Simultaneous Reconstruction of the Medial and Lateral Collateral Ligaments for Chronic Combined Ligament Injuries of the Ankle

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Background: Objective data on chronic injuries of the medial collateral ligament (MCL) of the ankle are scarce. Chronic MCL injuries are frequently associated with lateral collateral ligament (LCL) injuries. For patients with chronic combined MCL and LCL injuries, the authors have performed simultaneous surgery of the 2 ligaments.

Hypothesis: Simultaneous surgery of the 2 ligaments may be effectively used to treat chronic combined MCL and LCL injuries.

Study Design: Case series; Level of evidence, 4.

Methods: Surgical outcomes were evaluated in 29 consecutive patients presenting with chronic MCL and LCL injuries (30 ankles; 15 men and 14 women; mean age, 31 years; 13 competitive and 10 recreational athletes). Preoperative and postoperative clinical outcomes were measured with the Karlsson score and the Japanese Society for Surgery of the Foot (JSSF) ankle-hindfoot scale score. The patients underwent preoperative and postoperative functional measurements and a radiological examination. In addition, preoperative magnetic resonance imaging (MRI) results, arthroscopic findings, and histology of the MCL were evaluated.

Results: Preoperatively, the deep fibers of the MCL did not appear striated in 29 ankles, and high-intensity signal changes were observed in 23 ankles on T2-weighted or gradient echo MRI. MCL ruptures were confirmed with arthroscopic surgery. Medial impingement lesions and focal chondral lesions were confirmed in 10 and 21 ankles, respectively. Histology of the reconstructed MCL showed dense collagen fibers with vessels. The mean postoperative follow-up period was 30 months (range, 24-52 months). There was a significant change between preoperative and postoperative Karlsson scores (69.0 vs 96.1 points, respectively; $P < .0001$) and JSSF scores (69.8 vs 94.5 points, respectively; $P < .0001$). On varus and valgus stress radiography, the postoperative talar tilt angle was significantly lower than the preoperative angle. Postoperative anterior displacement on stress radiography was significantly lower than preoperative anterior displacement. Postoperatively, all 23 athletes returned to their preinjury level of sports participation.

Conclusion: MCL insufficiency resulted from medial ankle instability and medial impingement lesions. Outcomes in the patients indicated that MCL reconstruction or resection of medial impingement lesions, performed in addition to LCL reconstruction, is effective for treating chronic combined MCL and LCL injuries of the ankle.

Keywords: ankle; ligament reconstruction; medial collateral ligament; lateral collateral ligament

Ankle ligament injuries are among the most common injuries in sports and recreational activities.[6] Eighty-five percent of ankle injuries are inversion injuries,[1] which are typically associated with lesions of the lateral collateral ligament (LCL). Injuries to the medial collateral ligament (MCL) complex of the ankle account for approximately 15% of ligamentous trauma to the ankle joint.[12,16] Inadequate treatment in acute injury cases often results in chronic MCL injuries.[8] Chronic MCL injuries are frequently associated with chronic LCL injuries.[3,8] Although much is known about the kinematic changes and clinical presentation of lateral ankle instability, there are minimal objective data on chronic MCL injuries of the ankle.[2,8] Chronic combined lateral and medial ligament instability is known as rotatory instability[8,27]; however, the necessity of MCL reconstruction for these patients is still unknown.[2,8,27]

In our clinical experience, medial ankle pain was noted in some patients with lateral ankle instability. Some patients still complained of medial ankle pain after LCL

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reconstruction for lateral ankle instability. Medial ankle pain after a lateral ligament rupture has been previously reported, and chondral or osteochondral regions on the medial side were reported.[23] Okuda et al[19] reported that chondral lesions were found more frequently on the medial side than on the lateral side in chronic lateral ankle instability; however, they showed that focal chondral lesions did not influence the results of LCL reconstruction for chronic lateral ankle instability.

We speculated that one of the causes of medial ankle pain and feeling of giving way after LCL reconstruction may be medial ankle ligament impairment. Thus, since 2002, we have performed simultaneous surgery of the 2 ligaments for patients with combined MCL and LCL injuries. The aim of the current study was to describe our surgical procedure for uncommon combined injuries to the MCL and LCL and prospectively review the outcomes. Additionally, magnetic resonance imaging (MRI) results, arthroscopic findings, and histological features of the MCL are described. Our hypothesis was that our procedure could be effectively used for treating combined MCL and LCL injuries.

METHODS

This study was conducted in accordance with the World Medical Association Declaration of Helsinki. All patients provided informed consent, and the study was approved by our institutional review board (Receipt No. 1485). From July 2002 through September 2013, we surgically treated 31 ankles of 30 patients with chronic MCL and LCL injuries. All patients underwent a surgical procedure performed by a single surgeon (T.Y.). One patient (1 ankle) was lost to follow-up because she had moved and could not be contacted. The remaining 29 patients (30 ankles) completed follow-up for at least 2 years. There were 15 men and 14 women with a mean age of 31 years (range, 16-60 years). The mean body mass index was 24.7 kg/m^2. Three patients were smokers. The patient cohort included 13 competitive athletes who participated in sports every day and 10 recreational athletes who participated in sports once or twice a week (Table 1). Competitive athletes included 3 college and 1 high school basketball players, 2 college and 2 high school soccer players, and 3 semiprofessional rugby players. Each patient described a definite and severe injury of the ankle, after which the previously stable ankle had become unstable and symptomatic. The mean time from the primary injury to surgery was 48 months (range, 5-120 months). The preoperative diagnosis of chronic MCL and LCL injuries was made by a clinical examination (n = 30), stress radiography (n = 30), MRI (n = 30), and arthroscopic surgery (n = 27). The diagnosis of medial ankle instability was made as follows:

1. Clinical examination: Patients had pain on the medial side of the ankle or tenderness on the medial gutter of the ankle with a positive anterior drawer test finding.
2. Stress radiography: Patients exhibited medial ankle instability. A diagnosis of medial ankle instability on stress radiography was made based on the presence of instability with a talar tilt angle $\geq$2° compared with that on the contralateral side by the valgus stress test.
3. MRI: Patients had posterior tibiotalar ligament (PTTL) abnormalities on MRI. The PTTL was not striated, or high-intensity signal changes in the PTTL on T2-weighted or gradient echo images were present.
4. Arthroscopic surgery: If these 3 findings were all positive, these patients were diagnosed with medial ankle instability. Lastly, we confirmed an abnormal PTTL by arthroscopic surgery.

TABLE 1
Characteristics of Patients (n = 29)

Characteristics	Mean (Range) or n (%)
Sex	
Male	15 (51.7)
Female	14 (48.3)
Age, y	31 (16-60)
Side (n = 30)	
Right	17 (56.7)
Left	13 (43.3)
Body mass index, kg/m^2	24.7 (18.0-39.6)
Smokers	3 (10.3)
Athletes	
Competitive	13 (44.8)
Recreational	10 (34.5)
Time from injury to surgery, mo	48 (5-120)
Follow-up period, mo	30 (24-52)

On the other hand, medial impingement lesions did not show medial ankle instability on stress radiography. Patients had PTTL abnormalities on MRI. A high signal and hypertrophic change of the PTTL without a striated pattern were frequently seen. In addition, we confirmed a medial impingement lesion on arthroscopic examination.

There was no evidence of joint space narrowing on weightbearing radiographs in any of the patients. Patients associated with pes planovalgus caused by posterior tibial tendon dysfunction (PTTD) were excluded from this series. In ankles with lateral instability, the LCL was reconstructed in 27 ankles and repaired in 3 ankles. The MCL was reconstructed in 23 ankles with medial ankle instability, and lesion excision was performed in 7 ankles with medial fibrotic impingement lesions and no medial ankle instability. Preoperatively, all patients complained of ankle pain and/or repeated giving way during walking or running. Twenty-eight patients (29 ankles) had ankle pain. Preoperative ankle pain was located only on the lateral aspect in 2 patients, only the medial aspect in 10, and on both the lateral and medial aspects in 17. Two patients without complaints of medial ankle pain had tenderness on the medial gutter of the ankle and experienced medial ankle pain on valgus stress of the ankle during clinical examination. Twenty-seven patients (28 ankles) had a feeling of giving way. Nonoperative treatment, including ankle-foot orthoses, arch supports, or physical therapy, had failed in these patients. We investigated preoperative and postoperative clinical and radiographic results. In addition, preoperative MRI results, arthroscopic findings, and histology of the MCL were evaluated. The mean

Figure 1. Preoperative valgus stress radiograph showing an increased talar tilt angle.

Figure 2. Preoperative anterior drawer stress radiograph showing increased anterior displacement.

postoperative follow-up period was 30 months (range, 24-52 months).

Clinical Evaluation

All patients underwent a clinical examination preoperatively and every 6 months until the final follow-up examination. The clinical examination at follow-up included the evaluation of pain, feeling of giving way, return to sports activities, and range of motion of the ankle. We evaluated subjective outcomes using a questionnaire. Range of motion was measured by placing one goniometer arm parallel to the fibula and the other goniometer arm parallel to the long axis of the fifth metatarsal. The fulcrum of the goniometer was located below the lateral malleolus. Active dorsiflexion and plantar flexion were measured. All measurements were performed at least twice until 2 reproducible measurements within 1° of each other were achieved. In addition, we evaluated clinical results using the Karlsson scoring scale.[10] A score of 91-100 points was considered an excellent result, 81-90 points was a good result, 61-80 points was a fair result, and ≤60 points was a poor result.[10] In addition, clinical results were evaluated by assessing scores on the Japanese Society for Surgery of the Foot (JSSF) ankle-hindfoot scale,[17,18] which has a maximum score of 100 points (consisting of 40 points for pain, 50 points for function, and 10 points for alignment).

Varus, valgus, and anterior drawer stress radiography while applying manual force was performed preoperatively and at the final follow-up in all ankles. The talar tilt angle[21] was measured by varus and valgus stress radiography. A diagnosis of medial ankle instability on stress radiography was made based on the presence of instability with a talar tilt angle ≥2° compared with that on the contralateral side by the valgus stress test (Figure 1). The valgus stress test was performed using manual maximum force while the examiner grasped the heel of the patients.

Anterior displacement was measured on anterior drawer stress radiography (Figure 2). Length A was defined as the distance between the anterior and posterior margins of the distal end of the tibia. Length B was defined as the distance between the posterior margins of the talus on nonstress and stress radiographs. Anterior displacement was expressed as a percentage of the measurement B/A.[19,25]

Associated preoperative conditions included impingement exostosis in 5 ankles and an osteochondral lesion of the talus in 2 ankles and os trigonum in 2 ankles. Impingement exostoses and the os trigonum were resected, and osteochondral lesions were drilled at the time of ligament reconstruction.

Preoperative MRI

Preoperative MRI was performed in all patients to evaluate the overall signal intensity of the PTTL, which is one component of the MCL.[9,16] The PTTL was visible in all cases. The time from preoperative MRI to the surgical procedure was <4 weeks. A 1.5-T scanner (Signa HDxt 1.5T [GE Medical Systems], Symphony 1.5T [Siemens]) was used. T1- and T2-weighted images or gradient echo images in the coronal and sagittal planes were obtained.

We calculated the interobserver reliability to evaluate the signal pattern and signal changes on MRI using 20 preoperative scans of the patients in the present study. The identification labels of all of the MRI scans were removed.

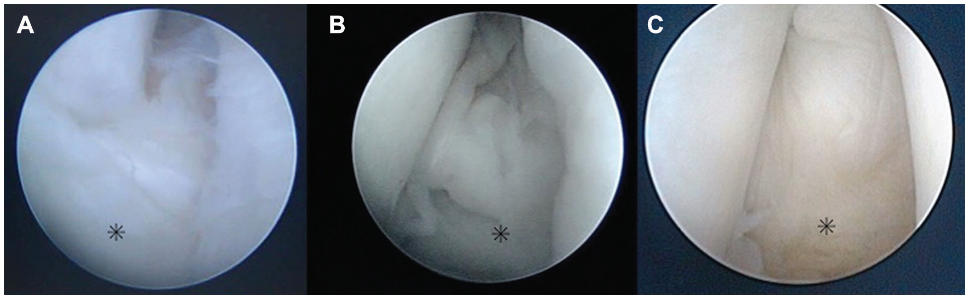

Figure 3. Arthroscopic findings. Medial collateral ligament (*). (A) Ruptured ligament (type I): the ruptured posterior tibiotalar ligament (PTTL) shows ligamentous fibers in most parts. (B) Partial fibrotic lesion (type II): the ruptured PTTL contains partial fibrotic scar lesions in most parts. (C) Meniscoid lesion (type III): the PTTL changed into a hypertrophic meniscoid lesion.

Two foot and ankle surgeons independently assessed the signal pattern and signal changes on MRI.

Arthroscopic Technique and Evaluation

Ankle arthroscopic surgery was performed with the patient in the supine position using a 0° 2.7-mm arthroscope and 30° 2.7-mm arthroscope. A tourniquet was used in all patients. Noninvasive distraction and a standard anteromedial portal were utilized. In addition, an anterolateral portal was used when necessary. A systematic arthroscopic examination was performed to visualize the articular cartilage of the ankle.[19] We evaluated MCL injuries and chondral lesions, and the PTTL was classified as follows: type I, tear of the PTTL; type II, partial fibrotic lesion; and type III, meniscoid lesion. We classified the injured PTTL as type I if the ruptured PTTL showed ligamentous fibers in most parts arthroscopically, type II if the ruptured PTTL contained partial fibrotic scar lesions in most parts, and type III if the PTTL changed into a hypertrophic meniscoid lesion[5,13] (Figure 3).

In addition, chondral lesions and locations were documented. Chondral lesions of the talus and tibia were graded according to arthroscopic findings: grade 1, fibrillation; grade 2, a partial-thickness defect of the articular cartilage with or without a chondral flap; and grade 3, a full-thickness defect of the articular cartilage with or without a chondral flap.[19]

Surgical Technique and Postoperative Management

In 27 ankles, anatomic reconstruction of the anterior talofibular ligament (ATFL) was performed using 4 strands of the palmaris longus tendon (Figure 4). The remnant calcaneofibular ligament (CFL) was sectioned at its point of insertion and advanced.

This surgical technique has been previously described.[19] Indications for anatomic reconstruction using palmaris longus tendons were lateral ankle instability with insufficient local ligamentous tissue,[4,11,15] with longstanding instability,[4,15] and with repetitive ankle sprains.[24] Large athletes (body mass index >25 kg/m^2) were also indicated.[15,24] Patients with severe ankle instability (talar tilt, >15°) were considered eligible.[4,11,24] This procedure was also performed for those with a large ossicle within the LCL, whereby ossicle removal resulted in a lack of remnant ligamentous tissue.[11]

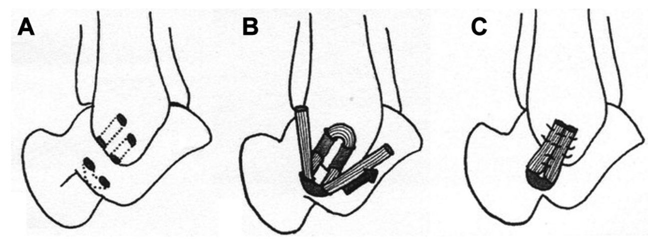

Figure 4. Reconstruction of the lateral collateral ligament (LCL). The LCL was reconstructed in 27 ankles using the palmaris longus tendon. (A) Two bone tunnels were made at the fibular insertion of the talofibular ligament. A U-shaped tunnel was made at the talar insertion of the anterior talofibular ligament. (B) Each end of the palmaris longus tendon was passed through the 2 bone tunnels in the fibula. Next, the upper end of the grafted tendon was passed into the upper talar tunnel and out of the lower talar tunnel, and the lower end was passed into the lower talar tunnel and out of the upper talar tunnel. Both ends of the palmaris longus tendon were returned to the lateral malleolus. (C) Both ends of the palmaris longus tendon were sutured to the grafted tendon itself and the periosteum.

In the remaining 3 ankles, bone tunnels were created at the fibular insertion of the ATFL and CFL, and the remnant ligaments were advanced. The MCL was reconstructed in 23 ankles with the previously mentioned clinical criteria for medial ankle instability. For reconstruction, the MCL including deep fibers was sectioned at its point of insertion on the medial malleolus, and the proximal end of the MCL (about 5 mm in length) was resected to shorten the ligament. After roughening of the medial aspect of the medial malleolus, 4 holes were drilled into the anterior colliculus and intercollicular groove; subsequently, the MCL, including the deep fibers, was reattached with sutures. The anterior and posterior aspects, including the PTTL, were sutured separately (Figures 5 and 6).

In 7 ankles presenting with medial fibrotic impingement lesions, including meniscoid lesions,[5,13] and no medial ankle instability, surgical management of the medial ankle was

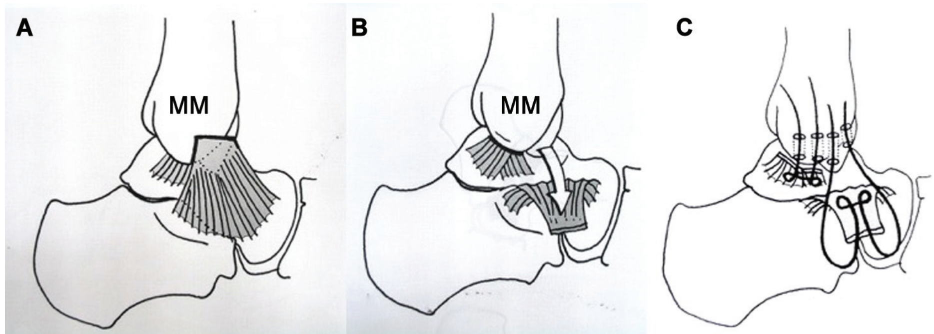

Figure 5. Reconstruction of the medial collateral ligament (MCL). Twenty-three ankles with medial ankle instability were treated with MCL reconstruction. (A) The MCL, including the deep fibers, was sectioned at its point of insertion on the medial malleolus (MM). (B) The proximal end of the MCL was resected (about 5 mm in length) and turned down. (C) Four holes were drilled into the anterior colliculus and intercollicular groove; subsequently, the MCL, including the deep fibers, was reattached with sutures.

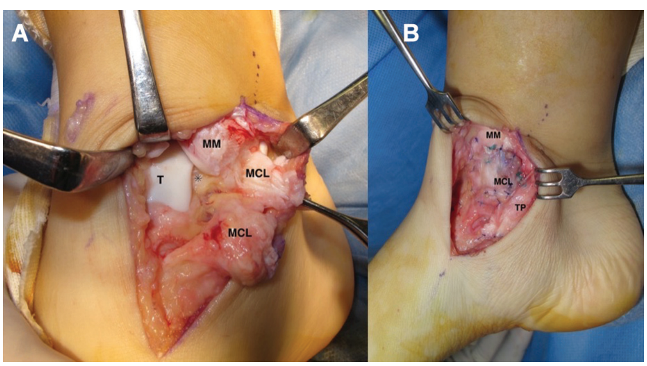

Figure 6. Operative photographs. (A) Operative photograph shows the anterior part of the MCL and posterior part including deep fibers (*). MCL, medial collateral ligament; MM, medial malleolus; T, talus. (B) The anterior and posterior aspects were sutured separately. TP, tibialis posterior tendon.

restricted to excision of the lesion. Reconstruction of the MCL was not performed in these 7 ankles.

Postoperatively, below-knee cast fixation and non-weightbearing were continued for 4 weeks. Weightbearing and range of motion exercises were encouraged after removing the cast, and a protective ankle brace was applied. Athletic activities were allowed at 13 weeks with a protective ankle brace.

Histological Examination

A specimen from the proximal end of the MCL or a specimen of the medial impingement lesion was obtained from patients during surgery. The tissue specimen was fixed in 20% buffered neutral formalin, dehydrated, and embedded in paraffin. The sections of the tissue were stained with hematoxylin and eosin and examined histologically.

Statistical Analysis

The Wilcoxon signed-rank test was used to analyze differences between preoperative and final postoperative measurements. Statistical significance was defined as $P < .05$. Kappa statistics were used to analyze the interobserver reliability using SPSS version 22.0 (IBM).

RESULTS

Clinical Results

The mean postoperative follow-up period was 30 months (range, 24-52 months). At the latest follow-up, 25 ankles were free from pain. The remaining 5 ankles had occasional mild pain; however, these patients had no trouble in their daily life and sports activities from this mild and infrequent pain. Three ankles had anterolateral pain, and 2 ankles had medial pain. No lateral and medial ankle instability was exhibited postoperatively in this patient group. No patient complained of repeated giving way during walking or running. Regarding ankle range of motion, none of the patients had limitations in dorsiflexion or plantar flexion. The mean plantarflexion angle of the involved ankle was 56.8° (range, 45°-65°) before surgery and 56.7° (range, 55°-60°) at the final follow-up; the difference was not statistically significant (P = .5861). The mean dorsiflexion angle of the involved ankle was 19.2° (range, 5°-30°) before surgery and 18.8° (range, 10°-30°) at the final follow-up; the difference was not statistically significant (P = .3256). The mean JSSF score was 69.8 points preoperatively and 94.5 points at the most recent follow-up examination ($P < .0001$). The mean preoperative Karlsson score was 69.0 points, and the mean Karlsson score at the final follow-up examination was 96.1 points; the difference was statistically significant ($P < .0001$) (Table 2).

Excellent clinical results on the Karlsson scoring system were achieved in 27 ankles, good clinical results were achieved in 2, and fair clinical results were achieved in 1 (77 points). Of the 29 patients, 23 were athletes, and they all had returned to their preinjury level of sports participation. The 13 competitive athletes had fully returned to sports (ie, played in a game at their preinjury level) at 3 to 4 months postoperatively.

TABLE 2
Clinical Results[a]

	Before Surgery	After Surgery	*P* Value
JSSF score, points	69.8 ± 5.8	94.5 ± 5.9	<.0001
Karlsson score, points	69.0 ± 5.4	96.1 ± 5.4	<.0001
Talar tilt angle (varus stress), deg	16.7 ± 4.1	4.6 ± 1.8	<.0001
Talar tilt angle (valgus stress), deg	4.1 ± 1.9	1.1 ± 0.3	<.0001
Anterior displacement, %	20.1 ± 4.2	10.1 ± 3.9	<.0001

[a]Values are reported as mean ± SD. JSSF, Japanese Society for Surgery of the Foot.

The mean talar tilt angle measured on varus stress radiography decreased from 16.7° preoperatively to 4.6° postoperatively ($P < .0001$). Similarly, the mean talar tilt angle measured on valgus stress radiography decreased from 4.1° preoperatively to 1.1° postoperatively ($P < .0001$). The mean anterior displacement of the talus on stress radiography decreased from 20.1% preoperatively to 10.1% postoperatively ($P < .0001$) (Table 2).

In the present series, there were no complications, including nerve injuries, infections, delayed wound healing, or complaints related to harvesting the palmaris longus tendon.

Preoperative MRI

The kappa value for the interobserver reliability of MRI was 0.64 for a signal pattern and 0.76 for a high signal alteration. According to the system of Landis and Koch,[14] these values corresponded to a substantial level of agreement. On T2-weighted MRI, the normal PTTL typically had a striated appearance (Figure 7).[16] However, the PTTL did not appear striated in 29 ankles on T2-weighted or gradient echo images; additionally, high-intensity signal changes in the PTTL were observed in 23 ankles (Figure 7).

Arthroscopic Findings

Superficial and deep fiber injuries of the MCL were identified in 27 ankles, with additional evidence of synovitis in the surrounding regions in all cases. The superficial fibers were ruptured or scarred, and chondral defects at the tibial insertion of the superficial fibers were seen in some patients (Figure 8).

The PTTL injuries were categorized as 3 types (Figure 3). Ruptured ligaments were noted in 3 ankles (type I), partial fibrotic lesions were noted in 19 (type II), and meniscoid lesions were noted in 5 (type III). Medial instability on stress radiography could be detected in all type I ankles. Among 19 type II ankles, 16 ankles had medial instability. On the other hand, 4 ankles had no ankle instability among 5 type III ankles. Arthroscopic surgery could detect medial fibrotic impingement lesions in 5 ankles with a type II deltoid ligament and in 5 ankles with a type III deltoid ligament. Medial impingement lesions were frequently accompanied by a chondral lesion at the medial facet of the talus (Figure 9).

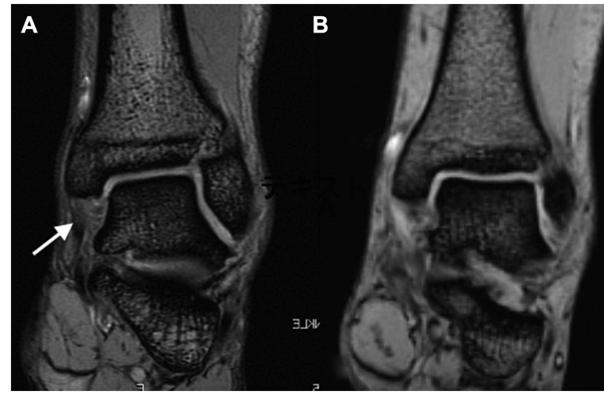

Figure 7. Magnetic resonance imaging (gradient echo images). (A) Normal posterior tibiotalar ligament (PTTL): the PTTL showed a striated appearance (arrow). (B) Injury of the PTTL: the PTTL did not appear striated, and high-intensity signal changes were observed.

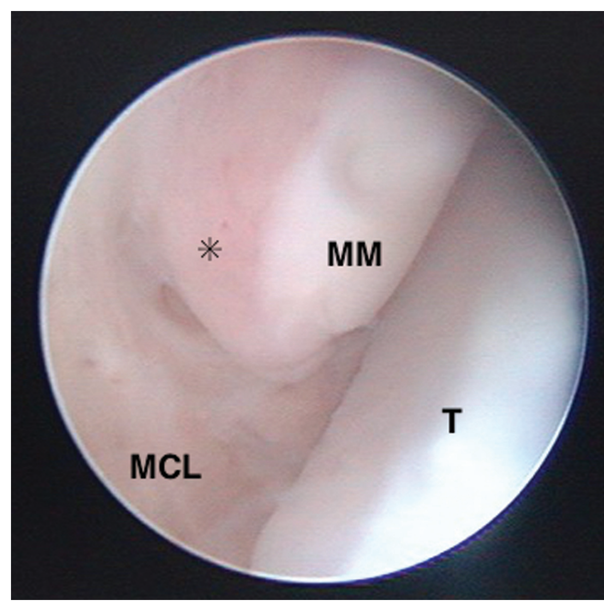

Figure 8. Arthroscopic findings. A chondral defect (*) at the tibial insertion of superficial fibers was seen. MCL, superficial fiber of medial collateral ligament; MM, medial malleolus; T, talus.

Focal chondral or osteochondral lesions were found in 21 (78%) of the 27 ankles. The distribution and grading of the chondral lesions are shown in Table 3. Chondral lesions were found more frequently on the medial side (21 lesions; 84%) than on the lateral side (4 lesions; 16%).

Histological Findings

In all 23 specimens, obtained tissue from the reconstructed MCL consisted of dense collagen fibers with highly cellular fibrovascular material, but the fiber bundles were not oriented along the axis of the ligament (Figure 10).

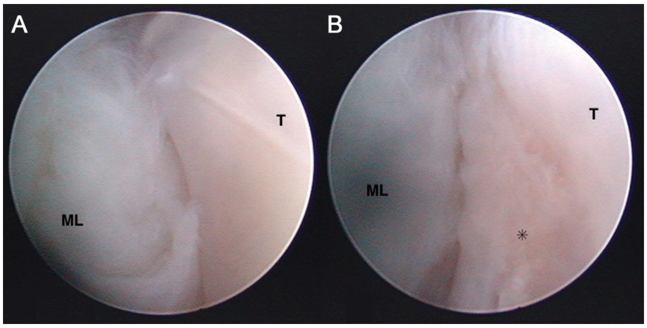

Figure 9. Medial impingement lesion. (A) A meniscoid lesion was detected. (B) A chondral defect (*) at the medial facet of the talus was seen. ML, meniscoid lesion; T, talus.

TABLE 3
Distribution and Grading of Chondral Lesions

	Chondral Lesions, n		
	Grade 1	Grade 2	Grade 3
Talus			
Medial side	4	2	6
Lateral side	1	1	0
Tibia			
Medial side	2	3	4
Lateral side	2	0	0

Obvious degenerative changes, such as fatty degeneration, mucoid degeneration, or vascular changes, were not observed in any reconstructed ligament specimen. On the other hand, the specimen of an impingement fibrotic lesion showed the proliferation of collagen fibers and degenerative changes, such as chondral metaplasia (Figure 11) or mucoid degeneration (Figure 12).

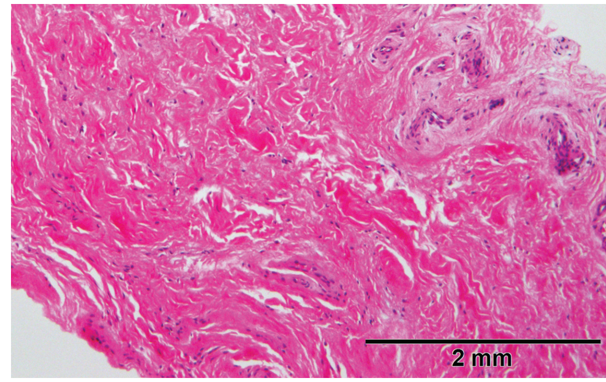

Figure 10. Histology of the medial collateral ligament (MCL) (hematoxylin and eosin). Histological examination of the specimen showed the MCL composed of irregularly arranged collagen fibers with highly cellular fibrovascular tissue.

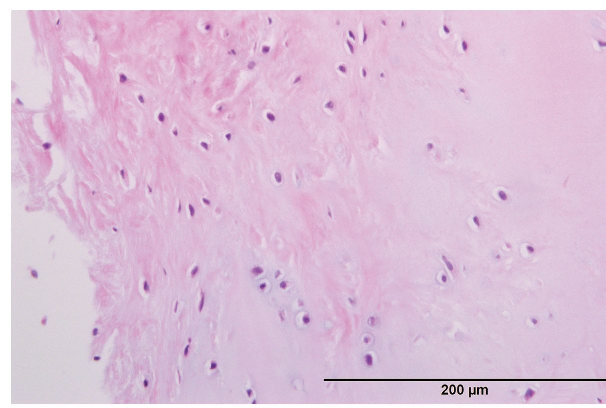

Figure 11. Histology of the excised impingement tissue (hematoxylin and eosin): chondral metaplasia in the collagen fibers was seen.

DISCUSSION

The MCL is composed of 3 superficial and 2 deep fibers; the PTTL is the strongest component, and this ligament could provide significant resistance to ankle dorsiflexion and to lateral or posterior shifting of the talus.[22] Harper[7] reported that valgus tilting of the talus was not possible in any specimen in which only the superficial or deep ligament was divided; however, it was possible after division of both the superficial and deep components. Jeong et al[9] mentioned that the evaluation of the PTTL, known as the intra-articular component and a major stabilizer of the mortise, might be important in predicting ankle stability and guide decision making for the appropriate treatment of ankle fractures.

Regarding MRI findings in the MCL, Mengiardi et al[16] reported that the PTTL was always visible and that a striated signal pattern was detected in a normal PTTL in all participants younger than 45 years and in 89% of the entire study population on T2-weighted images, and this was in accordance with the anatomic description of striations with interlaced fatty tissue. In our study, the PTTLs did not appear striated in all but 1 ankle, and high-intensity signal changes were frequently (76.7%) seen in the PTTL on T2-weighted or gradient echo images. We believe that the absence of this striation and the existence of high signal changes in the PTTL in young patients are indicative of injuries of the PTTL.

PTTL injuries were identified on arthroscopic surgery. We categorized PTTL injuries into 3 types (Figure 3). Medial instability on stress radiography could be detected in all type I ankles. In 19 type II ankles, 16 had medial instability. On the other hand, 4 ankles had no ankle instability among 5 type III ankles. Thus, type I and II ankles tended to be accompanied by medial instability. Medial impingement lesions were detected in 5 ankles of type II and in 5 ankles of type III and were frequently accompanied by chondral lesions at the medial facet of the talus (Figure 9). Some meniscoid lesions were resected arthroscopically using power instruments; therefore, we could not perform a histological examination in all impingement lesions. However, some specimens of meniscoid lesions showed degenerative changes (chondral metaplasia or mucoid degeneration)

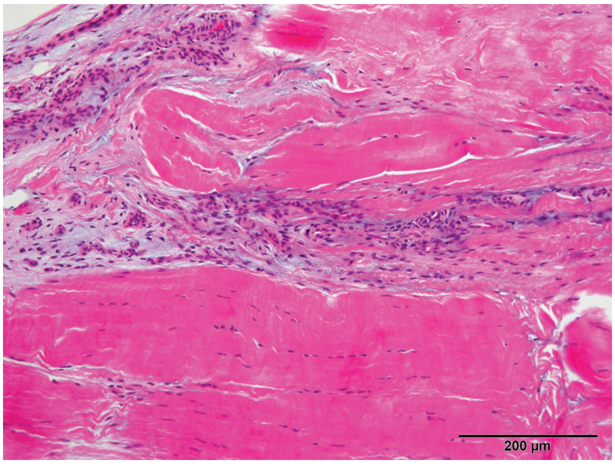

Figure 12. Histology of the excised impingement tissue (hematoxylin and eosin): mucoid degeneration in the collagen fibers was seen.

histologically. Chondral metaplasia in the ligament tissue might make the ligament hard; thus, this degenerative change, in addition to hypertrophy, caused the medial impingement lesion (Figure 11). The time from the primary injury to surgery was less than 6 months in patients with type I injuries, while the time was over several years in patients with type III injuries. Therefore, we believe that the ruptured deltoid ligaments changed from type I to type III over time. However, a detailed pathological study of the excised impingement tissue is necessary for understanding the relationship between injury type and duration from injury to surgery in the future.

Hintermann et al[8] reported 52 cases with medial ankle instability. They reported that lateral ankle instability was found in 77% of the patients with medial ankle instability and that lateral ligament insufficiency may chronically overload the anterior bundles of the deltoid ligament. Furthermore, they mentioned that treatment may include ligament reconstruction of both the lateral and medial ankle ligaments in cases of medial ankle instability with concomitant lateral ankle instability. However, the clinical results of reconstructing both the lateral and medial ankle ligaments were not reported. Yoo et al[26] reported a case of simultaneous reconstruction of the medial and lateral ligament complexes of the ankle joint with a semitendinosus tendon allograft. Medial sliding calcaneal osteotomy was added because their case had a hindfoot valgus deformity. In the present study, we confirmed that the MCLs were thick and strong intraoperatively, and we judged that these ligaments could be repaired without an allograft or autograft. Moreover, histological findings that showed dense collagen fibers with capillaries suggest that healing connective tissue can be used in the repair of a chronically ruptured MCL (Figure 10). No patients had heel valgus deformity caused by PTTD. We believe that medial ligament reconstruction using a tendon graft is required for patients with PTTD because heel valgus deformity gradually makes the deltoid and spring ligaments thin and weak. Consequently, the pathogenesis is different between ligamentous trauma in the present study and chronic ligamentous disorder associated with pes planovalgus.

Buchhorn et al[2] reported the combined reconstruction of both ligaments for chronic rotational instability of the ankle, and to the best of our knowledge, theirs is the only clinical case series. They performed reconstruction of both ligaments in 81 patients for only 2 years, although the indication for reconstruction of both ligaments was not mentioned. They regularly performed reconstruction of both ligaments; however, quantitative evaluation of medial instability was not performed using valgus stress radiography preoperatively and postoperatively. Thus, it seems that the necessity of reconstructing the MCL in every case was unclear in their series. In our patients, the pathogenesis of MCL insufficiency resulted from not only medial ankle instability but also medial impingement lesions. Hence, it is important to distinguish medial ankle instability and medial impingement lesions in patients with an insufficient MCL. We performed MCL reconstruction if ankles had medial ankle instability based on our preoperative criteria. Histology of the MCL showed dense collagen fibers with vessels, and degenerative changes were not seen (Figure 10). On the other hand, lesion excision was performed for patients with medial impingement lesions and no medial ankle instability. The histology of impingement lesions showed degenerative changes including chondral metaplasia or mucoid degeneration (Figures 11 and 12).

Our results confirmed good clinical outcomes of simultaneous surgery of the 2 ligaments. All competitive athletes had fully returned to sports at 3 to 4 months postoperatively. Moreover, our technique was associated with no postoperative complications. The present clinical results indicated that MCL reconstruction or the resection of medial impingement lesions, in addition to LCL reconstruction or repair, was an effective treatment for patients with an MCL injury concomitant with lateral ankle instability. Furthermore, we think that instability in the sagittal, coronal, and horizontal planes due to LCL insufficiency may chronically overload the MCL. Even if a patient with lateral ankle instability complains only of medial ankle pain or medial ankle instability, we believe that lateral ligament reconstruction or repair should be performed simultaneously with procedures for the MCL.

In the present study, we evaluated MRI and arthroscopic findings with particular attention to the PTTL, which caused medial impingement[20] and medial instability of the ankle.[7,9] We believe that patients with chronic injuries of only superficial fibers have no medial instability and no medial impingement; thus, these patients were not indicated for operative treatment of the MCL. Ziai et al[27] reported that the superficial layer of the MCL acts as a lateral stabilizer against supination/inversion in existing lateral dual-ligament instability; however, the lateral stabilizing role of the superficial ligament with an intact LCL is still unkown. Further study is needed to elucidate the necessity of MCL reconstruction in addition to LCL reconstruction for patients with only superficial chronic injuries combined with lateral instability. Consequently, the presence of talar tilt on valgus stress radiography indicated both superficial and deep fiber injuries of the MCL.[7]

On the other hand, medial impingement of the ankle was caused by PTTL injuries,[20] and our histological results showed degenerative changes of the PTTL. We believe that evaluation of the PTTL on MRI and arthroscopic surgery in addition to the talar tilt on stress radiography is very important in deciding on the operative method of the MCL for patients with both chronic MCL and LCL injuries. Furthermore, the type of injured PTTL on arthroscopic surgery might be related with the abovementioned medial ankle instability.

One limitation of the present study was its retrospective design. Moreover, the inclusion of a relatively small cohort of patients limited the statistical power of the study results. Randomized controlled studies might be useful; however, uncommon disorders may not easily be captured in a controlled trial. Another limitation was the use of the Karlsson score, which is not the most sensitive scoring system for the evaluation of pain because it places emphasis on instability and functional activities. Therefore, we added the JSSF score, which consists of 40 points for pain, 50 points for function, and 10 points for alignment. Lastly, MCL reconstruction was not performed in 7 ankles with medial impingement lesions; thus, it might be preferred that these 7 ankles be excluded in this study. However, it is important to distinguish medial ankle instability and medial impingement lesions; therefore, we described the clinical features and pathological findings of both, and an impingement group (7 ankles) was included in this study.

In conclusion, MCL reconstruction or resection of medial impingement lesions, performed in addition to LCL reconstruction or repair, seems effective for treating patients with chronic combined MCL and LCL injuries of the ankle. Additionally, it helps athletes to return to sports participation. To decide on the operative method of the MCL for patients with both chronic MCL and LCL injuries, it is important to distinguish between medial ankle instability and medial impingement lesions in patients with an insufficient MCL.

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