Surgical Technique

Does Mini-invasive Medial Collateral Ligament and Posterior Oblique Ligament Repair Restore Knee Stability in Combined Chronic Medial and ACL Injuries?

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Abstract

Background Residual laxity remains after ACL reconstruction in patients with combined chronic ACL and medial instability. The question arises whether to correct medial capsular and ligament injuries when Grade II and III medial laxity is present.

Description of Technique We developed a mini-invasive medial ligament plasty to repair the medial collateral ligament to correct residual medial valgus and rotatory laxity after ACL reconstruction.

Patients and Methods We prospectively followed 36 patients with an ACL deficiency combined with chronic Grade II or III valgus and rotatory medial instability. The mean age was 37 years (range, 15–70 years). For all patients, we obtained preoperative and postoperative Knee Injury and Osteoarthritis Outcome, International Knee Documentation Committee, Lysholm, and Tegner Activity Level Scores. The minimum followup was 2 years (median, 3 years; range, 2–7 years).

Results The mean subjective International Knee Documentation Committee score improved from 36 preoperatively to 94 at the last followup. While all patients had an International Knee Documentation Committee score

of Grade C or D preoperatively, no patient did postoperatively. The mean Knee Injury and Osteoarthritis Outcome Score improved from 45 preoperatively to 93 postoperatively. Valgus and external rotatory tests were negative in all patients. The mean Tegner activity level decreased from 7 preinjury to 6 postoperatively, and the mean Lysholm score improved from 40 preoperatively to 93 at last followup.

Conclusions This simple technique restored medial stability and knee function to normal or nearly normal in all patients.

Level of Evidence Level IV, therapeutic study. See the Guidelines for Authors for a complete description of levels of evidence.

Introduction

The medial collateral ligament (MCL) is the most frequently injured ligament in the knee [13]. Most MCL lesions heal with nonoperative treatment and chronic MCL instability is rare [18], but up to 78% of Grade III MCL injuries are associated with an ACL lesion [2]. Injuries to the posterior oblique ligament (POL) are associated with Grade III medial injuries [19] with resulting valgus and rotatory instability [4]. Residual laxities remain when surgeons perform ACL reconstruction in patients with combined ACL and medial instability, raising the questions of whether and how to repair the medial capsular and ligament structures in the presence of Grade II to III medial laxity [34]. Medial laxity implies a larger load on the ACL in chronic anteromedial instability [7].

Several surgical techniques describe reconstruction of the MCL without repairing the posteromedial structures or using capsular plication to tense the MCL and POL [4–6].

Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

Each author certifies that he has no commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.

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Lind et al. [13] described a technique to repair both the MCL and POL. Medial stability according to the International Knee Documentation Committee (IKDC) score was normal or nearly normal (Grade A or B) in 98% of patients and the overall IKDC score improved in these patients from 5% preoperatively to 74% with Grade A or B at followup. After MCL and PCL reconstruction, the authors allowed full weight bearing after 8 weeks. Evidence-based guidelines about the best treatment for patients with Grade II or III medial laxity after ACL-MCL injuries are still not available [11, 19]. To reduce stress on the reconstructed ACL and to simplify postoperative rehabilitation without compromising the restoration of function, we developed a mini-invasive medial ligament plasty. This addressed the MCL and POL to correct medial valgus and rotatory instability. We assessed stability, ROM, and function in patients with combined chronic medial and ACL injuries who underwent this procedure.

Surgical Technique

This technique had a specific indication: chronic residual medial laxity after ACL reconstruction. In patients with chronic distal lesions, a proximal repair cannot stabilize the medial compartment due to poor-quality scarring and we believe a reconstructive technique [20] should be used. However, none of our patients had poor-quality scarring. We performed all repairs at the same time as the ACL reconstruction and evaluated all the patients by means of MRI before surgery to obtain useful information to surgical planning.

A single surgeon (GLC) performed all surgeries. We routinely reconstructed the ACL with single-bundle bone-patellar tendon-bone autografts (BPTBs), using Number 2 FiberWire® (Arthrex, Inc, Naples, FL) and polyethylene buttons (Ethicon, Inc, Somerville, NJ) to fix the grafts over the cortical bone at the two extremities. After ACL fixation, we checked valgus and rotatory laxities with a probe positioned on the meniscus border at the level of the intermediate volute of the femoral medial condyle. In the case of a persistent medial joint opening (> 5 mm) and abnormal external tibial rotation, we added a medial repair (Fig. 1). A short longitudinal incision over the medial femoral epicondyle was made (Fig. 2). We then incised the retinaculum, exposing the medial ligament structures (Fig. 3). To regain the original tension, we sutured the MCL and POL proximally (Fig. 4) to the medial epicondyle with multiple figure-of-eight loops using Number 2 Ethibond® (Ethicon) (Fig. 5). We usually performed three figure-of-eight sutures, each starting at the medial epicondyle and extending distally approximately 3 cm. One was placed aiming slightly anteriorly and distally, one directly

Fig. 1 A photograph shows how the medial compartment is still open after ACL fixation. The probe is positioned at the inner border of the middle horn of the medial meniscus.

Fig. 2 A photograph shows the small incision over the medial epicondyle.

Fig. 3 A photograph shows the laxity of the medial compartment.

distally, and one slightly posteriorly and distally (in the direction of the POL). We tied the sutures and checked the tension in extension and flexion (Fig. 6). Additional sutures

Fig. 4 The photograph shows the lax medial tissue tightened up to the epicondyle; note the sutures of the POL.

Fig. 5 The photograph shows the nonabsorbable sutures of the MCL.

Fig. 6 The photograph shows sutures at the end of the procedure: the MCL and POL have been advanced proximally to the medial epicondyle.

were performed in the case of residual laxity (Fig. 7). Valgus stress and external rotation drawer tests were negative intraoperatively after the proximal reefing of both the MCL and POL in all patients (Fig. 8). We performed 15 partial meniscectomies: 12 medial and eight lateral irreparable meniscal tears. Five patients underwent a

Fig. 7 The photograph shows the sutures of the retinaculum.

Fig. 8 The photograph shows the physiologic gap of the medial compartment at the end of the procedure.

medial and lateral partial meniscectomy. In two patients, the medial meniscus was repaired with polydioxanone sutures. Ten patients had Outerbridge Grade II [22] chondral lesions, which we debrided with a basket punch (Acufex[®]; Smith and Nephew, Inc, Memphis, TN) and performed microfractures in two patients.

We instructed patients to use the same home, unsupervised rehabilitation as that of patients undergoing an isolated ACL reconstruction with two exceptions: using crutches for 4 weeks instead of 2 weeks and a hinged brace for 6 weeks with free ROM (not prescribed in isolated ACL reconstructions). Home rehabilitation progression was checked during clinical followups. We permitted weightbearing as tolerated from the day after surgery and allowed controlled sports activities after 3 months and contact sports after 6 months.

Patients and Methods

We prospectively collected data between 2002 and 2008 on 36 athletes practising competitive or recreational activities with symptomatic ACL deficiencies combined with chronic Grade II or III valgus or rotatory medial instability. During that time, we performed 612 ACL reconstructions and thus these 36 patients represented 5% of the total ACL reconstructions. There were 26 males and 10 females. The mean age was 37 years (range, 15–70 years). A 70-year-old patient was included in this study as he was performing a sports activity at the time of surgery. Associated injuries included chondral lesions in 10 patients and meniscal lesions in 17 (medial 12, lateral eight, medial and lateral five). 18 right knees and 18 left knees were affected. The mean time between injury and surgery was 37 weeks (range, 8–136 weeks; SD, 34.4 weeks; median, 22 weeks) (Table 1). Eleven patients (30%) had Grade II instability and 25 patients (70%) had Grade III instability. We intraoperatively confirmed valgus laxity by an opening of the medial tibiofemoral joint of 5 to 10 mm in Grade II and more than 10 mm in Grade III [10, 24]. Twenty-five patients showed positive valgus stress at 0° and 20° [24, 27] and 11 showed positive valgus stress at 20°. All patients had a positive external rotation test at 30° and 90° (> 10°). In all patients, the Lachman and pivot shift tests were positive and side-to-side AP displacement differences were more than 3 mm (Table 2). All patients underwent an MRI before surgery. No patients were lost to followup. The minimum followup was 2 years (median, 3 years; range, 2–7 years). All patients were re-examined specifically for this study.

The clinical followup protocol used at 1 and 2 weeks postoperatively included wound dressing and checking

progressive recovery of joint mobility, muscular strength, and weightbearing. Thereafter, we scheduled checkups at 1, 3, 6, and 12 months followed by annual checkups to monitor functional outcome. An author not involved in the surgery but experienced in the evaluation of knee disorders (TL) and a second author (AC) conducted the clinical examinations on all patients. No intraobserver or interobserver variability assessment was performed. We used the Lachman [31], pivot shift [3], and anterior drawer [15] tests to assess ACL instability and the valgus stress and external rotation test [24, 27] to assess medial laxity. The valgus stress test was performed with the knee both in full extension and at 20° of flexion [24]. We graded these tests according to the objective IKDC form [9] where Grade A was used for normal, B for nearly normal, C for abnormal, and D for severely abnormal knee functions (Table 2). We used the IKDC guidelines to define the symmetrical ROM: knee extension within 2° and knee flexion within 5° from the contralateral knee. Passive ROM was measured with a goniometer and recorded for both knees. To measure the side-to-side difference of anterior translation with the knee at 20° of flexion, we used the KT-1000™ arthrometer (MEDmetric Corp, San Diego, CA). We also classified the cartilage during the arthroscopic procedure according to the Outerbridge Classification [23]. To carry out further evaluations, we used four knee-specific scoring systems: the activity level scale of Tegner and Lysholm [30], the Lysholm and Gillquist score [14], the Knee Injury and Osteoarthritis Outcome Score (KOOS) [26], and the subjective IKDC form [8]. We calculated the Lysholm, KOOS, and IKDC Scores on a scale of 0 to 100, with 0 indicating the worst health and 100 indicating no knee problems.

We used the paired *t* test to compare pre- and postoperative data in relation to the KOOS and KT-1000™ arthrometer evaluations. We used chi square tests to compare pre- and postoperative values regarding IKDC evaluation (Table 2). For all analyses, we used the software of Stanton A. Glantz (Primer of Biostatistics, McGraw-Hill, New York, USA).

Table 1. Patient characteristics

Characteristic	Value
Number of patients	36
Gender (female/male)	10/26
Side (right/left)	18/18
Mean age (years)	37 (15–70)
Injury to surgery time (weeks)	
Mean	37 (8–136)
SD	34.4
Median	22
Meniscal lesions treated (number)	17 (47%)
Medial	12
Lateral	8
Medial + lateral	5
Chondroplasty treated (number)	10 (28%)
Microfracture associated	2

Results

In all patients, the valgus stress and external rotation tests were negative at followup (< 3 mm medial joint opening and < 6° of external rotation, respectively). All patients had IKDC Grade A or B at followup. Medial stability according to the IKDC Score, was 100% normal or nearly normal, with 30 patients categorized as Grade A and 6 as Grade B. The objective overall IKDC score improved from an abnormal Grade C or D in 100% of the patients preoperatively to 0% Grade C or D at followup (Table 2). ROM returned to the same level as that of the contralateral knee.

Table 2. Functional outcomes

Test	Preoperative	Last followup	p Value (method)
KT-1000 TM arthrometer side-to-side difference (mm)*	4.9 ± 1.4	0.6 ± 1.1	< 0.0001 (paired t test)
Overall IKDC evaluation (number of patients)			< 0.0001 (chi square test)
A (normal)	0	30 (83%)	
B (nearly normal)	0	6 (17%)	
C (abnormal)	35 (97%)	0	
D (severely abnormal)	1 (3%)	0	
IKDC medial instability (number of patients)			< 0.0001 (chi square test)
A (normal)	0	30 (83%)	
B (nearly normal)	0	6 (17%)	
C (abnormal)	35 (97%)	0	
D (severely abnormal)	1 (3%)	0	

* Values are expressed as mean ± SD; IKDC = International Knee Documentation Committee.

Table 3. Preoperative and postoperative KOOS in combined MCL-ACL

KOOS subscale	Preoperative	Followup	p Value (method)
Symptoms	52 (50/20.8)	94 (100/8.1)	< 0.0001 (paired t test)
Pain	54 (50/19.1)	95 (97/8.3)	< 0.0001 (paired t test)
ADL	56 (56.5/22)	99 (100/3.4)	< 0.0001 (paired t test)
Sports/ recreation	28 (25/18.3)	90 (95/10.4)	< 0.0001 (paired t test)
Quality of life	36 (38/13.7)	85 (100/19)	< 0.0001 (paired t test)

Data are presented as mean, with median/SD in parentheses; KOOS = Knee Injury and Osteoarthritis Outcome Score; MCL = medial collateral ligament; ADL = activities of daily living.

We observed stiffness in no case. The KT-1000TM arthrometer measurements for all patients improved, with normal scores in none of the patients preoperatively and in 89% at the last followup (Table 2). The KOOS profile demonstrated the ability to perform sports and quality of life improved after ACL reconstruction and medial repair (Table 3). The mean KOOS score was 45 preoperatively and 93 postoperatively. The mean subjective IKDC Score was 36 preoperatively (SD, 12.3; median, 39.7) and 94 postoperatively (SD, 5.7; median, 95.4). The mean Tegner activity level scale was 7 before injury (SD, 1.3; median, 7) and 6 after surgery (SD, 1.4; median, 6). The mean Lysholm Score was 40 preoperatively (SD, 15.6; median, 37) and 93 postoperatively (SD, 8.1; median, 95). 75% of patients returned to their preinjury activity level. 11% reported they did not practice any sports activities for fear of reinjury and 14% for lack of time. No patient abandoned sports because of knee problems.

There were no infections, deep venous thromboses, nerve injuries, or other operative complications in this series. No patient required further surgery at the time of the last followup.

Discussion

Acute MCL lesions usually heal without surgery and with early ROM and no repair [33]. Controversies still exist in the management of combined ACL and MCL injuries: according to some authors, ACL reconstruction is sufficient to restore knee stability [5, 16, 28], whereas others advocate repair of both the ACL and MCL [2, 6, 21]. The current trend consists in less aggressive treatment of medial laxity with great effort to improve ACL reconstruction [17], but in Grade III medial injuries, both the MCL and POL are damaged with a substantial increase of external rotation. We developed a mini-invasive technique applied to ACL reconstruction in patients with chronic medial laxity when the medial compartment was still lax after ACL fixation. We assessed stability, ROM and function in patients with combined chronic medial and ACL injuries who underwent this procedure.

Our study, while prospective, is subject to a number of limitations. Firstly, we had no control group without medial surgery or treated with medial reconstructive techniques. The knee function of all patients treated with this technique restored an IKDC score of normal or nearly normal without residual medial knee laxity, while in the literature, these residual laxities were observed in isolated ACL reconstructions [28]. Secondly, we did not use any instrument to objectively evaluate the medial compartment opening and the external rotation. Literature is still controversial on the correlation between instrumental and manual clinical evaluations [1, 23, 29, 32]. Third, while valgus stress X-rays can provide objective and reproducible measurements of medial compartment gaps [12], the external rotation test currently remains a manual and subjective evaluation.

Our data compared favorably with those presented in literature with reconstructive techniques: the reduced

Table 4. Comparison of our outcomes and those of selected articles

Study	Number of patients	Treatment	Key findings
Osti et al. [21] (2010)	22	MCL repair + ACL reconstruction	91% returned to sports at preinjury level
Lind et al. [13] (2009)	48	MCL reconstruction + multiligament reconstruction	74% had IKDC Grade A or B at followup
Zaffagnini et al. [34] (2007)	20	Grade II MCL managed nonoperatively + ACL reconstruction	Residual laxities remained when ACL reconstruction was performed in patients with combined ACL + MCL lesion
Millett et al. [17] (2004)	18	Grade II or III MCL managed nonoperatively + acute ACL lesion surgically managed	No difference in function or activity in Grade II vs Grade III MCL injury; early reconstruction allowed a faster MCL healing
Robins et al. [25] (1993)	20 (13 with lesions at or proximal to the joint line and 7 with disruptions distal to the joint line)	Both ACL + MCL repair	Location of MCL disruption is important: patients with double ligament injuries, where the MCL lesion was proximal, should be managed aggressively to regain motion
Shelbourne and Nitz [28] (1990)	68	MCL managed nonoperatively + ACL reconstruction	95% resumed their preinjury activity
Canata et al.	36	Grade II or III MCL repair + ACL reconstruction	100% had IKDC Grade A or B at followup; 75% returned to their preinjury activity level; no patient abandoned sports for knee problems

MCL = medial collateral ligament; IKDC = International Knee Documentation Committee.

invasiveness of this technique allowed immediate weight-bearing with free ROM and all our patients had a normal or nearly normal IKDC score without complications (Table 4). We observed no limitation in the ROM in our patients with proximal repair, while, in MCL reconstructions, Lind et al. [13] found ROM deficits in 20% of patients. The mini-invasive technique, associated with BPTB ACL reconstruction, restored the medial laxity not addressed by an isolated ACL reconstruction [32] and preserved the active medial restraints, which surgeons frequently use in reconstructive techniques.

Surgeons can apply this technique in chronic lesions, only exposing and tensing the proximal part of the MCL and POL. Our technique also saves the synergistic action of the posterior medial complex and the ACL [19]. The medial side should not be overlooked in chronic combined anteromedial instabilities when a residual laxity is observed after ACL fixation: in these patients, a medial ligamentous plasty can reduce stress on the reconstructed ACL [10]. Repair of all injured medial knee ligaments can ease the restoration of physiologic load sharing among these structures, which may be a factor for decreasing the risk of reinjury. In the presence of a chronic ACL insufficiency and chronic Grade II or III medial laxity, this surgical repair is an additional option to restore normal or nearly normal knee function.

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