RESEARCH ARTICLE

Arthroscopic Posteromedial Corner Reconstruction: A Novel Technique and Case Series

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Abstract

Objectives: This study aimed to introduce a novel arthroscopic treatment for medial and posteromedial instability of the knee and present the primary and follow-up results.

Methods: All patients who underwent the arthroscopic approach to treat medial and posteromedial corner instability from 2007 to 2017 were included in this report. Overall, 45 patients were included, among which 75.6% were male. The mean age of patients was 32.2 ± 8.4 years. Overall, 44.4% and 15.6% of patients had associated meniscal injuries and chondral lesions, respectively. The mean follow-up duration of patients was 84.2 ± 25.3 months.

Results: Overall, 37 patients developed a full range of motion (82.2%), and most patients (95.6%) showed excellent quadriceps strength (grades 4 and 5). All patients had a normal or 1+ posterior drawer test, Pivot shift test, and Lachman test on physical examination. Moreover, 60% had an associated isolated anterior cruciate ligament injury, 17.8% had an isolated posterior collateral ligament injury, and 17.6% had a combination of more than one ligament injury. One patient developed septic arthritis. Two patients experienced pain, and one pain patient developed pain with a bony spur formation in the medial epicondyle. Three patients showed a 2+ medial collateral ligament (MCL) test (moderate instability) at the final follow-up, all of whom had multi-ligament injuries. All patients, except the three patients who had a failed MCL reconstruction, returned to their previous activities.

Conclusion: This study described a novel arthroscopic treatment of MCL injury, and the results showed acceptable postoperative and clinical outcomes. As the use of minimally invasive surgery may minimize multiple complications associated with open surgery, it is suggested that further studies be conducted regarding this approach when faced with patients who have MCL injuries requiring surgery.

Level of evidence: IV

Keywords: Arthroscopy, Instability, Knee, Medial collateral ligament, Posteromedial corner

Introduction

The medial and posteromedial knee structures include the medial collateral ligament (MCL) and the posteromedial corner, which includes the posterior oblique ligament (POL), the semimembranosus expansions, and the posteromedial horn of the medial meniscus.[1] Treatment of MCL injuries is imperative, considering that 40% of all knee injuries are associated with some degree of ligament injury, and the MCL is the most common ligament injury in the knee.[2]

An isolated MCL injury has a high healing potential, and, to this date, orthopedic surgeons mostly take a conservative approach when faced with an injured MCL.[3] However, some factors reduce its healing ability, including an associated injury of the POL, cruciate ligaments, oblique popliteal extensions from the semimembranosus and other deep posteromedial corner injuries, and a rim compression fracture of lateral plateau or a valgus alignment of the knee.[4,5] Most injuries to the MCL that eventually require surgery are associated with an injury to the POL.[6]

Some of the indications for acute medial surgery include a bony avulsion of the MCL structure from the medial epicondyle, combined MCL and posterior cruciate ligament (PCL) injury, an existing bi-cruciate injury, and open medial injuries, interposition of the distal part of the MCL under the

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medial. Furthermore, there are other indications that are considered necessary by some surgeons, such as a complete tibial side MCL injury among athletes or combined anterior cruciate ligament (ACL) and MCL in valgus knees.[7]

Currently, open surgery for the injured MCL and posteromedial corner instability is commonly known and applied worldwide. Minimally invasive approaches, namely an arthroscopic-assisted approach, compared to open surgeries, are associated with better short-term outcomes, such as pain, in specific surgeries.[8] this study aimed to introduce a novel arthroscopic treatment for the medial and posteromedial instability of the knee and present the primary and follow-up results.

Materials and Methods

Study design and settings

This case series was conducted from 2007 to 2017. All patients who underwent arthroscopic MCL reconstruction in Atieh Hospital and Noorafshar Red Crescent Hospital, Tehran, Iran, and had a minimum follow-up of two years were considered for inclusion in the study. Patients with systemic musculoskeletal disorders, tibial plateau fractures, avulsion fractures, open injuries, or injury to the contralateral knee were excluded. All patients with acute injuries received 6-12 weeks of conservative treatment, which included a simple knee immobilizer brace and early active range of motion (ROM) before considering surgery.

The MCL injury grade was defined according to the Hughston classification system.[9] accordingly, a combination of severity and laxity on examination was used. Grade I is considered localized tenderness with no existing instability, and in 30° flexion of the knee, a 3-5 mm absolute medial joint separation from valgus stress. Grade II MCL tear involves generalized tenderness without existing instability and 6-10 mm absolute medial joint separation from valgus stress. Grade III includes instability and disruption of ligaments and >10 mm of medial joint separation in the valgus knee.

In this study, the indications for chronic MCL and posteromedial corner instability using the arthroscopy technique included:

- Grade II MCL and posteromedial corner instability in valgus knee
- Grade III MCL and posteromedial instability in normal alignment
- Any grade II or higher MCL instability in any knee alignment if combined with ACL and/or PCL tear
- Any grade MCL and posteromedial corner instability in substantial valgus deformity (performance of corrective osteotomy before MCL reconstruction in severe valgus deformities was preferred)

All patients underwent physical examinations, including the posterior drawer test (PDT), Lachman test, and pivot-shift test by the senior author. Moreover, all patients underwent knee X-rays and magnetic resonance imaging (MRI) prior to any plans for reconstructive surgery. In stress X-rays, physeal plate injuries were excluded.[10] The MRI was performed to evaluate other existing pathology, especially those of the posterolateral and posteromedial corners of the knee.

Surgical technique

The tibialis posterior allograft was prepared as a single- or double-strand, depending on the type of surgery. In cases of multiple ligament injuries, after the creation of the femoral tunnel of the ACL and/or PCL, a 30-mm deep socket was created on the medial epicondyle at the attachment site of the MCL. In cases where a double PCL tunnel reconstruction was performed, it was attempted not to make a femoral tunnel for the MCL. Moreover, by creating a 5-mm deep crater in the medial epicondyle, the MCL graft was put in the crate and fixed with a tendon staple. In cases of single tunnel PCL reconstruction,[11] the direction of the MCL tunnel was designated to be more proximal in order to prevent interference of femoral tunnels.

Creation of this tunnel could be arthroscopy-assisted or by means of a short incision over the medial epicondyle. In the arthroscopic procedure, by putting the scope from the lateral portal, the medial gutter was viewed, after which, by radiofrequency or shaver, the synovium over the MCL fold was excised, and the attachment site of the remnant of the MCL could be observed and palpated by probing. From the medial side of the knee, one spinal needle was inserted and aimed toward the remnants, and an appropriate arthroscopic portal was created. After that, the guide pin was inserted, and depending on the width of the tibialis posterior tendon, usually by a 6-mm reamer, the 30-mm deep femoral tunnel of the MCL was created.

Another way to create the femoral tunnel was to first make a 3-cm incision over the medial epicondyle, determining the medial epicondyle by palpating and direct vision, and reaming to the optimal size after inserting the guide pin [Figure 1].

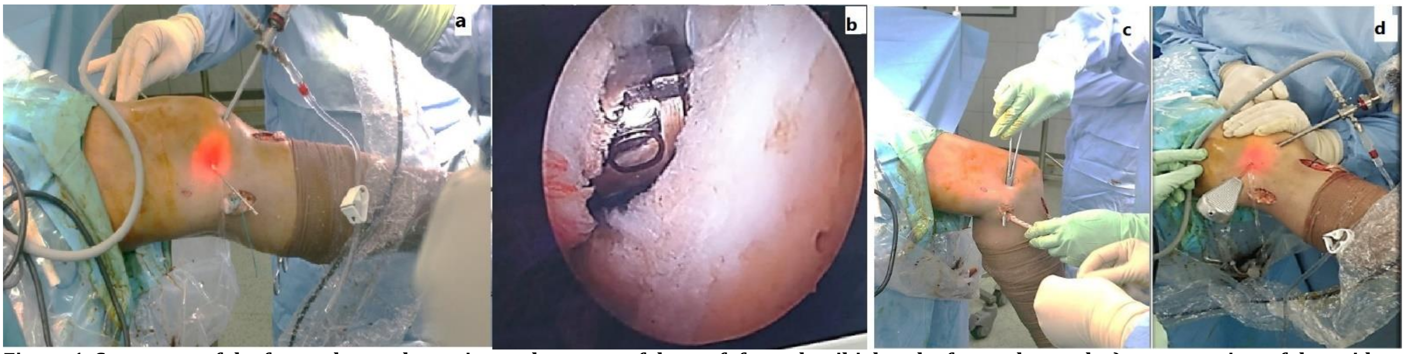

Figure 1. Sequences of the femoral tunnel creation and passage of the graft from the tibial to the femoral tunnel. a) an outer view of the guide pin insertion for the creation of the femoral tunnel in the arthroscopic medial collateral ligament reconstruction technique, b) creation of the femoral tunnel, c) passage of the graft from the tibial to the femoral tunnel, and d) fixation of the graft in the femoral tunnel using a bio-interference screw

For the creation of the tibial tunnel, which was the key point in this type of surgery, a narrow and low-profile PCL jig was placed just lateral to the tibial tuberosity or in cases when bone-tendon-bone (BTB) was used for ACL reconstruction, the jig could be put in the tibial crater of the BTB harvest. The aiming tip of the jig was inserted from the medial portal to the medial compartment and driven from underneath the medial meniscus to the posteromedial corner of the knee. This was to set the jig in place of the largest gap of the MCL or the posteromedial corner, after which the guide pin was drilled and, according to the width of the allograft, usually, a 6-8-mm wide tunnel was created from the tuberosity to the posteromedial corner.

Subsequently, the posteromedial side of the knee was exposed by a short incision. After which, by passing the guide pin with an islet, number 2 Ethibond, or Vicryl suture, replaced the pin. The allograft was initially passed through the tibial tunnel and then from under the deep fascia to the femoral tunnel. At first, the femoral tunnel was fixed by one bio-absorbable interference screw or tendon staple, and after putting enough tension, the tibial tunnel was fixed by another bio-interference screw. The screw size was the same as the tibial or femoral tunnel (30 mm in length with a diameter equal to the diameter of the tunnel). The knee was set in 30-degree flexion, and in varus with no rotation, tension was adjusted depending on the experience of the surgeon (similar to the ACL graft).

In this study, graft displacement was assessed during flexion and extension; however, similar to the ACL graft, a few millimeters of graft displacement during flexion and extension did not contradict graft isometry.

In cases with severe instability (when MCL and POL were severely injured), both ligaments were reconstructed by creating two tibial tunnels. It should be noted that in double tunnel reconstruction, the tendon was first inserted (single femoral double tibial) in the femoral tunnel and thereafter, guided through the tibial tunnels. On the tibial side, the screw was inserted from the anterolateral orifice of the tunnel in most instances; however, in some cases, it was inserted from the posteromedial orifice [Figure 2].

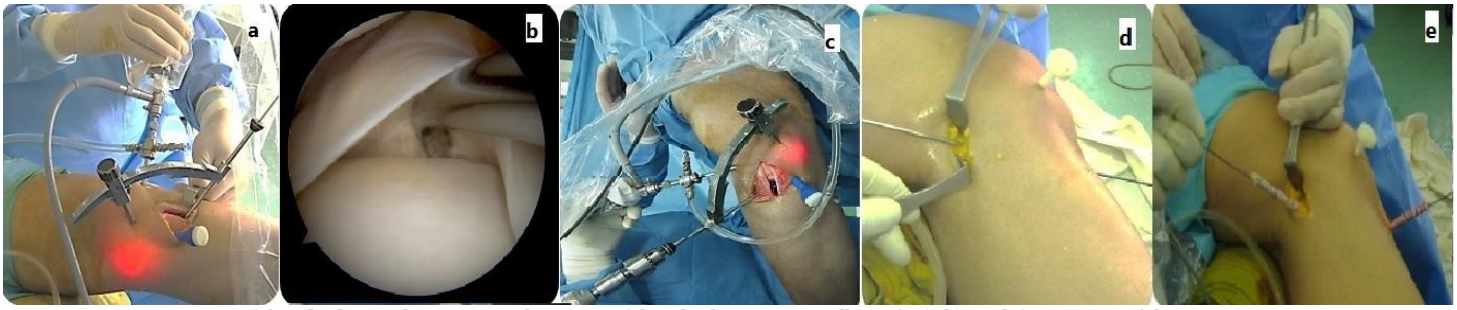

Figure 2. Sequences of the tibial tunnel creation and passing of the tibialis posterior allograft. a), b), and c) insertion of the narrow posterior cruciate ligament jig from underneath the medial meniscus at the center of the widest area in single tunnel medial collateral ligament reconstruction, d) and e) creation of the tibial tunnel and passage of the allograft

In cases of concomitant ACL/PCL reconstruction, a scope was used to monitor tibial tunnel interference, and in cases when interference existed, it was important to manage the tendons to avoid their engagement. Figures 3 and 4 show a schematic of the insertion point for both the single and double tunnel procedures [Figure 3 and 4].

In severe MCL tears, the posterior oblique ligament and medial retinaculum are usually injured and may cause gradual and fixed lateral subluxation of the patella. Therefore, in such cases, in addition to the allograft double tibial tunnel MCL reconstruction, reefing of the MCL and medial retinaculum was also performed.

Based on the experience of the authors, although there is no difference between mini-incision on the medial epicondyle and arthroscopic assisted exposure of the medial epicondyle, the creation of the femoral tunnel and fixation of the graft in the femoral tunnel could also be performed by arthroscopically-assisted procedures or a mini-incision over the medial epicondyle of the femur. Supplement file 1 shows a video describing the surgical technique used.

Furthermore, according to the experience of the authors, tibialis posterior allografts are usually more easily passed through the created bone tunnels. The tibialis and Achilles grafts are usually single-strand tendon grafts; however, semitendinosus and gracillis grafts (which we rarely use) are double-strand grafts. The double tunnel technique can be used in grade III MCL and posteromedial instabilities based on the preference of the surgeon.

Postoperative care

A simple knee immobilizer was applied in the operating room, and isometric quadriceps exercise and ankle pump were initiated immediately. Classic anti-deep vein thrombosis protocol was applied similarly to other knee procedures.

All patients were visited in the clinic at the end of the first week, and an active ROM was started. Partial weight bearing with knee immobilizer was started at the third week, and at the fourth to the sixth week after surgery the immobilizer was removed, the crutches were changed to a cane, and depending on the knee conditions, the cane was removed within one month.

The rehabilitation program was similar among all patients, and only modifications were made for each specific case. Rehabilitation programs were modified for patients with cartilage damage or meniscus repair. In patients with PCL injuries, ROM exercises were performed in the prone position, unlike exercises in patients with ACL injuries, which are performed in the supine position.

Patients were evaluated regarding quadriceps muscle strength, knee ROM, pain and effusion, patellar mobilization, PDT, pivot-shift test, Lachman, and MCL tests. Lachman and pivot-shift tests were performed to evaluate the condition of the ACL.

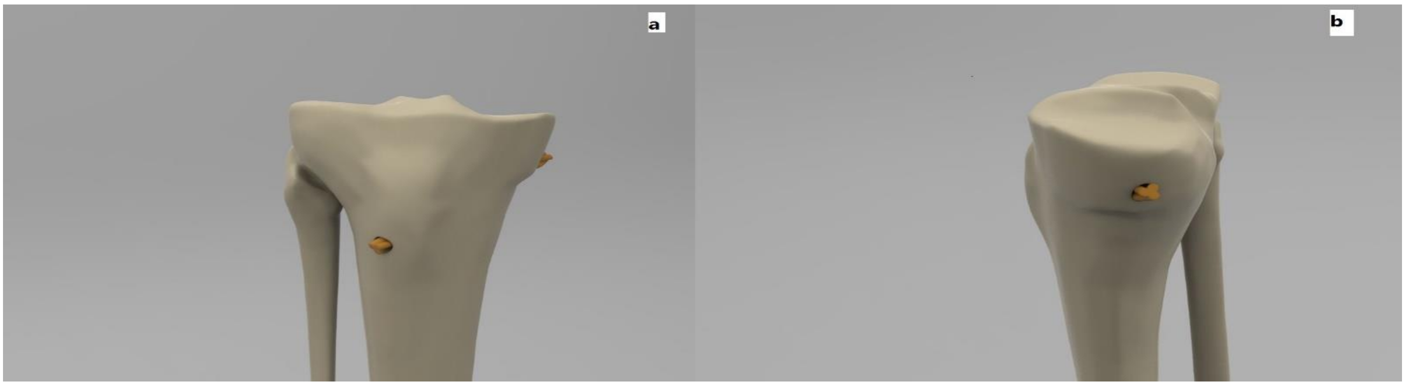

Figure 3. Single tunnel medial collateral ligament reconstruction. a) Single tunnel medial collateral ligament reconstruction from the anterior view, b) Single tunnel reconstruction from a lateral view

Figure 4. Double tunnel medial collateral ligament reconstruction. a) Double tunnel medial collateral ligament reconstruction from the anterior view, b) double tunnel reconstruction from a lateral view, c) a schematic view of the double tunnel reconstruction from above.

Definition of variables

The endpoint method was used for the evaluation of the Lachman test. In this method, a normal Lachman test was considered when no obvious injury to the knee existed, compared to the normal contralateral knee. Accordingly, when the knee of a patient moved 2-5 mm, compared to the contralateral knee, it was scored 1+ (mild). Moreover, when the knee moved 5-10 mm, compared to the contralateral knee, it was scored 2+ (moderate). Finally, when the knee moved 10-15 mm, it was scored 3+ (severe).[12]

Quadriceps muscle strength was graded as follows: grade 0 as no contraction in the muscle, grade 1 as contraction but no movement at the joint, grade 2 as movement in a horizontal plane with no movement in the vertical plane, grade 3 as movement in the vertical plane with no resistance against force, grade 4 as movement in the vertical plane with minor resistance against force, and grade 5 as normal muscle movement.[13]

Arthroscopy-assisted or completely arthroscopic MCL reconstructions in the present study were classified as follows: for those who had arthroscopy-assisted reconstructions, the tibial tunnel was created using arthroscopy and the femoral tunnel using a mini-open procedure, and for those categorized as completely arthroscopic, both femoral and tibial tunnels were created arthroscopically. Selection between the two techniques was dependent on the preference of the surgeon.

As this is a novel surgical technique, all surgeries were performed by the supervising surgeon and evaluated by the same surgeon.

Statistical analysis

Data were analyzed using the SPSS software for Windows (version 20) and reported as mean and standard deviations (SD) for quantitative variables as well as frequency and percentage for qualitative variables.

Results

Overall, 45 patients were included in this study who had arthroscopic MCL reconstruction during the 10-year study period. Regarding gender, 75.6% of them were male. Moreover, the mean ± SD of the age of patients in this study was 32.2 ± 8.4 years old. The left knee was involved in 55.6% of cases, and non-sport-related injuries constituted 52.4% of the total number of injuries. The mean ± SD of the interval between injury and surgery was 21 ± 11 weeks. In 52.4% of the patients, the type of injury was caused by contact injuries, and the rest were non-contact injuries.

Regarding preoperative examinations, at the first visit, the PDT was 2+ and 3+ in 46.2.2% and 46.2% of patients, respectively. Furthermore, the Lachman test was scored 2+ and 3+ among 40.6% and 43.8% of patients, respectively. In addition, the Pivot shift test was 2+ and 3+ in 60% and 40% of patients, and the MCL was 2+ and 3+ in 38.9% and 55.6% of patients, respectively.

Regarding associated ligament injuries, the majority of patients had an associated ACL tear (60%), followed by PCL tear (17.8%), a combination of ACL and other ligament injuries, including POL and posterolateral corner (PLC) injuries (15.4%), PCL and POL (2.2%), and the rest had isolated MCL injuries (4.4%). Based on the Schenk classification, among patients with associated ligament injuries (n=57), 91.2% had type I, and 8.8% had type IIIM injuries.

In total, 75.6% of MCL reconstructions were completely arthroscopic, while the femoral tunnel was created for the rest of them (24.4%) using a mini-open surgery (arthroscopy assisted). Moreover, MCL reconstructions were performed using the single tunnel approach (100%) and allografts (77.3%). The grafts used for MCL reconstruction were mostly tibialis posterior tendon allografts (71.1%), followed by semitendinosus autografts (17.8%). In total, 8.9% of MCL reconstructions were associated with MCL reefing.

Overall, 28.1% of ACL reconstructions were revision surgeries. Majority of the ACL reconstructions were performed using an autograft (70%). All allografts used for ACL reconstruction were tibialis posterior/anterior allografts (9/10), except for one case in which Achilles tendon allograft was used. The PCL grafts were all obtained from tibialis posterior allografts, half of which were reconstructed using a double tunnel approach (50%). In total, 44.4% of patients had associated meniscal injuries. Moreover, partial meniscectomy was the most common procedure (95%). It is noteworthy that chondral lesions were observed in 15.6% of patients. In total, three (6.6%) patients required posteromedial reconstruction [Table 1].

Table 1. Baseline and clinical characteristics of patients

Variables		Statistics
Age (years)[1]		32.2±8.4
Gender[2]	Male	34 (75.6)
	Female	11 (24.4)
Side of involvement[2]	Right	20 (44.4)
	Left	25 (55.6)
Etiology of injury[2]	Sport-related	20 (47.6)
	Sport-unrelated	22 (52.4)
Interval between injury and surgery (weeks)[1]		50.5±75.8
Mechanism of injury[2]	Contact	22 (52.4)
	Non-contact	20 (47.6)
Posterior drawer test[2]	1+	1 (7.7)
	2+	6 (46.2)
	3+	6 (46.2)
Lachman[2]	1+	5 (15.6)
	2+	13 (40.6)
	3+	14 (43.8)
Pivot shift[2]	1+	0 (0)
	2+	15 (60)
	3+	10 (40)

Table 1. Continued

	1+	2 (4.4)
MCL score²	2+	14 (38.9)
	3+	20 (55.6)

MCL: medial collateral ligament; ACL: anterior cruciate ligament; PCL: posterior cruciate ligament

Data presented as 1: mean ± standard deviation and 2: number (percent)

Mean (SD) of final follow-up of patients was 84.25 ± 25.37 months. At the final follow-up, 37 patients developed a full ROM (82.2%). Besides, 95.6% of patients showed excellent (grades 4 and 5) quadriceps strength. All patients had either a normal or 1+ PDT, Pivot shift test, and Lachman test on physical examination.

During follow-up, one patient developed septic arthritis and accordingly, underwent drainage and intravenous antibiotics. It should be mentioned that finally, it resolved over time. Two patients experienced pain (15 and 36 months postoperatively), and one pain patient developed pain with a bony spur formation (19 months postoperatively) in the medial epicondyle for which he received an intra-articular corticosteroid injection. Moreover, two patients developed mild arthrofibrosis.

Three patients showed a 2+ MCL test (moderate instability) at the final follow-up, all of whom had multi-ligament injuries (two had concomitant PCL injuries and one had a concomitant ACL injury). One of the patients with a failed reconstruction had a BTB ACL reconstruction and reefing of the MCL and medial retinaculum. However, this patient had bilateral valgus deformity of the knee. During follow-up, a negative Lachman and pivot shift test was recorded, and the patient was scheduled for varus osteotomy; nevertheless, the patient did not return for the follow-up visit. One of the other patients who had a failed operation developed septic arthritis during his follow-up, which was managed as mentioned before. All patients, except the three patients who had a failed MCL reconstruction, successfully returned to their previous level of activity. Specifics on follow-ups of patients are reported in detail in [Tables 2 and 3].

Table 2. Arthroscopic findings and operative characteristics

Variables		Statistics N (%)
	Isolated ACL	27 (60)
	Isolated PCL	8 (17.8)
Associated ligament injuries	ACL and PCL	5 (15.4)
	PCL and posterior oblique	1 (2.2)
	No associated ligament injury	4 (4.4)
	Completely arthroscopic	34 (75.6)
MCL reconstruction technique¹	Arthroscopy-assisted	11 (24.4)
	Single	45 (100)
MCL tunnel¹	Double	0 (0)
	Reconstruction alone	41 (91.1)
MCL surgery¹	Reconstruction and reefing	4 (8.9)
	Allograft	35 (77.3)
MCL graft¹	Autograft	10 (22.7)
	Tibialis posterior	32 (71.1)
MCL graft type¹	Semitendinosus	8 (17.8)
	Gracilis	2 (4.4)
	Tibialis anterior	2 (4.4)
	Achilles	1 (2.2)

Table 2. Continued

ACL injury[1]	Primary	23 (71.9)
	Revision surgery	9 (28.1)
ACL graft[1]	Allograft	10 (30)
	Autograft	22 (70)
ACL graft type[1]	BTB autograft	22 (68.7)
	Tibialis anterior/posterior allograft	9 (28.1)
	Achilles	1 (3.1)
PCL graft[2]	Tibialis posterior allograft	14 (100)
	Autograft	0
PCL tunnel[2]	Single	7 (50)
	Double	7 (50)
Meniscal injury[2]	Lateral	12 (60)
	Medial	7 (35)
	Medial and lateral	1 (5)
Meniscal surgery	Partial meniscectomy	19 (95)
	Partial meniscectomy and partial repair	1 (5)
Chondral lesion[2]		7 (15.6)

Data is presented as number (percent)

MCL: medial collateral ligament, ACL: anterior cruciate ligament, PCL: posterior cruciate ligament, BTB: bone-tendon-bone

Table 3. Clinical outcomes during follow-up among patients with arthroscopic MCL reconstruction

Variables		**Statistics**
First follow-up (weeks)[1]		2.5±7.6
Full ROM[2]		1 (2.5)
Quadriceps muscle strength[2]	0 or 1	2 (4.7)
	2 or 3	12 (27.9)
	4 or 5	29 (64.4)
Second follow-up (weeks)[1]		4.6±2.6
Full ROM[2]		4 (9.3)
Quadriceps muscle strength[2]	0 or 1	1 (2.3)
	2 or 3	5 (11.6)
	4 or 5	37 (86.1)
Third follow-up (weeks)[1]		10.2±7.3
Full ROM[2]		16 (38.1)

Table 3. Continued

	0 or 1	0 (0)
Quadriceps muscle strength²	2 or 3	6 (14.3)
	4 or 5	36 (85.7)
Forth follow-up (weeks)¹		18.1±10.0
Full ROM²		26 (66.7)
	0 or 1	0 (0)
Quadriceps muscle strength²	2 or 3	0 (0)
	4 or 5	39 (100)
Fifth follow-up (weeks)¹		82.3±33.8
Full ROM²		24 (92.3)
	0 or 1	0 (0)
Quadriceps muscle strength²	2 or 3	0 (0)
	4 or 5	39 (100)
Overall final follow-up (months)¹		84.2±25.3
Full ROM²		37 (82.2)
	0 or 1	0 (0)
Quadriceps muscle strength²	2 or 3	2 (4.4)
	4 or 5	43 (95.6)
Positive posterior drawer test²		1 (11.1)
Positive pivot shift²		1 (7.7)
Positive Lachman²		1 (4.8)
	0	22 (61.1)
MCL score²	1	11 (30.6)
	2	3 (8.3)
	Septic arthritis	1 (2.2)
	Pain	2 (4.4)
Complications²	Bony spur formation and pain	1 (2.2)
	Arthrofibrosis	2 (4.4)

ROM: range of motion; MCL: medial collateral ligament

Data presented as 1: mean ± standard deviation and 2: number (percent)

Discussion

This study presented the primary results of a novel arthroscopic approach to MCL tears among patients with isolated and combined MCL tears. It was found that most patients regained full ROM at the final follow-up. Physical examination for instability, including PDT, pivot shift test, and Lachman tests, were all acceptable (either normal or 1+) in almost all patients.

LaPrade et al. described an anatomic reconstruction of the MCL and POL using a hamstring tendon in a study performed on 28 patients (19 males) with a mean age of 32.4 years old.[14] Similar to the findings of the present study, all their patients had some degree of instability at the first visit. At a minimum follow-up of 6 months, they found that none of the patients reported postoperative laxity or side-to-side instability. However, one of the patients in their study reported postoperative wound infection at 3 months of follow-up, which was debrided.

Multiple surgical techniques have been introduced over the past years for the treatment of MCL injuries using different fixation methods and grafts, and almost all these techniques have rendered good postoperative results.[15–17] A recent systematic review that evaluated the anatomic and non-anatomic reconstruction of MCL reviewed 25 studies conducted on MCL reconstruction up to 2013[15]. In all the studies reported on either anatomic or non-anatomic reconstruction techniques, except three studies,[14,18,19] a percentage of patients were found to have a valgus stress test (MCL test) of more than 1+ after more than 16 months of follow-up (range: 16-53 months). When comparing different surgical techniques in their review, the authors found that except for the previously mentioned study by LaPrade et al.[14] that adapted an anatomic double-bundle reconstruction technique using both allografts and autografts, all the other techniques, including anatomic single bundle, non-anatomic single- or double-bundle, and non-anatomic tendon transfer reconstruction techniques were associated with some degrees of MCL failure (MCL>1+).

These results were comparable with those of the present report and arthroscopic technique, as only one patient was reported to have an MCL of 2+ during follow-up. However, that patient had a bilateral valgus deformity of the knee, which may have affected the outcomes. The sample size of patients in the present study was larger, compared to those of all the studies in the aforementioned review. Moreover, almost all of the patients in the present study gained full ROM at follow-up.

In this study, the efficacy of the arthroscopic technique was confirmed, considering that all of the cases in the present study had grade 3+ or 2+ MCL (posteromedial corner) injuries in physical examination at the first visit. Moreover, other than one patient, no case of instability or stiffness was documented in postoperative follow-up among our patients.

One interesting point in the present study was that despite the previous belief that a combined ACL/MCL would be associated with a medial meniscus injury termed the unhappy O'Donoghue triad, it was found that the majority of patients with ACL/MCL injuries had an associated lateral meniscus injury rather than a medial meniscus injury (51.6% vs. 35.5%). This was similar to that of the findings of a study performed by Shelbourne and Nitz.[20–22]

Compared to previous studies, the clinical results of the present study regarding the obtained ROM, instability, and muscle power were very similar to those of previous literature, which included an open surgical approach for the treatment of MCL injuries. More interestingly, the outcomes of the present study were much better, especially regarding postoperative complications, namely infections, wound healing, and pain, which are reported in open procedures.[17] this is extremely important as it shows the efficacy of the arthroscopic approach in terms of clinical application and outcomes when considering this minimally invasive modality.

Since we do not touch the injured native MCL, one of the advantages of this procedure and our technique is that the allograft works at least as an internal brace and promotes the healing of the native MCL. It is believed that most cases of MCL injuries heal without the need for surgical treatment. The authors of the present study recommend that patients with acute injuries (especially among patients with varus knees) receive a period of conservative treatment of 6 weeks before considering arthroscopic surgery. Indications of the authors for acute MCL reconstruction are cases with lateral tibial plateau fractures and/or multiple ligament injuries in whom early surgical intervention is indicated.

Regarding the patients in the present study, 12.6% of our ACL and MCL reconstructions were revision ACL reconstructions. This indicates that previously missed MCL injuries may be an important factor for revision ACL surgeries.

The novel approach used in the present study which included an arthroscopic allograft MCL reconstruction provides multiple benefits. As the findings indicate, this technique provides high rates of postoperative stability and restores normal ROM among patients. In addition, an arthroscopic approach naturally provides higher healing potential for the native MCL, compared to an open surgery. Moreover, an arthroscopic approach renders better cosmetic benefits as a minimally invasive procedure. Furthermore, saphenous nerve injury was non-existent in our arthroscopic technique, compared to other open procedures, which require large incisions in the medial side of the knee.[23] After the establishment of this technique, further prospective studies providing a stronger level of evidence would better demonstrate the short and long-term outcome of the arthroscopic technique for the treatment of MCL injuries.

It should be mentioned that the present study had some limitations. Although our clinical outcomes excelled, as this is a novel approach, a complete assessment of the outcomes of this technique remains to be further addressed in future studies. Moreover, compared to previous reports, we had a large sample size of patients with injuries to the posteromedial compartment who underwent our reconstruction technique. Although we did not report on any patients who had the double-tunnel reconstruction technique, our recent short-term (unpublished) results have been encouraging among these patients. All examinations and follow-up visits were performed by one experienced surgeon, minimizing any bias in subjective assessments.

Conclusion

The present study described a novel arthroscopic treatment of MCL injury, and the results showed acceptable postoperative and clinical outcomes. As the use of minimally invasive surgery may minimize multiple complications associated with open surgery, it is suggested that further studies be conducted regarding this approach when faced with patients who have MCL injuries requiring surgery.

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