MENTORS IN ORTHOPEDICS

OPEN VERSUS ARTHROSCOPIC REPAIR FOR CHRONIC LATERAL ANKLE INSTABILITY: A CRITICAL REVIEW AND DESCRIPTION OF ARTHROSCOPIC TECHNIQUES

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SUMMARY

Background: Ankle inversion injuries occur at a rate of 2.15 per 1000 person-years, frequently involving the anterior talofibular ligament (ATFL) and calcaneofibular ligament (CFL). While conservative management is effective for 80% of patients, the remaining 20% develop chronic lateral ankle instability (CLAI). The open Broström-Gould procedure remains the established surgical standard, yet arthroscopic techniques are increasingly utilized to minimize soft tissue morbidity and accelerate recovery.

Objective: This review evaluates the comparative efficacy, anatomical considerations, and technical methodologies of open versus arthroscopic lateral ligament repair for the management of CLAI.

Key Points: Anatomical studies indicate that the ATFL and CFL share a common fibular insertion, suggesting that ATFL tensioning may sufficiently stabilize the CFL without direct repair. The open Broström-Gould technique reinforces the repair using the inferior extensor retinaculum (IER), though the necessity of this modification is debated due to anatomical variations in IER morphology. Arthroscopic approaches, including all-inside and outside-in techniques, demonstrate biomechanical equivalence to open repair in cadaveric models. Clinical data suggest arthroscopic repair yields comparable functional outcomes, such as American Orthopaedic Foot and Ankle Society (AOFAS) scores, with potential advantages in surgical duration and time to weightbearing. However, some meta-analyses report higher complication rates, specifically superficial peroneal nerve paresthesia, associated with arthroscopic interventions.

Conclusion: Both open and arthroscopic Broström-Gould procedures are effective for treating CLAI. While arthroscopic repair offers a minimally invasive alternative with faster early recovery, further long-term randomized controlled trials are required to establish definitive superiority regarding complications and durable stability.

KEYWORDS

Ankle Joint; Joint Instability; Lateral Ligament, Ankle; Arthroscopy; Orthopedic Procedures

INTRODUCTION

Ankle inversion injuries are exceedingly common, with an incidence rate of 2.15 per 1000 person-year [1]. However, it has been reported that approximately 50% of patients that incur an ankle inversion injury seek medical attention [2]. Ligamentous disruption most commonly involves the anterior talofibular ligament (ATFL) and/or the calcaneofibular ligament (CFL) [3]. Conservative management is the first line of treatment and is successful in approximately 80% of patients [4]. However, the remaining 20% of patients may develop chronic symptoms leading to chronic lateral ankle instability and may require surgical treatment to achieve their pre-injury level of activity.

Surgical treatment can be broadly categorised into anatomic repair, nonanatomic repair, or reconstruction. More recently, an anatomic repair can further be achieved either by an open or arthroscopic technique. Nonanatomic repair includes a variety of techniques to stabilise the ankle joint by typically involving peroneus brevis tenodesis, a technique that sacrifices part of a main dynamic stabiliser of the ankle [5]. The concerns surrounding biomechanical malalignment [6,7], hindfoot stiffness, wound complication rates [8], and subsequent development of subtalar joint osteoarthritis [9] have rightly seen nonanatomic techniques decline in popularity over the past few years. However, nonanatomic repair may still be considered on rare occasions, such as the unstable ankle with considerable deformity where a robust lateral ligament repair is necessary, and concerns about loss of range of motion may be less [5].

The gold standard of surgical treatment for chronic lateral ankle instability remains the open Broström-Gould, an anatomic technique that is extremely successful when adequate local tissue is available for repair and normal hindfoot alignment is present [10]. The Broström-Gould is a modified technique of the original Broström technique that additionally reinforces the repaired lateral ligaments with the overlying inferior extensor retinaculum (IER) to strengthen ankle stability [11]. Arthroscopic and other minimally invasive approaches for the treatment of various conditions in the foot and ankle aim to reduce wound complications and potentially allow faster recovery without compromising outcomes have shown promise [12-14]. An arthroscopic application of the Broström-Gould technique has these theoretical advantages and is gaining popularity.

Several slightly different techniques have been described to date [15,16]. The comparative evidence of the open and arthroscopic Broström-Gould technique has been emerging, with modifications within the surgical technique itself. Specifically, the repair of the CFL may not be necessary for patients with concomitant ATFL and CFL injuries [5]. However, these studies have been limited in short- to medium-term follow-up. Therefore, further well-designed long-term clinical trials are warranted to provide more robust insight into the true treatment outcomes otherwise understood to be currently appropriate.

ANATOMY OF THE ANKLE LATERAL LIGAMENTS: IS THE REPAIR OF THE CFL NECESSARY?

ATFL rupture most commonly occurs at the attachment to the lateral malleolus (70%), followed by in the midsubstance (28%) and rarely at the attachment to the talus (2%) [3]. A common misconception perpetuated by incorrect anatomical illustrations in textbooks is that the ATFL and CFL are completely distinct ligaments. Cadaver studies have proven that the ATFL and CFL have a common insertion point into the lateral malleolus and

furthermore, there are connecting ligament fibres between the two ligaments distal to the fibular insertion [17,18]. The lateral talocalcaneal ligament is further involved in the ATFL and CFL connecting ligament structure. The clinical implication is notable because the repair of CFL may not be necessary as tensioning of the ATFL to the fibular insertion will, in most cases, necessarily tension the CFL.

Lee et al. indicated in a cadaver study that when the IER is advanced to the lateral malleolus, the IER follows the same vector as the CFL and may augment its function [19]. Notably, the strength of ATFL repair and advancement of the IER was comparable to the repair of both ligaments. In a case series with 10.6 years mean follow-up, Lee et al. further demonstrated that the Broström-Gould technique without CFL repair granted 28 of 30 (93.3%) patients return to pre-injury level activity [20]. At the final follow-up, the mean American Orthopaedic Foot and Ankle Society (AOFAS) score was 91. According to the Hamilton classification, 28 of these patients achieved good to excellent results, with the remaining two patients having fair results. Radiologically, mean anterior translation values at final follow-up were 6.9 and 6.1 mm on ipsilateral and contralateral sides, respectively. Talar tilt angles were 3.0° and 2.5° for ipsilateral and contralateral sides, respectively. However, Maffuli et al. reported that in 38 patients that underwent isolated ATFL repair for chronic lateral ankle instability in the mean follow-up of 8.7 years, eight and nine patients were classified to have failed the AOFAS and Kaikonnen score, respectively, according to the preoperative outcome criteria set [21]. Recurrent ankle instabilities were also observed in 6 patients.

THE GOLD STANDARD FOR ANKLE LATERAL LIGAMENT REPAIR: OPEN BROSTRÖM-GOULD

The open Broström-Gould procedure is considered to date the gold standard for the surgical treatment of chronic lateral ankle instability. Diagnostic arthroscopy with anteromedial and anterolateral portals is typically utilised prior to the open Broström to achieve complete visualisation of the joint and to deal with the commonly found additional pathologies such as soft tissue and bony impingement lesions as well as osteochondral lesions and loose bodies [22]. It is important to note that there have been variations in the surgical technique for the modified open Broström-Gould.

The current evidence to augment the Broström procedure by reinforcing the IER is mixed. Clinical trials have documented increased long-term stability of the ankle joint with good to excellent outcomes and low complication rates [20,23,24]. The efficacy of IER reinforcement may be different depending on whether the true IER or only the anterior part of the sural fascia is reconstructed as determined by the presence of the IER being morphologically a non-constant oblique superolateral band [25]. Theoretically, the presence of true IER has more consistent tissue mass and therefore, can provide greater ankle stability for reconstruction than sural fascia alone. Future anatomical studies are warranted to ascertain this.

Jeong et al. indicated in a prospective case series of 41 patients that underwent either the Broström procedure or the Broström-Gould procedure that IER reinforcement was only feasible in 31 patients (75.6%) and not feasible in the remaining ten patients (24.4%) due to anatomic variations [26]. Despite this, postoperative clinical and radiological outcomes did not significantly differ and therefore, the reinforcement of IER was not necessary to restore ankle stability. Behrens et al. similarly indicated in a biomechanical cadaver study that no significant difference in ankle stability was conferred by augmentation of the original Broström procedure by the Gould modification/IER reinforcement [27]. Therefore, the additional reinforcement of the IER must be reconsidered with its use currently approached cautiously. Further studies are warranted to determine the true clinical efficacy better and the need for the Gould modification.

A drawback of performing an open Broström-Gould procedure following an ankle arthroscopy is the extravasation of arthroscopic fluid into the soft tissues, especially if the arthroscopic procedure has been prolonged. Although this only rarely makes the subsequent open procedure impossible to perform, it does make the dissection more challenging and time-consuming for the surgeon. The approach of the Broström-Gould arthroscopically may negate this drawback.

ARTHROSCOPIC ANKLE LATERAL LIGAMENT REPAIR

The arthroscopic repair of the ankle lateral ligaments has been an increasingly popular approach as hastening of return to play has been evident with surgical insults minimised [5,15,28]. Suture anchors are again primarily utilised, comparable to the open Broström procedures described. The indications for arthroscopic repair are the in most occasions, the same as the indications as to the open repair. However, rarely in the case of primary subtalar instability, a formal open repair of the CFL may instead be recommended. Three arthroscopic techniques have been documented to date.

1. The arthroscopic-assisted technique

employs an accessory portal or an accessory incision for suture passage through the lateral ligamentous complex, and sutures are tied extracapsular [29].

2. All-arthroscopic repairs

involve suture passage under direct arthroscopic visualisation with no accessory ports and the suture tied extracapsular by either an “inside-out” technique or an “outside-in” technique. The all-arthroscopic repair technique has been the most employed and studied arthroscopic technique to date.

3. The all-inside arthroscopic techniques

also involve suture passage under direct visualisation, but the suture tied intracapsular. The biomechanical cadaver analysis that compared the torque failure, degrees to failure, and working construct stiffness between the open Broström-Gould and all-inside arthroscopic Broström-Gould indicated no significant differences between the procedures. The conclusion was that the all-inside arthroscopic technique is a valid alternative for the otherwise more invasive open precede [30].

TECHNIQUE OF ARTHROSCOPIC PROCEDURE

The patient is placed supine with the to be operated ankle elevated approximately 20cm above the contralateral ankle and the foot at the distal edge of the bed to allow full dorsiflexion [31]. Preoperative drawing of the “safe zone” based on superficial anatomic landmarks is performed. The “safe zone” marks the area between the superficial peroneal nerve (often seen using the fourth toe flexion sign) [32] and the peroneal tendons. The IER lies approximately a thumbs breadth distal to the lateral malleolus [33]. A regional popliteal block, a separate saphenous nerve block plus monitored anaesthesia care may be utilised [29], alternatively general anaesthesia with local anaesthetic infiltration of the portals and the joint after the procedure can be employed. If distraction is performed, the distraction must be reverted before the tightening ankle lateral ligaments.

Anteromedial and anterolateral arthroscopy portals are employed. The anteromedial arthroscope is introduced immediately lateral to the tibialis anterior tendon and it is further used to identify the correct position for the accessory anterolateral portal by transillumination of the skin [31]. Diagnostic arthroscopy is to be initially performed to identify further intraarticular pathologies before the principal ligament repair. Extensive debridement of the lateral gutter is essential to reduce impingement and allow adequate visualisation of the lateral ligament complex for straightforward repair [29].

A suture anchor is placed in the anatomical origin of the ATFL by the anterolateral portal [31]. The drill hole made approximately 7 mm distal to the lower edge of the anterior inferior talofibular ligament to allow the suture anchor to be inserted into this hole and exited through the anterolateral portal. A lasso-loop stitch is created using an 18G hollow needle with a 2-0 nylon thread placed through the anterolateral portal and into distal ATFL remnant. The needle is rotated several times one way and then in the opposite direction to enlarge the nylon loop and therefore, be retrieved and the needle is withdrawn. A loop of the suture created in the ATFL is achieved by passing one end of the suture anchor through the nylon loop, and then the nylon loop used to pull only the mid-portion of the suture anchor through the ATFL. The free end of the suture is then passed through this loop and tightened to create a self-clinching stitch, and the other end of the suture anchor is subsequently tightened. Square knot and granny knot are performed twice to complete the tightening using a knot pusher by turning to an axial thread. The ankle is then held in an everted position and posteriorly drawered for the remainder of the surgery to prevent premature loosening of the sutures. An internal brace can be added to the construct to provide additional stability.

The procedure can be converted to open if the surgeon deems adequate stabilisation of the ankle lateral ligaments were not achieved. For suspicion of peroneal tendon tears, an examination can be achieved either by a small incision over the tendons itself or a peroneal tendoscopy can be performed. Haemostasis is to be achieved, and the arthroscopic ports closed.

OUTCOME OF ARTHROSCOPIC PROCEDURE

The case series for arthroscopic ankle lateral ligament repair for ankle instability have been promising alone [24]. Yoo et al. demonstrated in a retrospective cohort study of 22 patients with an internal brace versus 63 without internal brace to augment the Broström repair in >6-month follow-up that patients with internal brace augmentation indicated a faster return to play [34]. Nery et al. reported in a case series of 38 patients that underwent the Broström-Gould procedure at a mean follow-up of 9.8 years, 94.7% of patients had good to excellent postoperative AOFAS scores, with two failure rates reported [35]. In Corte-Real & Moreira's case series of 28 patients that also underwent the Broström-Gould procedure at a mean follow-up of 24.5 months, improvement in AOFAS scores was achieved postoperatively [36]. However, a higher complication rate was observed in this case series with nine patients (29%), and three of these did not resolve (1 patient developed persistent superficial peroneal paraesthesia). Nery et al. also reported in a separate case series of 26 patients that specifically employed the "inside-out" Broström-Gould technique at a mean follow-up of 27 months, improvement in AOFAS score was similarly achieved, with only a single patient that experienced superficial peroneal nerve paraesthesia that resolved spontaneously [37].

Evidence is present to date to support both the open and arthroscopic approach to ankle ligament repair. The CFL is challenging to repair directly with an arthroscopic technique, with increased ease possible through a separate peroneal tendon sheath portal. Arthroscopic procedures can arguably be more technically demanding than the open procedure [28] and therefore, theoretically predispose higher complication rates.

In cadaver studies, no significant biomechanical differences have been found between the open and the arthroscopic Broström procedure in matched ankles [38,39]. Specifically, the degrees to failure, torque to failure, and hindfoot stiffness. In a randomised controlled trial that involved 25 patients that underwent the all-inside arthroscopic Broström-Gould procedure versus 23 patients that underwent the open Broström-Gould procedure, no differences in clinical or radiological outcomes at the final 1-year follow-up were present [10]. However, this finding may have been statistically underpowered. Rigby & Cottom indicated in a retrospective cohort study that involved 32 patients of the open Broström-Gould procedure versus 30 patients of the arthroscopic Broström-Gould procedure, statistical insignificances were identified in all functional and patient satisfaction outcome scores between procedures [40]. The mean follow-up in the open Broström-Gould arm was 3.7 years, and in the arthroscopic Broström-Gould arm was 1.3 years. In a retrospective cohort study that involved 19 patients treated with the open Broström-Gould versus 18 patients treated with the arthroscopic Broström-Gould, significantly shorter surgical duration and faster postoperative recovery with the arthroscopic procedure were observed [11]. However, statistical insignificance in both the baseline to follow-up and between arms of the Japanese Society for Surgery of the Foot ankle-hindfoot scores were revealed.

The evidence to support the arthroscopic repair of the ankle lateral ligaments has been insufficient, as per indicated by a systematic review by Matsui et al. [18]. Matsui et al. indicated that in 33 studies on minimally invasive surgical treatment for chronic ankle instability, the highest recommendation was Grade C (poor quality of evidence) to support the arthroscopic repair for the lateral ankle ligaments. In a separate systematic review by Guelfi et al., excellent efficacy of both the open and arthroscopic ankle lateral ligament repair procedures was indicated instead [41]. Higher complication rates were observed in the arthroscopic compared to the open procedures. However, this did not appear to affect the patient's satisfaction. The statistical heterogeneity of the systematic review observed limited definitive conclusions to be drawn. Brown et al. reported in a meta-analysis of four studies that AOFAS functional outcome scores were significantly superior in the arthroscopic arm compared to the open repair arm in the minimum follow-up of 12 months [42]. However, no significant differences were seen between the arthroscopic and open repair arm in regards to Karlsson functional outcome scores and complication rates. In addition, there were no differences in superficial peroneal nerve injury or wound complication rates.

Further studies are required to prove that the arthroscopic approach to lateral ligament repair is equivalent or superior to the open approach. These studies are ongoing, including a randomised controlled trial by the authors with 33 patients in each of the open and arthroscopic Broström-Gould treatment arms. Improvement in the mean AOFAS, identification of Function Ankle Instability (IdFAI), and Karlsson scores have been seen from baseline to the 2-year follow-up. Statistical significance in all outcome scores was also found between arms at baseline and the 2-year follow-up. The mean AOFAS score in both arms at the 2-year follow-up has been a perfect score of 100 out of 100. The arthroscopic approach appeared comparable to the open Broström-Gould with the added advantage of an earlier time to weightbearing.

TAKE-HOME MESSAGES

Ankle inversion injuries are extremely prevalent and therefore, the optimal treatment option is a research area of paramount importance [1,43,44]. The gold standard of surgical treatment for chronic lateral ankle instability remains the open Broström-Gould. However, several alterations to provide safer and augmented surgical outcomes for the Broström-Gould procedure are ongoing to date. The repair of the CFL does not appear necessary in most cases. The ATFL is relatively straightforward to assess arthroscopically. The evidence of the optimal surgical measure between the open and arthroscopic repair for chronic lateral ankle instability has been mixed to date. Further research is ongoing with the arthroscopic techniques generally appearing safe and effective

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