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A comparison of the "All-Inside" arthroscopic Broström procedure with the traditional open modified Broström-Gould technique: A review of 62 patients

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ABSTRACT

Background: The open Broström-Gould lateral ankle stabilization procedure has been the gold standard for primary lateral ankle stabilization. A new minimally invasive all-inside arthroscopic technique has been described for the correction of lateral ankle instability.

Methods: We performed a review of patients who underwent lateral ankle stabilization by either the traditional open Broström-Gould (BG) or the All-Inside Bröstrom (AIB) technique to compare and identify any discrepancies between functional and/or patient satisfaction outcomes. A total of 62 patients underwent a lateral ankle stabilization. Of those 62 patients, 32 received a traditional open Broström-Gould procedure and 30 patients underwent an All-Inside Bröstrom type procedure. The two groups were compared preoperatively with AOFAS ankle-hindfoot scoring system and Visual Analog Score (VAS) for pain. Postoperatively, AOFAS, Karlsson Peterson and VAS scores were compared.

Results: The mean preoperative VAS pain score for the open Broström-Gould was 7.28, the All-Inside Broström was 8.18. The mean postoperative VAS pain score for the open Broström-Gould was 1.2, the All-Inside Broström was 1.5. The mean preoperative AOFAS score for the Broström-Gould was 35.44, the All-Inside Broström was 35.07. The mean postoperative AOFAS score for the open Broström-Gould was 93.53, the All-Inside Broström was 95.33. The mean postoperative Karlsson Peterson score for the open Broström-Gould was 93.41, the All-Inside Broström was 91.80. The mean time to weight bearing for the Broström-Gould was 22 days, the All-Inside Broström was 12 days.

Conclusion: There were no statistically significant differences identified in any of the functional or patient satisfaction outcome scores using either technique. This review suggests the minimally invasive arthroscopic technique using bone anchors for lateral ankle stabilization may be comparable to the traditional open Broström-Gould with the added advantage of earlier time to weight bearing.

1. Introduction

Ankle sprains comprise 85% of all ankle injuries and are the most common sports injury at 14–21% [1–3]. Reports indicate approximately 25–45% of injuries to athletes participating in basketball, soccer, football and volleyball are ankle sprains with 85% being lateral inversion type sprains [3,4]. These injuries may range from minor stretching of the ligaments to partial or complete rupture.

Following acute ankle sprains, conservative treatment is considered the standard of care with functional rehabilitation if necessary. If this conservative attempts fail and pain persists with chronic instability ensuing then surgical intervention may be warranted. Many different surgical techniques have been described for lateral ankle stabilization to address insufficient ligamentous components of the lateral ankle.

In 1966, Broström first described an anatomical lateral ankle ligament repair which entailed a reconstruction of the Anterior Talofibular Ligament (ATFL) and Calcaneofibular Ligament (CFL) by imbricating these ligaments along with the joint capsule [5]. Gould in 1980, later modified this by adding the inferior extensor retinaculum as part of the repair [6]. Suture anchors have increasingly been used to add strength to the repair [7–10].

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Arthroscopy assisted techniques utilizing staples, suture anchors, thermal shrinkage and plication have also been described [11–16]. Although many techniques have been presented, the gold standard continues to be the open Broström-Gould technique.

We performed a review comparing the traditional open Broström-Gould technique using bone anchors with a minimally invasive all-inside arthroscopic technique also known as the “All-inside Broström” procedure. Both involve an arthroscopic debridement of the ankle joint and the use of bone anchors into the fibula to augment the repair. The anchors for the open Broström-Gould are placed through an open utility incision whereas the All-inside Broström anchors are placed arthroscopically through the anterolateral portal. A total of 62 patients were compared.

2. Methods

A retrospective study was performed of 62 patients between 2009 and 2013; 32 of which had received an open Broström-Gould (BG) and 30 the All-Inside Broström (AIB) for chronic lateral ankle instability. The AIB group had 21 females and 9 males and the BG had 18 females and 14 males. The AIB had 13 right and 17 left ankles as compared to the BG group with 16 right and 16 left ankles. Mean age for AIB was 47.89 years old (range 14–83) and BG was 37.72 years old (range 9–72). Mean follow-up for AIB was 1.3 years (0.7–1.7 years) and BG was 3.7 years (range 1.3–5.3). Inclusion criteria included mechanical instability with clinical stress maneuvers, clinical reports of instability and MRI findings of disrupted lateral ankle ligament structures. Patients who had previously undergone lateral ankle stabilization were excluded from this study. Preoperatively, all patients demonstrated mechanical or functional instability and had failed conservative treatment [12,16,17]. All patients underwent ankle arthroscopy to address intra-articular pathology prior to the lateral ankle stabilization. Afterwards, we then proceeded to perform either the BG technique using bone anchors or the AIB, as described by Acevedo and Mangone which also utilizes bone anchors [11]. VAS for pain, AOFAS and Karlsson Peterson scores were reviewed [18]. We also noted complications, time to full weight bearing, demographic variables and associated intra and extra-articular pathology.

2.1. Open Broström-Gould surgical technique

The BG technique for lateral ankle stabilization was performed using the following technique. Preoperative popliteal block was performed by the anesthesia department. The patient is placed in a supine position. After a well padded thigh tourniquet is applied the leg is positioned in a thigh holder with the foot elevated slightly off the operating table. General anesthesia is then administered. Anatomic landmarks are identified including the superficial peroneal nerve, medial and lateral malleolus and the peroneal tendons. A non-invasive ankle distractor is applied and ankle arthroscopy is performed using standard anterolateral and anteromedial portals. Arthroscopic debridement is completed addressing any intra-articular pathology. Arthroscopic instrumentation is then removed along with the ankle joint distractor. Attention is then directed to the distal aspect of the fibula. We prefer a curved longitudinal utility incision. Dissection is performed down to the inferior extensor retinaculum (IER) and ankle joint capsule. An ankle arthrotomy is performed within the anterolateral aspect of the ankle joint. The proximal aspect of the joint capsule is reflected off the distal anterior aspect of the fibula and two bioabsorbable bone anchors are placed at the origin of the ATFL. A pants-over-vest suture technique is performed for the Broström repair, with the ankle held in a neutral position with the heel slightly everted. It is imperative to place a bump under the distal leg to avoid anterior excursion of the talus from the heel resting on the table. The inferior extensor retinaculum is then imbricated and sutured using a pants-over-vest method with the foot held in the same position. The incisions are then closed in standard fashion. A well-padded splint is applied until the first postoperative appointment and then the patient is transitioned into a non-weight bearing below knee cast around 10–14 days postoperatively. If simultaneous pathology permits, patients resume weight bearing after 3 weeks in a cast or immobilization camwalker boot. Physical therapy is typically initiated between 4–6 weeks postoperatively.

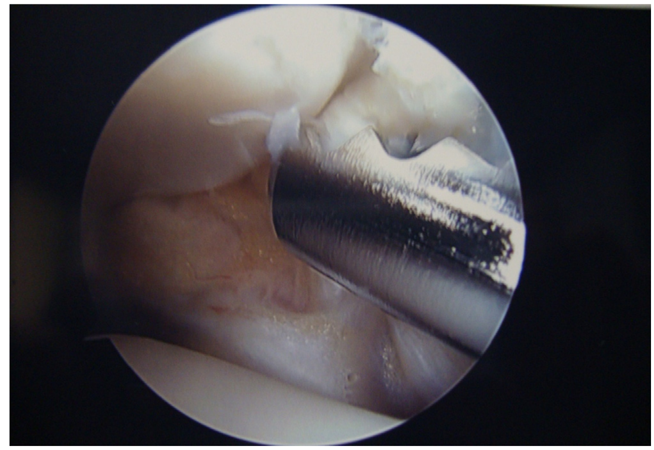


Fig. 1. Anterior lateral ankle joint is debrided with an arthroscopic shaver or ablator. This step is an important part in preparing the anterior face of the distal fibula as well as avoiding postoperative soft tissue impingement.

2.2. All-Inside Broström surgical technique

The AIB technique is performed using the same techniques for the ankle arthroscopy described above allowing the surgeon to address any concomitant intra-articular pathology. Once the standard ankle arthroscopy is completed, we then direct our attention arthroscopically to the anterior lateral ankle joint. It is imperative to completely debride this area to help avoid potential postoperative impingement. The anterior distal face of the fibula is then debrided with a shaver and/or ablator device (Fig. 1). It is necessary to adequately prepare the anterior face of the fibula creating raw bone in order to facilitate adherence of the soft tissues. A hemostat is used to then identify the medial, lateral and distal fibular surfaces to ensure proper placement of

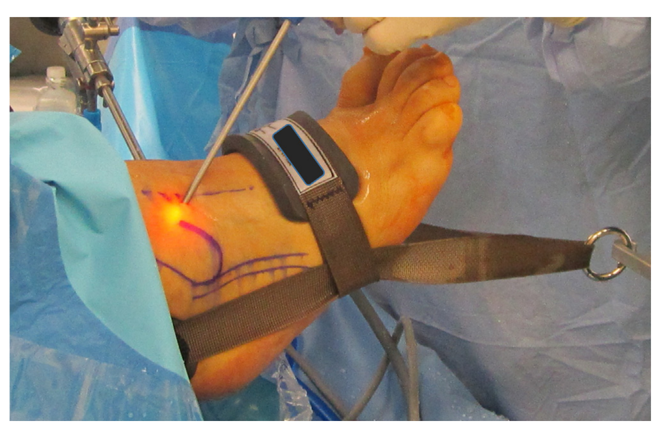


Fig. 2. The drill sleeve is inserted through the anterolateral portal and centered on the fibula. The pre-drill hole for the anchor is made. The anchor is then inserted through the canula and tapped into the fibula.

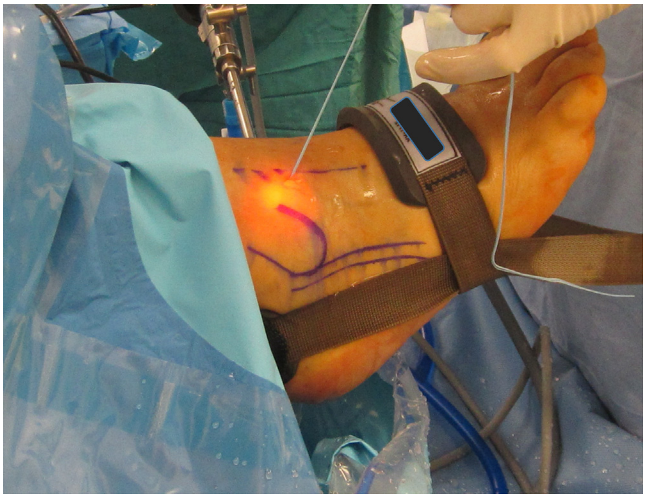
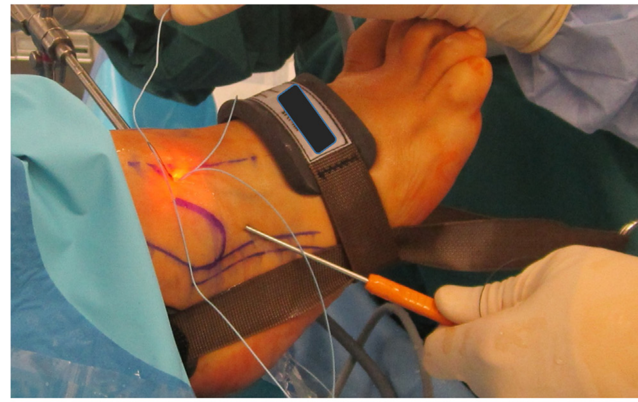


Fig. 3. Suture arms then exit the anterolateral portal before using microsuture lasso to capture the residual ATFL, capsule and the inferior extensor retinaculum.

the bone anchors. A drill/anchor guide is placed through the anterolateral portal and positioned centrally in the distal fibula approximately 1 cm proximal to the tip of the fibula (Fig. 2). The fibula is predrilled and the first of two bioabsorbable bone anchors (2.4 mm or 3.0 mm) is inserted. The two suture arms from the bone anchor then exit the anterolateral portal (Fig. 3). In order to sufficiently capture the ankle joint capsule, residual ATFL and IER we prefer the “outside-in” technique wherein a microsuture lasso is percutaneously inserted approximately 1.5 to 2 cm inferior and anterior to the distal fibula (Fig. 4). Care is taken to avoid the peroneal tendons and the sural nerve. The microsuture lasso is directed toward the anterior lateral portal at a depth sufficient to ensure incorporation of the ankle joint capsule, ATFL and IER. A nitinal wire is advanced through the microsuture lasso and one of the anchor sutures (#1) is passed. The second suture arm (#2) is then passed in the same manner using a starting point slightly more superior and further medial along the course of the IER. A second anchor is then placed in the same manner as the first and should be level with the lateral talar dome with as much bone bridge between anchors as possible. The second anchor’s suture arms (#3 and #4) are then routed in the same manner as #1 and #2 in 1 cm increments extending further anterior and medial along the fibers of the IER (Fig. 5). A small incision is then made between suture #2 and #3, with blunt dissection to the IER but not penetrating. A bluntly hooked probe is inserted subcutaneously and superficial to the IER and is used to pull each of the sutures into the accessory incision keeping them correlated to their respective bone anchors (Figs. 6 and 7). The non-invasive ankle distracter is released and the ankle is held in a neutral position with slight eversion while the sutures are hand tied to their corresponding bone anchors. Anterior drawer and inversion stress exams are completed to confirm adequate stabilization. The incisions are then closed in standard fashion (Fig. 8). A well padded non-weight bearing below the knee splint is applied until the first post-operative appointment at approximately 10 days. Patients are then placed in a short leg cast and are allowed to 50% weight bear for 10 days followed by 7–10 days of 100% weight bearing in a walking cast. At 4 weeks patients are transitioned into an immobilization boot and begin Physical Therapy.

We have since modified our postoperative protocol for the AIB procedure. Currently if concomitant procedures allow, the authors permit patients to start weight bearing in a tall camwalker immobilization boot at 3 days. This typically allows time for the popliteal block to fully dissipate before attempting ambulation. Physical therapy is now initiated at 21 days and patients return back to regular shoegear at 28 days. We allow earlier weight bearing in the AIB group because of our hypothesis that patients have less swelling, pain and we walked them in a controlled environment such as a cast or immobilization boot.

A



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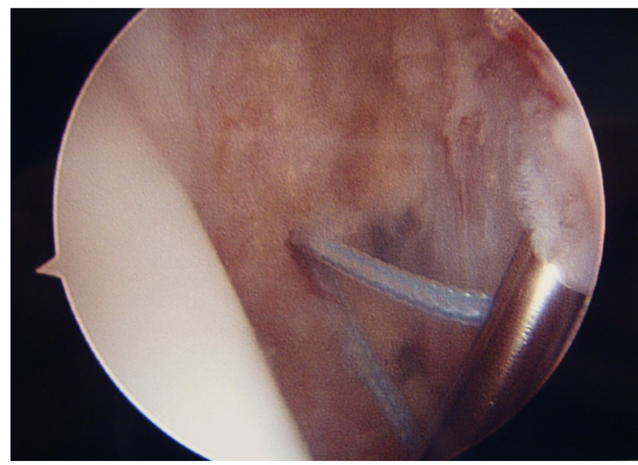

Fig. 4. A. Pass #1 is made using a curved microsuture lasso device starting 1.5–2.0 cm inferior and distal to the fibula. It is imperative to avoid the peroneal tendons with this pass. B. Bone anchor seated into the anterior distal face of the fibula with sutures exiting the anterolateral portal and direct visual confirmation of the microsuture lasso inside the joint as visualized with the arthroscope.

Fig. 5. All four suture arms are then passed along the course of the inferior extensor retinaculum.

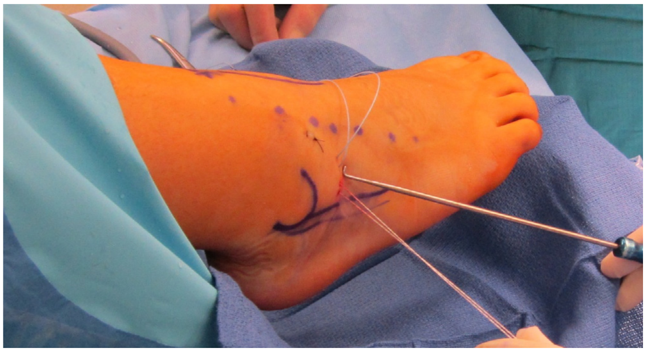

Fig. 6. A right angle probe is used via the accessory incision placed between position #2 and #3 to gather each suture into the accessory incision.

3. Results

The mean preoperative VAS pain score for the AIB was 8.18 (range 3–10) and BG was 7.28 (range 0–10). Mean postoperative VAS pain score for AIB was 1.5 (range 0–10) and BG was 1.2 (range 0–9.5). Mean preoperative AOFAS score for the AIB was 35.07 (range 23–62) and B-G was 35.44 (range 23–68). Mean postoperative AOFAS score for AIB was 95.33 (range 75–100) and BG was 93.53 (range 49–100). Mean postoperative Karlsson–Peterson score for the AIB was 91.8 (range 55–100) and BG was 93.41 (range 54–100). The mean time to weight bearing for the AIB was 12 days (range 9–16 days) and BG was 22 days (range 20–26 days). Physical therapy for both groups began 4–6 weeks postoperatively.

Intra-articular findings in the AIB groupwere as follows: Synovitis 30 (100%), anterior tibial spur 1 (3.33%), OCD Talus 1 (3.33%), and Loose Bodies 1 (3.33%). Other extra-articular pathologies were as follows: Peroneal tendon tear repaired via open incision 3 (10%), navicular fracture 1 (3.33%), tailors bunion 1 (3.33%). Complications consisted of deep vein thrombosis (DVT) 1 (3.33%), neuritis of sural nerve 1 (3.33%); this worker's compensation patient underwent peroneal tendon repair resulting in sural neuritis which ultimately required a sural neurectomy and continued to demonstrate posterior lateral ankle pain. One patient sustained a distal fibular fracture which was not related to the procedure but occurred during the post-operative period for which this patient became excluded. Twenty nine patients (97%) returned to full activity which included sports for athletic patients. The patient who underwent sural neurectomy did not return to full activity. There were no wound complications encountered in any of the 30 patients.

Fig. 7. Sutures are then brought into the accessory incision keeping them separated so as to correspond with their respective bone anchors. We have also found it important to free any subcutaneous tissue overlying the inferior extensor retinaculum before tying the sutures.

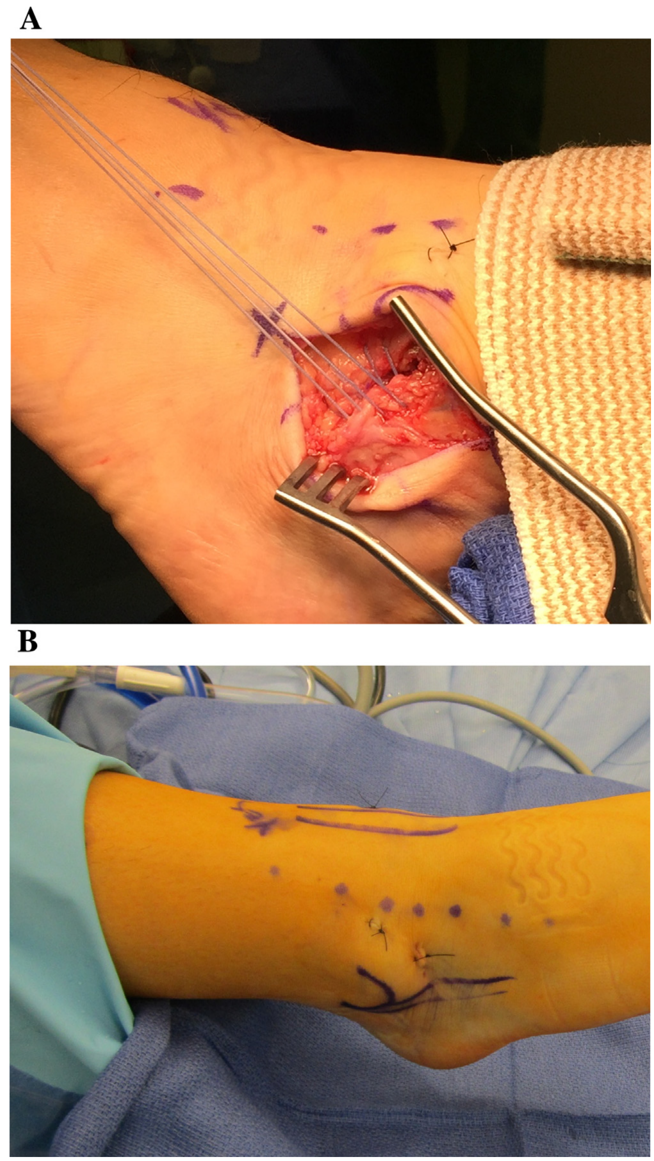

Fig. 8. A & B. Exposure typically required for open Brostrom procedure versus the All-Inside Brostrom procedure with only 3 stitches needed for closure; two of which are for the arthroscopy portals and bone anchor placement and one for the accessory incision.

Other concomitant findings treated at the time of stabilization in the BG group were as follows: Fibular avulsion 4 (12.5%), loose bodies 1 (3.13%), Low lying muscle belly 1 (3.13%), OCD of the talus 6 (18.75%), peroneal tendon tear repaired via open incision 6 (18.75), peroneal tubercle hypertrophy 2 (6.25%), ganglion cyst 1 (3.13%), anterior tibial bone spur 1 (3.13%), impingement 7 (21.88%), synovitis 13 (40.63%). Complications consisted of Superficial Peroneal neuritis in 2 patients (6.25%). Thirty one patients (97%) returned to full activity which included sports for athletic patients. One patient ended his post-operative follow up care early against our advice by not performing formal physical therapy. There were no wound complications encountered in any of the 32 patients.

Statistical analysis using a permutation test revealed no statistically significant difference between the two groups for any of the outcome scores (p-values: Preoperative VAS 0.3178, Postoperative VAS 0.9938, Preoperative AOFAS 0.6546, Postoperative AOFAS 0.5194, Karlsson–Peterson 0.9566).

4. Discussion

The open Broström-Gould procedure has primarily been a first line surgical option for patients diagnosed with chronic lateral ankle instability. Surgeons frequently and should perform an arthroscopic ankle joint examination prior to the procedure in order to address simultaneous intra-articular pathological entities. This has been demonstrated via reports in the literature to be greatly beneficial as concomitant pathologies are repeatedly identified [19–21]. After thorough arthroscopic identification and treatment of these pathologies, surgeons typically proceed to perform an open exposure incision in order to complete the typical modified Broström-Gould technique. This may be beneficial in order to inspect or repair simultaneous extra-articular pathologies such as those involving the peroneal tendons. However, when extra-articular exploration is deemed unnecessary, the benefits, as well as attractiveness of a minimally invasive arthroscopic ankle joint procedure are lost as a lateral open incision is created. For this reason, we have reported on a series review of patients treated with either the traditional open Broström-Gould or alternatively the Arthroscopic All-inside Broström (All-Inside Broström) technique.

The AIB procedure described herein was initially discussed by Acevedo & Mangone in 2011 [11]. They reported on 23 patients (24 ankles) who improved postoperatively as reported by the patient. In this report, they did not mention any pre or postoperative scoring systems. They did however discuss in detail some of the contraindications and complications to this procedure. Subsequently, Cottom & Rigby reported in 2013 on a prospective outcomes study using AOFAS Hindfoot/Ankle, Visual Analog Pain, and Karlsson Peterson scores [22]. In this study, the mean post-operative Karlsson Peterson score was 93.6 (range 82–100). Mean pre-operative AOFAS was 41.2 (range 23–64) and post-operative was 95.4 (range 84–100). The mean pre and post-operative VAS pain scores were 8.2 (range 4–10) and 1.1 (range 0–5) respectively. Additionally, their concomitant intra-articular findings were consistent with previously reported literature and were reported as follows: Synovitis 100% (40 pts), Anterior Tibial Spurring 2.5% (1 pt), OCD Talus 5.0% (2 pts), and Loose Bodies 2.5% (1 pt). Complications encountered consisted of DVT 2.5% (1 pt), neuritis of the superficial peroneal nerve 2.5% (1 pt), and distal fibular fracture 2.5% (1 pt). They reported that the fibular fracture was unrelated to the surgery. Additionally, they reported on simultaneous procedures as follows: anterior tibial spur resection 2.5% (1 pt), drilling OCD lesion of the talus 5.0% (2 pts), open repair peroneus brevis tendon tear 15% (6 pts), and repair of tailors bunion 2.5% (1 pt). In their study, they did not encounter any incisional wound dehiscence or infection. However, they did report that one patient required a revision secondary to hyperlaxity.

In the present study, the All-Inside Broström procedure was performed as a primary attempt of stabilization for each patient. However, in 2014 Prissel & Roukis reported a technique paper describing the use of an all-inside approach for revision lateral ankle repair while using standard All-Inside Broström technique combined with an Internal brace (InternalBrace, Arthrex, Inc., Naples, FL) [23].

A number of biomechanical studies have recently surfaced assessing the ability of an arthroscopic approach to adequately provide stability to the lateral ankle ligament complex. In 2014, Lee et al. reported on a cadaveric study of 22 ankles from 11 cadavers and reported the arthroscopic Broström was nearly identifical to an open Broström when comparing torque to failure, degree to failure, or working construct stiffness [24]. However, the open Broström repair did not include any form of bone anchor while the arthroscopic Broström incorporated the use of a single bone anchor in the distal fibula. Giza et al. in 2013, did compare open vs. arthroscopic Broström using 2 bone anchors for both techniques in a similar cadaveric study and still found no significant no difference in the degrees to failure, torque to failure, or stiffness [25]. Drakos et al. findings were consisted in that 20 paired cadaveric limbs demonstrated similar biomechanical function in both arthroscopic and open ligament repair [26]. These studies provide consistent consensus that an arthroscopic approach shows promising biomechanical abilities.

This study directly compares an open technique to a minimally invasive alternative. It should be considered that the open approach may allow access to the calcaneofibular ligament (CFL) for direct repair if the surgeon so desires. The All-Inside Broström technique described herein does not directly repair the CFL. In 2011, Nery reported the CFL ligament to be involved in approximately 15% of ankle inversion injuries [27]. In 2008, Lee et al. performed a cadaveric biomechanical study comparing stability of the modified Broström procedure with two variations [28]. Using radiographic measurements for varus tilting as well as anterior displacement distance they assessed a two ligament (ATFL & CFL) reconstruction group with a single ligament (ATFL) group involving advancement of the inferior extensor retinaculum in both groups. They found no significant difference between the two groups for either parameter of varus tilting or anterior displacement. For this reason, they advocated that the modified Broström procedure involving single ligament (ATFL) repair and advancement of the inferior retinaculum may be as stable as a two ligament repair. More recently in a clinical outcomes study, Lee et al. in 2011 reported long term outcomes for the modified Broström procedure [29]. In this technique, the CFL was not repaired and the length of follow up was a mean 10.6 years. Mean post-operative AOFAS score was 91. They reported that their objective assessment demonstrated integrity and good function of the lateral ankle complex. They also compared anterior translation and talar tilt angles and concluded the long term results of a modified Broström procedure without CFL repair were good to excellent when assessing subjective, functional and radiographic outcomes. Additionally, in 2013, Maffulli et al. reported on 38 athletes who had undergone the traditional open Broström ligament repair without addressing the CFL [30]. They demonstrated long term follow-up of an average of 8.7 (range 5–13) years and promoted a combined approach of which included ankle arthroscopy with an open Broström procedure. In their report, 6 (16%) patients considered their procedure to have failed. Overall, they reported excellent improvement in AOFAS and Kaikkonen scales. They stated that their results indicate it is not necessary to repair the CFL in primary procedures and such an approach may return patients to preinjury activity levels. It has been reported that the inferior extensor retinaculum (IER), which traverses from the calcaneus to the medial malleolus, may help to reinforce the same vector forces resisted by the CFL. This may be enhanced as the IER is further advanced and secured with bone anchors to the lateral malleolus such as is described in this technique.

Limitations to this study include its retrospective nature, along with a shorter follow up time for the AIB group. Additionally, we did not perform stress radiographs and functional outcomes were subjectively reported by the patient at final visit postoperatively for both pre and postoperative scores, thus limited by the patient's memory of their preoperative condition. Another shortcoming of this paper is the discrepancy between post-operative protocols however the protocols were different because the BG procedure required incision healing time whereas the AIB did not. Also, objective findings were noted by the authors wherein bias may influence outcomes. The BG group also had more concomitant procedures performed than the AIB group.

The All-Inside Broström technique offers patients a minimally invasive reconstruction alternative to the traditional Broström-Gould technique. This procedure is attractive in its convenience for simultaneously addressing intra-articular ankle joint pathology, confidence in allowing earlier time to weight bearing, potentially less chance of wound complications, and the ability to utilize bone anchors if desired. We did not see any adverse effects from not repairing the CFL in this study however longer term follow-up would be beneficial. We suggest with patient satisfaction scores similar to that of the open Broström-Gould that this technique is a viable option for chronic lateral ankle instability.

Conflict of interest

The authors declare that they have no conflict of interest.

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