Meniscal Root Repair Using a Two-Tunnel Technique

A knee technique guide as described by

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FIRSTPASS◊ MINI
Suture Passer

MENISCAL ROOT
Repair System

Overview

The meniscal roots are very important to overall joint health; however meniscal root tears are often underdiagnosed or misdiagnosed and, as stated by Dr. LaPrade, represent from 10% to 21% of overall tears seen on magnetic resonance image (MRI) scans. It has been reported that a posterior horn medial meniscus root tear is equivalent to a subtotal medial meniscectomy,[1,2] while a lateral meniscus root tear, where the meniscofemoral ligaments are also torn, likewise contributes to a meniscal deficient state.[3]

In patients with a meniscal root tear who have fairly normal articular cartilage of the ipsilateral compartment, Grade II chondromalacia or less, an attempt should be made for a meniscal root repair.[4]

Biomechanical studies have validated that a meniscal root tear, or a radial root tear within 1cm of the meniscal root attachment, can be reattached to the tibia and can significantly restore joint contact area and joint forces.[2, 4] In addition, it has been reported that a meniscal root repair that is performed in a non-anatomic position, which usually means a medial meniscus root tear that is subluxed posteromedially, is equivalent to a subtotal meniscectomy.[5,6] Therefore, all attempts should be made to try to release any adhesions causing meniscal root tears to be retracted in order to allow them to be located in the most anatomic position possible.[7]

There is no distinct upper age for a meniscal root repair. This should depend upon the patient's activity level, general overall health, associated comorbidities, joint alignment, and the degree of ipsilateral compartment chondromalacia. In patients who are otherwise active and who sustain a meniscal root tear, consideration should be made to performing a meniscal root repair.

This surgical technique was prepared with the guidance of Robert F. LaPrade, MD, PhD and contains a summary of techniques and opinions based upon his training and expertise in the field, along with his knowledge of Smith+Nephew products.

S+N does not provide medical advice and recommends that surgeons exercise their own professional judgement when determining a patient's course of treatment. This surgical technique is presented for informational and educational purposes only. **For more information on the products in this surgical technique, including indications for use, contraindications, effects, precautions and warnings, please consult the products' Instructions for Use (IFU).**

Introduction

A meniscus root tear is defined as either an avulsion of the meniscal root from its attachment point or a radial root tear within 1cm of the root attachment. There are five types of meniscal root tears, with the most common being a Type 2 radial root tear.[8]

Most patients present with complaints of posterior knee pain, or of feeling a pop, when they are at maximal knee flexion. In traumatic cases, patients often have multi-ligament injuries or an anterior cruciate ligament (ACL) tear.[9,10] An MRI can be especially useful to determine the presence of a meniscus root tear because it can show detachment of the root on the axial cuts, extrusion on the coronal cuts, and a 'ghost sign' present on the sagittal images, which would indicate there is a lack of meniscal tissue due to the root tear and/or medial or lateral meniscal extrusion.[4,11] Concurrent with an MRI, the patient should have a standing AP view, a Rosenberg view to assess for joint line narrowing, and a long-leg alignment x-ray to assess for malalignment. Concurrent injuries often include a chondral lesion, which is most commonly found with a posterior horn root tear of the medial meniscus, or with an ACL tear, which most commonly affects the posterior horn lateral meniscus root attachment.[10]

Indications and contraindications for meniscal root repairs

Meniscal root tear repairs should be considered in all patients who have a fairly normal activity level, knee ipsilateral compartment chondromalacia Grade Two or less, and in those who may have a concurrent ligament reconstruction with evidence of extrusion of the meniscus. Contraindications would be patients who have advanced arthritis, Grade Three to Four (which is not correctible with a cartilage repair procedure), severe malalignment, and in those with apparent extrusion of the root tear due to associated arthritis. In addition, all patients who have significant associated comorbidities that would preclude adequate healing or the ability to follow a focused postoperative rehabilitation program would not be good candidates for meniscal root repairs. Studies have demonstrated that patients have both improved clinical and radiographic outcomes with repairs compared to partial meniscectomies for root tears.[12–15] Overall, the transtibial repair technique has been validated as an effective method to restore the meniscal root.[16,17]

Figure 1: Right knee

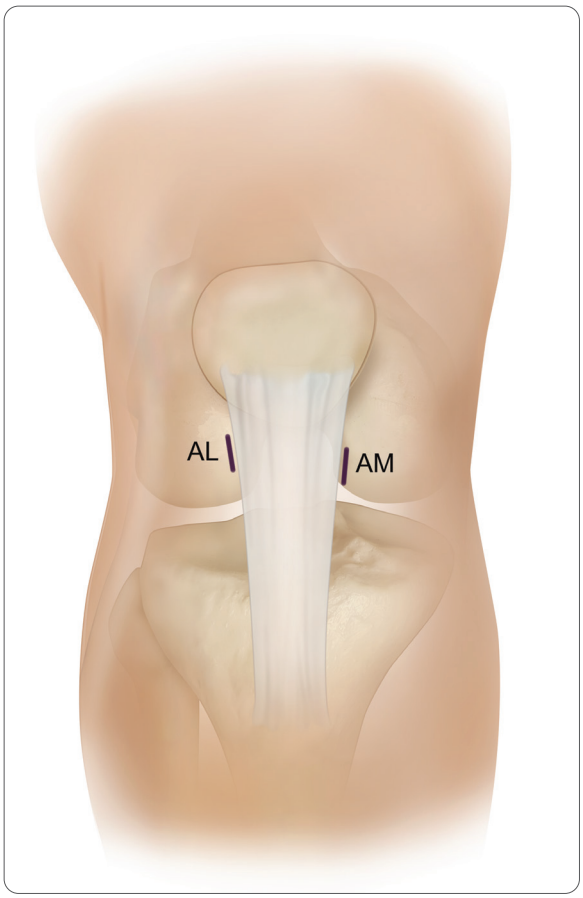


Figure 2: Right knee

Procedure

Patient positioning prior to the surgical incisions

It is recommended that the patient's operative leg is placed into a leg holder positioned at the upper thigh, with the contralateral knee placed in an abduction stirrup to both remove it from the operative field and adequately pad the leg and peroneal nerve. This is particularly important for medial meniscal root repairs, which may require the use of a posteromedial arthroscopic portal. The foot of the operating table should be flexed to 90° to allow for positioning of the knee, with the table height adjusted as necessary based on the surgeon's preference. The patient should then be sterilely draped off and given prophylactic antibiotics prior to the surgical incisions (**Figure 1**).

Arthroscopic portal placement

Standard arthroscopic portals can be made anteriorly. Anterolateral and anteromedial portals can be made adjacent to the patellar tendon and at the normal positions, which allows surgeons to perform a standard arthroscopic evaluation of the knee. An accessory medial or lateral portal can also be placed, depending upon the position of the root tear, to allow for placement of an arthroscopic grasper or other instruments as necessary (**Figure 2**).

Patients who have a tight medial compartment, limiting the placement of a suture passer from the anterior portals, may require the use of a posteromedial portal in order to pass a suture through the meniscal substance by accessing the root tear through the posteromedial aspect of the knee. This has been found to be the most common location for passing the root repair sutures when one is initially performing meniscal root repairs. Additionally, an arthroscopy needle may be used with a “pie-crusting” technique to complete a slight medial collateral ligament (MCL) release in tight joints.

Establishing the anterolateral portal

The anterolateral portal is established first and placed anterolaterally, just distal to the patellar tendon and patellar junction, to allow arthroscope positioning which minimizes placement through the retropatellar fat pad. This is performed with the use of a #11 blade. The blade should enter into the joint totally such that the arthroscopic instruments can be easily switched between the medial and lateral portals without difficulty.

Establishing an anteromedial portal

After the anterolateral portal is established, the arthroscopic camera should be inserted into the joint and the joint insufflated with normal saline. The arthroscope should then be positioned within the intercondylar notch. If there is an acute injury, some flushing out of the blood effusion may be necessary. The camera should then be positioned such that the 30° position is looking directly towards the anteromedial portal, and an arthroscopy needle should be used to localize the placement of this portal under direct vision. The portal should be placed just above the meniscal tissue and as close to the medial edge of the patellar tendon as possible. It is important not to place this portal too proximal or too medial because this can make it difficult to access the posteromedial aspect of the joint. A diagnostic arthroscopy can now be performed to assess the status of the suprapatellar pouch, patellofemoral joint, medial and lateral compartments, and to assess if any other intraarticular pathology needs to be treated.

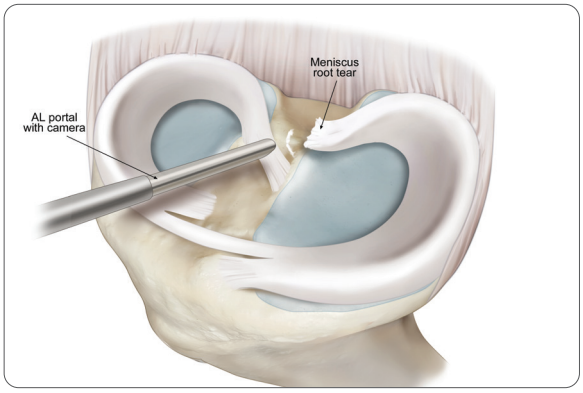


Figure 3

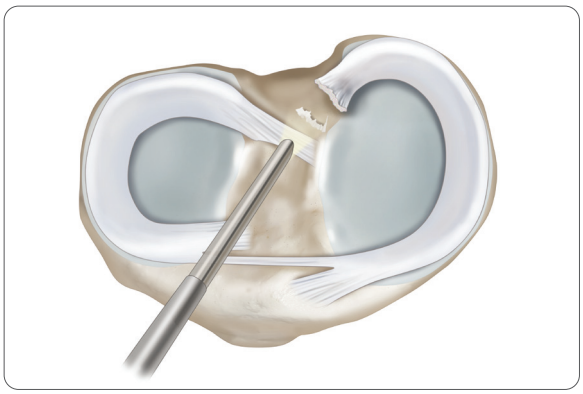


Figure 4

Assessing for a medial meniscus root tear

The best way to access the posteromedial aspect of the medial meniscal posterior root attachment is to position the arthroscopic camera in the anterolateral portal and then to place the camera directly medial to the posterior cruciate ligament and then to view directly down on the meniscal root attachment (**Figure 3**).

The surgeon can position the knee in an extended and valgus position in the leg holder, and then directly probe the meniscal attachment to confirm that a root tear is present. In many cases, the root tear is easily visible prior to placing the probe; however, the probe can help to assess the range of mobility in the meniscal root attachment, and to assess whether there is significant scarring that is retracting it into a nonanatomic posteromedial position.[5] The medial meniscal root attachment is located approximately 1cm posterior to the apex of the medial tibial eminence[7] (**Figure 4**).

Radial root repairs should be positioned medially based upon how far medial the radial tear occurred from the root attachment.

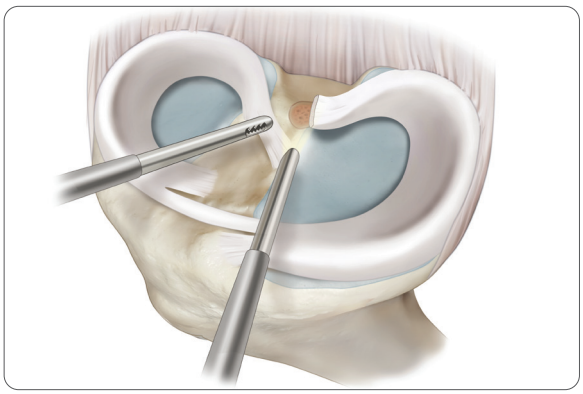


Figure 5

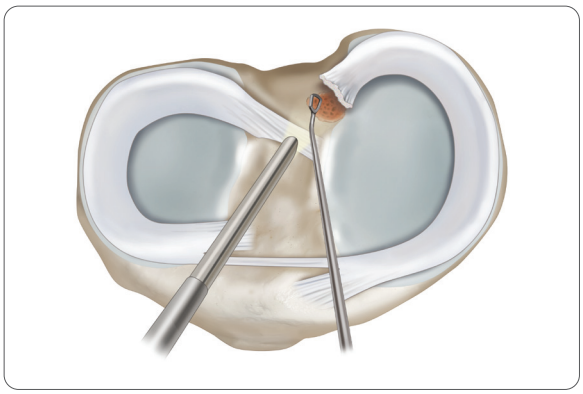


Figure 6

Preparation of root repair bed on tibia

Once the presence and reparability of the meniscal root tear is confirmed, and other significant pathology in the joint has been identified and treated as indicated, the next step is to prepare the bony bed for the meniscal root attachment on the posteromedial aspect of the tibia (**Figure 5**). A 4.5mm DYONICS◊ INCISOR◊ PLUS PLATINUM Blade and 4.5mm curved DYONICS INCISOR PLUS PLATINUM Blade can be used to remove any scar tissue that may limit visualization.

A curette in the Meniscal Root Repair System can be used to decorticate the bony area on the posterolateral aspect of the medial tibial plateau where the meniscal root attachment is planned to be re-approximated (**Figure 6**). It is important to ensure that this area of decorticated bone extends to the posterior aspect of the tibia in order to maximise bony healing of the meniscal root repair.

Preparation of the meniscal body

Except in very acute cases, most meniscal root tears have to be released from scar tissue. The ACUFEX◊ Rotary Scissors 20° right and ACUFEX Rotary Scissors 20° left can be very effective for releasing the scar tissue on both the inferior and superior surface of the meniscus. This can usually be accomplished by placing the camera in the anterolateral portal and accessing the meniscus from the anteromedial portal. In rare cases, a posteromedial portal may need to be placed in order to allow for the release of any scar tissue. During this step it is important to leave some capsule still attached to the meniscus to ensure that there is good meniscal substance present for the repair. The meniscus should be regularly grasped with a standard grasper to verify the level of mobility created by the release. Once it is determined that the meniscus is sufficiently released, the next step is to prepare the tunnels.

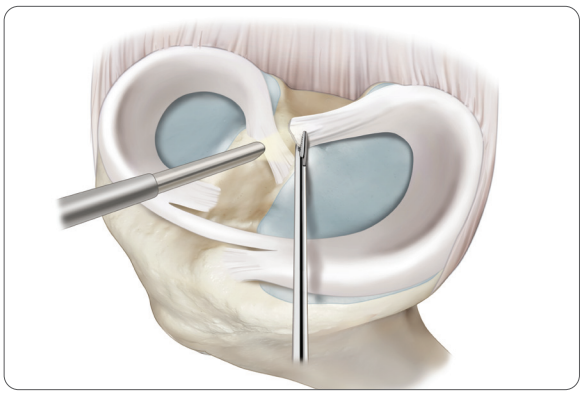


Figure 7

Figure 8

Two-tunnel drill preparation

The two-tunnel meniscal root repair technique utilizes two separate tunnels, placed approximately 5mm apart in order to best ensure meniscal tissue apposition against the decorticated tibia.[18] The Smith+Nephew Curved Aimer Guide is used to drill the first tunnel with a 2.8mm two-piece drill set, this will be the posterior tunnel for the repair.

Using the grasper to place the meniscus at the desired position, the surgeon can verify that there is no significant tension on the meniscus at this location, and then the drill guide tip can be positioned at this location (**Figure 7**).

The guide pin and sheath are then reamed and the position verified (**Figure 8**). Ideally, the sheath tip should be placed so that it is level with the tibial surface. It is best to have the sheath right at the level of the decorticated bone because the monofilament loop can be cut when it is pulled down the sheath when the sheath is protruding into the joint. Any bony or soft tissue debris around the sheath tip can be cleaned off with the shaver at this time.

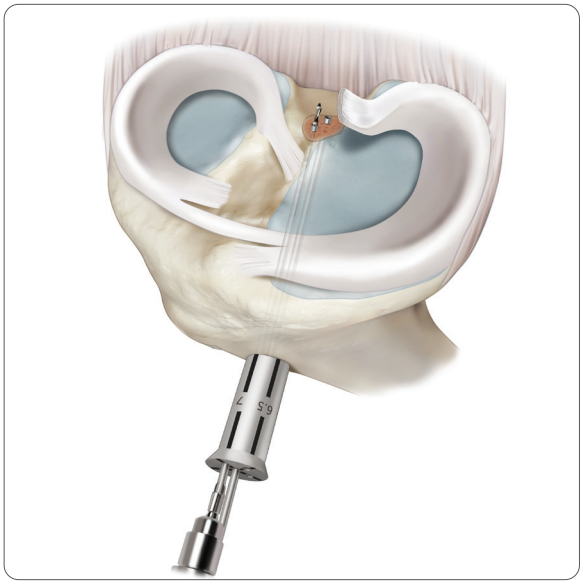
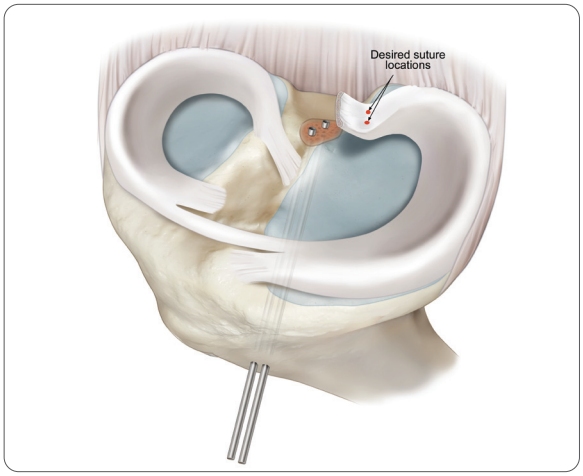


Figure 9



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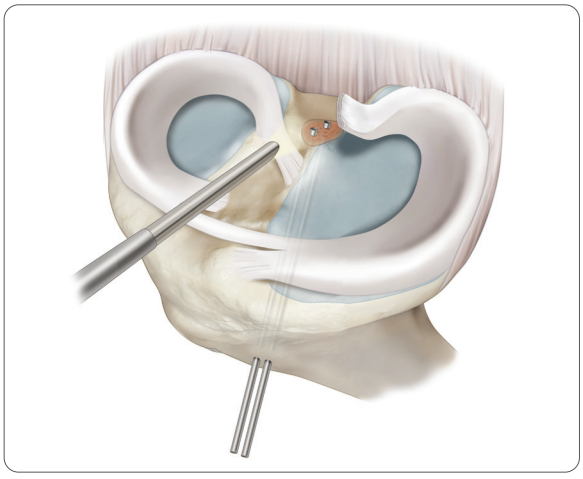

Figure 11

The Offset Guide Device is then used to pass the second sheath and drill. The Offset Guide has offsets of between 5–7mm to allow it to be positioned in a manner that allows for the ideal placement of the second tunnel. Once the tunnel is drilled and it is in the desired location, the drill can be removed and the sheath position can be assessed (**Figure 9**). Once both sheaths are placed, attention can be turned to passing sutures through the meniscus tear (**Figure 10**).

Passing the first suture

The FIRSTPASS◊ MINI Suture Passer is used to pass the sutures through the posterior horn of the meniscus. The FIRSTPASS MINI Suture Passer may be used to pass either #2 ULTRABRAID◊ Suture or ULTRATAPE◊ Suture. Based on the location of the repair and the operable knee, select either the FIRSTPASS MINI Straight, Right Curved, or Left Curved device that allows for the best access to the repair site. The FIRSTPASS MINI Suture Passer is best positioned through the anteromedial portal which is adjacent to the medial edge of the patellar tendon. The sutures should be passed through good substance and good tissue in the posterior horn of the meniscus, as far posterior as possible and leaving about a 3mm to 4mm lateral tissue bridge posteriorly. In general, the device is placed 4-5mm medial to the edge of the meniscus to ensure there is sufficient tissue to hold the sutures (**Figure 11**).

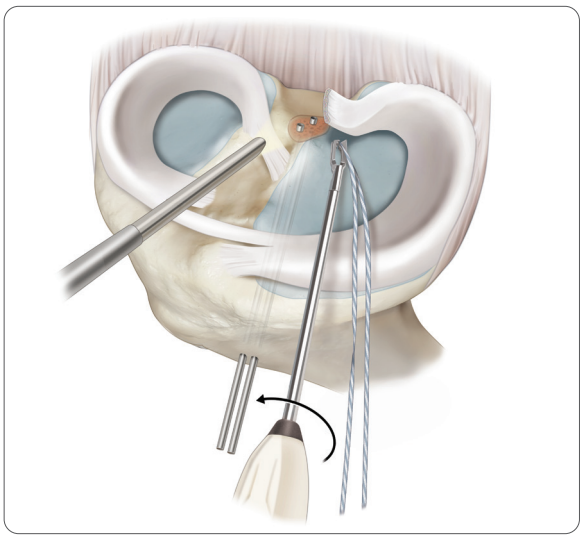

Figure12

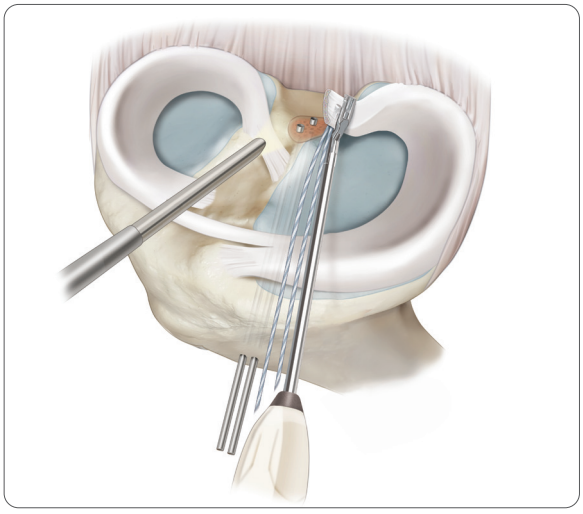

Figure13

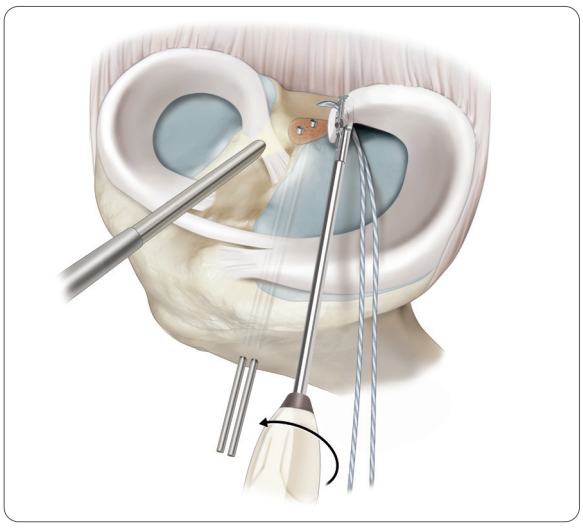

Figure 14

NOTE: When entering the joint space, the device may be turned 90° to help avoid disruption to articular cartilage (**Figure 12**). After grasping the meniscus (**Figure 13**), turn the device approximately 45° prior to deploying suture to help minimize disruption to the articular cartilage when deploying the needle (**Figure 14**).

It is very important to ensure that the sutures that are passed into the meniscus do not have a soft tissue bridge in the retropatellar fat pad because this could result in the meniscal sutures pulling out of the meniscus when the sutures are passed down the tibia. Therefore, a ring grasper is used to pull the sutures out over a CLEAR-TRAC◊ Threaded Cannula located in either the anteromedial or anterolateral arthroscopic portal.

NOTE: When using the FIRSTPASS◊ MINI Straight the minimum cannula diameter is 5.5mm while the minimum for the Left or Right Curved is 8mm. Once it is verified there is no soft tissue bridge, a monofilament passing suture is passed up the more posterior sheath, which is then concurrently pulled out through the cannula that has the sutures in the meniscus (**Figure 15**). The suture ends are then passed through the monofilament loop to allow it to be shuttled down the tibial tunnel. Prior to pulling the monofilament loop down the tibia, the sheath should be removed from the tibia with small pliers to ensure that the loop is not cut by the end of the sheath when the sutures are passed. Once the sheath has been removed with the pliers, the monofilament passing suture can then be used to slowly pull the sutures down through the posterior tunnel. A probe should then be used to ensure that the sutures are in the desired location around the meniscus substance. Once this step is completed, the second suture can be passed.

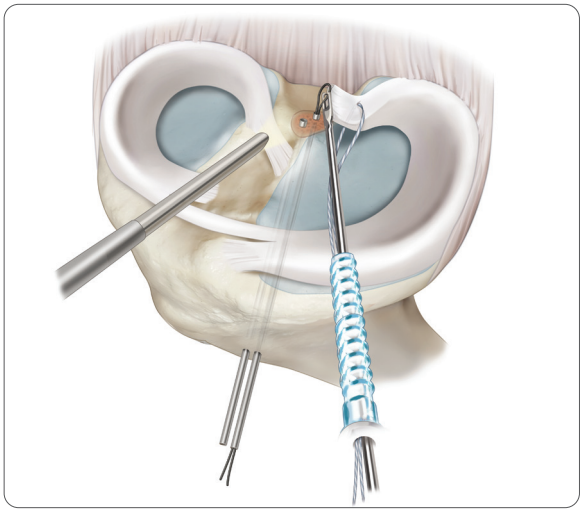

Figure 15

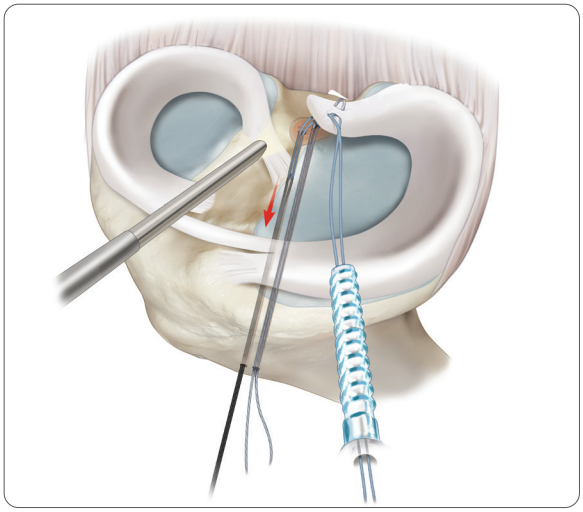

Figure 16

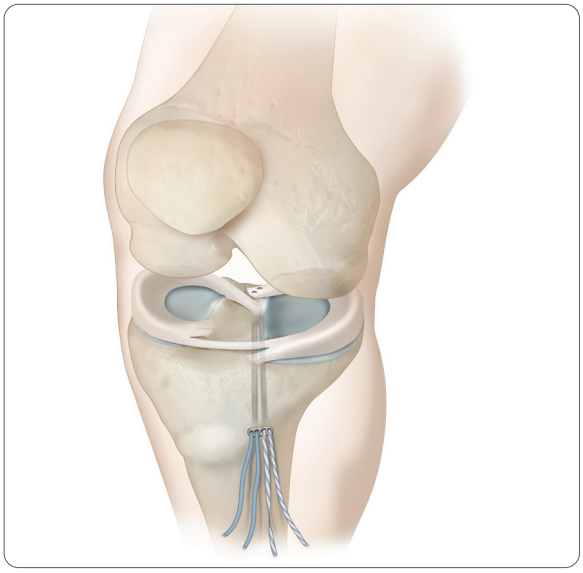

Figure 17

Passing the second suture

In a similar fashion to passing the first suture, the FIRSTPASS◊ MINI Suture Passer passing device is utilised to pass the suture through the substance of the posterior horn of the meniscus, in an anterior position compared to the previous suture. This suture is then passed out anteriorly through the cannula. After verification that there are no soft tissue bridges through the arthroscopic portal, a monofilament loop is passed up the second sheath (**Figure 16**). The loop is then pulled out the passing cannula and the metal sheath in the tibia is removed with pliers. The second suture can then be shuttled down the tibia. One should probe the sutures and ensure that they are circumferentially around the desired location of the meniscus root tear. The meniscus can then be probed and the knee can be flexed and extended to verify that the meniscus tissue has been sufficiently released and not tethered to posterior scar tissue, such that an early range of motion protocol can be performed.

The root repair sutures can then tied over an ENDOBUTTON◊ Fixation Device, over the anterior tibial cortex (**Figure 17**). The sutures in the posterior root should be tied first (over the holes on one side of the endobutton) followed by securing the root repair sutures in the anterior aspect of the root repair. Two ends of a single suture are tied together.

Use of an anteromedial arthroscopic portal

In some circumstances it can be difficult to access the posterior horn medial meniscus anteriorly with the passing suture device. In those circumstances, a small anteromedial accessory portal can be made. An arthroscopy needle is used to localize this portal, and a small poke hole is made through the skin and joint capsule, through which a grasper is placed. The grasper can then be used to position the meniscus substance into the desired location of the FIRSTPASS MINI Suture Passer device.

How to deal with a tight medial compartment

In some instances, it may be difficult to pass the devices into the medial compartment due to some tightness. In those circumstances, an arthroscopy needle can be used to gently place 7–10 poke holes in the meniscofemoral portion of the superficial medial collateral ligament, close to its femoral attachment site, to allow for an increased amount of medial compartment gapping. Medial compartment gapping of about 1mm to 1.5mm is usually sufficient to allow for adequate access from the anterior portals.

Posterior portal access for medial root tears

In some circumstances, it may not be possible to repair the meniscus root from the anterior portals. When this occurs, a posteromedial portal can be made and an ACCU-PASS◊ Suture Shuttle crescent device can be placed through the posterior horn of the meniscus and a monofilament shuttled through the meniscus and then pulled out an anterior portal. A suture can then be placed into the monofilament when the device is removed posteromedially. The sutures can also be shuttled out anteriorly, through an arthroscopic cannula, to ensure there is no soft tissue bridge. The sutures are then individually shuttled down the tibial tunnels, and this step repeated when necessary.

Posterolateral meniscal root tears

In the majority of cases, a posterior horn lateral meniscus root tear is associated with an ACL tear.[11] In those circumstances, the root tear can be arthroscopically visualised from the anterolateral arthroscopic portal, and most of the work performed from the anteromedial portal. The 4.5mm curved DYONICS◊ INCISOR◊ PLUS PLATINUM Blade can be used for preparing the root repair location. It is important to recognise that the lateral meniscal root attachment is only about 12mm posterior to the posterior aspect of the anterior root attachment, and 4.5mm posterior to the apex of the lateral tibial eminence.[8] Therefore, this is much more easily accessed than the posterior horn medial meniscus root when an ACL is torn. Performing the lateral root repair prior to placing the ACL graft is recommended in order to access this root and easily reposition it; only after drilling the tibial tunnel for the ACL to avoid potentially drilling through the root repair sutures and disrupting the repair. In most circumstances, the meniscal tissue can be accessed directly from the two anterior portals, although a small accessory lateral portal can be made after localisation with an arthroscopy needle and using a grasper to deliver the meniscal tissue into a meniscal suture passing device, if necessary.

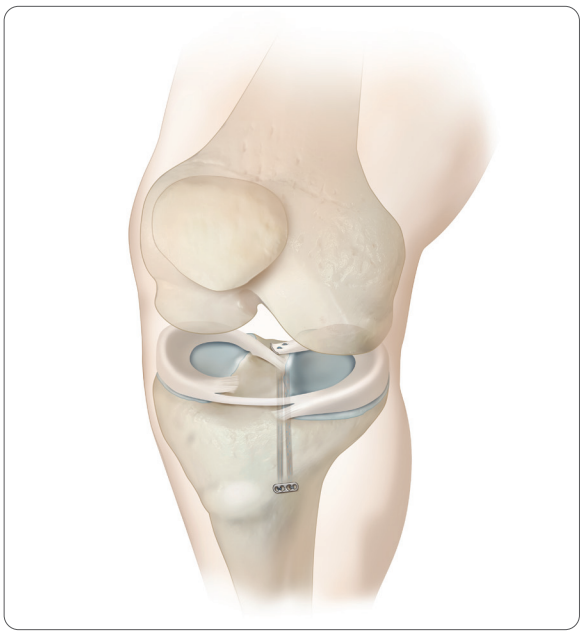

Figure 18

Postoperative rehabilitation*

Meniscal root tears have been found biomechanically to have significant stress on them when the knee is maximally flexed, especially past 90° (**Figure 18**). Therefore, meniscal root sutures should be tied with the knee flexed to 90° to ensure that motion can be performed to at least 90° initially. The rehabilitation protocol requires that the patient is non-weight bearing for six weeks, with knee flexion limited from 0° to 90° for the first two weeks. After two weeks, flexion is increased as tolerated. After the six-week postoperative time frame, patients may slowly initiate a partial protective weight bearing program and wean off of crutches when they can ambulate without a limp.

In patients with ipsilateral compartment malalignment, who did not also have a concurrent osteotomy, consideration may be given to an unloader brace for four months postoperatively. Leg presses past 70° during the first four months postoperatively should be avoided, as should cross-legged sitting, deep squats and squatting and lifting, due to the significant stress that is placed on the posterior horn of the meniscus repair with these maneuvers. In general, it takes five to seven months for the meniscus root repair to be sufficiently healed and for patients to resume impact activities (if these are indicated based on other associated pathology and the patient's desired activity level).

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Pearls to avoid technical difficulties:

- Engage the pin collar into the sheath prior to reaming
- Put the knee through a range of motion prior to tying the root repair sutures and with traction on the sutures to ensure the root repair does not have too much tension on it, and to verify that an adequate release of scar tissue was performed
- Pull the tibial metal sheath out prior to pulling the monofilament loop down the tibia
- Release enough scar to allow for the root tear to be positioned correctly

Aimer Guide Curved Alignment		
	Medial Meniscus	**Lateral Meniscus**
Right Knee	Aimer Guide Curve – Left	Aimer Guide Curve – Right
Left Knee	Aimer Guide Curve – Right	Aimer Guide Curve – Left

Special considerations for meniscal root repairs

- Patients with significant varus alignment, with a posteromedial root tear, and minimal chondromalacia of the ipsilateral compartment should consider a concurrent proximal tibial osteotomy (PTO)
- When there are posterior horn medial meniscus root tears associated with a posterior cruciate ligament (PCL) tear and a planned PCL reconstruction, place both the PCL and root repair guide pins and verify position with fluoroscopy prior to reaming either of the pins[20]
- When there are bilateral root tears, ensure the sheaths do not converge
- For a concurrent ACL reconstruction and a meniscal root tear, place the root repair tunnels and suture prior to reaming the ACL tibial tunnel; tie the sutures after securing the ACL graft in the femoral tunnel

References

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