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AMERICAN ORTHOPAEDIC FOOT & ANKLE SOCIETY®

Foot & Ankle Orthopaedics
2020, Vol. 5(3) 1-5

DOI: 10.1177/2473011420934735
journals.sagepub.com/home/fao

Effect of Periosteal Flap Augmentation on Outcomes of Modified Broström-Gould Procedure for Chronic Lateral Ankle Instability

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Abstract

Background: Chronic lateral ankle instability is relatively common after ankle sprains. The modified Broström-Gould procedure (MBG) is the gold standard operative treatment but has a known failure rate of up to 10%, or even more in high-risk groups. Periosteal flap augmentation (PFA) has been proposed to strengthen the repair. This study aimed to compare the outcomes of MBG with and without PFA.

Methods: A matched-pair study was performed based on prospectively collected registry data for all patients undergoing lateral ankle ligament reconstruction in a tertiary institution. Patients who underwent the MBG with PFA were matched in a 1:1 ratio with patients undergoing MBG alone, based on age, gender, and body mass index (BMI). Patients with generalized ligamentous laxity or obesity were excluded. Clinical outcome scores were compared preoperatively and 2 years postoperatively. A total of 48 patients were included in the study (24 in each group). The mean age was 24.1 years, mean BMI was 23.1, and all patients were male. The baseline demographics and clinical scores in both groups were similar.

Results: At 2 years postoperatively, both groups demonstrated significantly improved AOFAS Ankle-Hindfoot scores ($P < .001$), but there were no between-group differences in total AOFAS scores (PFA score 90, MBG score 88, $P = .79$). There were no recurrences of instability or revision surgeries.

Conclusion: Routine PFA did not improve the outcomes of MBG for chronic lateral ankle instability in the absence of risk factors for failure. Further studies are warranted to determine if there is a long-term benefit for augmentation in this population.

Level of Evidence: Level III, retrospective comparative study.

Keywords: reconstruction, sports, ankle, ligament, repair

Introduction

Chronic lateral ankle instability is a common affliction, occurring after up to 20% of ankle sprains.[1,6,10,11] This may be due to inadequate healing of the torn ligaments, healing in an elongated and thus incompetent state, persistent proprioceptive deficits, or peroneal muscle weakness.[18,19] Conservative management remains the mainstay of treatment. However, when this fails, surgery is indicated. Multiple operative techniques have been described in the literature, but anatomic reconstruction using the modified Broström-Gould (BG) technique remains the gold standard.[15] The BG procedure involves shortening and imbrication of the damaged anterior talofibular ligament (ATFL), followed by mobilization of the inferior extensor retinaculum and suturing it to the distal fibula, over the repair, to reinforce it.[5,14]

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Although largely successful, several shortcomings have been noted. Over time, the reconstructed ligaments may gradually lengthen, resulting in insufficiency. Certain risk factors such as obesity, ligamentous laxity, or high-demand athletes may also predispose to poorer outcomes.[16-18,20] Even in the absence of risk factors, a significant minority of up to 10% may experience recurrence of instability.[14,19,22] The patients undergoing surgery are typically young and active, and in view of the long-term consequences of chronic lateral ankle instability, it is of significant interest to minimize this failure rate. In light of the above, various authors have attempted to augment this repair. The senior author of this study has previously described a technique of periosteal flap augmentation of the Broström-Gould procedure, with a case series showing good outcomes.[8] This study is a follow-up on the previous case series. It aimed to compare the outcomes of periosteal flap augmentation with a standard modified BG procedure for patients with chronic lateral ankle instability. The hypothesis was that periosteal flap augmentation would result in better outcomes.

Methods

This study was approved by the institutional review board (IRB). Informed consent was obtained from all patients in the study.

We reviewed prospectively collected registry data for all patients who underwent lateral ankle ligament reconstruction by the senior author for chronic lateral ankle instability between 2012 and 2015 at a tertiary institution. The indications for surgery were based on patient's symptoms of persistent pain or ankle instability, with examination findings of local tenderness over the anterolateral aspect of the affected ankle, a positive anterior drawer test or a positive talar tilt test, and have attempted conservative therapy for at least 3 months with unsatisfactory outcomes. The exclusion criteria were as follows: previous ankle fracture, previous ankle surgery, or generalized ligamentous laxity as determined by a Beighton score of at least 4.[2]

Patients who underwent the periosteal flap augmentation (PFA group) were then matched by age, gender, and body mass index (BMI) in a 1:1 ratio to patients who underwent the BG procedure (BG group). The 2 groups were compared for demographic data and clinical outcomes.

A total of 24 consecutive patients underwent the periosteal flap augmented procedure and were matched with 24 patients who underwent the BG procedure. The baseline demographic data were comparable between the 2 groups (Table 1). The mean follow-up duration was 28.7 months.

The surgeries were all performed by the senior author, a fellowship-trained sports surgeon with more than 15 years of experience with the procedure. It was routine practice to perform BG alone without PFA up until the end of 2013. Subsequently, all surgeries were routinely performed with PFA. Preoperative and postoperative care were standardized.

Table 1. Baseline Demographic Data of Patients.

	PFA Group (n = 24)	BG Group (n = 24)	*P* Value
Gender, n (%)			
Male	24 (100.0)	24 (100.0)	>.99
Female	0 (0.0)	0 (0.0)	
Body mass index, mean ± SD	23.1 ± 2.5	23.0 ± 2.7	.81
Age, mean ± SD	24.1 ± 6.1	24.2 ± 6.3	.80

Abbreviations: BG, Broström-Gould; PFA, periosteal flap augmentation.

Operative Procedure

The operative procedure has been described in a previous study by the same senior author but will be included in full below for completeness.[8]

A 4- to 5-cm curvilinear incision was made about 5 mm distal to the distal fibular tip extending across the body of the ATFL. This allows both exposure to the ATFL and access to create the periosteal flap from the distal fibula. A rectangular periosteal flap, measuring about 3 cm by 1 cm was then elevated from proximal to distal, but it remained attached to the fibula distally. The inferior extensor retinaculum was dissected from the underlying capsule and ligaments and the intracapsular ATFL was incised, exposing the ankle joint, and a midbody section of the ligament was then removed. With the ankle held in a slightly dorsiflexed and everted position, the ATFL was repaired with nonabsorbable Ethibond 2-0 suture (Ethicon; Johnson and Johnson, Cincinnati, OH). Following this, the inferior extensor retinaculum was identified, mobilized, and imbricated with Ethibond 2-0 sutures superficial to the repair. The periosteal flap was then flipped distally so that it covered the repair and secured at its 2 distal edges by mattress sutures using Ethibond 2-0 nonabsorbable sutures. Gentle anterior drawer test was then performed to ensure ankle stability. The standard form of the modified Broström-Gould procedure was performed in an identical fashion, except for the omission of the periosteal flap component of the repair.

Postoperatively, the ankle was immobilized in a well-padded cast, in a neutral position with slight eversion and the patient was kept non-weight-bearing. After 2 weeks, the stitches were removed and the ankle was placed in a long walking boot (Aircast, Summit, NJ) for 6 weeks and the patient was allowed to bear weight as tolerated. The patient was also started on a physiotherapy regime consisting of ankle and subtalar range of motion exercises, peroneal muscle strengthening and proprioceptive training via balance board training. After 3 months, return to sports was allowed with the use of ankle braces for at least another 6 months.

Clinical outcomes were assessed using the American Orthopaedic Foot & Ankle Society (AOFAS) ankle and hindfoot score.[21] These assessments were performed independently by a blinded physical therapist preoperatively as well as 2 years postoperatively.

Table 2. Analysis of AOFAS Total and Component Scores.[a]

	PFA Group (n = 24)	BG Group (n = 24)	*P* value
Initial preoperative total AOFAS score	67 (57-77)	67 (57-76)	.71
Two-year postoperative total AOFAS score	90 (66-100)	88 (53-100)	.79
Difference between preoperative and postoperative scores			
Total AOFAS score	23 (−3 to 34)	23 (−16 to 33)	.81
Score component: Pain	10 (0-20)	15 (0-20)	.48
Score component: Function	3 (0-3)	3 (0-6)	.44
Score component: Maximum walking distance	0 (–1 to 1)	0 (–1 to 1)	.48
Score component: Walking surfaces	**0 (0-5)**	**0 (–2 to 2)**	**<.05**
Score component: Gait Abnormality	0 (0-0)	0 (0-0)	N.A.
Score component: Sagittal motion	0 (–4 to 0)	0 (–4 to 0)	.16
Score component: Hindfoot motion	0 (–3 to 5)	0 (–3 to 0)	.25
Score component: Hindfoot stability	8 (0-8)	8 (0-8)	.71
Score component: Alignment	0 (0-2)	0 (0-2)	.56

Abbreviations: AOFAS, American Orthopaedic Foot & Ankle Society; BG, Broström-Gould; PFA, periosteal flap augmentation.
[a]Bold indicates statistical significance. All scores shown as median (range).

Statistical Analysis

Statistical analysis was performed with IBM SPSS Statistics version 21 (IBM, Armonk, NY). Continuous variables were analyzed for normality using the Shapiro-Wilk test. Normally distributed variables were analyzed using parametric tests; otherwise nonparametric tests were used. A *P* value of <.05 was taken as significant.

Power analysis was performed using G* Power version 3.1.9.2 (Universität Düsseldorf, Germany). Using an estimated minimal clinically important difference (MCID) of 9 points for the AOFAS Ankle-Hindfoot score[9] to determine effect size, this study achieved a power of 93% with an alpha error probability of .05.

Results

There was a significant improvement in AOFAS scores in both groups from preoperatively to postoperatively ($P < .001$), with no between-group differences in terms of overall AOFAS score at either time point. The magnitude of change in overall AOFAS score in each group was also similar. However, when broken down into individual scoring components, a difference was seen in the "walking surfaces" component of the score, with the PFA group having slightly superior improvement postoperatively ($P < .05$). The remainder of the score components improved similarly in both groups (Table 2).

There were no recurrences of instability or revision surgeries within the 2-year follow-up period in both groups.

Discussion

This study demonstrated no overall difference in clinical outcomes between periosteal flap augmentation and a standard Broström-Gould procedure for chronic lateral ankle instability. Although there was a statistically significant difference in one of the subcomponents of the score, it was of questionable clinical significance. The Broström-Gould procedure has been described as the gold standard for operative management of chronic lateral ankle instability because of its high success rate of approximately 90%.[14,19,22] Nonetheless, there remain a significant minority of patients (about 10%) who experience recurrence of instability or failure of the repair, even in the absence of risk factors such as obesity, ligamentous laxity, or high physical demand. Augmentation of the Broström-Gould procedure was initially introduced to ameliorate the aforementioned risk factors for failure. Various techniques including the use of suture anchors, part of the peroneus brevis tendon, or a distal fibula periosteal flap have been described.[12,13,23,25]

The periosteal flap augmentation technique has since been used by several other authors with good outcomes.[3,7,8,24-26] The purported benefits include the use of a small incision, avoidance of a foreign implant with its attendant risks and costs, and preservation of local tendons. At the same time, it retains the benefits of an anatomic repair with near-normal kinematics.[8,25] However, none of the previous studies compared periosteal flap augmentation with an unaugmented Broström-Gould procedure. This is likely because many authors consider augmentation only in patients with risk factors, for whom the Broström-Gould procedure would be contraindicated due to an assumed increased failure rate. In our study, the periosteal flap augmentation was performed routinely as a modification of the surgeon's standard technique as it has minimal morbidity with the potential benefits of improved outcomes because of both biological and mechanical reasons. The periosteal flap has been shown to be biomechanically as strong as the native ATFL, and histologically it behaves in vivo as a scaffold for the formation of fibroblastic tissue and differentiation into ligament.[4,25] Despite this, our study demonstrated that there was no improvement in overall outcomes when compared to a matched control group, in a standard population with no risk factors. We postulate that in this group of

patients, the modified Broström-Gould procedure provided sufficient stability in the absence of extenuating circumstances. The addition of the periosteal flap did not provide a clinically significant benefit within the time frame of the study. It remains possible that in longer-term studies, the periosteal flap augmentation may prevent recurrence of instability that occurs as the repaired ligament elongates and stretches out over time.

The strengths of this study include the use of registry data, robust data collection by independent physical therapists, and a single-surgeon series, thus reducing confounding surgeon factors. It has its limitations as well. It is a retrospective study with inherent selection bias, although this was minimized because of the consecutive nature of patients and matching of a control group. The sample size, although small, is adequately powered for the outcome measure. The use of the AOFAS scale is also controversial, although a majority of studies on lateral ankle instability still use it, hence it remains useful as a point of comparison.[27] There is also a lack of data on complications beyond recurrence and reoperation. The relatively short follow-up duration also precludes us from drawing conclusions about the technique's potential long-term benefit.

Conclusion

In conclusion, this study demonstrates that routine periosteal flap augmentation did not improve the outcomes of the modified Broström-Gould procedure for chronic lateral ankle instability in the absence of risk factors for failure. Studies with longer follow-up are warranted to determine if there is a long-term benefit for augmentation in this population. Future studies may also focus on high-risk populations that may have greater benefits from augmentation.

Ethics Approval

Ethical approval for this study was obtained from Singhealth Institutional Review Board (CIRB Ref: 2012/1029/D).

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. ICMJE forms for all authors are available online.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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