

Comparison of Short-Term Clinical Effects of Minimally Invasive Anterior Talofibular Ligament Reconstruction versus Suture Anchor Repair for Chronic Lateral Ankle Instability

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Abstract: *Objective:* To compare the short-term clinical effects of minimally invasive anterior talofibular ligament (ATFL) reconstruction versus suture anchor repair in patients with chronic lateral ankle instability. *Methods:* A retrospective analysis was conducted on 68 patients at the 960th Hospital of the Chinese People's Liberation Army Joint Logistics Support Force between January 2022 and June 2023, patients were divided into two groups based on surgical procedure: Group A (ATFL reconstruction, 35 cases) and Group B (suture anchor repair, 33 cases). Follow-up ranged from 1 to 12 months, assessing the American Orthopaedic Foot and Ankle Society (AOFAS) score, VAS pain score, Tegner activity score, and patient satisfaction, while noting any recurrence of ankle instability or complications such as numbness or infection. *Results:* In Group A, the AOFAS score improved from 74.46 ± 2.96 preoperatively to 90.91 ± 2.79 at final follow-up, Tegner score from 2.40 ± 0.50 to 5.69 ± 0.76 , and VAS from 3.14 ± 0.85 to 1.60 ± 0.50 ; patient satisfaction was 8.31 ± 0.72 . In Group B, AOFAS improved from 74.48 ± 2.29 to 90.55 ± 3.12 , Tegner from 2.48 ± 0.51 to 5.76 ± 0.79 , and VAS from 3.45 ± 0.83 to 1.73 ± 0.50 , with patient satisfaction at 8.27 ± 0.63 . No significant statistical difference was found between groups in any score ($P > 0.05$), with both groups showing significant postoperative improvement ($P < 0.05$) and no serious complications within 1-year follow-up. *Conclusion:* Both ATFL reconstruction and suture anchor repair yield favorable short-term outcomes in treating lateral ankle instability. Further research is needed to assess if anatomical reconstruction offers superior biomechanical benefits in scar healing over the suture anchor repair in long-term follow-up.

Keywords: Chronic lateral ankle instability; Ankle arthroscopy; Anterior talofibular ligament injury

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1. Introduction

As a critical weight-bearing joint, the ankle relies heavily on its lateral collateral ligaments to maintain stability. This ligament complex primarily consists of the anterior talofibular ligament (ATFL), calcaneofibular ligament (CFL), and posterior talofibular ligament (PTFL), forming a solid barrier that safeguards the stability of the ankle's lateral aspect ^[1,2]. Ankle sprains are common injuries in everyday activities and sports, often involving damage to the lateral collateral ligaments ^[3]. Studies show that the ATFL is injured in about 85% of ankle sprains, while the CFL injury rate ranges between 50% and 75%; PTFL injuries are relatively rare, occurring in less than 10% of cases ^[4,5]. Most lateral collateral ligament injuries can be effectively treated with conservative measures such as immobilization and physical therapy, resulting in satisfactory recovery. However, 20–40% of patients continue to experience persistent pain, recurrent sprains, and joint instability, ultimately leading to chronic lateral ankle instability ^[6]. Consequently, exploring effective treatment options for chronic lateral ankle instability is essential. This article compares the short-term clinical effects of two methods: minimally invasive ATFL reconstruction and suture anchor repair.

2. Materials and methods

2.1. General information

This study selected a total of 68 patients with chronic lateral ankle instability who were admitted to the hospital between January 2022 and June 2023 as the research subjects. All enrolled patients underwent corresponding surgical treatments and were scheduled for regular follow-up observations postoperatively.

The specific inclusion criteria are as follows:

- (1) Patients must meet the diagnostic criteria for chronic lateral ankle instability.
- (2) Patients must have the diagnosis confirmed through physical examination (positive anterior drawer test of the ankle, **Figure 1**) and imaging with magnetic resonance imaging (MRI) showing injury to the anterior talofibular ligament (**Figure 2**).
- (3) Patient age must be within the range of 18 to 60 years old.
- (4) Patients with ankle instability caused by other diseases or injuries must be excluded.



Figure 1. Positive anterior drawer test of the ankle

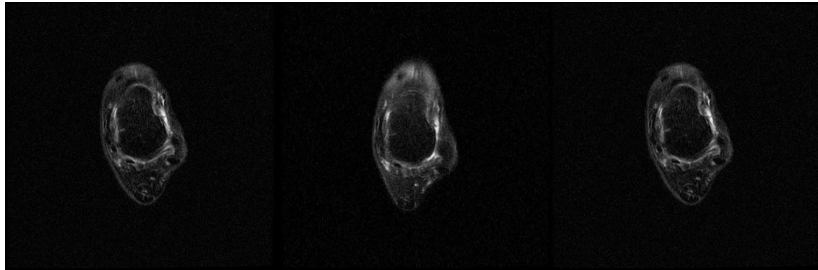


Figure 2. MRI showing injury to the anterior talofibular ligament

The 68 patients were divided into two groups according to different surgical methods:

- (1) Group A: The anterior talofibular ligament reconstruction group included 35 patients, with 18 male and 17 female patients, and an average age of 35.61 ± 7.21 years.
- (2) Group B: The suture anchor repair group consisted of 33 patients, with 17 male and 16 female patients, and an average age of 34.80 ± 6.50 years.

Statistical analysis showed no significant differences between the two groups in terms of gender, age, and disease course ($P > 0.05$), indicating good comparability between the groups.

2.2. Surgical method

Arthroscopic examination revealed the condition of the anterior talofibular ligament injury. If there was a major tear with only minor connections, and the ligament appeared loose and thin, anterior talofibular ligament reconstruction surgery was chosen, and the patient was included in Group A (**Figure 3**). If there was a partial tear with evident ligament laxity and scar thickening, a suture anchor repair surgery was selected, placing the patient in Group B (**Figure 4**).

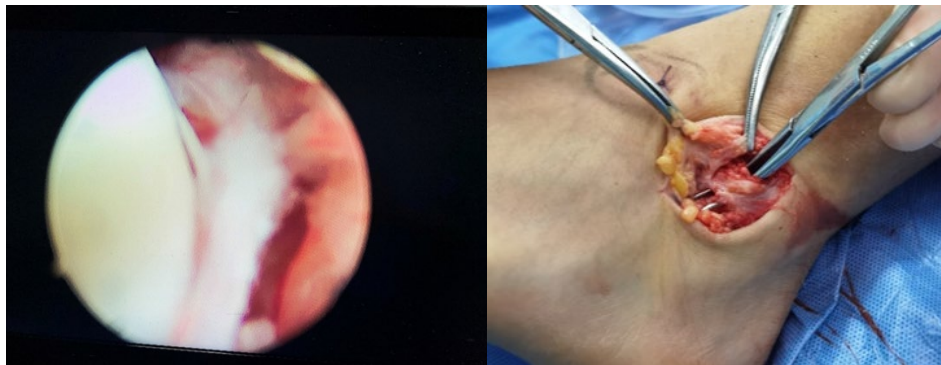


Figure 3. A major tear with only minor connections, and the ligament appeared loose and thin

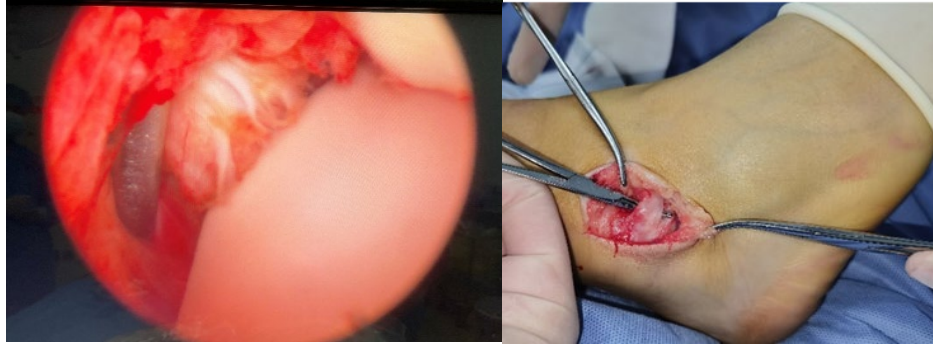


Figure 4. A partial tear with evident ligament laxity and scar thickening

Group A underwent anterior talofibular ligament reconstruction (**Figure 5**): The procedure involved exposing the peroneus brevis tendon both proximally and distally while preserving the superior peroneal retinaculum. The anterior half of the tendon was isolated distally and split proximally up to the musculotendinous junction. A guide pin was inserted at the talar attachment point of the anterior talofibular ligament near the tip of the lateral malleolus. A bone tunnel was created through the talus and fibula. The isolated half of the peroneus brevis tendon was passed through the fibular tunnel and directed into the talar tunnel. After tension adjustment, the tendon was secured with a suture anchor.

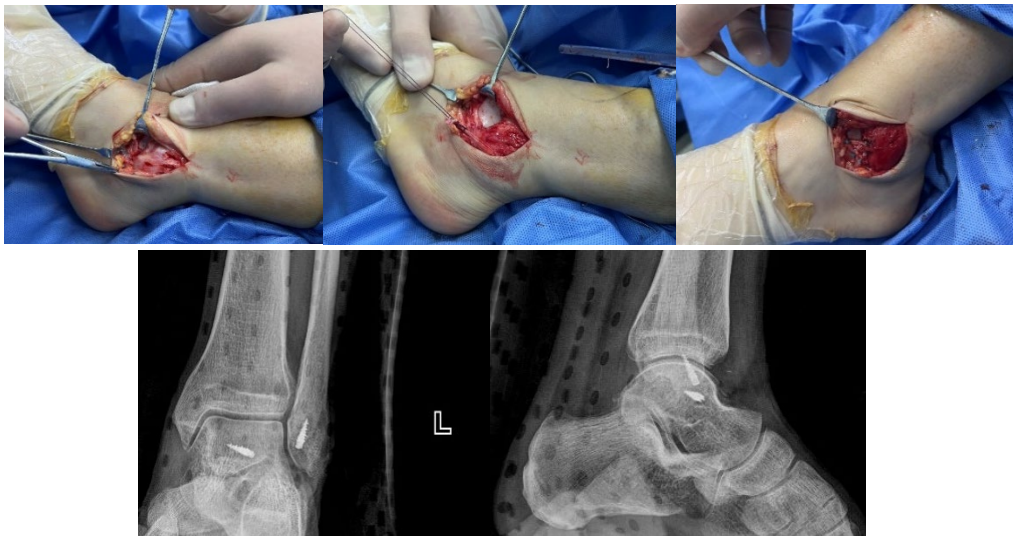


Figure 5. Anterior talofibular ligament reconstruction and X-rays after the procedure

Group B underwent suture anchor repair surgery using the Broström-Gould approach (**Figure 6**).



Figure 6. X-rays after suture anchor repair surgery

After surgery, both groups of patients were treated with an ankle brace in an eversion position for six weeks and encouraged to begin early functional rehabilitation exercises. Specifically, suture removal was performed two weeks post-surgery, after which passive ankle joint exercises were initiated and gradually progressed to active movement. At six weeks post-surgery, weight-bearing exercises were introduced, with incremental increases based on the patient's recovery progress.

2.3. Observation indicators

- (1) American Orthopaedic Foot & Ankle Society (AOFAS) score: This score is used for a comprehensive assessment of ankle function, covering aspects such as pain, range of motion, and stability. Higher scores indicate better ankle function.
- (2) Visual Analog Scale (VAS) for pain: This 0–10 visual scale assesses the patient's pain level, with 0 representing no pain and 10 representing the worst possible pain.
- (3) Tegner activity level scale: This scale evaluates the patient's level of physical activity, with higher scores indicating a better level of activity function.
- (4) Patient satisfaction: A satisfaction survey developed by the hospital was used, with a maximum score of 10, where higher scores indicate greater patient satisfaction.
- (5) Complication rate: Various postoperative complications were recorded in both groups, including lateral ankle instability recurrence, limb numbness, and wound infection.

2.4. Statistical methods

Statistical analysis was conducted using SPSS27.0 software. For continuous variables, data were expressed as mean \pm standard deviation (SD) and compared between the two groups using an independent-samples *t*-test. Categorical data were expressed as percentages (%) and compared using the chi-square (χ^2) test. A *P*-value of less than 0.05 was considered statistically significant.

3. Results

3.1. Comparison of general information between the two groups

There were no statistically significant differences between the two groups in terms of gender, age, duration of illness, or injury mechanism ($P > 0.05$), as shown in **Table 1**.

Table 1. Comparison of general information between the two groups

Group	n	Gender (n)		Age (years)	Average disease duration (months)	Injury mechanism (cases)	
		Male	Female			Sports injury	Non-sports injury
Group A	35	18	17	35.61 ± 7.21	12.55 ± 4.81	23	12
Group B	33	17	16	34.80 ± 6.50	11.85 ± 3.97	21	12
		χ^2/t				0.032	
		P				0.858	

3.2. Comparison of AOFAS scores, VAS scores, Tegner scores, and patient satisfaction before and after surgery

Prior to surgery, there were no significant differences between the two groups in AOFAS, VAS, and Tegner scores ($P > 0.05$). Postoperatively, AOFAS and Tegner scores significantly improved compared to preoperative scores ($P < 0.05$), while VAS scores significantly decreased ($P < 0.05$). There was no statistically significant difference in patient satisfaction between the two groups ($P > 0.05$). The results are shown in **Table 2**.

Table 2. Comparison of AOFAS scores, VAS scores, Tegner scores, and patient satisfaction at various time points before and after surgery

Group	n	AOFAS score		Tegner score		VAS score		Satisfaction	
		Before surgery	Final follow-up	Before surgery	Final follow-up	Before surgery	Final follow-up	Final follow-up	
Group A	35	74.46 ± 2.96	90.91 ± 2.79*	2.40 ± 0.50	5.69 ± 0.76*	3.14 ± 0.85	1.60 ± 0.50*	8.31±0.72	
Group B	33	74.48 ± 2.29	90.55 ± 3.12*	2.48 ± 0.51	5.76 ± 0.79*	3.45 ± 0.83	1.73 ± 0.50*	8.27±0.63	
		t	0.031	0.502	0.653	0.372	1.520	1.072	0.243
		P	0.975	0.617	0.516	0.711	0.133	0.288	0.809

Note: *indicates that there is statistical significance between the final follow-up and pre-operation in the same group ($P < 0.05$)

3.3. Comparison of postoperative complications between the two groups

Neither group experienced complications such as recurrent lateral ankle instability, limb numbness, or wound infection after surgery.

4. Discussion

Lateral ankle instability is a common type of sports injury, primarily caused by damage to the ATFL. There is currently no unified standard for the treatment of chronic lateral ankle instability. For patients with relatively mild symptoms, conservative treatment is often a suitable option. In contrast, surgical intervention is recommended for those who do not respond to conservative treatment or experience recurrent issues. In recent years, the application of minimally invasive techniques in ankle surgery has become increasingly widespread. Compared to traditional open surgery, minimally invasive procedures offer numerous advantages, including smaller incisions, faster recovery times, and lower rates of complications.

The results of this study indicate that both ATFL reconstruction and the use of suture anchors for ATFL repair achieve favorable postoperative outcomes during short-term follow-up. At various postoperative time points, both groups showed significant improvements in the AOFAS scores, VAS pain scores, and Tegner activity scores compared to preoperative levels, with statistical significance ($P < 0.05$). Furthermore, there were no statistically significant differences between the two groups ($P > 0.05$). This confirms that both surgical approaches can effectively enhance ankle function and improve patients' quality of life.

The advantage of ATFL reconstruction lies in its ability to restore the anatomical structure of the ligament, theoretically providing stronger stability to the ankle joint. In contrast, the suture anchor repair method is simpler and causes less trauma, resulting in a quicker recovery for patients. With the ongoing development and maturation of arthroscopic techniques, the reconstruction of the lateral collateral ligaments of the ankle joint under arthroscopy has garnered considerable attention from researchers, showing efficacy comparable to that of traditional open surgery [7,8]. For instance, Zhang *et al.* [7] conducted a retrospective analysis of 28 patients who underwent arthroscopic lateral collateral ligament reconstruction and 32 who received open reconstruction, finding no significant differences in clinical outcomes at two-year follow-up. Similarly, Yang *et al.* [9] compared clinical data of two groups (10 patients each) who underwent lateral collateral ligament reconstruction using allografts via either open or arthroscopic methods, and found no notable differences in outcomes at two-year follow-up. Su *et al.* [8] prospectively compared 31 patients undergoing arthroscopic reconstruction and 26 patients undergoing open reconstruction, reporting that the arthroscopic group resumed full weight-bearing and activity earlier than the open group at three and six months postoperatively, along with higher relevant scores.

However, this study also has limitations. Firstly, the sample size is relatively small, and the follow-up period is short; thus, further studies with larger sample sizes and longer follow-ups are needed to more thoroughly validate the long-term efficacy of these two surgical approaches. Secondly, this research did not compare the biomechanical properties of the two surgical methods, which could be explored in future studies using biomechanical experiments.

5. Conclusion

In conclusion, both minimally invasive ATFL reconstruction and suture anchor repair effectively treat chronic

lateral ankle instability and yield good clinical outcomes. Each surgical method has its own advantages and limitations, and the choice of surgical approach should be based on the specific clinical condition of the patient.

Disclosure statement

The authors declare no conflict of interest.

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