

Clinical outcomes of a modified all-inside arthroscopic repair of anterior talofibular ligament for chronic ankle instability

A preliminary report

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Abstract

The present study was conducted to evaluate the clinical outcomes of a modified all-inside arthroscopic repair technique via anterolateral and accessory anterolateral port for anterior talofibular ligament (ATFL) repair. A consecutive series of 32 patients (34 ankles) with chronic ankle instability were included and treated with the modified all-inside arthroscopic repair. The function was assessed using the American Orthopaedic Foot and Ankle Society (AOFAS), visual analog score (VAS) score system, the Sefton grading system, and the anterior drawer test and talar tilt test. A total of 29 cases (30 ankles) were followed up for a mean of 33.7 ± 4.5 (range 30–44) months. Based on the Sefton grading system, 12 patients were regarded as excellent, 13 were good, 2 were fair, and 2 were poor. Twenty-five cases (86.2%) achieved satisfactory functional results. Ankle mobility returned to normal in 93% of patients. The AOFAS scores increased from 55.1 ± 12.3 (range 25–69) preoperatively to 89.7 ± 5.9 (range 74–100) ($P < .001$) at the last follow-up, while the VAS score decreased significantly ($P < .001$). There was no wound infection or nerve injury in all cases. In conclusion, based on high satisfaction rate in terms of ankle mobility and low complication rate, the modified all-inside arthroscopic repair of ATFL via anterolateral and accessory anterolateral port appears to be an effective treatment method for chronic ankle instability. Further studies are needed.

Abbreviations: acAL = accessory anterolateral, AL = anterolateral, AM = anteromedial, AOFAS = American Orthopaedic Foot and Ankle Society, ATFL = anterior talofibular ligament, CAI = chronic ankle instability, IER = inferior extensor retinaculum, MRI = magnetic resonance imaging, OCL = osteochondral lesion, VAS = visual analog score.

Keywords: ankle instability, arthroscopic repair, outcome scores

1. Introduction

Lateral ankle ligament injuries are among the most common sports injuries. Despite effective conservative treatment, there are approximately 20% cases progress to chronic ankle instability

(CAI), resulting in severely limited daily activities. Basically, surgical treatment is required for most of these patients, to restore ankle stability and function.^[1,2] Many surgical techniques have been reported for the treatment of CAI, including anatomic repair, anatomic reconstruction, and nonanatomic tenodesis. Anatomic repair procedure, which is also called the Broström procedure involving direct reattachment of the disrupted ligament, was once widely used because of its low complication risk.^[3] This technique was later modified by Gould who strengthened the repair by augmentation with the extensor retinaculum (IER).^[4] Anatomic repairs have the advantage of restoring the anatomy and kinematics of the ankle while preserving subtalar joint motion. Even after 5 decades, the modified Broström procedure is still considered as the “gold standard” for the treatment of CAI.^[1,2,5]

In recent years, various arthroscopic repair techniques to treat CAI were reported,^[2,6–10] of which the reported advantages including: minimally invasiveness, rapid recovery, the ability of simultaneous discovery, and treatment of intra-articular diseases, such as synovitis, impingement, osteochondral lesions (OCL), and loose bodies. However, accumulating studies have reported that the overall complication rate of arthroscopic treatment was almost double as the traditional open surgeries.^[2,8] These complications include delayed wound healing, nerve or tendon injuries, skin irritation of suture knots, as well as lateral ankle pain,^[7–10] among which, nerve injury is the severest condition and is most frequently reported. The purpose of this study was to describe a modified all-inside arthroscopic technique via anterolateral and accessory anterolateral (acAL) port for CAI treatment.

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2. Methods

2.1. Patients and methods

This study was approved by the Ethics Committee of Wuhan General Hospital. Written informed consents were obtained from all patients. In total, 32 consecutive patients (34 ankles) with CAI were treated in our hospital from June 2015 to July 2016. The indications for surgery were:

- (1) recurrent ankle sprain and signs of ankle instability: an anterior drawer greater than 5 mm and talar tilt greater than 9° on stress radiography^[11];
- (2) no significant functional improvement after conservative treatment for over 3 months;
- (3) anterior talofibular ligament (ATFL) damage indicated by magnetic resonance imaging (MRI).

Exclusion criteria were:

- (1) a combined ligament injury with acute fibular fracture;
- (2) previous ankle surgeries, foot or ankle malalignment;
- (3) poor quality of ligament tissue on MRI.

2.2. Surgical technique

All surgeries were performed by a senior surgeon (SJW), under a general anesthetic or regional nerve block with sedation based on patient preference and the experience of the anesthesiologist. Patients were positioned supine, and the ipsilateral hips were elevated with soft pad. A proximal thigh tourniquet was placed without the use of distraction devices. Anatomic landmarks were outlined on the skin, including medial and lateral malleoli, anterior joint line, tibialis anterior tendon (plantar flexion/dorsiflexion), peroneus tertius tendon, superficial peroneal nerve, and ATFL running. Skin preparation was performed in a standard approach. An Esmarch bandage was used to exsanguinate the leg, and the tourniquet was inflated.

During the surgery, standard anteromedial (AM) and anterolateral (AL) portals were established, and ankle arthroscopy was performed. Extensive arthroscopic debridement was performed using a 2.7 mm 30° arthroscope and 2.9 mm motorized shaver. During the surgery, the associated intra-articular lesions including ankle impingement, synovitis, loose bodies, and cartilage injury were checked and treated. The lateral gutter, excessive inflammatory synovium including the distal part of the anterior inferior tibiofibular ligament, were fully debrided with shaver. The remnant fibers of ATFL was palpated and evaluated with probe. Under direct arthroscopic visualization, the anterior drawer test was also performed. To facilitate ligamentous adhesions, debridement of the distal fibula to the bone was applied using a curette. After that, the arthroscopy was removed to AL portal.

Under arthroscopic visualization, an acAL portal which was 1.0 to 1.5 cm anterior to the tip of the fibula was established. A suture anchor (2.8-mm titanium, Smith & Nephew, Mansfield, MA or 3.0-mm Gryphon Peek, Johnson & Johnson, Neuchâtel, Switzerland) was placed on the center of the fibular footprint of the ATFL via this portal (Fig. 1A, D, G, H), using a 0 # nylon monofilament loaded into a suture hook (ACCU-PASS suture shuttle, Smith & Nephew) directed 45° toward the same side (ie, left hook for a left ankle). The suture shuttle was then applied into the joint and penetrated the upper third of the remnant ligament and ankle capsule via the acAL portal. The monofilament loop of suture shuttle was fed into the joint through the remnant ligament

under direct arthroscopic visualization, which was then retrieved from acAL portal by a mosquito clamp. One limb of the suture anchor was separated and passed through the monofilament loop outside of the skin, then the free ends of the monofilament were pulled, to allow the monofilament loop to lead on the suture to penetrate the remnant ATFL exit the acAL portal (Fig. 1B, C, E, F, I). Using the same technique, another limb of the suture anchor was retrograded through the lower third of remnant ATFL. It should be noted that the penetrated point of suture shuttle should be ensured and fixed. The 2 sutures were then tied over the anterior surface of fibula using arthroscopic knot-tying technique (we prefer a Samsung Medical Center knot) with the assistant holding the ankle in a neutral position (Fig. 2A, B, D, E). By applying the knot pusher, and pulling the knot downward the anterior surface of fibula, the ATFL and ankle capsule were secured to the anterior fibula. It should also be noticed that the suture strands should not be cut at this point. Next, the anterior drawer test was gently performed under direct arthroscopic visualization. If there was any doubt about the stability, next procedure should be performed (3 cases in this study). The superficial and deep surfaces of the IER should then be freed by blunt dissection from the acAL port, then the IER should be pulled out through the acAL port with a mosquito clamp. Two limbs of the suture anchor should be threaded through the IER under direct visualization and tied with the conventional knot technique (Fig. 2C). Finally, the skin incisions were closed and elastic bandages were applied.

2.3. Rehabilitation protocol

Postoperative management consisted of a soft compressive dressing and splinting of the ankle in neutral position in a removable brace. Partial weight-bearing and active range of motion exercise were permitted over 1 week with the goal of an early return to sports activity. Full weight-bearing was allowed after 4 to 6 weeks. Adversarial sport activity was allowed after 3 months postoperatively.

2.4. Clinical evaluation

All patients were preoperatively assessed using American Orthopaedic Foot and Ankle Society (AOFAS) score^[12] and visual analog scores (VAS) system,^[13] which together with Sefton grading system^[14] and the complications rates were evaluated postoperatively. Anterior drawer test and talar tilt test were examined by fluoroscopy before surgery and at the final follow-up. All the clinical results were compared with the contralateral limb.

2.5. Statistical methods

Statistical analysis was performed using SPSS 16.0 (IBM Corp, Armonk, NY). Data were presented as mean ± standard deviation. Wilcoxon signed-rank test was conducted for the evaluation of changes in the AOFAS score, VAS and radiographic parameters before and after surgery. A value of $P < .05$ was considered statistically significant.

3. Results

A total of 29 cases (30 ankles) were followed up for a mean of 33.7 ± 4.5 (range 30–44) months. Three cases were excluded due

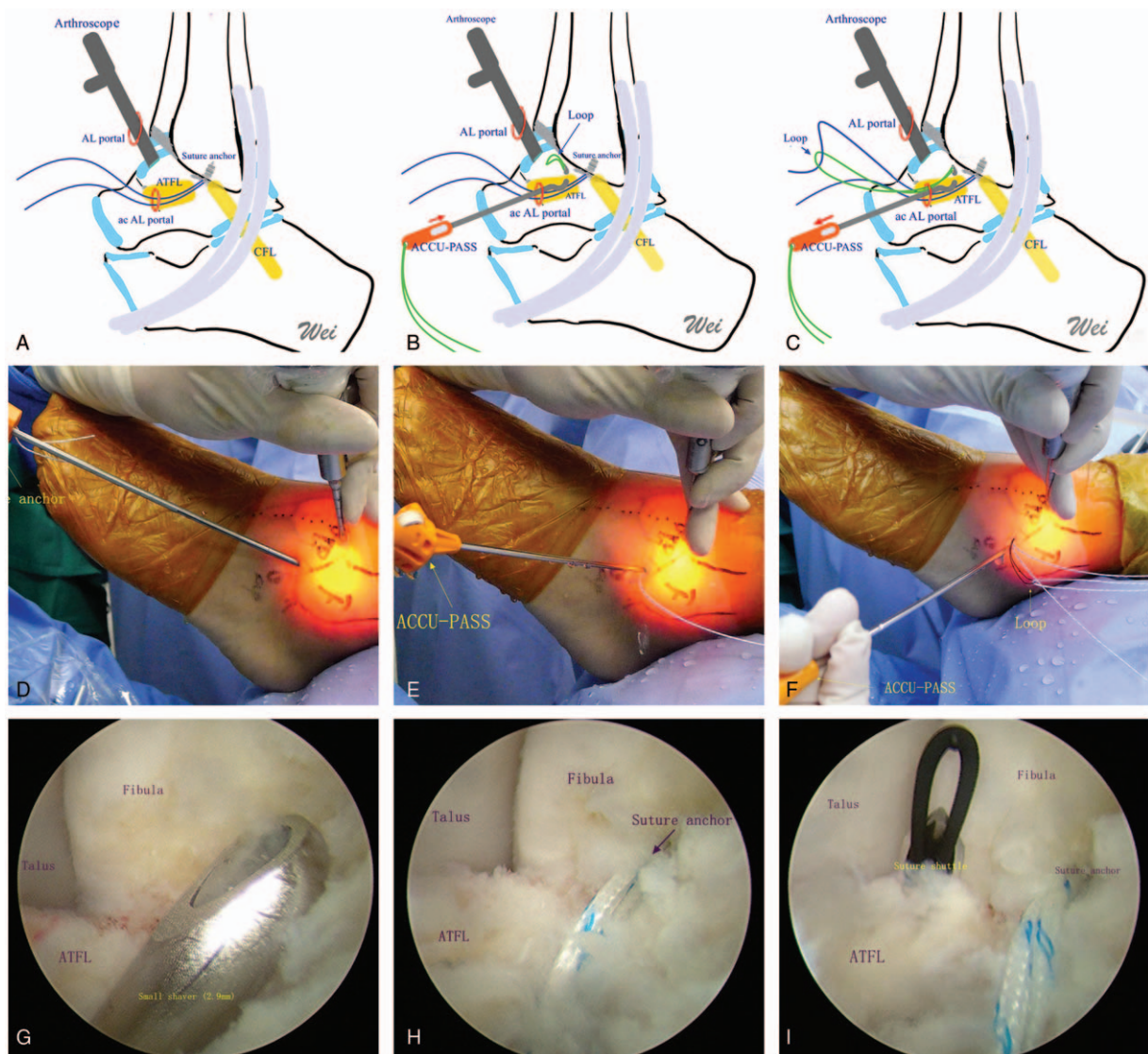


Figure 1. (A–I) The suture anchor was placed on the center of the fibular footprint of the ATFL via this portal (A, D, G, H). The suture shuttle then penetrated the upper third of the remnant ligament and ankle capsule via the acAL portal. The monofilament loop was passed through the remnant ligament. The loop was then retrieved by a mosquito clamp. One limb of the suture anchor was separated and passed through the loop, then the loop leads on the suture to penetrate the remnant ATFL exit the acAL portal (B, E, C, F, I). acAL=accessory anterolateral, ATFL=anterior talofibular ligament.

to loss of follow-up. Of the 29 cases, 8 were female (27.6%), 21 were male (72.4%), 17 were right ankle (58.6%), 11 were left ankle (37.9%), and 1 were bilateral ankles (3.4%). The average age was 34.3 ± 10.3 (range 20–55) years, with 11 smokers. Stress fluoroscopy performed at the final follow-up showed a talar tilt angle of $2.8^\circ \pm 1.6^\circ$ (range 0° – 5°) against a $15.3^\circ \pm 3.5^\circ$ (range 10° – 23°) angle preoperatively. The anterior talar translation decreased from 12.9 ± 1.6 (range 11–16) mm preoperatively to 3.4 ± 1.0 (range 2–5) mm. The AOFAS scores increased from an average preoperative score of 55.1 ± 12.3 (range 25–69) to 89.7 ± 5.9 (range 74–100) at the last follow-up. The average VAS score decreased from 6.8 ± 1.5 (range 5–10) preoperatively to 0.9 ± 0.8 (range 0–3) at the last follow-up (Table 1). Based on the Sefton grading system at final follow-up, 12 cases were considered as excellent, 13 cases were good, 2 cases were fair, and 2 cases were poor. Therefore, 25 cases (86.2%) achieved satisfactory functional results (Table 2). Regarding concomitant

intra-articular pathologic findings, synovitis was observed in all cases (100%), OCL of the talus was observed in 16 cases (55.2%), impingement was observed in 15 cases (51.7%), os subfibulare and loose body was confirmed in 5 cases (17.2%) and 6 cases (20.7%), respectively (Table 3). There was no wound infection or nerve injury in all cases. Only 3 cases of irritation at the suture knot site were encountered (10.3%), all of which were resolved with stitches removal. All patients returned to nonfrontal sport activities without difficulties at 3 months after surgery. At the last follow-up, 2 cases required revision surgery because of additional ankle sprain. Representative images of typical case were shown in Figures 1 to 4.

4. Discussion

Lateral ligament sprains of the ankle are among the most common sporting injuries. Most of these patients recover with

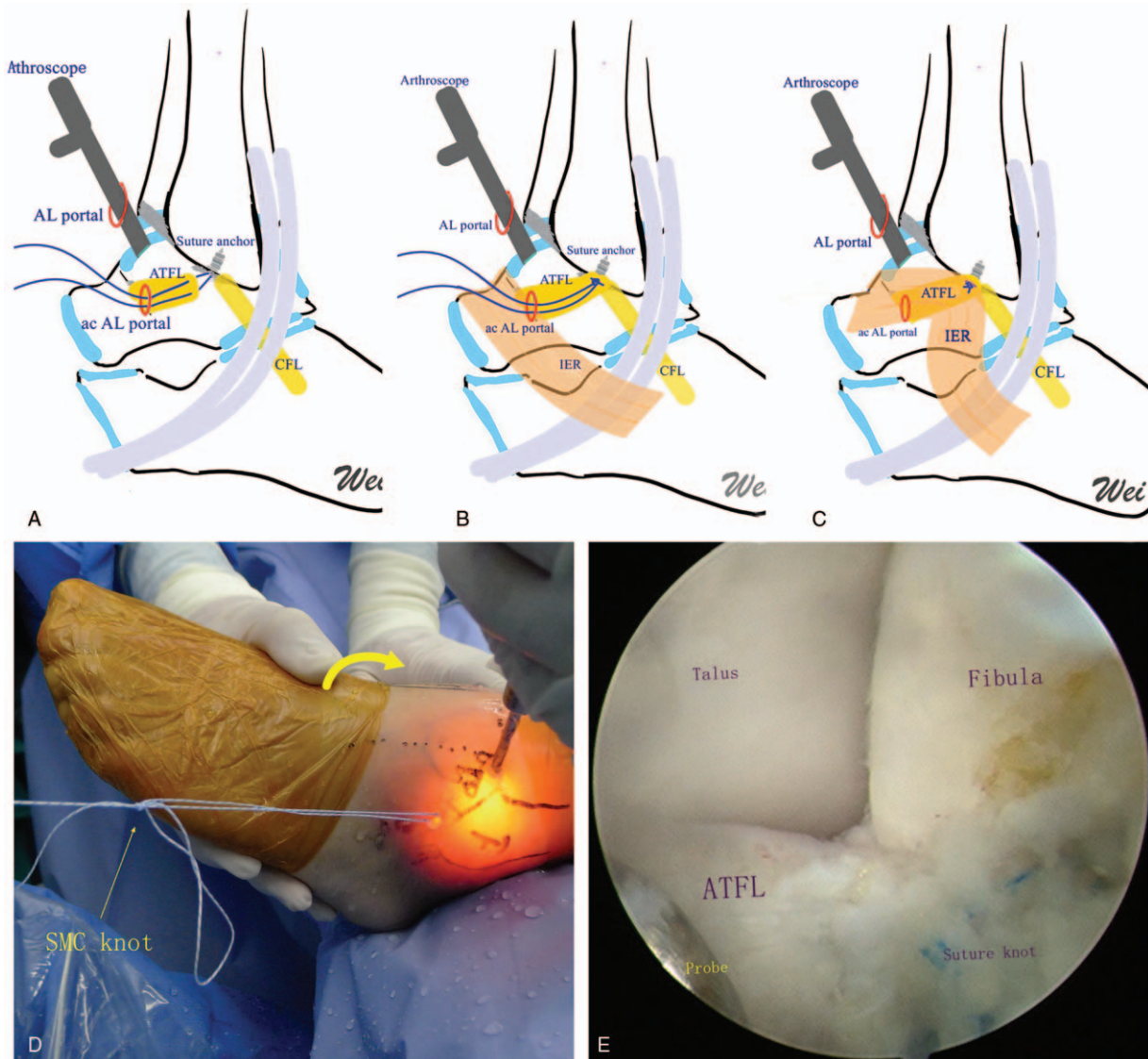


Figure 2. (A–E) Another limb of the suture was passed through the lower third of remnant ATFL. The 2 sutures were then tied using arthroscopic knot-tying technique, while the ankle was maintained in a neutral position (A, B, D, E). If there is any doubt about the stability, The IER was pulled out through the acAL port with a mosquito clamp. The 2 limbs of the suture anchor were threaded through the IER under direct visualization and tied with the conventional knot technique. acAL = accessory anterolateral, ATFL = anterior talofibular ligament, IER = inferior extensor retinaculum.

conservative treatment; however, a large amount of patients continues to have long term problems such as ankle pain, swelling, and disability. CAI may develop from an inversion-type ankle sprain, usually affect the ATFL.^[2,7,8] Many different surgical procedures are available to treat CAI. The modified Broström procedure is currently the standard method for the

anatomic repair of symptomatic chronic lateral ankle instability, of which without culaneofibular ligament reconstruction for CAI the long-term results were reported to be good to excellent in terms of functional, clinical, and radiographic assessments.^[15]

Table 1
Results of all-inside arthroscopic repair of anterior talofibular ligament for chronic ankle instability.

	Preoperative	Postoperative	P-value
AOFAS score	55.1 ± 12.3	89.7 ± 5.9	<.001
VAS score	6.8 ± 1.5	0.9 ± 0.8	<.001
Talar title, °	15.3 ± 3.5	2.8 ± 1.6	<.001
Anterior drawer translation, mm	12.9 ± 1.6	3.4 ± 1.0	<.001

AOFAS = American Orthopaedic Foot and Ankle Society, mm = millimeter, VAS = visual analog scores.

Table 2
Evaluation of functional results of all-inside arthroscopic repair of anterior talofibular ligament for chronic ankle instability using Sefton grading system.

Grade	Description	No. of patients
Excellent	Full activity, including strenuous sports; no pain, swelling, or giving way	12
Good	Occasional aches only after strenuous exercise; no giving way or feelings of apprehension	13
Fair	No giving way but some remaining apprehension, especially on rough ground	2
Poor	Recurrent instability and giving way during normal activities, with episodes of pain and swelling	2

Table 3
Intraoperative arthroscopic findings of all-inside arthroscopic repair of anterior talofibular ligament for chronic ankle instability.

Intraoperative arthroscopic findings	No. of patients
Intra-articular synovitis	29 (100%)
OCL	16 (55.2%)
OCL in the medial talar dome	7
OCL in the lateral talar dome	8
OCL in the anterior tibial plafond	1
Impingement	15 (51.7%)
Os subfibulare	5 (17.2%)
Loose body	6 (20.7%)

OCL = osteochondral lesion.

With the development of surgical equipment and technology, minimally invasive surgery for CAI is the future trend. To date, numerous arthroscopic surgical procedures for anatomical repair provide good clinical results.^[2,6,9,10,16] Two cadaveric studies showed that arthroscopic repair technique could achieve comparable biomechanical results to the open ones.^[17,18] In the present study, most of cases repaired only ATFL with 3 cases reinforcing by IER. The stability of ankle is gently checked under direct arthroscopic visualization. If there is any doubt, reinforcing procedure was performed. The results of our study showed that ankle stability was reconstructed in all cases except only 2 case

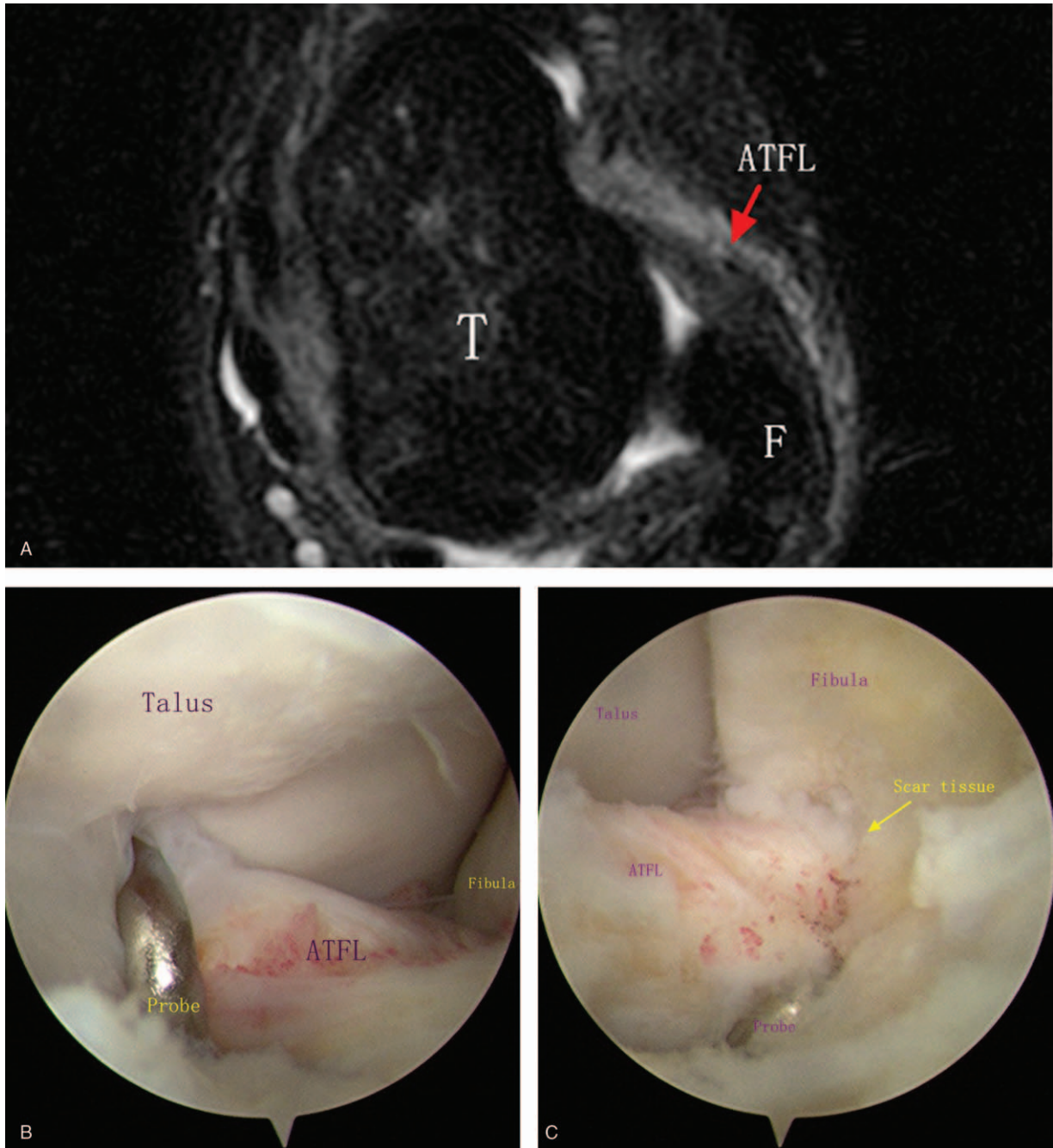


Figure 3. (A–C) A 22-year-old female patients with CAI, T2-weighted axial image shows the thickened anterior talofibular ligament at the anterior fibula. Arthroscopic assessment shows a sleeve-like avulsion at the point of ATFL/fibula connection, with fibrous scar tissue connection between the ligament remnant and bone surface. ATFL=anterior talofibular ligament, CAI=chronic ankle instability.

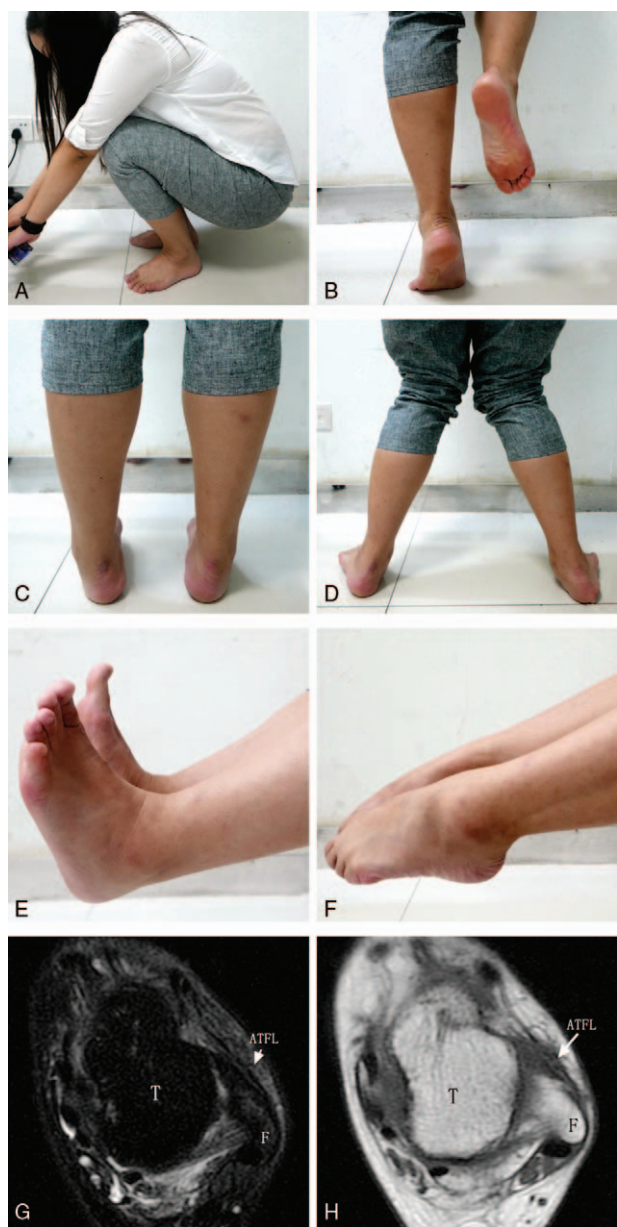


Figure 4. (A–F) 24 months after surgery, the ankle function recovered well without stiff of the subtalar joint. The AOFAS score increased from 57 points to 100 points, and the VAS score decreased from 7 points to 0 points, respectively. The Sefton Grading System score was excellent. (G–H) The morphology configuration of ATFL was showed normal on MRI. AOFAS= American Orthopaedic Foot and Ankle Society, ATFL=anterior talofibular ligament, MRI=magnetic resonance imaging, VAS=visual analog score.

with additional ankle sprain that need an additional revision surgery.

Ankle instability is usually accompanied by intra-articular pathological conditions, including OCL, synovitis, loose bodies, and impingement.^[19,20] As reported by Ferkel et al, the incidence of CAI associated with intra-articular pathology was up to 93% of CAI cases.^[20] Concomitant arthroscopy of the ankle joint followed by repair of the ligaments is particularly important. Several studies found a significant association between cartilage injury and postoperative ankle pain. Patients with OCL were more likely to suffer from poor function than patients without

these lesions.^[21–23] The modified Broström-Gould arthroscopic technique could be a viable alternative to the gold-standard Broström-Gould procedure for anatomic repair of CAI and management of intra-articular lesions.^[23] In this study, concomitant intra-articular pathologic findings included synovitis (100%), OCL of the talus (55.2%), impingement (51.7%), os subfibulare (17.2%), and loose body (20.7%). In our practice, appropriate debridement was easily performed for the management of anterior impingement and OCL through standard AM and AL portals. We prefer a small end-cutting shaver (2.9 mm) to debride the excessive synovium of lateral gutter, because the shaver allowed us to expose the remnant ATFL safely (Fig. 1G). Os subfibulare also occur in the insertion of ligament. Treatment depends on the size of the fragment. If it was small (<10 mm), it should be excised. In our cases, no imaginary rupture like the anterior cruciate ligament injury was observed. ATFL combined with capsule and periosteum was torn from the bone surface just like sleeve (Fig. 3C). Scar tissue connected between the surface of fibula and the remnant ligament was removed easily by small curette and shaver. The remnant ligament and capsule, together with the periosteum, were fixed to the bone surface using suture anchor to achieve better healing, which might be the reason for the good result of this repair technique.

Although successful outcomes of the arthroscopic repair technique have been reported by accumulating studies, previous works also demonstrated an overall complication rate almost double as open ones.^[1] The most-reported complications included delayed wound healing, superficial infection, nerve injury, portal or knot irritation, recurrent ankle instability, during which the major complication was nerve injury.^[1,16] Many experienced surgeons try to reduce the incidence of complication following arthroscopic procedures. Takao et al have simplified the modified Broström arthroscopic technique: a medial midline port for viewing and an acAL port as a working port, without the need for a percutaneous procedure or extension of the skin incisions.^[9] Acevedo et al reported that preoperative drawing of the anatomic landmarks was imperative to avoid risky procedures. In the lateral ankle region, the “safe zone” included the distal fibula, the superior margin of the peroneal tendons, and the intermediate branch of the superficial peroneal nerve.^[10] In this study, we used the standard AM and AL portals to treat concomitant intra-articular pathologies. All incisions were made through the skin, using nick and spread technique to protect the cutaneous nerve. We have modified the arthroscopic technique for Broström repair: AL portal for viewing and acAL portal for working. First, the entire frame of ATFL can be easier inspected by rotating the arthroscope via the AL portal (Fig. 3B). It should be reminded that although being rare, sometimes ATFL tear occurs on the talus side. Second, using the acAL portal for working allows easy insertion of the suture anchor in the correct position and direction. Third, we used the acAL portal to complete the suture of remnant ligament without percutaneous procedure, even if IER was needed to augment. All procedures underwent in the “safe zone,” which might explain why no nerve injury happened in our cases.

We acknowledge that there were several important limitations to our study. First, this was a retrospective study without a control group, and the sample size was relatively small, which might decrease the robustness of the conclusions. However, because of the strict inclusion and exclusion criteria, a sample size of consecutive 29 cases (30 ankles) might represent the preliminary clinical outcomes of this novel procedure. Thus,

we still believe that this procedure may be suitable for treatment of CAI. Second, the follow-up time was relatively short, and the results might change with a longer follow-up. Thus, future clinical trials were still needed to further confirm the clinical outcomes in long postoperative period. Third, using Biodex system to analysis balance and also centre of pressure could give more precise results and data, which should be conducted in future studies. Nevertheless, this study does provide useful insight into the clinical efficacy of the modified all-inside arthroscopic repair technique.

5. Conclusion

In conclusion, the modified all-inside arthroscopic repair of ATFL via AL and acAL port may be suitable for treatment of CAI due to ideal postoperative function recovery and fewer complications.

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