



Modified arthroscopic Broström procedure using a soft anchor for chronic lateral ankle instability: Short-term follow-up results

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Ankle sprain is the most common lower extremity injury in sports, and lateral ankle sprains constitute the majority of ankle sprains.^[1] The mechanism of injury involves an inversion force applied on the foot while in plantar flexion. This type of trauma may cause damage to the lateral collateral ligament complex (anterior talofibular ligament [ATFL], calcaneofibular ligament [CFL], posterior talofibular ligament [PTFL]).^[2] Many patients receive conservative treatment, but recurrence is common.^[3] Nearly one-third of patients with lateral ankle sprain develop chronic ankle instability (CAI) characterized by the persistence of instability for six months after initial trauma.^[4] In patients with CAI, ATFL is almost always present, either solitarily (per se) or coexisting with CFL injury.^[5-7]

Ligament tear is observed in addition to pathological hypermobility detected in the tibiotalar

Received: December 31, 2020

Accepted: April 15, 2021

Published online: November 19, 2021

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Doi: 10.52312/jdrs.2021.34

Citation: Moradi R, Cengiz B. Modified arthroscopic Broström procedure using a soft anchor for chronic lateral ankle instability: Short-term follow-up results. Jt Dis Relat Surg 2021;32(3):744-751.

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ABSTRACT

Objectives: This study aims to examine the clinical outcomes and complications of lateral ligament reconstruction performed using soft anchors according to the arthroscopic modified Broström technique (MBT) for the treatment of chronic ankle instability (CAI) and to evaluate the frequency of return to sports.

Patients and methods: A total of 14 patients with CAI (9 males, 5 females; mean age: 30.1±4.6 years; range, 22 to 38 years) who underwent the MBT with soft anchors between January 2015 and December 2019 were retrospectively analyzed. Ankle function was evaluated using the American Orthopaedic Foot & Ankle Society (AOFAS) Ankle-Hindfoot Scale and Karlsson Ankle Function Score (Karlsson/Peterson, K/D score), while pain was evaluated using the Visual Analog Scale (VAS) after a minimum follow-up of 12 months.

Results: The mean follow-up was 23.6±7.7 months. The mean overall AOFAS score was 74.0±2.6 preoperatively, which improved to 96.2±1.9 in the postoperative period (p=0.001). The mean pre- and postoperative K/P scores were 72.4±3.1 (range, 68 to 78) and 95.3±2.2 (range, 92 to 98), respectively (p=0.001). The mean preoperative VAS score was 2.4±0.9 (range, 1 to 4) and showed a significant improvement to 0.6±0.5 (range, 0 to 1) in the postoperative period (p=0.001). Nine (64.3%) patients returned to sports activities after surgery at a mean period of 9±2.1 months.

Conclusion: In the treatment of CAI, arthroscopic MBT performed with soft anchors provides successful outcomes in short-term follow-up. In addition to being a minimally invasive technique, MBT is a reliable and safe approach with low complication rates and significant functional improvement. However, the low ratio of return to sports should be considered as a failure of this technique.

Keywords: Ankle instability, arthroscopic reconstruction, lateral ankle ligaments, soft anchor.

joint in patients who exhibit signs of mechanical instability. Moreover, patients who have signs of functional instability may experience problems associated with ankle sprain, as well as more subjective findings due to the increased proprioception-without

any radiological pathologies.^[8] Due to the high possibility for adverse consequences resulting from CAI itself and instability-related risks,^[9] surgical treatment should be considered, unless satisfactory functional outcomes and stability can be ensured with conservative treatment.

The open modified Broström technique (MBT), which is commonly preferred in lateral ankle instability, has been used for anatomic reconstruction^[10] with successful functional outcomes.^[11,12] However, isolated lateral ligament repair performed with this technique has been shown to result in poor clinical outcomes in the presence of coexisting intraarticular pathologies that are not treated in the same session.^[13,14] In addition, it has been suggested that some intraarticular pathologies cannot be visualized with preoperative magnetic resonance imaging (MRI)^[13,15,16] and priority should be given to arthroscopic evaluation in such treatment procedures.^[13,17-19] Good clinical outcomes compared to open surgery have been reported in many previous studies.^[10,20-22] However, complication rates due to the anchor use are also known to be high.^[23]

In the present study, we aimed to examine the clinical outcomes and complications of lateral ligament reconstruction performed using soft anchors according to the arthroscopic MBT for the treatment of CAI and to evaluate the frequency of return to sports activities.

PATIENTS AND METHODS

This single-centre, retrospective study was conducted at Private Sincan Koru Hospital, Department of Orthopedics and Traumatology between January 2015 and December 2019. A total of 14 patients with CAI (9 males, 5 females; mean age: 30.1±4.6 years; range, 22 to 38 years) who underwent the MBT for full-thickness ATFL rupture with soft anchors were included. All procedures were performed by a single surgeon. Exclusion criteria were as follows: presence of an evident bone deformity, neuromuscular disorders, general joint laxity, and augmented ATFL reconstruction with tendons. A written informed consent was obtained from each patient. The study protocol was approved by the Acibadem University Ethics Committee (No: 2020-19/26; Date: 03.09.2020). The study was conducted in accordance with the principles of the Declaration of Helsinki.

There was at least one inversion injury of the ankle in all patients. All patients continued to complain of instability after at least six months of conservative

treatment. Based on the clinical examinations, every patient had a positive anterior drawer and talar tilt test. Preoperative standard anteroposterior, lateral and varus stress radiographs and MRIs of the ankles were obtained. The MRI studies revealed that all patients had a complete or partial CFL lesion in addition to a complete ATFL lesion.

All scoring and assessments at pre- and postoperative time points were performed by the same observer. The examination consisted of pre- and postoperative Visual Analog Scale (VAS), American Orthopaedic Foot & Ankle Society (AOFAS) Ankle-Hindfoot Scale, and Karlsson/Peterson (K/P) scores. For all patients, thorough surgical data and intraoperative findings recorded during surgery were documented. All patients with CAI were followed for at least 12 months after surgery. Preoperative assessments were performed and recorded one week before surgery, and postoperative assessments were recorded at the last follow-up investigation of each patient.

Surgical technique

Routine anterior ankle arthroscopy portals are used in this technique. However, the anterolateral portal is placed at nearly 1 cm to the anterior of the lateral malleolus, at the normal superior border of the ATFL. At the initial stage, diagnostic arthroscopy is used to evaluate the ATFL and if a tear is detected, debridement is performed at the attachment of the fibula with a shaver to reveal the footprint of the ligament. During diagnostic arthroscopy, the intraarticular lesions are evaluated and figured out. This is followed by placing a four-thread soft anchor (2.9 mm JuggerKnot™, Zimmer-Biomet Orthopedics, Warsaw, Indiana, USA) perpendicular to the fibula and parallel to the fifth metatarsal into the mid-portion of the footprint area of the fibula prepared before. Then, the anchor threads are advanced through the ankle capsule and inferior extensor retinaculum at 7, 8, 9 and 10 o'clock positions on the left side and 2, 3, 4 and 5 o'clock positions on the right side 1 to 1.5 cm anterior to the lateral portal, with same-colored threads remaining adjacent. The threads are pulled below the skin, while they are free to check whether the lateral malleolus is covered by the inferior extensor retinaculum with a scope. Then, same-colored threads are knotted together, after which portal entries are closed, and a short leg splint is placed on the leg with the ankle fixed at 90 degrees. Controlled active and passive movements are initiated after removing the splints after a three-week recovery period. Load bearing is postponed, until the end of postoperative sixth week for the operated extremity (Figures 1-3).



FIGURE 1. Perioperative stress radiography under fluoroscopy showing lateral opening in the ankle with varus stress.

Clinical evaluation

An experienced orthopedic surgeon conducted clinical examinations comprised of subjective functional and physical evaluations. The surgeon performing clinical evaluations was blinded to the repair procedure. The AOFAS, K/P and VAS scores were included in the functional examination, and the

physical examination included the anterior drawer test (ADT). Clinical ADT evaluation was performed for both sides: a side-to-side difference less than 5 mm in tibiotalar translation was considered normal (Grade 0); 5 to 10 mm was considered Grade 1; 10 to 15 mm was considered Grade 2, and higher than 15 mm was considered Grade 3.^[17]

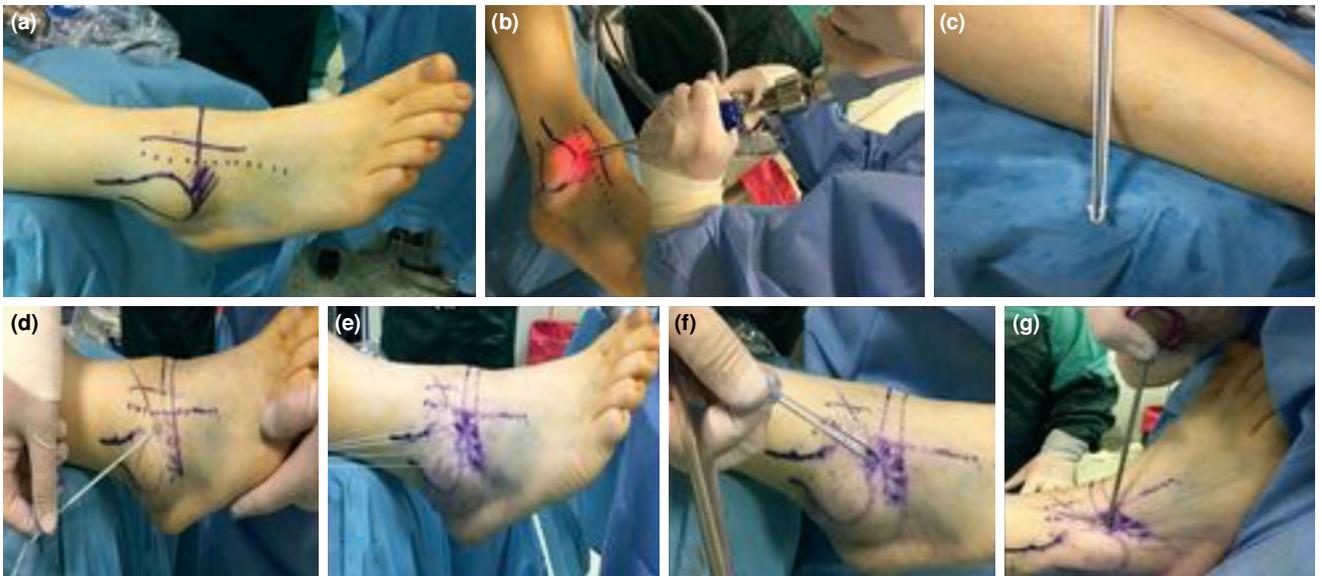


FIGURE 2. (a) Marking of the important structures of the right foot of the patient preoperatively. The patient was positioned in the supine position. Lateral and medial malleolus, tibialis anterior tendon, superficial peroneal nerve, and inferior extensor retinaculum were marked; (b) Arthroscopically, placing the soft anchor on the ruptured ATFL footprint in the fibula; (c) 2.9 mm soft anchor used in Modified Broström operation; (d) Checking the stability of the anchor by pulling the threads together after the anchor placement in the footprint; (e) Passing the anchor threads under the inferior extensor retinaculum in the right foot at 2, 3, 4, 5 o'clock; (f) The threads carried from the subcutaneous to the portal; (g) The same colored threads knotted together, while at the same time confirming arthroscopically that the inferior extensor retinaculum covers the footprint.

ATFL: Anterior talofibular ligament.

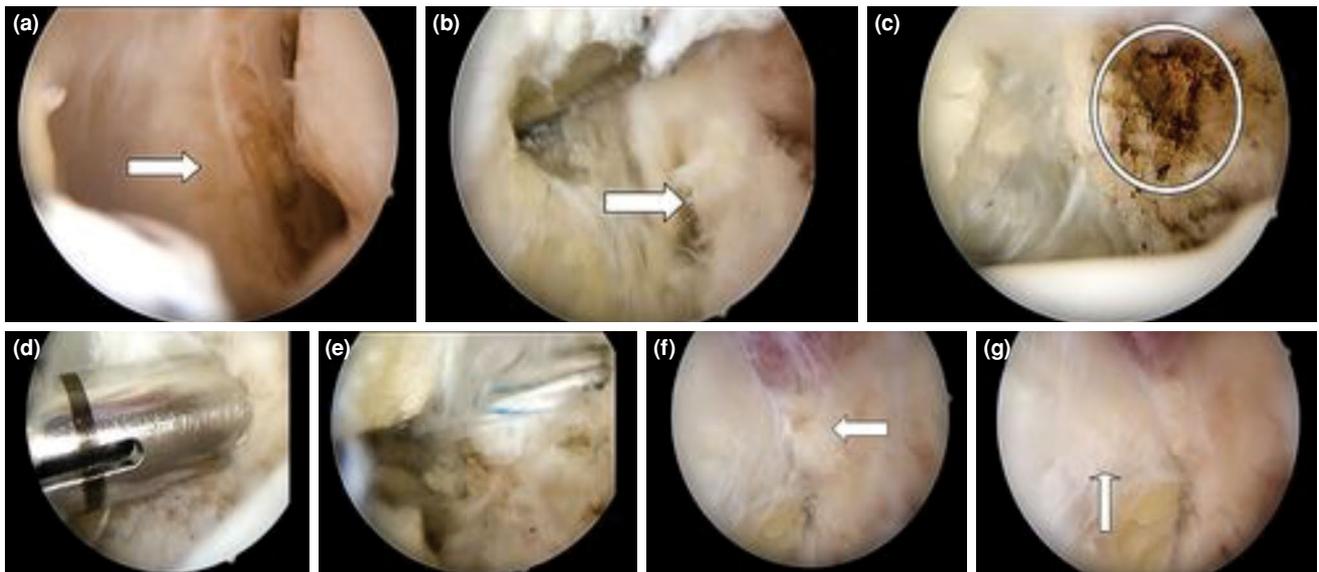


FIGURE 3. (a) Arthroscopic view from the anterolateral portal, white arrow shows the degenerated and ruptured ATFL as seen the footprint is empty; (b) Degenerated stump remaining from ATFL after debridement with shaver (white arrow); (c) The image from the anteromedial portal of the marked footprint of ATFL on the fibula after debridement; (d) Arthroscopic placement of the soft anchor in the footprint area of the fibula; (e) The appearance of the threads after placing the soft anchor in the footprint; (f, g) After the anchor suture limbs were passed through the ankle capsule and inferior extensor retinaculum and knotted, covering the footprint was checked with the scope. White arrows show the coverage of the footprint from the anterolateral portal.
 ATFL: Anterior talofibular ligament.

Statistical analysis

Statistical analysis was performed using the IBM SPSS version 21.0 software (IBM Corp., Armonk, NY, USA). For the normality check, the Shapiro-Wilk test was used. Data were expressed in mean ± standard deviation (SD) or median (min-max) for continuous variables and in number and frequency for categorical variables. Normally distributed variables were analyzed using the two-way repeated measures analysis of variance (ANOVA). Non-normally distributed variables were analyzed using the Wilcoxon signed-rank test for repeated measurements. Pairwise comparisons were performed with the Bonferroni correction method. A *p* value of <0.05 was considered statistically significant.

RESULTS

Demographic data of the patients are summarized in Table I. The mean duration of instability symptoms after ankle trauma until surgery was 34.0±12.8 (range, 18 to 60) months. The mean follow-up was 23.6±7.7 (range, 12 to 33) months. Ankle instability was not observed in any of the patients and all ankles had normal ADT results (Grade 0) postoperatively.

Accompanying lesions were talar osteochondral lesions (OCL) in three patients (n=1 Grade 1 and n=2 Grade 2 according to Berndt and Harty classification). In patients with Grade 2 OCL, the fringed parts were debrided with a shaver. No intervention was applied to the patient with Grade 1 OCL. These lesions had no effect on follow-up and treatment. No accompanying lesions were seen except for OCLs.

The mean overall AOFAS score was 74.0±2.6 (range, 70 to 78) preoperatively, and improved to

TABLE I Demographic characteristics of patients			
Variable	n	%	Mean±SD
Age (year)			30.1±4.6
Sex			
Male	9	64.3	
Female	5	35.7	
Duration of symptoms			34.0±12.8
Follow-up period			23.6±7.7
SD: Standard deviation.			

TABLE II

Comparisons of outcome scores before and after operation

	Mean±SD	p
AOFAS Ankle-Hindfoot Scale		0.001
Preoperative	74.0±2.6	
Postoperative	96.2±1.9	
Karlsson-Peterson		0.001
Preoperative	72.4±3.1	
Postoperative	95.3±2.2	
VAS		0.001
Preoperative	2.4±0.9	
Postoperative	0.6±0.5	

SD: Standard deviation; AOFAS: American Orthopaedic Foot & Ankle Society; VAS: Visual Analog Scale.

TABLE III

Return to sports activities after operation

Sports activity type	Returning to sports activities			
	Yes		No	
	n	%	n	%
Competitive (n=9)	8	88.9	1	11.1
Recreational (n=5)	1	20.0	4	80.0
Total (n=14)	9	64.3	5	35.7

96.2±1.9 (range, 92 to 98) in the postoperative period ($p=0.001$). The mean pre- and postoperative K/P scores were 72.4±3.1 (range, 68 to 78) and 95.3±2.2 (range, 92 to 98), respectively ($p=0.001$). The mean preoperative VAS score was 2.4±0.9 (range, 1 to 4), and showed an improvement to 0.6±0.5 (range, 0 to 1) in the postoperative period ($p=0.001$) (Table II).

Nine (64.3%) patients returned to sports activities after surgery. The mean time until return to sports was 9±2.1 (range, 6 to 12) months. Five of the patients were interested in recreational sports and nine were interested in competitive sports. While eight (88.9%) of nine patients who did competitive sports returned to sports during follow-up, one (20.0%) of five patients who did recreational sports were able to return to sports. While nine of 14 (64.3%) patients returned to sports in total, this rate was quite high in the group engaged in competitive sports (88.9%) (Table III). None of the patients had major complications. One patient exhibited superficial peroneal nerve paresthesia treated with conservative therapy. One patient had stiffness in the ankle treated with rehabilitation. None of the patients experienced wound problems or infections associated with surgery.

DISCUSSION

Arthroscopic lateral ankle ligament reconstruction using soft anchors with the arthroscopic MBT was found to be a reliable, safe and effective technique, when the outcomes were assessed at a minimum one-year follow-up, which is the most important finding obtained in this study. In addition, it should be noted that this minimally invasive procedure yields a high frequency of return to sports activities.

Although there were no additional lesions other than talar OCL detected in three cases in our study, CAI is a chronic disorder, indeed, that manifests with secondary coexisting lesions in the joint and leads to functional problems in patients, and MRI fails to suffice in visualizing these pathologies in some cases.^[13,24] Open MBT is accepted as the gold-standard procedure in the surgical treatment of CAI, with several studies reporting good to excellent clinical outcomes.^[25,26] However, considering the relevant literature, Lee et al.^[27] investigated coexisting intraarticular pathologies in 28 patients diagnosed with CAI and reported the presence of additional pathologies in 22 patients and Ferkel and Chams^[19] reported that the rate of intraarticular pathologies was 95% in a case series including 21 patients. In this context, arthroscopic MBT, which was the preferred method in this study, satisfies the need for evaluation and treatment of intraarticular structures and enables anatomic ligament reconstruction with the additional advantage of shorter recovery. Therefore, arthroscopic MBT emerged as a commonly preferred procedure in the treatment of patients with CAI, particularly when additional lesions are suspected.^[28,29]

There are numerous studies in the literature on arthroscopic MBT. Considering the clinical outcomes of the technique, in a study by Corte-Real and Moreira,^[30] the mean postoperative AOFAS score was reported to be 94.4 among 31 patients followed for 25 months. In another study by Nery et al.,^[21] the mean AOFAS score was reported to be 90 after a 10-year long-term follow-up in a case series of 38 patients. In the present case series of 14 patients, the mean AOFAS score improved from 74 to 96.21 between the pre- and postoperative period. In this respect, the present study has obtained successful results with arthroscopic MBT, similar to previous publications.

It is possible to speculate that the greatest technical challenge in arthroscopic MBT is the difficulty of arranging the anchor positions, since the distal fibula is a relatively small structure in the mediolateral plane. Implants that are easy to apply and provide effective results are necessary,

as large-profile anchors pose a risk of damage to the bone.^[31,32] Additionally, it has been reported that biodegradable implants have problems ranging from premature degradation to instantaneous breakage.^[33,34] In the present study, we used soft anchors, which are easy to apply and have shown to have biomechanically superior properties.^[34] Similar studies have reported the use of two 1.4-mm soft anchors for lateral ligament reconstruction;^[34] however, we obtained similar reconstruction strength to the double-anchor method, since the single 2.9-mm soft anchor we employed was equipped with four threads. Therefore, this approach eliminated the necessity of identifying two anchor deployment positions and also reduced the cost of surgery.

According to the literature comparing single- or double-suture anchor use in ATFL repair, double-suture anchor use was reported to yield higher AOFAS and K/P scores and a high frequency of return to sports activities.^[35] Based on our study results, it is possible to conclude that the use of a single soft anchor for arthroscopic MBT in the present study may lead to similarly high AOFAS and K/P scores, as well as low VAS scores.^[36]

Although the superiority of different techniques to each other was not investigated in our study, some previous studies compared the results of open technique and arthroscopic surgery. In randomized-controlled study in which similar scores were used to our study and the results of open MBT and arthroscopic MBT were compared, Yeo et al.^[37] found that VAS, AOFAS, and Karlsson scores were significantly improved at six weeks, six months, and 12 months in both groups. They also reported that there was no significant difference between techniques in terms of scores and complication rates.^[37] On the other hand, it has been reported that arthroscopic MBT has higher complication rates compared to open techniques, and that the majority of these complications result from the use of suture anchors.^[23,38] Therefore, bone tunnel techniques have been developed to replace anchor use.^[38] However, soft anchor use led to low complication rates in the literature^[28] and bone tunnel techniques were not superior to the suture anchor technique from the biomechanical aspect.^[39] In a recent study, although there were no complications in either group, it was reported that the VAS score was higher in the open surgery group, compared to the arthroscopic surgery group.^[40] In the present study, there were no permanent complications, except for one case with transient joint stiffness and one case who developed transient paresthesia. Based on these findings, our

results seem to be among the successful results in the literature.

Despite the clinical improvements, however, it is difficult to suggest the same success rates in terms of return to sports. While the mean time until return to sports was 9 ± 2.1 months in our study, this period was shorter in previous studies.^[41,42] In addition, those who did competitive sports returned to sports more frequently than those who did recreational sports at the end of the follow-up (89% vs. 20%, respectively) in our study. Although the mean AOFAS scores improved in both groups, this may be due to the fact that the patients in the recreational sports group have a lower motivation to return to sports and have more anxiety about experiencing trauma again.

Nonetheless, this study has some limitations. First, the sample size is relatively small with a retrospective study design. Second, postoperative talar tilt angles, which are expected to reduce after surgery, were not measured and MRI studies to evaluate intraarticular healing were not performed. Even so, functional results demonstrated significant improvements at postoperative assessments, and the number of patients that were able to return to sports activities in the short-term was high. Finally, the follow-up time can be considered to be short for the investigation of the functional scores.

In conclusion, arthroscopic MBT performed with soft anchors has successful short-term outcomes in the treatment of CAI. In addition to being a minimally invasive technique, MBT is a safe and reliable technique with low complication rates and significant improvements in functional scores. However, a low ratio of return to sports can be considered the failure of the technique. Further large-scale, prospective studies should be conducted to draw a more accurate conclusion.

Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding

The authors received no financial support for the research and/or authorship of this article.

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