Technical Note

# Arthroscopic Medial Meniscal Transplant Using Multiple Fixation Techniques

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**Abstract:** The critical role of the meniscus in the biomechanics of the knee and articular cartilage preservation has led to an increased awareness of the importance of the meniscus. Meniscal allograft transplantation is a challenging surgical intervention that is saved as a last resort for patients who meet stringent criteria for salvage from meniscal deficiency. Proper arthroscopic implantation of a meniscal allograft takes precision and implementation of multiple fixation techniques to obtain a successful outcome.

Meniscal injuries of the knee are one of the most common orthopaedic injuries across all ages of patients.[1] Both the medial and lateral fibrocartilaginous menisci are essential for joint stability, shock absorption, and load distribution.[1,2] It is important to address symptomatic injuries, as damage to the menisci can potentiate the development of osteoarthritis in the knee joint, as well as instability.[3]

Meniscal tears have traditionally been addressed with meniscectomy or meniscal repair.[4,5] Recently, meniscal allograft transplants have gained particular interest to address total or subtotal meniscal damage.[6-9] Currently, options for meniscal allograft transplant include open and arthroscopic techniques. Furthermore, fixation techniques for securing the graft into place include all-inside, inside-out, and outside-in. In this Technical Note, we present our technique of arthroscopic meniscal transplant using a multifixation approach.

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## Surgical Technique

Current indications for performing meniscal transplants are 1) age <50 years with previous subtotal or total meniscectomy, 2) symptomatic pain in the tibiofemoral compartment, and 3) arthroscopic evidence of articular cartilage deterioration, correlating to an Outerbridge classification grade I or II. Contraindications to meniscal allograft transplants include 1) limb malalignment, 2) skeletal immaturity, 3) knee joint instability, and 4) body mass index >35. Our surgical technique is categorized into 7 steps to replicate this procedure as shown in the Video 1.

### Graft Selection and Preparation

A meniscal allograft is obtained from a certified tissue bank, matching for patient height and weight using weightbearing knee radiographs. The frozen meniscus allograft with tibial bone block is placed onto a sterilely draped field and thawed in a warm bacitracin-infused saline bath. Once thawed, an 8-mm coring reamer is used to prepare the bone plugs on the anterior and posterior root attachments. A rongeur and oscillating burr are used in conjunction to remove the excess bone, creating 7 × 8-mm bone plugs. Next, #2 Ethibond (Ethicon, Somerville, NJ) sutures are placed through the anterior and posterior roots of the meniscus, exiting on either side of the bone plugs. #2-0 Orthocord (DePuy-Mitek, Warsaw, IN) is then placed at the junction of the midbody and posterior horn of the meniscus in a horizontal mattress configuration. The word "top" is written on the graft for

**Fig 1.** The meniscal allograft is prepared with sutures at the root of the anterior and posterior horns (white arrows) after the bone plugs have been shaped. The word "top" is written on the graft to maintain orientation.

orientation purposes and placed into a moist sponge on the back table (Fig 1).

### Patient Positioning and Visualization

The patient is placed in the supine position with a venous sequential boot on the nonoperative extremity.

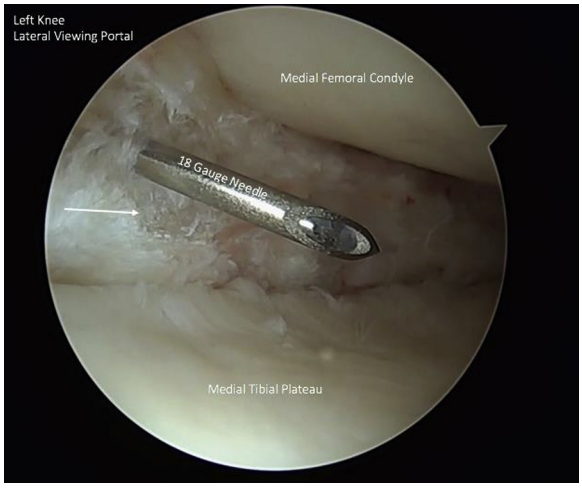


**Fig 2.** Left knee viewed from the lateral viewing portal. The previous meniscal remnant (white arrow) is prepared using a shaver. An 18-gauge needle is used to trephinate the meniscus to encourage neovascularization.

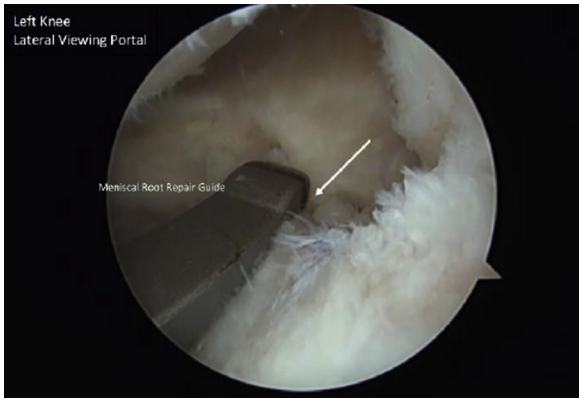


**Fig 3.** Left knee viewing from the lateral portal. A low-profile meniscal root repair guide is placed through the medial portal at the footprint of the native posterior medial root attachment (white arrow).

The foot of the bed is maintained straight, and a side post is placed against the proximal third of the operative thigh. The operative extremity is then prepped and draped in the usual fashion. A viewing portal is first created in the anterolateral position, cheating slightly high and tight against the patella tendon. An anteromedial portal is then established under direct visualization using an 18-gauge spinal needle. A diagnostic arthroscopic evaluation is performed, paying special attention to the remaining meniscus and visualizing the prior anterior cruciate ligament repair. The remaining meniscus is prepared using a shaver and an outside-in trephination technique with an 18-gauge spinal needle to encourage neovascularization (Fig 2).

A 3 × 12-mm PassPort Cannula (Arthrex, Naples, FL) is placed into each portal to allow for ease of instrument

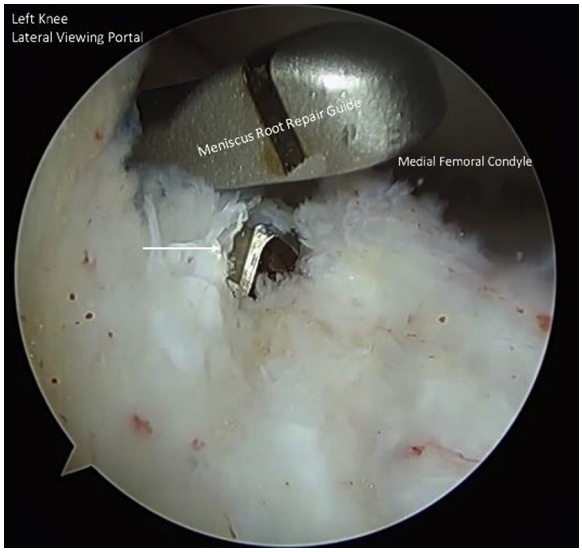


**Fig 4.** Left knee viewing from the lateral portal. A FlipCutter drill is used to create a tunnel at the anterior medial meniscus root attachment (white arrow).

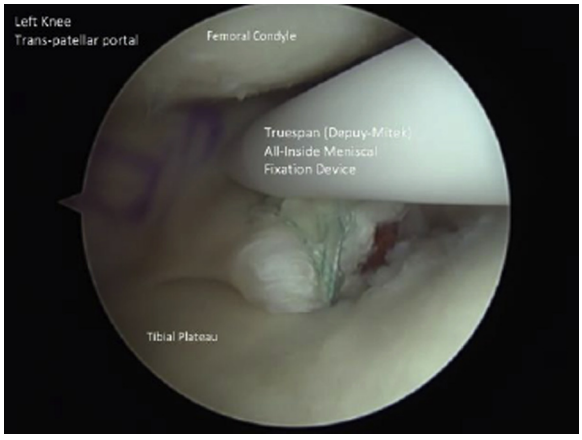


**Fig 5.** Left knee viewing from a transpatellar portal. An all-inside meniscal device is used to begin fixation slightly medial to the root insertion. "Top" can be partially seen on the graft.

passage and suture management. The origin of the native posterior-medial meniscus root is identified and marked on the tibial plateau with underwater electrocautery VAPR (Depuy-Mitek). To allow for access to the posterior horn, an 18-gauge spinal needle is used to trephinate the medial collateral ligament at the joint line while applying a valgus load to the knee. At the posterior root, a low-profile meniscal root repair guide is placed at the native footprint through the medial portal (Fig 3). Once the guide is appropriately placed at ~55°, an 8-mm retrocutting FlipCutter (Arthrex) is drilled, and a 8-mm-wide socket is created. Next, a metal suture shuttling wire is passed through the guide into the joint and retrieved through the lateral cannula. The above steps are then repeated at the footprint of the native anterior horn of the medial meniscus, with a second tibial tunnel created with an ~1-cm bone bridge (Fig 4).

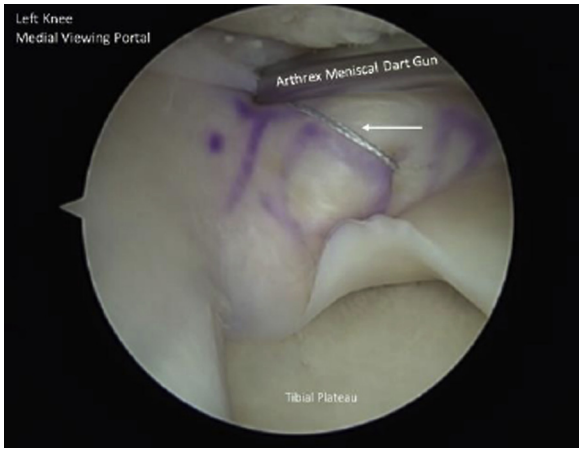


**Fig 6.** Left knee viewing from the medial portal. The Meniscal Dart Gun needle and suture is delivered through the lateral portal, creating an inside-out mattress configuration (white arrow).

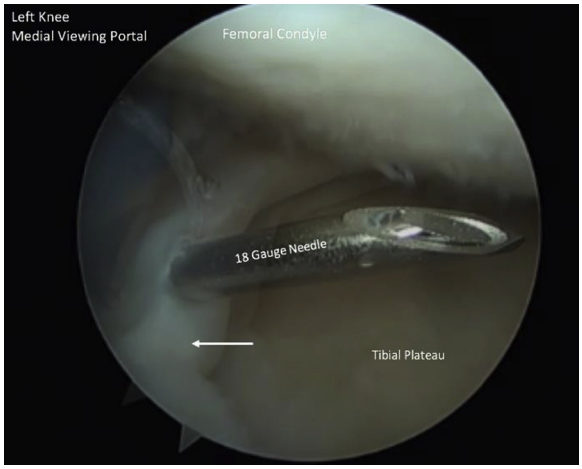


**Fig 7.** Left knee viewing from medial portal. Using an outside-in technique, the anterior horn of the meniscus (white arrow) is fixed with an 18-gauge spinal needle and a metal suture shuttling device.

## Graft Placement: The Roots

After tunnel preparations, the sutures from the posterior horn of the graft are shuttled through the lateral cannula. The sutures are then pulled out of the tibial tunnel, introducing the graft into the knee joint. Next, a probe is used to position the graft against the medial capsule. The remaining anterior horn sutures are shuttled through the anterior tibial tunnel. Next, the 2 sets of suture limbs on the medial aspect of the proximal tibia are provisionally tied with a half hitch and clamped with a needle driver with the knee in full extension. Definitive fixation of the roots is reserved until the completion of the procedure.

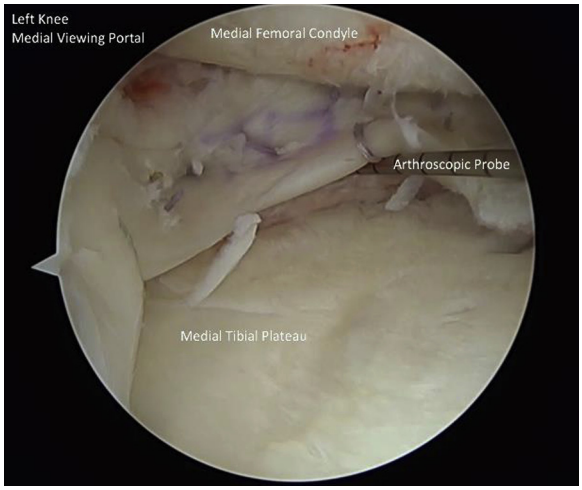


**Fig 8.** Left knee viewing from medial portal. An arthroscopic probe is used to test the fixation of the medial meniscus transplant. Areas needing supplemental fixation are secured with all-inside sutures.

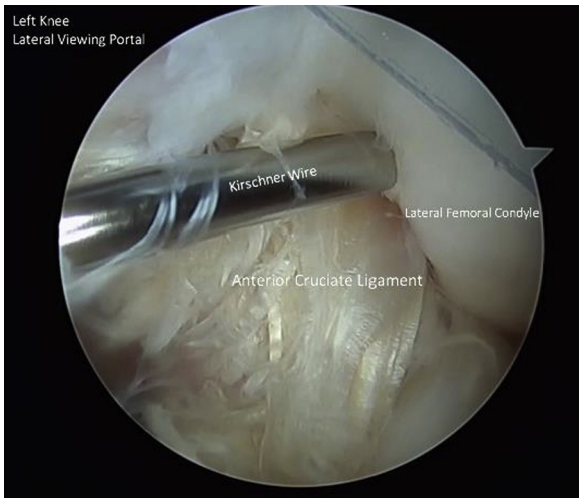


**Fig 9.** Left knee from lateral viewing portal. A Kirschner wire is used to trephinate the intercondylar notch to stimulate bone marrow.

An 18-gauge spinal needle and suture shuttler are used at the posteromedial joint line to allow for shuttling of the 2-0 midbody graft sutures. The first limb of suture is loaded and passed through the capsule and skin. This step is repeated with ~5 mm between needle passes in a horizontal mattress configuration, allowing for the second limb to be passed. The limbs are temporarily secured using a half-hitch, with definitive tying delayed until the conclusion of the procedure.

### All-Inside Technique: Posterior Horn

While viewing through the lateral cannula, an all-inside meniscal device, Truespan (Depuy-Mitek), is used to begin meniscal fixation just adjacent to the posterior meniscal root. The all-inside portion of the repair focuses on the posterior horn of the meniscus. A 12° insertion gun is used to allow for ease of passage around the medial femoral condyle. The Truespan device provides a dual-load PEEK anchor barb configuration. Beginning 5 mm medial to the root repair, alternating vertical and horizontal mattress sutures are placed to the junction of the posterior horn and midbody of the meniscus (Fig 5).

**Table 1.** Pearls to Avoid Iatrogenic Pitfalls

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| During the bone plug preparation, care should be used to ensure the length of the plug is 7 to 8 mm to facilitate seating it into the tibial socket. |
| Trephination of the medial collateral ligament should be performed before drilling of the posterior root socket to avoid iatrogenic cartilage damage. |
| When facilitating the seating of the bone plugs into the tibial socket, a transpatellar portal can be used to insert a grasper. |
| Before shuttling the 2-0 suture inside-out or outside-in, make a small skin incision while the needle is still present at the skin to avoid injury to the suture. |

### Inside-Out Technique: Midbody

Once the midbody is reached, a disposable 15° curved cannula Meniscal Dart Gun (Arthrex) is placed through the lateral portal and up against the meniscal allograft at the midbody. A 2-0 dual-loaded suture needle is the delivered through the curved cannula, passing through the meniscus, capsule, and skin (Fig 6). The curved cannula is then placed 5 mm from the initial suture pass, and the second limb of the suture needle is delivered by hand. These limbs are then tied down over the capsule with the leg in extension, and the steps are repeated, alternating horizontal and vertical mattress configurations. This technique is used to join the midbody and anterior horn.

### Outside-In Technique: Anterior Horn

At the junction of the midbody and the anterior horn, fixation is achieved through an outside-in technique. With the knee flexed to 90°, an 18-gauge spinal needle and suture shuttler are introduced from outside of the body, piercing the skin, capsule, and meniscus, and are then retrieved through the medial portal (Fig 7). A 2-0 fiber wire suture is shuttled through the medial portal and exits back out through the spinal needle. The above steps are repeated to create alternating vertical and horizontal mattress sutures. Each mattress suture is individually tied using low-profile knots.

### Completing the Repair

To complete the repair, attention is turned back to the 2 sets of suture limbs exiting the proximal tibial tunnels from the roots. With the leg in full extension, the sutures from each tunnel are tied over the bone bridge separating the tunnels. The arthroscope is then returned to the lateral portal, and a final inspection is undertaken (Fig 8). Finally, a 0.62-mm Kirschner wire is introduced into a non-weightbearing portion of the notch to allow for bone marrow stimulation (Fig 9). The knee is then drained and closed using 4-0 Monocryl suture. The patient is placed into a sterile dressing with knee immobilizer.

## Discussion

Meniscal preservation and restoration have been shown to have many benefits, including chondral protection.[10] For patients without sufficient meniscus who meet inclusion criteria, meniscal transplantation

**Table 2.** Risks and Limitations of Arthroscopic Medial Meniscal Transplant Using Multiple Fixation Techniques

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| Iatrogenic injury to the saphenous nerve |
| Iatrogenic injury to medial femoral cartilage |
| Technically challenging footprint compared with open approach |
| Failure of all inside anchors |
| Tunnel convergence if concomitant procedures performed |

offers a good option to restore function and quality of life.

Arthroscopic meniscus transplantation is not without its limitations and can prove to be technically challenging. Table 1 outlines the most common risks encountered during this procedure.

## Conclusions

We present a minimally invasive, arthroscopic method for medial meniscus transplantation that uses a multifixation methodology. The benefits of this technique include ease of reproducibility, minimally invasive features, and avoidance of posterior knee dissection for suture passing. Additionally, by avoiding common pitfalls (Table 2), the risk of iatrogenic transplant failure is low. We believe that this technique can be reproduced in a safe and timely manner.

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