

Meniscal Ramp Repair: Double-Row Anatomic Repair in Acute Anterior Cruciate Ligament Tears



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Abstract: The surgical management of medial meniscus ramp lesions can be challenging. Currently, repairs are performed via a trans-notch view, combined with a single posteromedial working portal. This technique, however, does not allow for a direct and complete visualization of the structures being injured, making a precise appreciation of the injured structures, as well as an anatomical repair, difficult. To overcome this limitation, a 2-portal posteromedial approach has recently been described. It allows better visualization of the mediolateral extent of the tear and a precise identification of the injured structures. In this Technical Note, an anatomic repair technique using this approach is presented. It consists of a double-row of sutures to repair individually both the meniscotibial and meniscocapsular ligament, thus restoring the 2 main components of the posterior horn of the medial meniscus to their natural insertion site.

Due to their high prevalence, which is estimated from 16%¹ to 40%,^{2,3} ramp lesions should always be investigated in the context of an anterior cruciate ligament (ACL) injury. These injuries involve both the meniscotibial ligament (MTL) and/or meniscocapsular ligament (MCL), the 2 main anatomical components of the posterior horn of the medial meniscus (PHMM). They are reported to be disrupted in the majority of ramp subtypes.⁴ Lesions of these structures are known to be associated with increased anterior translation of the tibia and excessive rotational knee laxity.⁴⁻⁷ Furthermore, knees with ramp lesions demonstrated

accelerated degeneration of cartilage composition in the medial compartment already at 2-year follow-up.¹ Correct diagnosis and treatment of these tears is thus necessary to restore normal joint kinematics,^{4,8} possibly preventing osteoarthritic changes,⁹ meniscal degeneration,¹⁰ and reducing excessive strain forces on the graft after ACL reconstruction.⁶

The trans-notch view coupled with a posteromedial (PM) portal for instrument passing has been considered the “gold standard” to repair ramp lesions for many years. However, there are some clear limitations to this approach. Triangulation between camera and

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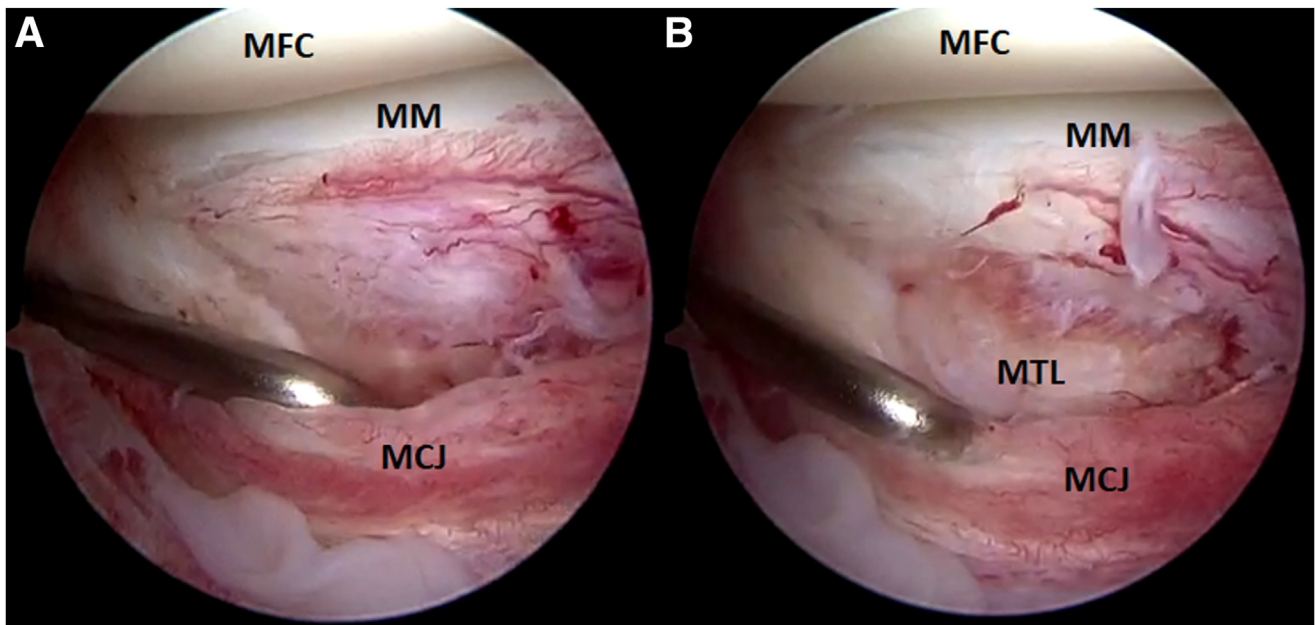


Fig 1. Acute ramp lesion. Posteromedial view of an acute ramp lesion in a right knee. (A) Acute ramp lesion before debridement. The posteromedial view allows visualization of the full extent of the lesion. (B) Acute ramp lesion after debridement. The image shows a complete disruption of both MTL and MCJ. The MTL is retracted and now clearly identifiable compared with before debridement. (MCJ, meniscocapsular junction; MFC, medial femoral condyle; MM, medial meniscus; MTL, meniscotibial ligament.)

instruments can be challenging even for experienced surgeons, and only a partial visualization of the PM compartment is possible. Recently a 2-portal PM approach has been described by Siboni et al.¹¹ The use of an additional PM portal to directly visualize the ramp facilitates both repair and identification of structures being injured.

Recent anatomical studies have shown different insertion points for the MTL and MCaL on the PHMM, advocating suture hook repair to restore the MTL stump.¹² With the standard trans-notch view, however, clear distinction of the injured structures remains challenging. A 2-portal PM approach would help to provide an anatomical repair of the ramp, by differentiating and repairing separately each of the injured structures.

In this paper, the authors propose a surgical technique that takes advantage of this approach to reconstruct the MTL and MCaL individually to their original insertion site on the PHMM using a double-row of sutures in the event of an acute ramp lesion.

Surgical Technique (With Video Illustration)

Patient Positioning, Ramp Lesion Identification, and Posteromedial Portals Establishment

The patient is placed lying supine on the operating table with the operated limb being positioned in a leg-holder at 90° of knee flexion. A tourniquet is placed on the proximal thigh. During the meniscal procedure,

the latter is usually not inflated. Standard anteromedial and anterolateral portals are used for initial arthroscopic exploration of the knee. The stability of the posterior horn of the medial meniscus is always tested with a probe to identify any tear or instability (i.e., if the posterior horn can be displaced under the medial femoral condyle).

To explore the PM compartment, a trans-notch view is performed.¹¹ The latter is often sufficient to confirm the ramp lesion, especially for acute cases. Nevertheless, the presence of a hidden meniscotibial and/or meniscocapsular ligament injury cannot be entirely excluded with this approach. Needling through a PM portal, as well as verification of the PM capsular tension during repetitive passive flexion–extension movements is thus recommended.

Following the trans-notch view, 2 PM portals are established according to Siboni et al.¹¹ Once direct visualization through the PM-viewing portal is obtained, palpation with the arthroscopic probe through the PM-working portal can confirm the diagnosis and extent of the ramp lesion (Fig 1). At this point, a debridement with a 5-mm shaver is carried out (Fig 2) to allow correct appraisal of the injured structures and of the mediolateral extension of the lesion. It also allows to remove the biomechanically inefficient tissue and may stimulate the healing response. If both the meniscotibial and meniscocapsular ligaments are affected and if it is possible to individualize them, a

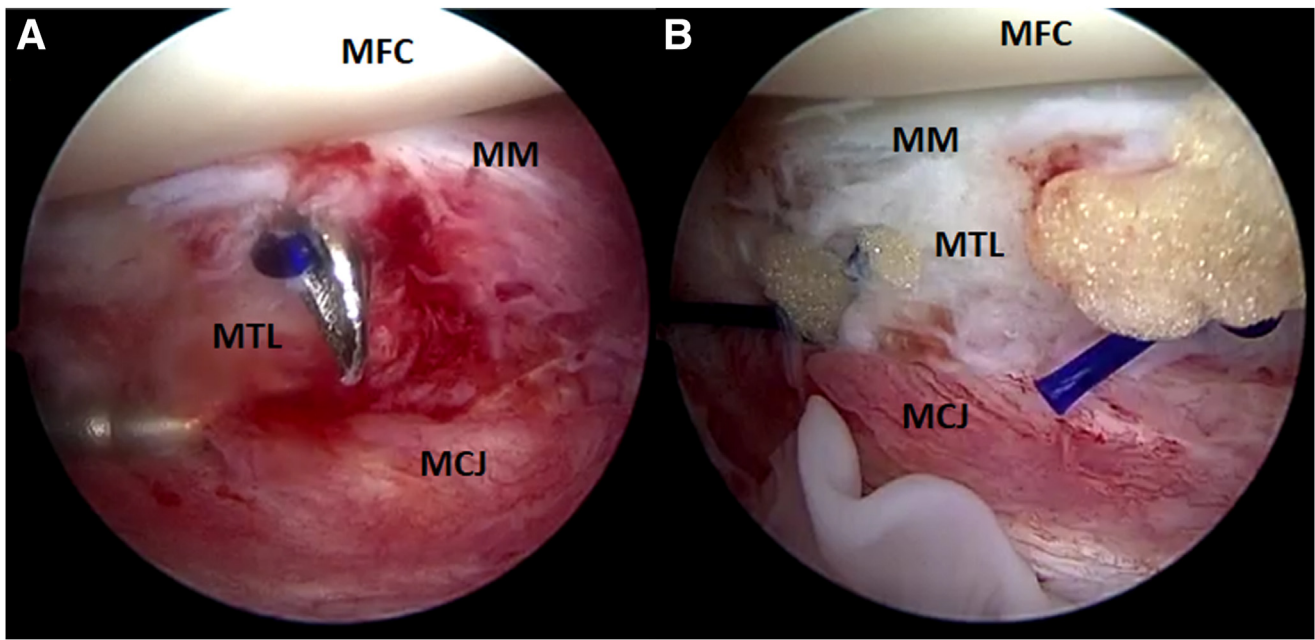


Fig 2. Double-row ramp repair, first row—deep layer. Posteromedial view of an acute ramp lesion in a right knee. (A) Meniscotibial ligament repair. A left-angled 90° curved hook loaded with a PDS 1 suture is passed through the meniscotibial ligament remnants and then through the inferior portion of the meniscal wall. The lesion is repaired from medial to lateral with stitches placed approximately every 4-5 mm. (B) Final view after deep layer repair of the meniscotibial ligament. Usually, 2 or 3 stitches are required for anatomic repair. (MCJ, meniscocapsular junction; MFC, medial femoral condyle; MM, medial meniscus; MTL, meniscotibial ligament; PDS, polydioxanone.)

double-row repair is foreseen. Although these 2 structures are often difficult to distinguish in chronic cases due to scar formation, they can usually be easily identified in acute injuries.

Double-Row Anatomic Repair

Curved needles are the instruments of choice for this type of repair (e.g., Spectrum; Conmed Linvatec, Largo, FL). The preferred instrument of the senior author is a 90° curved hook, right-angled for a left knee repair and left-angled for the right knee. However, depending on the location of the repair site, either a left- or right-angled 60° or 90° curved hook can be chosen. The repair instrument is loaded with a polydioxanone (PDS) 1 suture. The lesion is repaired from medial to lateral, starting with the meniscotibial ligament that constitutes the deep layer (Fig 2 A and B; Video 1). First the distal, posterior tissue is grasped with the curved hook, then the instrument is passed through the inferior half of the posterior wall of the meniscus to allow for an anatomic repair (Fig 2A). The PDS 1 suture is then advanced and retrieved with a grasping forceps. A sliding knot is then applied (Fig 2B). Stitches are repeated every 4 to 5 mm. Two to three stitches are usually necessary for a complete repair. Once repair of the meniscotibial ligament is completed, a second row of sutures is passed, superficially to the repair, to anatomically restore the meniscocapsular attachment. Suture passing is carried out in the same fashion as previously described, but grasping

the posterior capsule first and thereafter the superior half of the posterior wall of the meniscus or the remnants of the meniscocapsular ligament which is still attached to it (Fig 3A). Usually, 2 to 3 PDS 1 stitches are necessary for the repair of the second superficial layer.

Throughout the procedure, care should be taken to avoid iatrogenic cartilage injuries of the tibial plateau and femoral condyle. At the end of the procedure, the stability of the repair is tested with a probe as well as repetitive flexion–extension movements. When the repair is successful a cord-like plica can usually be palpated on the posteromedial inferior capsule. At probing, this structure provides a feeling similar to a “guitar string” (Fig 4; Video 1).

Discussion

This paper presented a technique, using a previously described double-PM portal approach,^{11,13} and a double row of sutures to separately repair the meniscotibial ligament and the meniscocapsular junction which can easily be distinguished in acute ramp lesions. The authors believe that this technique allows for a more anatomic approximation of the MTL remnants to their insertion point on the meniscus as compared with a standard single-row repair (Table 1).

Studies regarding the anatomy of the MTL and MCal attachments on the PHMM report conflicting evidence, with some authors suggesting a common attachment

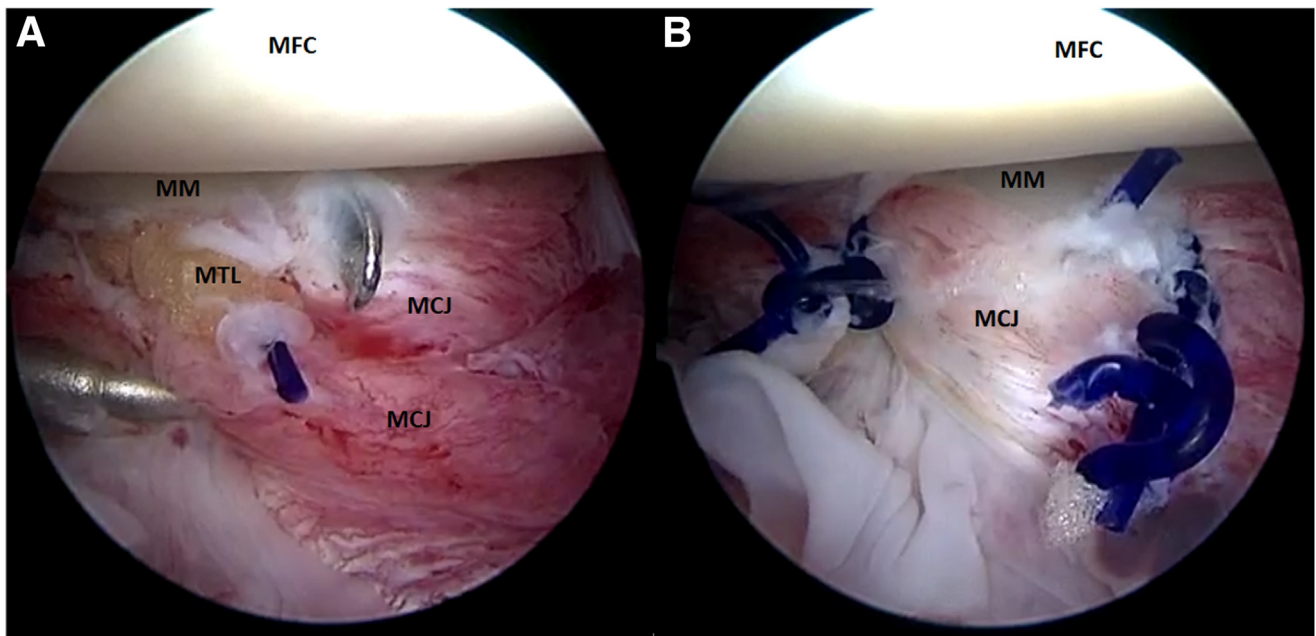


Fig 3. Double-row ramp repair, second row—superficial layer. *Posteromedial view of an acute ramp in a right knee. (A) Meniscocapsular junction repair. A left-angled 90° curved hook loaded with a PDS 1 suture is passed through the meniscocapsular junction and then through the meniscocapsular ligament remnants and the superior portion of the meniscal wall. The lesion is repaired from medial to lateral with stitches placed approximately every 4-5 mm. (B) Final view after superficial layer repair of the meniscocapsular junction. Usually, 2 or 3 stitches are required for anatomic repair. (MCJ, meniscocapsular junction; MFC, medial femoral condyle; MM, medial meniscus; MTL, meniscotibial ligament.)*

site,¹⁴ whereas others claim the existence of two separate insertion points.¹² In the authors' experience the latter hypothesis seems to better reflect what is commonly found in their clinical practice with the use of the 2-portal PM approach. Both MTL, MCaL and their attachment sites appear visually different from one another and easily identifiable, especially in acute lesions. Biomechanical analyses on MTL and MCaL sectioning confirmed the role of both of these structures in controlling anterior tibial translation and rotation^{4,6,8,15}; however, their relative importance is still unclear. To the authors' knowledge, no biomechanical analysis has been conducted to date to determine the relative effect of MTL and MCaL repair on meniscus stability. However, when considering 2 different attachment sites on the PHMM, it seems reasonable to hypothesize that a separate anatomical repair of these structures might lead to a better restoration of their mechanical properties. Further biomechanical studies should be undertaken to verify this hypothesis.

Although commonly used, the trans-notch view in most cases offers only a partial visualization of the full mediolateral extent of the lesion and makes triangulation between instruments and scope challenging.¹⁶ Using a 2-portal PM approach^{11,13} provides a better visualization of the ramp lesion while facilitating instrument triangulation with a second PM working portal in line with the camera. Furthermore, the PM

view allows for a better identification of the posteromedial meniscal attachments and a clear distinction between the MTL and the MCaL. The MTL in particular is not often identifiable with a standard trans-notch view as it tends to retract under the capsular folds. This often leads to an underestimation of the lesion and an inadequate repair of this structure.

Current ramp repair techniques are based on all-inside suture devices or suture hooks using an intercondylar trans-notch view. The use of all-inside devices is a common instance for ramp repair, but has been shown to lead to secondary meniscectomy rates as high as 25%. Recent literature supports the use of suture hook techniques, reporting lower failure rates.^{17,18} Furthermore, when considering 2 different attachments of the MTL and MCaL on the PHMM, all-inside devices might not be adequate to properly restore the MTL stump, strengthening the recommendation for suture hook techniques.¹²

The diameter of most suture hooks is small and piercing both the MTL and MCaL in a single pass is often not feasible, requiring double passes with interposed suture retrieval. This double-row configuration makes suture management easier compared to other previously described techniques,¹⁹ reducing surgical time, while enhancing the anatomical restoration.

The disadvantage of using 2 posteromedial portals is represented by the risk of a iatrogenic injury of the saphenous structures.¹³ However, the senior author has

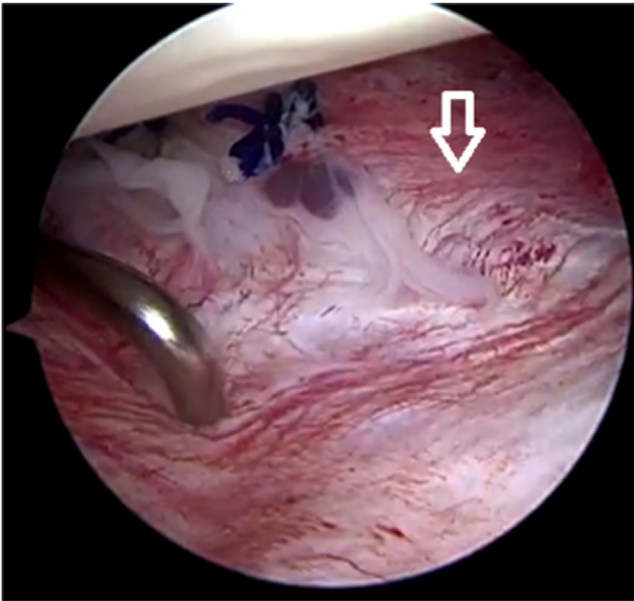


Fig 4. Evaluation of capsular tension after successful double-row ramp repair. Posteromedial view of an acute ramp lesion after double-row ramp repair in a right knee. At the end of the procedure, the stability of the repair is tested with a probe, as well as repetitive flexion–extension movements. The white arrow indicates the “cord-like” plica, this structure under the probe gives a feeling similar to that of a “guitar string.”

been using the 2-PM portal technique for more than 6 years without any complication to date. Care should be taken to use transillumination to minimize the injury risk of the saphenous structures, which may be challenging in patients with obesity. As for the double-row ramp repair, the main limitation is that identification of the MTL and MCL is often not possible in chronic cases due to scar formation between the 2 structures. Therefore, the main application of this technique remains acute ramp lesions. Another possible limitation of a double-row repair compared with a

single layer might be represented by the bulk effect of the knots in the PM compartment. This might lead to persistent pain or discomfort in the PM knee, at least for the time of suture resorption. However, the space required by the sutures is comparable to that of most all-inside implants, and the authors experienced no such complication to date.

Conclusions

This technique uses 2 posteromedial portals to perform a double-row of sutures in order to repair the meniscotibial and meniscocapsular attachments of the posterior horn of the medial meniscus individually. This suture configuration in acute ramp lesions might allow for better anatomic healing and restoration of mechanical properties compared with a standard single-row repair.

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Table 1. Double-Row Ramp Repair: Pearls and Pitfalls

Pearls

- Allows to better approximate the meniscotibial and meniscocapsular ligament on their native attachment site on the meniscus
- Provides a stable repair
- Practical, reduces operation time compared to other double passing suture techniques
- Use strong absorbable monofilament sutures (e.g., PDS-1)

Pitfalls

- Often only applicable in acute cases as the meniscotibial and meniscocapsular ligament are not distinguishable due to scarring in chronic ones
- Bulky knots might cause discomfort until suture resorption
- Requires knowledge and experience on how to perform a 2-portal approach

PDS, polydioxanone.

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