# Comparison of Function- and Activity-Related Outcomes After Anterior Talofibular Ligament Repair With 1 Versus 2 Suture Anchors

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**Background:** Few studies have compared the clinical outcomes of using 1 versus 2 suture anchors for anterior talofibular ligament (ATFL) repair.

**Purpose:** To compare the function and activity-related outcomes of arthroscopic ATFL repair using 1 versus 2 suture anchors.

**Study Design:** Cohort study; Level of evidence, 3.

**Methods:** This retrospective study involved 46 patients (22 patients in the 1-anchor group, 24 patients in the 2-anchor group) who underwent ATFL repair between January 2015 and December 2017. American Orthopaedic Foot & Ankle Society score, Karlsson and Peterson score, and Tegner activity level were evaluated preoperatively and $\geq$2.5 years postoperatively. At follow-up, patients were also asked about time to return to sport as well as level and intensity of physical fitness. Satisfaction was evaluated with the Sefton grading system.

**Results:** After $\geq$2.5 years of follow-up (30 months in the 1-anchor group, 33 months in the 2-anchor group), patients in the 2-anchor group had a higher Tegner activity level than those in the 1-anchor group (mean $\pm$ SD, 4.75 $\pm$ 1.07 vs 4.05 $\pm$ 1.17; $P = .039$). As compared with patients in the 2-anchor group, fewer patients in the 1-anchor group returned to their preoperative activity level (54.2% vs 22.9%; $P = .029$); the rate of activity at the same or higher intensity as preinjury was also lower in the 1-anchor group (50% vs 79.2%; $P = .038$). However, there were no differences between the groups in terms of American Orthopaedic Foot & Ankle Society and Karlsson and Peterson scores, time to return to work/sport, duration of activity participation, level of physical fitness, or satisfaction according to Sefton grading.

**Conclusion:** Arthroscopic ATFL repair appears to be an effective treatment regardless of whether 1 or 2 suture anchors are used. The techniques had similar functional outcome scores, but 1-anchor repair produced inferior activity-related outcomes.

**Keywords:** lateral ligament repair; arthroscopy; ankle instability; anchor; sport recovery

Ankle sprains are one of the most common sports injuries, and the majority are caused by inversion and plantarflexion of the foot. The anterior talofibular ligament (ATFL) is the weakest ligament in the lateral malleolus and involved in 75% to 80% of ankle sprains.[11] The majority of ATFL injuries respond well to nonoperative therapy, but up to 40% progress to a level of instability that limits the ability to participate in the activities of daily life.[10] At this point, surgical intervention is indicated to restore the mechanical stability and function of the ankle. Numerous studies have revealed that ATFL repair can restore stability and achieve satisfactory functional and clinical outcomes.[4,15,16,26,27]

Interestingly, there is no uniform standard regarding the use of 1 or 2 suture anchors in ATFL repair. Cottom and Rigby[4] performed arthroscopic ATFL repair using 2 bioabsorbable bone anchors (1 suture loaded in each anchor). Yeo et al[26] used a single absorbable Bio-Suture Tak anchor (Arthrex) tagged with 2 sutures to repair the ATFL. Li et al[13] described the use of both techniques to surgically repair the ATFL. In addition, several surgeons[16,25,27] used 1 anchor loaded with 1 suture in their procedures and reported excellent outcomes. Overall, it has been demonstrated that ATFL repair, regardless of the type and number of anchors, significantly relieves clinical symptoms and improves function.

However, the rate of return to activities varies after ATFL repair. Li et al[14] investigated return-to-sport outcomes in a group of athletes and reported that 94% of

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patients returned to their preinjury sports levels. However, another study reported that only 58% of patients participated in sports at their preinjury levels after Broström ATFL repair.[15] Li et al[13] found that the percentage of sports participation after ATFL repair with 2 anchors loaded with 1 suture was higher than that with 1 anchor loaded with 2 sutures (68% vs 30%). There are few studies focusing on return-to-sport outcomes after ATFL with 1 anchor loaded with 1 suture.

Because activity-related outcomes have received increasing attention among patients and arthroscopists,[18,20] this study was conducted to compare the function- and activity-related outcomes of arthroscopic ATFL repair using 1 versus 2 suture anchors (with 1 suture loaded in each anchor). It was hypothesized that 2-anchor ATFL repair would produce more favorable outcomes than 1-anchor repair.

## METHODS

### Participants

This study received ethics committee approval. Patients who underwent arthroscopic ATFL repair between January 2015 and December 2017 were retrospectively recruited for this study. Informed consent was obtained from all patients and this study received ethics committee approval. The indications for ATFL repair were as follows: clinical reports of instability, mechanical instability with manual anterior drawer test stress maneuvers, and magnetic resonance imaging findings of disrupted ATFL. Patients were excluded if they had bony fracture or skeletal deformity, neurogenic dysfunction, systemic disease, simultaneous calcaneus fibular ligament treatment, surgical history of the affected ankle, or other orthopaedic issues that prevented them from performing the functional rehabilitations. Ultimately, 46 patients were included in this study: 22 underwent the arthroscopic procedure using 1 suture anchor (1-anchor group), while 24 underwent the repair using 2 suture anchors (2-anchor group).

Regarding the group assignments, 2-anchor fixation, in which 2 holes were drilled on the fibula, seemed to be a method that was close to the gold standard operation of using 2 sutures/holes to fasten the ligament. As such, in the beginning of the study period, repair with 2 anchors was the main option. However, several studies reported encouraging results using a single suture anchor,[16,17,26] which encouraged us to gradually introduce usage of only 1 anchor to fasten the ligament.

TABLE 1
Baseline Characteristics of the Patients[a]

| | 1-Anchor Group (n = 22) | 2-Anchor Group (n = 24) | $t/\chi^2$ | *P* Value |
|---|---|---|---|---|
| Age, y | 29.13 ± 5.65 | 28.67 ± 7.88 | 0.275 | .785 |
| Body mass index, kg/m$^2$ | 22.49 ± 3.35 | 23.44 ± 3.55 | –0.928 | .359 |
| Sex | | | 0.300 | .584 |
| Male | 12 (54.5) | 15 (62.5) | | |
| Female | 10 (45.5) | 9 (37.5) | | |
| Injured side | | | 1.048 | .306 |
| Right | 16 (72.7) | 14 (58.3) | | |
| Left | 6 (27.3) | 10 (41.7) | | |
| Time from injury to surgery, mo | 12 (6-30) | 14 (6-36) | 0.617[b] | .537 |
| Activity duration, h/wk | 3.18 ± 1.10 | 3.31 ± 0.96 | –0.43 | .669 |
| Follow up, mo | 30.27 ± 4.09 | 33.08 ± 5.57 | –1.936 | .059 |

[a]Data are reported as mean ± SD, No. (%), or median (range).
[b]Mann-Whitney *U* test.

Detailed demographic data as well as intraoperative findings were documented for all patients. The follow-up assessment was performed with subjective questionnaires and physical examination in the outpatient service. There were no significant differences between the groups in preoperative demographic data, including age, sex, body mass index, injured side, time from injury to surgery, or time participating in sport activities (Table 1).

### Operative Technique

A routine arthroscopic evaluation using a 30° arthroscope with a 4.0-mm diameter (Arthrex) was performed through the traditional anterolateral and anteromedial portals; intra-articular lesions (eg, synovitis, anterior osteophyte, and osteochondral lesions) were managed prior to ATFL repair. Synovial tissue was debrided with a shaver and ablator (Arthrex), and the osteophyte was addressed via grinding and reshaping. For cartilage with a rough surface or fibrillation, only debridement was performed. Microfracture was performed for a cartilage defect with a diameter $\leq$15 mm; an osteochondral autograft was recommended for those patients with a defect diameter >15 mm.[12] Subsequently, ATFL repair was performed via arthroscopy with the assistance of accessory portal, which was 1.5 cm distal

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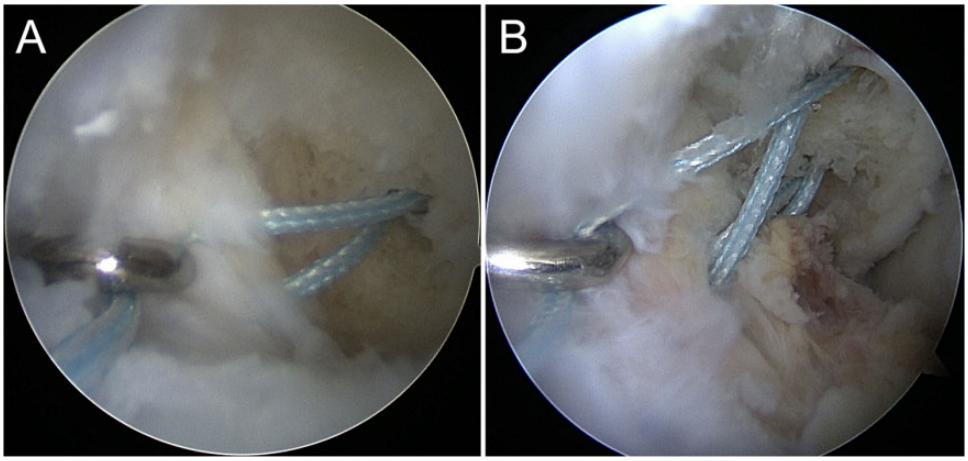


**Figure 1.** (A) The 1-anchor technique, in which both limbs of the anchor were used to repair the anterior talofibular ligament. (B) The 2-anchor technique, in which 2 suture anchors were inserted into the fibula. The inferior limb of the upper anchor and both limbs of the distal anchor were used to repair the anterior talofibular ligament.

to the standard anterolateral portal.[28] All procedures were performed by a single surgeon (B.S.).

The ATFL insertion at the fibula was then fully debrided with a motorized shaver, grinding drill, and ablator; thus, the resulting raw bone and bleeding could facilitate the readhesion of the ligament. The subsequent repair procedure was mainly managed through the anterolateral and accessory portals. For the 2-anchor insertion technique, 1 anchor loaded with 1 suture (3.0 mm, SutureTak; Arthrex) was first placed at the distal insertion of the ATFL on the fibula. The second anchor was then placed superiorly at the proximal insertion on the fibula. In the 1-anchor group, a suture anchor was placed at the midpoint of the ATFL footprint. A curved suture hook (SutureLasso; Arthrex) loaded with a PDS suture (polydioxanone synthetic; Ethicon) was then introduced into the cavity and placed deep enough to capture the residual ATFL. The PDS was advanced through the lumen of the lasso and shuttled through the suture limbs to pass through the ATFL, inferior extensor retinaculum, and subcutaneous tissues (in that order). When a single anchor tagged with 1 suture (3.0 mm, SutureTak; Arthrex) was inserted, both suture limbs were used to capture the ATFL; however, if 2 anchors were inserted, the ATFL was pierced with the 3 limbs except for the superior one of the proximal inserted anchor (Figure 1). After all suture limbs were pulled out of the cavity, the Samsung Medical Center knot was made outside and slipped toward the joint by the knot pusher with the ankle held in a neutral-flexion slightly everted position.

## Postoperative Rehabilitation

Isometric contraction of the muscle groups around the ankle joint and flexion-extension of the hip and knee joints were encouraged on the first postoperative day. A short cast was used to fix the ankle in a neutral position for 2 weeks with no weightbearing, which was then replaced by a short leg brace. This device could be removed when the patient started passive or active range-of-motion exercise. The patient was then allowed to partially bear weight with the ankle brace for 4 weeks. From postoperative week 6, progressive weightbearing was allowed, and full weightbearing gait was permitted without the ankle brace from then on. Meanwhile, proprioceptive training and resistance exercises were permitted. Returning to work was allowed if patients felt no discomfort, according to the circumstance and intensity of their jobs. A return to noncontact sport was expected at about 10 weeks postsurgically. After a period of adaptive training, gradual transition to contact sports occurred at 4 months postoperatively. Patients were encouraged to continue rehabilitation training and tolerable exercises and return to previous activities as they wished. If any pathologic issues had been simultaneously addressed during the surgery, the rehabilitation process was moderately postponed.

## Pre- and Postoperative Assessment

The clinical assessments—including physical examination, subjective function evaluation, and estimation of return to sport and recreational activities timing—were performed by an experienced surgeon who was blinded to the surgical procedures (Z.-Z.Z.). The Tegner activity scale[12,14] was used to determine activity levels, and American Orthopaedic Foot & Ankle Society (AOFAS)[9] and Karlsson and Peterson (K-P)[8] scores were collected at the patients' pre- and postoperative encounters. The Sefton grading system[19] was administered to patients postsurgically and in an outpatient setting.

In addition, a sports and activity assessment form (Appendix) was used to ascertain patients' engagement in physical activities. Data regarding the sports in which they preoperatively participated as well as the duration of sports activities (hours per week) were collected. Whether the patient's preinjury activities were restored (partially or full) was also recorded as the duration and time they resumed work or activity. Additionally, subjective changes in physical fitness as compared with the preinjury level became symptomatic (worse or not) were assessed. The difference between pre- and postsurgical intensity was also calculated, with response

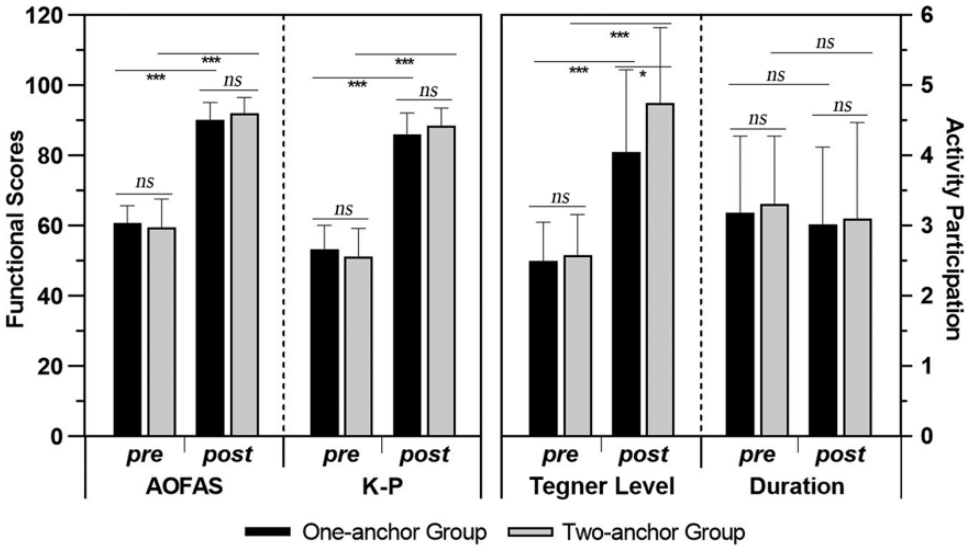


**Figure 2.** Pre- and postoperative (Pre, Post) AOFAS score, K-P score, Tegner activity level, and activity duration (h/wk) between the 1- and 2-anchor groups. AOFAS, American Orthopaedic Foot & Ankle Society, K-P, Karlsson and Peterson; ns, nonsignificant. *$P < .05$. ***$P < .001$. Values are presented as mean ± SD.

options "lower," "similar," or "higher." The representative physical examination was the anterior drawer test, which was evaluated bilaterally with the following classification criteria: If the side-to-side difference in anterior translation was <5 mm, the laxity was considered grade 0; 5 to 10 mm, grade 1; 10 to 15 mm, grade 2; and >15 mm, grade 3.[15]

## Statistical Analysis

All data were analyzed using SPSS Version 22.0 (IBM). Normally distributed numerical data were presented as mean and standard deviation, and the paired *t* or independent *t* test was used to compare the pre- and postoperative data or the differences between groups, respectively. Otherwise, the data were presented as median (range), and the Mann-Whitney *U* test or Wilcoxon signed rank test was performed, respectively. The Mann-Whitney *U* test was used to compare the pre- and postoperative data, while the Wilcoxon signed rank test was used for the comparison between groups. Categorical variables were presented as frequencies and percentages and analyzed by the chi-square test. $P < .05$ indicated statistical significance.

The sample size was calculated with reference to a previous study that retrospectively compared the surgical outcomes of 2 ankle stabilization techniques.[10] In the present study, the noninferiority margin was set at 6 points of the K-P scoring system. As a result, 21 patients in each group were needed to detect the minimal clinically important difference between the 1- and 2-anchor groups with a statistical power of 80% and a critical *P* value of .05.

## RESULTS

The articular findings and concomitant operations were recorded prior to the ligament-stabilization process. Synovitis of varying extent was identified via arthroscopy in all patients, and each patient underwent arthroscopic debridement. The osteochondral lesion was found in 3 patients (13.6%) in the 1-anchor group and 4 (16.7%) in 2-anchor group, and the anterior tibial osteophyte was present in 2 (9.1%) and 5 (20.8%) in 1- and 2-anchor groups, respectively. Neither the osteochondral lesion ($P = .551$) nor anterior tibial osteophyte ($P = .245$) showed statistical differences between the groups. The osteochondral lesions were treated with the microfracture technique because their diameters were <15 mm. Osteophyte grinding and reshaping were performed for patients with anterior impingement syndrome. On postoperative physical examination, no general complications, such as wound infection, limited range of motion, sensory loss, or numbness, were encountered in either group. Grade 0 for the anterior drawer test of all ankles indicated that ankle stability had been recovered in all cases after surgery. No patient underwent revision lateral ligament surgery during follow-up.

The mean duration of follow-up was 30.27 ± 4.09 months (range, 24-40) in the 1-anchor group and 33.08 ± 5.57 months (range, 26-45) in the 2-anchor group. In the 1-anchor group, the mean AOFAS score improved from 60.82 ± 4.93 preoperatively to 90.18 ± 4.92 at the final follow-up visit, and the K-P score improved from 53.23 ± 6.92 to 85.95 ± 6.24. In the 2-anchor group, the mean AOFAS and K-P scores improved from 59.58 ± 8.08 to 92.04 ± 4.46 and from 51.21 ± 8.04 to 88.46 ± 5.12, respectively. Both subjective questionnaire outcomes revealed significant improvement as compared with the preoperative baselines. However, there was no significant difference of postoperative AOFAS ($P = .185$) or K-P ($P = .142$) score between the groups. As evaluated by the Tegner scale, the activity level increased from 2 (range, 1-5) to 4.05 ± 1.17 in the 1-anchor group and from 2.5 (range, 1-5) to 4.75 ± 1.07

TABLE 2
Postoperative Assessment Using the Sefton Grading System

| Grade | Description | 1-Anchor Group (n = 22) | 2-Anchor Group (n = 24) |
|---|---|---|---|
| Excellent | Full activity, including strenuous sports; no pain, swelling, or "giving way" | 9 | 12 |
| Good | Occasional aches only after strenuous exercise; no "giving way" or feelings of apprehension | 11 | 10 |
| Fair | No "giving way" but some remaining apprehension, especially on rough ground | 2 | 2 |
| Poor | Recurrent instability and "giving way" during normal activities, with episodes of pain and swelling | 0 | 0 |

in the 2-anchor group. Moreover, the difference of activity level after surgery between the groups exhibited statistical significance ($P = .039$) (Figure 2).

With the assessment by the Sefton grading system, the 1-anchor group included 9 excellent cases, 11 good cases, and 2 fair cases, and the 2-anchor group included 12 excellent cases, 10 good cases, and 2 fair cases. Therefore, 20 cases (90.9%) in the 1-anchor group and 22 (91.7%) in the 2-anchor group achieved satisfactory results. No significant difference was seen in the Sefton grade between the groups ($P = .823$) (Table 2).

All patients returned to their previous employment, but 13 patients partially altered and 4 completely changed to nonweightbearing activities (eg, yoga, swimming, and cycling) in the 1-anchor group, as compared with 8 and 3 patients, respectively, in the 2-anchor group. The reasons were divided into 2 categories: subjective intention and objective state. In the 1-anchor group, 6 patients (35.3%) changed their activities because of subjective factors, including interest and lifestyle changes, while the remaining 11 patients (64.7%) mainly attributed to their objective state when participating in sports, such as uncomfortable, pain, and fear of reinjury. In the 2-anchor group, 5 patients (45.5%) changed their activities for subjective intention whereas 6 patients (54.5%) for objective state ($P = .591$). Overall, 5 (22.7%) patients in the 1-anchor group and 13 (54.2%) in the 2-anchor group were able to return to 100% of the sports in which they had participated before injury ($P = .029$). Patients participated in physical activities for a mean of 3.02 ± 1.1 and 3.15 ± 1.37 hours per week postoperatively in the 1- and 2-anchor groups, respectively ($P = .735$). When compared with their preinjury baselines (3.18 ± 1.10 and 3.31 ± 0.96 h/wk; $P = .669$), neither group showed significant differences (Figure 2, right column). Within these cases, 11 (50%) in the 1-anchor group and 19 (79.2%) in the 2-anchor group participated in the same or higher intensity–level activities (vs preinjury condition; $P = .038$). Table 3 contains the activity-related outcomes of all patients at the time of final contact.

TABLE 3
Work- and Activity-Related Outcomes After Surgery

| | Group, Mean ± SD or No. (%) | | | |
|---|---|---|---|---|
| | 1 Anchor (n = 22) | 2 Anchors (n = 24) | $t/\chi^2$ | $P$ Value |
| Return to work, wk | 5.93 ± 3.42 | 5.75 ± 2.67 | 0.202 | .841 |
| Return to activities | | | | |
| At least 1 activity | 18 (81.8) | 21 (87.5) | 0.016 | .900 |
| Full return | 5 (22.9) | 13 (54.2) | 4.763 | .029 |
| Time from surgery to return | | | | |
| At least 1 activity, wk | 11.95 ± 1.33 | 11.75 ± 1.85 | 0.428 | .671 |
| Full return, mo | 10.5 ± 1.5 | 11.15 ± 1.72 | –0.743 | .468 |
| Duration of activities, h/wk | 3.02 ± 1.1 | 3.15 ± 1.37 | –0.341 | .735 |
| Same or longer duration[a] | 12 (54.5) | 16 (66.7) | 0.708 | .400 |
| Same or improved subjective level of physical fitness[a] | 20 (90.9) | 21 (87.5) | 0.138 | .711 |
| Same or higher activity intensity level[a] | 11 (50) | 19 (79.2) | 4.305 | .038 |

[a]Compared with preinjury.

## DISCUSSION

The main finding of the present study was that arthroscopic ATFL repair with 1 suture anchor showed certain inferiority on sport activity–related recovery to repair with 2-suture anchors, although both methods obtained satisfactory functional and clinical outcomes. As compared with double-anchor treatment, single-anchor repair produced a lower rate of full return to activities and a lower probability of recovery to the same or higher subjective intensity.

Various techniques have been reported to repair the lateral ligaments for patients with chronic ankle instability. During each surgery, 1 or 2 suture anchors were chosen to reattach the ATFL to the fibula. Cottom and Rigby[4] reported an arthroscopic ATFL repair and inferior extensor retinaculum augmentation using 2 anchors. Forty consecutive patients underwent this treatment, and the AOFAS score increased from 41.2 preoperatively to 95.4 postoperatively at a mean follow-up of 12.13 months. Matsui et al[16] developed an arthroscopic ATFL repair using 2 suture anchors and reported that patients returned to daily work 5.3 weeks postoperatively and sports activities at 16.5 weeks postoperatively. Yeo et al[26] used an absorbable suture anchor loaded with 2 sutures in arthroscopic ATFL repair. The AOFAS score increased from 67.5 to 90.3 and the K-P score from 45 to 76.2 at 1 year after the surgery.

Moreover, Zeng et al[27] evaluated the results of 27 patients treated with arthroscopic ATFL repair using 1 titanium anchor loaded with 1 suture. They reported that the AOFAS score improved from 63.4 preoperatively to 92.4 postoperatively and the K-P score from 59.6 to 89.2. Wei et al[25] also used 1 anchor with 1 suture to treat ATFL tears via arthroscopy, and the mean AOFAS score increased from 55.1 to 89.7 at a follow-up of 33.7 months. This research revealed that satisfactory results could be obtained after arthroscopic ATFL repair using either single or double anchors (loaded with 1 or 2 sutures). In our study, the AOFAS score at the final follow-up was 90.18 in the 1-anchor group and 92.04 in the 2-anchor group, and the K-P score was 85.95 and 88.46, respectively. The functional and clinical recovery of patients and the time interval at which they returned to work or activities in our study were similar to those in the published literature, certifing that 1- and 2-anchor repair of ATFL under arthroscopy is a viable treatment for chronic lateral ankle instability.

However, few investigators have compared the results of these fixation methods or materials, and it is not clear whether 1- and 2-anchor repair is equally effective, particularly for outcomes other than function scores. In the present study, the functional scores of the 1- and 2-anchor groups were comparable. No significant difference was found in AOFAS score and K-P score between the groups. But the Tegner activity level of the patients in the 1-anchor group was significantly lower than that of the 2-anchor group. This finding was consistent with a previous study: Li et al[13] investigated 51 patients who underwent arthroscopic ATFL repair using 1 anchor loaded with 2 sutures (20 ankles) or 2 anchors (1 suture per anchor; 31 ankles) and found that the mean postoperative K-P score and Tegner activity level of the 2-anchor group were significantly higher. Those authors also revealed that the percentage of sport participation after surgery in the 2-anchor group (68%) was higher than that in the 1-anchor group (30%). More detailed records in our study demonstrated that the rate of return to at least 1 preinjury sport was 81.8% in the 1-anchor group and 87.5% in the 2-anchor group, which showed no significant difference. However, the rate of 100% return to sport in the 2-anchor group (54.2%) was higher than that in the 1-anchor group (22.9%). With regard to the reasons, objective states—including discomfort, pain, and fear of reinjury—were possible explanations for the change of activities in both groups (64.7% vs 54.5%). In other words, subjective factors had a relatively small impact on the change, especially in the 1-anchor group. In terms of sporting experience, it led us to conclude that 1-anchor fixation would not produce similar or better outcomes than 2-anchor repair. Additionally, more participants who underwent 2-anchor repair returned to sport with the same or higher intensity level, while more patients in the 1-anchor group changed to nonweightbearing activities. These findings indicated that arthroscopic ATFL repair using 2 anchors might additionally produce better activity-related outcomes as compared with using 1 suture anchor.

It has been reported that the ATFL is mainly composed of 2 bundles, with an incidence of 50% to 100%.[2,7,22] The bands have a divergent course from their fibular origin to their talar insertions and show varied morphology and tension according to the position of the ankles. In detail, the upper part of the ligament remains relaxed while the lower part becomes taut in dorsiflexion, whereas the lower part remains relaxed and the upper part becomes tight in plantarflexion.[21] Moreover, a similar phenomenon has been observed in superior and inferior parts of single-bundle ATFL.[5] Thus, it was presumed that the different branches of the double-bundle ATFL or even the different parts of the single-bundle ATFL had specially varied function in the ankle. Whether loaded with 1 or 2 sutures, the 1-anchor repair theoretically provided only a single point for the reattachment of the ligament on the fibula. Two-anchor repair, for its separated insertions, could provide a wider attachment and independently maintain the tension for different parts of the ligament. Therefore, separate fixation for each part might be more conducive to the restoration of its original ligament structure and function.

The mechanical parameters of the intact ATFL were previously disclosed by several investigators as follows: Ultimate failure load ranged from 154 to 160.9 N, and stiffness ranged from 12.4 to 14.5 N/mm.[6,23,24] Waldrop et al[24] performed a biomechanical study to explore the intact or repaired ATFL's stiffness and ultimate load to failure and found that neither the ultimate failure load (79.2 N) nor the stiffness (6.8 N/mm) after treatment with suture anchor (1 anchor loaded with 2 sutures) was restored to normal. In addition, Cottom et al[3] investigated the biomechanics of repaired ATFL using 2 suture anchors loaded with 1 suture, which generated 12.1 N/mm of stiffness and 156.43 N of load to ultimate failure. Moreover, Brown and colleagues[1] certified that 2 all-soft suture anchors resulted in >80% restoration of stiffness as compared with the intact ATFL. These findings indicated that ATFL repair using 2 anchors could produce better biomechanical strength than using 1 anchor, which might explain the relatively favorable activity-related outcomes in the 2-anchor group. However, it should be noted that we had no mechanical failures or abnormal anterior drawer test results in either group.

The study has several limitations. First, it was a retrospective study without randomization. The number of cases included in the 2 groups was not consistent. Additionally, we did not perform objective measurement, such as Telos measurement and stress radiographs, to assess ankle stability. Function- and activity-related evaluations were mainly based on subjective questionnaires, which have inherent biases of assessment. Second, we did not analyze whether concomitant lesions and related operations influence the clinical outcomes. In the present study, no significant difference was found between the 1- and 2-anchor groups regarding the incidence of osteochondral lesion and anterior tibial osteophyte. Therefore, it was presumed that the combined injuries and procedures would not affect the comparison between the groups. Third, the sample size was small, and the follow-up period was relatively short. In the future, a

prospective clinical trial with a more rigorous design should be conducted to validate the findings of this study.

## CONCLUSION

Patients who underwent arthroscopic ATFL repair in the 1- and 2-anchor groups had encouraging function outcomes and high patient satisfaction. When compared with 2-anchor surgical treatment, 1-anchor repair of the ATFL produced inferior activity-related outcomes in this study population. For younger patients or those with a strong desire to engage in sports, a double-anchor repair may provide better outcomes.

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## APPENDIX

### Work and Activities Assessment Form

Name:_____ Date:_____

1) Patient age:_____

2) Gender: Male_____ Female_____

3) Date of injury:_____; Date of surgery:_____

4) Which ankle(s) did you have surgery on? R _____ L _____ Both _____

5) Was this the first surgery on your_____(repair side) ankle? Yes_____ No _____

6) If no, what type/s of surgery have you had previously? _____

7) Have you had surgery on your_____(opposite side) ankle? Yes_____ No_____

8) If yes, what type/s of surgery? _____

9) Is this your first ATFL repair or is it a revision? Primary_____Revision_____

10) If revision, how many surgeries did you have previously? 1_____ 2_____ 3_____ >3_____

11) Why did you have an ATFLrepair?

To return to work _____ To play sports/activities _____ To relieve pain _____

To improve motion_____ Other_____

12) Did you have a job **within three years** prior to the surgery? Yes_____No_____

13) If yes, what was your occupation? _____

14) How would you classify your job status **within three years** prior to surgery?

Sedentary_____Light physical work_____Heavy work_____

Retired/Unemployed_____Retired/Unemployed due to ankle_____

Retired/Unemployed due to other medical conditions_____

15) Did you return to work after surgery? Yes_____No_____

16) If yes, how long did it take to return to work after surgery? _____

17) Did you participate in any sports/activities **within three years** prior to your surgery? Yes_____No_____

18) If yes, what type(s) of sports/activities did you do **within three years** prior to the surgery

_____

19) If yes, how many hours a week did you do sports?_____hours/week

20) Did you return to sports activities after surgery? Yes_____No_____

21) If yes, did you return to the same sport(s)? partially returned_____or fully returned_____

22) If yes, how long did you partially/fully return to the activities? Partially_____ (Fully_____)

23) Did you restart any activities that you didn't participate before injury? Yes_____No_____

24) If yes, what type of the sport(s)? _____

25) If so, how long did it take to restart the activities after surgery? _____

26) If you stopped your main sport, what were the reasons? _____

27) Overall, how many hours a week did you do sports after surgery?_____hours/week

28) How does your physical fitness now compare to the injury? Better_____ Similar_____ Worse _____

29) How would you evaluate your current intensity in your activity compared to your level before symptom onset?

Higher_____ Same_____ Lower_____

30) How satisfied are you with your ability to play sports now?

Very satisfied_____ Satisfied_____ Fairly_____ Dissatisfied _____

Thank you for your participation.

## ANNOTATION

The questionnaire items were designed with references to previous studies on activity recovery after anterior talofibular ligament (ATFL) repair or reconstruction[1-3] in addition to those reported in other joint-related studies.[4-7]