

Distal Knee Medial Collateral Ligament Repair With Suture Augmentation



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Abstract: The medial collateral ligament (MCL) is the most commonly injured ligament of the knee. Given its extra-articular location, the MCL has great healing capacity such that the mainstay of treatment for most injuries remains conservative management. However, certain injury patterns place patients and athletes at risk of residual valgus laxity, which may require delayed surgical care and prolonged time out from sports. As such, identifying the specific injuries known to place patients at risk for failure with nonoperative management is of paramount importance. Although controversy remains regarding the optimal treatment of grade III MCL injuries, it is generally accepted that MCL ruptures from the distal tibia attachment require operative fixation. This technique article with accompanying video provides a detailed description of a technique for repairing the distal MCL attachment with suture augmentation. There are several advantages associated with an augmented direct repair including early, safe rehabilitation; prevention of valgus instability; and avoiding the comorbidities associated with a larger reconstruction.

The medial collateral ligament (MCL) is composed of superficial and deep fibers. The superficial MCL is the primary restraint to valgus stress of the knee, whereas the deep MCL acts as a secondary stabilizer.¹ Per LaPrade et al.,² the proximal origin of the superficial MCL is 3.2 mm proximal and 4.8 mm posterior to the medial epicondyle, whereas the broad distal attachment of the superficial MCL is located 61.2 mm distal to the tibial joint line and just anterior to the posteromedial crest of the tibia. Injury to the MCL may occur in either contact or noncontact sports via a number of mechanisms, including the application of a valgus stress, an external rotation pivoting force, a blow to the anterolateral knee, or a knee dislocation.¹ To test

for MCL instability, the knee is flexed to 30°, and a valgus stress is applied. The injury is graded based on the amount of medial joint line opening in which grades I, II, and III correlate to 3 to 5 mm, 6 to 10 mm, and >10 mm of opening, respectively.^{1,3} Valgus opening at 0° correlates to an even more severe injury, generally involving the posterior oblique ligament, MCL, and possibly the cruciate ligaments.

Despite being the most frequently injured ligament of the knee, treatment of MCL injuries remains controversial. One of the primary reasons is that, unlike the anterior cruciate ligament (ACL), the MCL has tremendous healing capacity because of its robust vascular supply and extra-articular location.³ The grading of an MCL injury, as well as the presence of any associated injuries, plays a significant role in appropriate patient management. Most grade I and II injuries are treated successfully with a conservative approach emphasizing early rehabilitation.^{1,3} Meanwhile, the optimal treatment of grade III injuries continues to be debated. Traditionally, grade III injuries have been treated surgically, but given adequate results with nonoperative management the pendulum has swung toward conservative management.^{1,3,4} The decision-making algorithm for the treatment of grade III MCL tears is frequently complicated by the high rate of concomitant ligament injuries, which Fetto et al.⁵ reported to be 78%. In the setting of a concomitant ACL injury, the most common associated injury, the

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mainstay of treatment is delayed reconstruction of the ACL, allowing the MCL adequate time to heal; however, some investigators have challenged that dogma both in regard to repairing the MCL at the time of ACL reconstruction, as well as earlier timing of the ACL reconstruction alone.⁶⁻⁸ With further research, treatment algorithms will likely continue to evolve.

One of the few surgical indications for an acute repair or reconstruction of an isolated or concomitant MCL injury is an avulsion from the distal tibial insertion (Fig 1).^{4,9-12} When the distal insertion is ruptured, the MCL fibers can retract and displace superficial to the pes tendon, becoming a Stener-type lesion. Alternatively, the ligament can retract so much that it becomes incarcerated into the medial joint space. In either scenario, anatomic healing is impossible, resulting in valgus instability. Although a trial of nonoperative management may be reasonable and could not be faulted for this injury, the senior author prefers a surgical approach for athletes that would enable expedited rehabilitation and return to play. Two prior technique articles have detailed the advantages of an augmented MCL repair; however, a minimally invasive augmented MCL repair technique has never been described for a distal tibial rupture.^{6,13} The purpose of this article is to provide a detailed description and video of the steps necessary to perform an anatomic repair of the distal

MCL with augmentation using a collagen-coated suture tape.

Surgical Technique

Patient Positioning and Anesthesia

A preoperative knee examination should be performed with the patient under anesthesia on the day of surgery to confirm MCL pathology. The patient is placed on the operating table and a nonsterile tourniquet is placed proximally around the upper thigh. The operative leg is then prepped and draped in standard sterile fashion (Video 1). An appropriate setup should allow for any necessary concomitant procedures to be performed. In this example, the patient had sustained a lateral meniscus tear requiring knee arthroscopy and an all-inside repair.

Incision and Exposure

Pertinent osseous anatomy should be identified and outlined, including the medial epicondyle, medial joint line, proximal posteromedial border of the tibia, and tibial tubercle. After limb exsanguination with an Esmarch, a 4-cm incision is made over the distal insertion of the MCL distal. Dissection is carried through the subcutaneous tissue until the sartorial fascia is identified. The sartorial fascia is incised revealing the underlying

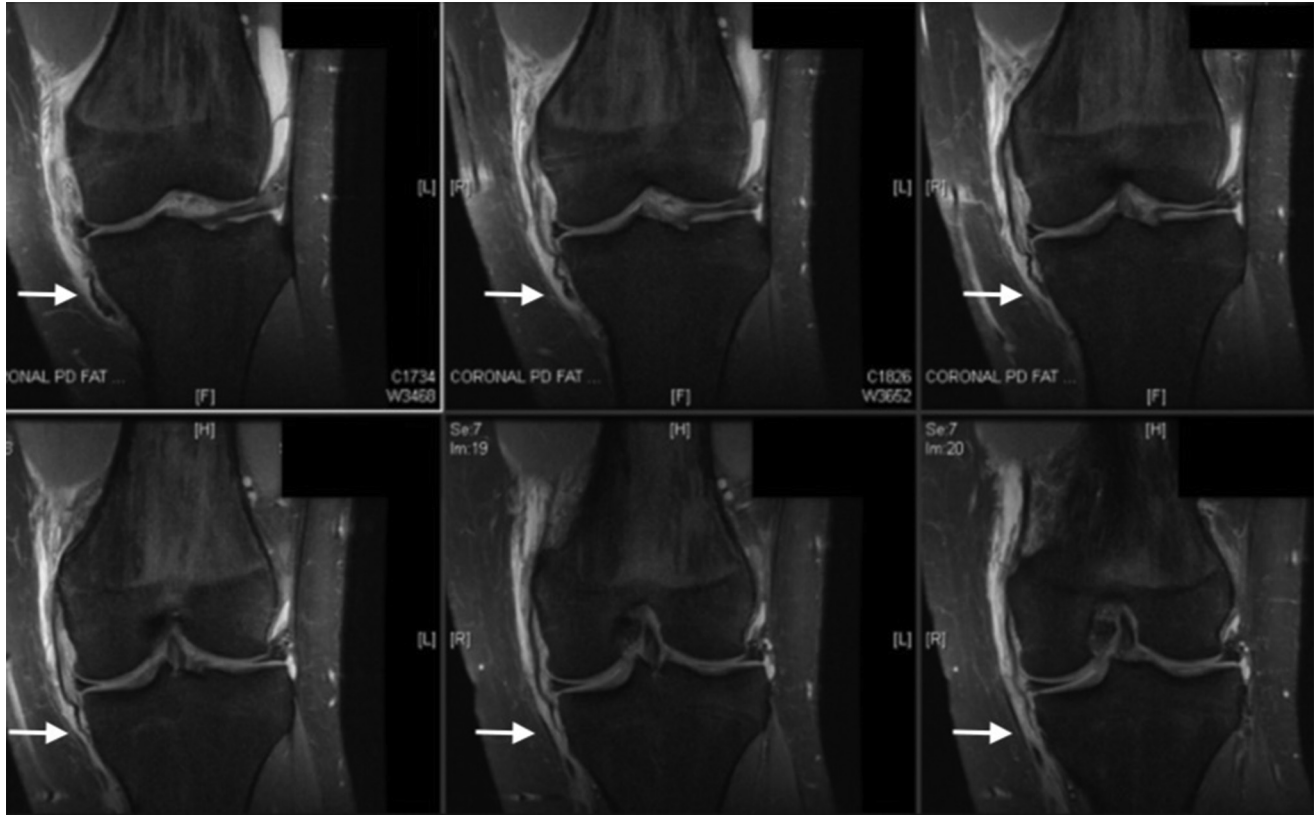


Fig 1. Six consecutive coronal fat-suppressed proton density sequences of the left knee revealing a tear of the medial collateral ligament from its distal tibial attachment, as indicated by the white arrows.

avulsed MCL, which was completely detached from its distal insertion (Fig 2 A and B). The distal insertion site is then debrided of soft tissue, and the underlying cortical bone is abraded to stimulate a healing response with a curette and rongeur. Care should be taken to avoid injury to the nearby hamstring tendons during the approach and preparation.

MCL Repair

After adequate debridement, a punch and tap are used to place of a 3.5-mm suture anchor (Arthrex) loaded with 2 no. 2 high-tensile nonabsorbable sutures. The anchor is placed slightly proximal to the distal insertion point 6 cm from the joint line (Fig 3A). Proximal placement will help recreate the broad proximal footprint of the distal MCL attachment onto the tibia and maximize the amount of ligament healing to bone. Using a free needle, each of the 4 sutures is passed in simple fashion through the substance of the ligament, 2 anteriorly and 2 posteriorly (Fig 3 B and C). The proximal anterior and posterior sutures limbs are then tied together with the knee held in 30° of knee flexion with a gentle varus stress followed by the distal 2 sutures limbs. This provides a broad area of compression for ligament to bone healing, thus completing the primary repair (Fig 3D).

Repair Augmentation

A small percutaneous incision is made just posterior to the medial epicondyle. The soft tissue is dissected until bone is exposed and a guidewire is placed at the anatomic origin of the superficial MCL (Fig 4A).² A 3.5-mm cannulated drill is used to create a hole 25 mm in depth, which is tapped. A 4.75-mm nonabsorbable suture anchor (Arthrex) is then placed (Fig 4B). This anchor is loaded with 2-mm suture tape (Arthrex) that is collagen coated and will serve as the MCL repair augmentation.

Next, a second guidewire is placed at the anatomic distal insertion of the superficial MCL located 6 cm

distal to the joint line (Fig 5A).² Before placement of the final suture anchor, a hemostat is used to tunnel the limbs of the suture tape under the skin bridge distally. The isometric point of the MCL is then determined by wrapping the suture tape around the guidewire and adjusting its position so that it does not change length with knee flexion and extension (Fig 5B). A second drill hole is created and tapped for a second 4.75-mm nonabsorbable suture anchor at the identified isometric point. The suture tape is loaded into the anchor, which is inserted into the drill hole, ensuring adequate compression across the MCL as it is placed (Fig 5C). Before final tightening, a hemostat is placed under the suture tape augmentation construct to ensure the MCL has not been overconstrained (Fig 5D). Finally, a free needle is used to weave the anterior and posterior limbs of the No. 0 repair suture from the final suture anchor along the anterior and posterior aspects of the MCL to enhance the final repair construct (Fig 6). The excess tape and sutures are cut. Finally, knee motion and valgus stability at 0° and 30° of knee flexion are assessed. The wounds are then closed in layers and a hinged knee brace is placed.

Postoperative Rehabilitation

The patient is discharged home the same day. In this specific case, the patient was made non-weight-bearing locked in extension because of the need to protect the lateral meniscal repair. Patients undergoing MCL repair with augmentation in isolation are made weight-bearing as tolerated with a hinged knee brace locked in extension during ambulation until return of quadriceps control.⁶ The brace is unlocked for range of motion as tolerated during supervised therapy initiated in the first postoperative week to prevent any chance of arthrofibrosis. A strengthening program is initiated 4 to 6 weeks after surgery, with return to play dictated by return of quadriceps strength.

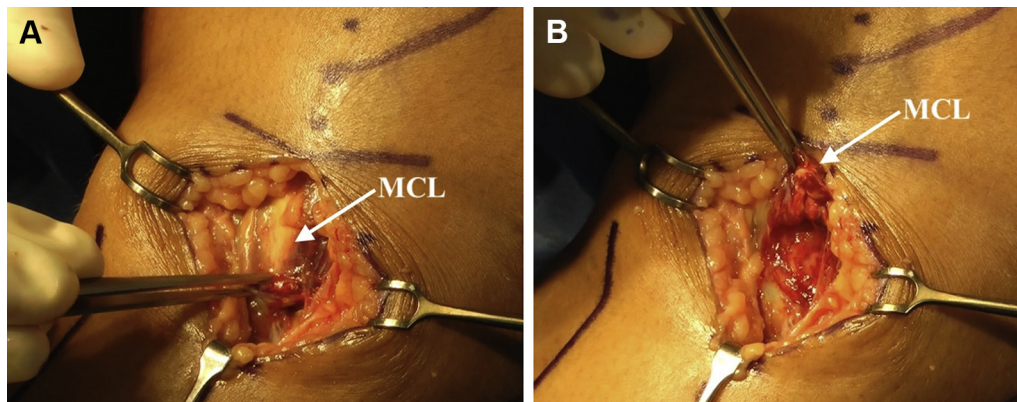


Fig 2. Supine position, left knee. After dissection through the subcutaneous tissue, the sartorial fascia is identified and incised. (A) This reveals the underlying avulsed MCL, which is being grasped at its distal fibers and (B) subsequently reflected proximally without any surgical dissection. (MCL, medial collateral ligament.)

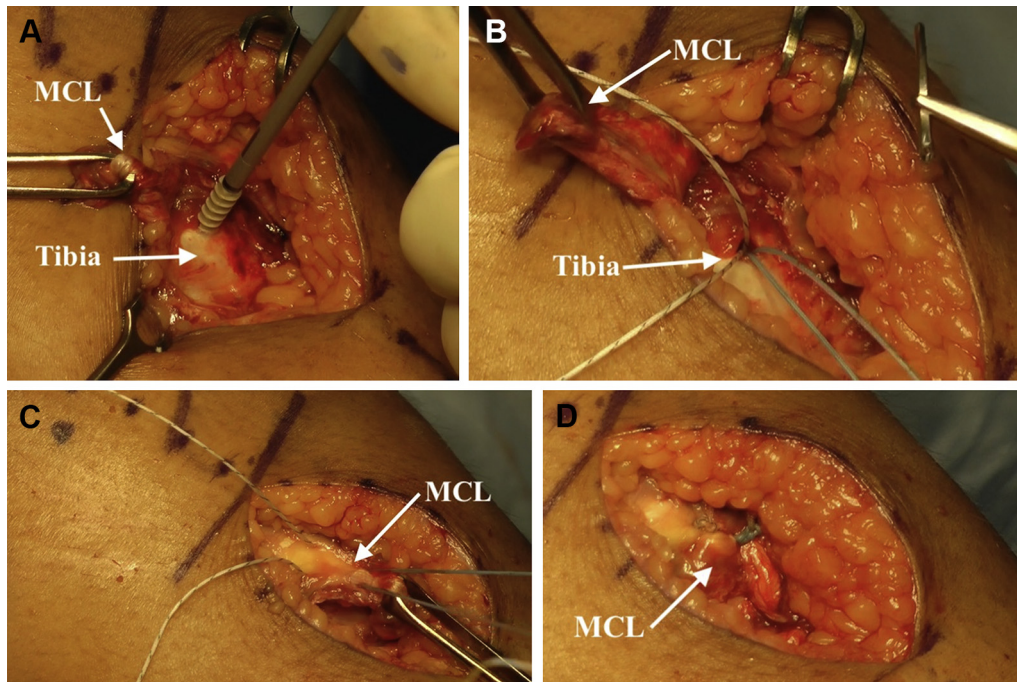


Fig 3. Supine position, left knee. (A) Placement of a 3.5-mm double-loaded suture anchor to facilitate primary repair of the distal MCL. (B) After the suture anchor is placed, the 4 suture limbs are spread out in their anticipated configuration in preparation for simple suture placement into the substance of the distal ligament using a free needle. (C) Two sutures will be passed proximally and distally in an anterior and posterior fashion and (D) subsequently tied together to complete the repair. These sutures are tied with the knee positioned in 30° of flexion while a gentle varus stress is applied. (MCL, medial collateral ligament.)

Discussion

The treatment of ligamentous injuries around the knee continues to evolve at a rapid pace. Although the majority of both isolated and concomitant acute MCL injuries are treated without surgery, there are specific MCL injuries that require operative intervention. An avulsion of the MCL from the distal tibial insertion is 1 such example.^{4,9-12} Unfortunately, the majority of literature discussing nonoperative and surgical management of MCL injuries does not distinguish the site of ligamentous injury, making the true incidence and associated treatment outcomes of distal injuries difficult to discern. Nevertheless, there is evidence to suggest that distal tibial MCL injuries do not do well

with conservative management. For instance, in 2004, Wilson et al.¹² reported that a number of athletes had failed conservative management of grade III MCL injuries. These athletes were found to have complete detachments of the distal MCL from the tibia requiring delayed surgical intervention. As such, the authors changed their treatment algorithm at that time to early surgical repair when grade III injuries were identified in athletes with distal ruptures. A basic science investigation of superficial MCL injuries in rabbits also found that the ligament took longer to heal when injured at the femoral or tibial attachment compared with a midsubstance injuries.¹⁴ Furthermore, the morphology of the ligament insertion was characterized by

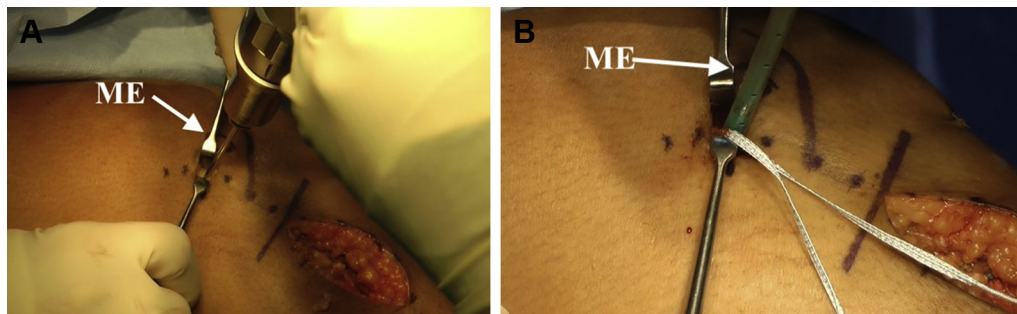


Fig 4. Supine position, left knee. (A) In preparation for placement of the suture tape augmentation, a small percutaneous incision is made posterior to the ME and a guidewire is placed at the anatomic femoral origin of the superficial MCL. (B) A 4.75-mm suture anchor loaded with 2-mm collagen-coated suture tape is placed. (MCL, medial collateral ligament; ME, medial epicondyle.)

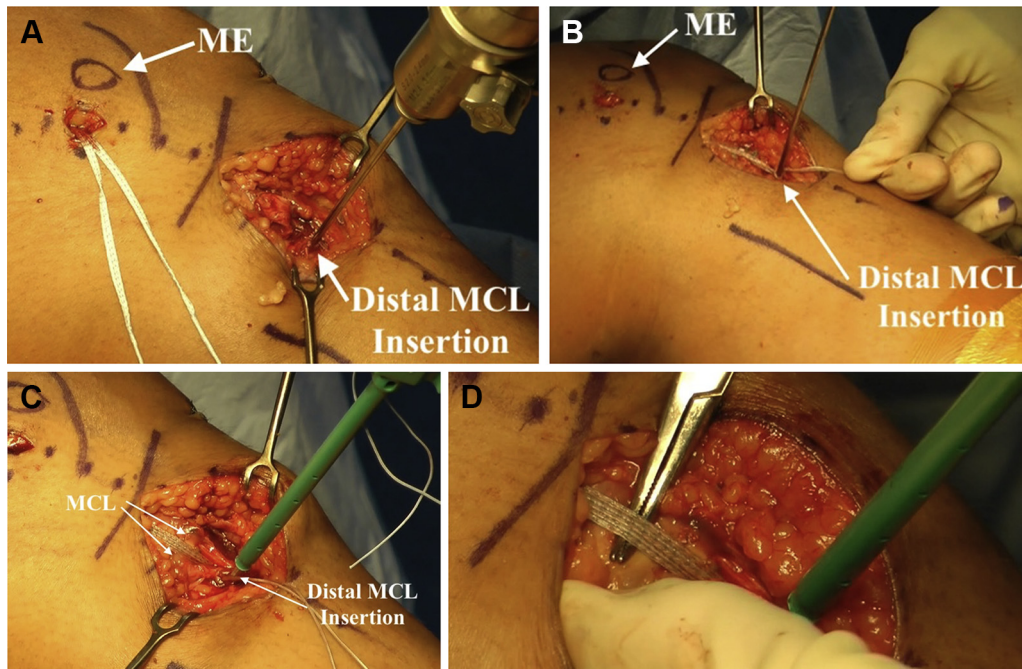


Fig 5. Supine position, left knee. To secure the suture augmentation distally, a second guidewire is placed at the anatomic insertion of the superficial MCL on the tibia 6 cm distal to the joint line. (A) The ME is labeled for orientation. (B) The suture tape limbs for augmentation are tunneled distally and wrapped around the guidewire to assess isometry as the knee is taken through flexion and extension range of motion (C). After confirmation of isometry, the suture is loaded into a second suture anchor, which is inserted while ensuring adequate compression across the MCL. (D) Before the suture anchor is completely tightened, a hemostat is placed under the suture to prevent overconstraining the augmentation construct. (MCL, medial collateral ligament; ME, medial epicondyle.)

abnormal callus formation and patchy bone resorption that was worse on the tibial side. Such data support the well-cited notion that distal tibial avulsions are prone to failure with conservative management.

Given the potential for failure in the setting of an acute distal rupture, the authors prefer an anatomic repair with suture augmentation through a minimally invasive technique. In this setting, a repair is preferable over a

reconstruction, regardless of concomitant injuries, for several reasons. As has been previously documented, these advantages include preservation of patient anatomy and proprioception, avoidance of autografts and allografts, no need for bone tunnels, and a less invasive, quicker surgery.^{6,13} Furthermore, patient-reported

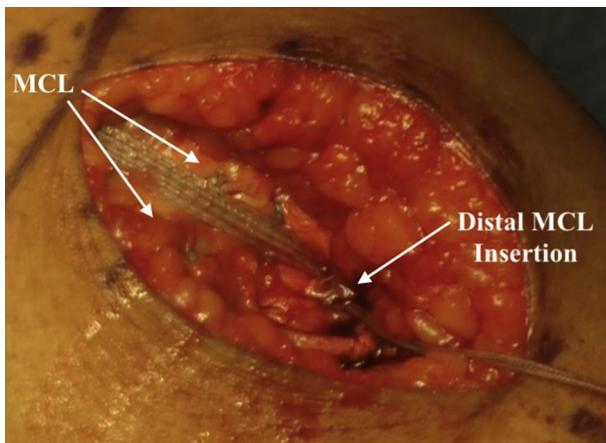


Fig 6. Supine position, left knee. Final appearance of the MCL repair with suture augmentation. (MCL, medial collateral ligament.)

Table 1. Advantages and Disadvantages of MCL Repair

Advantages

- Avoids the need for an MCL reconstruction, thus preserving the patient's native anatomy and proprioception.
- MCL repair with augmentation provides superior biomechanical properties compared with a repair alone and has similar biomechanical properties to a reconstruction.¹⁶
- Suture augmentation affords patients quicker return to play as a result of accelerated rehabilitation with early range of motion.
- Simple, quick, and reproducible technique.
- Distal tibial avulsion is 1 of the few clear indications for operative treatment of an acute MCL tear.

Disadvantages

- Further investigations are necessary to fully evaluate the long-term functional benefits of MCL repairs with augmentation.
- Clinical application of MCL repair is limited to a select subset of patients with MCL pathology.
- There is a potential to overconstrain the medial knee if the construct is placed too tightly.
- This technique cannot be used in the setting of a chronic MCL injury.⁶

MCL, medial collateral ligament.

Table 2. Surgical Pearls and Potential Pitfalls of Distal MCL Repairs

Pearls
<ul style="list-style-type: none"> • The first suture anchor should be placed proximal to the distal attachment of the MCL to recreate the broad footprint of the distal MCL.² • Tie the repair sutures and tighten the suture tape augmentation with the knee at 30° of flexion. • Identification of the isometric point at the distal insertion is essential for proper suture anchor placement. • Prevent overconstraint of the suture tape by placing a hemostat under the ligament to make sure it is not too tight.
Pitfalls
<ul style="list-style-type: none"> • This technique is not meant to repair attenuated or chronically injured ligaments; as such, appropriate patient selection is paramount to success. • A firm understanding of anatomic landmarks is necessary for appropriate anchor placement. • Avoid over-tensioning the construct to prevent overconstraining the medial knee.

MCL, medial collateral ligament.

outcomes have shown that MCL repairs, albeit in the setting of multiligamentous knee injuries, are superior to reconstructions.¹⁵ Finally, DeLong et al.¹¹ recently performed a review of MCL repairs analyzing the results of 16 investigations. The authors concluded that repair was an effective and reliable treatment in regard to improving valgus stability and patient-reported outcomes. Interestingly, only 5 of the included investigations described the location of MCL tears, documenting a total of 36 (34.0%) tibial-sided tears of 106 MCL injuries.

Similar to the technique presented here, Lubowitz et al.¹³ and van der List et al.⁶ have also previously advocated for suture augmentation of MCL repairs to provide extra protection and allow early range of motion, accelerated rehabilitation, and quicker return to play. For example, a typical MCL repair protocol may involve non-weight-bearing for 3 weeks, with progression to weight-bearing as tolerated within 6 weeks, while limiting range of motion.¹² With an augmented repair, patients may be immediately weight-bearing and start range-of-motion exercises under the supervision of a therapist within the first week of surgery. Such aggressive rehabilitation is supported by biomechanical evidence that indicates repair of medial-sided knee injuries with suture augmentation is superior to repairs alone and is similar in strength to allograft reconstruction techniques.¹⁶

In conclusion, MCL repair with augmentation is a minimally invasive technique that reduces patient morbidity by minimizing the amount of soft-tissue dissection and allowing for accelerated rehabilitation. As such, this is a significant addition to the sports medicine physician's armamentarium and can be used in the acute setting when a distal MCL tear is diagnosed. The technique has numerous advantages compared

with more complex procedures that rely on grafts and nonanatomic reconstructions (Table 1). Pearls and pitfalls of our surgical procedure are outlined in Table 2.

References

1. Miyamoto RG, Bosco JA, Sherman OH. Treatment of medial collateral ligament injuries. *J Am Acad Orthop Surg* 2009;17:152-161.
2. LaPrade RF, Engebretsen AH, Ly TV, Johansen S, Wentorf FA, Engebretsen L. The anatomy of the medial part of the knee. *J Bone Joint Surg Am* 2007;89:2000-2010.
3. Wijdicks CA, Griffith CJ, Johansen S, Engebretsen L, LaPrade RF. Injuries to the medial collateral ligament and associated medial structures of the knee. *J Bone Joint Surg Am* 2010;92:1266-1280.
4. Marchant MH, Tibor LM, Sekiya JK, Hardaker WT, Garrett WE, Taylor DC. Management of medial-sided knee injuries, part 1: Medial collateral ligament. *Am J Sports Med* 2011;39:1102-1113.
5. Fetto JF, Marshall JL. Medial collateral ligament injuries of the knee: A rationale for treatment. *Clin Orthop Relat Res* 1978:206-218.
6. van der List JP, DiFelice GS. Primary repair of the medial collateral ligament with internal bracing. *Arthrosc Tech* 2017;6:e933-e937.
7. Millett PJ, Pennock AT, Sterett WI, Steadman JR. Early ACL reconstruction in combined ACL-MCL injuries. *J Knee Surg* 2004;17:94-98.
8. Ateschrang A, Döbele S, Freude T, Stöckle U, Schröter S, Kraus TM. Acute MCL and ACL injuries: First results of minimal-invasive MCL ligament bracing with combined ACL single-bundle reconstruction. *Arch Orthop Trauma Surg* 2016;136:1265-1272.
9. Bollier M, Smith P. Anterior cruciate ligament and medial collateral ligament injuries. *J Knee Surg* 2014;27:359-368.
10. Tandogan NR, Kayaalp A. Surgical treatment of medial knee ligament injuries: Current indications and techniques. *EFORT open Rev* 2016;1:27-33.
11. DeLong JM, Waterman BR. Surgical techniques for the reconstruction of medial collateral ligament and posteromedial corner injuries of the knee: A systematic review. *Arthroscopy* 2015;31:2258-2272.
12. Wilson TC, Satterfield WH, Johnson DL. Medial collateral ligament "tibial" injuries: Indication for acute repair. *Orthopedics* 2004;27:389-393.
13. Lubowitz JH, MacKay G, Gilmer B. Knee medial collateral ligament and posteromedial corner anatomic repair with internal bracing. *Arthrosc Tech* 2014;3:e505-e508.
14. Frank CB, Loitz BJ, Shrive NG. Injury location affects ligament healing. A morphologic and mechanical study of the healing rabbit medial collateral ligament. *Acta Orthop Scand* 1995;66:455-462.
15. Hanley JM, Anthony CA, DeMik D, et al. Patient-reported outcomes after multiligament knee injury: MCL repair versus reconstruction. *Orthop J Sport Med* 2017;5:2325967117694818.
16. Gilmer BB, Crall T, DeLong J, Kubo T, Mackay G, Jani SS. Biomechanical analysis of internal bracing for treatment of medial knee injuries. *Orthopedics* 2016;39:e532-e537.