Investigation of factors affecting the clinical results of arthroscopic anterior talofibular ligament repair for chronic lateral ankle instability

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Abbreviations:

ATFL, anterior talofibular ligament

CLAI, chronic lateral ankle instability

TTA, talar tilt angle

TAD, Talar anterior drawer distance

CFL, calcaneofibular ligament

MRI, magnetic resonance imaging

JSSF, Japanese Society for Surgery of the Foot

Abstract

The study aimed to examine the factors affecting the clinical outcomes of anterior talofibular ligament (ATFL) repair surgery with arthroscopy for chronic lateral ankle instability (CLAI). From 2015 to 2018, 18 consecutive patients diagnosed with CLAI after conservative treatment for 3 months or more underwent arthroscopic ATFL repair surgery using the Broström-Gould technique. Clinical scores at 1 year postoperatively involving the Karlsson scoring scale (median, 85 points) and the Japanese Society for Surgery of the Foot scale (median, 90 points) were significantly improved compared to preoperative scores (median, 50 and 66 points; $p<0.001$ and <0.001, respectively). The median period to start jogging was 2 and 6 months for patients without (n=11) and with cartilage damage (n=7), respectively, showing significant difference ($p=0.006$). Four patients with cartilage damage could not return to pre-injury sports within 1 year after surgery.

In the stress radiographs, the talar tilt angle (TTA) significantly improved from median of 6° preoperatively to a median of 3.5° postoperatively ($p=0.002$). Talar anterior drawer distance (TAD) significantly improved from a median of 6.5 mm preoperatively to a median of 4.1 mm postoperatively ($p<0.001$). There was no significant difference in TTA and TAD between patients without and with cartilage damage.

The period to start jogging postoperatively was significantly correlated with postoperative TTA and

TAD. It was suggested that the postoperative period to start activities was delayed because of the larger postoperative TTA and TAD.

According to our results, the postoperative period to start activities may depend on cartilage damage and instability remaining postoperatively.

Level of Clinical Evidence: Level 4, case control study

Keywords: anterior talofibular ligament, arthroscopy, ankle sprain, chronic lateral ankle instability

Introduction

An ankle sprain is a common trauma in sports injuries, and often involves the ankle lateral ligament complex injuries (1,2). The anterior talofibular ligament (ATFL) and the calcaneofibular ligament (CFL) are damaged in severe ankle sprains. Primary treatments for ankle sprains are conservatively performed, and more than 80% of patients are healed and return to activities such as sports (3,4). However, in 5% to 20% of patients with ankle sprains, chronic lateral ankle instability (CLAI) remains despite adequate conservative treatment (3,4). For the evaluation of CLAI, the anterior drawer and talar tilt tests are important clinical examinations (5,6). In addition, stress radiography is also performed. However, although several studies have shown the reliability and efficacy of stress radiography for evaluating CLAI, the reproducibility and normal findings in stress radiographs are controversial (5,7,8). On the other hand, it has a relatively low sensitivity (56% for ATFL and 50% for CFL), although magnetic resonance imaging (MRI) has extreme specificity (100% for ATFL and 83% for CFL) for examination of the ankle ligament injury (3,4). However, MRI is a reliable and valid decisional tool to choose the surgical technique for CLAI (9). Furthermore, MRI is useful for the evaluation of not only ATFL rupture but also additional pathologies, such as osteochondral lesions. Several previous studies have reported about invasive open surgeries as treatment for CLAI (10-13). However, these techniques are not anatomical and require sacrifice of normal structures, such as the peroneal tendon. Subsequently, Broström described the surgical procedure of suturing the ATFL remnant for the treatment of ATFL injury (14). Furthermore, Gould et al. reported the augmentation method with the inferior extensor retinaculum (IER), and Karlsson et al. showed the method of suturing and reattaching the ATFL using drill holes of the lateral malleolus (15,16). Recently, the Broström and Karlsson procedures with arthroscopy have been developed, which showed good clinical outcomes (17-23) and more complications (24). Its major technique is to reattach the ATFL to the fibula with the suture anchor by drilling at the lateral malleolus of the fibula and augmentation with the IER using the other anchor. These arthroscopic procedures were associated with equal or better clinical results compared to the conventional open methods (23,25,26). In our hospital, arthroscopic surgery for patients with symptoms of CLAI was performed. However, several patients developed chronic pain of the ankle after exercise resumption, which resulted in a delay in return to sports. To our knowledge, there were no previous reports that showed the obvious causes of delaying the return to sports after arthroscopic surgery.

Therefore, the purpose of this study was to examine the factors influencing postoperative clinical outcomes, particularly including clinical scores and the postoperative period to return to sports activity, after arthroscopic repair surgery of ATFL for CLAI. We hypothesized that the outcomes after arthroscopic surgery for CLAI were related to the amount of instability of the ankle and cartilage damage of the ankle joints.

Patients and methods

This study was performed prospectively. Approval from the ethics committee was obtained before conducting the study and informed consent was obtained from the patients. From April 2015 to March 2018, consecutive patients, who underwent arthroscopic surgery for CLAI and who were followed up for one year or more after surgery, were included in this study. All patients had been playing sports activities. A preoperative diagnosis of CLAI was made through a clinical examination, stress radiography, and MRI. All patients initially underwent conservative treatments, such as immobilization, orthosis, bandage, and rehabilitation, for 3 months or more. Two patients who had osteoarthritis or a previous history of surgical treatment in their ankles were excluded. Eighteen patients (9 men, 9 women) with a median age of 26 (range, 14-60) years were analyzed in this study. Surgery, measurement with stress radiographs, and analysis of data described below were performed by one senior orthopedic surgeon (M.H.) in this study.

Clinical and radiographic assessments

Patients had pain or tenderness on the lateral side of the ankle, feeling of instability, and a positive anterior drawer test finding. Stress radiography including assessment of varus and anterior drawer stress was performed with the Telos Stress Device (Aimedic MMT, Japan). Patients sat with their knee flexed at approximately 20°. The heel was fixed with a swivel clamp, then the pressure roll was placed at approximately 5 cm above the lateral malleolus or anterior of the tibia. Pressure load for routine examination was defined as 15daN. The talar tilt angle (TTA) was defined as the angle between the tibial plafond and talus in the frontal view, and the talar anterior drawer distance (TAD) was defined as the distance between the posterior horn of the tibial plafond and talus dome in the lateral view. CLAI was diagnosed in patients with TTA >2° compared to that on the contralateral side, or TAD of >5 mm. Clinical scores were evaluated using the Karlsson scoring scale and the Japanese Society for Surgery of the Foot (JSSF) ankle-hindfoot scale (27-29). All patients underwent clinical and radiographic examinations before surgery and at one year after surgery. The time when patients could start usual exercises, such as jogging, and when patients could return to sports activity was examined.

Surgical techniques and postoperative procedures

Arthroscopic examination was performed first. Articular cartilage injury of the tibia and talus was evaluated. When cartilage damage was present, debridement and micro-fracture procedures were performed regardless of the size of cartilage lesion.

ATFL was performed according to the techniques described by Matsui et al. (20). Briefly, arthroscopic

ATFL repair was performed with one anchor, which was placed between the center and the superior side of the fibular footprint of the ATFL. Then, the Gould augmentation procedure was performed subcutaneously, with the other anchor introduced to the proximal aspect of the first anchor. The superficial and deep surfaces of the IER were released from the arthroscopic portal, then one limb of the suture anchor was passed into the IER from the deep layer to the superficial layer. Finally, the IER was tied to the lateral malleolus with the sliding knot technique.

The postoperative procedure included immobilization with a plaster slab, and the patients were encouraged to perform non-weight-bearing gait for two weeks after surgery. At 3 weeks postoperatively, range of motion exercises and weight-bearing gait were allowed if there was no articular cartilage injury. When articular cartilage damage was observed, weight-bearing gait was only started at 5 weeks postoperatively. An ankle orthosis was used for six months after removal of the plaster slab.

Patients were allowed to start jogging when swelling and effusion of the ankle were absent. Then, sports activities were started if the patients had no discomfort and no recurrence of swelling and effusion.

Statistical analysis

Statistical analyses were conducted using SPSS version 25 (IBM, Armonk, NY, USA). The Wilcoxon signed-rank test was used to compare the preoperative and postoperative values among all 18 cases. The Spearman rank correlation coefficient test was used to examine the correlation between the time to start activities and the background data of patients. The Mann-Whitney U test was used to compare the characteristics of patients with and without cartilage damage. In either statistical analysis, a significance probability of ≤5% was regarded as significantly different.

Results

In the stress radiographs using the Telos Stress Device, the TTA significantly improved from the preoperative median of 6° (range, 3° to 14°) to the postoperative median of 3.5° (range, 0° to 6°) (p=0.002). The TAD significantly improved from the preoperative median of 6.5 mm (range, 4.5-8.5 mm) to the postoperative median of 4.1 (range, 1.0 to 6.0) mm (p<0.001). Karlsson scores also improved in all cases, and patients obtained a postoperative median score of 85 (range, 50 to 100) points from the preoperative median score of 50 (range, 34 to 70) points (p<0.001). JSSF scale scores improved in all cases, and patients obtained a postoperative median score of 90 (range, 87 to 90) points from the preoperative median score of 66 (range, 28 to 69) points (p<0.001). The median period when all patients could start jogging postoperatively was 3 (range, 1 to 6) months.

Arthroscopic examinations showed cartilage damage in 7 patients, including 6 talar lesions, and 1 talar and tibial plafond lesion. There was no significant difference in age, sex, body height, weight, and body mass index (BMI) between patients with and without cartilage damage (Table 1). In patients without cartilage damage, the median period to start jogging was 2 (range, 1 to 3) months. In patients with cartilage damage, the median period to start jogging was 6 (range, 3 to 6) months. There was a significant difference in the time to start jogging between patients with and without cartilage damage (p=0.006). Furthermore, in patients without cartilage damage, the postoperative median period to return to sports was 4 (range, 2 to 4) months. However, 3 of seven patients with cartilage damage could not return to pre-injury sports activity level within 1 year after surgery.

The postoperative period when patients could start jogging or return to sports was not correlated with age, body height, weight, BMI, preoperative TAA, and preoperative TAD (Table 2). However, postoperative TTA and TAD had a significant high correlation coefficient with postoperative period to start jogging (correlation coefficient: 0.576 and 0.633, respectively) (Table 2), and the period to return to sports was significantly correlated with postoperative TAD (correlation coefficient: 0.784).

Discussion

On the basis of the results of this study, the clinical scores after ATFL repair surgery using the arthroscopic procedure for CLAI were improved; however, the periods to start jogging and to return to preoperative sports were affected by cartilage damage. Broström reported an anatomical procedure that used an open technique for repairing ATFL using its remnant, and then his procedure was accepted as a gold standard technique for ATFL repair (14). Gould et al. modified this technique with the reinforcement of the IER (15). Then, the open Broström-Gould procedure was considered the most fundamental method for the treatment of CLAI (30). In all published articles, good postoperative results have been reported for the open Broström-Gould procedure. Recently, many authors have proposed performing the Broström procedure completely with arthroscopy (17-25). In arthroscopic surgery, postoperative pain is minimal and the return to activities of daily living is early compared to that with conventional open techniques (25). In this study, the JSSF scale and Karlsson scores were improved in all patients after surgery; thus, the arthroscopic procedure was considered sufficiently useful for treating CLAI.

However, there was no report about the relationship between clinical outcomes after surgery for CLAI and cartilage damage of the ankle. In this study, the postoperative time to start jogging in patients with cartilage damage (median; 6 , range; 3 to 6 months) was obviously delayed compared to that of patients without cartilage damage, even considering the postoperative course that the time to non-weight bearing gait was delayed for two weeks. Furthermore, there were two patients who could not return to their pre-injury sports activity level within one year after surgery. Therefore, cartilage damage associated with CLAI is an important factor that delays the start of activities, and arthroscopic examination of cartilage damage is considered meaningful to predict the postoperative time to start jogging and return to sports.

The postoperative period to start jogging or return to sports was not correlated to age, body height, weight, BMI, and preoperative examination of stress radiograph. However, postoperative TTA and TAD had a significant high correlation coefficient with postoperative period to start jogging, and the period to return to sports was significantly correlated with postoperative TAD. It was suggested that the postoperative period to start activities may depend on the instability remaining postoperatively. Relatively large TTA and TAD after surgery may be a problem because of our surgical technique. However, Yasui et al. reported that successful outcomes of ATFL repair procedures may depend on the ligament quality and patient characteristics (31). Therefore, in patients in whom return to sports activities was delayed, large postoperative TTA and TAD might be related to not only preoperative instability and surgical technique but also poor quality of residual ATFL. We consider that, if TTA and TAD are relatively large as confirmed by fluoroscopy during surgery, or patients have a significant joint laxity, augmentation surgery with artificial ligament or reconstruction surgery should be performed.

There are several limitations to this study. First, it involved a relatively small number of patients.

Large-scale studies should be performed in the future to validate our findings. Second, repeat arthroscopic examination was not performed in patients with cartilage damage. MRI was performed postoperatively in only a few patients. Thus, the differences in clinical outcomes due to the extent of postoperative repair of cartilage are unclear. Third, the quality of ATFL was not investigated intraoperatively. The postoperative outcomes may improve if a procedure for evaluating the quality of ATFL during surgery is established. However, despite our appreciation of the limitations of our investigation, we believe that the results of this study could be useful in the future development of prospective cohort studies and randomized controlled trials that focus on the association between cartilage damage in patients who undergo arthroscopic surgery for CLAI and the postoperative period to return to sports.

In conclusion, the clinical scores after arthroscopic repair of ATFL for CLAI were good. Our data also revealed that the postoperative period to start jogging and to return to sports was delayed in patients with cartilage damage and with ankle instability remaining. In the future, further research including the extent of cartilage damage and treatment procedure is expected.

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Table 1

Patient demographic data and pre- and postoperative measurement

	Patients without cartilage damage n=11	Patients with cartilage damage n=7	*p* values
Gender (male／female)	6 (54.5%)／5 (45.5%)	3 (42.9%)／4 (57.1%)	
Age (years)	35 (14−44)	26 (18−60)	1.000
Body height (cm)	170 (140−178)	166 (154−180)	0.375
Body weight (kg)	60 (50−83)	71 (53−85)	0.328
BMI(kg/m^2)	25.5 (20.7−28.7)	24.9 (21.3−29.9)	0.860
Preoperative TTA (°)	9 (3−14)	6 (3−8)	0.085
Preoperative TAD (mm)	6.5 (5.0−8.0)	6.5 (4.5−8.5)	0.536
Preoperative JSSF scale (pt)	66 (62−69)	66 (28−69)	0.733
Preoperative Karlsson score (pt)	45(35−67)	45(34−70)	0.961
Postoperative TTA (°)	3 (0−5)	5 (0−6)	0.151
Postoperative TAD (mm)	4.0 (1.0−5.0)	5.0 (2.0−6.0)	0.056
Postoperative JSSF scale (pt)	90 (87−90)	90 (87−90)	0.256
Postoperative Karlsson scale (pt)	85(75−95)	85(50−100)	0.301
Postoperative period to start jogging (month)	2 (1−3)	6 (3−6)	0.006 *
Postoperative period to return to sports (month)	4 (2−6)	6 (4−12) †	0.056

The values show the median and (range).

†: the value including four patients who could return to sports within 1 year after surgery

P values: Mann-Whitney U test

*: $p \leq 0.05$

body mass index; BMI, TTA; talar tilt angle, TAD; talar anterior drawer distance

Table 2

The correlation with postoperative period to start jogging or to return to sports

	Postoperative period to start jogging n=18	Postoperative period to return to sports n=15 †
Age (years)	0.089 (0.752)	-0.254 (0.362)
Body height (cm)	0.394 (0.105)	0.319 (0.246)
Body weight (kg)	0.462 (0.054)	0.165 (0.557)
BMI(kg/m^2)	0.324 (0.189)	0.080 (0.777)
Preoperative TTA (°)	-0.270 (0.278)	-0.230 (0.409)
Preoperative TAD (mm)	0.283 (0.255)	0.406 (0.133)
Postoperative TTA (°)	0.576 (0.012) *	0.155 (0.581)
Postoperative TAD (mm)	0.633 (0.005) *	0.784 (0.001) *

The values show the Spearman rank correlation coefficient and (*p* values).

†: the analyses were performed in 15 patients who could return to sports within 1 year after surgery.

*: $p \leq 0.05$

body mass index; BMI, talar tilt angle; TTA, talar anterior drawer distance; TAD