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Injuries to the Medial Collateral Ligament and Associated Medial Structures of the Knee

By Coen A. Wijdicks, PhD, Chad J. Griffith, MD, Steinar Johansen, MD, Lars Engebretsen, MD, PhD, and Robert F. LaPrade, MD, PhD

Investigation performed at the Department of Orthopaedic Surgery, University of Minnesota, Minneapolis, Minnesota, and the Oslo University Hospital and Faculty of Medicine, University of Oslo, Oslo, Norway

The superficial medial collateral ligament and other medial knee stabilizers—i.e., the deep medial collateral ligament and the posterior oblique ligament—are the most commonly injured ligamentous structures of the knee.

The main structures of the medial aspect of the knee are the proximal and distal divisions of the superficial medial collateral ligament, the meniscofemoral and meniscotibial divisions of the deep medial collateral ligament, and the posterior oblique ligament.

Physical examination is the initial method of choice for the diagnosis of medial knee injuries through the application of a valgus load both at full knee extension and between 20° and 30° of knee flexion.

Because nonoperative treatment has a favorable outcome, there is a consensus that it should be the first step in the management of acute isolated grade-III injuries of the medial collateral ligament or such injuries combined with an anterior cruciate ligament tear.

If operative treatment is required, an anatomic repair or reconstruction is recommended.

The understanding of the anatomy, biomechanics, and treatment of medial knee injuries continues to evolve. Quantitative techniques for the measurement of anatomic structures and biomechanical testing and digital radiography have improved anatomic definition of the severity of injuries. The development of new reconstruction techniques may lead to improved surgical outcomes.

The superficial medial collateral ligament and other medial knee stabilizers—i.e., the deep medial collateral ligament and the posterior oblique ligament—are the most commonly injured ligamentous structures of the knee. The incidence of injuries to these medial knee structures has been reported to be 0.24 per 1000 in the United States in any given year and to be twice as high in males (0.36 compared with 0.18 in females). The majority of medial knee ligament tears are isolated. These injuries occur predominantly in young individuals participating in sports activities, with the mechanism of injury involving valgus knee loading, external rotation, or a combined force vector occurring in such sports as skiing, ice hockey, and soccer, which require knee flexion.

**Anatomy**

**Superficial Medial Collateral Ligament**

The superficial medial collateral ligament, commonly called the *tibial collateral ligament*, is the largest structure of the medial aspect of the knee (Fig. 1, A). This structure consists of one femoral attachment and two tibial attachments. Quantitative assessment has shown the femoral attachment to be oval and, on the average, 3.2 mm proximal and 4.8 mm posterior to the medial epicondyle. As the superficial medial collateral ligament courses distally, it has two tibial attachments. The proximal tibial attachment is primarily to soft tissue over the termina-

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tion of the anterior arm of the semimembranosus tendon and is located an average of 12.2 mm distal to the tibial joint line. The distal tibial attachment of the superficial medial collateral ligament is broad and is directly to bone at an average of 61.2 mm distal to the tibial joint line; it is located just anterior to the posteromedial crest of the tibia. The two distinct tibial attachments have been reported to result in two distinct functioning divisions of the superficial medial collateral ligament.

**Posterior Oblique Ligament**

The posterior oblique ligament is a fibrous extension off the distal aspect of the semimembranosus that blends with and reinforces the posteromedial aspect of the joint capsule (Fig. 1, A). It consists of three fascial attachments at the knee joint, with the most important portion being the central arm. On the average, the central arm of the posterior oblique ligament attaches on the femur 7.7 mm distal and 2.9 mm anterior to the gastrocnemius tubercle. In some of the earlier descriptions of medial knee anatomy, the superficial medial collateral ligament and the posterior oblique ligament were identified as one confluent structure. Brantigan and Voshell reported an oblique portion of the superficial medial collateral ligament, which is now recognized as the posterior oblique ligament. Slocum and Larson reported that the posterosuperior and posteroinferior fibers that coursed off the posterior aspect of the superficial medial collateral ligament formed a triangular membrane, which coursed over the posteromedial aspect of the capsule, reinforcing the posterior aspect of the capsule, and also attached to the tibia. While they did not identify it as such, their description fits closely with the description of the central arm of the posterior oblique ligament.

More recent authors have noted that the superficial medial collateral ligament and the posterior oblique ligament are separate structures, although there has been a wide variation in the descriptions of the femoral attachment site of the posterior oblique ligament. It is important to recognize that the femoral attachment of the posterior oblique ligament extends outside of the zone described by some authors as the oblique portion of the superficial medial collateral ligament. Until recently, when it was reported that there are three osseous prominences along the medial aspect of the knee, descriptions of the femoral attachment of the posterior oblique ligament were inconsistent. However, with the recognition that the femoral attachment of the posterior oblique ligament is located closer to the gastrocnemius tubercle than to the adductor tubercle, much of the above ambiguity has been elucidated.

**Deep Medial Collateral Ligament**

The deep medial collateral ligament comprises the thickened medial aspect of the joint capsule that is deep to the superficial medial collateral ligament. It is divided into meniscofemoral and meniscotibial components (Fig. 1, B). The meniscofemoral...
portion has a slightly curved convex attachment 12.6 mm distal and deep to the femoral attachment of the superficial medial collateral ligament. The meniscotibial portion, which is much shorter and thicker than the meniscofemoral portion, attaches just distal to the edge of the articular cartilage of the medial tibial plateau, 3.2 mm distal to the medial joint line, and 9.0 mm proximal to the proximal tibial attachment of the superficial medial collateral ligament. Other authors have also reported that the meniscofemoral portion attaches deep to the superficial medial collateral ligament and the meniscotibial portion attaches just distal to the tibial articular surface.

**Classification**

The grading of medial knee ligament injuries on physical examination relies on both the patient’s ability to relax and the clinician’s ability to detect an end point during the application of a valgus load at between 20° and 30° of knee flexion. When the patient has pain leading to guarding and the clinician does not wish to cause more pain, a valgus stress test or valgus stress radiograph may result in an underestimation of the amount of medial knee laxity. The uninjured contralateral side is used as a baseline for comparison.

A widely utilized scale for grading medial knee injuries was established by the American Medical Association Standard Nomenclature of Athletic Injuries (Fig. 2, Table I). With this system, an isolated grade-I, first-degree tear presents with localized tenderness and no laxity. An isolated grade-II, second-degree tear presents with a broader area of tenderness and partially torn medial collateral and posterior oblique fibers. Isolated grade-III injuries present with complete disruption, and there is laxity with an applied valgus stress.

![Fig. 2](antomedial view of the left knee, showing the injury grading scale established by the American Medical Association Standard Nomenclature of Athletic Injuries).

Grades 1, 1, 2, and 3, correspond to subjective gapping of the medial joint line of 3 to 5 mm, 6 to 10 mm, and >10 mm, respectively, when compared with the uninjured, contralateral side. Clinicians can utilize this system to define the initial grade of injury, to plan treatment (nonoperative or operative), and to determine evidence of healing with nonoperative treatment.
TABLE I Grading Scale for Medial Knee Injuries

<table>
<thead>
<tr>
<th>Classification</th>
<th>Definition</th>
<th>TABLE I Grading Scale for Medial Knee Injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade I²⁰</td>
<td>Localized tenderness with no instability</td>
<td>Increase in medial joint gapping of 1.7 mm at 0° of knee flexion and 3.2 mm at 20° of knee flexion*</td>
</tr>
<tr>
<td>Grade II²⁰</td>
<td>Localized tenderness and partially torn medial collateral and posterior oblique fibers</td>
<td>Increase in medial joint gapping of 6.5 mm at 0° of knee flexion and 9.8 mm at 20° of knee flexion*</td>
</tr>
<tr>
<td>Grade III²⁰</td>
<td>Complete disruption; instability with an applied valgus stress</td>
<td>Increase in medial joint gapping of 10 mm at 0° of knee flexion*</td>
</tr>
<tr>
<td>Clinical subjective³,21-24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1+</td>
<td>3-5 mm laxity</td>
<td></td>
</tr>
<tr>
<td>2+</td>
<td>6-10 mm laxity</td>
<td></td>
</tr>
<tr>
<td>3+</td>
<td>&gt;10 mm laxity</td>
<td></td>
</tr>
<tr>
<td>Stress radiograph⁵⁰</td>
<td>Isolated injury of superficial medial collateral ligament</td>
<td>Increases in medial joint gapping of 1.7 mm at 0° of knee flexion and 3.2 mm at 20° of knee flexion*</td>
</tr>
<tr>
<td>Complete medial knee injury (superficial medial collateral ligament, posterior oblique ligament, and deep medial collateral ligament)</td>
<td>Increases in medial joint gapping of 6.5 mm at 0° of knee flexion and 9.8 mm at 20° of knee flexion*</td>
<td></td>
</tr>
</tbody>
</table>

*Reflects the average findings in one study rather than a classification system.

Healing

The superficial medial collateral ligament has been reported to have an abundant vascular supply. Healing of this ligament follows the classic model of healing involving hemorrhage, inflammation, repair, and remodeling²⁷. Studies of the variables involved in the healing of the superficial medial collateral ligament in animals have shown that the healing is location dependent. In one study of a rabbit superficial medial collateral ligament injury model, the ligament took longer to heal when it was injured near either attachment site than when it had a midsubstance injury²⁶.

The biological effects of immobilization have also been widely studied in superficial medial collateral ligament injury models. In a rabbit model, a reduction of collagen mass and increased collagen degradation were observed after twelve weeks of immobilization²⁷. These negative effects of immobilization were noted to be caused by collagen matrix reorganization and catabolic behavior within the medial collateral ligament after injury²⁸,²⁹. In another study, dogs that had undergone surgical transection of the superficial medial collateral ligament were divided into three treatment groups: early motion, immobilization for three weeks, and immobilization for six weeks³⁰. The authors concluded that early motion protocols lead to enhanced healing and improved biomechanical properties of the superficial medial collateral ligament. This information was subsequently used to promote and reinforce similar nonoperative rehabilitation protocols for these injuries in humans.

Clinically Relevant Biomechanics

A complete understanding of medial knee biomechanics is valuable for the assessment of which injured structures should be repaired or reconstructed. An understanding of the degree of abnormal joint motion that occurs when a structure is injured greatly assists with the interpretation of the results of the clinical examination and helps to determine the presence of concurrent ligament injury. With the trend toward more anatomic reconstruction, it is important to understand the function of, and the differences between, the individual components of these main medial knee-stabilizing structures. Biomechanical studies have shown that the superficial medial collateral ligament is the primary restraint to valgus laxity of the knee³¹-³⁴. One study, in which buckle transducers were used, quantitatively demonstrated differences between the two divisions of the superficial medial collateral ligament in terms of their responses to applied loads³⁵. The implications of these observations are that, although the superficial medial collateral ligament has previously been biomechanically tested and operatively reconstructed under the assumption that it is one continuous structure³⁶,³⁷-⁴⁰, the two divisions of the ligament actually function as conjoined but distinct structures. Thus, the biomechanical study³⁶ suggests that the aim of an operative repair or reconstruction of the superficial medial collateral ligament should be to restore the distinct functions of both divisions by reattaching the two tibial attachments in an attempt to reproduce the overall function of the superficial medial collateral ligament construct.

The posterior oblique ligament reinforces the postero-medial aspect of the capsule, which courses off the distal aspect of the semimembranosus tendon²⁸,³⁴. From a biomechanical perspective, the posterior oblique ligament functions as an internal rotator and valgus stabilizer at between 0° and 30° of knee flexion³,²,¹⁰,³³,³⁷,³⁸,⁴¹,⁴². It has also been reported that, with applied internal rotation torques at 0° of knee flexion, the loads on the posterior oblique ligament are significantly higher than those on either division of the superficial medial collateral ligament³⁰. In addition, it has been reported that
there is a reciprocal load response to internal rotation torque between the posterior oblique ligament and the superficial medial collateral ligament as the degree of knee flexion increases, with a higher load response in the superficial medial collateral ligament at 90° of knee flexion. This observation demonstrates that there is a complementary relationship between the posterior oblique ligament and the superficial medial collateral ligament with regard to the resistance of internal rotation torques that depends on the knee flexion angle. A subsequent study of load distribution with buckle transducers showed that sectioning of the components of both the deep medial collateral ligament and the superficial medial collateral ligament resulted in significant increases, compared with the intact state, in the forces experienced by the posterior oblique ligament under valgus loads at 0°, 20°, and 30° of knee flexion. This observation correlates both with previous reports that the posterior oblique ligament in intact knees experiences tensile load with valgus forces, especially close to knee extension, and that the posterior oblique ligament has a secondary role in providing valgus stability of the knee. Compared with the number of studies on the function of the superficial medial collateral ligament, there are fewer reports on the isolated function of the deep medial collateral ligament. The authors of previous sequential sectioning studies done to evaluate the function of the deep medial collateral ligament described it as a secondary restraint to valgus loads. More specifically, they found that valgus stabilization was provided by the meniscofemoral portion of the deep medial collateral ligament at all tested flexion angles and by the meniscotibial portion of the deep medial collateral ligament at 60° of knee flexion. The deep medial collateral ligament was also reported to provide restraint against external rotation torque in knees flexed between 30° and 90°.

These results demonstrate that injuries to the individual components of the medial aspect of the knee alter the intricate load-sharing relationships that exist among all of the medial knee structures and, if left untreated, could potentially increase the risk of further injury. Therefore, on the basis of the synthesis of information from the literature and our personal perspective, we believe that, in cases in which an operative repair or reconstruction is indicated, consideration should be given to repairing or reconstructing all injured medial knee structures to restore the normal load-sharing relationships among those structures at the time of operative treatment.

An anatomic medial knee reconstruction technique (Fig. 3), based on previous quantitative anatomic and biomechanical studies, provides a biological, anatomically correct, and technically feasible reconstruction method. The reconstruction technique (Fig. 3) is based on previous quantitative anatomic and biomechanical studies.
mechanical studies, was developed in an attempt to restore normal stability to a knee following complete sectioning of the superficial medial collateral ligament and posterior oblique ligament. It was reported that this reconstruction restored nearly normal stability to the knee and that, following an applied load, the reconstructed ligaments did not have a greater force response than intact ligaments at any point during testing. This suggests that overconstraint of the knee and overloading of the reconstruction grafts, which could lead to graft failure, was prevented by the use of this technique.

**Diagnosis**

**History**

Patients often describe a mechanism of injury involving a contact or noncontact valgus force to the knee. They also report pain and swelling along the medial aspect of the knee. When asked to explain the type of instability that they feel with activities, individuals with medial knee injuries involving the superficial medial collateral ligament, posterior oblique ligament, and deep medial collateral ligament often described a side-to-side feeling of instability, especially when they were athletes who performed cutting and pivoting maneuvers.

**Clinical Evaluation**

Physical examination of the knee remains the most suitable tool for obtaining a diagnosis of injury to its medial structures. Beginning with visual inspection, clinicians may observe localized swelling or ecchymosis over the femoral or tibial attachment of the superficial medial collateral ligament. These areas can be palpated to help to identify tenderness of the superficial medial collateral ligament. It is important to understand the anatomy of the medial side of
the knee to appropriately palpate and assess the structures involved.

A valgus load applied at 20° to 30° of knee flexion is used to detect medial joint opening (Fig. 4, A). Applying the valgus stress at both 0° and 30° of knee flexion can further assist in the diagnosis of the injury pattern because when a knee has increased medial joint space opening at 30° of flexion but not at 0° the posterior oblique ligament is most likely still intact. An additional assessment performed at this time of valgus moment application is evaluation of the integrity of the so-called end point. If the medial knee structures are completely ruptured, there will be no definitive end point and the anterior cruciate ligament may be providing a secondary restraint to the valgus stress46. It is therefore important to verify this observation with the Lachman77, anterior drawer, and pivot shift tests and assess the integrity of the anterior cruciate ligament in association with medial knee injury.

Palpation of the femur-based and tibia-based portions of the medial knee structures can often delineate the location of the ligament injury. The anteromedial drawer test, performed by flexing the knee approximately 90° while externally rotating the foot 10° to 15° and applying an anteromedial rotational force to the knee, should also be done to determine if there is a concurrent injury to the posterior oblique ligament and/or the posteromedial aspect of the capsule. It has also been reported that a complete injury to the medial structures will cause increased external rotation at both 30° and 90° of knee flexion, resulting in a positive dial test41,46 (Fig. 4, B). Therefore, careful correlation with the results of valgus stress testing and assessment of the location of tibial subluxation during the dial test are necessary to exclude the possibility of a posterolateral, rather than a medial, knee injury.

Radiographic Evaluation

It has been reported that the location of anatomic landmarks of the major medial knee structures and related osseous anatomy can be predicted accurately in a highly reproducible manner by multiple observers evaluating radiographs59. Correlating radiographic findings with known anatomic attachment sites of the primary structures of interest before a medial knee reconstruction allows improved preoperative planning and facilitates intraoperative and postoperative assessment of reconstructions or repairs (Fig. 5).

Valgus stress radiographs can also be useful for quantitative grading of medial knee injuries and to verify the location of medial compartment gapping (Fig. 6). In one study, a load applied by a clinician to a knee with a simulated isolated grade-III superficial medial collateral ligament injury increased medial joint gapping, compared with that in the intact knee, by 1.7 and 3.2 mm at 0° and 20° of flexion, respectively59. A complete medial knee injury with sectioning of the superficial and deep medial collateral ligaments and the posterior oblique ligament increased gapping by 6.5 and 9.8 mm at 0° and 20°, respectively, under the clinician-applied load59.

Magnetic resonance imaging is commonly used to assess the involved structures in patients with injuries to the medial side of the knee (Fig. 7). In a study of sixty-three patients who were clinically evaluated for a medial collateral ligament injury by an orthopaedic surgeon and then with a 1.5-T magnetic resonance imaging system by an experienced musculoskeletal radiologist who had no knowledge of the clinical findings, the imaging was found to have an accuracy of 87% for the assessment of medial collateral ligament injuries51. There have been few studies of the classification of deep medial collateral injury and/or involvement of the posterior oblique ligament. In a prospective study, Miller et al. classified trabecular microfractures and bone bruises in sixty-five patients with an isolated injury of the medial collateral ligament52. Of these patients, twenty-nine (45%) had associated bone bruises, which were predominantly located on the lateral tibial plateau (six patients) or lateral femoral condyle (ten patients), or both (eight patients). The lesions completely resolved in all cases, over the span of two to four months after the injury52.

Results of Clinical Series

Nonoperative Treatment

Despite the fact that the medial structures are the most frequently injured knee ligaments, controversy remains concerning their treatment. Historically, treatment of acute medial collateral ligament injuries has focused on nonoperative therapies with early controlled motion and protected weight-bearing, and fairly good patient outcomes have been reported53-59. Overall, there is a consensus that nonoperative management should be the first step in the treatment of acute isolated grade-I or II injuries because of a typically acceptable clinical outcome54,57,60-62. Several rehabilitation protocols are available, and each has had successful results56,61,63-66. It should be noted that these treatment protocols vary according to the clinician providing them, and, to our knowledge, there has not yet been a study prospectively comparing different rehabilitation treatments for a specific grade of medial knee injury (see Appendix). It is therefore difficult to compare studies; yet, there is much overlap in the exercises and the time frames utilized.

Acute grade-III medial knee injuries are usually treated with a nonoperative protocol that includes a functional rehabilitation program. The initial nonoperative treatment includes control of pain and swelling and possibly the use of a hinged knee brace for six weeks to protect against valgus stress and external rotation67,68. A protocol including immediate knee range-of-motion exercises, early weight-bearing, and progressive strength training has been reported to produce excellent results and a high rate of return to the prior activity level69. It is also important to note that the success of nonoperative treatment of complete tears of the medial knee structures relies on an intact anterior cruciate ligament70.

Operative Treatment

A high frequency of combined superficial medial collateral ligament and posterior oblique ligament injuries has been reported in knees with severe acute or chronic valgus instability, signifying the important role of the posterior oblique ligament...
in providing static stabilization to the medial side of the knee\textsuperscript{11,14}. Operative techniques for these combined injuries include direct repair of the superficial medial collateral ligament and posterior oblique ligament\textsuperscript{11}, primary repair with augmentation\textsuperscript{17}, advancement of the tibial insertion site of the superficial medial collateral ligament\textsuperscript{12}, pes anserinus transfer\textsuperscript{13}, advancement of the superficial medial collateral ligament with pes anserinus transfer\textsuperscript{14}, and reconstruction techniques that have not been validated biomechanically\textsuperscript{40}.

Our preferred technique for the treatment of complete medial knee injuries that involve the superficial medial collateral ligament, posterior oblique ligament, and deep medial
The collateral ligament is an anatomic reconstruction of the superficial medial collateral and posterior oblique ligaments (Figs. 3 and 8). The technique consists of a reconstruction of the two main structures of the medial side of the knee with use of two separate grafts with four reconstruction tunnels. A single anteromedial incision or three small knee incisions are performed to access the anatomic femoral and tibial attachment points of the superficial medial collateral ligament and the posterior oblique ligament. The superficial medial collateral ligament is tightened at 30° of knee flexion because biomechanical studies have demonstrated that sectioning of the medial structures at this flexion angle results in the greatest change in valgus laxity. The posterior oblique ligament is tightened at 0° of knee flexion on the basis of previous biomechanical studies that demonstrated that this ligament has the greatest role in primary restraint of internal rotation at 0° of knee flexion.

**Postoperative Rehabilitation**

It is essential that motion of the knee be achieved as soon as possible after treatment so that intra-articular adhesions do not develop. It is important to inform patients prior to the operation that their full return to activity can take up to six to nine months postoperatively. At our institutions, we utilize a treatment protocol that focuses on early motion and strengthening exercises (see Appendix).

For the first week after a medial knee reconstruction, it is vital to avoid aggressive range-of-motion exercises, which could stretch out the reconstruction grafts. However, the patient is instructed to initiate range-of-motion exercises between 0° and 90° of knee flexion in the first two weeks and simple strengthening exercises while wearing a hinged brace immediately postoperatively. These include quadriceps-setting exercises, straight-limb raises, and hip extension and abduction exercises. The initial range-of-motion exercises are performed to prevent adhesion formation; extension is allowed to 0°, but it is essential to avoid both hyperextension and flexion past 90°, which can place undue tension on the grafts. After the initial two weeks, knee flexion is progressed to a full range of motion as tolerated. It is recommended that no resistive or repetitive hamstring exercises be performed for approximately four months after the reconstruction to minimize joint translation, which could potentially stretch the healing grafts. After the initial six weeks of protected weight-bearing, closed-kinetic-chain exercises are permitted for functional strengthening. Two-limb-support squatting may be initiated, but it is limited to 70° of knee flexion to minimize excessive joint translation. Avoidance of tibial external and internal rotation is...
advised. The patient should be educated about avoiding pivoting motions of the limb on a planted foot.

Once full weight-bearing is permitted at the seven-week mark, special attention must be paid to the restoration of normal gait mechanics. Also, the therapist must observe that the return to full weight-bearing is tolerated and that an effusion does not develop. A persistent effusion in the joint can contribute to quadriceps muscle inhibition and negate the progress made with strengthening. The therapist must observe the gait pattern closely to ensure that the patient is not employing a quadriceps-avoidance pattern with a hyperextension thrust at the knee joint during stance phase. It is also critical that the patient avoid posting the foot of the surgically treated extremity lateral to the base of support in stance in an attempt to unload the joint. This movement pattern increases the valgus moment at the knee joint, potentially compromising the grafts. Provided that lower-extremity strength, motion, and proprioception have been appropriately regained, jogging and basic plyometric and agility exercises may be initiated at sixteen to twenty weeks postoperatively. The patient must be able to tolerate 1 to 2 mi (1.6 to 3.2 km) of brisk walking without a limp and demonstrate adequate kinematic control with single-limb squatting prior to initiating an interval jogging program. Once the patient has completed this rehabilitation program without problems, the surgeon can talk to the patient about returning to full activity if appropriate strength is noted on functional testing and objective knee stability is observed on clinical examination. A similar rehabilitation protocol is implemented after a medial knee reconstruction in combination with an anterior cruciate ligament reconstruction, although there is a longer delay before a full return to activity.

Confounding Variables

The so-called Pellegrini-Stieda syndrome is typically diagnosed with the use of anteroposterior plain radiographs and is characterized by intraligamentous calcification in the region of the femoral attachment of the medial collateral ligament caused by the chronic tear of the ligament (Fig. 9)\textsuperscript{74}. Treatments to alleviate pain over the sites of mild and moderate cases of post-traumatic heterotopic ossification of the superficial medial collateral ligament have been reported to include local corticosteroid injection and range-of-motion exercises\textsuperscript{75}. Operative excision of the calcification and treatment of the chronic tear in the medial collateral ligament can be considered for more severe cases\textsuperscript{75,76}.

Another confounding variable is the presence of concurrent injuries, which can obscure the findings of the physical examination\textsuperscript{24}. If a primary operative repair or reconstruction is indicated in the presence of multiple-ligament

![Fig. 7](image_url)

Proton-density-weighted magnetic resonance image showing an acute avulsion of the superficial medial collateral ligament and the meniscotibial division of the deep medial collateral ligament off their tibial attachments. A trabecular microfracture of the lateral epicondyle, most likely caused by an impaction force, can be seen. The arrowhead indicates the distal attachment of the superficial medial collateral ligament, which has been avulsed from its tibial attachment.
knee injuries, it should be performed concurrently with cruciate ligament reconstruction(s) and shortly after the injury because scar tissue, tissue retraction, and tissue necrosis can develop and reduce the quality of the remaining tendon and of the repair. Also, patients with valgus alignment who need a reconstruction should undergo the procedure promptly because...
of the higher risk of the reconstruction stretching out if the injury becomes chronic. To prevent fluid extravasation, a diagnostic arthroscopy could be helpful either before or after the initial surgical exposure to identify meniscal tears and the site of the deep medial collateral ligament injury. In patients with severe medial knee injuries, it may be useful to perform the operative approach and identify the injured medial structures prior to fluid extravasation; otherwise, definition of the injury is more difficult.

Complete medial knee ligament injuries may not always heal. Operative treatment is usually indicated for chronic medial knee injuries in patients with symptomatic instability, pain, and excessive medial joint gapping. Because of contracture of the ligament ends, the formation of scar tissue, and the loss of the potential for healing that characterize chronic tears, a reconstruction with a hamstring autograft or allograft may be required. An arthroscopic examination can be performed after the initial operative approach to identify and treat intra-articular lesions such as chondral defects or meniscal tears. Various techniques for treatment of medial knee injuries, such as tendon transfer, advancement and retensioning procedures, and free autograft or allograft tendon reconstructions, have been described. However, chronic injuries usually require complete reconstruction of the superficial medial collateral and posterior oblique ligaments because of extensive pericapsular scar formation.

The operative approaches for medial knee repairs and reconstructions predominantly involve an anteromedial incision. The proximity of the saphenous nerve to the medial portion of the knee makes the nerve vulnerable to injury. Disruption of the saphenous nerve at the knee can result in a spectrum of neuropathy ranging from inconsequential sensory loss to painful neuralgia. An anatomic study defined the location of the sartorial branch of the saphenous nerve and characterized a safe zone for a medial knee reconstruction that avoids compromise of the nerve. Accurate knowledge of the location of the sartorial branch of the saphenous nerve is necessary to avoid injury while at the same time being able to fully repair or reconstruct the medial knee structures to restore their native anatomic state.

Appendix

Tables listing clinical series of medial knee ligament injuries reported in the literature and describing rehabili-
tation protocols for these injuries are available with the electronic version of this article on our web site at jbs.org (go to the article citation and click on “Supporting Data”).

References


