

MANAGEMENT OF COMBINED INJURIES OF THE ACL AND MEDIAL KNEE

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SUMMARY

Background: Combined injuries of the anterior cruciate ligament (ACL) and medial knee structures occur in 20% to 40% of ACL ruptures, typically resulting from valgus stress or excessive rotation. Despite their prevalence, management remains controversial due to a lack of consensus in the literature and the risk of chronic instability or early osteoarthritis.

Objective: This article reviews the anatomy, biomechanics, and diagnostic strategies for medial knee injuries and presents treatment algorithms and clinical outcomes based on the 2023 Société Française d'Arthroscopie (SFA) symposium.

Key Points: Medial stability is maintained by three layers, including the superficial medial collateral ligament (sMCL), deep medial collateral ligament (dMCL), and posterior oblique ligament (POL). Diagnosis relies on comparative clinical exams, including valgus stress and the anteromedial rotatory instability test, supplemented by stress radiography and MRI. Grade 1 injuries require no medial intervention. Grade 2 injuries may be managed non-operatively unless distal entrapment or elite athletic status necessitates repair. Grade 3 injuries, characterized by laxity in extension, require surgical reconstruction. Technical requirements include precise anatomical tunnel placement for sMCL, dMCL, and POL grafts. Data from 722 patients indicate that while ACL+MCL injuries have higher rates of stiffness and repeat surgery for cyclops lesions, early mobilization and weight-bearing without rigid bracing optimize functional recovery.

Conclusion: Effective management of combined ACL and medial knee injuries requires a grade-based approach. Early anatomical reconstruction and immediate mobilization are essential to restore kinematics and minimize the risk of postoperative joint stiffness.

KEYWORDS

Anterior Cruciate Ligament Injuries; Medial Collateral Ligament, Knee; Joint Instability; Orthopedic Procedures; Range of Motion, Articular

INTRODUCTION

Damage to the anterior cruciate ligament (ACL) and the medial knee is common in sporting injuries, especially in traumas that involve excessive rotation or valgus stress. These combined injuries may involve the ACL, the medial collateral ligament (MCL), or the other structures of the posteromedial knee such as the posterior oblique ligament (POL). These injuries occur in 20 to 40 % of cases of ACL rupture, and they have an impact on the functional prognosis and choice of treatment [1]. Combined ligament injuries are a challenge to treat because of the potential consequences on long-term stability of the knee, particularly in those who practise sports that involve pivoting or high-intensity activities. Inadequate management may lead to chronic instability, a decline in athlete performance and, in the longer term, early osteoarthritis.

Although combined ligament injuries are well-known, the findings in the literature vary and are usually based on small studies [2]. For this reason, there is very little consensus on management.

This article is based on the Société Française d'Arthroscopie (SFA) [French Arthroscopy Society] symposium in 2023 (N. Bouguennec, E. Cavaignac, T. Neri, B. Freychet, C. Herce, C. Lutz, C. Kajetanek, A. Hardy, M. Ollivier). Its aim is to present a thorough review of the anatomy and biomechanics of the medial knee, diagnostic strategies, treatment options and post-operative outcomes based on the SFA prospective study.

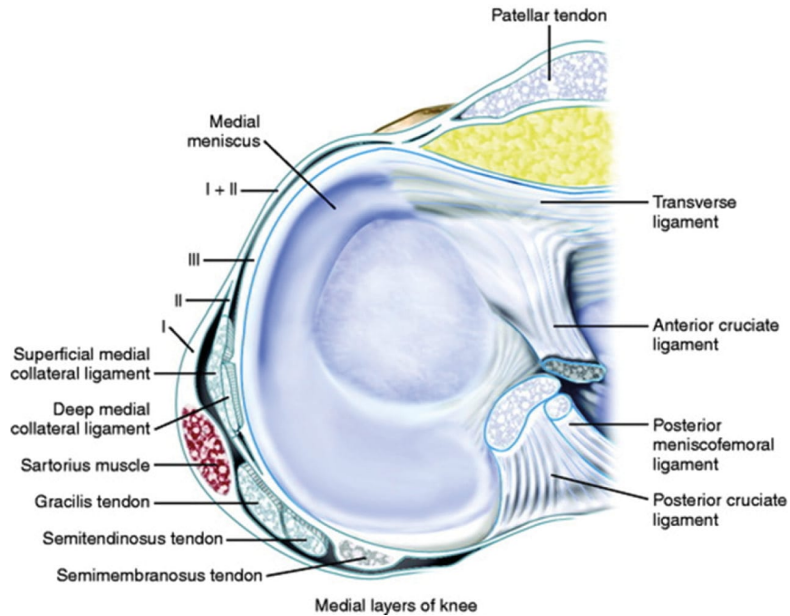
ANATOMY AND BIOMECHANICS OF THE MEDIAL KNEE

The medial side of the knee is made up of three distinct layers, described by Warren and Marshall (figure 1), that act as primary and secondary stabilisers of the knee, especially during valgus movements and rotation.

Layer 1 Sartorius and fascia (patellar retinaculum)
 gracilis, semitendinosus, and saphenous nerve run
 between layer 1 and 2

Layer 2 Semimembranosus, **superficial MCL**, MPFL,
 posterior oblique ligament

Layer 3 Deep MCL, capsule, coronary ligament



Source : 1 - Medial and Anterior Knee Anatomy, Editor(s): Frank R. Noyes, Sue D. Barber-Westin, Noyes' Knee Disorders: Surgery, Rehabilitation, Clinical Outcomes (Second Edition), Elsevier, 2017, Pages 2-22.

1. Main anatomical structures

- Superficial layer: This consists of the fascia, sartorius and patellar retinaculum (Figure 2).



Figure 2 : Superficial layer

- Middle layer: This includes the superficial medial collateral ligament (sMCL), semimembranosus, semitendinosus, gracilis and posterior oblique ligament (POL). This ligament inserts over the medial epicondyle and terminates over the proximal tibia, 6cm below the joint line. It follows an oblique course down and forwards (Figure 3).

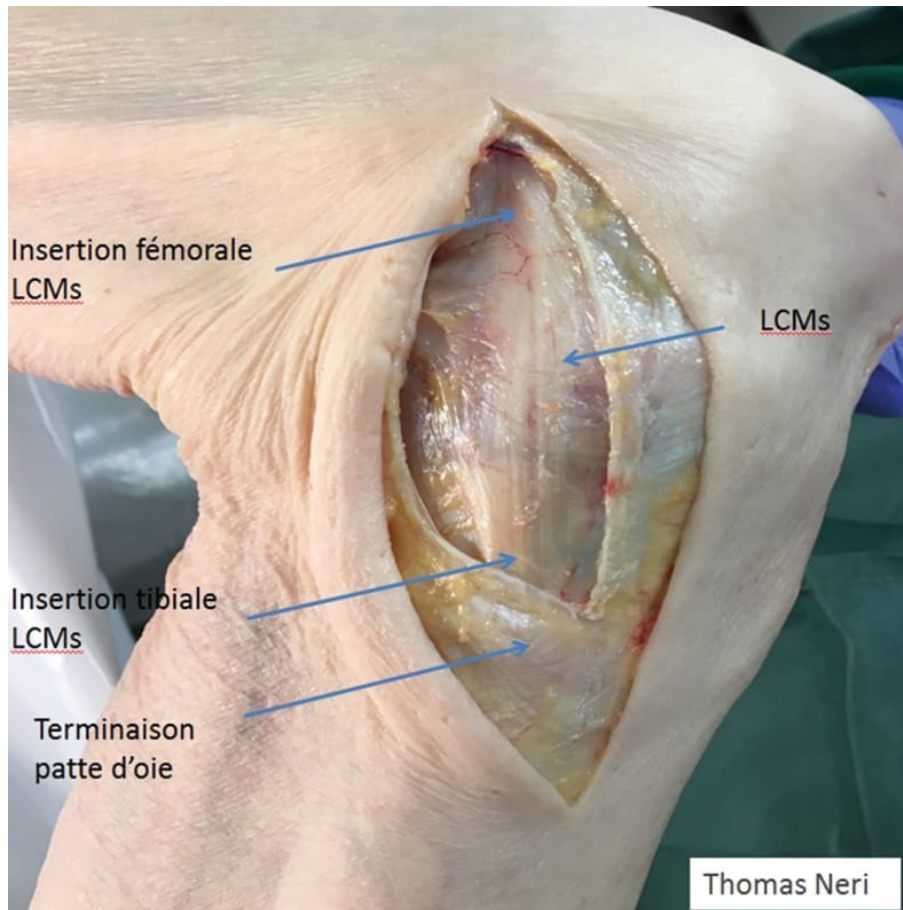


Figure 3 : Superficial medial collateral ligament (sMCL).

The POL forms the point of the posteromedial corner of the knee, together with the posteromedial joint capsule and the posterior horn of the medial meniscus. It inserts on the femur posteriorly and distally to the adductor tubercle. It ends at the semimembranosus tendon (at the anterior or reflected arm) (Figure 4).

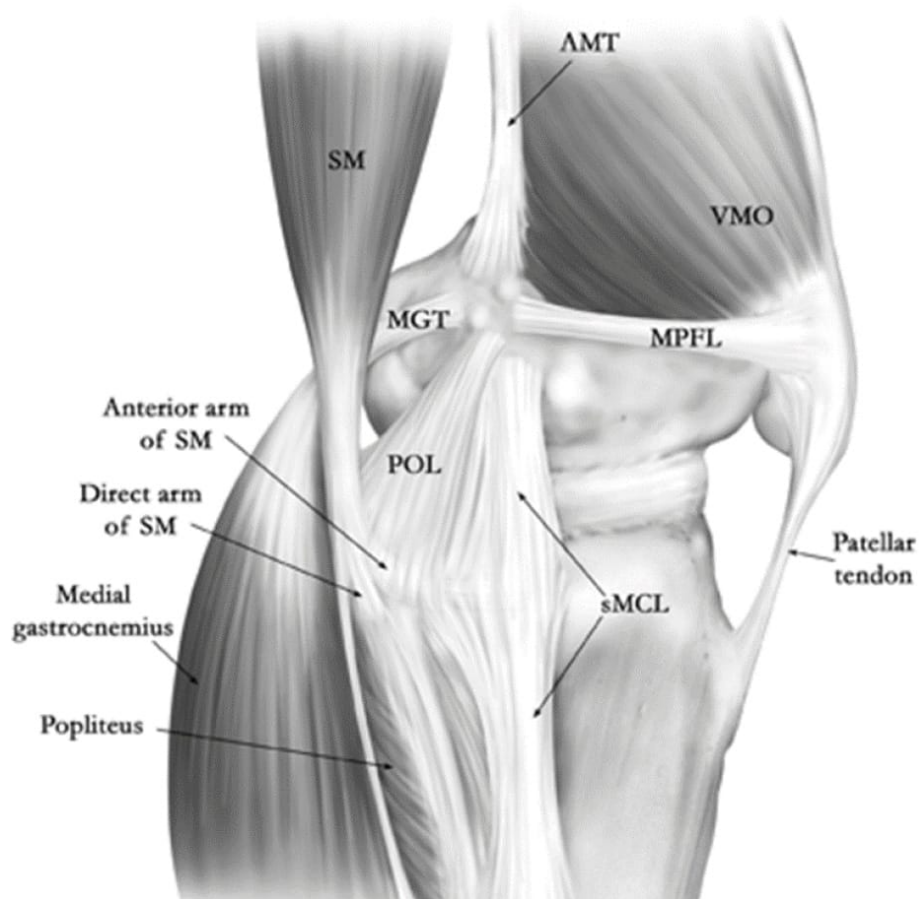


Figure 4 : Posterior oblique ligament (POL). [4] Source : Coobs BR, Wijdicks CA, Armitage BM, Spiridonov SI, Westerhaus BD, Johansen S, Engebretsen L, LaPrade RF. An in vitro analysis of an anatomical medial knee reconstruction. *Am J Sports Med.* 2010;38:339-347

- Deep layer: This layer includes the deep medial collateral ligament (dMCL), the joint capsule and the meniscotibial (or coronary) ligaments (Figure 5). The main role of the dMCL is to stabilise anterior translation and movements in valgus. It is made up of two parts: the meniscofemoral and meniscotibial ligaments. Its proximity to the joint capsule is worth noting as this explains the symptomatology of dMCL rupture, with the risk of joint stiffness in flexion.

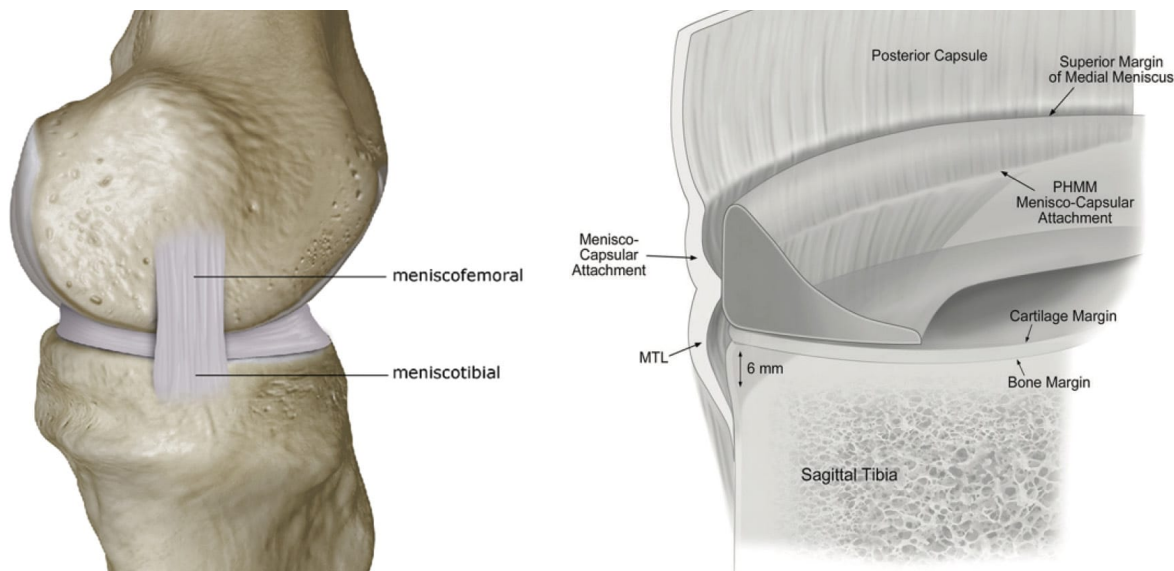


Figure 5 : Deep medial collateral ligament (dmCL) (dmCL) [5] Source: Quantitative and Qualitative Assessment of the Posterior Medial Meniscus Anatomy Defining Meniscal Ramp Lesions Nicholas N. DePhillipo,*y MS, ATC, OTC, Gilbert Moatshe,yz§ MD, PhD, Jorge Chahla,z MD, PhD, Zach S. Aman,z BA, Hunter W. Storaci,z MSc, Elizabeth R. Morris,z BA, Colin M. Robbins,z BA, Lars Engebretsen,§ MD, PhD, and Robert F. LaPrade,*k MD, PhD

2. Biomechanics of the medial knee

From a biomechanical perspective, there are three important functions to focus on: valgus forces, rotation and translation.

- **Valgus** : The structures of the medial and posteromedial knee provide stability in valgus at different points during flexion and extension. At 30° of flexion, the sMCL and dmCL respond to valgus stress, with the sMCL playing the major role (80%) [6]. In full extension, stability in valgus is mainly controlled by the POL. The medial hamstring tendons, known as pes anserinus, are also secondary stabilisers under valgus stress [6].
- **Rotation** : Recent biomechanical studies have clarified the stabilising role of the medial structures in restricting anteromedial knee rotatory instability (AMRI). It has been demonstrated that the sMCL and dmCL both play an important role as a restraint against AMRI. Clinically, a concomitant injury of the ACL and dmCL, or of both medial collateral ligaments (sMCL and dmCL), can lead to an AMRI [7].
- **Tibial translation** : This secondary function is performed by all the medial structures, with the dmCL playing the most important role.

DIAGNOSTIC STRATEGY

1. Clinical examination

The clinical examination is crucial in determining the extent of medial aspect and ACL injury. This must be a bilateral examination that compares the two limbs.

- **ACL tests**: It is standard to perform ACL tests to include the anterior drawer (Lachman's test at 30° and direct anterior drawer at 90°) and the pivot shift test. Anterior subluxation of the tibia may be absent in combined ACL

and MCL injuries. In the SFA symposium series, this test was positive in 99% of cases when there was a grade 1 ACL+MCL injury and in only 85% of cases in grade 2 or 3 ACL+MCL injury.

- Valgus stress test: The valgus stress test at 30° is used to isolate sMCL injury. In extension, the valgus stress test assesses the POL (open < 8mm), then the MCL (> 8mm), then the ACL.

The AMA sets out 3 grades for valgus stress testing:

- Grade I: Pain, no laxity in extension or at 30°
 - Grade II: Pain, laxity at 30°, no laxity in extension (MCL injury)
 - Grade III: Pain, laxity in extension and at 30° (MCL and POL injury)
- ADER test : PTo assess AMRI, the direct anterior drawer test in 15° of external rotation is performed. The knee is placed in 90° of flexion. Anterior tibial translation increases when external rotation is applied (compared to a neutral rotation). This sign indicates a combined ACL and MCL injury. In this video, Dr Bouguennec offers an explanation of this test [7]

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A combined injury of the dMCL and ACL with no sMCL involvement will not always lead to laxity in valgus, and this external translation-rotation test can therefore prove to be useful for diagnosis.

2. Additional examinations

Additional examinations are essential to confirm the clinical diagnosis and plan surgical management if necessary.

- Radiography: Weight-bearing plain film radiographs (AP, lateral and femoropatellar) are the first investigations to perform. In the acute phase, these are able to detect associated bone injuries (fractures, avulsions) (figure 6) and any soft tissue swelling.



Figure 6 : Stieda fracture = Femoral bony avulsion

In the chronic phase, stress radiographs are also used to measure opening of the joint space under valgus forces (figure 7). Bilateral radiographs must be taken for comparison. An increase exceeding 3 mm in 30° of flexion demonstrates a complete tear of the sMCL, an increase of around 10 mm indicates an sMCL and dMCL injury and exceeding 10 mm is a combined MCL and POL injury, often in conjunction with an injury to one or both cruciate ligaments [8].

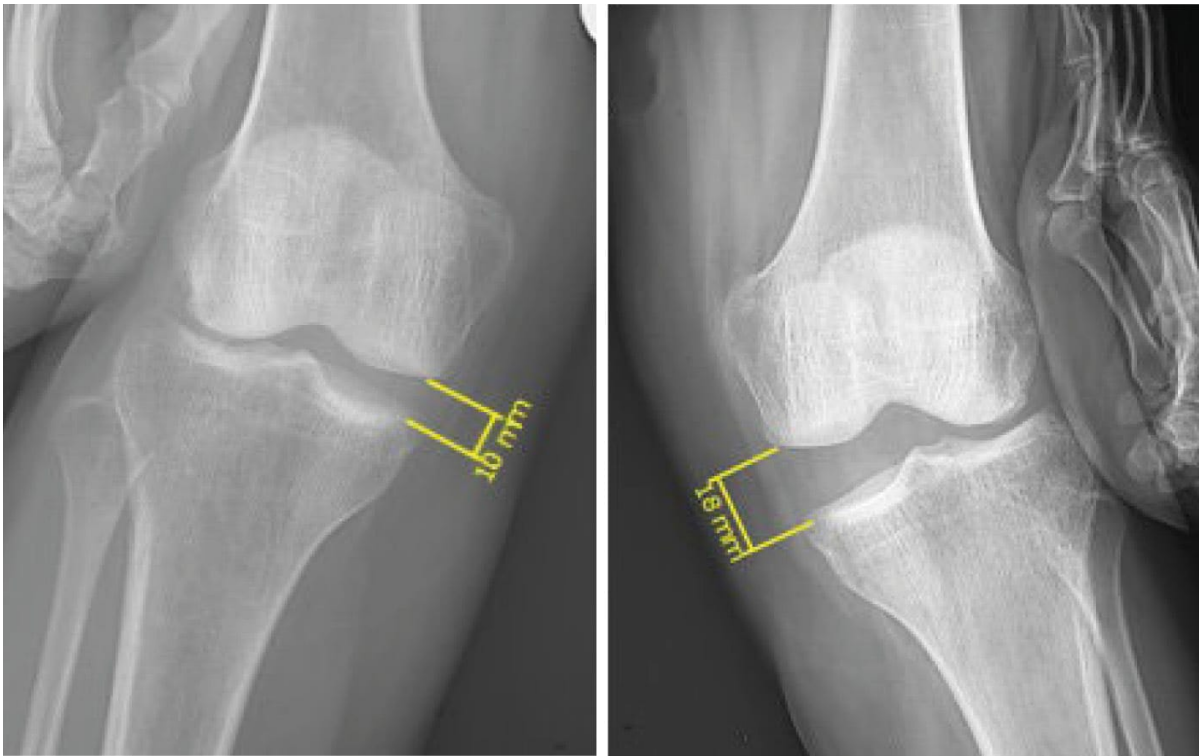


Figure 7 : Left: 10 mm gap meaning probable sMCL and dMCL injury / Right: 18 mm gap meaning probable MCL+ POL injury

Down the line from a trauma, Pellegrini-Stieda disease may also be evaluated, as this is ossification of the MCL at its femoral insertion seen on radiography (Figure 4) in conjunction with chronic pain (Figure 8). The main differential diagnosis is chondrocalcinosis deposits in the medial recess.



Figure 8 : Pellegrini-Stieda disease = ossification of the MCL at its femoral insertion

- Ultrasonography : A musculoskeletal ultrasound scan is very often used for disambiguation, as it can dynamically evaluate the medial ligament structures, and is especially useful in identifying superficial sMCL injury (figure 9). The relevant finding is a hypoechoic and thickened appearance in conjunction with haematoma. This allows a partial tear to be differentiated from a complete tear. It is useful to look for a Stener-like lesion, which is entrapment of the MCL in the joint space. Ultrasound may also be useful to visualise involvement of the medial hamstring tendons. Finally, this modality can also be used to guide injections to treat chronic pain (such as in Pellegrini-Stieda disease).

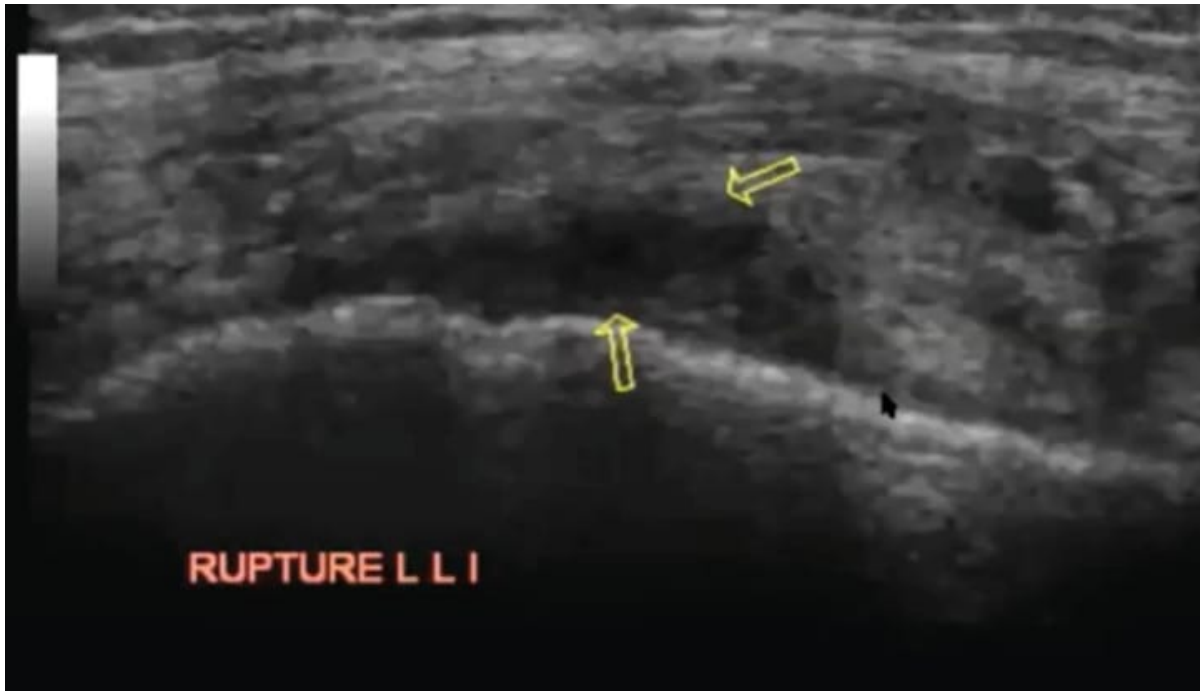


Figure 9 : Ultrasound image of an MCL injury

- MRI : Magnetic resonance imaging (MRI) is the gold standard examination for evaluating MCL and POL injuries. MRI is able to show the precise location of the injury, its severity and whether there is any other intra-articular damage (ACL, PCL, cartilage, menisci, subchondral bone or joint capsule).

Classification once again falls into three grades (Figure 10) but it differs from the AMA clinical classification. There is no real correlation between the two.

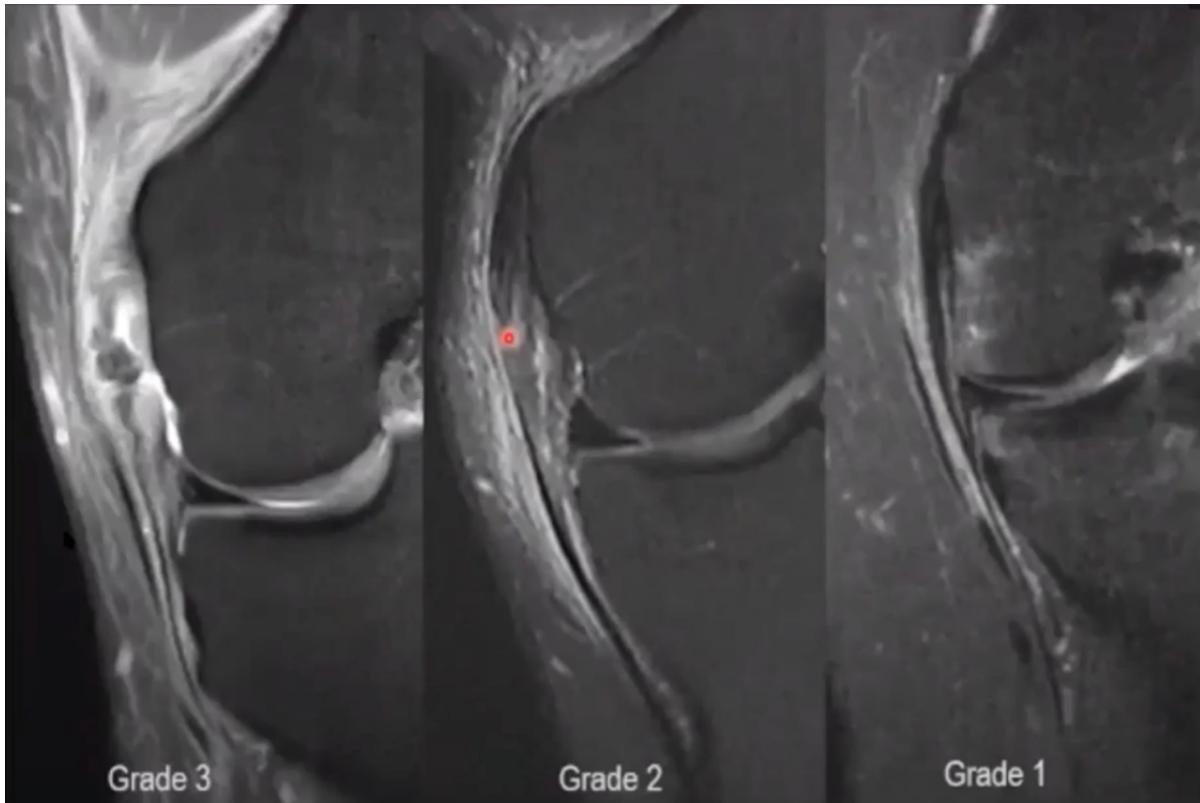


Figure 10 : 3 MRI grades of MCL injury

- Grade I: High signal intensity, oedema around the ligament
- Grade II: High signal intensity within the ligament, thickening, partial disruption of the fibres
- Grade III: Entesis not visible, complete disruption, ligament appears distended, bony avulsion

On the axial images, the point of the posteromedial corner can be seen, including: POL, posteromedial joint capsule, posterior horn of medial meniscus, semimembranosus. If there is an injury, these structures will appear with low signal intensity on all sequences (Figure 11) [9].

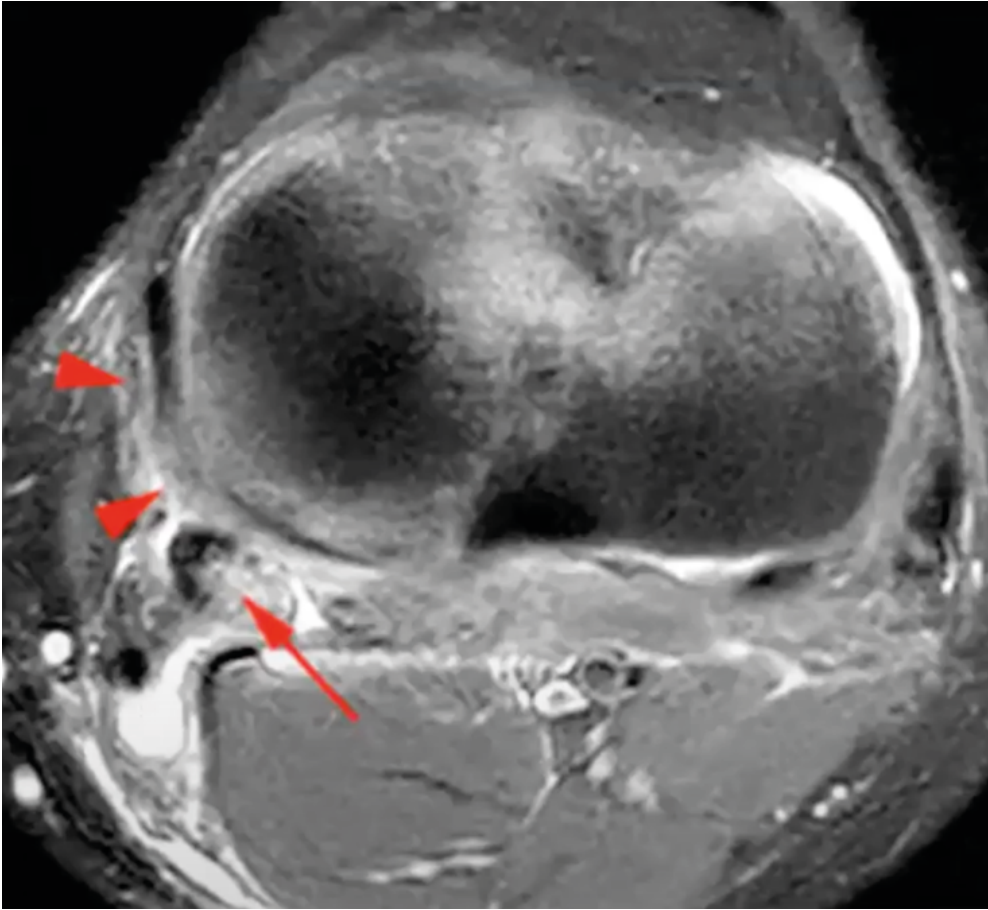


Figure 11 : Axial image showing a POL and semimembranosus injury

Finally, MRI can be used to look for a Stener-like lesion, which is entrapment of MCL between the torn structures at the tibia, which can occur under the hamstrings, within the joint or under the medial meniscus (Figure 12).

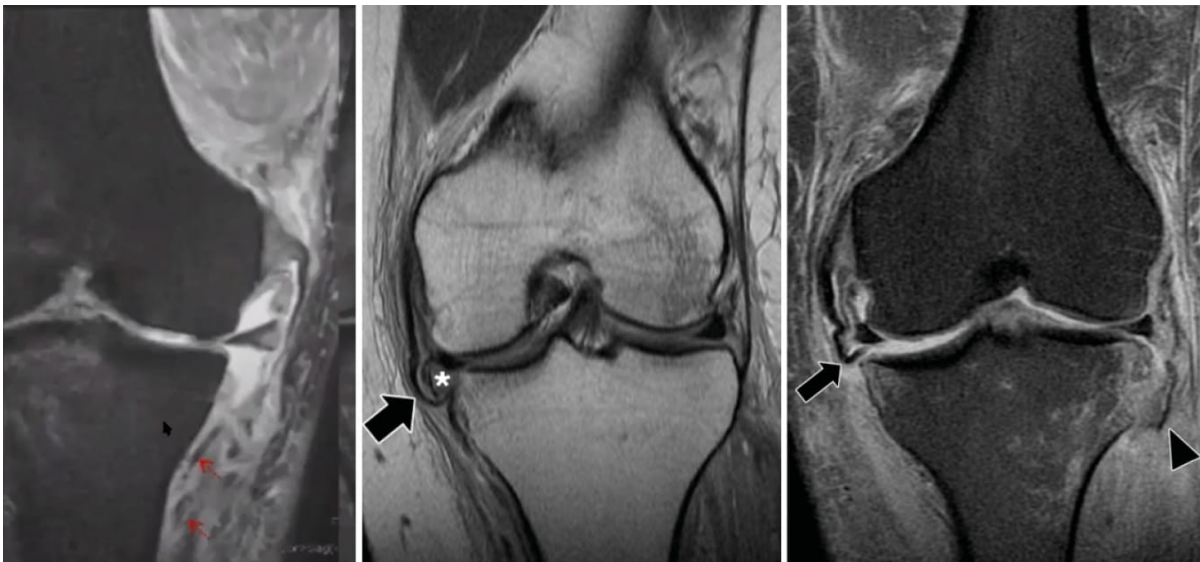


Figure 12 : Stener-like lesion of the MCL

1. Indications

There is no consensus on this topic. However, on the basis of the trends that emerge we can put forward treatment algorithms for these combined ACL and MCL injuries, separating out acute (Figure 13) from chronic cases (Figure 14).

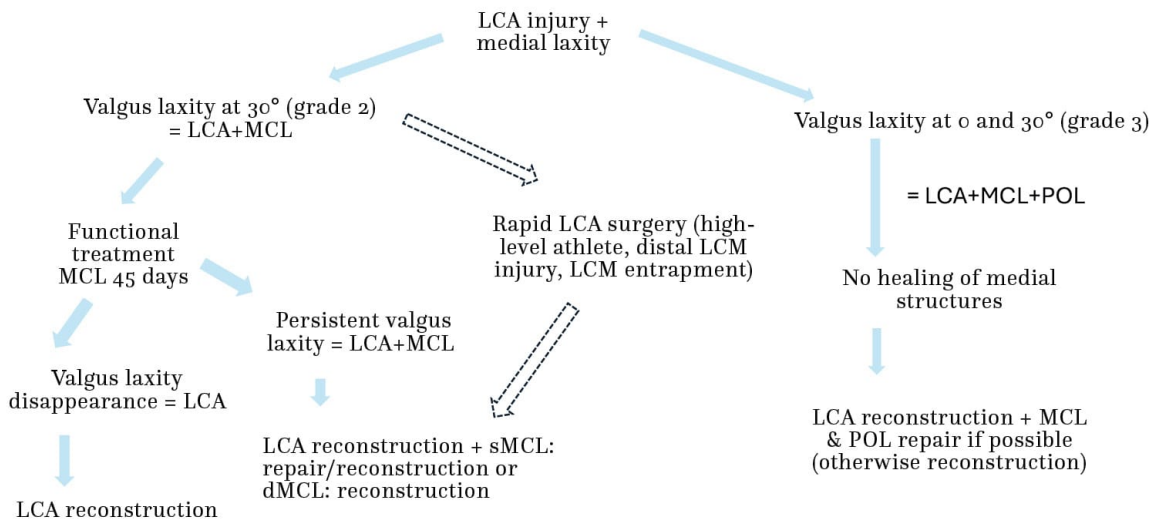


Figure 13 : Algorithm for the management of acute combined medial aspect and ACL injuries

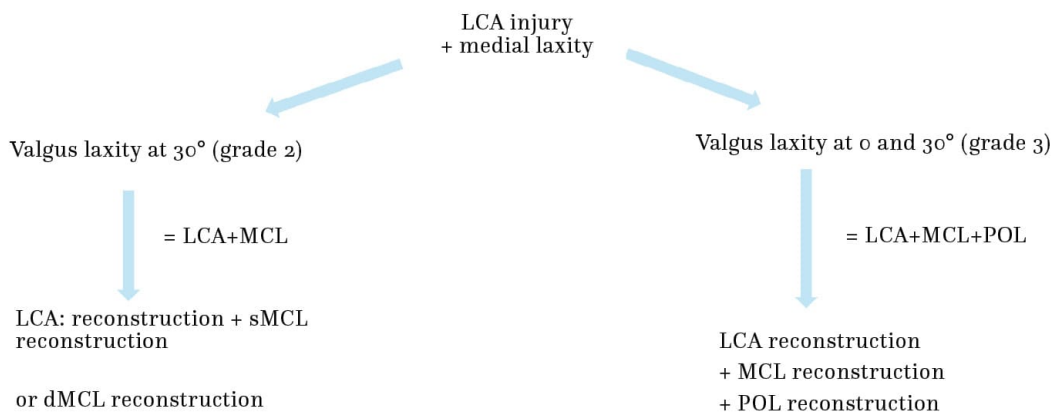


Figure 14 : Algorithm for the management of chronic combined medial aspect and ACL injuries

The treatment indications depend broadly on the grade:

- Grade 1: Pain without medial laxity: no surgical treatment of MCL
- Grade 2: Medial laxity at 30° with no laxity in extension:

If ACL surgery is deferred (stiffness or other reason): non-operative management of MCL

Quick surgery to ACL (for elite athletes, distal MCL injury and entrapment): surgical management of MCL (repair)

- Grade 3: Medial laxity at 30° and laxity in extension: surgical management of MCL (repair and/or reconstruction)

There is currently no consensus on non-surgical management of ACL in the grade 2 cases. Strict immobilisation and restricted weight-bearing should be avoided (risk of stiffness, AMI, etc.) A better choice is a hinged brace for 3 to 6 weeks. Weight-bearing should be permitted.

2. Surgical strategies

2.1 Anatomical requirements

To restore intact knee kinematics, reconstruction surgery must comply with certain rules.

- sMCL : The insertion over the tibia must be 6 cm below the joint line and posterior to the pes anserinus. The graft must be taut and fixed at 30° of flexion.
- dMCL : The femoral bone tunnel must be distal (6 mm) and posterior (5 mm) to the medial epicondyle. The tibial tunnel must be 8 mm below the joint line. The graft must be taut and fixed at 30° of flexion.
- POL : The insertion over the femur must be posterior to the medial epicondyle of the femur. The tibial insertion is over the reflected arm of the semimembranosus tendon. The graft must be taut and fixed at 0° of flexion.

2.2 Biomechanical requirements

In order to comply with the biomechanical requirements, it is important to test the behaviour of the grafts (checking positioning is correct) and to secure the grafts in the right positions (Figure 15).

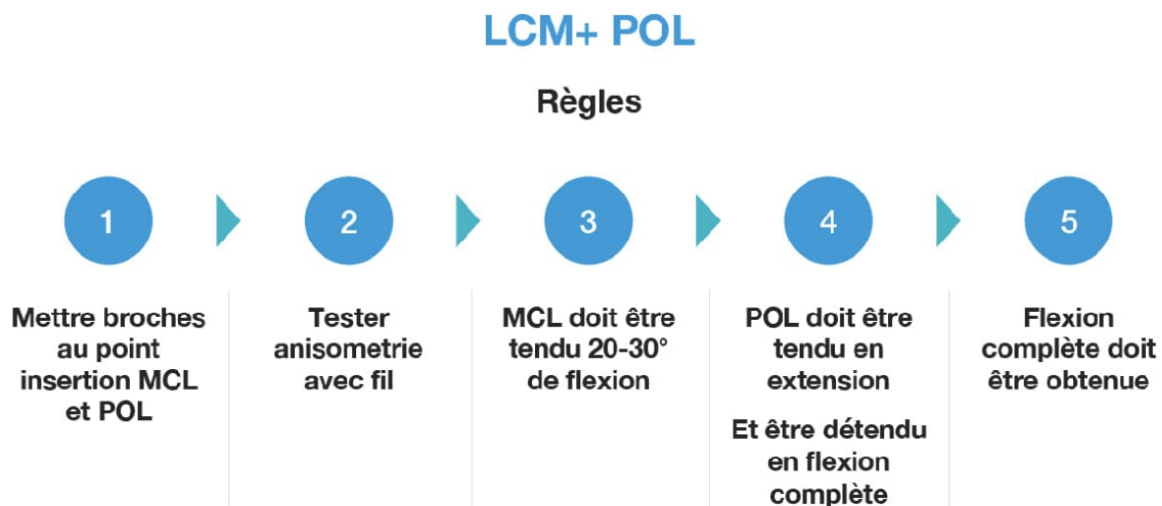


Figure 15 : Surgical sequence to follow to comply with biomechanical requirements

2.3 Surgical techniques

There are numerous medial knee reconstruction techniques, of which, we find the following to be the most useful:

- Isolated anatomic sMCL reconstruction (Figure 16): This technique can be performed using a percutaneous technique with one incision opposite the medial epicondyle and one opposite the pes anserinus, to create the tibial tunnel for the sMCL and for the ACL.

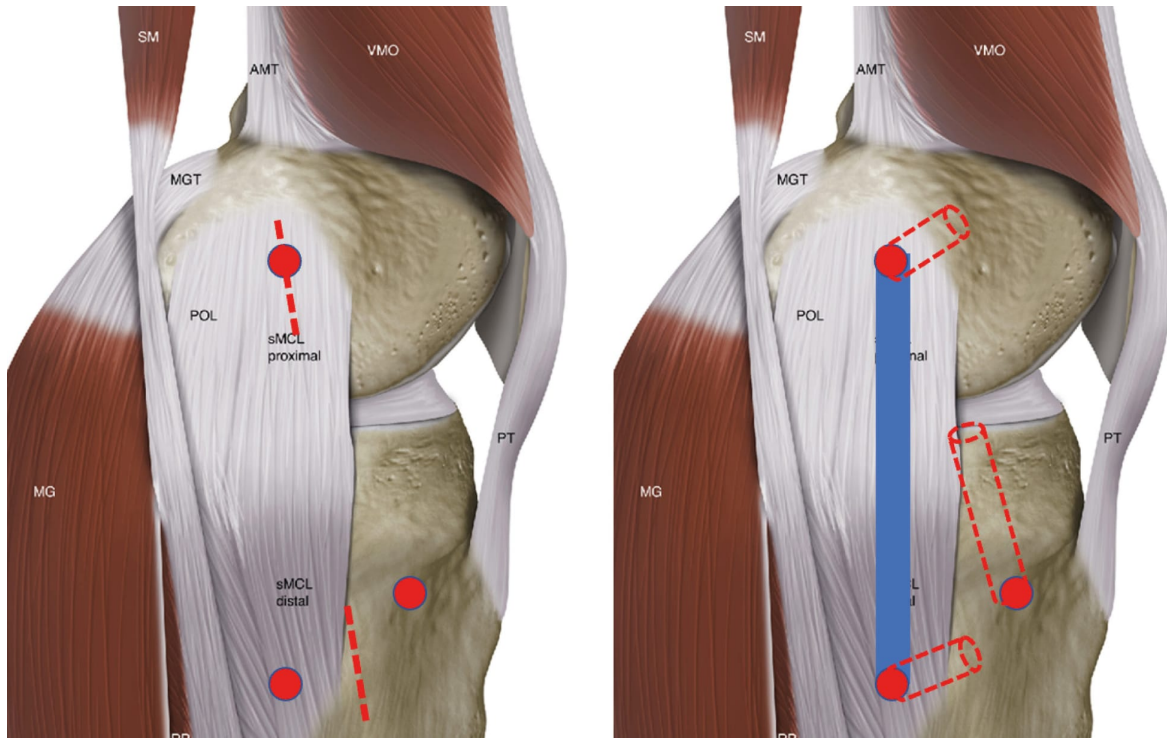


Figure 16 : Percutaneous anatomic reconstruction of the sMCL

- Isolated dMCL reconstruction (Figure 17): Mirror Anterolateral Ligament technique, as described by the team at the Clinique du Sport de Bordeaux [10].

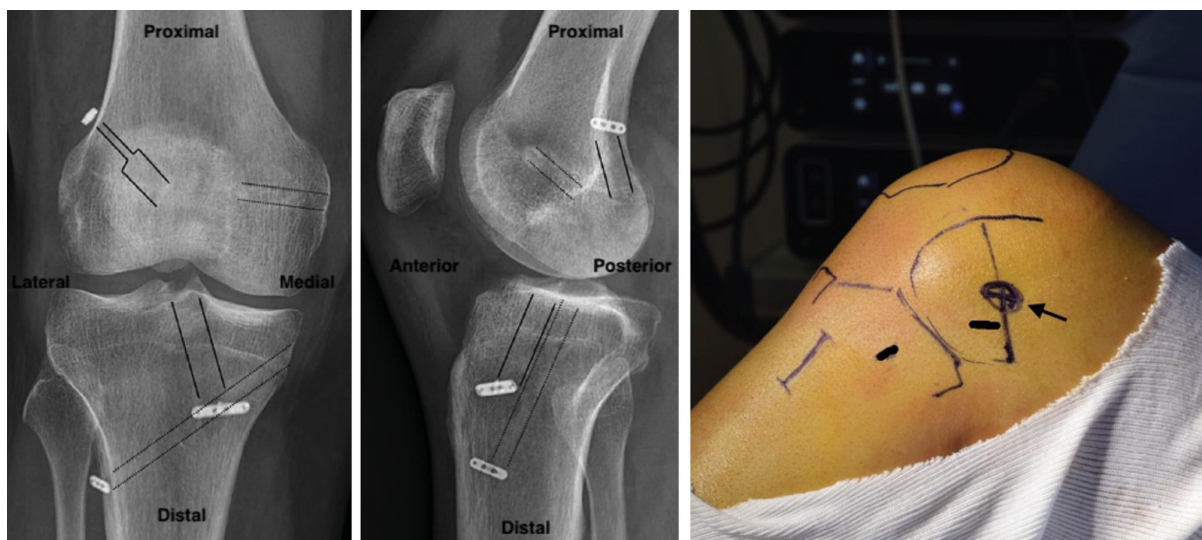


Figure 17 : Isolated dMCL "Mirror ALL" reconstruction technique (courtesy N Graveleau et N Bouguennee)

- Anatomic reconstruction of the MCL and POL (Figure 18): This technique, first described by Laprade, uses two grafts, the sMCL and POL, which are independent with two tibial tunnels and two femoral tunnels. Now this technique can be performed percutaneously. It is preferable to create an anteroposterior tibial tunnel for the POL to avoid impingement with the ACL tibial tunnel [4].

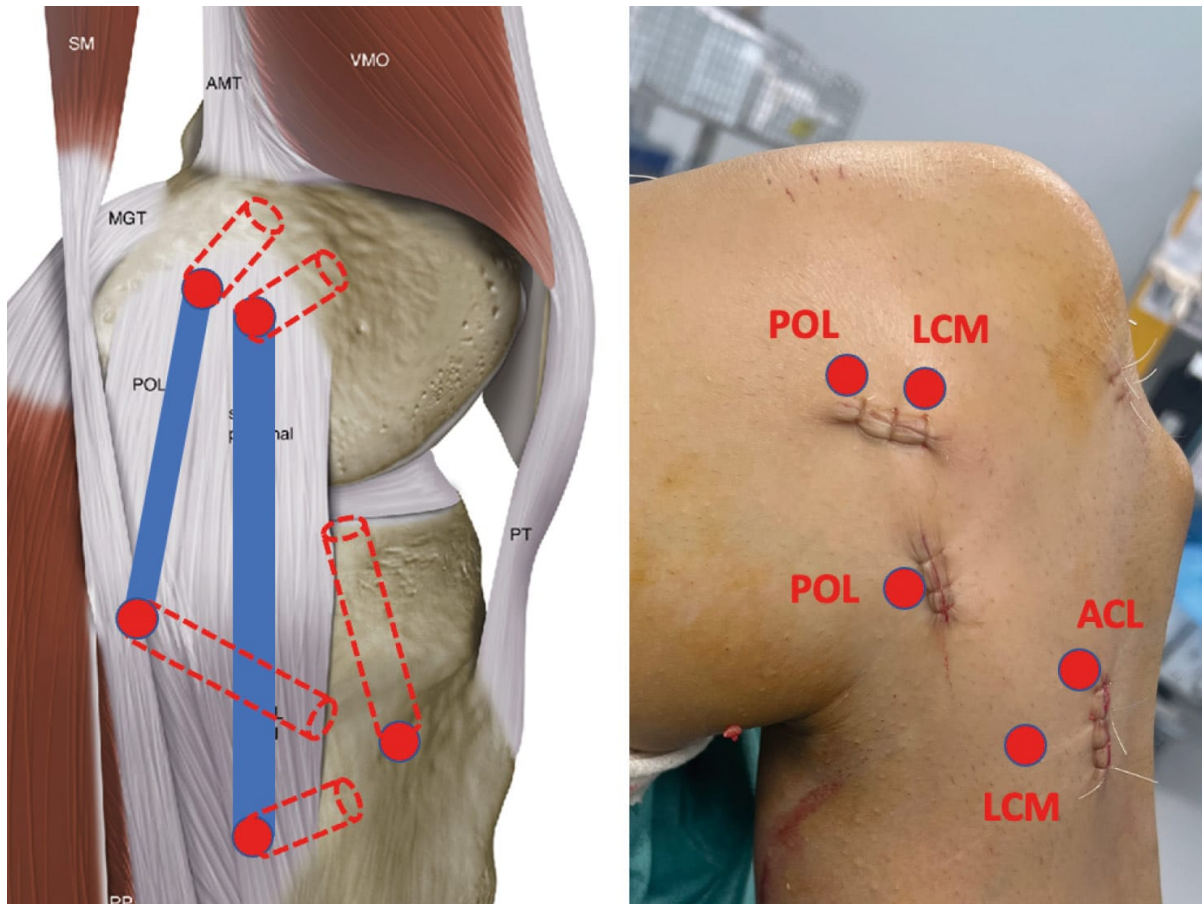


Figure 18 : Anatomic and percutaneous sMCL and POL reconstruction technique

- Non-anatomic reconstruction of the sMCL and POL (Figure 19): In some cases (small size, concomitant PCL injury), it is challenging to create two femoral tunnels as there are significant collision risks. In this case, a single femoral tunnel, shared by both grafts, can be created. It must be positioned posterior to the medial epicondyle of the femur.

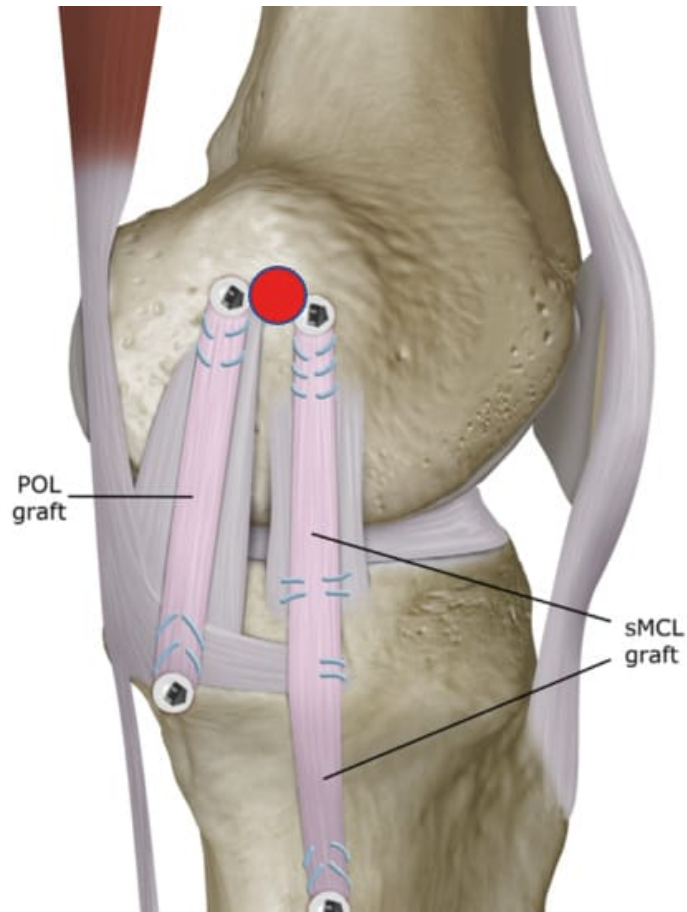


Figure 19 : Non-anatomic sMCL and POL reconstruction technique

- Non-anatomic reconstruction of the sMCL and POL (Figure 20): In this technique described by Lind, one of the medial hamstring tendons is rerouted: moved posteriorly over the tibia then fixed on the femur and then routed back down to the tibia to form the POL.

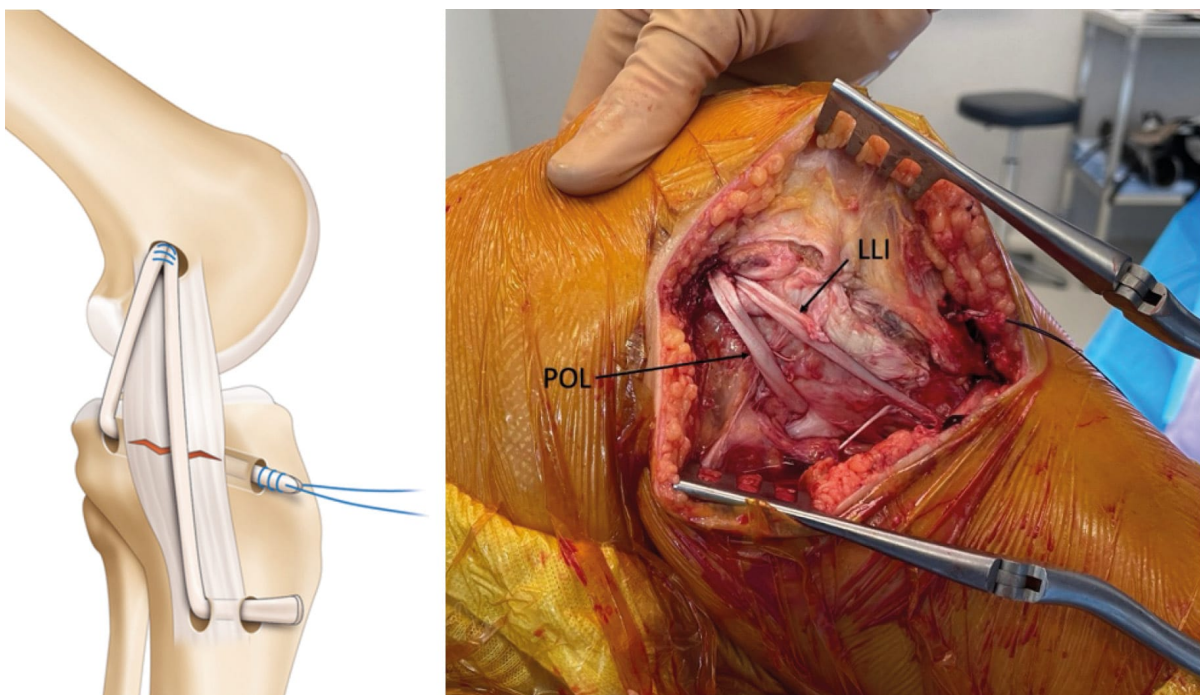


Figure 20 : Non-anatomic sMCL and POL reconstruction technique (courtesy E Cavaignac)

2.4 Choice of graft

There are many possible options. The usual graft for the ACL can be used. In a biomechanical study, we have shown that the medial hamstrings were secondary stabilisers under valgus stress. However, if medial stability is corrected, it is possible to use them. In other words, gracilis and semitendinosus can only be used if the MCL is repaired or reconstructed. If this is not done, it is better to choose a different graft for the ACL.

Allografts are increasingly being used for the medial knee. Tendons such as the posterior or anterior tibial tendons are well suited to use as allografts. If the option of an autologous graft is chosen, the modified Lind technique offers a way to use a hamstring tendon to reconstruct the MCL and POL.

3. Post-operative recovery

Once again, there is no consensus over the strategy. In our experience and based on the results of the SFA prospective multicentre study, mobilisation of the knee can begin immediately. Full weight-bearing is permitted. Better functional results seem to be achieved if a brace is not used, without increasing the risk of a repeat tear. In some cases that are judged to present greater risk, a hinged brace can be prescribed but it should be used for a maximum of 6 weeks. Extension braces should be avoided. The goal is to reduce as far as possible the risk of stiffness in flexion, which is the most common complication in surgery for combined medial knee and ACL injuries.

RESULTS AND COMPLICATIONS

The results of the Société Française d'Arthroscopie (SFA) prospective series in 2023 mean that the efficacy of combined ACL and medial knee reconstructions can be evaluated in a large cohort of patients.

1. Results

In the SFA study, 722 patients were included with an average length of follow-up of 18 months. Of these, 408 patients had combined ACL and MCL injuries, while 314 had isolated ACL injuries. The rate of repeat tears and repeat surgery, scores on functional outcome measures (IKDC, Tegner and SKV) and the time to resuming sport were all assessed. The two groups were comparable except that meniscal damage was more common in the ACL+MCL group, and this may have had a negative impact on the outcome measure scores for this group.

- Repeat tear: MCL injury had no impact.
- Repeat surgery: More common in the grade 2-3 ACL+MCL group (cyclops lesion and stiffness, could be an effect of immobilisation).
- Functional outcomes: Less good in the ACL+MCL group, especially if patients had surgery (this can be explained by this group being the patients that had more severe injuries).
- Resuming sport: The wait was shorter if management was quick.

2. Complications

The main complication found was joint stiffness in flexion, generally due to insufficient physiotherapy or excessive protection of the joint in the early weeks.

CONCLUSION

Combined ACL and medial knee injuries require personalised management. An understanding of the anatomy and biomechanics is indispensable for the management of these injuries. The diagnosis and the treatment strategy are based on the clinical examination (3 grades) and MRI findings (coronal and axial images). For patients with a grade 1 injury (pain without laxity), no immobilisation and no surgery are required. Only the ACL will be reconstructed. Laxity in valgus in flexion (grade 2 = MCL involvement) must be differentiated from laxity in extension (grade 3 = MCL+POL). For grades 2 and 3, the results of the prospective series show that an appropriate and if possible early repair or reconstruction, together with a suitable physiotherapy protocol (weight-bearing and little or no immobilisation), delivers optimal functional recovery in the majority of cases.

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