Tears of the medial collateral ligament (MCL) are the most common knee ligament injury. Incomplete tears (grade I, II) and isolated tears (grade III) of the MCL without valgus instability can be treated without surgery, with early functional rehabilitation. Failure of non-surgical treatment can result in debilitating, persistent medial instability, secondary dysfunction of the anterior cruciate ligament, weakness, and osteoarthritis.

Reconstruction or repair of the MCL is a relatively uncommon procedure, as non-surgical treatment is often successful at returning patients to their prior level of function. Acute repair is indicated in isolated grade III tears with severe valgus alignment, MCL entrapment over pes anserinus, or intra-articular or bony avulsion. The indication for primary repair is based on the resulting quality of the native ligament and the time since the injury. Primary repair of the MCL is usually performed within 7 to 10 days after the injury.

Augmentation repair for the superficial MCL (sMCL) is a surgical technique that can be used when the resulting quality of the native ligament makes primary repair impossible.

Reconstruction is indicated when MCL injuries fail to heal in neutral or varus alignment. Reconstruction might be advisable to correct chronic instability. Chronic, medially sided knee injuries with valgus misalignment should be treated with a two-stage approach. A distal femoral osteotomy should be performed first, followed by reconstruction of the medial knee structures.

Keywords: current management; ligament reconstruction; MCL

Introduction

Understanding the anatomy of the medial side of the knee is essential for a correct diagnosis and treatment of isolated medial collateral ligament (MCL) tears. Conservative treatment of these lesions usually provides good results, even for individuals with high physical demands. However, surgical treatment is necessary in cases of severe medial or multi-ligament injury to prevent chronic instability and posttraumatic arthritis.

Epidemiology

MCL is the most common knee injury in high school, collegiate, and professional football. The annual incidence of MCL injuries among high school football players is 24.2 per 100,000 athletes. Nearly 78% of patients who sustained a grade III MCL injury had an injury to another associated structure. Of those additional injuries, 95% involved the anterior cruciate ligament (ACL).

Relevant anatomy and biomechanics

LaPrade et al have extensively described the anatomy and biomechanics of the medial side of the knee. It is important for physicians to have a good knowledge of the three bony prominences on the femur (adductor tubercle, medial epicondyle, and gastrocnemius tubercle) and the four tendons on the medial side of the knee (adductor magnus, medial head of the gastrocnemius, semimembranosus, and pes anserinus). The three medial ligaments are described below.

Superficial medial collateral ligament (tibial collateral ligament)

The superficial medial collateral ligament (sMCL) is the more extensive anatomical structure of the medial side of the knee. It has a barbell configuration, a single point of femoral insertion, and two distal tibial insertions. In quantitative anatomical studies, LaPrade et al reported that the femoral insertion has an oval shape and is on average 3.2 mm (range, 1.6 to 5.2 mm) proximal and 4.8 mm (range, 2.5 to 6.3 mm) posterior to the medial epicondyle. In the distal course, the tibial insertion has a
first proximal tibial insertion to soft tissue closely related to the anterior part of the semimembranosus tendon and is approximately 12.2 mm distal to the joint line. The proximal tibial insertion does not present a direct insertion to bone. There are no relationships between the superficial fascicle of the sMCL and the deep fascicle or any bursa between them. The distal tibial insertion of the sMCL is extensive and on average 61.2 mm distal to the joint line. The distal insertion is located just anterior to the posteromedial crest of the tibia and is closely related to the bursa of pes tendons.

These two distal insertions are important references because they have different biomechanical properties. The main stabilizer against valgus stress at all degrees of knee flexion is the sMCL in its proximal tibial insertion, while its distal insertion is mainly responsible for stability in external rotation to 30° and 60° of knee flexion and internal rotation. The authors therefore recommend sMCL reconstruction in its two distal tibial insertions.

Deep medial collateral ligament (mid-third medial capsular ligament)

The deep medial collateral ligament (dMCL) is closely related to the joint capsule below the sMCL. The course of the dMCL is practically parallel to the course of the sMCL. The dMCL presents two components: the meniscofemoral and the meniscotibial ligaments. The first has its femoral insertion immediately caudal to the insertion of the sMCL in the femur, approximately 15.7 mm proximal to the femoral joint line. The second is shorter and thicker, and its insertion is on average 3.2 mm distal to the tibial joint line and 9 mm proximal to the proximal insertion of the sMCL.

Both the meniscofemoral and meniscotibial fascicles collaborate in stabilizing the valgus with the proximal sMCL. The fascicles also help control internal rotation (meniscofemoral at 20°, 60° and 90° and meniscotibial at 30° and 90°) and external rotation (meniscofemoral at 30° and 90°).

Posterior oblique ligament

The posterior oblique ligament (POL) is anatomically and functionally distinct from the sMCL. The POL is a distal fibrous expansion of the semimembranosus tendon, which merges and reinforces the capsule. The POL has three distinct arms: superficial, capsular and central. The central arm is the thickest and largest of the three arms and has a posterior oblique direction, with connections to the meniscofemoral and meniscotibial ligaments, as well as the medial part of the meniscal posterior horn. On average, the POL is inserted in the femur 7.7 mm (range, 6.1 to 9.8 mm) distal and 6.4 mm (range, 4.5 to 10.6 mm) posterior to the adductor tubercle and 1.4 mm (range, 0.8 to 2.1 mm) distal and 2.9 mm (range, 2.1 to 4.1 mm) anterior to the third osseous prominence over the medial part of the knee (the gastrocnemius tubercle). The distal attachment of the POL is adjacent to the semimembranosus tendon and has an additional attachment to the medial meniscus. The POL is a primary restraint to internal rotation and a secondary restraint to valgus deformity between 0° and 30° of knee flexion.

Diagnosis of medial collateral ligament injuries

Patient history

Isolated MCL injuries occur with a valgus moment across a flexed knee and can occur in a contact or non-contact situation. Rotational mechanisms more commonly result in multiple ligament injuries.

Physical examination

The most notable clinical findings are ecchymosis and painful swelling over the medial joint line. The application of valgus stress in both full extension and at 20° to 30° of knee flexion (Fig. 1) makes it possible to compare it with the uninjured knee and thereby evaluate the compartment gapping. The Fetto and Marshall classification divides medial-sided knee injuries into grade I (no valgus laxity), grade II (valgus laxity at 30° of flexion), and grade III (valgus laxity at 0° and 30°).

As mentioned, valgus instability at 30° of flexion (when the posteromedial capsule is slackened) is suggestive of a tear in the sMCL. With valgus instability at full extension, both the sMCL and the posteromedial capsule are likely to be torn. The anteromedial drawer test is performed with 90° of knee flexion and the foot at 10° to 15° of external rotation. This test determines whether the injury primarily affects the sMCL or the POL and dMCL. Standard cruciate examination and evaluation of the lateral structures should always be performed, given that Fetto and Marshall found an 80% incidence rate of combined ligament injuries with grade III MCL tears.

Imaging studies

Plain radiographs

All patients should undergo antero-posterior and lateral plain radiographs. Bony avulsions of the medial structures are rare. The so-called Pellegrini-Stieda syndrome is diagnosed with antero-posterior plain radiographs and consists of a calcification of the femoral attachment of the MCL caused by a chronic tear.

Fluoroscopy

Valgus stress radiographs can also be useful for a more quantitative measure of medial compartment gapping. A comparison with the normal contralateral knee can quantify the amount of medial compartment gapping from the...
tibial to femoral surfaces. Stress radiographs can be manually performed or can employ a Telos device (Fig. 2). A complete medial knee injury with both cruciate ligaments tears creates gaps of 21.6 mm and 27.6 mm at 0º and 20º, respectively (Table 1).

**Magnetic resonance imaging**
Magnetic resonance imaging (MRI) is useful for confirming the clinical examination and evaluating the location (femoral vs. tibial vs. midsubstance), accompanying lesions (medial meniscus and cruciate ligaments), and the degree of injury. The MRI classification defines three grades: grade I indicates an intact ligament with the presence of periligamentous oedema, grade II indicates a partial tear with surrounding oedema, and grade III indicates a complete tear of the ligament. There have been studies on the sMCL tibial side avulsion classification. The sMCL tibial side avulsion revealed the characteristic waving of the sMCL midsubstance portion on MRI images, which Taketomi et al called the ‘wave sign’⁷. The sMCL tibial avulsions were classified into three types depending on the location of the ruptured end with respect to the pes anserinus tendons: type 1, the sMCL was detached from the original tibial insertion, and the ruptured end was identified beneath the pes anserinus tendons; type 2, the sMCL was located over or above the pes anserinus tendons (the Stener-like lesion); and type 3, the sMCL was entrapped in the medial knee joint space (Fig. 3).⁷ Miller et al reported that 29 patients (45%) with an isolated medial injury had associated bone bruises, which were predominantly located on the lateral tibial plateau or the lateral femoral condyle. The lesions completely resolved 2 to 4 months after the injury.⁸

**Arthroscopy**
Medial compartment gapping can be confirmed during arthroscopic examination of the knee under valgus load and at 20º of flexion, the so-called ‘medial drive-through’ test. The arthroscopic finding is an excessive opening (greater than 1 cm) of the medial femoral condyle and tibial plateau. Arthroscopy can help determine the site of the deep MCL injury. The meniscus will typically remain in close proximity to the uninjured side, while gapping as well as other associated injuries will occur at the injured side (Fig. 4).

**Treatment**

**Non-surgical treatment**
Medial-sided injuries can often be managed non-surgically. It is generally accepted that incomplete tears (grades I and II) and isolated tears (grade III) without valgus instability can be treated non-surgically with early functional rehabilitation.⁹ Failure of non-surgical treatment can result in debilitating, persistent medial instability, secondary anterior cruciate ligament (ACL) dysfunction, weakness, and osteoarthritis.¹⁰ In a review by Varelas et al, the most common surgical indications were patients with chronic instability who had failed non-surgical treatment or who had multi-ligament knee injuries.¹¹

**Operative treatment**
The operative treatment of isolated medial knee injuries should consider the following four factors (level of evidence III at best):¹²

1) Length of time since the injury: Acute is considered < 3 weeks and chronic > 6 weeks.
2) Alignment: valgus knees with grade III medial injury would likely benefit from acute operative intervention, because these knees do not tolerate valgus laxity well.
3) The presence of bony avulsions identified on x-ray.
4) Tibial-sided MCL injuries with entrapment of the ligament in the medial knee joint space and/or communication with the synovial fluid from the joint or displaced avulsions over the pes anserinus tendons (Stener-like lesion).

The treatment of combined grade III MCL and ACL is controversial. A number of authors have described an algorithm that includes a short period of rest and oedema control followed by physical therapy and ACL reconstruction 5 to 7 weeks after injury. Alternatively, early ACL reconstruction can be performed with conservative management of the MCL. The third option is a combined early ACL reconstruction with an acute MCL repair (Fig. 5).

Treatment of MCL injuries associated with bicruciate injuries, however, is less well defined. A number of authors have advocated delayed cruciate reconstruction while the medial structures are protected with a brace and allowed to heal. Other authors recommend acute repairs or reconstruction of medial structures, although a higher risk of arthrofibrosis has been reported. A systematic review reported an absence of sufficient studies to allow formulation of evidence-based recommendations for the treatment of MCL injuries in the multiligament injury population.

### Table 1. Radiographic stress classification

| Gapping at 20° of flexion | Injury |
|---------------------------|--------|
| < 3.2 mm                  | No injury or grade I, II injury |
| 3.2 to 9.8 mm             | Isolated grade III sMCL injury |
| > 9.8 mm                  | Complete medial knee injury |
| > 27.6 mm                 | Complete medial knee injury with both cruciate ligament tears |

*Note. sMCL, superficial medial collateral ligament.*

Fig. 3 (A) MRI findings: the typical bunched medial collateral ligament (MCL) fibres are obvious on the T2-weighted MR image (arrow). Countercoup oedema is evident in the lateral tibial plateau. (B) Anatomical findings: the fibres are short and abruptly jump over the semitendinosus tendon. The femoral insertion site remained intact. Note. sMCL, superficial MCL.

Fig. 4 Arthroscopic examination demonstrating the medial compartment ‘drive-through’ sign in a patient with a medial knee injury: the medial femoral condyle and the tibial plateau show excessive joint opening, and a tibial-sided MCL injury (meniscus stays with the femur) can also be observed.

When treating multi-ligament injuries, cruciate reconstructions need to be performed first before approaching the MCL.

### Repair

*Acute repair is indicated in isolated grade III tears with severe valgus alignment, MCL entrapment over pes anserinus, or intra-articular or bony avulsion. The treatment of grade III MCL tears and combined ACL injuries is controversial.*

#### Primary repair

The indication for primary repair is based on the resulting quality of the native ligament and the length of time since the injury. Primary repair of the MCL is usually performed within 7 to 10 days of the injury. Torn structures can be repaired with sutures alone, or sutures plus suture anchors.

A) Bony avulsion of MCL: Femoral avulsion of the sMCL leaves the best tissue for repair using suture anchors, staples, or a screw and washer. However, repair in this location is associated with postoperative stiffness more than in other locations because of capsular adhesions and dysfunction of the extensor mechanism. Tibial avulsions can be reattached using suture anchors or staples. ‘Peel-off’
injuries of the POL can be addressed with suture-anchor fixation. Large implants should be avoided, and the fixation should be stable enough to allow early range of movement (ROM) exercises. Intrasubstance injuries require augmentation or allograft reconstruction due to the poor quality of the remaining tendon.14

B) MCL entrapment of its distal part under the medial meniscus or proximally and superficially to the pes anserinus tendons (which Corten et al. called a Stener-like lesion).15 In general, Stener-like lesions are an indication for surgical treatment, because the sartorius aponeurosis becomes interposed between the ruptured end of the ligament and its insertion, precluding anatomic healing. During surgery, the displaced MCL fibres must be relocated and reattached to the tibial insertion site (Fig. 6).15

Augmentation repair

Augmentation repair for the sMCL is a surgical technique that can be used when the resulting quality of the native ligament impedes the primary repair. The indications are similar to reconstruction. The original augmentation repair of the MCL was described in 1952 by Bosworth, who performed a release of the semitendinosus tendon from its proximal musculotendinous attachment, preserving the distal semitendinosus tendon insertion and proximally reattaching the graft at the femoral sMCL.16 The Bosworth technique has been modified, releasing the semitendinosus tendon from its proximal insertion, looping it around the epicondyle, and reattaching it distally, essentially creating a non-anatomical double-bundle reconstruction. Kim et al. fixed the free end of the semitendinosus under the anterior arm of the semimembranosus tendon.17 Stannard fixed the free end of the semitendinosus to the intact attachment of the semimembranosus (Fig. 7).18 Other augmentation repair techniques can be performed with an internal brace. An internal brace consists of combining a high-strength tape suture and knotless bone anchors to bridge the injury, allowing healing and early movement.19 Gilmer et al. demonstrated in a cadaver study that internal bracing is biomechanically superior to repair alone and is similar to allograft reconstruction for the treatment of medial knee injuries.20

Reconstruction

Reconstruction (Fig. 8) is indicated when MCL injuries fail to heal in neutral or varus alignment. Reconstruction could be advisable for correcting chronic instability. Chronic, medial-sided knee injuries with valgus misalignment
should be treated with a two-stage approach. A distal femoral osteotomy should be performed first, followed by reconstruction of the medial knee structures. Reconstruction is also indicated to prevent valgus overload on a reconstructed ACL (Fig. 9). Varelas et al, in a systematic review of 10 studies and 275 knees with MCL reconstruction, reported that only 46 knees were isolated MCL reconstructions and 229 were combined reconstructions (ACL, PCL, and/or posterolateral corner).\(^\text{11}\)

**Single-bundle anatomical (isolated sMCL reconstructions)**

Preserving the insertion of a semitendinosus autograft for augmentation repair for the sMCL has limitations. The graft does not reconstruct the course of the native MCL ligament (too anterior on the tibia). Grafts placed anterior to the sMCL insertion can limit knee flexion and cause loss of valgus stability. Modern reconstruction techniques have also been described using free tendon grafts. The advantages of these techniques are that they avoid incisions across the medial side of the knee and use two small skin incisions to minimize the risk of surgical overexposure. The advantages of medial stability reconstruction with a single bundle rather than with a double bundle are an easier technique, reduced surgical time and less hardware required.

Yoshiya et al employed the autologous semitendinosus and gracilis tendons to anatomically reconstruct the anterior longitudinal component of the sMCL. The graft was fixed proximally with an interference screw and distally with an extra cortical device.\(^\text{21}\)

Marx and Hetsroni described another reconstruction technique with an Achilles tendon allograft to avoid donor site morbidity during autograft harvesting. An Achilles tendon allograft is fixed bone to bone on the anatomic origin of the femur with a metal interference screw and distally at the insertion of the sMCL just above the pes anserinus tendons with a cortical screw and a spiked washer. In all 14 cases studied, grade 0–1 valgus stability was achieved. In cases of MCL with primary ACL reconstruction, this technique has demonstrated that recreational athletes are able to return to their pre-injury levels of activity.\(^\text{22}\)

Hetsroni and Mann used a partial thickness quadriceps tendon–bone autograft for MCL reconstruction. They performed two incisions over the anatomic insertions on the femur and on the tibia. The MCL graft was fixed with an interferential screw in the femur and distal tibia insertions, and the proximal tibial was fixed with an anchor.\(^\text{23}\)

**Double-bundle non-anatomical**

Reconstruction of the sMCL and POL using a single femoral tunnel can be performed. Various methods for double-bundle technique have been described for the surgical treatment of chronic medial instability. Borden et al advocated reconstructing the MCL using the anterior tibialis tendon allograft. They used a two-incision approach, one on the medial epicondyle at the femoral attachment site for both bundles and another between the tibial tubercle and the medial edge of the tibia, with a separate attachment for the two free ends of the allograft.\(^\text{24}\)

Lind et al described a similar technique for combined MCL and POL reconstructions. They used a semitendinosus tendon autograft preserving the tibial attachment, the so-called Danish technique. The double-looped semitendinosus tendon graft is placed in a tunnel on the femoral insertion. One arm of the graft is fixed distally to reproduce the sMCL while the other arm is fixed just anterior to the semimembranosus insertion to reproduce the POL. The
graft will remain as an inverted V. Fifty patients were treated using this technique; 98% of the patients had medial laxity of less than 5 mm, and 74% had International Knee Documentation Committee (IKDC) scores of A or B.25

Dong et al used an allograft because it counters the valgus stress effects of the pes anserinus tendon. The proximal and distal parts of the graft were reconstructed in a triangular shape, with the triangular vector improving rotational stability. The authors analysed 56 patients with medial knee instability treated with MCL reconstruction. There was a reduction in the medial opening from a preoperative 10.1 mm to a postoperative 2.9 mm and a reduction of rotational instability from 67.9% to 9.4%. In this study, 83.9% of patients were graded as normal or nearly normal according to the IKDC symptom scores.26

Double-bundle anatomical
Reconstruction of the sMCL and POL using double femoral tunnel can also be performed. There are studies that have shown that ligament reconstructions resembling anatomy are related to improvements in biomechanical tests. In recent years, LaPrade et al developed a surgical technique that consists of an anatomical reconstruction of the proximal and distal fascicles of the sMCL and POL, using two independent grafts and four bone tunnels. Allografts or gracilis and semitendinosus autografts can be used. A single anteromedial incision or three small knee incisions are performed. The skin incision is made on the medial knee region, 4 cm medial to the patella with caudal direction to 7 or 8 cm distal to the joint line.27

The first surgical step is to identify the distal tibial insertion of the sMCL, which is deeper than the pes anserinus bursa, about 6 cm distal to the joint line. The fascia of the sartorius muscle is then incised in an oblique form, and the gracilis and semitendinosus tendons are exposed. At this time, harvesting can be performed with a tubular tenotome.

A pin is used as a guide transversely across the tibia. A 7-mm diameter reamer is then employed to ream to approximately 25 mm deep. The tibial tunnel of the POL is then performed. The location of the central arm of the POL is in the posteromedial tibia epiphysis, immediately anterior to the insertion of the direct arm of the semimembranosus tendon. A pin is once again employed in an oblique direction to Gerdy’s tubercle. The tunnel is completed in this position at a depth of 25 mm.

The identification of the insertion of the sMCL and POL can be difficult in the femur; intraoperative fluoroscopy can be used for this purpose. First, the adductor magnus tubercle is identified. The bony prominence that follows distally and parallel to the femoral diaphysis is the medial epicondyle. On average, it is 12.6 mm distal and 8.3 mm anterior to the adductor tubercle. The anatomic femoral insertion is slightly posterior and proximal to the medial epicondyle. A pin is placed perpendicular to the bone surface. Completion of the tunnel is then achieved, using a 7-mm diameter cutter to a depth of 25 mm.

The next step is to identify the femoral insertion of the POL. In the posteromedial knee region, the medial gastrocnemius tendon can be identified. The anatomical femoral insertion of the central arm of the POL can be found proximal to the gastrocnemius tubercle, 7.7 mm distal and 2.9 mm anterior to the gastrocnemius tubercle.

A new pin is drilled across the femur in a similar manner to the previous one and parallel to it. A tunnel 25 mm deep and 7 mm wide is once again made. Creating the
femoral tunnel is not recommended by the authors until a second pin is inserted to prevent the two tunnels from coalescing or breaking the tunnel walls (Fig. 10).

Ideally, two grafts are required, one measuring 16 cm for the sMCL and another measuring 12 cm for the POL. As an autograft, the semitendinosus and gracilis may be used. As allografts, the tibialis tendons (anterior or posterior) and Achilles tendon may be used, creating two independent grafts with bone ends that are preferably attached to the femur. The 25 mm of tendon intratunnel ensures sufficient stability in biomechanical tests.

The grafts are then pulled into their respective femoral tunnels and are fixed with interference screws (Fig. 11). The POL graft is passed in the posterior direction across the native POL and is pulled into the tibial tunnel in the posteromedial corner of the tibia. In the same manner, the sMCL is passed under the sartorius fascia and remnants of the same ligament to the previously created tunnel. Once this step has been completed, the graft-associated ligament reconstructions (ACL, posterior cruciate ligament - PCL) need to be fixed. The medial structures can then be fixed to the tibia.

First, the POL graft is tightened and fixed in full extension. The sMCL graft should then be fixed in 20° of knee flexion, neutral rotation and applying a varus reduction force to avoid medial compartment gapping. Both grafts are fixed with interferential screws. The proximal tibial insertion of the sMCL graft must then be fixed at 12.2 mm on average distal to the joint line with a suture anchor.

LaPrade et al have reported excellent results in 28 patients, with a reduction in joint opening when comparing preoperative valgus stress radiographs with postoperative stress radiographs (6.2 mm on average before surgery versus 1.3 mm on average after surgery). In isolated injuries of the MCL retentioning of the posteromedial structures is not necessary.

**Rehabilitation**

**Phase I (0 to 2 weeks)**
- Hinged knee brace.
- 0° to 90° of passive or passive-assisted knee flexion.
- No weight bearing.
- Isometrics quadriceps sets and straight leg raises.

**Phase II (2 to 6 weeks)**
- ROM may progress as tolerated, with the goal of restoring full ROM.
- Closed-chain kinetic exercise.
- Weight bearing must not be allowed. This fact does not depend on the procedure (repair vs. repair/reconstruction).

**Phase III (6 to 12 weeks)**
- Weight bearing as tolerated.
- Walking, elliptical training, cycling encouraged.

**Phase IV (> 12 weeks)**
- Discontinue brace except for activities (lower-profile hinged brace used).
- Light jogging, gradual return to sport-specific drills.
- Return to play when greater than 80% quadriceps strength returns and adequate performance on functional tests.

**Complications**

Surgical treatment of medial knee lesions can injure the saphenous nerve. The saphenous nerve divides into the infrapatellar branch and sartorial branch. The infrapatellar branch travels anteriorly and travels inferior to the patella and sartorial terminal to innervate the anteromedial aspect of the knee. The sartorial branch has a vertical course posterior to the medial knee structure, and provides...
sensation to the medial part of the leg. Wijdicks et al reported that the distance of the sartorial branch of the saphenous nerve from the adductor tubercle was $5.0 \pm 1.1$ cm, $6.1 \pm 1.0$ cm from the medial epicondyly, and $4.8 \pm 0.9$ cm from the anterior border of the sMCL to $2$ cm distal from the joint line. The distance was increased distally with a mean distance of $4$ cm distal, $4.1 \pm 0.8$ cm from the joint line and $6$ cm distal, $3.8 \pm 0.8$ cm from the joint line.²⁹

Postoperative stiffness is common in medial knee surgeries. Performing anatomical reconstruction techniques that allow early postoperative knee motion is important. The stiffness can be associated with the timing of repairs and with non-anatomical repairs. Residual laxity is another common complication and can be caused by failure to recognize all components of the injury, especially the meniscus and posteromedial structures. A valgus gaping of less than $2$ mm compared with the healthy contralateral knee on stress radiographs is considered successful (restoration of medial stability).³⁰

**Conclusions**

Incomplete tears (grade I, II) and isolated tears (grade III) of the MCL without valgus instability can be treated nonsurgically with early functional rehabilitation. Non-surgical treatment is often successful at returning patients to their prior level of function. Failure of non-surgical treatment can lead to debilitating, persistent medial instability, secondary ACL dysfunction, weakness, and osteoarthritis. Acute repair is indicated in isolated grade III tears with severe instability, MCL entrapment over the pes anserinus, and intra-articular or bony avulsion. The indication for primary repair is based on the resulting quality of the native ligament and the length of time since the injury. Primary repair of the MCL is usually performed within $7$ to $10$ days after the injury. Augmentation repair for the sMCL can be used when the resulting quality of the native ligament makes the primary repair impossible. Reconstruction is indicated when MCL injuries fail to heal in neutral or varus alignment. Reconstruction might be advisable for correcting chronic instability. Chronic, medial-sided knee injuries with valgus misalignment should be treated using a two-stage approach. A distal femoral osteotomy should be performed first, followed by reconstruction of the medial knee structures.

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**E F O R T  o p e n r e v i e w s**

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