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Original Article

Arthroscopic Brostrom technique: clinical and functional results

Thiago Penido Moreira Ferreira[1], Mateus Martins Marcatti[1,2], Fabrício Melo Bertolini[1], Otaviano de Oliveira Junior[1,2], Gustavo Araújo Nunes[2,3]

1. Hospital Universitário Ciências Médicas (FCMMG), Belo Horizonte, MG, Brazil.
2. Instituto Orizonti, Belo Horizonte, MG, Brazil.
3. Grecmip MIFAS (Group of Research and Study in Minimally Invasive Surgery of the Foot – Minimally Invasive Foot and Ankle Society), Belo Horizonte, MG, Brazil.

Abstract

Objective: To present the clinical and functional results of surgical treatment of patients with chronic instability of the ankle using the arthroscopic Brostrom technique.

Methods: This is a case series of patients who underwent surgical treatment for chronic instability of the lateral ligament of the ankle using the arthroscopic Brostrom technique. Clinical assessments of ankle stability were performed preoperatively and at the last follow-up using the American Orthopedic Foot and Ankle Score (AOFAS), a visual analog scale (VAS) for pain, and the anterior drawer and talar inversion tilt tests. Surgical complications and patient satisfaction ratings were also analyzed.

Results: A total of 16 patients were analyzed, with a mean follow-up of 14 months. There was a statistically significant ($p<0.001$) improvement in mean AOFAS, which increased from 67.2 to 90.8 points and the mean VAS for pain score reduced from 6.5 to 1.5 points. All ankles were stable and had normal results for the anterior drawer test and the talar inversion tilt test. Three patients (19%) reported that resumption of sporting activities provoked subjective pain in the ankle, which improved progressively during follow-up. Two patients (12.5%) exhibited neurapraxia of the superficial peroneal nerve. A majority of the patients (81%) rated treatment as good or excellent.

Conclusion: Treatment of chronic instability of the ankle ligament using the arthroscopic Brostrom technique restored ankle stability and achieved good clinical results. There was a high rate of early complications, but the majority were transitory and underwent complete remission during follow-up.

Level of Evidence IV; Therapeutic Studies; Case Series.

Keywords: Joint instability; Ankle; Arthroscopy.

Introduction

Ankle ligament injuries are among the most common causes of orthopedic consultations. They account for around 25% of all musculoskeletal system injuries[1,2]. They most frequently affect young patients, who regularly engage in physical activities. These injuries occur when the ankle is sprained in supination, inversion, and plantar flexion. The ligaments most often injured are the anterior talofibular ligament (ATFL), in 80% of cases, and the calcaneofibular ligament (CFL), in 15%[3-5].

In general, excellent results are achieved with conservative treatment, primarily consisting of functional rehabilitation with support and early mobilization. However, approximately 20% of these injuries may develop instability refractory to non-surgical treatment, and remain painful, swollen, and prone to instability and recurrent sprains[3,6]. In cases of residual instability, surgical repair of the ligaments should be considered[7-9].

Several surgical techniques have been proposed for management of chronic lateral instability of the ankle[10-14] and,

Study performed at the Hospital Universitário Ciências Médicas (FCMMG), Belo Horizonte, MG, Brazil.

Correspondence: Gustavo Araujo Nunes. 111 Prof. Otavio Coelho de Magalhaes St., Mangabeiras, Zip Code: 30210-300, Belo Horizonte, MG, Brazil. **E-mail:** gustavoanunes@hotmail.com. **Conflicts of interest:** none. **Source of funding:** none. **Date received:** March 31, 2020. **Date accepted:** June 27, 2020. **Online:** April 30, 2020.

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even after many years, the open Brostrom-Gould technique is considered the gold standard for treatment of this pathology[15,16]. With the advent of ankle arthroscopy, offering benefits such as lower surgical morbidity, early return to normal and sporting activities, and the ability to assess and treat intraarticular pathologies[17], several authors have developed a technique for lateral ligament repair assisted by arthroscopy in a single percutaneous stage[3,5,7]. This technique, known as arthroscopic Brostrom repair, attempts to stabilize the ankle by placing anchors in the fibula under arthroscopic guidance and passing the sutures percutaneously under the lateral ligament and the inferior extensor retinaculum (IER)[5].

Although several different studies have described excellent clinical results with this technique, a high rate of complications (5.3% to 29%) has been reported, primarily with relation to nerve damage and prominent implants[4,5,7,8].

The objective of this article is to present the clinical and functional results of patients with chronic ligament instability treated with the arthroscopic Brostrom technique.

METHODS

This study was approved by the Institutional Review Board and registered on the Plataforma Brazil database under CAAE (Ethics Evaluation Submission Certificate) (86807618.9.0000.5122). All patients signed a free and informed consent form to be included in the study.

This is a retrospective study that assessed 16 patients, six men and ten women with diagnoses of chronic instability of the ankle, who were treated surgically using the arthroscopic Brostrom technique between August 2016 and November 2018 and followed-up for a mean of 14 months (range: 12 to 18 months).

Clinical assessments of ankle stability were conducted preoperatively and at the last follow-up consultation using the anterior drawer and inversion tilt tests. These tests were always conducted on the basis of comparison and were considered positive when there was greater anterior excursion of the talus in the drawer test and greater inversion in the talar tilt test, when compared with the contralateral ankle.

All ankle X-rays in anteroposterior view and anteroposterior with 20 degree internal and lateral rotation were normal in all patients. No X-rays with manual stress were taken. Magnetic resonance showed chronic anterior talofibular ligament injury in all patients.

The inclusion criteria for the study were adult patients with diagnoses of chronic ankle ligament instability with no improvement after 6 months of conservative treatment using orthopedic ortheses, analgesics, and functional physiotherapy and rehabilitation. A diagnosis of instability was defined as patients with recurrent ankle sprains combined with pain, swelling, and insecurity to perform sporting activities, positive drawer and inversion tilt tests, and ligament injuries seen on magnetic resonance. Patients were excluded from the study if they had additional injuries found on clinical examination or magnetic resonance that needed other surgical procedures, such as: osteochondral talus lesion, peroneal tendon injury or pes cavovarus. Patients were also excluded if they had prior surgery, deformities, hypermobility syndromes, collagen diseases, or neuromuscular diseases.

The American Orthopedic Foot and Ankle Score for the hindfoot and ankle (AOFAS)[18] and a visual analog scale (VAS) for pain[19] were administered preoperatively and at the last follow-up consultation. Surgical complications were assessed and recorded during follow-up. Patients' satisfaction with treatment was assessed using the classification described by Coughlin[20] and recorded.

Normality of data distribution was assessed using the Kolmogorov-Smirnov test. Since it exhibited normal distribution, statistical analysis was conducted using the *t* test for paired samples to compare means before and after intervention.

Surgical technique

The patient, under spinal anesthesia and sedation, is placed on the operating table in supine decubitus with a bump under the ipsilateral buttock.

Anatomic landmarks are marked out to ensure risk structures were avoided when establishing arthroscopy portals and a "safety zone" is marked out on the lateral part of the ankle, and a safety zone is market out on the lateral part of the ankle, including the distal fibula, the superior margin of the peroneal tendons, and the intermediate branch of the superficial peroneal nerve . The inferior extensor retinaculum is marked 1.5 cm from the distal fibula (Figure 1).

The traditional ankle arthroscopy portals are made (anteromedial and anterolateral). No manual distraction is performed.

The ankle joint is inventoried to assess presence of injuries.

Exploration of the lateral groove, with debridement of the anterior inferior tibiofibular ligament (AITL, Bassett's ligament). We use this ligament as an anatomic landmark to locate the "footprint" of the ATFL on the fibula. We attempt to identify and obtain a good view of the ATFL, to preserve it during exposure of the anterior margin of the fibula.

Figure 1. Safety zone marked out on the anterolateral aspect of the ankle

Via the anterolateral portal, the first 3.5mm metallic anchor is inserted, 1 cm above the point of the lateral malleolus. Maintaining the ankle in neutral dorsiflexion and slight eversion, with the aid of a long needle (Suture-lasso, Arthrex®, Naples, United States), sutures are threaded separately from the anterolateral portal to the previously marked extensor retinaculum, exiting through the most inferior region of the safety zone, spaced at a distance of approximately 1.0 cm (Figure 2 A and B).

The second anchor is inserted 0.5 to 1.0 cm above the first (close below the talar dome) and its sutures are threaded in a similar manner, but exiting through the most superior region of the safety zone. (Figure 3 A, B). A final arthroscopic inventory is performed to check that the sutures had not become entangled internally.

Two small incisions are made, between the exit holes of each suture, which are paired and tied together. Two arthroscopic knots are made with the ankle in neutral dorsiflexion and slight eversion, re-tensioning the ligament structures, capsule, and extensor retinaculum.

Postoperative

During the first week, patients did not put weight on the foot and wore an orthopedic boot to maintain the ankle in a neutral position. During the second and third week, they were allowed to partially load the ankle, with support from crutches. From the fourth week on, patients substituted the boot with a semi-rigid orthosis and started a physiotherapy rehabilitation program.

Patients stopped wearing the orthoses in the sixth week, but continued their physiotherapy rehabilitation programs.

RESULTS

In this study, 16 patients with diagnoses of chronic instability of the ankle were treated surgically using the arthroscopic Brostrom technique.

There was a statistically significant ($p<0.001$) improvement in mean AOFAS, from 67 points at baseline to 90 points during the postoperative period, and in the mean VAS for pain score from 6 points at baseline to 2 points during the postoperative period (Table 1). All of the ankles were stable with normal anterior drawer test and talar tilt inversion test results.

With regard to complications, two patients (12.5%) exhibited neurapraxia of the superficial peroneal nerve. After drug-based clinical treatment, one patient had full resolution of the condition while the other only achieved partial recovery. There were no cases of infection or of recurrence of instability.

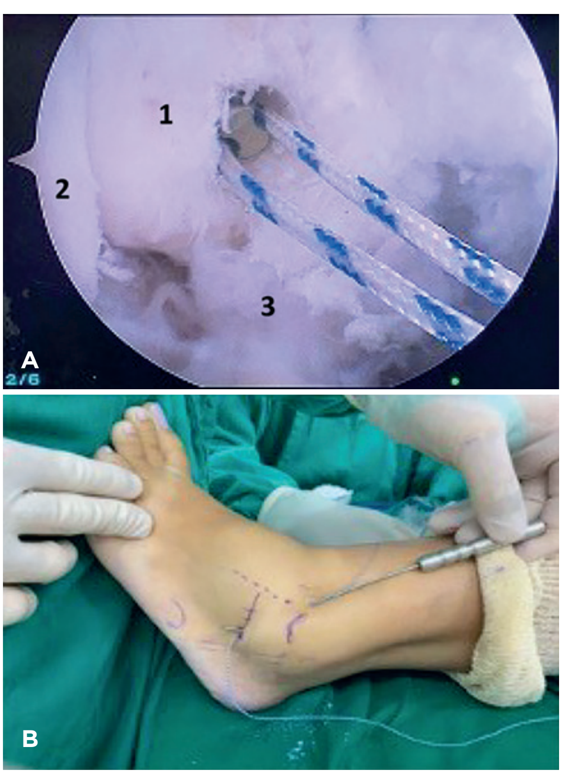

Figure 2. (A) First anchor arthroscopically inserted into the lateral malleolus (1) Distal fibula (2) Lateral wall of the talus (3) Anterior talofibular ligament. (B) Sutures passed percutaneously

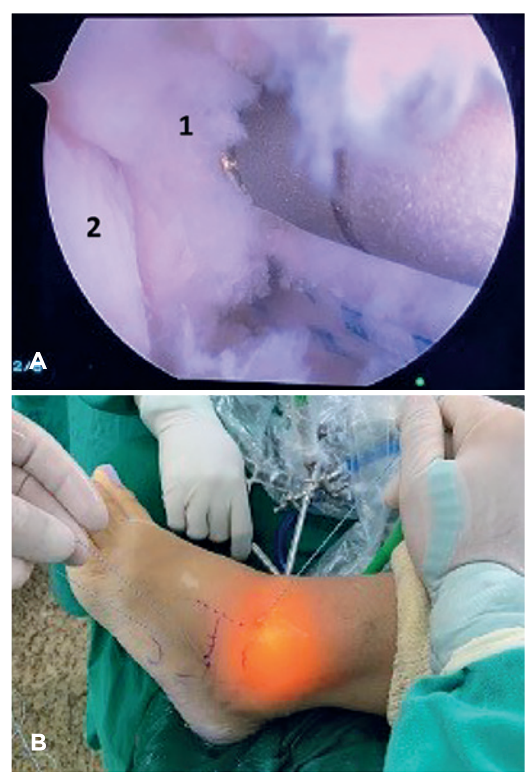

Figure 3. (A) Second anchor arthroscopically inserted into the lateral malleolus (1) Distal fibula (2) Lateral wall of the talus. (B) Sutures passed percutaneously

Table 1. Pre- and postoperative data

Patients	Age (years)	Sex	Follow-up (months)	Preop. vas	Postop. vas	Preop. aofas	Postop. aofas	Satisfaction	Complication
1	37	M	12	5	2	72	93	Good	No
2	42	F	14	5	3	76	89	Good	No
3	26	F	12	8	5	75	79	Regular	Transitory pain
4	28	F	16	5	1	72	95	Excellent	Transitory pain
5	21	M	18	5	0	84	100	Excellent	No
6	35	F	13	6	2	81	97	Excellent	No
7	18	M	18	3	0	95	100	Excellent	No
8	39	F	12	6	2	71	96	Excellent	No
9	46	M	14	7	1	45	79	Regular	Transitory pain
10	37	F	17	9	2	62	94	Excellent	No
11	36	M	14	8	1	49	86	Good	Neurapraxia
12	40	F	16	7	2	47	78	Regular	Neurapraxia
13	32	M	15	6	2	64	87	Excellent	No
14	38	F	15	8	3	63	86	Excellent	No
15	24	F	13	8	2	58	100	Excellent	No
16	36	F	12	8	2	68	94	Excellent	No
Mean	33		14	6,5	1,8	67,2	90,8		

Preop. vas: (Preoperative visual analog scale for pain); Postop. vas: (Postoperative visual analog scale for pain); Preop. aofas: (Preoperative American Orthopedic Foot and Ankle Score); Postop. aofas: (Postoperative American Orthopedic Foot and Ankle Score).

During their return to sporting activities, approximately 4 months after surgery, three patients (19%) reported subjective discomfort in the ankle when running. Clinical examination revealed that the discomfort occurred during plantar flexion. There was also discrete reduction in plantar flexion in the operated ankle compared with the contralateral ankle. This difference in amplitude was detected during the lateral inspection when performing maximum active plantar flexion of both ankles. Flexion was performed with the patient seated, maintaining the knee flexed at 90 degrees and the lower extremities hanging over the edge of the examination table. These patients needed an additional period of physiotherapy lasting approximately 3 months, delaying their return to usual sporting activities (road running), which occurred uneventfully after this period. These complaints were considered early and transitory complications, because the patients exhibited complete remission of symptoms over the course of follow-up.

Assessment of subjective satisfaction with treatment showed that 13 patients (81%) classified the result as excellent or good, and another three (19%) as regular. Two of the patients who rated the treatment as regular had complained of subjective discomfort in the ankle during sporting activities and the third had complained of neurapraxia, which only improved partially. There was no need to reoperate on any of the patients before the end of the follow-up period.

Discussion

In this study, surgical treatment of chronic ankle ligament instability performed using the arthroscopic Brostrom technique achieved good clinical results in terms of a reduction in VAS for pain scores from 6.5 to 1.8 points and improved AOFAS from 67.2 to 90.5 points and was effective for reestablishing ankle stability. There were no recurrence or need for surgical reintervention. There was an elevated rate of early complications (31.5%), but they were transitory and the majority progressed to complete remission during follow-up.

Ligament repair using the Brostrom technique via arthroscopy has been described before, with similar results to our study[7,9,10]. In a case series with 40 patients, Cottom and Rigby observed an improvement in AOFAS from 41.2 to 95.4 points and VAS improved from 8.2 to 1.1 points, with no cases of relapse[10]. Similarly, Acevedo and Mangone reported a high rate of satisfaction and a low rate of recurrence in a case series with 73 patients and mean follow-up of 28 months[21]. Although some studies have demonstrated excellent results and low recurrence rates employing just a single anchor and two suture threads with this technique[3,7], Feng et al. reported that using two anchors produced better results[22], which is why the authors opted for two anchors in this study.

During their return to sporting activities, approximately 4 months after surgery three patients (19%) in this series reported subjective pain and discomfort in the ankle when running. It is worth mentioning that although these patients achieved complete remission of symptoms during follow-up, this complaint delayed their return to running and had a negative impact on their satisfaction with the treatment. During clinical examination, it was found that the discomfort was triggered during plantar flexion of the ankle. It was also found that there was a slight reduction in the amplitude of plantar flexion of the operated ankle compared to the contralateral ankle during maximum active plantar flexion of both ankles. Since the difference in the amplitude of movement was discrete, it was not detected objectively. Moreover, methods for assessment of the amplitude of ankle movement are still considered imprecise, particularly those used to measure plantar flexion[22,23]. This finding was only considered of importance by the authors because it was accompanied by pain, since it is normal that there is some degree of restriction of movement in an ankle that has undergone ligament repair[11]. Considering that all of the patients in the study followed the same postoperative rehabilitation protocol, the authors hypothesize that this may have taken place because the arthroscopic Brostrom-Gould technique does not result in a fully anatomic ligament repair. The technique tensions the ligament and the same suture takes in the capsule, the retinaculum, and the sural fascia, creating a large fibrosis at the lateral groove of the ankle. The suture also pierces the capsule at several points, resulting in a large plication. It is likely that the additional period of physiotherapy needed by patients who reported this discomfort was necessary to release the fibrosis generated at the lateral groove of the ankle.

Another complication was neurapraxia of the fibular nerve, observed in two patients (12.5%). Other studies have reported similar rates of this neurological complication[5,7,12]. A 15% rate of neurapraxia of the superficial peroneal nerve was observed in a case series described by Pellegrini et al. Although this is an elevated rate, patients improved over the course of follow-up[12]. Studies by Acevedo et al.[5] and Corte-Real et al.[7] observed 6.8% and 10.7 % respectively. A safety zone has been defined to protect anatomic structures in the lateral part of the ankle during suturing and it is essential to be able to visualize the superficial peroneal nerve in order to draw this zone[5]. However, as has been described elsewhere in the literature[24], we encountered difficulty with visualizing this nerve in patients with high body mass index and elevated quantities of subcutaneous fat. The plantar flexion inversion maneuver may create a false sense of security in these cases, because the location of the peroneal nerve changes with the different positions of the ankle. The nerve moves approximately 2.4 mm laterally when the ankle is displaced from plantar flexion in inversion to a neutral position or dorsiflexion[24,25]. Another hypothesis for the cause of this neurological complication comes from an anatomic study by Daumau-Pastor et al. They describe the IER as aponeurotic tissue that is contiguous with the sural fascia and has imprecise limits, so, when we traction this structure we are also indirectly tractioning the sural fascia and the superficial fibular nerve[26].

Our study presents the results of surgical treatment of chronic ankle ligament instability using the arthroscopic Brostrom Gould technique, with results and late complications rates compatible with current literature[7,9,10,12]. We report an early complication rate (31.5%) higher than in the current literature, which we believe that can be result of measurement bias, with more stringent criteria for detection of complications.

One limitation of this study is that the AOFAS is not a validated scale for results to assess ankle instability and, consequently, certain clinical features could have been ignored[27]. A clinical score specifically for assessing ankle instability would have enhanced the study's validity. Other limitations include the absence of a control group, and a mean follow-up time considered short for assessment of certain complications, in particular relapse of instability, in addition to failure to measure the amplitude of ankle movement in all of the cases operated.

Conclusion

Treatment of chronic ankle ligament instability using the arthroscopic Brostrom technique effectively restored ankle stability and achieved good clinical results according to the improvements in AOFAS and VAS pain scores. There was a high rate of early complications, but the majority of them were transitory, with complete remission was achieved during follow-up.

Authors' contributions: Each author contributed individually and significantly to the development of this article: TPMF *(https://orcid.org/0000-0003-4835-7618) wrote the article, interpreted the results of the study; MMM *(https://orcid.org/0000-0002-6963-5704) wrote the article, interpreted the results of the study; FMB *(https://orcid.org/0000-0001-6700-0513) wrote the article, interpreted the results of the study; OOJ *(https://orcid.org/0000-0001-7766-9974) wrote the article, interpreted the results of the study; GAN *(https://orcid.org/0000-0003-4431-5576) conceived and planned the activities that led to the stud, wrote the article, approved the final version. *ORCID (Open Researcher and Contributor ID) iD.

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