No Differences in Clinical Outcomes of Suture Tape Augmented Repair Versus Broström Repair Surgery for Chronic Lateral Ankle Instability

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Background: Suture tape (ST) augmented repair, an alternative to traditional Broström repair (BR), may protect the repaired anterior talofibular ligament during ligament healing. No systematic review of cohort studies has been conducted to compare traditional BR with ST-augmented repair for chronic lateral ankle instability.

Purpose: To review the current evidence in the literature to ascertain whether ST-augmented repair is superior to traditional BR in managing chronic lateral ankle instability.

Study Design: Systematic review; Level of evidence, 3.

Methods: A literature search was performed to identify relevant articles published in PubMed, Embase, and Cochrane Library databases in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The search included cohort studies comparing the efficacy of BR and ST-augmented repair procedures in terms of incidence of instability recurrence, functional scores, talar tilt angle (TTA), anterior talar translation (ATT), and complication rate. Methodological quality was assessed using the Jadad scale for randomized studies and the Newcastle-Ottawa Scale for nonrandomized studies.

Results: A total of 4 clinical trials with 254 patients were included. No significant differences were detected between BR and ST-augmented repair procedures in terms of incidence of recurrent instability, American Orthopaedic Foot & Ankle Society score, Foot and Ankle Outcome Score, Foot and Ankle Ability Measure, TTA, ATT, or complication rate. The ST group appeared to have a shorter operation time compared with the BR group.

Conclusion: No significant differences were found between ST-augmented repair and BR surgery regarding incidence of recurrent instability, functional outcome scores, or complication rates. Although technically challenging, the ST-augmented repair procedure appears to be a safe and fast option.

Keywords: ankle instability; anterior talofibular ligament; repair; suture tap; meta-analysis

Lateral ankle sprains are among the most common musculoskeletal injuries, and about 12% to 40% of individuals who have a lateral ankle sprain develop chronic lateral ankle instability (CLAI).[18,36,43,51] CLAI is a challenging clinical problem, particularly among young athletes who have complex rupture of the ankle lateral collateral ligament.[15,34,36,47] Studies have demonstrated that anatomic repair of the lateral collateral ligament results in better functional outcomes and less secondary osteoarthritis than nonanatomic repair.[38,56] The modified Broström anatomic repair (BR) procedure, which often fixes the anterior talofibular ligament (ATFL) onto the fibular insertion, with or without the calcaneofibular ligament, has been suggested as a gold standard to treat CLAI.[1,17,27,53] In a long-term follow-up investigation (mean, 8.7 years), Maffulli et al[32] demonstrated that BR surgery was safe and allowed most patients to return to preinjury levels of daily and sport activities.

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Final revision submitted March 8, 2020; accepted March 25, 2020.

One or more of the authors has declared the following potential conflict of interest or source of funding: This study was supported by the National Natural Science Foundation of China (No. 81572209), Shanghai Excellent Talents Program (No. 201609), and Shanghai Sports Science and Technology "Comprehensive Plan" Project (18Z004). AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.

The Orthopaedic Journal of Sports Medicine, 8(9), 2325967120948491
DOI: 10.1177/2325967120948491

Traditional BR can be used only in select cases with a ligament remnant of good tissue quality.[26,62] When the ligament remnant is of poor tissue quality, precluding the use of the modified Broström procedure, anatomic reconstruction using fibular periosteal flap augmentation or a free tendon graft may be considered.[4,10,20,28,50] Augmented reconstruction using periosteal flap or tendon graft is time-consuming and invasive, whereas the suture tape (ST) augmentation technique is easier. Anatomic ATFL repair with suture augmentation offers the benefit of maintaining some proprioceptive properties of the native ligament while reinforcing the repair, especially in patients whose remnant ligament tissue is of poor quality.[8,9,13,54] ST-augmented repair has become an effective option because it may protect the repaired ligament during healing.[2,14,31,57] BR with ST augmentation has been demonstrated to be effective for young female patients,[8] revision surgeries,[6] and patients with generalized ligamentous laxity.[9] Coetzee et al[12] reported that the average American Orthopaedic Foot & Ankle Society (AOFAS) score was 94.3 at a mean follow-up of 11.5 months; further, 79% of patients had a Foot & Ankle Ability Measure (FAAM) score of more than 90 after BR with ST augmentation. Recently, Cho et al[5] investigated 24 patients who underwent ST augmentation at a follow-up of more than 2 years and found that patient-reported functional outcomes significantly improved after lateral ligament augmentation using ST. However, concerns persist as to whether ST-augmented repair will lead to better functional outcomes and lower complication rates compared with BR.

To date, no systematic review of cohort studies has been conducted to compare traditional BR with ST-augmented repair techniques for CLAI. Therefore, the purpose of this study was to perform a meta-analysis to ascertain whether the traditional repair or ST-augmented repair procedure will result in a lower incidence of instability recurrence, a lower rate of complications, and better function as measured by the AOFAS score, FAAM, Foot and Ankle Outcome Score (FAOS), talar tilt angle (TTA), and anterior talar translation (ATT). Our hypothesis was that these studies would favor the ST-augmented repair procedure with regard to clinical outcomes and complication rate compared with the traditional BR procedure.

METHODS

Search Strategy

Two independent reviewers searched multiple comprehensive databases including PubMed, Embase, and the Cochrane Library in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, with 1 senior author (Y.H.) conducting any difference arbitration.[30] There were no restrictions on languages or dates. The detailed search strategy was as follows: (ankle instability OR lateral ankle ligament OR anterior talofibular ligament OR ATFL OR calcaneofibular ligament OR CFL) AND (surgery OR repair OR reconstruction OR fiber tape OR suture tape OR internal brace).

Two independent reviewers (Hong L., Y.Z.) reviewed the titles and abstracts and all studies that were eligible in full text. Next, the reference list and literature review of the included studies found in the initial search were manually screened to find other articles that met the inclusion criteria. When there were 2 published studies on the same population, updated studies were retained.

Eligibility Criteria

The inclusion criteria were (1) clinical research after surgical repair or reconstruction comparing results with ST and without ST repair, including randomized controlled trials, prospective cohort studies, and retrospective cohort studies; (2) a minimum of 10 patients who underwent CLAI repair; (3) an average follow-up time of more than 6 months; and (4) full text provided. The exclusion criteria were (1) noncomparative studies, (2) review studies, and (3) cadaveric or biomechanical research.

Quality Assessment

The methodological quality was assessed using the Jadad scale (5-point scale) for randomized studies and the Newcastle-Ottawa Scale (NOS) (9-point scale) for nonrandomized studies.[22,23] Relatively high quality was considered as a score $\geq$3 points on the Jadad scale and $\geq$7 points on the NOS.[58] Each study was independently evaluated by 2 authors (Hong L., Y.Z.), and any differences were resolved through discussion.

Data Extraction

Two blinded reviewers performed data extraction and analysis using predetermined data sheets. Relevant information was recorded, including study design, population size, patient age, incidence of recurrent instability, postoperative functional scores (AOFAS, FAOS, FAAM), TTA, ATT, return to sports, complications, and operation time. Recurrent instability included subjective and mechanical instability, new ankle sprain, and grade 2 (side-to-side difference of $\geq$10 and $<$15 mm) or grade 3 (side-to-side difference of $\geq$15 mm) on the anterior drawer test. TTA was defined as the angle between the articular surface of the distal tibia and the proximal articular surface of the talus on the varus stress view. ATT was defined as the shortest distance between the posterior articular border of the distal tibia and the posterior articular surface of the talus on the lateral radiograph. Details of complications (stiffness, subsequent sprains, deep vein thrombosis, revision surgery, wound infection, and nerve damage) were summarized.

Statistical Analysis

All statistical analyses were conducted using Review Manager Version 5.3 software (The Cochrane Collaboration). The I^2 statistic was applied to quantify heterogeneity between studies.[19] An I^2 value of $<$25% indicated low heterogeneity and $>$75% indicated high heterogeneity. When the I^2 value was $>$50%, a random-effects model was

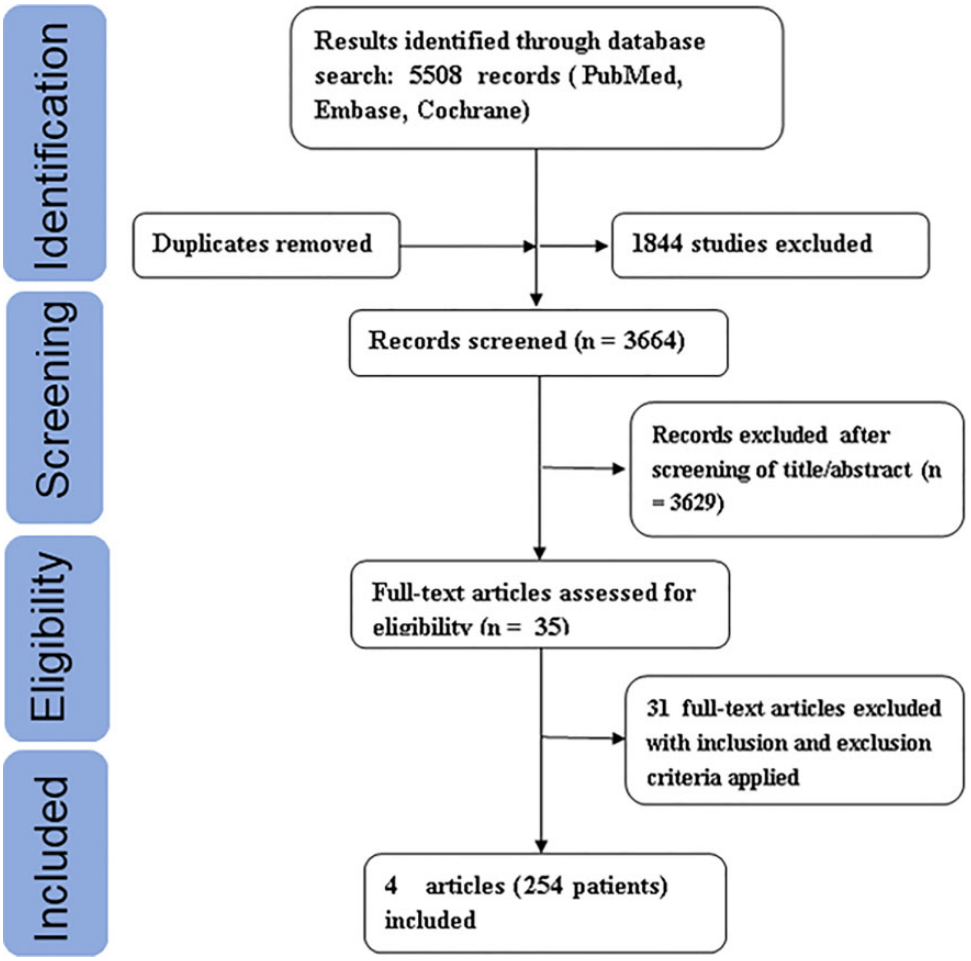

Figure 1. Flow chart of the literature search process using the PRISMA (Preferred Reporting Items for Systematic Meta-Analyses) guidelines.

applied; otherwise, a fixed-effects model was applied. Descriptive analysis was conducted on data that could not be merged owing to inconsistent or nonexistent data types. A P value of $<.05$ was considered statistically significant.

RESULTS

Study Selection Process

The initial literature search yielded 5508 studies. After removal of duplicates, the articles were screened according to inclusion and exclusion criteria, 35 unique studies were evaluated, and full texts were evaluated for eligibility. Of these, 31 articles were excluded for the following reasons: (1) noncomparative studies (n = 16); (2) review studies (n = 10); (3) cadaveric or biomechanical research (n = 5). The screening process and inclusion and exclusion criteria are detailed in Figure 1. Ultimately, this review included 4 clinical trials. These 4 studies included 254 patients, 105 of whom underwent ST-augmented repair and 149 who had the traditional BR method. The study by Yoo and Yang[63] included only male patients, and the study by Cho et al[7] included only female patients. Table 1 summarizes the study characteristics. Table 2 summarizes the results of our meta-analysis.

Incidence of Instability Recurrence

Recurrence of instability was reported in all 4 reviewed studies. The analysis showed there was no significant difference in the rate of recurrent instability between the ST group (2.9%) and the BR group (2.7%), and the risk ratio for recurrent instability was 0.79 in favor of ST (95% CI, 0.19-3.31; $I^2 = 0\%$; $P = .75$) (Figure 2).

AOFAS Score

Postoperative AOFAS scores were reported in 2 studies, which consisted of 47 patients in the ST group and 91 patients in the BR group. Xu et al[59] reported a mean AOFAS of 97.5 ± 3.3 for the ST group and 96.3 ± 6 for the BR group. Yoo and Yang[63] reported a mean AOFAS of 98 ± 16.8 for the ST group and 96.5 ± 5.4 for the BR group. No significant difference in AOFAS scores between groups was detected in these studies.

TABLE 1
Study Characteristics[a]

Lead Author (Year)	Study Design	LOE	No. of Patients	Patient Age, y, Mean (Range)	Sex Ratio (M/F), n	Follow-up, mo, Mean (Range)	Jadad/NOS Score
Yoo[63] (2016)	RCS	3	ST: 22 BR: 63	23 (19-44)	ST: 22/0 BR: 63/0	7.4 (6-9)	8
Cho[7] (2019)	RCT	2	ST: 28 BR: 27	ST: 26.6 (16-40) BR: 28.1 (17-39)	ST: 0/28 BR: 0/27	ST: 34.6 (24-45) BR: 33.8 (24-44)	3
Ulku[52] (2020)	RCT	2	ST: 30 BR: 31	ST: 27.8 (19-44) BR: 28.6 (20-51)	NA	ST: 35.9 (26-54) BR: 36.8 (27-58)	3
Xu[59] (2019)	RCS	1	ST: 25 BR: 28	ST: 26.6 (16-50) BR: 28.1 (17-55)	NA	ST: 24 BR: 24	8

[a]BR, Broström repair; F, female; LOE, level of evidence; M, male; NA, not applicable; NOS, Newcastle-Ottawa Scale; RCS, retrospective cohort study; RCT, randomized controlled trial; ST, suture tape.

TABLE 2
Patient Outcomes[a]

Lead Author (Year)	RRI, (%)	AOFAS	FAOS	FAAM	FAAM, Sports Activity	TTA	ATT	Complication Rate, %
Yoo[63] (2016)	ST: 0 BR: 0	ST: 98 ± 16.8 BR: 96.5 ± 5.4	NA	NA	NA	NA	NA	ST: 9 BR: 4.8
Cho[7] (2019)	ST: 7.1 BR: 3.7	NA	ST: 91.9 ± 6.7 BR: 93.3 ± 6.1	ST: 89.4 ± 7.4 BR: 92.2 ± 6.5	ST: 84.6 ± 9.8 BR: 89.1 ± 8.8	ST: 4.6 ± 2.6 BR: 3.9 ± 2.3	ST: 4.5 ± 2.3 BR: 4.2 ± 2.1	ST: 3.6 BR: 7.4
Ulku[52] (2020)	ST: 3.3 BR: 6.5	NA	ST: 91.5 ± 7.7 BR: 90.6 ± 5.2	ST: 93 ± 13 BR: 89.3 ± 15	ST: 90.4 ± 12 BR: 84.9 ± 14	ST: 4.5 ± 4.4 BR: 4.7 ± 4.8	ST: 4.3 ± 4.5 BR: 4.6 ± 4.1	ST: 0 BR: 3.2
Xu[59] (2019)	ST: 0 BR: 3.6	ST: 97.5 ± 3.3 BR: 96.3 ± 6	NA	ST: 93.1 ± 2.3 BR: 90.5 ± 5.1	ST: 87.1 ± 5.4 BR: 78.2 ± 12	ST: 2.4 ± 1.3 BR: 2.7 ± 1.4	ST: 2.9 ± 1.6 BR: 3.1 ± 1.3	ST: 12 BR: 3.6

[a]Scores are expressed as mean ± SD. AOFAS, American Orthopaedic Foot & Ankle Society; ATT, anterior talar translation; BR, Broström repair; FAAM, Foot and Ankle Ability Measure; FAOS, Foot and Ankle Outcome Score; NA, not applicable; RRI, recurrence rate of instability; ST, suture tape; TTA, talar tilt angle.

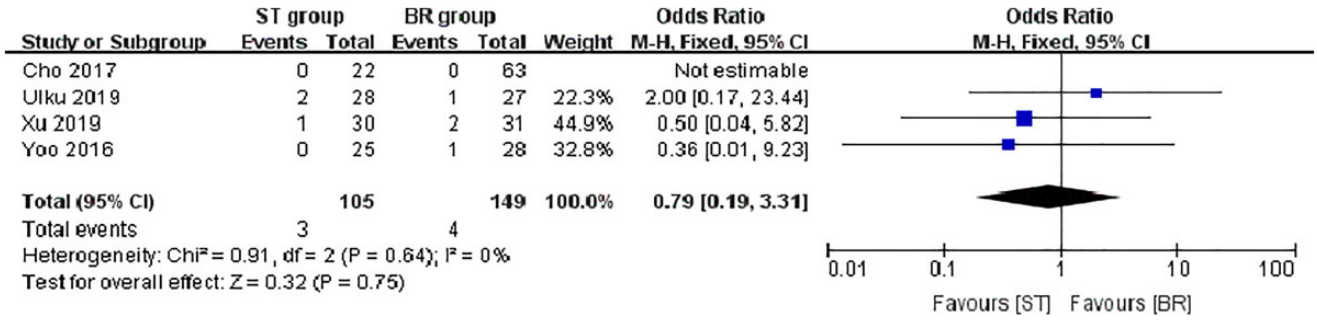

Figure 2. Results of aggregate analysis for comparison of recurrence rate of instability between suture tape (ST) group and Broström repair (BR) group. Numbers for "events" refer to failure; numbers for "total" refer to total participants. M-H, Mantel-Haenszel method.

FAOS

FAOS results were reported in 2 studies, which included 55 ST patients and 61 BR patients. Cho et al[7] reported that the mean FAOS was 91.9 ± 6.7 for the ST group and 93.3 ± 6.1 for the BR group. Ulku et al[52] reported a mean FAOS of 91.5 ± 7.7 for the ST group and 90.6 ± 5.2 for the BR group. No significant between-group difference in FAOS was detected in these studies.

FAAM Score

FAAM total scores were reported in 3 studies, which consisted of 83 ST patients and 86 BR patients. The mean FAAM scores were 89.4 ± 7.4 for the ST group and 92.2 ± 6.5 for the BR group in the study by Cho et al[7]; 93 ± 13 for ST and 89.3 ± 15 for BR in the study by Ulku et al[52]; and 93.1 ± 2.3 for ST and 90.5 ± 5.1 for BR in the study by Xu et al.[59] No significant difference was found

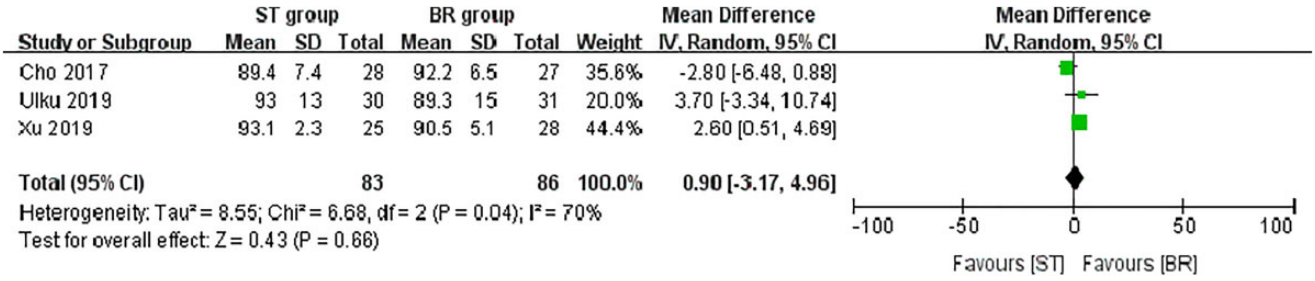

Figure 3. Results of aggregate analysis for comparison of Foot and Ankle Ability Measure scores between suture tape (ST) group and Broström repair (BR) group. IV, inverse variance.

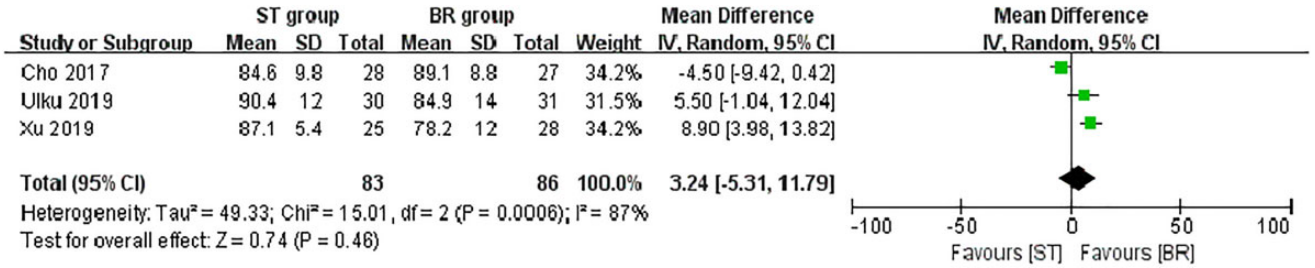

Figure 4. Results of aggregate analysis for comparison of Foot and Ankle Ability Measure sports activity scores between suture tape (ST) group and Broström repair (BR) group. IV, inverse variance.

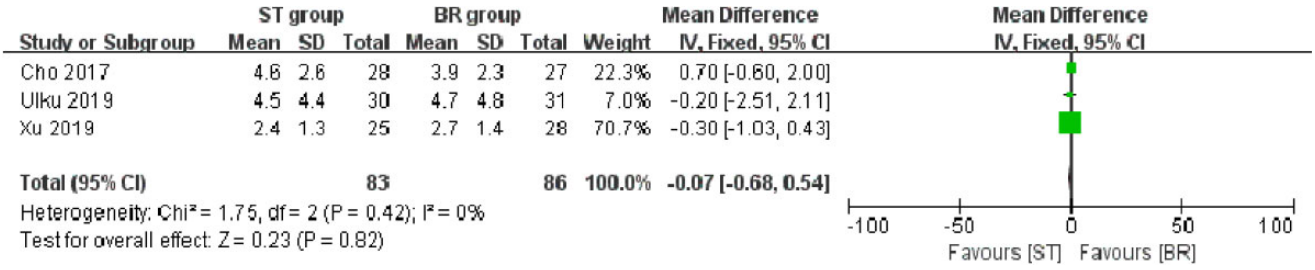

Figure 5. Results of aggregate analysis for comparison of talar tilt angle between suture tape (ST) group and Broström repair (BR) group. IV, inverse variance.

between the ST and BR groups (mean difference [MD], 0.90; 95% CI, –3.17 to 4.96; $I^2 = 70\%$; $P = .66$) (Figure 3).

FAAM Sports Activity

FAAM sports activity scores were reported in 3 studies,[7,52,59] which consisted of 83 patients in the ST group and 86 patients in the BR group. No significant difference was seen between the ST and BR groups (MD, 3.24; 95% CI, –5.31 to 11.79; $I^2 = 87\%$; $P = .46$) (Figure 4).

Talar Tilt Angle

The TTA was reported in 3 studies,[7,52,59] which consisted of 83 ST patients and 86 BR patients. The analysis showed no significant difference between the ST and BR groups (MD, –0.07; 95% CI, –0.68 to 0.54; $I^2 = 0\%$; $P = .82$) (Figure 5).

Anterior Talar Translation

The ATT was reported in 3 studies,[7,52,59] which included 83 patients in the ST group and 86 patients in the BR group. The analysis showed no significant difference between the ST and BR groups (MD, –0.06; 95% CI, –0.69 to 0.56; $I^2 = 0\%$; $P = .84$) (Figure 6).

Complications

All 4 studies reported an overall complication rate (Table 3). The analysis showed no significant difference in complication rates between the ST group (5.7%) and the BR group (4.7%) (MD, 1.29; 95% CI, 0.43 to 3.81; $I^2 = 0\%$; $P = .65$) (Figure 7).

Operation Time

The operation time was reported in 3 studies. Xu et al[59] reported there was no significant difference in operation

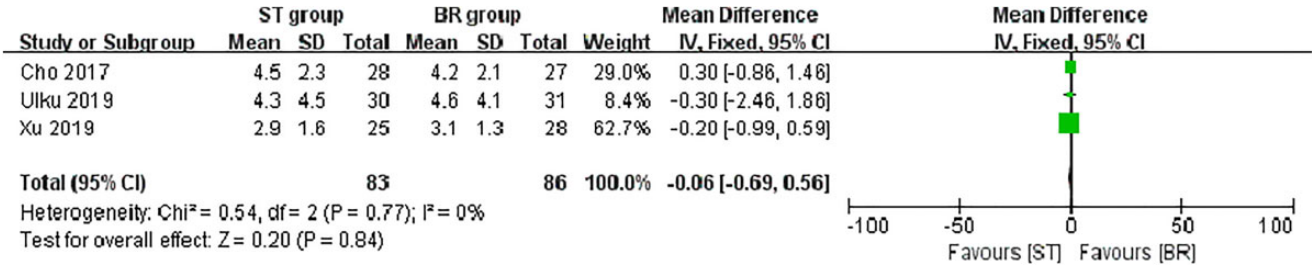

Figure 6. Results of aggregate analysis for comparison of anterior talar translation between suture tape (ST) group and Broström repair (BR) group. IV, inverse variance.

TABLE 3
Complications[a]

Lead Author (Year)	Wound Infection	Nerve Injury	Stiffness or Limited Range of Motion
Yoo[63] (2016)	NA	ST: 0 BR: 2 patients (3.2%) presented signs of neuritis of the intermediate dorsal cutaneous nerve	ST: 2 patients (9%) presented signs of an inversion deficit of >10° BR: 3 patients (4.8%) showed an inversion deficit of >10°
Cho[7] (2019)	ST: 0 BR: 1 case (3.7%) of local wound infection	ST: 1 case (3.6%) of damage to the sural nerve BR: 1 case (3.7%) of damage to the superficial peroneal nerve	NA
Ulku[52] (2020)	ST: 0 BR: 1 case (3.2%) of local wound infection	NA	NA
Xu[59] (2019)	ST: 0 BR: 1 case of wound infection	ST: 3 cases of abnormal dorsal foot paresthesia, which may damage the superficial peroneal nerve BR: 0	NA

[a]BR, Broström repair; NA, not applicable; ST, suture tape.

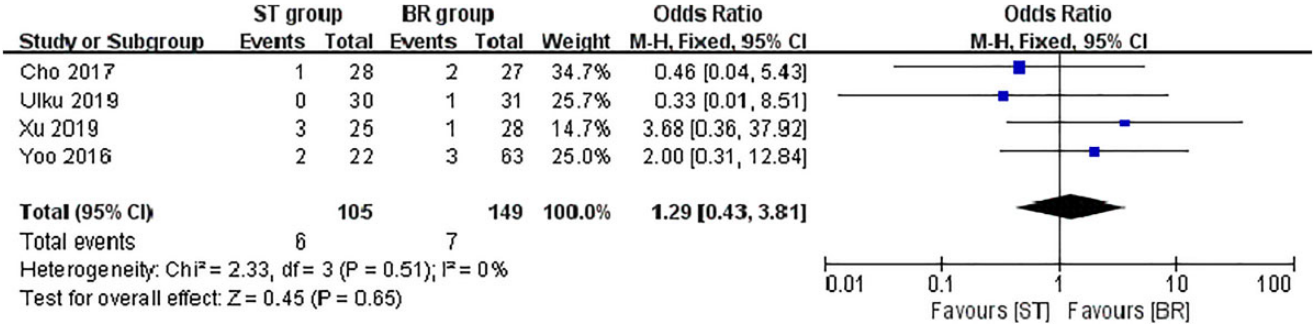

Figure 7. Results of aggregate analysis for comparison of complication rate between suture tape (ST) group and Broström repair (BR) group. M-H, Mantel-Haenszel method.

time between groups but provided no detailed data. Ulku et al[52] reported that the mean operation time for the ST and BR groups was 35.2 ± 5.2 and 48.6 ± 5.6 minutes, respectively. Cho et al[7] reported that the mean operation time for ST and BR groups was 24.6 ± 4.4 and 32.5 ± 4.8 minutes, respectively. The ST group appeared to have a shorter operation time compared with the BR group.

DISCUSSION

The most important finding of this study was that no significant difference was detected between the ST group and the BR group with regard to recurrent instability incidence, functional outcomes, or complication rate. Moreover, ST-augmented repair was associated with decreased operative time compared with BR. So far, STs have been applied

in the repair of anterior inferior tibiofibular ligament,[49] deltoid ligament,[11,37] and lateral collateral ligament.[8]

Our analysis showed no significant difference in the rate of recurrent instability between the ST group (2.9%) and the BR group (2.7%). Recurrent instability may occur even with successful repair of lateral ankle ligaments.[24,32] Li et al[29] surveyed 52 high-demand athletes who underwent repair of lateral ankle ligaments via suture anchors; the investigators found that 6% of patients had rerupture at 2-year follow-up. Petrera et al[41] investigated 49 patients who underwent modified BR and found that 3 patients (6.1%) reported residual instability after a traumatic retear at mean follow-up of 42 months. When using an ST augmentation technique, Cho et al[7] reported that 2 cases (7.1%) in the ST group had recurrent instability and 1 case (3.7%) in the BR group had recurrent instability. Ulku et al[52] observed that 1 patient (3.3%) had recurrence in the ST group and 2 patients (6.5%) in the BR group. Xu et al[59] found 1 case of mechanical instability in the BR group, which was treated with modified BR with augmentation using ST. Coetzee et al[12] reported that 1 patient experienced ankle inversion sprains at 1 year postoperatively during basketball games, but it did not result in recurrent instability.

In our study, we found that ST-augmented repair had shorter operative time compared with BR. In the studies by Ulku et al[52] and Cho et al,[7] the surgeons used knotless anchors for ST-augmented surgery and knot anchors for BR. Knot anchor repair required the surgeon to pass sutures through ATFL remnants, which might increase operative time. The present meta-analysis found no significant difference in clinical functional outcomes between the ST and BR groups. This finding indicates that both repair techniques were effective for chronic ankle instability. Generalized ligamentous laxity is an independent predictor of poor outcomes and a risk factor for recurrent instability following the modified Broström procedure for CLAI.[39,60] Cho et al[9] applied ST-augmented repair in CLAI patients with generalized ligamentous laxity and reported that FAOS and FAAM scores had significantly improved from an average 63.2 and 54.3 points preoperatively to 90.6 and 89.5 points at final follow-up, respectively.

Cho et al[6] used ST in revision surgery for a failed modified Broström procedure and found that the mean FAOS and FAAM scores improved significantly to 87.5 and 85.1 points at final follow-up, respectively. Previously, for a failed modified Broström procedure, ligament reconstruction with autograft or allograft tendon had usually been indicated for revision surgery.[20,28,33] Song et al[46] demonstrated that their reconstruction group (12 patients) showed a significantly higher AOFAS score and lower visual analog scale score than those in the Broström group (16 patients) at 12 months after surgery, although the difference between the 2 groups was not statistically significant 30 months later. Anatomic reconstruction appeared to give the best results, although it might be more invasive than anatomic repair. Because it is less invasive, augmentation with ST has been proposed for these situations. Based on these results, it was presumed that an ST augmentation repair technique has a wider range of applications for CLAI.

Return to sports after lateral ankle ligament injury is a major concern for clinicians.[40,45,48] Regarding sports activity, no significant difference was found between the ST group and the BR group in this review. Maffulli et al[32] investigated 34 patients at an average of 8.7 years after BR surgery and found that 58% of patients returned to sports at their preinjury level and 10 patients (26%) gave up all sports activities. Recently, Porter et al[42] reported that primary repair combined with artificial ligament resulted in better total FAOS results and higher Tegner activity scores at 5-year follow-up compared with the Broström procedure among physically active patients with chronic lateral ligament instability. Yoo and Yang[63] reported that 18 patients (81.8%) in the ST group returned to sports activity without limitations whereas only 17 patients (27.0%) in the BR group were able to do so at 12 weeks after surgery. BR surgery might not be suitable for patients with generalized laxity or poor ligament quality. Augmented repair with tendon graft or ST should be considered in order to allow early and safe return to sports.[12,21,35]

Viens et al[55] conducted a biomechanical analysis of the strength of ST augmentation repair and demonstrated that the mean ultimate load to failure of ST augmentation (315.5 ± 66.8 N) was significantly higher than that of the intact ATFL (154.0 ± 63.7 N). Moreover, Schuh et al[44] reported that ST augmentation repair was statistically superior in terms of angle at failure as well as failure torque compared with the Broström procedure. These findings indicate that ST protects the repaired ATFL during ligament healing in the early time after surgery so as to allow early return to sports, similar to artificial ligaments in anterior cruciate ligament reconstruction.[3]

Concerns remain regarding potential complications, including foreign body reaction, inversion limitation, nerve entrapment, wound complications, regional pain syndrome, and scar tenderness.[13,25,61] The present meta-analysis showed no significant difference in complication rates between the ST group (5.7%) and the BR group (4.7%), indicating that ST-augmented repair is a safe procedure. Limitation of range of motion is another concern after augmentation surgery. Ellis et al[16] investigated 11 patients at a mean of 3.5 ± 1.7 years after lateral ankle ligament reconstruction of allograft tendon, at which time 6 patients had mild restrictions and 1 patient reported moderate activity restriction. Regarding ST-augmented repair, Yoo and Yang[63] reported that 2 patients (9%) in the ST group presented signs of an inversion deficit of $>10^\circ$ compared with 3 patients (4.8%) in the BR group. Coetzee et al[12] reported that the tape measure method and ankle dorsiflexion comparisons showed a significant difference: 9.2 ± 3.3 cm (operative side) versus 10.4 ± 3.7 cm (contralateral side), although a comparison of ankle plantarflexion (by goniometer) showed no significant difference: 48.5° ± 11.5° (operative side) versus 49.7° ± 11.9° (contralateral side). ST augmentation should be performed cautiously, without overtightening; marking the distance between the

original site of the fibula and the insertion site of the talus on the ST can be useful.

The current study had several limitations. The selected studies included both open and arthroscopic procedures. However, previous investigation has reported no significant difference in functional outcomes after open repair versus arthroscopy.[27] Thus, this technique difference may have had little influence on patient-reported outcomes. Mean follow-up times differed among the included studies, ranging from 6 to 58 months. Because a longer follow-up time was statistically related to a good result, one could question whether outcomes would be influenced with different follow-up times. In the study by Yoo and Yang,[63] which entailed 6 months of follow-up, the patients had already recovered and no significant between-group differences in functional scores was found. Thus, the influence of follow-up time may be relatively small. In addition, there was large heterogeneity in the FAAM scores and FAAM sports activity scores, which might be attributable to the fact that the study by Cho et al[7] included only female patients. Finally, our review included only 4 studies, and 2 of the included studies had a low level of evidence and were retrospectively conducted, thus making selection bias a possibility. Because the current evidence is still limited, further prospective high-level studies with longer follow-up are required.

CONCLUSION

The current meta-analysis did not support our hypothesis. We found no significant differences in recurrent instability incidence, functional outcome scores, or complication rates between ST-augmented repair and BR surgery. Despite being technically challenging, the ST-augmented repair procedure seems to be a safe and fast option.

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