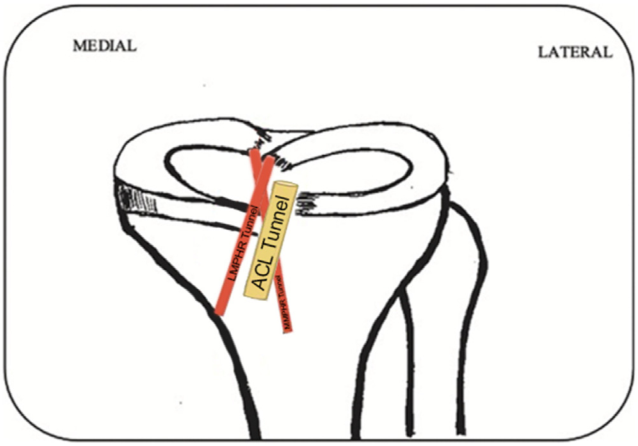

Fig 5. Diagrammatic representation of the tunnels of the roots and ACL. (ACL, anterior cruciate ligament.)

Discussion

Our proposed method involves starting with a repair from the posterior root of the medial meniscus to the posterior root of the lateral meniscus, followed by ACL reconstruction. This sequence benefits from enhancing visibility and reducing confusion by addressing structures from the back to the front. This approach also establishes a continuous reference point, aiding in the identification of anatomical footprints for further repairs or reconstructions.

We opted for a cinch-type suture technique for the posterior meniscal root repair, using transosseous tunneling for its significant advantage of easier loop placement through the meniscus, potentially offering superior strength over other suture configurations.[2] Despite various constructs explored in past research, none fully matched the native meniscal root's strength, although the loop stitch was the most effective.[2,3] Our choice of a single-cinch suture, specifically using FiberTape for its broader contact area than No. 0 ULTRABRAID, aims to minimize meniscal damage and secure the posterior root effectively.

Employing the transosseous tibial pullout technique allows for anatomic alignment and stable fixation of the meniscal root, preventing its displacement. This method has been shown to restore joint contact pressure and area to a state comparable with the intact knee, facilitating precise placement for the posterior horns. The meniscal function can get significantly affected with just 3 mm of nonanatomic displacement, according to mechanical studies.[4,5]

Feucht et al.[6] reported on a case involving both medial and lateral meniscus root injuries and an ACL tear, where the meniscus roots were repaired using transtibial pull-out sutures without reconstructing the ACL, recommending a 5-mm bony bridge between the tunnels.

Chernchujit et al.[7] documented a case of simultaneous medial and lateral meniscus root repair with ACL reconstruction, advising drilling the meniscus root tunnels from the anterolateral tibia to avoid tunnel collision, arranging the tunnels from medial to lateral as the ACL tibial tunnel, the MMPHR tunnel, and the LMPHR tunnel. However preparing the tunnels on the anterolateral side presents a different technical challenge: having to place the tibia guide while avoiding the tibial spines, as well as working under the musculature on the anterolateral tibia.

Shetty et al.[1] have presented a similar case of simultaneous medial and lateral meniscus root repair with ACL reconstruction. The arrangement of tunnels from medial to lateral were MMPHR tunnel, LMPHR tunnel, and ACL tibia tunnel over the anteromedial surface of tibia.

Our technique emphasizes the arrangement of tunnels in a triangular fashion, with the arrangement of tunnels from medial to lateral as LMPHR, ACL tibial tunnel and the MMPHR tunnel, with ACL tunnel forming the apex of the triangle proximally, as shown in Figure 5.

Another significant difference in our method as compared with the previous methods is the use of a 2.4-mm Beath pin for the drilling of tunnels of the menisci roots. This reduces the risk of tunnel coalition as well as reduced the generation of stress risers in the proximal tibia. The direction of pull described in our technique seems to be mechanically superior to other methods described in literature, as shown in the diagram.

Patients who underwent an all-inside repair with a boney trough for MMPRT had better functional and radiologic outcomes as compared with the transtibial pullout repair.[8] This technique has been found to allow less displacement under cyclic loading compared with the transtibial pullout method. Advantages and disadvantages are mentioned in Table 1.

Table 1. Advantages and Disadvantages

Advantages	Disadvantages
Single-cinch suture minimizes meniscal tissue injury as well as time and is easy to perform.	Use of 3 transtibial tunnels has increased chances of tunnel collision compared with use of suture anchor repair of the meniscus root.
Use of 2.4-mm Beath pins instead of a 4.5-mm drill bit reduces the risk of tunnel coalition.	Drilling of 3 tunnels can make the proximal tibial metaphysis weak, which calls for a delayed weight-bearing
The direction of our tunnels for the posterior horn roots seems to be mechanically superior and allows for more anatomical reduction of the root.	

Disclosures

All authors (M.S.L., A.P.S., L.B.) 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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