

Use of an Accessory Anteromedial Portal to Facilitate Repair of Mid-Body Radial Tears of the Lateral Meniscus in Children and Adolescents



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Abstract: Meniscal tears in adolescent patients are commonly treated with repair to preserve meniscal tissue and prevent future degenerative changes. Historically, meniscal tears best suited for repair are acute vertical tears in patients aged <40 years with a normal mechanical axis, >1 cm and <4 cm in size, within the red–red zone, and concurrent with anterior cruciate ligament reconstruction. However, with continued advancements in technology and the development of new techniques, the possibilities and indications for meniscal repair have broadened. This paper presents the use of an accessory medial portal to facilitate the repair of radial tears of the mid-body of the lateral meniscus. Previous techniques described include all-inside, outside-in, and inside-out repairs, but these techniques can be challenging to achieve optimal simultaneous meniscus reduction, visualization, and suture trajectory. In this Technical Note, we describe the use of an inside-out technique, with emphasis on an accessory anteromedial portal to improve visualization and suture trajectory.

Meniscal injuries are common in the adolescent population, and the incidence is increasing.¹ Treatment largely consists of meniscectomy versus repair depending on the tear pattern. However, it is believed that adolescent patients have improved healing potential of their menisci compared with adult patients.² In addition, it has been shown that there is a significant increase in the development of osteoarthritis or other degenerative changes following meniscectomy.³ These factors contribute to the increasing favorability of meniscal preservation in this population.

Recent literature indicates meniscal tears best suited for repair are acute vertical tears in patients aged <40 years with a normal mechanical axis, >1 cm and <4 cm in size, within the red–red zone, and concurrent with anterior cruciate ligament reconstruction.⁴ However, with continued advancements in technology and technique development, the possibilities for repair continue to evolve. In recent years, indications have expanded to include radial tears, most specifically those that extend toward the vascular periphery.^{4,5} Although these tears are uncommon, biomechanical studies have shown that radial tears can increase focal articular cartilage stress similarly to complete meniscectomy.⁶ As treatment of radial tears with a meniscal repair is becoming more common, orthopaedic surgeons need to be aware of and understand the different surgical techniques of management.

The lateral mid-body radial meniscus tear can be technically challenging to treat. Multiple arthroscopic repair techniques have been described, with newer all-inside suture delivery systems gaining wide popularity due to their ease of use and decreased surgical times.⁷ However, in our experience, when working in the lateral compartment at the level of the mid-body of the meniscus, all-inside devices can prove difficult to obtain ideal trajectory for repair and can additionally pose risk to the popliteus tendon and other neurovascular structures. Outside-in techniques have additionally been described, and although they are more

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Table 1. Advantages and Disadvantages Using of an Accessory Anteromedial Portal for Inside-Out Lateral Mid-Body Meniscus Repair

Advantages	Disadvantages
Improved lateral compartment and tear visualization	Additional arthroscopy portal required
Improved suture fixation trajectory	Possible neurovascular injury passing from inside to outside
Smaller posterolateral incision	Possible loss of reduction during final tying
Decreased cost compared with a commercially available suture delivery system	Sutures may pull through tissue when tying; however, it is decreased by use of a broad suture tape
No intra-articular knot stack	
No need for arthroscopic knot tying, which can be technically challenging	

cost-effective, are more technically demanding, resulting in increased intraoperative assistance, larger surgical incisions, and increased operative time.⁷ Furthermore, ideal suture placement can again be challenging with this technique.

Inside-out repairs are considered a gold standard for repair techniques and for many orthopaedic surgeons is the technique of choice, with the additional benefit of decreased cost compared with all-inside techniques.⁷ In this Technical Note, a modified inside-out technique that uses an accessory medial portal to facilitate arthroscopic visualization and suture trajectory is described.

Table 2. Pearls and Pitfalls while Using an Accessory Anteromedial Portal for Inside-Out Lateral Mid-Body Meniscus Repair

Pearls	Pitfalls
Visualize tear from both AM and AL portals prior to decision on repair	Making AAM portal incision before checking trajectory with spinal needle
Use spinal needle localization to make AAM portal	Not checking reduction and suture tension before tying each suture
Use portal skid to minimize iatrogenic cartilage damage when passing sutures	
Check for adequate tension and maintenance of reduction arthroscopically prior to tying each suture sequentially	
May switch between AM and AAM portals as needed to achieve adequate fixation trajectory	

AAM, accessory anteromedial; AL, anterolateral; AM, anteromedial.

Surgical Technique (With Video Illustration)

Indications

Indications for surgery include children and adolescents who have sustained a radial mid-body meniscal tear that is full-thickness, i.e., a complete radial tear that traverses the entire width of the lateral meniscus from medial peripheral edge to the meniscal capsular junction with accompanying symptoms such as pain and mechanical symptoms.

Preoperative Preparation and Positioning

Patients are positioned supine on a standard operating table and induced under general anesthesia with laryngeal mask airway or endotracheal intubation. A preoperative examination is performed of the operative extremity.

A nonsterile tourniquet is placed on the thigh, and the operative extremity is draped free. Standard preoperative prophylactic antibiotics are administered intravenously. The surgical technique is illustrated in [Video 1](#). The advantages and disadvantages of this technique as well as pearls and pitfalls are detailed in [Tables 1](#) and [2](#), respectively.

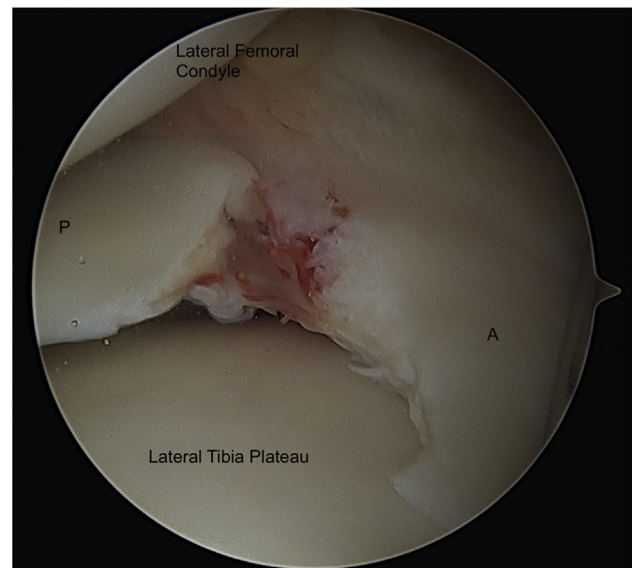


Fig 1. An intraoperative arthroscopic image of the left knee lateral compartment viewed from the standard anteromedial portal. The full-thickness mid-body radial tear of the lateral meniscus is identified. When this standard portal is used as the entry point for the portal skid and zones specific cannula, you can appreciate the direct access one can gain for repair. For this reason, making the additional accessory anteromedial portal allows for adequate viewing of the tear and direct access with your repair instrumentation. The top of the image is proximal, the bottom is distal, and right of the image is anterior (A) and the left of the image is posterior (P).

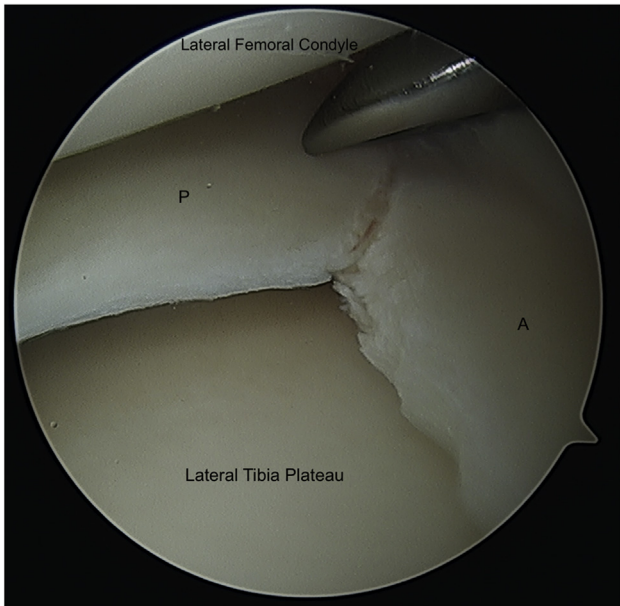


Fig 2. An intraoperative arthroscopic image of the left knee lateral compartment. The mid-body radial tear of the lateral meniscus is shown hereafter preparation of tear and attempted reduction viewed from the standard anteromedial portal. Once the accessory anteromedial portal is made for the scope, the standard anteromedial portal can be used for instrumentation with the zone-specific cannula, providing direct access for ease of repair. The top of the image is proximal, the bottom is distal, and right of the image is anterior (A) and the left of the image is posterior (P).

Anatomical Considerations

The superficial anatomy is measured and marked out in detail as the common peroneal nerve (CPN) is at risk of injury. The CPN is commonly located 1 to 2 cm below the fibular head. These markings are later used as a guide when planning our suture trajectory.

Arthroscopic Evaluation

Standard arthroscopic examination of the knee is performed beginning with standard anteromedial (AM) and anterolateral (AL) arthroscopy portals. Any intra-articular pathology aside from the known meniscal tear is addressed before proceeding to repair.

Identification of Tear and Preparation

The lateral compartment of the knee is entered in a standard fashion. The tear is identified, documented, and investigated. Edges are debrided to allow for confluent edge to edge closure, as well as to stimulate healing potential. Once prepared, attempted reduction of the meniscus is performed to evaluate for likely success and technical feasibility of repair. This can be performed with a blunted instrument or probe. It is important to note that the tear should be visualized from both the AL and AM portals before making definitive decisions on repair versus meniscectomy.

Figures 1 and 2 demonstrate the meniscal tear before preparation and after with tear reduction, respectively.

The trajectory of the suture tape from inside the joint to outside the lateral aspect of the knee is then planned. The goal of trajectory is to be proximal to the fibular head as to avoid CPN injury. The markings made at the start of the procedure are used as a guide at this time to ensure there is no iatrogenic neurovascular injury during suture passage. Figure 3 demonstrates our preparation and the desired suture trajectory after sutures have been passed in an inside-out fashion.

Use of Accessory Anteromedial (AAM) Portal

An AAM portal is established medially to the standard AM portal. This portal is to be used for enhanced visualization, which we believe improves the trajectory of sutures through an already-difficult path. The surgeon setup and visualization are demonstrated in

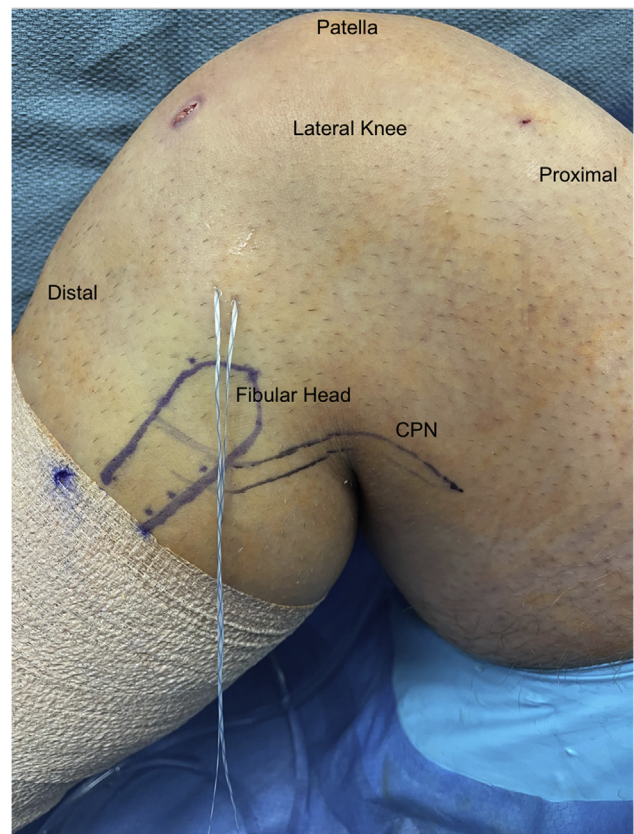


Fig 3. Intraoperative photo demonstrating our pre-operative planning for suture trajectory. The fibular head is marked out, as well as the estimated position of the common peroneal nerve. Sutures are placed anterior to these structures mitigating the risk of an iatrogenic nerve injury. The desired location of suture placement is shown once a single horizontal mattress is passed. With the use of an accessory anteromedial portal, it eases the technique for repair, which we believe decreases the chance for iatrogenic injuries. The right of the image is proximal and the left is distal. (CPN, common peroneal nerve.)

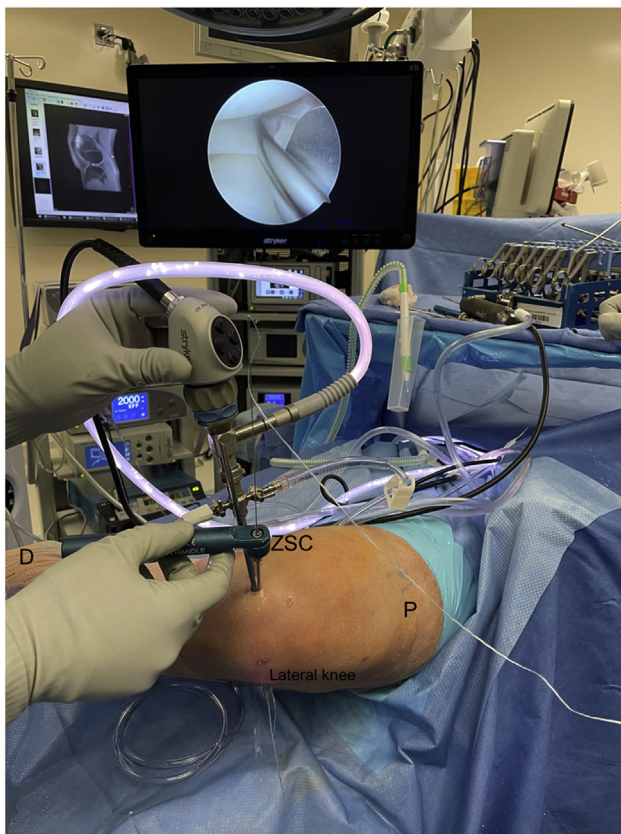


Fig 4. Intraoperative photo demonstrating the positioning of instrumentation while working in the lateral compartment. The arthroscope is located within the accessory anteromedial portal. The zone-specific cannula (ZSC) is located within the standard anteromedial portal. This figure also demonstrates the use of the portal skid, which is located in the standard anteromedial portal along with the ZSC. This photo is significant for reproducibility amongst other surgeons as it demonstrates instrument positioning, leg positioning, and additionally the camera view. The right of the image is proximal and the left is distal.

Figure 4. The scope is placed into the AAM portal, while a zone-specific cannula is placed in the AM portal. We believe with the AAM portal; the surgeon has a much greater perspective for triangulation and trajectory for optimal suture placement.

Meniscal Repair

The leg is brought into a figure-4 position for access into the lateral compartment. Inside-out horizontal mattress stitches are placed using a broad suture tape intended to increase contact with the torn tissue to decrease abrasion and subsequent tissue pull out. This is performed with 2.0 Mini Suture Tape Meniscus Repair Needles (AR-7523 Arthrex, Naples, FL) using the zone-specific cannula (Fig 5). Also note that we use a portal skid (AR-4505; Arthrex) to protect from chondral damage while inserting the zone-specific cannula. With this method, there is direct visualization of the

mid-body radial tear and a clear trajectory of the zone-specific cannula. The number of sutures passed can be variable and is dependent on case-specific scenarios. Customarily, at least 3 sutures are placed. Alternate configurations are also possible, including the “oblique mattress stitch” used in this specific case as seen in Figure 6. Most importantly, the pattern and number of sutures are dependent on what is required for adequate meniscal reduction. After all, sutures are passed, they will be located along with the lateral knee, as seen in Figure 7. With the knee flexed to 45°, soft-tissue dissection is carried down through the skin and subcutaneous tissue along the trajectory of the sutures through a small <3-cm incision. We believe that identifying our suture trajectory before making our posterolateral incision allows for a less-invasive skin incision and dissection, which potentially can decrease surgical morbidity. This is carried down further where the sutures are seen exiting the iliotibial band (Fig 8) and eventually the capsule where the sutures are tied sequentially (Fig 9). It is important to note that all slack must be taken out of each suture before tying, and the maintenance of reduction should be checked arthroscopically before tying each suture sequentially. Figure 6 demonstrates the final inside-out mid-body radial meniscus tear repair.

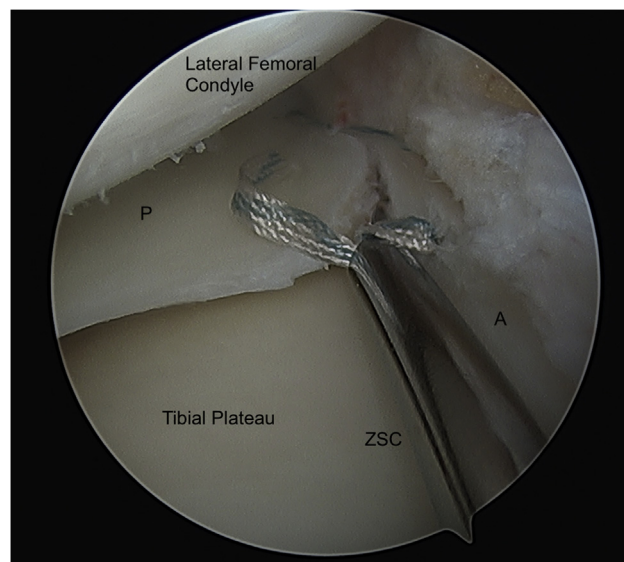


Fig 5. Intraoperative photo viewed from the accessory anteromedial portal. Here both ends of the horizontal mattress using 2.0 Mini Suture Tape Meniscus Repair Needles (AR-7523; Arthrex) have been passed and are being tensioned along with the lateral knee. The zone-specific cannula (ZSC) is located within the standard anteromedial portal. The accessory anteromedial portal allows for instrumentation through the standard anteromedial portal, making a historically difficult repair less technically demanding. The top of the image is proximal, the bottom is distal, the left is posterior (P), the right is anterior (A).

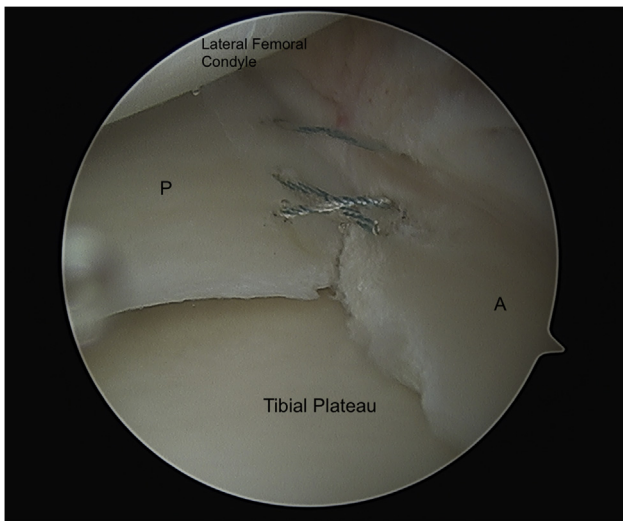


Fig 6. Intraoperative photo viewed from the accessory anteromedial portal demonstrating the completed meniscal repair construct with 2 horizontal mattresses and an oblique mattress using broad suture tape. The number of sutures passed can be variable and is dependent on case-specific scenarios; however, the most important take-home message is to use a pattern and number of sutures that allows for adequate meniscal reduction. The top of the image is proximal, the bottom is distal, the left is posterior (P), the right is anterior (A).

Closure

Incisions are irrigated and closed in a layered manner with monofilament suture. [Figure 10](#) demonstrates the patient's postoperative surgical scars healed.

Postoperative Management

Postoperatively, children are discharged home the same day following surgery. They are placed into a rehabilitative knee range of motion brace locked in full extension and are non-weight-bearing for 6 weeks. Children are permitted to remove the brace for hygiene, home exercises, physiotherapy. Postoperative pain control is often obtained using a regional block with 0.25% bupivacaine with epinephrine, especially when meniscal work is performed in conjunction with cruciate reconstruction. Acetaminophen and ibuprofen are used as needed for pain. No more than 10 doses of opiate medication are prescribed, and in the senior author's experience, usually <5 doses are typically used. Physical therapy is initiated within 1 to 2 weeks of surgery. Immediate range of motion is encouraged, to 90° of knee flexion until week 6, then advancing as tolerated to restore full motion. A functional progression to weight-bearing and gait normalization commences at 6-weeks postoperative. Return to sport is initiated at 6 months following surgery.

Discussion

As meniscal tears become increasingly more common in the adolescent population, trends are moving toward

meniscal preservation rather than meniscectomy, which was historically the treatment of choice.⁸ As we continue to improve our ability to effectively repair meniscal tears, radial tears remain a challenging problem to treat. More specifically, lateral mid-body radial meniscus tears often prove irreparable due to difficulty with suture trajectory and risk of significant iatrogenic chondral damage. Proposed repair techniques for such tears have been sparse in the literature.

There have been several previously proposed inside-out techniques for full-thickness mid-body lateral meniscus radial tears.⁹⁻¹¹ In a Technical Note, Pareek et al.¹⁰ describe performing an inside-out technique through the use of standard AM and AL portals without an AAM portal. In addition, they use 2-0 nonabsorbable suture for repair and make the posterolateral incision before passing the suture through the capsule. Leafblad

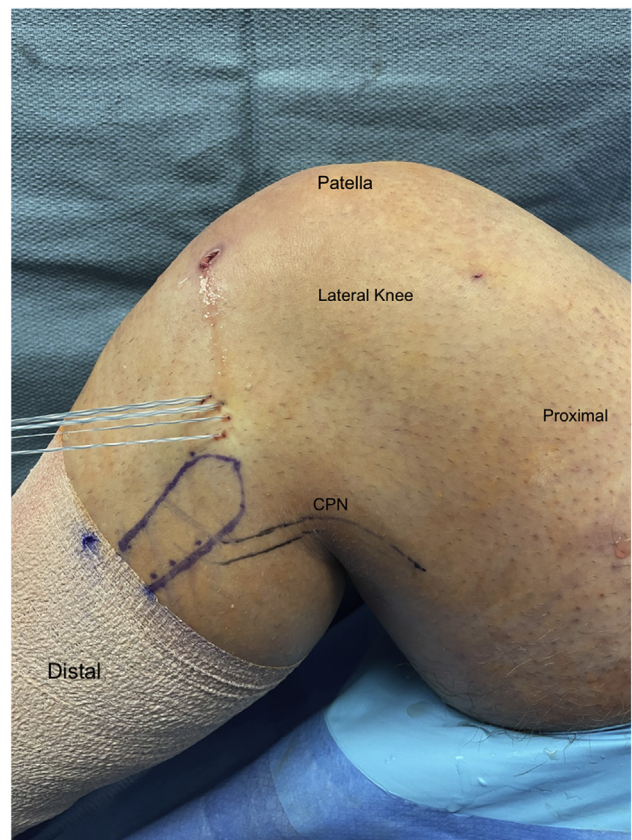


Fig 7. Intraoperative photo of the left knee demonstrating desired suture trajectory on the lateral aspect of the knee. Referencing our anatomical landmarks will help ascertain that the common peroneal nerve is safe from iatrogenic injury. Making the lateral incision after the sutures are already passed allows our technique to provide a smaller (<3 cm) incision. Thus, these aforementioned techniques on top of the use of an accessory anteromedial portal enhances the ability to repair lateral mid-body radial tears through an inside-out approach. The right of the image is proximal and the left is distal.

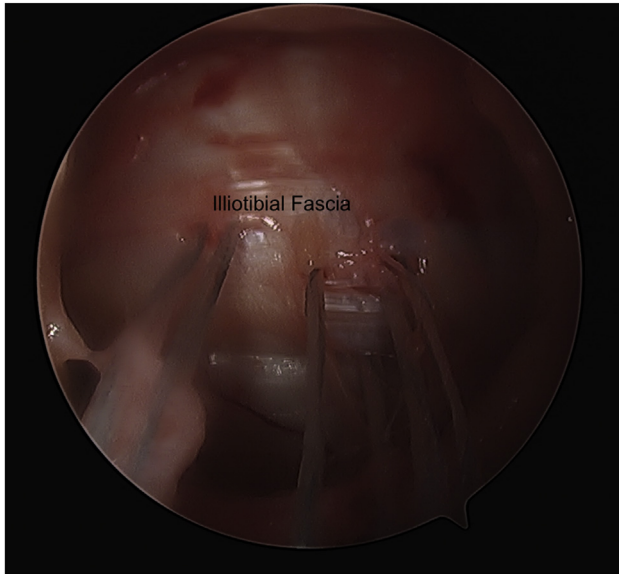


Fig 8. Extra-articular intraoperative photo viewed using the arthroscope inside the posterolateral incision. Seen are the sutures once dissected down through the skin and subcutaneous tissue until seen exiting through the iliotibial fascia. The top of the figure is anterior, the bottom is posterior, the right is proximal and the left is distal.

et al.¹¹ additionally describes his technique using only standard AM and AL portals and performs the posterolateral incision prior to passing suture through

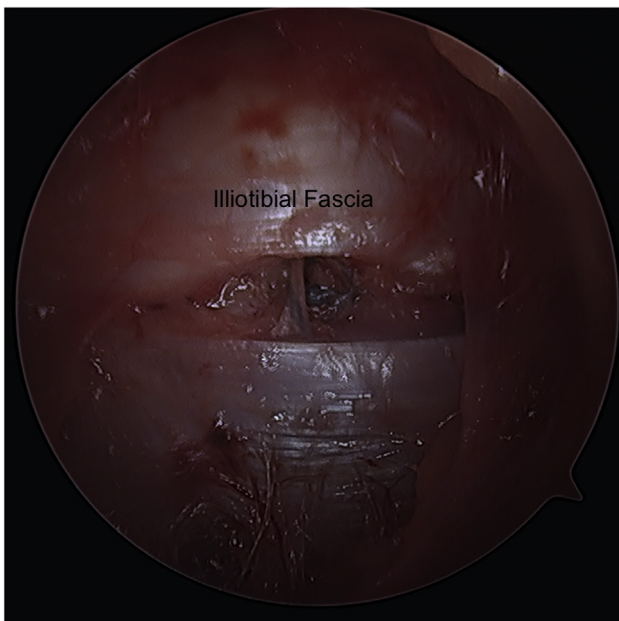


Fig 9. Extra-articular intraoperative photo viewed using the arthroscope inside the posterolateral incision. Seen are the sutures once dissected down through the skin, subcutaneous fat, and additionally through the iliotibial fascia and tied along with the lateral joint capsule. The top of the figure is anterior, the bottom is posterior, the right is proximal and the left is distal.

the meniscus and capsule. Nelson and Bonner⁹ make mention of the need to make the standard AM portal more superior and possibly more medial for access to the body of the lateral meniscus for repair. However, their technique does not take advantage of making an additional AAM portal and having your viewing and working portal aimed directly toward the lateral compartment.

Regardless of technique, suture trajectory and adequate visualization during suture passage remain a technical challenge. With the use of an AAM portal, both suture trajectory and visualization of reduction are improved. In addition, as all suture passage is anterior to the fibula, the risk to the CPM is mitigated and a lateral incision can be made after suture passage which allows for a smaller incision and thus limits surgical morbidity.

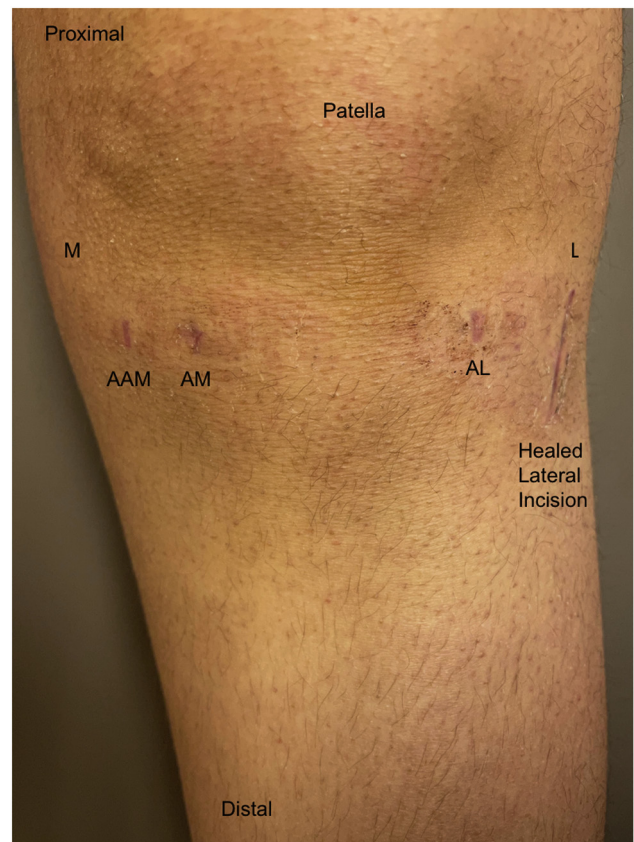


Fig 10. Postoperative image of the knee demonstrated healed surgical incisions. This figure allows one to appreciate the desired positioning of the accessory anteromedial (AAM) in relation to the standard anteromedial (AM), and anterolateral (AL) portal. In addition, one can appreciate the compact size of the lateral incision once healed. Although this technique requires an additional incision, you can see that the technique overall allows for relatively minor surgical scars, and importantly a smaller lateral incision. The top of the image is proximal, the bottom is distal, the right is lateral (L), and the left is medial (M).

Conclusions

Full-thickness lateral meniscus mid-body radial tears are uncommon with only limited data available for repair through an inside-out technique. This technical note attempts to further add to the available methods of fixing a challenging uncommon tear type. With the use of an accessory anteromedial portal, an alternate technique is presented to enhance a surgeon's ability to approach lateral mid-body radial tears through an inside-out approach.

References

1. Jackson T, Fabricant PD, Beck N, Storey E, Patel NM, Ganley TJ. Epidemiology, injury patterns, and treatment of meniscal tears in pediatric patients: A 16-year experience of a single center. *Orthop J Sports Med* 2019;7:2325967119890325.
2. Kramer DE, Kalish LA, Martin DJ, et al. Outcomes after the operative treatment of bucket-handle meniscal tears in children and adolescents. *Orthop J Sports Med* 2019;7:2325967118820305.
3. Bhan K. Meniscal tears: Current understanding, diagnosis, and management. *Cureus* 2020;12:e8590.
4. Laible C, Stein DA, Kiridly DN. Meniscal repair. *J Am Acad Orthop Surg* 2013;21:204-213.
5. Doral MN, Bilge O, Huri G, Turhan E, Verdonk R. Modern treatment of meniscal tears. *EFORT Open Rev* 2018;3:260-268.
6. Kopf S, Beaufils P, Hirschmann MT, et al. Management of traumatic meniscus tears: The 2019 ESSKA meniscus consensus. *Knee Surg Sports Traumatol Arthrosc* 2020;28:1177-1194.
7. Elmallah R, Jones LC, Malloch L, Barrett GR. A meta-analysis of arthroscopic meniscal repair: Inside-out versus outside-in versus all-inside techniques. *J Knee Surg* 2019;32:750-757.
8. Stender ZC, Cracchiolo AM, Walsh MP, Patterson DP, Wilusz MJ, Lemos SE. Radial tears of the lateral meniscus—two novel repair techniques: A biomechanical study. *Orthop J Sports Med* 2018;6:2325967118768086.
9. Nelson CG, Bonner KF. Inside-out meniscus repair. *Arthrosc Tech* 2013;2:e453-e460.
10. Pareek A, O'Malley MP, Levy BA, Stuart MJ, Krych AJ. Inside-out repair for radial meniscus tears. *Arthrosc Tech* 2016;5:e793-e797.
11. Leafblad ND, Leland DP, Camp CL, Stuart MJ, Krych AJ. Arthroscopic repair of double radial tears of the lateral meniscus. *Arthrosc Tech* 2019;8:e541-e547.