Technical Note

Arthroscopic Primary Medial Collateral Ligament Repair With Suture Anchor

Hirotaka Nakashima, M.D., Ph.D., Yasuhiro Takahara, M.D., Ph.D., Yoichiro Uchida, M.D., Ph.D., Hisayoshi Kato, M.D., Ph.D., Satoru Itani, M.D., Ph.D., and Yuichi Iwasaki, M.D.

Abstract: A medial collateral ligament (MCL) tear is common in cases of isolated injury or in those combined with anterior cruciate ligament injury. Although conservative treatment for an MCL tear is popular, some cases result in residual instability. Thus, the treatment approach of grade III MCL injury remains controversial. In this Technical Note, we present the technique of arthroscopic primary MCL repair with suture anchor. With this technique, proximal MCL injuries can be repaired with minimal invasion. This technique improves valgus stability and enables early rehabilitation, including range of motion and weight-bearing exercise.

A medial collateral ligament (MCL) tear is a common injury among the athletic population.1,2 As the MCL has a good healing capacity, conservative treatment is popular.3,4 Most MCL tears can be treated conservatively and healed without instability, even in cases of grade III MCL injury. In general, when combined with an anterior cruciate ligament (ACL) tear, an MCL tear can be treated conservatively and an ACL tear can be treated operatively.3 However, there are some cases that leave residual instability after conservative treatment. Thus, the treatment approach of grade III MCL injury remains controversial.5

In this article and Video 1, we report the surgical technique of arthroscopic primary MCL repair with suture anchor that can be used in cases of isolated MCL injury, combined ACL and MCL injury, or multiligamentous knee injury.

From the Department of Orthopedic Surgery, Nippon Kokan Fukuyama Hospital, Fukuyama, Japan.

The authors report that they have no conflicts of interest in the authorship and publication of this article. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received May 28, 2020; accepted October 4, 2020.
Address correspondence to Hirotaka Nakashima, 1844 Tsunoshita Daimon-cho, Fukuyama City, Hiroshima 721-0927, Japan. E-mail: hirutakanakashima58@gmail.com

© 2020 by the Arthroscopy Association of North America. Published by Elsevier.

Surgical Technique (With Video Illustration)

Preoperative Evaluation and Radiographic Imaging

Findings of the patient’s physical examination should include a positive valgus stress test. We also conduct other physical examinations, such as range of motion (ROM), tenderness, instability including the Lachman test, the anterior drawer test, and posterior drawer test, and the McMurray test. It is important to pay attention to other combined symptoms, including multiligament injury. A routine radiograph is required to exclude the presence of a fracture, as an avulsion fracture of femoral attachment of MCL should be treated operatively.4 The preoperative valgus stress radiograph shows valgus instability at 20° flexion and extension (Fig 1). Magnetic resonance imaging (MRI), which is also important for diagnosing other concomitant injuries, showed deep MCL and superficial MCL tears at the femoral side (Fig 2); therefore, this case was diagnosed as grade III MCL injury.3 The preoperative location of the MCL tear should be confirmed because this surgical technique is indicated for femoral-side MCL tear.

Surgical Technique

Knee arthroscopy is performed with the patient in the supine position under general or spinal anesthesia. A tourniquet is placed on the operative thigh and used if necessary. Routine arthroscopic evaluation is performed to assess intra-articular lesions using anteromedial and anterolateral portals. Arthroscopic evaluation of the medial compartment should be performed during valgus stress. Arthroscopic evaluation...
shows the “drive-through” sign or “floating meniscus” sign, which indicates injury of the meniscocapsular junction (Fig 3).\textsuperscript{4,6,7} Capsular tear and deep MCL tear are confirmed when evaluating the medial femoral epicondyle (Fig 4). A medial portal (MP) is established at the medial femoral epicondyle because attachment of the superficial MCL is in the posterior position of the medial femoral epicondyle (Fig 5A).\textsuperscript{8} If it is difficult to identify the medial femoral epicondyle to establish MP, fluoroscopy may help in identifying radiographic bony landmark. A 1.5-mm JuggerKnot Soft Anchor (Zimmer Biomet, Warsaw, IN) is inserted at the medial epicondyle though the MP (Fig 5B). A far-anteromedial portal is established for suture relay. A 20-G needle with PROLENE (ETHICON, Johnson & Johnson, Blue Ash, OH) is penetrated though the MP to the joint capsule and deep MCL at femoral attachment, after which the suture relay is performed though the FAMP (Fig 5C and D). This work is repeated and knot tying is performed at 20° to 30° flexion (Fig 5E). After knot tying, the capsular and deep MCL tear are repaired (Fig 5F). Arthroscopic view of the medial compartment in the right knee shows improvement of the drive-through sign after MCL repair (Fig 6). Postoperative radiograph shows that valgus instability is improved after surgery (Fig 7). Pearls and pitfalls of this surgical technique are summarized in Table 1.

Postoperative Management and Rehabilitation Protocol
The primary purpose of rehabilitation is to obtain early ROM and normalized gait. Combined with other ligament injuries such as an ACL tear, a secondary surgery is planned to acquire a normal ROM. In general, patients wear a brace with weight-bearing as tolerated, which is locked in extension until quadriceps control is regained. ROM exercise is begun 1 week after surgery.

Discussion
This is a Technical Note showing arthroscopic MCL repair with suture anchor. Our surgical technique is
minimally invasive and allows patients to start functional rehabilitation (Table 2). This surgical technique preserves native MCL, and it can be expected that proprioception and biomechanical properties of native MCL are preserved.

Medial-side stabilizers of the knee consist of the superficial MCL, deep MCL (composed of the meniscotibial and meniscofemoral ligaments), and the posterior oblique ligament. Black et al. reported that rupture of these structures leads to medial meniscal destabilization and extrusion, making their stability of utmost importance during the rehabilitation phase of patient recovery.

MCL tears are common injuries, and most of them can be treated conservatively and healed without instability, even in cases of grade III MCL injury. Reider et al. reported positive outcomes of isolated MCL injuries in athletes with early functional rehabilitation. In addition, Halinen et al. reported in their randomized controlled trial that nonoperative and operative treatments of MCL injuries lead to equally positive results in cases with early ACL reconstruction. These reports support the conservative treatment for grade III MCL injury; however, there are some cases that show residual instability after conservative treatment. Recent studies showed that the MCL was important in restoring anterior stability with ACL and MCL injury. Zhu et al. reported that combined ACL and MCL reconstruction resulted in a better restoration of anterior stability compared with ACL reconstruction alone in a biomechanical study. Funchal et al. reported that the “floating meniscus” sign was an indicator for surgical intervention in patients with combined ACL and grade II MCL injury. They described that the isolated ACL reconstruction group had a greater rate of ACL reconstruction failure and residual MCL laxity in cases of ACL and MCL injury with the “floating meniscus” sign. Thus, treatment of grade III MCL injury remains controversial. In case of failed conservative treatment, operative treatment is indicated. As primary MCL repair is usually performed within 7 to 10 days of injury, it is not recommended after failed conservative treatment and is best replaced with MCL reconstruction or augmentation repair, which has recently been performed with the InternalBrace (Arthrex, Naples, FL). Our surgical technique did not require graft harvesting and may not affect ACL reconstruction in cases of combined MCL and ACL injury. Thus, it may be a good intervention for combined MCL and ACL injury.

Although positive outcomes of surgical treatment for avulsion fracture of femoral attachment of MCL have been reported, the report by Calcei et al. demonstrated a case that required operative treatment for painful nonunion avulsion fracture of the femoral attachment of the MCL. Thus, we also think these fractures should be treated operatively immediate after injury. In addition, there are 2 special MCL injuries that we believe are best treated using primary MCL repair. The first is the MCL tibial-side avulsion injury, which is called a Stener-like lesion. Taketomi et al. recommended primary operative treatments. The “wave

**Fig 3.** Arthroscopic view of the medial compartment in the right knee shows the drive-through sign (white arrowhead) with the patient in the supine position (camera via AL portal, probe via AM portal). (AL, anterolateral; AM, anteromedial.)

**Fig 4.** Arthroscopic view of the capsular tear at the medial femoral epicondyle in the right knee with the patient in the supine position (camera via AL portal). White arrowheads show capsular and deep MCL tear. (AL, anterolateral; MCL, medial collateral ligament.)
The drive-through sign is a characteristic finding on MRI in the case of a distal superficial MCL tear. The second is proximal deep medial collateral ligament injury, which Narvani et al. reported that no patients with injured deep MCL responded to conservative treatment and were, therefore, treated operatively. Nonetheless, all patients were
able to return to their sports after surgery. In addition, deep MCL may affect the persistent symptoms following low-grade MCL injury. Jones et al.\textsuperscript{23} reported that, in patients with persistent medial joint pain following grade I/II MCL sprain, pain from the deep MCL must be considered. Our surgical technique may be good indication for the deep MCL injury.

There are some disadvantages for this surgical technique (Table 2). First, an arthroscopic technique including knot tying is required. Second, indication of this surgical technique is only for a femoral-side MCL injury. Third, this technique is not effective on an isolated superficial MCL tear because a suture anchor is inserted at the medial femoral epicondyle and deep MCL suturing is performed in this technique.

In conclusion, we have presented the surgical technique of arthroscopic primary MCL repair with suture anchor. With this technique, proximal MCL injuries (especially deep MCL injuries) can be repaired with minimal invasion. This technique provides valgus stability and enables early rehabilitation including restored ROM and performance with weight-bearing exercise.

### Table 1. Pearls and Pitfalls of Arthroscopic Primary MCL Repair With Suture Anchor

| Pearls                        | Pitfalls                      |
|-------------------------------|-------------------------------|
| To identify the MCL tear location and other concomitant injuries | Poor visualization          |
| Immediate coagulation using a radiofrequency probe            | Secure knot tying            |
| To establish the medial portal in correct position            |                               |
| Viewing from anterolateral portal and working through the anteromedial and far- anteromedial portal. |                               |
| Insert suture anchor at MCL footprint |                               |

MCL, medial collateral ligament.

### Table 2. Advantages and Disadvantages of Arthroscopic Primary MCL Repair With Suture Anchor

| Advantages                                      | Disadvantages                                      |
|------------------------------------------------|---------------------------------------------------|
| Minimally invasive technique                   | Arthroscopic technique is needed                   |
| The native MCL is preserved                    | Indication of this technique is only for the femoral side of MCL injury |
| Concomitant intra-articular pathology is addressed | This technique is not effective on superficial MCL tears |
| Early restored range of motion is possible     |                                                   |
| There is a lower risk of residual laxity compared with conservative treatment | |
References

1. Swenson DM, Collins CL, Best TM, Flanagan DC, Fields SK, Comstock RD. Epidemiology of knee injuries among U.S. high school athletes, 2005/2006-2010/2011. Med Sci Sports Exerc 2013;45:462-469.

2. Lundblad M, Hägglund M, Thomeé C, et al. Medial collateral ligament injuries of the knee in male professional football players: A prospective three-season study of 130 cases from the UEFA Elite Club Injury Study. Knee Surg Sports Traumatol Arthrosc 2019;27:3692-3698.

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. Encinas-Ullan CA, Rodriguez-Merchan EC. Isolated medial collateral ligament tears: An update on management. EFORT Open Rev 2018;3:398-407.

5. Marchant MH Jr, Tibor LM, Sekiya JK, Hardaker WT Jr, Garrett WE Jr, Taylor DC. Management of medial-sided knee injuries, part 1: Medial collateral ligament. Am J Sports Med 2011;39:1102-1113.

6. Black AK, Schlepp C, Zapf M, Reid JB. Technique for arthroscopically assisted superficial and deep medial collateral ligament–meniscotibial ligament repair with internal brace augmentation. Arthrosc Tech 2018;7:e1215-e1219.

7. Funchal LFZ, Astur DC, Ortiz R, Cohen M. The presence of the arthroscopic floating meniscus—sign as an indicator for surgical intervention in patients with combined anterior cruciate ligament and grade II medial collateral ligament injury. Arthroscopy 2019;35:930-937.

8. Wijdicks CA, Griffith CJ, LaPrade RF, et al. Radiographic identification of the primary medial knee structures. J Bone Joint Surg Am 2009;91:521-529.

9. Reider B, Sathy MR, Talkington J, Blyznak N, Kollias S. Treatment of isolated medial collateral ligament injuries in athletes with early functional rehabilitation. Am J Sports Med 1993;22:470-477.

10. Halinen J, Lindahl J, Hirvensalo E, Santavirta S. Operative and nonoperative treatments of medial collateral ligament rupture with early anterior cruciate ligament reconstruction: A prospective randomized study. Am J Sports Med 2006;34:1134-1140.

11. Zhu J, Dong J, Marshall B, Linde MA, Smolinski P, Fu FH. Medial collateral ligament reconstruction is necessary to restore anterior stability with anterior cruciate and medial collateral ligament injury. Knee Surg Sports Traumatol Arthrosc 2018;26:550-557.

12. Tandogan NR, Kayaalp A. Surgical treatment of medial knee injuries. EFORT Open Rev 2016;1:27-33.

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. van der List JP, DiFelice GS. Primary repair of the medial collateral ligament with internal bracing. Arthrosc Tech 2017;6:e933-e937.

15. Mehil JT, Kia C, Murphy M, et al. Posteriormedial collateral ligament repair of the knee with suture tape augmentation. A biomechanical study. Am J Sports Med 2019;47:2952-2959.

16. Guo D, Yu H, Huang B, Gao X, Qin Y, Liu X. Avulsion of the femoral attachment of the medial collateral ligament in the setting of knee multiligament injury: A case report. Medicine (Baltimore) 2019;98, e18376.

17. Calcei JG, Henry JK, Suryavanshi JR, Fabricant JD, Fabricant PD. Operative treatment for a painful nonunion avulsion fracture of the femoral attachment of the medial collateral ligament in a teenager: A case report. JBJS Case Connect 2019;9, e0281.

18. Brimmo OA, Senne JA, Crim J. MRI findings of Stener-like lesion of the knee: A case series with surgical correlation. Eur J Radiol 2019;121:108709.

19. Aliaa EF, Rosenberg ZS, Aliaa MJ. Stener-like lesions of the superficial medial collateral ligament of the knee: MRI features. Am J Roentgenol 2019;213:W272-W276.

20. Taketomi S, Uchiyama E, Nakagawa T, et al. Clinical features and injury patterns of medial collateral ligament tibial side avulsions: ’Wave sign’ on magnetic resonance imaging is essential for diagnosis. Knee 2014;21:1151-1155.

21. Boutin RD, Fritz RC, Walker REA, Pathria MN, Marder RA, Yao AO. Tears in the distal superficial medial collateral ligament: The wave sign and other associated MRI findings. Skeletal Radiol 2020;49:747-756.

22. Narvani A, Mahmud T, Lavelle J, Williams A. Injury to the proximal deep medial collateral ligament. J Bone Joint Surg Br 2010;92-B:949-953.

23. Jones L, Bismill Q, Alyas F, Connell D, Bell J. Persistent symptoms following non operative management in low grade MCL injury of the knee—The role of the deep MCL. Knee 2009;16:64-68.