Technical Note

Meniscal Ramp Lesions Repair: An Under-Meniscus All-Inside Suture in Cases of Isolated Meniscotibial Ligament Tears

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Abstract: Anterior cruciate ligament ruptures are commonly associated with ramp lesions of the medial meniscus. These posterior longitudinal peripheral tears induce medial meniscus instability and increase the anteroposterior and rotational knee laxity. We divided ramp lesions in 3 types: meniscocapsular ligament tears, meniscotibial ligament tears, and a combination of both lesions. The conventional surgical technique for treating meniscal ramp lesions is to use a suture hook device through a posteromedial approach, which is a complex process requiring a learning curve and extensive surgical time. An anterior approach often is criticized as underestimating the true incidence of ramp lesion and to offer insufficient operating space. The purpose of this technical note is to describe our arthroscopic repair technique in cases of isolated meniscotibial ligament tears. The suture is performed by an under-meniscus anterior approach with a percutaneous medial collateral ligament release to create an additional opening of the medial compartment. This simple procedure allows for accurate diagnoses of the meniscotibial lesions and enables repair of the lesions with an all-inside suture device without the usual drawbacks of a posteromedial approach.

Ramp lesions are associated with anterior cruciate ligament (ACL) injuries in 16% of cases.[1] Capsulomeniscal lesions of the posterior segment cause instability of the medial meniscus and increase anteroposterior and rotatory laxity of the knee.[2,3] These ramp lesions also can increase the tension on the ACL graft and cause potential failure. Ramp lesions display as either a meniscocapsular ligament tear, a meniscotibial ligament tear, or a combination of the 2 types of lesions (Fig 1).

The most commonly used arthroscopic technique to repair these kinds of lesions uses an all-inside hook suture device through a posteromedial portal.[4] It is a complex procedure requiring a long learning curve and extended surgical time. Ultimately, this technique is rarely performed in daily practice. The significant consequences of these lesions, however, require thorough consideration, as they could lead to residual knee laxity even after reconstruction of the ACL.[5]

Some studies have reported good clinical outcomes of ramp lesion sutures through the standard anterior approach using an all-inside meniscal repair device.[6] However, this technique is criticized as underestimating the true incidence of ramp lesion and causes articular cartilage damages due to insufficient operating space.[7]

A recent publication[8] has shown that a local release of the medial collateral ligament increases the posteromedial gap, improving the visual field and the operating space without causing residual valgus instability.

The purpose of this technical note is to describe the steps to perform an effective systematic evaluation to correctly diagnose ramp lesions solely through the use of an anterior arthroscopic approach and to describe a repair technique in cases of isolated lesions of the meniscotibial ligament by way of an under-meniscus all-inside suture technique.

Surgical Technique (Video 1)

Each technique step is shown in Video 1. Advantages/disadvantages and pearls/pitfalls are described in Tables 1 and 2.

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The authors report the following potential conflicts of interest or sources of funding: C.L. reports grants from SBM, and correction and translation services from Stryker, during the conduct of the study. N.G. is a consultant for SBM and Stryker. N.B. is a consultant for SBM. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received December 14, 2020; accepted February 7, 2021.

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2212-6287/201987

https://doi.org/10.1016/j.eats.2021.02.005

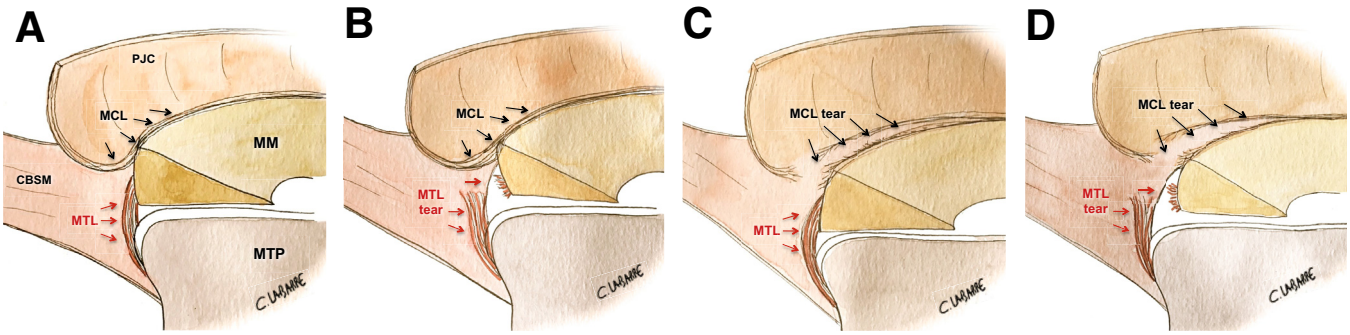

Fig 1. Classification of posteromedial lesions of the meniscus. Lateral view of the posteromedial compartment. (A) Posteromedial compartment, without any lesion. The meniscotibial ligament and the meniscocapsular ligament are inserted on the posterior part of the medial meniscus. The first one attaches the inferior edge of the medial meniscus to the tibial plateau. The second one attaches the superior edge to the joint capsule. (B) Meniscotibial ligament tear: Only the meniscotibial ligament is injured. Testing with a needle and a posteromedial exploration find an intact meniscocapsular ligament. (C) Meniscocapsular ligament tear: The posteromedial exploration finds a lesion of the meniscocapsular ligament. A suture with hook suture devices with a posteromedial approach is needed. (D) Combination of both lesions: avulsion of meniscotibial and meniscocapsular ligament. (CBSM, capsular branch of the semimembranosus muscle; MCL, meniscocapsular ligament; MM, medial meniscus; MTL, meniscotibial ligament; MTP, medial tibial plateau; PJC, posterior joint capsule.)

Table 1. Advantages and Disadvantages

Advantages	Disadvantages
This technique provides for a secure meniscotibial ligament and meniscal fixation at their original attachment locations.	No option for minimal debridement of the superficial meniscocapsular area, which is possible through a posteromedial portal.
Standard approach and conventional all-inside suture device: fast learning curve and less time-consuming.	All-inside suture device: risk of implant breakage, synovitis, migration of the implant, injury to the cartilage (if insufficient gap).
No posteromedial portal with its drawbacks: prolonged operation time, iatrogenic damages, complex procedure with a long learning curve.	Risks of the pie-crusting release: potential valgus instability, saphenous nerve and vein damages with hematoma, persistent medial pain.
Allowing for a systematic exploration of the lesion during a simultaneous ACL reconstruction: better outcomes and lower failure rates.	Only for isolated meniscotibial tears.
Suture biomechanically strong, like a vertical mattress suture	
Pie-crusting release:	
Easy and effective technique with documented good outcomes and few complications	
Decreased risk of iatrogenic chondral injury due to increased working space	

ACL, anterior cruciate ligament.

Table 2. Surgical Pearls and Pitfalls

Pearls	Pitfalls
Good visualization of the posterior part of the meniscus to diagnose ramp lesions and define type of lesion.	Iatrogenic damages with the pie-crusting needle on extra-articular structures (saphenous vein and nerve) or intra-articular surfaces (cartilage, meniscus) if performed outside anatomical landmarks and without arthroscopic control.
Increased joint space opening with a reliable and validated technique.	Chance of overlooking meniscocapsular tears if transcondylar view is not performed.
Perform the entire suture procedure with same optic and instrumental portals.	
A strong vertical mattress suture with the first implant fixed upward in the meniscocapsular wall and the second downward to grasp the meniscotibial ligament.	
The ability to observe how the tear is closed and how the posterior peripheral meniscus is fixed at its original attachment.	

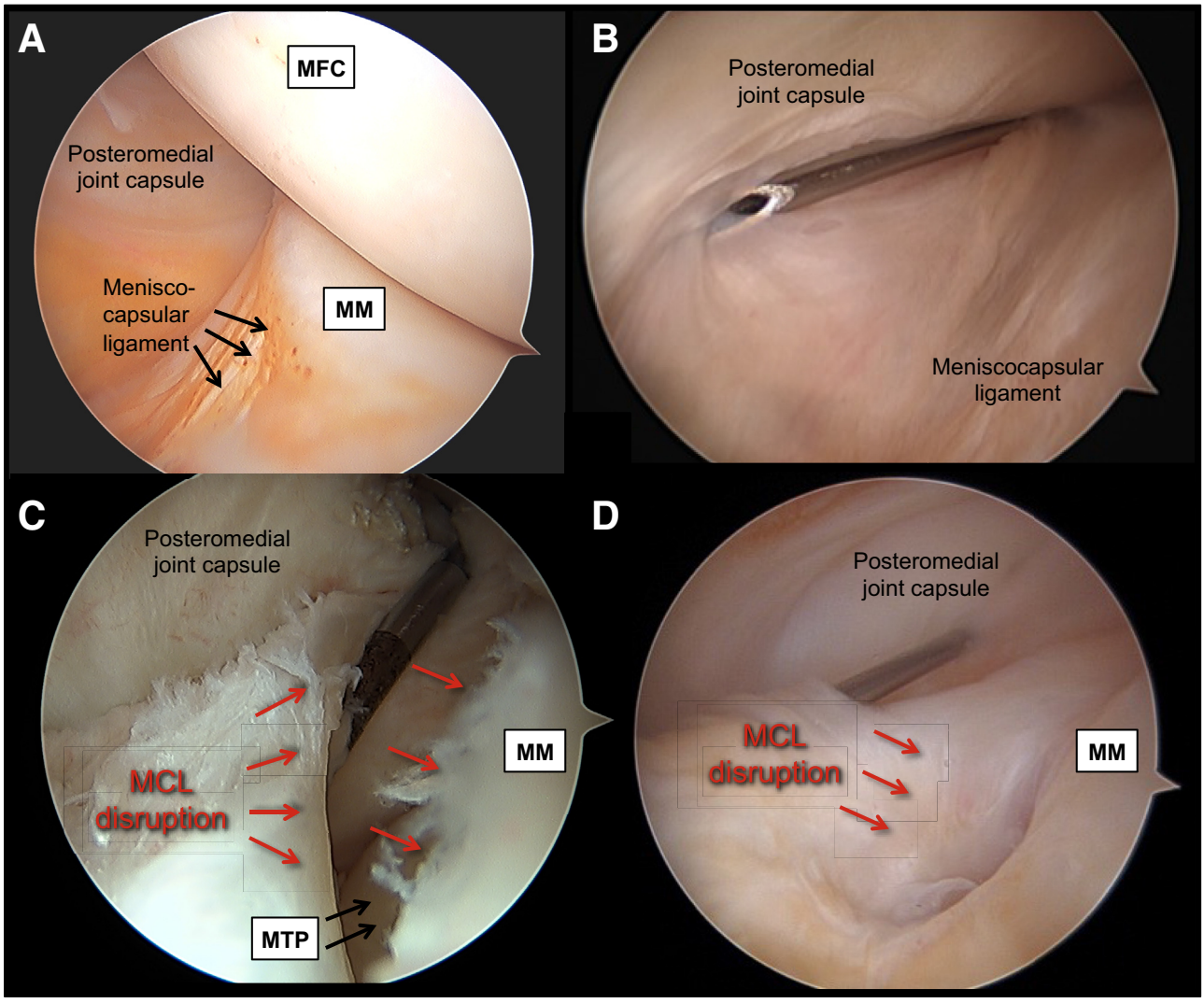

Fig 2. Diagnostic arthroscopy in a right knee flexed at 90°. Posteromedial exploration through notch view using the anterolateral portal with a 30° optic rotated at 4 o'clock. (A) Meniscocapsular ligament is still attached to the posterior horn of the medial meniscus. (B): A needle is inserted through the posteromedial side and is used to unfold the synovial membrane and helps to define the lesion. It probes for the integrity of the meniscocapsular tissues. (C-D) The needle highlights a complete meniscocapsular disruption. The medial tibia plateau appears through the tear. In these cases, repair of the ramp lesion requires a suture hook device through a posteromedial portal. (MCL, meniscocapsular ligament; MFC, medial femoral condyle; MM, medial meniscus; MTP, medial tibia plateau.)

Patient Positioning

The procedure is performed with the patient in the supine position under general or spinal anesthesia. A tourniquet is placed high on the operated thigh, and a lateral support is well fixed around the level of the tourniquet to provide an efficient valgus. The knee is placed at a 90° flexion with a foot support to allow for a full range of knee motion.

Arthroscopic Evaluation

We perform all the procedures (arthroscopic exploration and suture) with a classic 30° arthroscope. We use a standard anterolateral parapatellar portal for the optic and an anteromedial parapatellar portal for the instruments. In case the patient needs a concurrent ACL reconstruction, all compartments of the knee are examined and we debride the intercondylar notch with the ACL remnant. The medial compartment examination and the diagnosis of a posterior peripheral lesion are conducted as follows in three steps:

Step 1: Standard Anterior Arthroscopic Exploration

In valgus position, we inspect the medial joint line through a standard anterolateral approach and evaluate

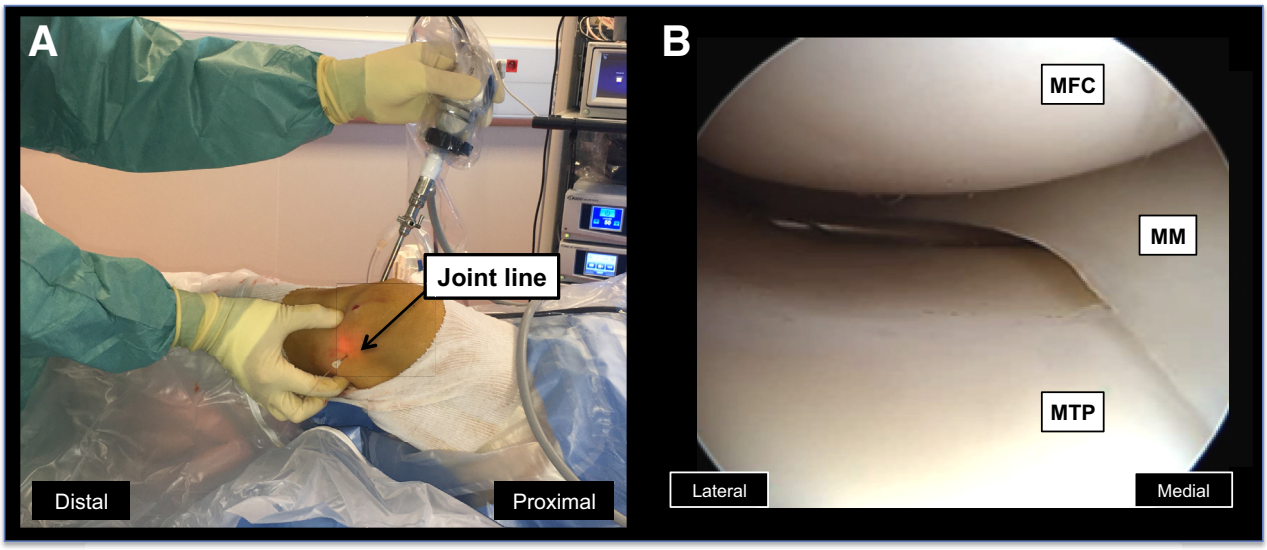

Fig 3. Position for the medial collateral ligament release and joint line identification (A) View of a right knee from the medial side. The surgeon places the patient's operative leg on his/her hip and provides a valgus force with the knee flexed to 20° to stretch the medial collateral ligament fibers. (B) The 30° arthroscope through the anterolateral portal monitors the joint line localization with an 18-gauge needle introduced by the medial side. (MFC, medial femoral condyle; MM, medial meniscus, MTP, medial tibia plateau.)

the compartment gap with the probe tip as reference (tip measure 5 mm). We test the stability of the posterior segment with a hook probe. An excess of mobility suggests a peripheral lesion. Give careful attention when the inferior face of the meniscus can be reversed when pulling on it. Sometimes in this stage, if the space is sufficient, a meniscosynovial tear can already be exposed under the meniscus. However, next steps should be always performed.

Step 2: Posteromedial Exploration With Notch View

Using the anterolateral portal, the arthroscope is advanced through the intercondylar notch, along the medial femoral condyle under the posterior cruciate ligament (Fig 2). We use a blunt trocar to prevent damages of the camera optic when advancement of the camera optic into the posteromedial compartment is difficult. The optic is rotated facing the tibial plateau to assess the meniscocapsular junction. A needle is introduced into the posteromedial compartment to unfold the synovial membrane and thus to define the lesion. This allows to ensure the integrity of the meniscocapsular tissues.

Step 3: Medial Collateral Ligament Release

One should now return to the anterior part of the knee and the medial knee joint line. The patient's operative leg is placed on the surgeon's hip, and we provide a valgus force with the knee flexed to 20° to stretch the medial collateral ligament fibers. We locate the medial joint line with an 18-gauge needle, which is introduced in the posterior third of the joint line under the medial meniscus (Fig 3). Then, the needle is removed and positioned 1 cm distal to the joint line in the medial collateral ligament fibers, ensuring an unimpeded course of the saphenous nerve and vein with trans illumination. Maintaining the valgus stress, percutaneous punctures are progressively performed with anteroposterior sawing motions (pie-crusting motion) (Fig 4). Concurrently, we control the opening of the joint space with the arthroscope. The release of the ligament is stopped when the posterior part of the medial meniscus is in full view and instruments can easily pass through without damaging the cartilage. The meniscotibial ligament tear is clearly exposed when approaching the optic toward the posterior part under the meniscus (Fig 5).

Meniscal Repair

We keep the same valgus position for the suture. A meniscal rasp is used to abrade both sides of the tear to stimulate the healing response. Before introducing the repair device (AIR; Stryker, Kalamazoo, MI), we curve the flexible needle. With a slotted cannula (Stryker) to protect the cartilage, the device is advanced to under the meniscus, close to the meniscotibial ligament tear. We insert the first implant obliquely with the needle looking upward in the peripheral third of the meniscus and we fix it on the meniscocapsular tissue. The second implant is introduced under the meniscus too, but the needle is curved downward and directly inserted into the meniscotibial ligament.

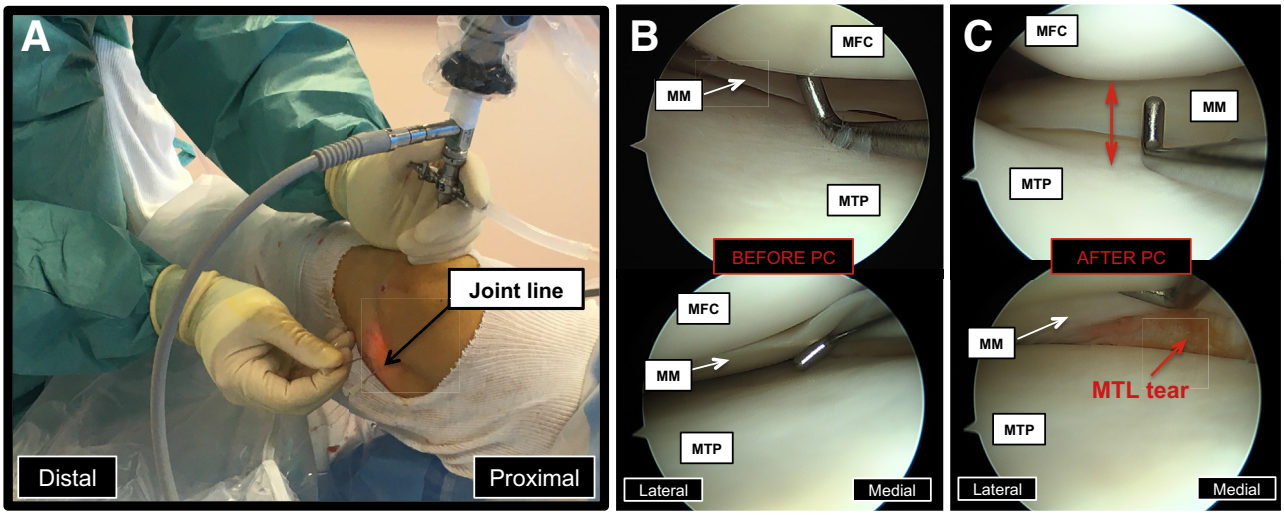

Fig 4. The medial collateral ligament release: increase of the posteromedial gap. (A) View on a right knee from the medial side in valgus position. The 18-gauge needle is introduced 1 cm distal to the joint line in the medial collateral ligament fibers, taking care to protect the course of the saphenous nerve and vein, using trans illumination with the scope. Thereafter, a multipoint pie-crusting release of the medial collateral ligament is performed. Concurrently the opening of the intra-articular gap is controlled with the arthroscope. The release is stopped when the space suddenly opens. (B) View of a right knee with a 30° optic. Evaluation of the posteromedial compartment gap before pie-crusting. (C) The posteromedial gap is increased and highlights the meniscotibial ligament tear under the meniscus. (MFC, medial femoral condyle; MM, medial meniscus, MTP, medial tibia plateau; PC, pie-crusting.)

The sliding knot is gradually tightened closing the tear with the knot pusher or the hook probe and achieving secure fixation of the posterior peripheral meniscus at its original attachment (Fig 6). At this moment, the inferior face of the meniscus can no longer be reversed.

Postoperative Rehabilitation

The patient is allowed to bear full weight, protected with crutches, for 2-4 weeks. We do not advice wearing a brace to promote a faster muscle recovery. Physical therapy is directly initiated focused on edema control, quadriceps activation, active straight leg elevation training and full range of motion exercises. At 4 weeks, patients must be able to carry out an active knee flexion of more than 90°.

Discussion

Ramp lesions are reported in 16% of ACL injuries, as reported in several studies.[1,6] There is currently an increasing interest due to the biomechanical effects on the knee in the event of inadequate treatment. Capsulomeniscal lesions of the posterior segment cause instability of the medial meniscus and increase anteroposterior and rotatory laxity of the knee.[2,3] In ACL surgery reconstruction, the meniscus repair is therefore performed to decrease the risk of too much stress on the ACL graft causing potential subsequent failure of the graft.[5]

Ramp lesions behave like distinct entities according to the tear location. Thaunat et al.[9] describe a complete classification of 5 types, which, however, hardly seems to apply to daily practice. To facilitate therapeutic application, we only distinguish between the meniscotibial ligament tear through the under-meniscus view, the meniscocapsular ligament tear by the posteriomedial exploration with notch view, or the combination of both (Fig 1).

Because of a narrow intra-articular gap, posteromedial compartment access can be very challenging to diagnose and treat posterior medial meniscal tears in knee arthroscopy. Several techniques for the management of these lesions have been described. Previously, Ahn et al.[4] have reported good healing rates for meniscal ramp lesions repair using a posteromedial approach to pass a hook suture device. More recently, techniques have been described for ramp lesion repair using the all-inside meniscal suture device through an anterior approach with or without additional posteromedial portal.[10,11] The all-inside meniscal suture device has advantages: it is reliable and requires little procedure time. Studies[6,12] have reported good clinical outcomes after meniscal repair with ACL reconstruction.

Li et al.[11] describe their all-inside repair technique with only anterior approaches for all ramp lesions. Unlike them, we believe that meniscotibial ligament tears and meniscocapsular tears require specific repair. When the meniscotibial ligament is fully retracted or in case of large meniscocapsular lesions, we believe a posteromedial approach with a hook device is required to reach the retraction site. Based on the technique by Li et al.,[11] Negrín et al.[10] used an additional instrumental

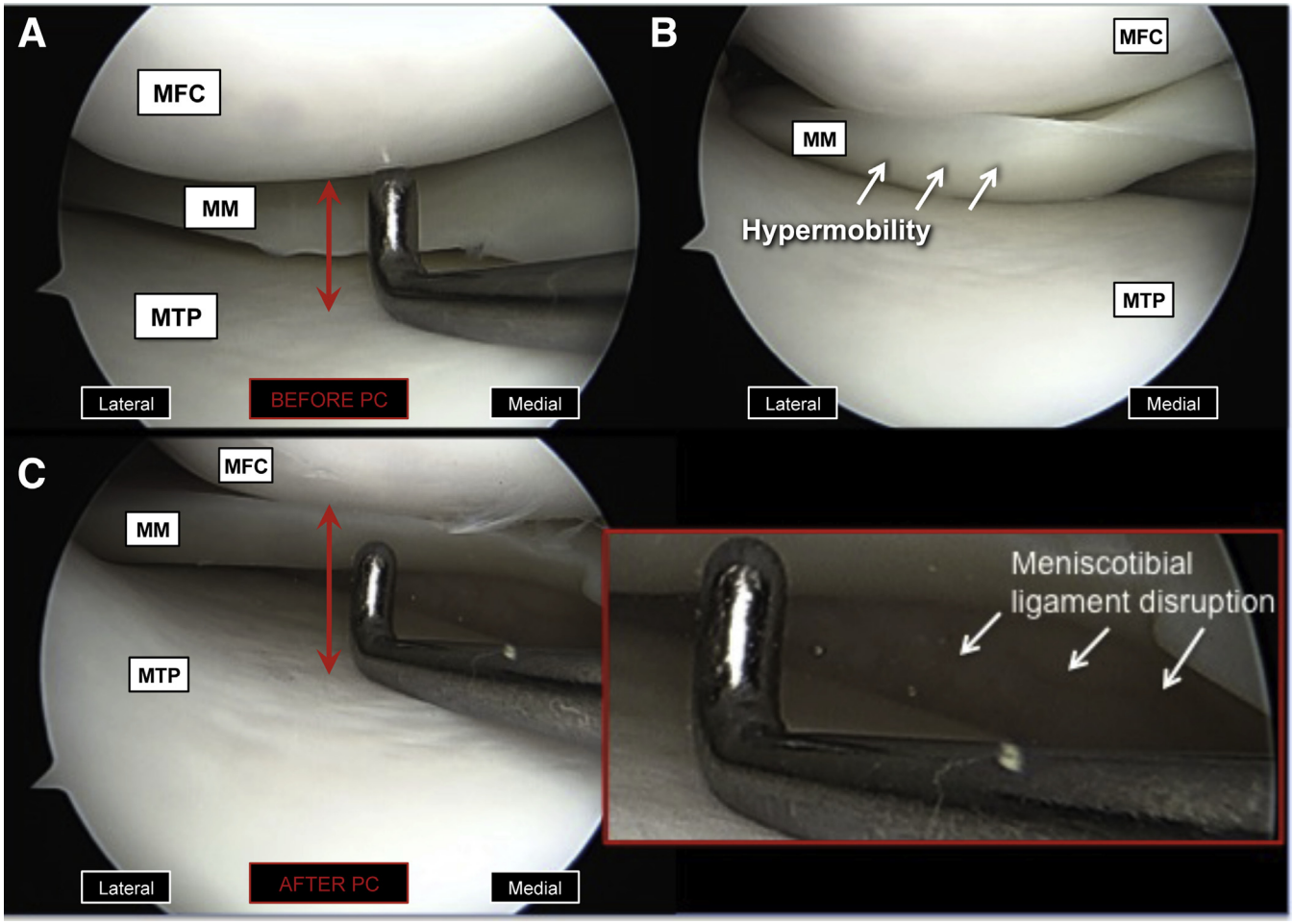

Fig 5. Arthroscopic pie-crusting (PC) release of the medial collateral ligament: increase of the posteromedial gap. Posteromedial compartment view on a right knee with a 30° optic through the anterolateral approach. (A) Evaluation before PC of the posteromedial compartment gap with the probe tip introduced through the anteromedial approach. (B) Stability testing of the posterior segment with hook probe, before PC. The excess of mobility suggests a peripheral lesion. We can also expect it when the inferior face of the meniscus can be reversed when pulling on it. (C) Increase of the posteromedial gap after PC. The meniscotibial ligament tear is clearly exposed under the meniscus. (MFC, medial femoral condyle; MM, medial meniscus, MTP, medial tibia plateau.)

posteromedial portal to grasp the meniscotibial ligament when it is fully retracted and replace it at his original attachment to ensure an efficient suture.

Techniques using only anterior approaches are criticized to underestimate the true incidence of ramp lesion. Sonnery-Cottet and al.[7] suggest a systematic arthroscopic exploration of the posteromedial compartment involving an additional posteromedial portal to ensure that a tear is not overlooked. However, it is a complex process requiring experience and extended surgical time. Like the posteromedial portal, release of the medial collateral ligament allows to improve visualization of the posterior horn of the medial meniscus. The main concerns with this technique are risks of residual valgus knee instability and saphenous vein and nerve injuries. In a recent study, Han et al.[8] evaluated the effect of release of the medial collateral ligament on the visual field of the posteromedial space and the postoperative medial stability in patients who had undergone a meniscal arthroscopy surgery. They determined that a release of the medial collateral ligament increases the medial joint space with an average of 3.2 mm without any residual valgus instability of the knee nor negative effects to the clinical outcomes of the meniscal surgery.

To avoid saphenous nerve and vein injury, puncture should be performed at the posterior half part of the medial compartment to stay away from the infrapatellar branch[13] whilst supporting the procedure with trans illumination.

Release of the medial collateral ligament is a safe and effective technique to increase the posteromedial gap and thus avoiding the need for an additional posteromedial portal. Both the expansion of the visual field as well as the operating space through only standard anterior approaches enables us to use a conventional all-inside meniscal suture device. Even if the created space decreases the risks of iatrogenic chondral damages, special care must be given to the introduction of

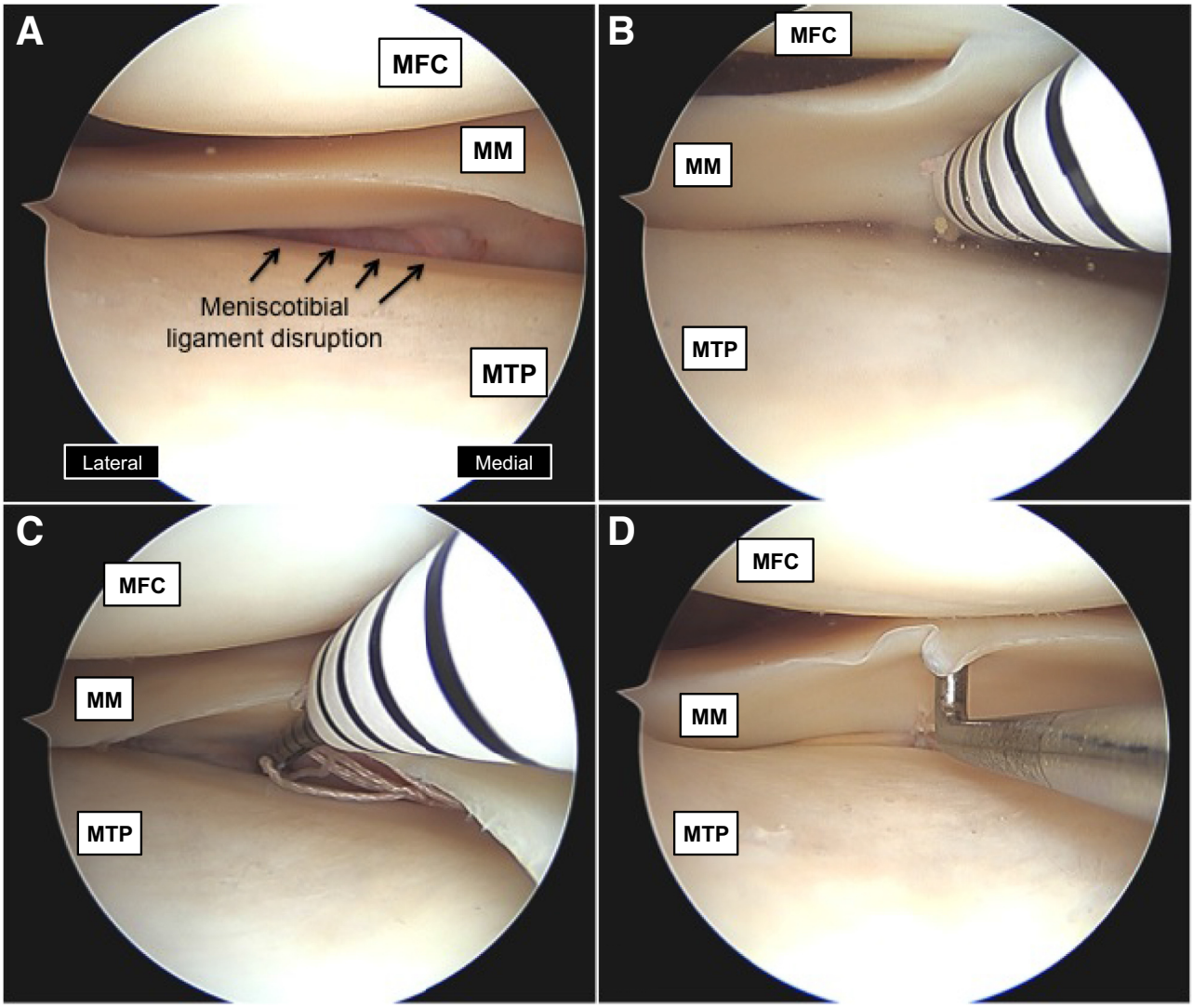

Fig 6. All-inside under-meniscus suture in meniscotibial ligament tear repair. Posteromedial compartment view on a right knee with a 30° arthroscope through the anterolateral approach. Implants are introduced through the anteromedial instrumental portal. (A) The meniscotibial ligament tear is clearly exposed under the meniscus, after the medial collateral ligament release. (B) The first implant is inserted obliquely with the needle looking upward in the peripheral third of the meniscus and fixed behind on the meniscocapsular tissue. The compartment gap is appropriate to employ instruments without affecting the cartilage. (C) The second implant is introduced under the meniscus with the needle curved downward and directly inserted into the meniscotibial ligament. (D) The sliding knot is gradually tightened closing the tear. The posterior peripheral meniscus is replaced at his original attachment. There is no noticeable cartilage damage after of the repair procedure. (MFC, medial femoral condyle; MM, medial meniscus, MTP, medial tibia plateau.)

the devices into the articular cavity, using protection by a cannula at all times. This technique is adapted only for isolated meniscotibial ligament tears and a posteromedial approach should be performed in case of additional meniscocapsular tears.

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