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RESEARCH

Two portals are sufficient for all-inside arthroscopic isolate anterior talofibular ligament repair

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Abstract

Purpose All-inside arthroscopic repair of the anterior talofibular ligament (ATFL) using two or three portals is one of the most commonly performed procedures for managing chronic lateral ankle instability (CLAI). However, it remains unclear whether there are differences in functional outcomes between the use of two versus three portals.

Methods This retrospective comparative study included 66 patients with CLAI who underwent an all-inside arthroscopic isolated ATFL repair procedure between 2018 and 2021. Patients were divided into two groups according to the number of portals introduced. In the two-portal group (n = 31), the ATFL was repaired using two portals. In the three-portal group (n = 35), the ATFL was repaired using three portals. The American Orthopedic Foot and Ankle Society (AOFAS) scores, Karlsson Ankle Function Score (KAFS), Anterior Talar Translation (ATT), Active Joint Position Sense (AJPS), complications, as well as the time of return to sports were compared between the two groups.

Results All patients were followed up for a minimum of 2 years. Improvement in functional outcomes (AOFAS, KAFS, ATT and AJPS) was recorded at the final follow-up. No significant differences were observed between the two groups in terms of operative time, AOFAS, KAFS, ATT, AJPS, or the time of return to sports. However, no nerve complications were observed in the two-portal group.

Conclusion In patients with CLAI undergoing all-inside arthroscopic isolate ATFL repair, the use of either two or three portals results in comparable and favorable functional outcomes. The two-portal procedure was also associated with no superficial peroneal nerve injuries.

Level of evidence Level III.

Keywords Chronic lateral ankle instability · Arthroscopic ATFL repair · Portal

Abbreviations

ATFL	Anterior talofibular ligament
CLAI	Chronic lateral ankle instability
AOFAS	American Orthopedic Foot and Ankle Society score
KAFS	Karlsson Ankle Function Score
ATT	Anterior Talar Translation
AJPS	Active Joint Position Sense

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Introduction

Injuries to the lateral ankle ligament complex, particularly the anterior talofibular ligament (ATFL), are among the most frequent musculoskeletal injuries, often occurring during sports or physical activity. ATFL injuries account for approximately 65% of lateral ankle ligament injuries [15, 20]. While most ATFL injuries respond well to conservative treatment and rehabilitation over 3 to 6 months, 10–12% of patients experience persistent symptoms, including lateral ankle pain, recurrent sprains, and instability, leading to a

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condition known as chronic lateral ankle instability (CLAI) [5, 23, 30].

Surgical intervention is typically recommended for symptomatic CLAI after conservative management failed. Among the surgical options, all-inside arthroscopic ATFL repair has gained popularity due to its minimally invasive nature and clinical outcomes comparable to those of open repair techniques [17, 32, 33]. Two-portal and three-portal arthroscopic approaches are the mostly used techniques for ATFL repair [16, 22, 24, 28]. However, there is no established consensus on the optimal number of portals, as this decision often depends on the surgeon's preference and expertise.

This study explores the functional outcomes of CLAI patients who underwent all-inside arthroscopic ATFL repair using two-portal and three-portal techniques. The null hypothesis tested in this study was that there is no significant difference in functional outcomes between the two techniques for all-inside arthroscopic ATFL repair in CLAI patients.

Materials and methods

After institutional review board approval was obtained, prospectively collected data from patients with CLAI who had undergone arthroscopic isolated ATFL repair between February 2018 and October 2021 were retrospectively reviewed. Each patient provided informed consent and consented to the Health Insurance Portability and Accountability Act.

Patients were included in the study if they met the following conditions: (1) diagnosed with CLAI and had not responded to at least of 6 months of conservative treatment; (2) had undergone an all-inside arthroscopic isolated ATFL repair procedure using two or three portals; (3) had a minimum follow-up period of 24 months with complete data. Patients were excluded from the study if they met any of the following conditions: (1) had ankle osteoarthritis; (2) had generalized ligamentous laxity; (3) had a history of surgery on the affected limb or sustained a secondary injury to the operated ankle during the postoperative follow-up period.

Participants

During the 44 month study period, 108 consecutive patients with CLAI underwent an all-inside arthroscopic isolated ATFL repair, performed by a fellowship-trained foot and ankle surgeon. A total of 42 patients did not meet the inclusion criteria and were subsequently excluded from the study. The reasons for exclusion included: 9 patients had a prior history of foot and ankle surgery, 12 patients had sustained secondary injuries to the operated ankle, 13 patients were lost to follow-up before completing 24 months, 5 patients had ankle osteoarthritis, and 3 patients had generalized ligamentous laxity. A total of 66 patients with CLAI were ultimately included in this study, based on the specified inclusion and exclusion criteria.

The patients were categorized into two groups based on the number of portals used. In the two-portal group (n = 31), the ATFL was repaired using two portals and a single-loaded suture anchor. In the three-portal group (n = 35), the ATFL was repaired through three portals, also with a single-loaded suture anchor.

Surgical technique

With the patient in the supine position, the operated ankle was positioned over the distal edge of the operating table to facilitate the procedure.

In the two-portal group, with the ankle in passive dorsiflexion, the medial midline portal was established laterally to the tibialis anterior tendon at the anterior joint line (Fig. 1). With the ankle dorsiflexed, the accessory anterolateral portal, located 1.5 cm anterior to the distal tip of the fibula, was introduced as a working portal [8]. The medial midline portal served as the viewing portal, providing excellent visualization of the ATFL. Through the accessory anterolateral portal, which functioned as the working portal, a probe was used to evaluate the tension and integrity of the ATFL, and various arthroscopic procedures could be performed with ease (Fig. 2). The footprint region of the ATFL on the fibula was prepared using a motorized burr. A single-loaded suture anchor (Healix Transtend 2.9 mm, Depuy Synthes) was then inserted into the mid-portion of the footprint through the accessory anterolateral portal. The ATFL was sutured in a loop configuration via the accessory anterolateral portal (Fig. 3).

In the three-portal group, the standard anterolateral and anteromedial portals were first established to evaluate the intra-articular lesions (Fig. 1). The accessory anterolateral portal was then created to expose a bleeding bony surface at the footprint region of the fibula, which was prepared using a motorized burr. A single -loaded suture anchor (Healix Transtend 2.9 mm, Depuy Synthes) was inserted in the same manner as in the two-portal group, and the ATFL was also sutured using a loop configuration.

Finally, with the ankle slightly dorsiflexed and everted, the suture limbs were tied using a knot pusher.

Postoperative management

A short leg brace was applied to immobilize the operated ankle in a slight dorsiflexion and eversion position during the first two weeks following surgery. On the second postoperative day, non-weight-bearing functional exercises and isometric exercises for the affected limb were initiated

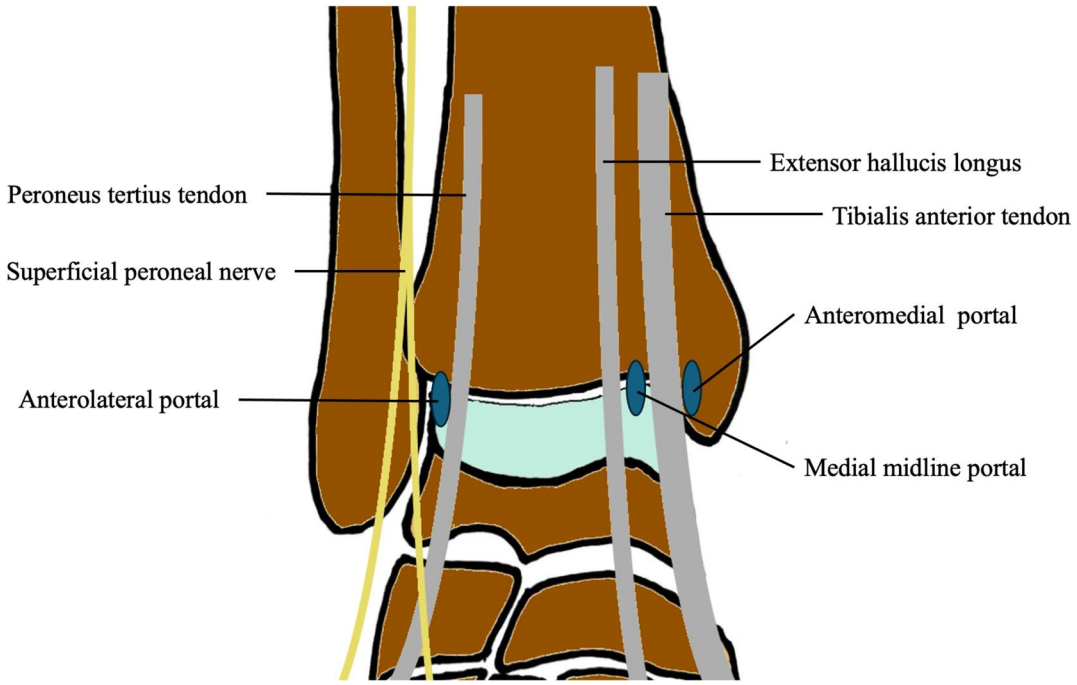

Fig. 1 Arthroscopic portals of the anterior ankle

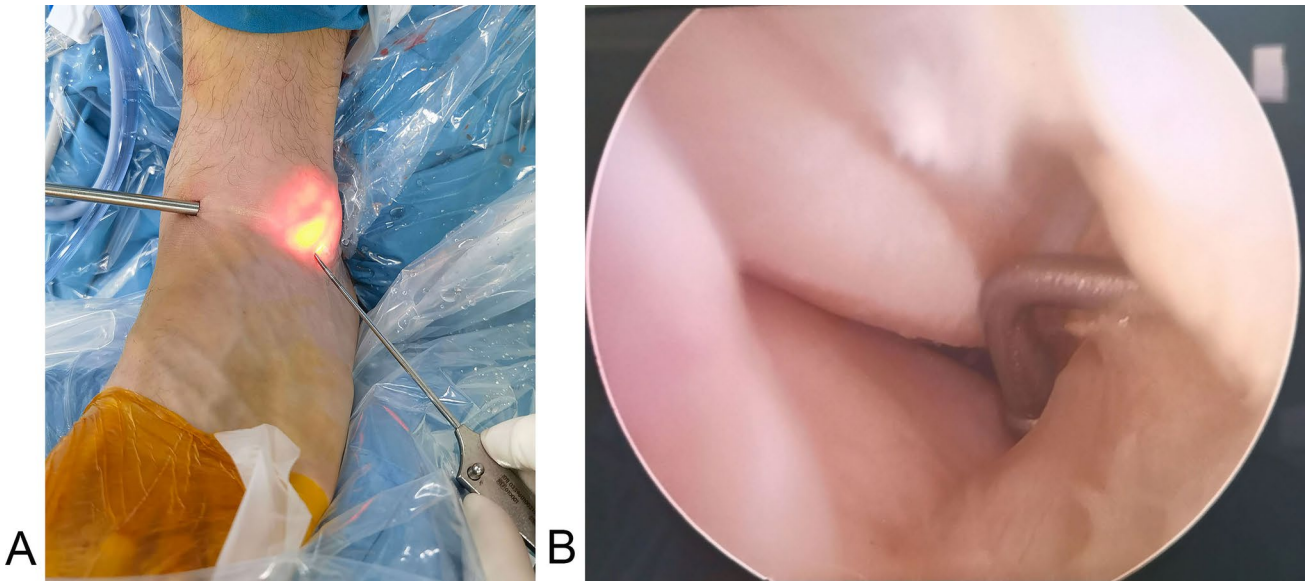

Fig. 2 Combined images of external portal intervention (**A**) and intra-articular arthroscopic views (**B**)

under the supervision of a physical therapist. A walking air boot was used for the next four weeks, during which weight-bearing functional exercises were introduced. Dynamic balance exercises and ankle proprioception rehabilitation commenced at week seven. Patients were then gradually encouraged to return to normal physical activities.

Evaluation of outcomes

All patients were followed up at 6 months, 1 year, and 2 years postoperatively. The postoperative measurements taken at each follow-up visit were conducted by two experienced ankle surgeons, who were blinded to the surgical procedure. Ankle function and therapeutic efficacy were assessed using the American Orthopedic Foot and Ankle

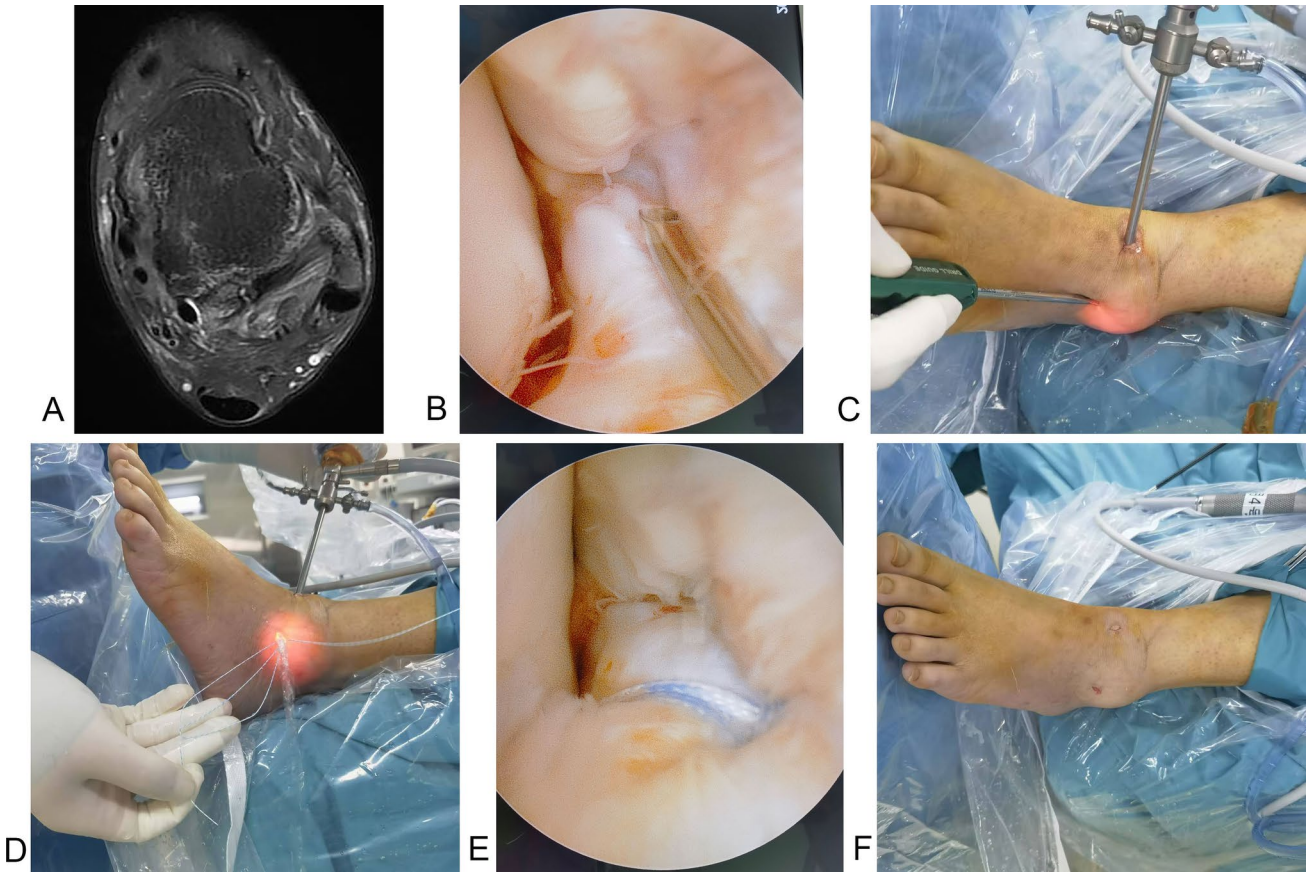

Fig. 3 Technique of two-portal all-inside arthroscopic anterior talofibular ligament repair in the left ankle. **A** chronic lateral ankle instability confirmed at the magnetic resonance imaging; **B** The anterior talofibular ligament was detached from the distal fibula; **C** A single-loaded suture anchor was inserted into the mid-portion of the fibular footprint; **D**, **E** The anterior talofibular ligament was sutured in a loop configuration; **F** Overview of the two portals

Society (AOFAS) scoring system, the Karlsson Ankle Functional Score (KAFS), and Anterior Talar Translation (ATT). Ankle proprioception was evaluated using the Active Joint Position Sense (AJPS) test [7]. Data on the time taken to return to recreational activities, as well as postoperative recurrence and complications, were also collected.

Statistical analysis

Data analysis was performed using SPSS 24.0 statistical software and GraphPad Prism 9.4.1. The pre- and postoperative variables within each group, as well as between the two groups, were compared using the Student's t-test (for normally distributed data) or the Mann–Whitney U test (for data with asymmetric distribution). Categorical variables were analyzed using the Pearson chi-square test. A post hoc power analysis was conducted to assess the statistical power of the sample sizes. A p-value of less than 0.05 was considered statistically significant.

Results

The two groups were similar in terms of patient characteristics, including age, BMI, AOFAS, KAFS, ATT, and disease duration (n.s.). (Table 1).

Table 1 Characterization of the Sample

Variable	Two-portal group (n = 31)	Three-portal group (n = 35)	*P* value
Age, yr	33.23 ± 8.13	32.23 ± 8.12	n.s
BMI, kg/m^2	23.61 ± 3.06	23.11 ± 2.42	n.s
AOFAS	67.35 ± 8.31	68.60 ± 7.15	n.s
KAFS	65.16 ± 6.48	66.14 ± 7.04	n.s
ATT	9.29 ± 1.97	9.74 ± 2.53	n.s
Disease duration, mo	13.94 ± 2.18	13.97 ± 1.99	n.s

BMI Body Mass Index, *AOFAS* American Orthopaedic Foot and Ankle Society, *KAFS* Karlsson Ankle Function Score, *ATT* Anterior Talar Translation, *n.s.* non-significant

The operative times in the two-portal and the three-portal groups were similar (23.16 ± 6.26 min vs. 24.57 ± 5.90 min, p = 0.350). During the follow-up period, no general complications, such as wound infections, vascular injuries, or ankle stiffness, were observed in either group. However, in the three-portal group, three patients experienced transient paraesthesia along the superficial peroneal nerve, whereas no nerve complications were recorded in the two-portal group.

Table 2 Functional outcomes comparison of the two groups

Variable	Two-portal group (n = 31)	Three-portal group (n = 35)	*P* value	Power[a]
AOFAS				
6 months	90.87 ± 3.77	90.71 ± 3.09	n.s	0.054
1 yr	93.39 ± 2.97	94.11 ± 3.54	n.s	0.143
2 yr	94.97 ± 3.29	95.74 ± 2.97	n.s	0.165
KAFS				
6 months	88.26 ± 3.15	88.20 ± 4.73	n.s	0.050
1 yr	91.29 ± 2.58	92.03 ± 3.07	n.s	0.182
2 yr	93.16 ± 3.20	93.91 ± 3.38	n.s	0.149
ATT, mm				
1 yr	3.48 ± 1.03	3.69 ± 1.05	n.s	0.127
2 yr	3.71 ± 1.13	3.89 ± 1.02	n.s	0.102
AJPS, degree				
Plantar flexion 10°				
6 months	7.74 ± 0.89	7.54 ± 1.04	n.s	0.132
1 yr	8.16 ± 0.82	8.09 ± 0.89	n.s	0.062
2 yr	8.77 ± 0.62	8.63 ± 0.91	n.s	0.112
Plantar flexion 20°				
6 months	17.13 ± 1.23	16.97 ± 1.04	n.s	0.086
1 yr	17.90 ± 1.01	17.66 ± 0.97	n.s	0.162
2 yr	18.42 ± 0.96	18.43 ± 1.04	n.s	0.050

AOFAS American Orthopaedic Foot and Ankle Society, *KAFS*, Karlsson Ankle Function Score, *ATT* Anterior Talar Translation, *AJPS* Active Joint Position Sense, *n.s.* non-significant

[a]Power is computed to reject the null hypothesis of equal means

No patients in either group required revision surgery for lateral ligament repair during the 2-year follow-up period.

Significant improvements were observed in the AOFAS, KAFS, ATT and AJPS in both groups when compared to preoperative baseline values. However, at each follow-up visit, the AOFAS, KAFS, ATT, and AJPS scores remained comparable between the two groups throughout the 2-year follow-up period (Table 2, and Figs. 4, 5, 6).

All patients returned to their previous employment. However, five patients in the three-portal group partially adjusted their activities, and one completely switched to non-weight-bearing activities such as swimming and cycling. In contrast, four and one patient, respectively, in the two-portal group made similar changes. Overall, 26 patients (83.87%) in the two-portal group and 29 patients (82.86%) in the three-portal group were able to return to 100% of the sports they participated in prior to their ankle sprain (n.s.). The mean time of the patients return to sports activities was 12.52 ± 3.61 week in the two-portal group and 12.06 ± 3.17 week in the three-portal group (n.s.).

The group sample sizes of 31and 35 resulted in less than 20.00% power (for AOFAS, KAFS, ATT and AJPS scores, respectively) to reject the null hypothesis of equal means, with a significance level (α) of 0.05, using a two-sided, two-sample unequal-variance t-test (Table 2).

Discussion

The main finding of this study was that all-inside arthroscopic repair of the ATFL using two portals yields functional outcomes comparable to those achieved with three portals. No significant differences were observed between the two groups in terms of clinical outcomes, including operative time, AOFAS, KAFS, ATT, AJPS, and rate and time of return to sports and other activities. Both two-portal and three-portal all-inside arthroscopic ATFL repair are reliable techniques for treating CLAI, with favorable ankle function

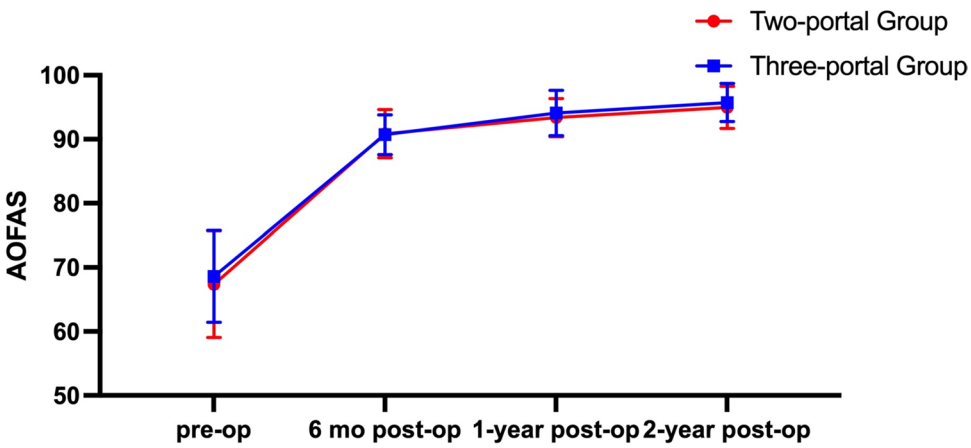

Fig. 4 AOFAS score of the two groups

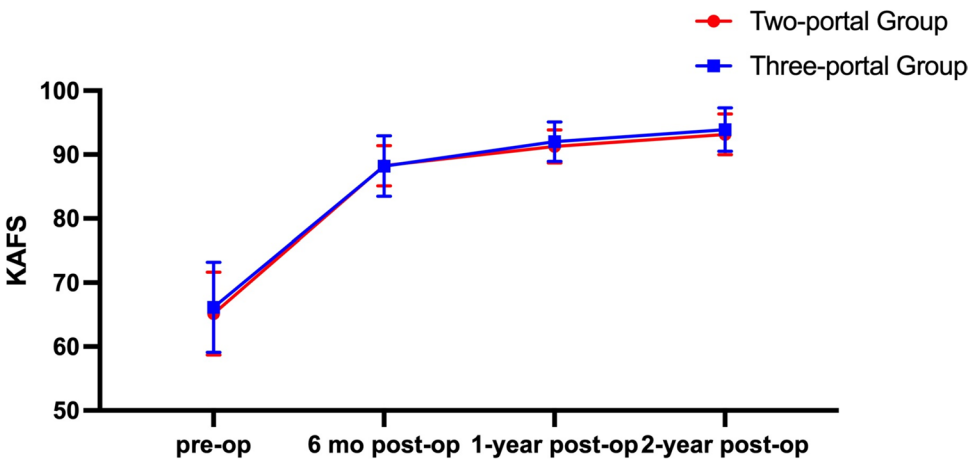

Fig. 5 KAFS score of the two groups

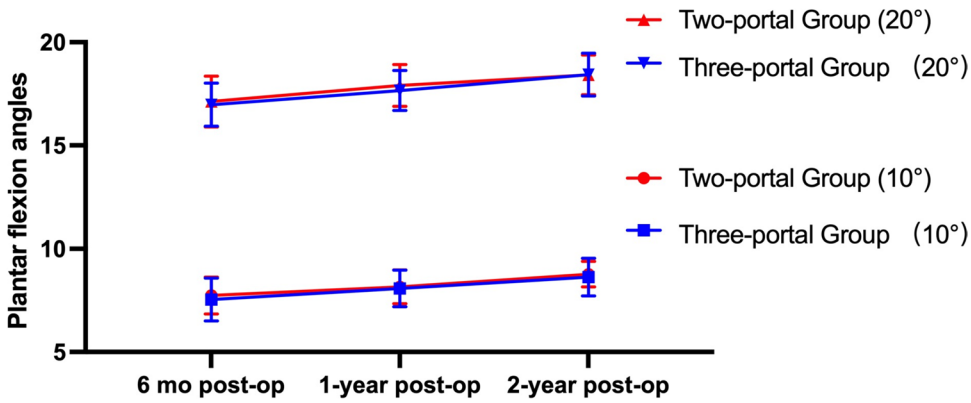

Fig. 6 AJPS score of the two groups

outcomes. The two-portal procedure was associated with no nerve injury complications.

There is no consensus on the optimal number of portals for performing all-inside arthroscopic repair of the isolated ATFL. While various surgical techniques utilizing different portal configurations have been reported for ATFL repair in patients with CLAI, two or three portals are typically employed for reattaching the ATFL [14, 26, 29]. Feng et al. [9] treated 71 patients with CLAI using arthroscopic ATFL repair surgery through three portals: anterolateral, anteromedial, and accessory anterolateral. At the final follow-up, all patients demonstrated significant improvements in the AOFAS, KAFS, AJPS, and ATT, indicating reliable functional outcomes. In a separate study, Feng et al. [10] retrospectively analyzed the functional results of 37 CLAI patients who underwent all-inside arthroscopic ATFL repair via the same three portals. After a mean follow-up of 33.16 months, improvements were observed in both the AOFAS (from 73.16 to 92.53) and KAFS (from 75.02 to 93.36) scores. All patients achieved excellent or good functional outcomes, with no reported activity limitations. Batista et al. [3] utilized two portals, the anterolateral and anteromedial portals, for arthroscopic repair of the lateral ligament in 22 patients. The AOFAS scores improved from a mean of 63 points (range 52–77) to 90 points (range 73–100) at an average follow-up of 25 months, with no recurrences of ankle instability. In 2019, Shimozono et al. [27] described a two-portal technique, using a medial midline portal and an accessory anterolateral portal, for arthroscopic repair of the ATFL. However, they did not report the outcomes of this technique in clinical patients. Based on the clinical results from the current cohort of 66 patients, with a follow-up period of over two years post-surgery, both the two-portal group (n = 31) and the three-portal group (n = 35) demonstrated significant improvements in AOFAS, KAFS, ATT, and AJPS scores. These findings are consistent with previous studies, supporting the reliability of all-inside arthroscopic ATFL repair using either two or three portals for the treatment of CLAI. No significant differences were observed in any of the functional outcome measures (ATT, AOFAS, KAFS, and AJPS) between the two groups. Both two-portal and three-portal techniques yielded comparable functional outcomes. However, the two-portal group had no cases of superficial peroneal nerve injury, while three patients in the three-portal group sustained this complication. Therefore, the two-portal approach is recommended as

a reliable method for achieving optimal functional outcomes while minimizing the risk of neurovascular injury.

The anteromedial and anterolateral portals are the most commonly utilized access points in ankle arthroscopy [11, 18]. For the three-portal approach, the anteromedial portal is first established as the viewing or working portal. This portal is considered the safest option, as it is located away from any major neurovascular structures. During an ATFL repair procedure, using the anteromedial portal as the viewing portal to assist with lateral ligament repair may make it challenging to fully evaluate the entire ATFL, even with the ankle in extreme dorsiflexion [31]. Therefore, the anterolateral portal is typically chosen as the viewing portal to provide a clearer view of the lateral compartment. An accessory anterolateral portal is then established as the working portal to perform the repair [13, 21]. However, it is important to note that the anterolateral portal is situated near the peroneus tertius tendon and the superficial peroneal nerve, which places it at a higher risk for nerve injury [6, 25]. Despite numerous studies aimed at reducing the incidence of superficial peroneal nerve injury, the overall rate of nerve injury remains between 1.3% and 32.7% when the anterolateral portal is used [1, 2, 19]. Compared to the anterolateral portal, which is located 4.8 mm from the superficial peroneal nerve, the medial midline portal is located 11 mm away from the dorsalis pedis artery and 11.2 mm from the superficial peroneal nerve [4, 12]. The medial midline portal provides an excellent view of the lateral compartment of the ankle, allowing for effective evaluation of the ATFL, particularly when the ankle is in dorsiflexion. This portal is positioned between the extensor hallucis longus and the tibialis anterior tendon, ensuring no risk of damage to the neurovascular structures [4].

The present study offers several notable strengths. First, to the best of our knowledge, this is the first investigation to compare the use of two versus three portals for all-inside arthroscopic ATFL repair, specifically evaluating ankle stability, function, and proprioception. Second, it is the first study to report the modified two-portal technique for managing CLAI using all-inside arthroscopy in 66 patients. Third, the study is adequately powered, with a large and representative sample of CLAI patients. However, there are some limitations to be acknowledged. First, as a retrospective study, potential selection bias cannot be ruled out, despite the rigorous surgical techniques and thorough statistical analysis employed. Secondly, the two-portal procedure is not suitable for patients with CLAI who require treatment for osteochondral lesions located on the talar dome or medial talus, as this represents a significant limitation. Although the lesions can be adequately accessed through the medial midline portal, it is difficult to effectively manage these lesions via the accessory portal. However, when treatment of intra-articular or osteochondral lesions is necessary, a standard anterolateral portal can be introduced to facilitate the procedure. In addition to the aforementioned limitations, one of the major drawbacks of all-arthroscopic techniques is the difficulty or even inability to adequately evaluate and address peroneal tendon pathology. Moreover, this approach also limits the surgeon's ability to critically assess the quality of the ATFL tissue, which is essential when considering internal brace augmentation or allograft reconstruction. These limitations should be carefully considered when selecting the surgical procedure, particularly in patients with suspected peroneal tendon involvement or poor ligament quality.

It is important to highlight that this is the first study to compare two portals with three portals in the context of all-inside arthroscopic ATFL repair for CLAI. The findings of this research provide valuable insights, suggesting that, when performing all-inside arthroscopic ATFL repair, the two-portal approach should be considered as the primary option.

Conclusion

In patients with CLAI undergoing all-inside arthroscopic isolated ATFL repair, the use of either two or three portals yielded reliable and favorable postoperative ankle functional outcomes. At a 2 year follow-up, the clinical results (measured by ATT, AOFAS, KAFS, and AJPS scores) were comparable between the two-portal and three-portal approaches. However, the two-portal approach was associated with no risk of superficial peroneal nerve injury.

Author contributions Shi-Ming Feng: investigation, writing, supervision—original draft preparation, review and editing; Yue Xue and Zi-He Zhang: data curation, Formal analysis; Chong Xue and Shun-Hong Gao: methodology, validation.

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Data availability The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Conflict of interests The authors declare no competing interests.

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