Outcomes of a Modified Arthroscopic-assisted Reconstruction Technique for Lateral Ankle Instability

Resultados de uma técnica modificada de reconstrução assistida por artroscopia para instabilidade lateral do tornozelo

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Abstract

Objective The present study assesses the results of a minimally invasive surgical technique for acute and chronic ankle instability management.

Methods The present case series study retrospectively evaluated 40 patients undergoing arthroscopic-assisted percutaneous ankle ligament reconstruction from 2013 to 2019.

Results The present study included 17 males and 23 females with an average age of 38.3 years old. Postintervention follow-up using American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot scores identified improvement of > 30 points in function and pain control. The most frequently occurring associated injuries were osteochondral (35%). No patient required reintervention or had infection during follow-up.

Conclusion The technique in the present study is easy and achieves satisfactory results for function and pain control.

Level of Evidence IV.

Keywords
- ankle joint
- arthroscopy
- joint instability
- ligaments, articular
- subtalar joint
- tendons

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Resumo

Objetivo O presente estudo avalia os resultados de uma técnica cirúrgica minimamente invasiva para o manejo da instabilidade aguda e crônica do tornozelo.

Métodos O presente estudo de uma série de casos avaliou retrospectivamente 40 pacientes submetidos à reconstrução percutânea assistida por artroscopia do ligamento do tornozelo entre 2013 e 2019.

Resultados O estudo incluiu 17 homens e 23 mulheres com idade média de 38,3 anos. O acompanhamento pós-intervenção utilizou a pontuação American Orthopaedic Foot and Ankle Society (AOFAS, na sigla em inglês). As pontuações do tornozelo-retropé identificaram melhora > 30 pontos na função e no controle da dor. As lesões associadas mais frequentes foram as osteocondrais (35%). Nenhum paciente precisou de reintervenção ou teve infecção durante o acompanhamento.

Conclusão A técnica do presente estudo é fácil e consegue resultados satisfatórios para a função e o controle da dor.

Nível de Evidência IV.

Palavras-chave

- articulação do tornozelo
- artroscopia
- instabilidade articular
- ligamentos articulares
- articulação subtalar
- tendões

Introduction

Lateral ankle sprain is a relevant reason for consultation in orthopedics. Conservative management of the acute injury, including rehabilitation, usually results in excellent recovery of ankle stability and function.[1–5] Still, even with proper management, between 20 and 40% of the patients persist with ankle instability, which raises the risk of recurrent sprains that deteriorate joint quality and function.[6–8] This condition, known as lateral ankle instability (LAI), can be further classified into acute or chronic is accompanied by a wide debate. The LAI concept has evolved since 1965 from the “proprioceptive deficit” described by Freeman to the consolidation of concepts in 2013.[4,9–11] Despite this, there are still some discrepancies regarding the specific cause for LAI. Some authors describe that the loss of proprioception (neuromuscular reaction/strength/ control) could predispose to mechanical instability.[1–3,8,12] This has caused great controversy. Other authors consider the lack of response to conservative management within the concept of LAI; however, is not a definitive part of its diagnosis.[4,9,13] Furthermore, the concept of microinstability described by Vega et al. has gained popularity.[14] These authors state that the deficiency of the anterior talofibular ligament (ATFL) could be responsible not only for the instability, but also for chronic pain and associated lesions.

The LAI inevitably alters gait biomechanics. Gait studies demonstrate that anterior talofibular ligament injury favors anterior talus displacement, especially in plantar flexion.[8] This displacement eventually limits ankle dorsiflexion and triggers a sequence of events leading to early development of arthrosis.[1,4,5,9,13–16] Stabilization of the lateral ligament complex of the ankle is fundamental in avoiding the development of this condition.

The literature describes > 80 surgical techniques after the initial studies by Bröstrom in the 1950s.[2–5,17] Bröstrom surgical technique was further modified by Gould, and the Bröstrom–Gould (BG) procedure remains the standard of care today.[3,13,17–19] With the development of arthroscopy, less invasive techniques for ankle stabilization emerged. Several authors have described different approaches, but with adequate results, aiming to reproduce the BG procedure.[20–25] To date, no reports have established the superiority of the open surgical technique compared with the closed arthroscopic-assisted ones, and there seems to be no functional difference beyond 5 years of follow-up.[9,13,18,26] Retrospective studies and case series consistently report satisfactory functional results with both open and closed surgical techniques.[6,7,14–17,27–29]

The present study assesses the results of a minimally invasive surgical technique for acute and chronic ankle instability management.

Methods

This is a descriptive, observational, case series study conducted in patients with acute or chronic LAI undergoing arthroscopic-assisted percutaneous modified technique performed by one surgeon from 2013 to 2019.

The present study included 40 patients > 18 years old surgically treated in a teaching institution and in the private practice of the surgeon. Patients with previous osteotomy for angular deformities, patients with rheumatic diseases, and patients with no follow-up in the first 90 postoperative days were excluded from the study.

The patients included in the present study received postoperative follow-up for at least 1 year. The authors evaluated pre- and postoperative function using the American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot score. Collection, tabulation, and codification of data were performed using REDcap, and the R software (R Foundation, Vienna, Austria) was used for information analysis.

Description of quantitative variables included central tendency (mean and median) and dispersion (standard

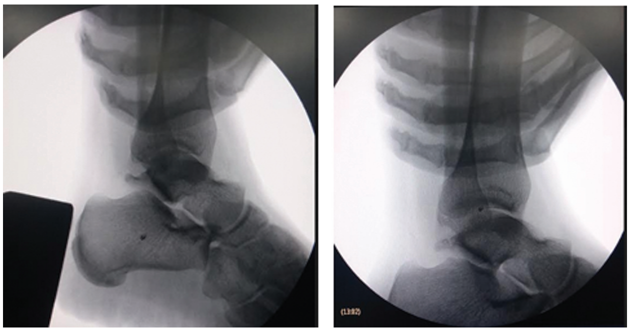

Fig. 1 Radiologic anterior-drawer test. Note forward talar displacement in the image on the right.

deviation [SD] and range) measurements. Description of qualitative variables used absolute and relative frequencies.

A bivariate descriptive analysis was performed to compare clinical variables at surgery and follow-up. Also, AOFAS Ankle-Hindfoot scores at surgery and follow-up were compared using a box diagram.

The present study was approved by the ethics committee of the institution and informed consent was obtained from every patient.

Surgical Technique

The surgical technique was developed by the senior surgeon. All patients presented a complete ATFL injury deemed irreparable. The technique is performed, using general or regional anesthesia, in the following sequence: The surgeon first verifies the ankle anterior instability using an image-guided anterior drawer test (►**Figure 1**). The patient is then placed in the supine position, with a pneumatic tourniquet at 250 mmHg and a soft-tissue traction device to widen the articular space (►**Figure 2**). The surgeon delineates the safety zones (according to the techniques described in literature[20–25]), including the lateral branch of the superficial fibular nerve, and marks the sites for anteromedial and anterolateral portals. Through the anteromedial mark, the surgeon infiltrates the joint with 20 cc of saline solution and introduces the 4.0 mm 30° arthroscope, protecting the articular cartilage from damage. Viewing directly from the anteromedial portal, the surgeon uses a sterile needle to create an anterolateral portal, then assesses the articular surfaces of the tibia, the talus, and the fibula, along with the lateral and medial recesses. The assessment focuses on the search for osteochondral lesions and lateral recess impingement. A synovectomy, using radiofrequency and a shaver blade, exposes the lateral recess where the anchor is to be inserted. A joint tester examines the lateral gutter for instability (►**Figure 3**). During direct viewing from the anteromedial portal, the surgeon places a Twinfix 3.5 mm suture anchor (Smith and Nephew) 1 cm from the distal end of the fibula through the anterolateral portal. Once the anchor is fixed, the surgeon retrieves the sutures through the anterolateral portal, and pulls the sutures to prove proper anchor fixation. A 0.5-cm incision is performed 1.5 cm distal and 1.5 cm anterior from the distal border of the lateral malleolus. After blunt dissection, a BirdBeak (Arthrex) suture passer is introduced through the last incision, in a distal to proximal direction, grasping the extensor retinaculum toward the anterolateral portal. Two white sutures are retrieved through the initial incision from the anterolateral portal. A new incision is performed, 2 cm medial from the former incision,

Fig. 2 Patient positioning with traction device.

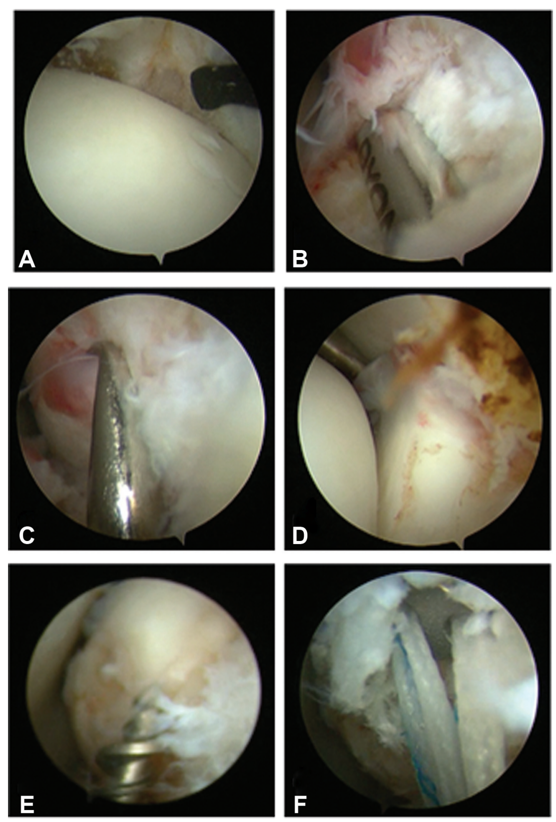

Fig. 3 (**A**) Chondral lesion identification and removal with radiofrequency. (**B**) Synovium removal with shaver blade. (**C–D**). Lateral instability assessment with joint tester, displacing the fibula laterally in the distal tibiofibular joint in the lateral recess (Left: talus. Right: fibula. Up: tibia). (**E–F**). Anchor fixation in a point previously marked through the anterolateral accessory portal.

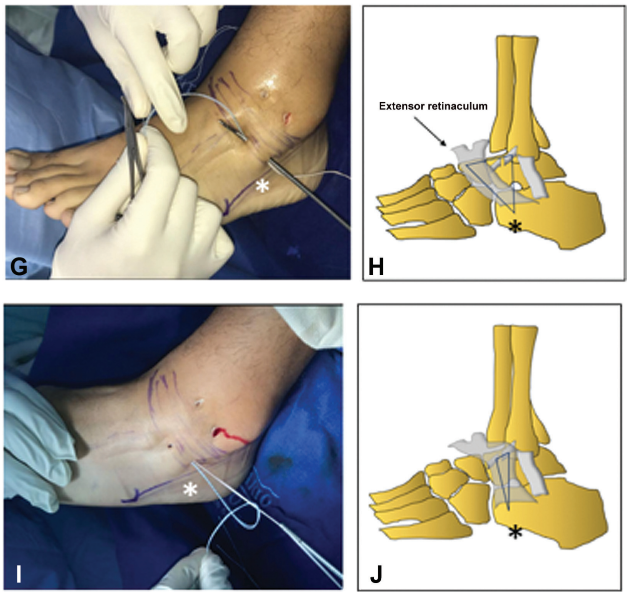

Fig. 4 (G-H) Lateral ligament complex reconstruction with extensor retinaculum. (**I-J**). Percutaneous anchor pass and retrieval through incisions and anterolateral port suture knot tying through lateral incision (Asterisk: lateral skin incision).

in the same plane, also directed toward the anterolateral portal, and the same procedure is repeated to retrieve the remaining sutures (►**Figure 4**). Finally, all sutures are retrieved with the BirdBeak towards the initial incision and five knots are tied with a knot pusher while keeping the ankle in eversion. Ankle stability is intraoperatively proven to ensure proper reconstruction.

Results

The present study followed up 40 LAI patients who underwent the surgical technique described in the present paper. ►**Table 1** displays their main characteristics.

The average age at surgical intervention was 38.3 years old (SD: 14.2), and the average follow-up period was 2.3 years (SD: 1.5). Only 2 cases (5%) required additional hindfoot osteotomy to correct varus deformity of the hind foot. Osteochondral lesions were the most frequent associated lesion (present in 35% of cases), followed by ankle impingement in 12.5%. Most of the cases corresponded to chronic instability, except for two acute instability cases. These two cases were of high-performance athletes who require an early return to sport.

►**Tables 2** and **3** present patient characteristics before and after surgery. No case had infection, superficial fibular nerve injury or surgical reintervention.

Table 1 Description of the study population

	Overall ($n = 40$)
Year of initial surgery	
2013	1 (2.5%)
2014	1 (2.5%)
2015	3 (7.5%)
2016	1 (2.5%)
2017	8 (20%)
2018	11 (27.5%)
2019	15 (37.5%)
Years after the initial surgery	
Mean (SD)	2.33 (1.49)
Median (min, max)	2.0 (1.0– 7.0)
Age at the moment of surgery	
Mean (SD)	38.3 (14.2)
Median (min, max)	38 (17–64)
Biological gender	
Male	17 (42.5%)
Female	23 (57.5%)
Injury laterality	
Right	22 (55%)
Left	18 (45%)
Associated injury	
Osteochondral lesion	14 (35%)
Loose bodies	–
Impingement	5 (12.5%)
Other	4 (10%)
None	17 (42.5%)
Time from injury to surgery	
Days	2 (5%)
Months	16 (40%)
Years	22 (55%)

Abbreviation: SD, standard deviation,

Discussion

There are many reports on open and close techniques for LAI management. With the advent of ankle arthroscopy, the number of studies on arthroscopic-assisted repair is growing. A review of the current literature yields a certain number of observational studies. Most are, like the present study, retrospective.[6,7,15–17,27–30] Most of these studies have been on nonathletes, except for the study by Russo et al.,[6] which was the only one performed exclusively on athletes. The average age at surgery is < 50 years old in all articles. Similarly, in the present study, the average age was 38.3 ± 14 years old.

In the literature, the average follow-up varies widely, from 29 months to 15 years.[6,17] The great variability in follow-up, along with the diversity of techniques, make a valid comparison among studies difficult. However, results are positive, which reflects success for open and minimally invasive arthroscopic-assisted techniques.[6,7,15–17,27–30] Studies comparing open techniques with minimally invasive arthroscopic-assisted techniques measured by AOFAS score also show satisfactory functional recovery with both approaches.[27,30]

Table 2 Clinical condition before and after surgery

	Before surgery ($n = 40$)	After surgery ($n = 40$)
Pain		
None	1 (2.5%)	23 (57.5%)
Mild/occasional	4 (10%)	15 (37.5%)
Moderate/daily	25 (62.5%)	2 (5%)
Severe/almost always present	10 (25%)	–
Activity limitation, support requirements		
No limitation/no support requirement	–	24 (60%)
No limitation of daily activities, limitations of recreational activities, no support	14 (35%)	14 (35%)
Limited daily and recreational activities, cane	23 (57.5%)	2 (5%)
Severe limitation of daily and recreational activities, walker, crutches, wheelchair, brace	3 (7.5%)	–
Gait abnormality		
None, slight	27 (67.5%)	40 (100%)
Obvious	9 (22.5%)	–
Marked	4 (10%)	–
Sagittal motion (flexion plus extension)		
Normal or mild restriction (≥ 30°)	12 (30%)	33 (82.5%)
Moderate restriction (15–29°)	24 (60%)	7 (17.5%)
Severe restriction (< 15°)	4 (10%)	–
Ankle - hindfoot stability (anteroposterior, varus - valgus)		
Stable	–	40 (100%)
Definitely unstable	40 (100%)	–
AOFAS score		
Mean (SD)	55.4 (14.4)	93.7 (6.71)
Median [min, max]	59 [23 - 85]	96 [74 - 100]

Abbreviations: AOFAS, American Orthopaedic Foot and Ankle Society; SD, standard deviation,

Table 3 Characteristics of the study population after follow-up

	Overall ($n = 40$)
Maximum walking distance (blocks)	
> 6	40 (100%)
4 to 6	–
1 to 3	–
< 1	–
Walking surfaces	
No difficulty on any surface	34 (85%)
Some difficulty on uneven terrain, stairs, inclines, ladders	6 (15%)
Severe difficulty on uneven terrain, stairs, inclines, ladders	–
Hindfoot motion (inversion plus eversion)	
Normal or mild restriction (75–100%)	39 (97.5%)
Moderate restriction (25–74% of normal)	1 (2.5%)
Marked restriction (< 25% of normal)	–
Foot alignment	
Good, plantigrade foot, ankle-hindfoot well aligned	40 (100%)
Fair, plantigrade foot, some ankle-hindfoot malalignment observed, no symptoms	–
Poor, nonplantigrade foot, severe malalignment, symptoms	–

Reports comparing open and closed techniques do not identify a difference in postoperative functional scores beyond 5 years.[18,26] Even so, the minimally invasive approach has theoretical advantages for the patient, including a reduced postoperative recovery period with earlier resumption of activity, smaller surgical wounds, and reduced risk of infection.[1–6,10,15,18,27,30] The chance for articular surface assessment in a search for associated injuries potentially affecting the prognosis is also an added value of the arthroscopic-assisted approach.

The improvement of 38.3 points in the AOFAS scores of patients in the present study is consistent with an improvement > 30 points in other studies of arthroscopic-assisted surgical techniques.[6,17,30] In the literature, similarly to the results of the present study, final AOFAS scores in arthroscopic-assisted surgeries are usually > 90 points,[6,17,27,30]

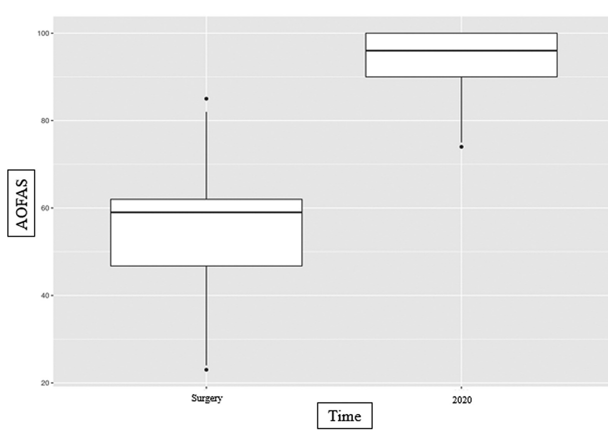

Fig. 5 Evolution of AOFAS score after surgery.

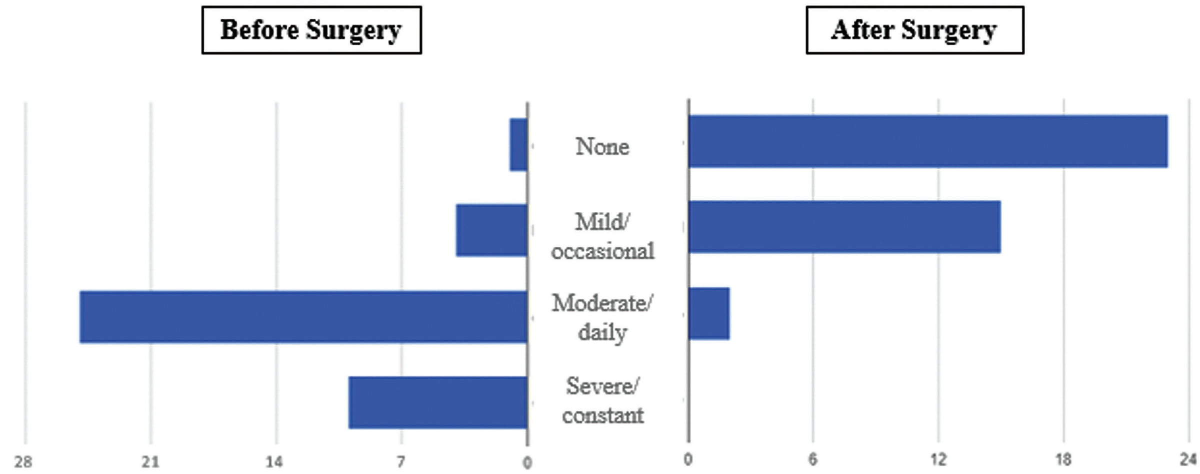

Fig. 6 Pain reported by patients before and after surgery.

while scores for open techniques are > 80 points[15,16,27–30] Regardless of the technique, it seems that the outcomes for surgical procedures to treat LAI are in general satisfactory. Also, outcomes are stable through time (►**Figure 5**). The higher AOFAS score with arthroscopic-assisted techniques may be due to reduced postoperative pain, as reported in several studies.[1–3,5,6,15,17,18,27,30] This is also consistent with findings in the present study (►**Figure 6**).

Like other publications, the present study has various limitations. Being a case series of the technique used by only one surgeon, it is difficult to extrapolate results to other populations, as well as to apply any inferential statistics. The findings presented in the present case series should not be considered as an absolute truth and just reflect the results of this technique. Furthermore, lack of an open technique comparison group and the selection of the study sample represent an important selection bias.

Conclusion

The surgical technique in the present study achieves satisfactory postoperative results for LAI patients with functional recovery measured by AOFAS score and an important positive impact on pain management. The authors recommend the use of this easy and reproducible surgical technique for positive results in patients with LAI.

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Conflict of Interests
The authors have no conflict of interests to declare.

References

1 Miklovic TM, Donovan L, Protzuk OA, Kang MS, Feger MA. Acute lateral ankle sprain to chronic ankle instability: a pathway of dysfunction. Phys Sportsmed 2018;46(01):116–122
2 Al-Mohrej OA, Al-Kenani NS. Chronic ankle instability: Current perspectives. Avicenna J Med 2016;6(04):103–108
3 Guillo S, Bauer T, Lee JW, et al. Consensus in chronic ankle instability: aetiology, assessment, surgical indications and place for arthroscopy. Orthop Traumatol Surg Res 2013;99(8, Suppl) S411–S419
4 Sarcon AK, Heyrani N, Giza E, Kreulen C. Lateral Ankle Sprain and Chronic Ankle Instability. Foot Ankle Orthop; 2019
5 Rodriguez-Merchan EC. Chronic ankle instability: diagnosis and treatment. Arch Orthop Trauma Surg 2012;132(02):211–219
6 Russo A, Giacchè P, Marcantoni E, Arrighi A, Molfetta L. Treatment of chronic lateral ankle instability using the Broström-Gould procedure in athletes: long-term results. Joints 2016;4(02):94–97
7 Araoye I, De Cesar Netto C, Cone B, Hudson P, Sahranavard B, Shah A. Results of lateral ankle ligament repair surgery in one hundred and nineteen patients: do surgical method and arthroscopy timing matter? Int Orthop 2017;41(11):2289–2295
8 de Vries JS, Kingma I, Blankevoort L, van Dijk CN. Difference in balance measures between patients with chronic ankle instability and patients after an acute ankle inversion trauma. Knee Surg Sports Traumatol Arthrosc 2010;18(05):601–606
9 Webster KA, Gribble PA. Functional rehabilitation interventions for chronic ankle instability: a systematic review. J Sport Rehabil 2010;19(01):98–114
10 Al Adal S, Pourkazemi F, Mackey M, Hiller CE. The prevalence of pain in people with chronic ankle instability: A systematic review. J Athl Train 2019;54(06):662–670
11 Freeman MA, Dean MR, Hanham IW. The etiology and prevention of functional instability of the foot. J Bone Joint Surg Br 1965;47 (04):678–685
12 Simpson JD, Stewart EM, Macias DM, Chander H, Knight AC. Individuals with chronic ankle instability exhibit dynamic postural stability deficits and altered unilateral landing biomechanics: A systematic review. Phys Ther Sport 2019;37:210–219
13 Thompson C, Schabrun S, Romero R, Bialocerkowski A, van Dieen J, Marshall P. Factors Contributing to Chronic Ankle Instability: A Systematic Review and Meta-Analysis of Systematic Reviews. Sports Med 2018;48(01):189–205
14 Vega J, Peña F, Golanó P Minor or occult ankle instability as a cause of anterolateral pain after ankle sprain. Knee Surg Sports Traumatol Arthrosc 2016;24(04):1116–1123
15 Matheny LM, Johnson NS, Liechti DJ, Clanton TO. Activity Level and Function After Lateral Ankle Ligament Repair Versus Reconstruction. Am J Sports Med 2016;44(05):1301–1308
16 Mabit C, Tourné Y, Besse JL, et al.Sofcot (French Society of Orthopedic and Traumatologic Surgery) Chronic lateral ankle instability surgical repairs: the long term prospective. Orthop Traumatol Surg Res 2010;96(04):417–423

17 Arroyo-Hernández M, Mellado-Romero M, Páramo-Díaz P, García-Lamas L, Vilà-Rico J. Chronic ankle instability: Arthroscopic anatomical repair. Rev Esp Cir Ortop Traumatol 2017;61(02):104–110

18 Song YJ, Hua YH. Similar Outcomes at Early Term After Arthroscopic or Open Repair of Chronic Ankle Instability: A Systematic Review and Meta-Analysis. J Foot Ankle Surg 2019;58(02):312–319

19 Feger MA, Glaviano NR, Donovan L, et al. Current trends in the management of lateral ankle sprain in the United States. Clin J Sport Med 2017;27(02):145–152

20 Hawkins RB. Arthroscopic stapling repair for chronic lateral instability. Clin Podiatr Med Surg 1987;4(04):875–883

21 Acevedo JI, Mangone P. Ankle instability and arthroscopic lateral ligament repair. Foot Ankle Clin 2015;20(01):59–69

22 Drakos M, Behrens SB, Mulcahey MK, Paller D, Hoffman E, DiGiovanni CW. Proximity of arthroscopic ankle stabilization procedures to surrounding structures: an anatomic study. Arthroscopy 2013;29(06):1089–1094

23 Kashuk KB, Landsman AS, Werd MB, Hanft JR, Roberts M. Arthroscopic lateral ankle stabilization. Clin Podiatr Med Surg 1994;11(03):407–423

24 Corte-Real NM, Moreira RM. Arthroscopic repair of chronic lateral ankle instability. Foot Ankle Int 2009;30(03):213–217

25 Vega J, Golanó P, Pellegrino A, Rabat E, Peña F. All-inside arthroscopic lateral collateral ligament repair for ankle instability with a knotless suture anchor technique. Foot Ankle Int 2013;34(12):1701–1709

26 Cao Y, Hong Y, Xu Y, Zhu Y, Xu X. Surgical management of chronic lateral ankle instability: a meta-analysis. J Orthop Surg Res 2018;13(01):159

27 Mota Garcia Moreno MV, de Souza Guimarães J, Torres Gomes MJ, Marçal Vieira TE, Souza Jalil V, Júnior FH. SNG. Avaliação funcional pós-operatória da instabilidade crônica do tornozelo: comparação das técnicas Bröstrom Artroscópico versus Bröstrom-Gould modificada. Tobillo Pie 2016;8(02):121–127

28 Hsu AR, Ardoin GT, Davis WH, Anderson RB. Intermediate and Long-Term Outcomes of the Modified Brostrom-Evans Procedure for Lateral Ankle Ligament Reconstruction. Foot Ankle Spec 2016;9(02):131–139

29 Guerrero Forero AS, De La Hoz LE, Fonseca Carrascal A. OJJ. Reconstrucción del ligamento fibulotalar anterior: resultados de una tècnica mínimamente invasiva Anterior talofibular ligament reconstruction: results from a mini open technique. Tobillo Pie 2015;7(01):38–42

30 Hidalgo-González H, Gerstner-Garcés JB, Ramírez-Dávila CE, Fernández-Román CV, Carvajal R. Inestabilidad cronica lateral del tobillo: comparacion entre la reparacion de brostrom-gould y una tecnica artroscopica. Rev Colomb Ortop Traumatol 2019;33(3–4):82–88

