Meniscal root repair

Using a single-tunnel technique

A knee technique guide as described by

James Robinson, MB, BS, MRCS, FRCS (Orth), MS
Consultant Orthopaedic Knee Surgeon, Avon Orthopaedic Centre, Bristol, UK

Founding Partner, Knee Specialists, Bristol, UK

Robert F. LaPrade, MD, PhD

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MENISCAL ROOT
Repair System

Overview

The integrity of the meniscal root attachments is critical to normal meniscal function, preventing meniscal extrusion and allowing the dissipation of axial load. Meniscal root tears are often underdiagnosed or mis-diagnosed, yet can profoundly affect normal knee joint function. Medial meniscus posterior horn root tears result in similar biomechanical consequences to total meniscectomy.[1,2] Lateral meniscal root tears also contribute to a meniscal deficient state[3] and may be implicated in anterior cruciate ligament (ACL) deficient knees presenting with high grade pivot laxity.[4]

In active patients with a meniscal root tear, without significant osteoarthritis, it is reasonable to attempt meniscal root repair.[5] Meniscal root repairs may be particularly beneficial to patients with intact articular cartilage and who have evidence of spontaneous osteonecrosis of the knee (SONK) (medial femoral condyle).[6]

Biomechanical studies have shown that repair of meniscal root tears (or radial tears within 1cm of the meniscal root attachment) can restore contact articular cartilage loading to that of the intact state.[2,5] However, restoration of the meniscus to its normal position is important as non-anatomic repair is equivalent to sub-total meniscectomy. Therefore, attempts should be made to reduce the meniscus back to the most anatomic position possible.[7-9] The medial meniscus may extrude following a posterior horn root tear and scar tissue formation at the posteromedial capsule may prevent reduction. In most medial meniscal root tears (apart from very acute injuries) it is necessary to release the scar tissue adhesions, in order to achieve anatomical positioning.

There is no distinct upper age limit for a meniscal root repair. This should depend upon the patient's activity level, general overall health, associated comorbidities, joint alignment, and the condition of the cartilage in the ipsilateral compartment.

The following technique guide was prepared under the guidance of James R. Robinson, MB, BS, MRCS, FRCS (Orth), MS and Robert F. LaPrade, MD, PhD. Created in close collaboration with the surgeons, it contains a summary of medical techniques and opinions based upon their training and expertise in the field, along with their knowledge of Smith+Nephew's products. Dr. Robinson is a paid consultant of S+N.

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 guide is presented for educational purposes only and is not intended to serve as medical advice nor to endorse any named medical institution. **Prior to performing this technique, or utilising any product referenced herein, please conduct a thorough review of each product's indications, contraindications, warnings, precautions and instructions as detailed in the Instructions for Use provided with the individual components.**

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.[10]

Most patients present with complaints of posterior knee pain, or of feeling a pop, with the knee in deep flexion. In traumatic cases, patients often have multi-ligament injuries or an ACL tear.[11,12] A magnetic resonance image (MRI) can be especially useful to determine the presence of a meniscus root tear. Detachment of the root on the axial cuts, extrusion on the coronal cuts, and a 'ghost sign' present on the sagittal images would indicate there is a lack of meniscal tissue due to the root tear and/or medial or lateral meniscal extrusion.[5, 13] Additionally, the patient should have a standing anteroposterior (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.[12]

Figure 1. Right knee

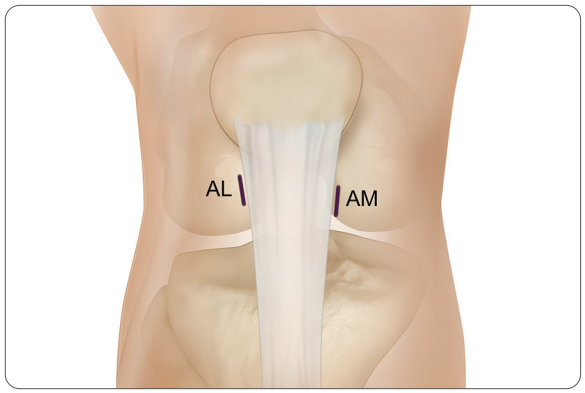

Figure 2. Right knee

Patient positioning prior to the surgical incisions

For medial root tears, a lateral side support (or alternatively a leg holder) should be used to allow a valgus force to be applied to the knee in order to open the medial compartment. For lateral root tears, the patient should be positioned to allow the leg to be placed into the figure 1 position, thus opening the lateral compartment. The patient should then be sterilely draped prior to the surgical incisions (**Figure 1**).

Arthroscopic portal placement

Anterolateral and anteromedial portals can be made adjacent to the patellar tendon and a standard arthroscopic evaluation of the knee is performed. An accessory medial or lateral portal can also be placed, depending upon the position of the root tear (**Figure 2**).

Establishing the anterolateral portal

A high anterolateral portal is made with a #11 blade. It is recommended that the portal is placed adjacent to the patella tendon in order to facilitate visualisation of the posterior root attachments.

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. If there is an acute injury, some flushing out of the haemarthrosis may be necessary. The anteromedial portal is established under direct vision. The portal should be made adjacent to the patella tendon to improve access to the posterior root attachments. It is recommended that an 18 gauge arthroscopy needle is introduced into the joint in the planned position of the portal in order to assess the trajectory of instruments passed towards the posterior root attachments.

For tears of the medial meniscus posterior root attachment, the anteromedial portal should be placed just above the anterior horn of the medial meniscus, close to the medial edge of the patella tendon. 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.

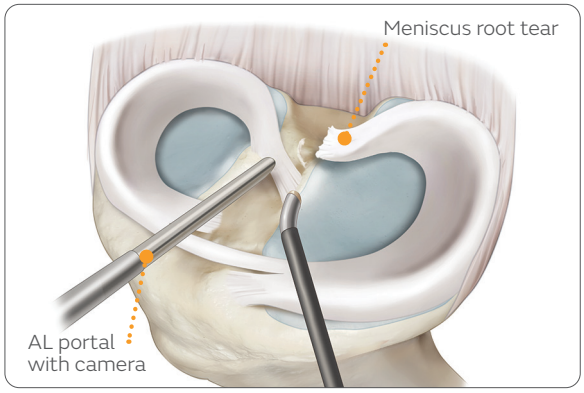

Figure 3

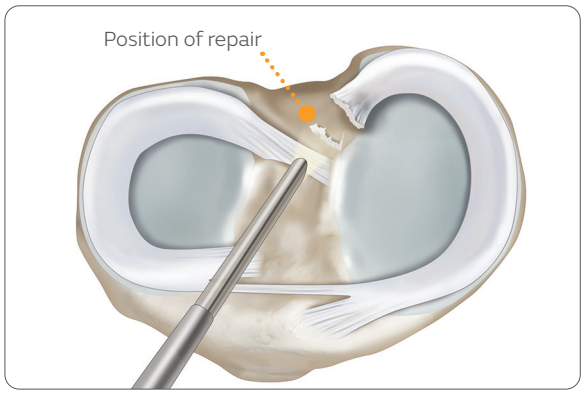

Figure 4

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 arthroscope within the intercondylar notch, medial to the posterior cruciate ligament (PCL) and lateral to the medial femoral condyle, and to view directly down onto the meniscal root attachment. A FLOW 50◊ COBLATION◊ Wand may be used to clear synovial tissue overlying the PCL to further improve the view (**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.[7] The medial meniscal root attachment is located approximately 1cm posterior to the apex of the medial tibial eminence[9] (**Figure 4**). Repairs of radial tears within 1cm of the root attachment should be positioned medial to the root attachment site to reduce the meniscus to an anatomical position.

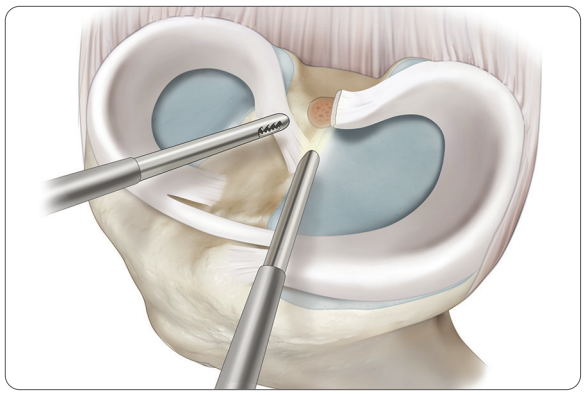

Figure 5

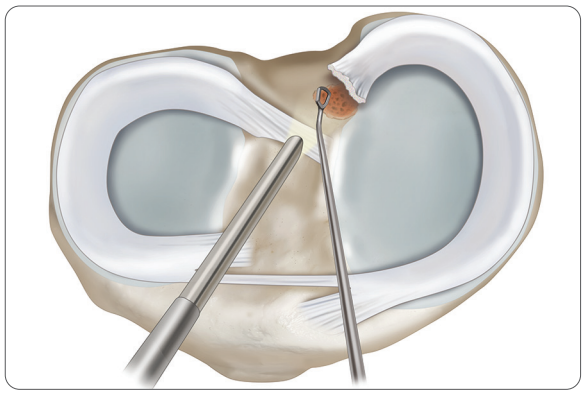

Figure 6

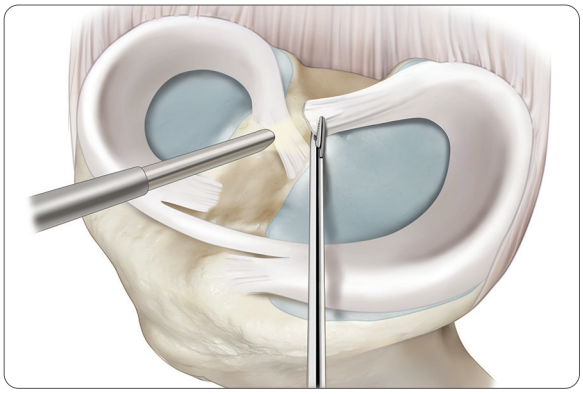

Figure 7

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 DYONICS Curved INCISOR Plus PLATINUM Blade can be used to remove any scar tissue. Additionally 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 used 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. 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 transosseous tunnel.

Transosseous tunnel preparation

Using the grasper to place the meniscus at the desired position, the surgeon can verify that there is no significant tension on the meniscus, that meniscal extrusion has been reduced, and that the meniscus is lying in an anatomic location. This determines the location of the transosseous tibial tunnel (**Figure 7**).

The tip of the Smith+Nephew Curved Aimer Guide is positioned at this location through the anteromedial portal. Either the Curved Aimer Guide, Left or Curved Aimer Guide, Right, depending on which fits best around the femoral condyle and tibial spine, are used to access the meniscal root attachment site.

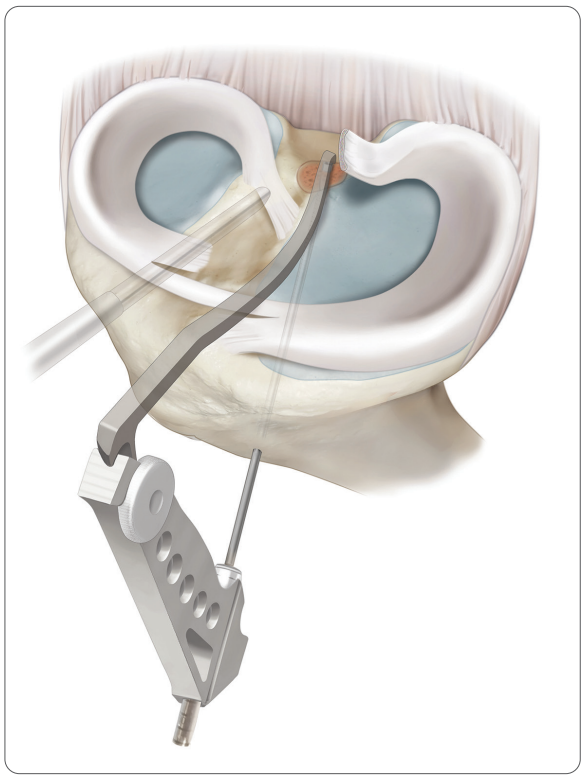

Figure 8

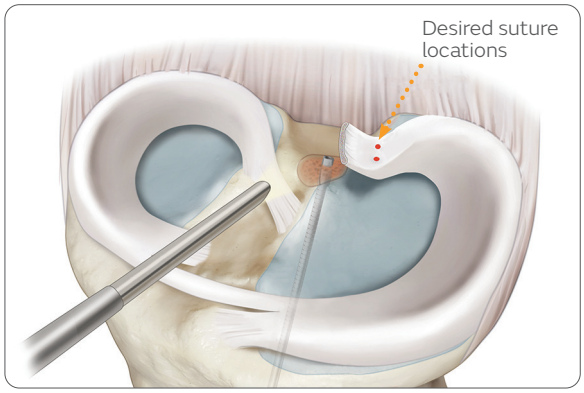

Figure 9

The Smith+Nephew Curved Aimer Guide is attached to a ACUFEX◊ Director MRR handle with a standard 2.4mm bullet. A 2.4mm drill-tipped pin is drilled to the repair site (**Figure 8**). The aimer is disassembled leaving the 2.4mm drill tipped pin in place. This is then over-drilled with a 4.5mm cannulated drill. It is recommended that whilst drilling, a spoon curette is introduced through the anteromedial portal and placed over the tip of the wire to prevent it moving proximally into the posterior compartment. The 2.4mm wire is then removed leaving the 4.5mm cannulated drill in place (**Figure 9**).

NOTE: For single tunnel technique, it is recommended to use a standard 2.4mm bullet, rather than the 2.8mm bullet included in the MENISCAL ROOT Repair System.

Passing the first tape

To avoid suture management issues and, in particular a suture bridge and entrapment in the retropatella fat pad, it is recommended to use a CLEAR-TRAC◊ 5.5x72mm Threaded Cannula located in the anteromedial 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.

The strength of transosseous medial meniscal root repair using a simple suture technique is dependent on suture material and position.[21] The FIRSTPASS MINI Suture Passer may be used to pass ULTRATAPE◊ Suture through the posterior horn of the medial meniscus. 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. Tape is recommended over suture to improve repair strength and to best ensure meniscal tissue apposition against the decorticated tibia.[21] It is important to place the tape into the substance of the meniscal body rather than the root ligament or transition zone to improve pull-out strength.

The FIRSTPASS MINI Suture Passer is introduced through the cannula and is used to pass ULTRATAPE Suture directly through the posterior horn of the meniscus. The tape should be passed through good tissue in the mid-substance of the meniscus, avoiding the root ligament and the transition zone to ensure there is sufficient tissue to hold the tapes.[21] The FIRSTPASS MINI Suture Passer is withdrawn from the cannula and the free end of the tape is disengaged from the self-capturing jaws.

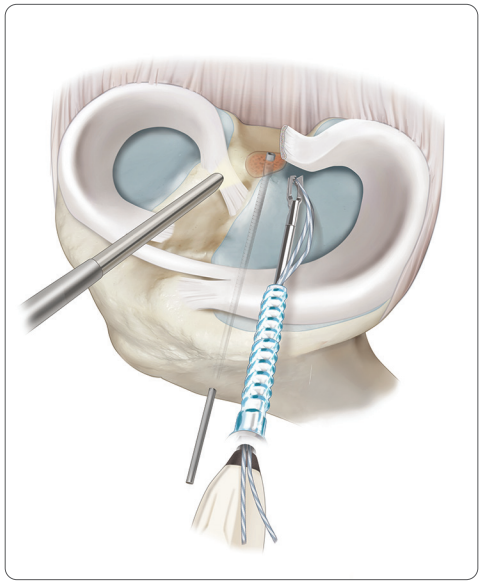

Figure 10

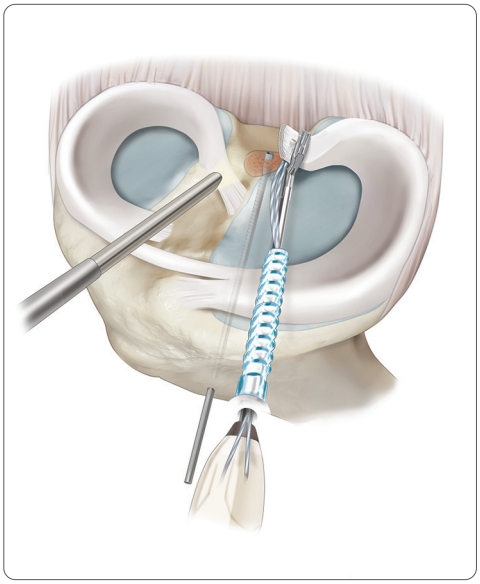

Figure 11

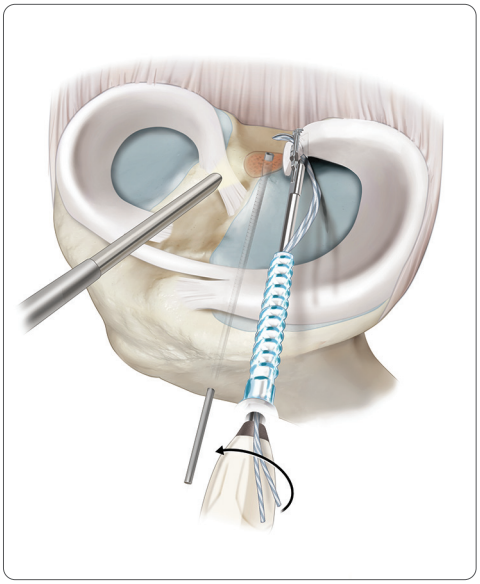

Figure 12

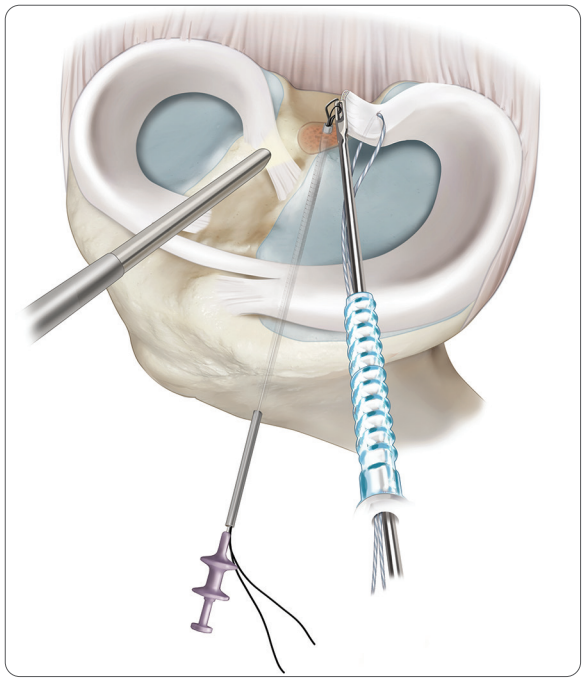

Figure 13

When entering the joint space, the device may be turned 90˚ to help avoid disruption to articular cartilage (**Figure 10**). After grasping the meniscus (**Figure 11**), turn the device approximately 45˚ prior to deploying suture to help minimise disruption to the articular cartilage when deploying the needle (**Figure 12**).

A 5-10mm length of monofilament loop is passed through the wire loop of a lavender suture retriever, which is then passed up the cannulated 4.5mm drill delivering the monofilament loop into the knee (**Figure 13**). The monofilament loop is retrieved through the cannula using a ring grasper. The tape ends are then passed through the monofilament loop to allow them to be shuttled down the tibial tunnel. The 4.5mm cannulated drill should be removed to ensure that the loop is not cut by the end of the drill when the sutures are passed. Once the 4.5mm cannulated drill has been removed, the monofilament can then be used to slowly pull the tapes down through the transosseous 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.

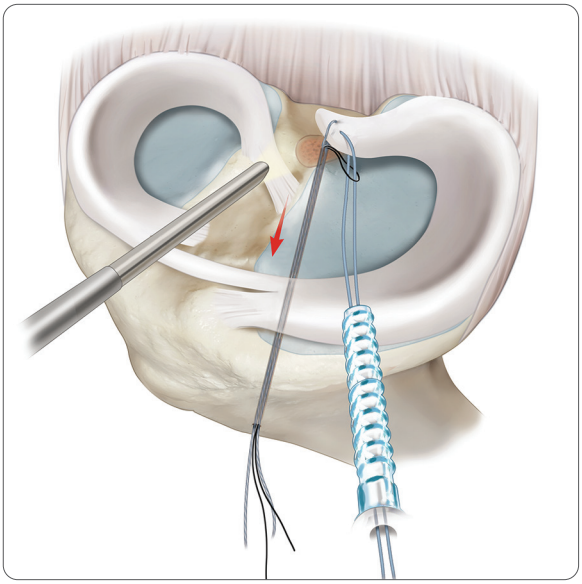

Figure 14

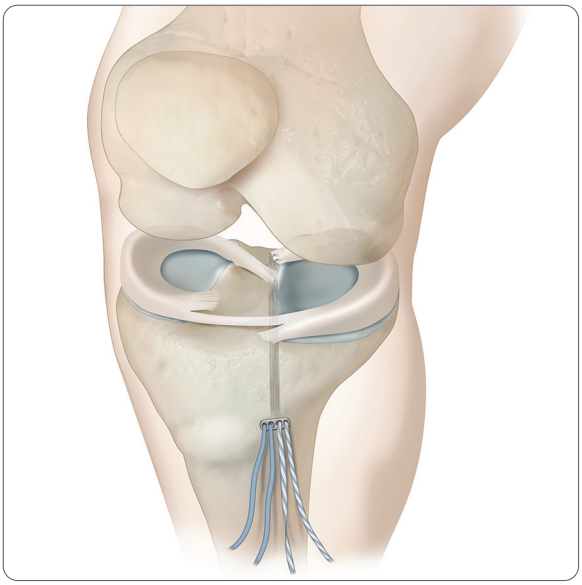

Figure 15

Passing the second tape

In a similar fashion to passing the first tape, the FIRSTPASS◊ MINI Suture Passer is utilised to pass the tape through the substance of the posterior horn of the meniscus. Gentle traction on the ends of the first tape can help pull the meniscus towards the repair site, facilitating positioning of the second tape further into the meniscal substance. The FIRSTPASS MINI Suture Passer is withdrawn through the cannula and the tape is disengaged. A monofilament passing loop is fed up through the transosseous tunnel using a lavender suture retriever and retrieved out anteriorly through the cannula.

The second tape can then be shuttled down the tibial tunnel (**Figure 14**). 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 is not tethered to posterior scar tissue, such that an early range-of-motion protocol can be performed. Sometimes a third tape can be passed, particularly if there is a vertical split in the meniscus adjacent to the root, or to improve apposition of the meniscus to the repair site.

The root repair sutures can then be tied over an ENDOBUTTON◊ Fixation Device, at the anterior tibial cortex (**Figure 15**).

How to deal with a tight medial compartment

In some instances, it may be difficult to pass instruments into the medial compartment. In these circumstances and to facilitate access to the medial meniscus posterior root attachment, a percutaneous, selective medial collateral ligament (MCL) release can be performed. This can be made proximally or distally.

Proximal, selective MCL release

The knee is positioned in an extended and valgus position. The arthroscope is placed in the medial compartment and the posterior border of the superficial MCL is palpated. Transillumination helps determine the fibres proximal to the meniscus. An 18 gauge arthroscopy needle is then used to percutaneously perforate the superficial MCL. The ligament is progressively released through multiple perforations ('pie crusting'). The femoral condyle can be seen to lift away from the posterior horn of the medial meniscus. The release will allow up to approximately 3-4mm of additional medial opening.

Distal, selective, percutaneous MCL release

An incision is made just proximal and lateral to the attachment of the Pes Anserinus. This incision may be the same as that used for autologous hamstring tendon graft harvest or for transosseous tunnel drilling for meniscal root repair. The deep crural fascia proximal to the gracilis tendon is incised to demonstrate the fibres of the superficial MCL just proximal to its tibial attachment. These fibres may be selectively perforated with an 18 gauge needle whilst a valgus stress is applied to the knee.

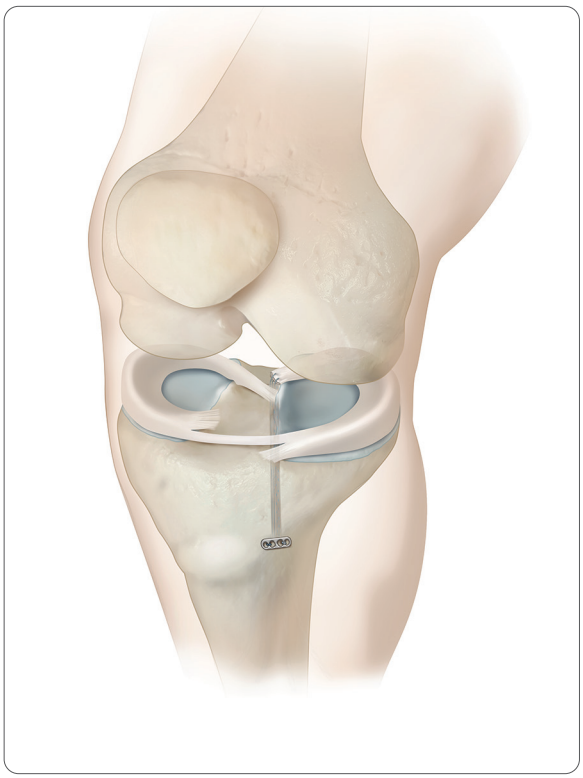

Figure 16

Lateral 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 DYONICS◊ Curved INCISOR◊ Plus PLATINUM Shaver 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.[9] 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.

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 16**).[2,3,5] 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, in whom concomitant osteotomy is not performed, consideration may be given to the use of a post-operative unloader brace for four months. Leg presses past 70°, cross-legged sitting, deep squats and lifting, should be avoided in the first four post-operative months due to the significant stress the activities place on the posterior horn of the meniscus repair. 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).

* The views and opinions expressed for postoperative care are solely those of the surgeon(s) and do not reflect the views of Smith+Nephew. In no event shall Smith+Nephew be liable for any damages whatsoever (including, without limitation, damages for loss of business profits, business interruption, loss of business information, or other pecuniary loss) arising out of the use of or inability to use the expressed views.

Pearls to avoid technical difficulties

- 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 4.5mm cannulated drill out prior to pulling the monofilament loop down the tibia
- Release enough scar tissue to allow the meniscus to be positioned correctly
- Pass each tape individually to avoid inadvertently knotting them

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

- Concurrent high tibial osteotomy (HTO) should be considered for patients with significant varus alignment and a medial meniscal posterior horn root tear
- With combined PCL reconstruction and medial meniscus posterior horn root repair, place both the PCL and root repair guide pins and verify position with fluoroscopy prior to reaming either of the pins[22]
- For a concurrent ACL reconstruction and a meniscal root tear, place the root repair tunnels and suture prior to reaming the ACL tibial tunnel

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Ordering information

FIRSTPASS◊ MINI Suture Passers	
Reference #	Description
72290128	FIRSTPASS MINI Straight Suture Passer
72290129	FIRSTPASS MINI Left Curved Suture Passer
72290130	FIRSTPASS MINI Right Curved Suture Passer

MENISCAL ROOT Repair System	
Reference #	Description
7193J001	MENISCAL ROOT Repair System
System includes:	
71935072	ACUFEX◊ DIRECTOR MRR Angled Bullet
71935073	ACUFEX DIRECTOR MRR Drill Guide Handle
71935071	Open Curette S
71935076	MENISCAL ROOT Repair Offset Guide
71935074	Aimer Guide Curve - Left
71935075	Aimer Guide Curve - Right

Disposable Kits	
Reference #	Description
71935070	Meniscal Root Repair Pack with ULTRABRAID◊ Suture
71935068	Meniscal Root Repair Pack with ULTRATAPE◊ Suture
71935360	MENISCAL ROOT Repair Instuments Pack

Referenced Products	
Reference #	Description
72203013	4.5mm DYONICS◊ INCISOR◊ Plus PLATINUM Blade
72205109	4.5mm DYONCIS Curved INCISOR Plus PLATINUM Blade
7205524	ACUFEX DIRECTOR Angled Bullet
010814	ACUFEX Rotary Scissors 20° Hooked, Left
010815	ACUFEX Rotary Scissors 20° Hooked, Right
72200907	CLEAR-TRAC◊ 5.5x72mm Threaded Cannula
72200425	CLEAR-TRAC 8x72mm Threaded Cannula
013186	ENDOBUTTON◊ 4x12mm Fixation Device
7207315	ENDOBUTTON 4.5mm Cannulated Drill Bit
72203897	ULTRATAPE Suture
72200887	ULTRABRAID Suture
72290037	FLOW 50◊ COBLATION◊ Wand

To order the instruments used in this technique, call **+1 800 343 5717** in the U.S. or contact an authorized Smith+Nephew representative. Prior to performing this technique, consult the Instructions for Use documentation provided with individual components – including indications, contraindications, warnings, cautions and instructions.

Caution: U.S. Federal law restricts these devices to sale by or on the order of a physician.

Learn more at **smith-nephew.com**

Manufactured by:
ArthroCare Corporation
7000 West William
Cannon Drive
Austin, TX 78735, USA

Sports Medicine
Smith & Nephew, Inc.
150 Minuteman Road
Andover, MA 01810

www.smith-nephew.com
T +978 749 1000
US Customer Service:
+1 800 343 5717