# Acute Medial and Posteromedial Injury

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Davide Edoardo Bonasia, Roberto Rossi, Federica Rosso, Umberto Cottino, Corrado Bertolo, and Filippo Castoldi

## 3.1 Introduction

Injuries to the medial collateral ligament (MCL) complex of the knee are the most common ligamentous lesions. A correct diagnosis, based on accurate physical examination and classification as well as imaging, is essential in treating these injuries. If correctly treated in the acute setting, these lesions usually do not result in medial chronic knee instability, with no need for more complex reconstruction procedures. A sound knowledge of the anatomy and biomechanics of the MCL complex is essential in achieving good results. The static portion of the MCL complex can be thought of as three linked components: the superficial MCL (sMCL), the deep MCL (dMCL), and the posterior oblique ligament (POL), which blends continuously with the first two. For precise description of the medial anatomy of the knee, the authors refer to the specific chapter of the present textbook. This chapter will review different aspects regarding MCL complex lesions, including injury pattern, clinical examination, classification, imaging, indications, conservative treatment, surgical anatomy, repair techniques, and results.

D.E. Bonasia, MD (✉) • C. Bertolo • F. Castoldi
Department of Orthopaedics and Traumatology, Azienda Ospedaliera Citta' della Salute e della Scienza, Presidio CTO- Maria Adelaide, Via Zuretti 29, Torino 10100, Italy
e-mail: davidebonasia@virgilio.it; corrado.bertolo@gmail.com; filippo.castoldi@unito.it

F. Rosso • U. Cottino
Department of Orthopaedics and Traumatology,
Azienda Ospedaliera Ordine Mauriziano, Largo Turati 62, Torino 10128, Italy
e-mail: federica.rosso@yahoo.it; umberto.cottino@gmail.com

R. Rossi
Department of Orthopaedics and Traumatology,
Mauriziano "Umberto I" Hospital, Largo Turati 62, Torino 10128, Italy
e-mail: rossir@fastwebnet.it

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## 3.2 Injury Pattern

Isolated injuries to the MCL complex primarily occur by two main mechanisms. The most common injury is a direct blow to the outside of the knee with the foot planted, producing direct valgus stress (i.e., in contact sports such as football, soccer, or rugby). Although the order in which the MCL complex structures become damaged is still debated, the sMCL and dMCL are thought to tear before the POL [1].

The second injury pattern involves a valgus stress coupled with tibial external rotation (i.e., in cutting and pivoting sports, such as basketball, soccer, and skiing). With this injury mechanism, it has been postulated that the POL and posteromedial corner are injured first, followed by the deep and superficial MCL. Both injury mechanisms place other knee structures at risk (mostly ACL, PCL, and menisci) [1].

Sims and Jacobson reviewed the charts of 93 knees with operatively treated isolated and combined medial-sided knee injuries and described the associated medial injury patterns. The authors found that the POL was torn in 99 % of the cases, the sMCL in 33 %, the dMCL in 25 %, the semimembranosus tendinous expansions in 70 %, the meniscotibial and meniscofemoral ligaments in 83 %, and the meniscus in 43 %. Associated ACL injuries were found in 73 knees and associated PCL injuries in 2 knees. The POL had a focal lesion in 71 % of the cases (femoral 32 %, interstitial 12 %, and tibial 27 %) and a multifocal lesion in 29 % of the cases. Out of 93 knees, the sMCL had a focal lesion in 27 % of the cases (femoral 11 %, interstitial 1 %, and tibial 15 %) and a multifocal lesion in 6 % of the cases. Meniscal injuries had been recorded in 40 knees (20 peripheral tears, 17 body tears, and 3 tears that involved both the body and periphery) [2].

## 3.3 Classification, Clinical Examination, and Imaging

In the diagnosis of MCL lesions, the authors prefer the Fetto and Marshall classification. This classification divides medial-sided knee injuries into grade 1 (no valgus laxity), grade 2 (valgus laxity at 30° of flexion), and grade 3 (valgus laxity at 0° and 30°) [3]. The stability of the knee is then tested in all planes in order to evaluate anteroposterior, lateral, and rotational instability.

By definition, patients with medial-sided injuries have increased laxity with valgus stress. The examiner applies a valgus stress to the knee at both 0° and 30° of flexion. For isolated sMCL injuries, the greatest joint space opening occurs with the knee in 30° of flexion [4]. Joint space opening with the knee fully extended indicates an injury to the capsule, the POL, or both. Grade III MCL injuries are frequently associated with injury to another ligament (mostly the ACL) [5].

Other physical examination maneuvers combine rotation with various amounts of knee flexion in an attempt to discriminate between MCL and MCL/PMC injuries. One of the most common involves a valgus stress to the knee in 30° of flexion with the foot externally rotated [5]. The presence of anteromedial rotary instability (AMRI) is indicative of PMC injury. AMRI is detected by performing the anterior drawer test with the tibia both in neutral and in external rotation. Increased translation with the tibia in external rotation is indicative of AMRI [6, 7].

Increased external rotation and AMRI indicate injury to the PMC and possibly to the ACL as well.

Weight-bearing radiographs of the knee are obtained in anteroposterior and lateral views. If valgus malalignment is present, a weight-bearing long leg radiograph is obtained. MRI is helpful in diagnosing associated bone and soft tissue injuries (anterior and posterior cruciate ligaments, posterolateral corner, and menisci) as well as determining the location and extent of medial/posteromedial ligamentous injuries. However, it has been shown that MRI tends to overestimate injury to ligamentous structures [8].

## 3.4 Indications

In the acute setting (<3 weeks), the treatment of isolated and combined grade I–II injuries is mostly conservative [9, 10], but significant controversies exist regarding the treatment of isolated and combined grade III lesions [11, 12]. In case of isolated grade III injuries, conservative treatment can be considered with varus or neutral alignment. On the other hand, surgery is indicated in case of severe valgus alignment, bony avulsions, and intra-articular MCL entrapment [13].

In case of combined ACL and grade III MCL injuries, the treatment is controversial. The first option is to conservatively treat the MCL and delay the ACL reconstruction. If medial opening >4 mm compared to contralateral knee is present after ACL reconstruction, MCL reconstruction or capsular procedures should be considered. Otherwise, an early ACL reconstruction can be performed, with subsequent conservative MCL treatment. Lastly, acute MCL repair with concomitant ACL reconstruction can be performed.

The treatment is controversial also in case of combined ACL, PCL, and grade III MCL injuries. The different options include (1) conservative MCL + delayed PCL/ACL reconstruction, (2) acute MCL repair/PCL reconstruction + delayed ACL reconstruction, and (3) acute MCL repair/ACL/PCL reconstruction [13].

## 3.5 Conservative Treatment

When adopting conservative treatment for MCL complex lesions, the authors' preferred protocol is as described by Edson [14].

*Grade I MCL injuries*. Weight bearing as tolerated with crutches if necessary. Active ROM exercises as soon as tolerated. Active strengthening exercises as tolerated. Progress to agility, proprioceptive, and sport-specific drills as tolerated. Return to sports when strength, agility, and proprioception are equal to the uninvolved side [14].

*Grade II MCL injuries*. Long leg brace for ambulation with weight bearing as tolerated with crutches. Brace may be locked in extension for 1–2 weeks depending upon pain, valgus opening, and anatomic alignment. Crutches can be discontinued when patient attains a nonantalgic gait. Active ROM exercises are started immediately. Electrical stimulation to the quadriceps, quad sets, and single leg raise are initiated immediately. Long leg brace is opened at the end of the third week and full weight bearing is encouraged. Severe grade II injuries may require 6 weeks of bracing. Once full ROM and functional strength is attained, proprioceptive and agility drills can be initiated [14].

*Grade III MCL injuries*. Immobilization in long leg brace locked in extension for 3–6 weeks depending on anatomic alignment. Nonweight bearing for 3 weeks in patients with valgus alignment. Toe-touch weight bearing for neutral or varus. Immediate ROM out of the brace two to three times a day for neutral or varus alignment, after 3 weeks for patients with valgus. Strengthening is done throughout the 6-week period in the form of quad sets, single leg raise, and electrical stimulation. Closed chain exercises are initiated at the appropriate time depending upon patient's weight-bearing status [14].

## 3.6 Surgical Anatomy

The anatomy of the medial side of the knee has been extensively described by LaPrade and colleagues (Figs. 3.1 and 3.2) [15]. The structures of the medial side of the knee include (1) bony landmarks (medial epicondyle, adductor tubercle,

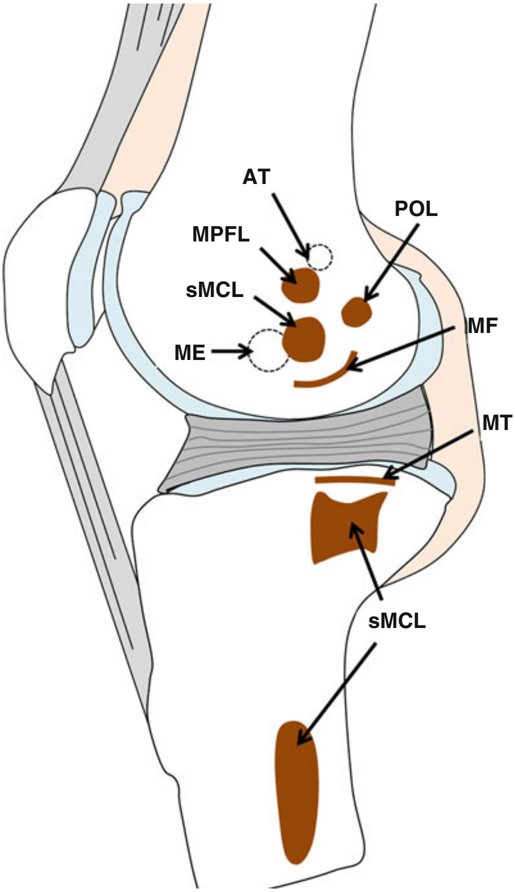


**Fig. 3.1** Medial view of the knee: attachment sites (Redrawn from Bonasia et al. [13]). *AT* adductor tubercle, *ME* medial epicondyle, *sMCL* superficial medial collateral ligament, *MPFL* medial patellofemoral ligament, *POL* posterior oblique ligament, *MF* meniscofemoral ligament, *MT* meniscotibial ligament

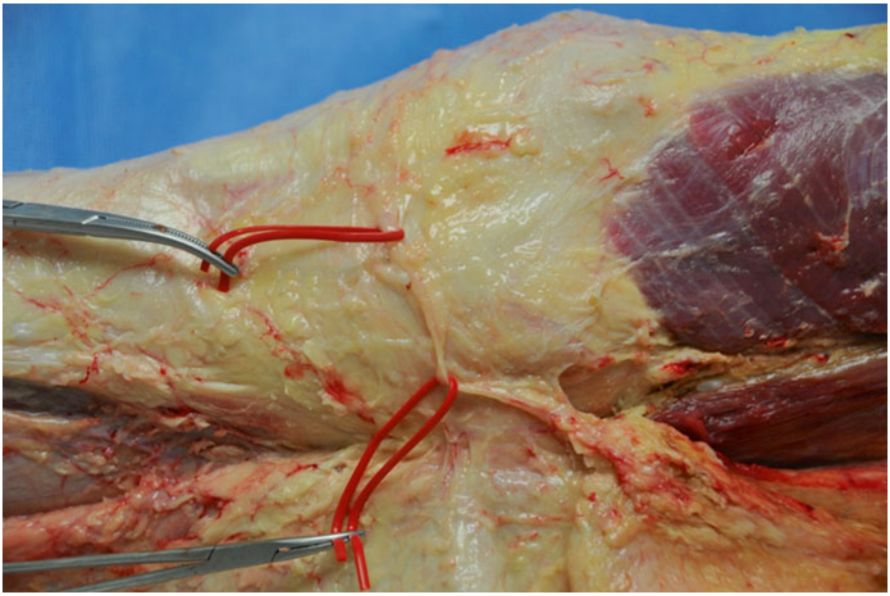

**Fig. 3.2** Saphenous nerve and infrapatellar branch of the saphenous nerve

gastrocnemius tubercle on the femur, medial tibial plateau, medial aspect of the patella), (2) ligaments (superficial medial collateral ligament, deep medial collateral ligament, posterior oblique ligament, medial patellofemoral ligament, posteromedial capsule), and (3) tendons (adductor magnus, medial head of the gastrocnemius, semimembranosus, and pes anserinus).

The sMCL (Figs. 3.1 and 3.3) has 1 femoral and 2 tibial attachments (proximal and distal). The femoral attachment has an oval shape and is located 3.2 mm proximal and 4.8 mm posterior to the medial epicondyle. The proximal tibial attachment is primarily to soft tissues, mainly to the anterior arm of the semimembranosus tendon. The distal tibial attachment of the sMCL is just anterior to the posteromedial crest of the tibia. The average distance of the proximal tibial attachment is 12.2 mm from the tibial joint line. The average distance of the distal tibial attachment is 94.8 mm from the femoral attachment and 61.2 mm from the tibial joint line. The average distance from the distal tibial attachment to proximal tibial attachment is 49.2 mm [15].

The dMCL (Figs. 3.1 and 3.3) is a thickening of the medial joint capsule. The dMCL consists of the meniscofemoral (MF) and meniscotibial (MT) ligaments. The MF ligament is longer than the MT ligament and its attachment is located 15.1 mm posterior and distal to the medial epicondyle. The MT ligament is shorter and thicker and attaches just distal (3.2 mm average) to the cartilage of the medial tibial plateau [15].

The posterior oblique ligament (POL) consists of three fascial attachments (Figs. 3.1 and 3.3): superficial, central (tibial), and capsular. The three attachments

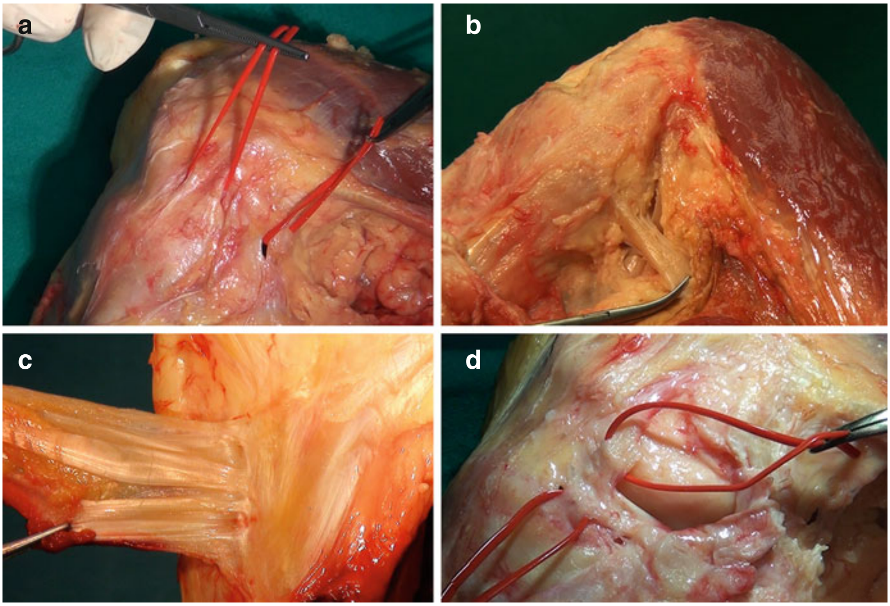


**Fig. 3.3** Anatomy of the medial side of the knee. (**a**) sMCL (*left loop*) and POL (*right loop*). (**b**) Semimembranosus tendon (held by the Kelly clamp). (**c**) Distal sMCL insertion (after detachment of the pes anserinus). (**d**) dMCL with meniscofemoral (proximal loop) and meniscotibial (distal loop) ligaments

course off the distal aspect of the semimembranosus tendon mainly, but also off the medial meniscus, posteromedial tibia, and medial head of the gastrocnemius. On the average, the POL attaches on the femur 7.7 mm distal and 6.4 mm posterior to the adductor tubercle and 1.4 mm distal and 2.9 mm anterior to the gastrocnemius tubercle [15].

## 3.7 Repair Technique

Examination under anesthesia is performed to completely assess the injury. Arthroscopy can be used to rule out any other associated lesions and determine the site of the dMCL injury. In the acute setting, arthroscopy should be performed quickly and with gravity inflow, to minimize fluid extravasation. A hockey stick (or longitudinal) incision is made from the medial proximal tibia to the medial femoral epicondyle, curving posteriorly in line with the intermuscular septum. For isolated distal or proximal detachment repair, a more limited approach can be used. In the case of combined treatment of acute complete MCL tear and an ACL tear, exposure of the MCL is easier if approached through a separate medial incision as opposed to extending the tibial incision for the ACL reconstruction. Attention should be paid to preserve the saphenous nerve (Fig. 3.2). The crural and sartorial

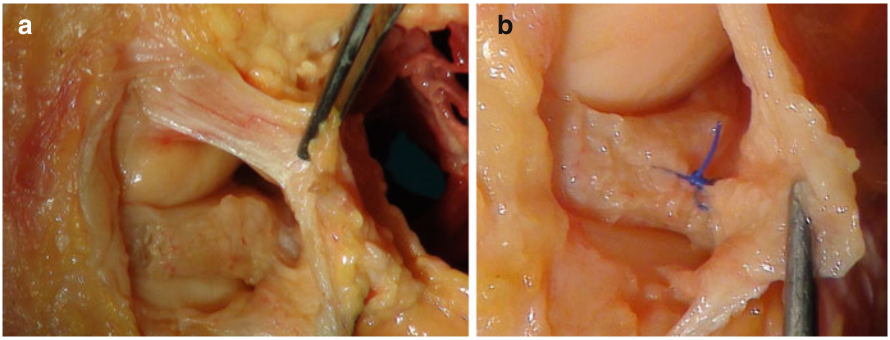


**Fig. 3.4** (**a**) Capsular detachment of the medial meniscus. (**b**) Repair of the capsular detachment with an open technique

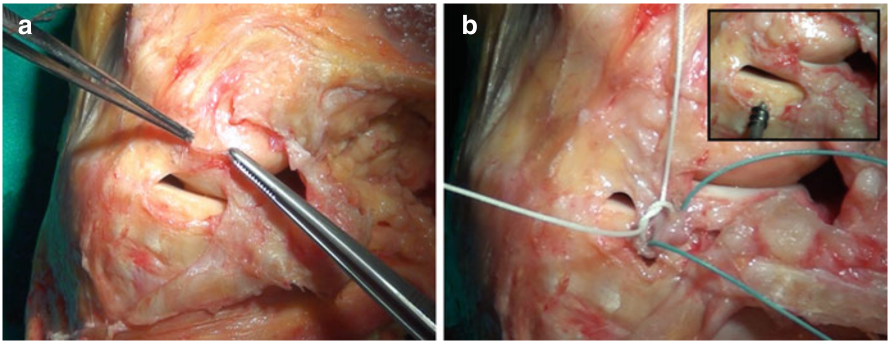


**Fig. 3.5** Repair technique. (**a**, **b**) A meniscotibial ligament tear repaired with suture anchor fixation

fascia is incised longitudinally. Hematoma is removed. The injured structures are then identified [16].

The injured structures are identified and should be repaired from the deepest structure outward. A peripheral tear of the medial meniscus is commonly seen and repaired with an open technique (Fig. 3.4) [16]. A meniscofemoral ligament tear can be directly repaired using sutures alone or suture anchors (Fig. 3.5). Suture anchor fixation is preferred for meniscotibial ligament tear. If injured, the POL is repaired by direct suture back to the femur. Repair of the deep structures is completed with the knee held in varus and full extension [16].

Femoral avulsion of the sMCL (Fig. 3.6) leaves the best tissue for repair using suture anchors, staples, or a screw/washer. However, repair in this location is associated with postoperative stiffness, more than in other locations [17]. This is due to the great importance of the femoral isometric point of the sMCL. It is difficult to attach the sMCL back to the femoral isometric point, due to soft tissue retraction. Acute complete avulsions off of the tibia can be repaired, using either suture anchors or staples [16].

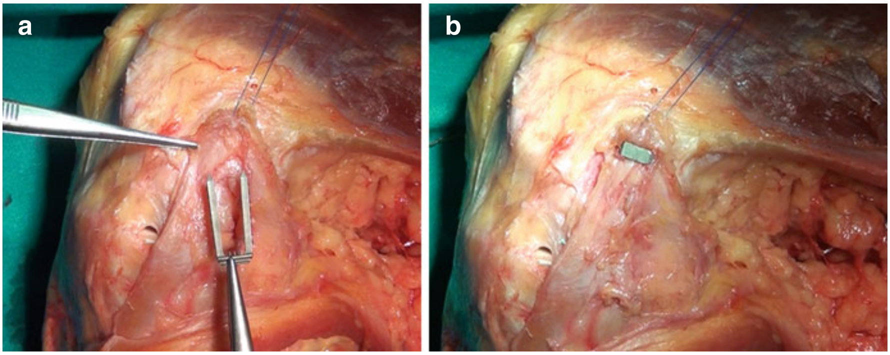


**Fig. 3.6** Repair technique. (**a**, **b**) Femoral avulsion of the sMCL repaired using Richard's staples

The semimembranosus portion of the POL can be repaired with interrupted absorbable sutures and sutured to the posterior border of the MCL in a pants-over-vest fashion. Occasionally, mid-substance and tibial-sided injuries require augmentation, due to the poor soft tissue quality. The sMCL is fixed at 30° of knee flexion [16]. Finally, the tourniquet is deflated and inspection and control of potential excessive bleeding from the inferior medial geniculate artery and its branches is performed. A compressive dressing is applied postoperatively.

Postoperatively, the patient is kept in a hinged knee brace with protected weight bearing. Passive range of motion from 0 to 90° is begun immediately. Hyperextension and flexion over 90° should be avoided during the first 2 weeks. Isometric and closed kinetic chain strengthening are allowed immediately. Full range of motion is allowed 2 weeks after surgery, and full weight bearing is allowed 6 weeks after surgery. Return to sports is generally allowed 6 months after surgery.

## 3.8 Results

Good results have been reported for the conservative treatment of grade I and II MCL complex tears [18, 19].

Several authors reported good results after conservative management of isolated grade III medial-sided knee injuries [3, 20–23]. As a consequence, many orthopedic surgeons initially treat isolated MCL complex injuries nonoperatively regardless of the grade.

Indelicato prospectively evaluated the results of conservative treatment (20 knees) and primary repair (16 knees) in 36 patients with isolated grade III MCL complex injuries [24]. The percentage of patients with good to excellent stability after treatment was higher in the operative group (94 % vs. 85 %). However, no functional significance was found between the two groups in combined objective-subjective scoring. Patients treated nonoperatively started range of motion sooner and completed the rehabilitation program significantly faster. Notably, no MCL complex was considered normal after treatment in either group, nor did it ever provide the same firmness as the uninjured side.

In 1983, Hughston and Barrett [25] reported the results of acute MCL complex repair in 89 patients with anteromedial instability (2+ or more). With an average follow-up of 7.8 years, 94 % of the patients returned to preinjury level of performance.

In 1994, Hughston [26] reported the results of acute MCL complex repair in 40 patients with anteromedial instability (2+ or more), at an average 20-year follow-up. Ninety-three percent of the patients had good results and only a 7 % rate of failure was reported.

**Conclusions**

Grade I and II MCL complex lesions can be successfully managed with conservative treatment.

Although controversies still exist regarding the correct treatment for grade III MCL complex lesions, the treatment should be based on different factors, including patient's age and activity level, lower limb alignment, and concomitant lesions to other structures. Therefore, the treatment should be tailored on each specific case.

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