

All-Inside and All-Knotless Soft Tissue Anchor Repair for Chronic Lateral Ankle Instability: A Retrospective Study of a New Surgical Technique

Maria Inês Peixoto^{1 *}, Luís Fabião², Daniel Freitas³, Guilherme França³, Filipe Malheiro³, Nuno Esteves², Bruno S. Pereira^{2 3 4 5}

(*) Corresponding author: minespeixoto13@gmail.com

1. School of Medicine, University of Minho, Rua da Universidade, Braga, Portugal

2. Unidade Local de Saúde de Barcelos/Esposende, Orthopedic Department, Campo da República 181, Barcelos, Portugal

3. Clínica Espregueira – FIFA Medical Centre of Excellence, Estádio Dragão - Entrada Nascente, Porto, Portugal

4. 3B's Research Group, University of Minho, Zona Industrial da Gandra, Guimarães, Portugal

5. Foot and Ankle Unit, Human Anatomy Unit, School of Medicine, University of Barcelona, Barcelona, Spain



Background: Chronic lateral ankle instability (CLAI) is a common pathology among athletes. Although the open modified Broström-Gould procedure remains the gold standard, arthroscopic approaches have gained popularity due to their minimally invasive nature and promising outcomes. Despite growing clinical adoption, evidence on the effectiveness of these techniques - especially those using knotless anchor systems - remains relatively limited.

Purpose: This study aims to evaluate the clinical and functional outcomes of arthroscopic repair of CLAI using a knotless anchor system, contributing to the growing body of literature supporting this approach.

Methods: We analyzed patients who underwent arthroscopic CLAI repair with a knotless anchor system. Clinical assessments were performed at three time points: preoperatively, and at 6 and 12 months postoperatively. Variables collected included age, sex, Visual Analog Scale (VAS) for pain, American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Score, Karlsson-Peterson score, patient satisfaction, and surgery-related complications.

Results: A total of 36 patients were included (64% male, 36% female), with a mean age of 27.5±8.0 years. Statistically significant improvements were observed in VAS, AOFAS, and Karlsson-Peterson scores at both 6 and 12 months ($p < 0.001$). The median AOFAS score improved from 61.0 preoperatively to 96.0 at 6 and 12 months. The Karlsson-Peterson score rose from 45.0 to 95.0. At 12 months, 91.7% of patients reported being very satisfied and 8.3% satisfied. Only two minor complications were recorded. No significant correlation was found between outcomes and patient age or sex.

Conclusion: Arthroscopic repair of CLAI using a knotless anchor system demonstrates excellent short-term clinical and functional results. These findings support its continued use and encourage further comparative studies with open Broström-Gould procedures and alternative arthroscopic techniques.

What this study adds: This study provides retrospective evidence supporting the effectiveness of all-arthroscopic, knotless anchor repair for chronic lateral ankle instability, showing excellent short-term clinical and functional outcomes with high patient satisfaction and low complication rates.

Potential impacts on research, practice, or policy: These findings support wider use of arthroscopic knotless anchor techniques in clinical practice and may influence surgical decision-making and future guidelines.

Study Design: Retrospective cohort study

Level of evidence: Level III

Keywords: Ankle; Ankle arthroscopic repair; Arthroscopy; Chronic lateral ankle instability; Joint; Knotless tissue anchor; Ligament; Minimally invasive surgery

<https://doi.org/10.70885/hmsj.2026.02.002>

INTRODUCTION

The ankle is a hinge-type synovial joint whose stability relies on both bony congruence and three primary ligamentous complexes – lateral collateral, medial-lateral collateral, and syndesmosis – ensuring coordinated biomechanical

interactions among bones, ligaments and tendons [1][2]. The anterior talofibular ligament (ATFL), one of the primary stabilizers of the ankle joint [3], is implicated in approximately 85% of acute ankle sprains, particularly during inversion combined with plantar flexion [4].

Chronic lateral ankle instability (CLAI) is a frequent consequence of ankle sprains, characterized by recurrent episodes of instability, pain, functional limitation, and reduced sports participation [5][6]. This condition is associated with several pathologies, such as osteochondral lesions or peroneal tendinopathy [6][7]. Anatomical factors, including cavus foot and fibular misalignment [8][9], predispose individuals to this condition.

There is no definitive diagnostic standard. Clinical examination remains the most reliable method for identifying lateral ankle instability, with the anterior drawer and talar tilt tests being the most commonly used [10]. Conservative management should be undertaken during the first three to four months after diagnosis [4], focusing on functional rehabilitation [11]. Surgery is indicated if CLAI persists after 3-6 months of conservative management [10].

Numerous surgical techniques have been described to treat CLAI [12]. The open modified Broström-Gould procedure is considered the gold standard for surgical repair of CLAI [1], involving the use of tendon grafts to restore the anatomy and biomechanics of the ATFL and PTFL, often using anchors, bone tunnels with interference screws, or devices like endobuttons [12]. These methods are particularly beneficial for patients with previous unsuccessful repairs, chronic instability, attenuated tissue quality, ligament laxity, or cavovarus deformity [13].

Arthroscopy ligament repair involves surgically separating the ATFL from the capsule and reattaching it to the fibula using knot or knotless anchors. This procedure offers several benefits, including reduced scarring, decreased pain, minimized swelling, less disruption to skin sensation, and potentially faster recovery [14]. However, knot-related complications, including irritation [15], have been reported, with an overall complication rate of 11.6% [16], comparable to that of open techniques.

A minimally invasive arthroscopic technique for ATFL reconstruction using knotless anchors, reattaching the ligament to the fibula ligament, was developed to mitigate these issues, aiming to simplify the procedure and reduce implant-related morbidity [17].

Despite growing clinical adoption, evidence regarding the functional and clinical outcomes of all-inside arthroscopic repair using knotless soft-tissue anchors remains limited, particularly in consecutive patient series with standardized follow-up protocols. Therefore, the present study aimed to evaluate the short-term clinical and functional outcomes of CLAI with an all-inside, all-knotless arthroscopic repair technique.

METHODS

Study population

The study population of this project belongs to a database, with data collected between January 2020 and December 2021, of all patients who underwent arthroscopic repair of CLAI at Clínica Espregueira – FIFA Medical Centre of Excellence, and who, at that time, signed the free and informed consent form.

Inclusion Criteria

The inclusion criteria included: (i) patients with 16 years or older (all patients had closed physis); (ii) recurrent inversion ankle sprains or repeated “giving away” during daily or recreational activities secondary to trauma for at least 1-year; (iii) positive anterior drawer test or stress radiographs compared with the uninjured side; (iv) magnetic resonance imaging (MRI) showing ATFL damage with or without CFL damage; and (v) unresponsive to physical therapy for over 3 months.

Exclusion Criteria

The exclusion criteria consisted of: (i) neurovascular disorders; (ii) ankle deformity; (iii) general joint laxity; (iv) previous surgery on the affected ankle, and (v) concomitant lesions of the affected ankle, such as osteochondral lesions of the talus, impingement syndrome, os subfibulare, deltoid ligament injury, peroneal tendon tear, syndesmosis injury and arthritis.

Study Design and Data Collection

This analytic, longitudinal study was conducted at the Foot Unit of Clínica Espregueira – FIFA Medical Centre of Excellence.

Participants who met the inclusion criteria and were symptomatic with a combination of chronic ankle instability and avoidance of sports and presented with a positive anterior drawer test upon the physical examination were eligible to participate.

All patients underwent arthroscopic lateral ligament reconstruction using an all-inside, all-knotless soft-tissue anchor technique [17].

Demographic data (age and sex) were collected. Clinical outcomes were assessed using the VAS for pain [18], the AOFAS Ankle-Hindfoot Scale (**Appendix 1**) [19], and the Karlsson-Peterson score (**Appendix 2**) [20], recorded preoperatively and at 6 and 12 months postoperatively. Patient satisfaction at 12 months was evaluated using a four-level categorical scale (dissatisfied, not very satisfied,

satisfied, and very satisfied). Surgical-related complications were documented throughout the follow-up period.

Statistical Analysis

The statistical analysis of the data was assessed using version 29.0 of Statistical Package for the Social Science (SPSS) software. The confidence interval for all variables was set as 95% and was considered statistically significant when $p < 0.05$.

Normality of continuous variables was tested using the Shapiro-Wilk test, skewness and kurtosis values, and visual inspections of plots [21]. As several variables did not meet normality assumptions, non-parametric tests were used for inferential analyses. Continuous variables were presented as median (Mdn) and interquartile range (IQR) or as mean (M) and standard deviation (SD), depending on their distribution, while categorical variables were presented as absolute (n) and relative (%) frequencies [22].

Changes over time – preoperative, 6 months, and 12 months postoperative – were analyzed using the Friedman Test [23]. When significant, pairwise comparisons were performed to identify differences between time points. Effect size for the Friedman Test was calculated using Kendall's W [24].

Correlation between the age and gender and 12 months postoperative outcomes was assessed using Spearman's or Pearson's correlation coefficients, according to data distribution.

Comparisons between genders were performed using the Mann-Whitney U test [25]. The effect size was calculated using the formula for Pearson's correlation - $r: Z/\sqrt{N}$ (where N represents the number of participants) [23].

Ethical Considerations

This project followed the investigation protocol, previously submitted, and approved by the Clinical Council of Clinica Espregueira - FIFA Medical Centre of Excellence.

It should be noted that the principles of the Declaration of Helsinki were complied with throughout the whole clinical trial, by the rules of Ethical Conduct and Good Clinical Practice, the Convention on Human Rights and Biomedicine, and the Council of International Organizations of Medical Sciences.

RESULTS

Patient baseline characteristics

A total of 38 patients agreed to participate in the study. After the exclusion of 2 patients due to exit follow-up, 36

participants were included (**Figure 1**). The follow-up of the 2 excluded patients was lost because they were foreigners and had returned to their countries of origin. In this sample, 23 (64%) were male and 13 (36%) were female. The overall mean age was 27.5 ± 8.0 years (range 16 to 43). In the male group, the mean age was 28.4 ± 8.5 (range 16 to 43), while in the female group, the mean age was 26.0 ± 6.9 (range 17 to 39).

Outcome measurements

The results regarding the scores presented to the patients before the surgery (pre-op) and 6 and 12 months postoperative (post-op) are displayed in **Tables 1 and 2**.

The results of the Friedman Test indicated that there was a statistically significant difference in VAS score across the three time points ($\chi^2 = 65.97$, $p < 0.001$). Inspection of the median values showed a decrease in pain of statistics from preoperative (Md = 8.0 (1.0)) to 6 months postoperative (Md = 1.0 (2.0)) and a further decrease at 12 months postoperative (Md = 0.5 (1.0)). There was a statistically significant difference between preoperative score evaluation and 6 months postoperative ($p < 0.001$) and between preoperative score evaluation and 12 months postoperative evaluation ($p < 0.001$). No statistically significant differences were found between 6 months postoperative and 12 months postoperative ($p = 0.377$).

A statistically significant difference was observed in the AOFAS Ankle-Hindfoot Scale across the three times ($\chi^2 = 63.13$, $p < 0.001$). Median scores increased from preoperative (Md = 61.0 (8.0)) to 6 and 12 months postoperative, as these had the same median (Md = 96.0 (6.0)). There was a statistically significant difference between preoperative score evaluation and 6 months postoperative ($p < 0.001$) and between preoperative evaluation and 12 months postoperative evaluation ($p < 0.001$). There were no statistically significant differences between 6 months postoperative and 12 months postoperative ($p = 0.585$).

The Friedman Test results revealed a statistically significant difference in the Karlsson-Peterson score between the three-time points ($\chi^2 = 66.71$, $p < 0.001$). There was an improvement in the statistical result from preoperative (Md = 45.0 (5.0)) to 6 months postoperative (Md = 95.0 (6.0)) and 12 months postoperative (Md = 95.0 (5.0)). Preoperative score evaluation and 6 months postoperative and preoperative score evaluation and 12 months postoperative evaluation showed statistically significant differences ($p < 0.001$ and $p < 0.001$, respectively). Between 6 and 12 months postoperative, there were no statistically significant differences ($p = 0.867$).

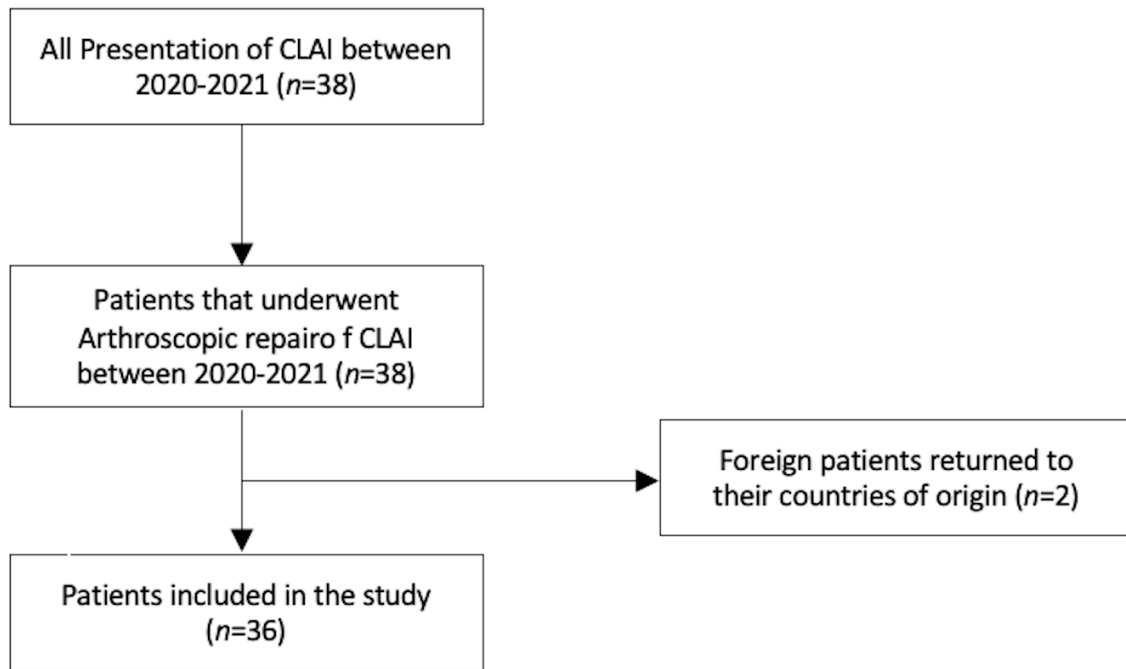


Figure 1. Sample flow chart.

Table 1. Outcome measures.

	Pre-Op Md (IQR)	6 months Post-Op Md (IQR)	12 months Post-Op Md (IQR)	χ^2	ρ	W
VAS	8.0 (1.0)	1.0 (2.0)	0.5 (1.0)	65.97	<0.001	00.92
AOFAS AHS	61.0 (8.0)	96.0 (6.0)	96.0 (6.0)	63.13	<0.001	00.88
Karlsson-Peterson	45.0 (5.0)	95.0 (6.0)	95.0 (5.0)	66.71	<0.001	00.93

Legend: AOFAS AHS – American Orthopedic Foot and Ankle Society Ankle-Hindfoot Scale; Md – Median, Pre-Op – Preoperative; Post-Op – Postoperative; IQR – Interquartile range; χ^2 – Friedman Test; W – Kendall's W

Table 2. Differences between groups.

	Statistic Test	Adjusted p value
VAS		
Pre-Op – Post-Op 6m	1.319	<0.001
Pre-Op – Post-Op 12m	1.681	<0.001
Pos-Op 6m – Post-Op 12m	0.361	0.377
AOFAS AHS		
Pre-Op – Post-Op 6m	-1.347	<0.001
Pre-Op – Post-Op 12m	-1.653	<0.001
Pos-Op 6m – Post-Op 12m	-0.306	0.585
Karlsson-Peterson		
Pre-Op – Post-Op 6m	-1.375	<0.001
Pre-Op – Post-Op 12m	-1.625	<0.001
Pos-Op 6m – Post-Op 12m	-0.250	0.867

Legend: AOFAS AHS – American Orthopedic Foot and Ankle Society Ankle-Hindfoot Scale; Md – Median, Pre-Op – Preoperative; Post-Op – Postoperative

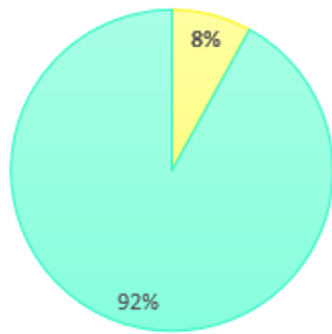
One year after the surgery, patient satisfaction was assessed. Of the 36 patients evaluated, 33 (91.7%) felt very satisfied, and 3 (8.3%) felt satisfied, as displayed in **Figure 2A**. Among the 3 satisfied patients, two of them had 2 minor surgical-related complications (**Figure 2B**): one showed stiffness and the other had lateral conflict. The third patient had a traumatic sprain 8 months after the surgery. These minor surgical-related complications represent 6% of the patients, and 94% of the patients did not have surgical-related complications.

Correlation between age and 12 months postoperative outcomes was assessed to investigate whether other variables could be considered as factors that influence the participant's postoperative outcomes. By Spearman's correlation, no significant correlation was found ($p > 0.05$) between age and 12 months postoperative outcomes, as displayed in **Table 3**.

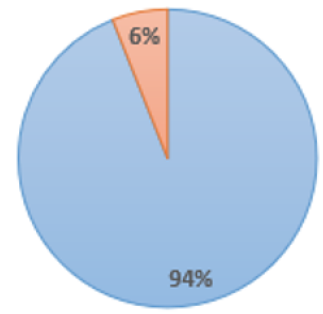
No statistically significant differences were observed in 12 months postoperative outcomes between gender ($p > 0.05$), using the Mann-Whitney U test. The influence of these variable in the 12 months postoperative outcomes is shown in **Table 4**.

DISCUSSION

The main finding of this study is that the arthroscopic repair using an all-inside, all-knotless soft-tissue anchor technique [17] demonstrated positive clinical outcomes with minimal complications. Knotless sutures provide a secure and inconspicuous repair without knot impingement or loosening and require minimal bone removal [17]. Biomechanical studies have shown that knotless anchor fixation exhibits greater strength and less variability compared to knotted constructs in securing a suture loop [26]. These results are consistent with previous studies, which reported that the technique is less time-consuming [27] and reduces the likelihood of knot-related irritation or impingement [28].

A

■ Dissatisfied ■ Not very satisfied ■ Satisfied ■ Very Satisfied

B

■ None ■ Minor ■ Major

Figure 2. Descriptive analysis of gender.

Table 3. Descriptive analysis of gender.

	r	p
Age		
VAS Post-Op 12 m	0.094	0.585
AOFAS AHS Post-Op 12m	-0.111	0.520
Karlsson-Peterson Post-Op 12m	0.138	0.422

Legend: AOFAS AHS – American Orthopedic Foot and Ankle Society Ankle-Hindfoot Scale; r – Spearman's Correlation.

Table 4. Descriptive analysis of gender.

	Gender	Md (AIQ)	U	p	r
VAS Post-Op 12m	Male	1.0 (1.0)	127.0	0.404	-0.139
	Female	0.00 (1.0)			
AOFAS AHS Post-Op	Male	96.0 (6.0)	127.5	0.448	-0.126
12 m	Female	96.0 (10.0)			
Karlsson-Peterson	Male	95.0 (5.0)	124.5	0.348	-0.145
Post-Op 12m	Female	95.0 (6.00)			

Legend: AOFAS AHS – American Orthopedic Foot and Ankle Society Ankle-Hindfoot Scale; Legend: Md – Median; Pre-Op Preoperative; Post-Op – Postoperative; IQR – Interquartile range; U – Mann-Whitney U Test; r – Pearson's Correlation

The Open Broström-Gould surgery has long been considered the standard for lateral ankle ligament repair. However, the emergence of orthopedic endoscopy has prompted the exploration of less invasive techniques aimed at reducing postoperative discomfort [29][30]. Vega *et al* were the first to describe an arthroscopic approach using knotless suture anchors for ATFL repair, successfully restoring ankle stability

in all patients without neurological or major complications [31]. In addition to aesthetic advantages, the arthroscopic procedure allows simultaneous diagnosis and treatment of intra-articular lesions, which are commonly associated with ankle instability and are critical to address during surgery [32]. Collectively, these factors support the adoption of arthroscopic repair using knotless anchors.

Minimally invasive approaches that limit subcutaneous dissection have been associated with faster recovery and rehabilitation [33], which may have contributed to the favorable postoperative outcomes observed in this study at 6 and 12 months.

In this study, VAS score decreased significantly ($p < 0.001$), from 8 preoperatively to 1 at 6 months and 0.5 at 12 months postoperatively, consistent with prior reports of postoperative pain reduction following arthroscopic ATFL repair [34]. This postoperative pain relief likely reflects the minimally invasive nature of the technique [17].

The AOFAS Ankle-Hindfoot Scale increased from 61 points preoperatively to 96 points at both 6 and 12 months postoperatively ($p < 0.001$), in agreement with previous reports showing improvements from 67 to 97 using knotless anchors [31]. These results support evidence suggesting higher functional scores with arthroscopic Broström procedure compared to open surgery [35]. Similarly, the Karlsson-Peterson score improved from 45 preoperatively to 95 postoperatively ($p < 0.001$), aligning with prior studies indicating that this scale effectively evaluates functional recovery and return to sport following lateral ligament repair [34][36]. Based on these findings, patients were likely able to return to sport activities by 6 months postoperatively.

No statistically significant differences were observed in functional scores between 6 and 12 months postoperative ($p > 0.001$). Given the small sample size ($n = 36$), these findings should be interpreted cautiously, and the possibility of differences between these time points cannot be excluded.

Patient satisfaction at 12 months was high, with 91.7% reporting being very satisfied and 8.3% satisfied. Among the three satisfied patients, two experienced minor surgery-related complications (stiffness and lateral conflict), and one sustained a traumatic sprain at 8 months. Minor surgical-related complications occurred in 5.6% of patients, which is lower than rates reported in systematic reviews comparing arthroscopic procedures (35%) to open Broström-Gould surgery (29.6%) [37]. Importantly, these minor complications did not appear to affect overall patient satisfaction, consistent with prior literature [37][38].

No significant correlation was found between age or gender and 12 months postoperative outcomes ($p > 0.001$), in line with recent evidence [15]. This contrasts with studies suggesting older women may experience poorer outcomes following arthroscopic repair with anchors [36], highlighting the applicability of this technique across age and gender groups.

The clinical relevance of these findings is substantial. Arthroscopic repair using all-inside and all-knotless soft-

tissue anchors [17] offers comparable functional outcomes to other arthroscopic and open techniques while minimizing complications such as knot irritation, nerve injury, and postoperative pain. This approach may represent a safe and effective alternative to open Broström-Gould repair.

The strengths of this study are the evaluation of a recently published technique for CLAI17 repair and the absence of major surgery-related complications, demonstrating the procedure's safety. The surgeries were performed by the same orthopaedic surgeon in the same center, and the technique was consistently applied with the same specific methods, which may have contributed to the positive outcomes.

Limitations included the small sample size, absence of long-term follow-up, and lack of a direct comparative group using knotted suture, which may introduce information bias.

Further research with high-powered and high-quality randomized controlled trials comparing the surgical technique with open Broström-Gould surgery and/or arthroscopic technique with knot systems is needed to strengthen recommendations and determine if the best functional outcome is achieved with the arthroscopic repair with knotless suture anchor.

CONCLUSION

The arthroscopic technique using all-inside and all-knotless soft-tissue anchors used in CLAI repair yielded significant short-term improvements in pain and functional outcomes. Significant reductions in pain and increases in AOFAS and Karlsson-Peterson scores were observed from baseline to 6 and 12 months after surgery ($p < 0.001$), with no significant differences between the two postoperative time points. After 12 months, all patients reported satisfaction with the procedure, and only minor complications were observed in 6% of cases. These findings support this technique as a safe and effective option for short-term management of CLAI. Further studies should be carried out comparing the surgical technique with open Broström-Gould surgery and/or arthroscopic technique with knot systems.

Open access statement

This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial (CC BY-NC 4.0, see <https://creativecommons.org/licenses/by-nc/4.0/>) licence, which permits the sharing and adapting work, as long as it is for non-commercial purposes and proper credit is given to the original creator.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

Conflict of interest

The authors have no conflict of interest to declare.

References

- Mayet Z, Ferrao PNF, Saragas NP, Paterson R, Magobotha SKM, Alexander A, et al. Chronic lateral ankle instability: A current concepts review. *South African Orthopaedic Journal*. 2021;20(2):106–13. DOI: 10.17159/2309-8309/2021/v20n2a7
- Moore KL, Dalley AF, Agur AMR. Moore's Clinically Oriented Anatomy. 7th ed. 2014. 1134 p. ISBN 978-1-4511-1945-9
- Medina McKeon JM, Hoch MC. The ankle-joint complex: A kinesiologic approach to lateral ankle sprains. *J Athl Train*. 2019;54(6):589–602. DOI: 10.4085/1062-6050-472-17
- McCriskin BJ, Cameron KL, Orr JD, Waterman BR. Management and prevention of acute and chronic lateral ankle instability in athletic patient populations. *World J Orthop*. 2015;6(2):161–71. DOI: 10.5312/wjo.v6.i2.161
- Ma Y, Yin K, Zhuang W, Zhang C, Jiang Y, Huang J, et al. Effects of combining high-definition transcranial direct current stimulation with short-foot exercise on chronic ankle instability: A pilot randomized and double-blinded study. *Brain Sci*. 2020;10(10):1–14. DOI: 10.3390/brainsci10100749
- Smith GH, Maffulli N, Calder JD. Cartilage pathology with concomitant ankle instability. *Oper Tech Orthop* [Internet]. 2014;24(3):152–6. Available from: <http://dx.doi.org/10.1053/j.oto.2014.04.001>
- Park HJ, Cha SD, Kim HS, Chung ST, Park NH, Yoo JH, et al. Reliability of MRI findings of peroneal tendinopathy in patients with lateral chronic ankle instability. *Clin Orthop Surg*. 2010;2(4):237–43. DOI: 10.4055/cios.2010.2.4.237
- Chilvers M, Manoli A. The Subtle Cavus Foot and Association with Ankle Instability and Lateral Foot Overload. *Foot Ankle Clin*. 2008;13(2):315–24. DOI: 10.1016/j.fcl.2008.01.003
- Kobayashi T, Suzuki E, Yamazaki N, Suzukawa M, Akaike A, Shimizu K, et al. Fibular malalignment in individuals with chronic ankle instability. *Journal of Orthopaedic and Sports Physical Therapy*. 2014;44(11):872–8. DOI: 10.2519/jospt.2014.5217
- Michels F, Pereira H, Calder J, Matricali G, Glazebrook M, Guillo S, et al. Searching for consensus in the approach to patients with chronic lateral ankle instability: ask the expert. *Knee Surgery, Sports Traumatology, Arthroscopy*. 2018;26(7):2095–102. DOI: 10.1007/s00167-017-4556-0
- Corte-Real N, Caetano J. Ankle and syndesmosis instability: consensus and controversies. *EFORT Open Rev*. 2021;6(6):420–31. DOI: 10.1302/2058-5241.6.210017
- 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(1):1–15. DOI: 10.1186/s13018-018-0933-8
- Clanton TO, Viens NA, Campbell KJ, Laprade RF, Wijdicks CA. Anterior talofibular ligament ruptures, part 2: Biomechanical comparison of anterior talofibular ligament reconstruction using semitendinosus allografts with the intact ligament. *American Journal of Sports Medicine*. 2014;42(2):412–6. DOI: 10.1177/0363546513509963
- Camacho LD, Roward ZT, Deng Y, Daniel Latt L. Surgical management of lateral ankle instability in athletes. *J Athl Train*. 2019;54(6):639–49. DOI: 10.4085/1062-6050-0536-18
- Zhi X, Zhang Y, Li W, Wang Y, Zou Y, Lu L, et al. Absorbable suture anchor and knotless anchor techniques produced similar outcomes in arthroscopic anterior talofibular ligament repair. *Knee Surgery, Sports Traumatology, Arthroscopy* [Internet]. 2022;30(6):2158–65. Available from: <https://doi.org/10.1007/s00167-021-06855-7>
- Dias S, Lewis TL, Alkhalfan Y, Ahluwalia R, Ray R. Current concepts in the surgical management of chronic ankle lateral ligament instability. *J Orthop* [Internet]. 2022;33(April):87–94. Available from: <https://doi.org/10.1016/j.jor.2022.07.006>
- Pereira BS, Peixoto MI, Fabião L, Esteves N, França G, Malheiro FS, et al. Chronic Lateral Ankle Instability Repair Technique Using All-Inside and All-Knotless Soft-Tissue Anchors. *Arthrosc Tech*. 2025 Jun 1;14(6). DOI: 10.1016/j.eats.2025.103471
- Heller GZ, Manuguerra M, Chow R. How to analyze the Visual Analogue Scale: Myths, truths and clinical relevance. *Scand J Pain* [Internet]. 2016;13:67–75. Available from: <http://dx.doi.org/10.1016/j.sjpain.2016.06.012>
- Burn A, Buerer Y, Chopra S, Winkler M, Crevoisier X. Critical evaluation of outcome scales assessment of lateral ankle ligament reconstruction. *Foot Ankle Int*. 2013;34(7):995–1005. DOI: 10.1177/1071100713481669
- Karlsson J, Peterson L. Evaluation of Ankle joint function: the use of a scoring scale. *Foot*. 1991;1(1):15–9. DOI: 10.1016/0958-2592(91)90006-W
- Ghasemi A, Zahediasl S. Normality tests for statistical analysis: A guide for non-statisticians. *Int J Endocrinol Metab*. 2012;10(2):486–9. DOI: 10.5812/ijem.3505
- Chan YH. 101 - Data presentation. *Singapore Med J*. 2003;44(6):280–5.
- SPSS Survival Manual. Vol. 181, Automotive Industries AL. 2016. 718 p.
- Maciej Tomczak, Ewa Tomczak. The need to report effect size estimates revisited. An overview of some recommended measures of effect size. *Trends Sport Sci* [Internet]. 2014;1(21):19–25. Available from: <https://www.researchgate.net/publication/303919832>
- Chan YH. Biostatistics 102: Quantitative Data - Parametric & Non-parametric Tests. *Singapore Med J*. 2003;44(8):391–6.
- Denard PJ, Adams CR, Fischer NC, Piepenbrink M, Wijdicks CA. Knotless Fixation Is Stronger and Less Variable Than Knotted Constructs in Securing a Suture Loop. *Orthop J Sports Med*. 2018;6(5):1–6. DOI: 10.1177/2325967118774000
- Vaishnav S, Millett PJ. Arthroscopic rotator cuff repair: Scientific rationale, surgical technique, and early clinical and functional results of a knotless self-reinforcing double-row rotator cuff repair system. *J Shoulder Elbow Surg*. 2010;19(2 SUPPL.):83–90. DOI: 10.1016/j.jse.2009.12.012

28. Rhee YG, Cho NS, Parke CS. Arthroscopic rotator cuff repair using modified mason-allen medial row stitch: Knotless versus knot-tying suture bridge technique. *American Journal of Sports Medicine*. 2012;40(11):2440–7. DOI: 10.1177/0363546512459170
29. Brown AJ, Shimozone Y, Hurley ET, Kennedy JG. Arthroscopic versus open repair of lateral ankle ligament for chronic lateral ankle instability: a meta-analysis. *Knee Surgery, Sports Traumatology, Arthroscopy* [Internet]. 2020;28(5):1611–8. Available from: <http://dx.doi.org/10.1007/s00167-018-5100-6>
30. Yasui Y, Murawski CD, Wollstein A, Takao M, Kennedy JG. Operative treatment of lateral ankle instability. *JBJS Rev*. 2016;4(5):1–11. DOI: 10.2106/JBJS.RVW.15.00070
31. 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):1701–9. DOI: 10.1177/1071100713502322
32. Guelfi M, Nunes GA, Malagelada F, Cordier G, Dalmau-Pastor M, Vega J. Arthroscopic-Assisted Versus All-Arthroscopic Ankle Stabilization Technique. *Foot Ankle Int*. 2020;41(11):1360–7. DOI: 10.1177/1071100720938672
33. Matsui K, Burgesson B, Takao M, Stone J, Guillo S, Glazebrook M. Minimally invasive surgical treatment for chronic ankle instability: a systematic review. *Knee Surgery, Sports Traumatology, Arthroscopy*. 2016;24(4):1040–8. DOI: 10.1007/s00167-016-4041-1
34. Zhi X, Lv Z, Zhang C, Kong C, Wei S, Xu F. Does arthroscopic repair show superiority over open repair of lateral ankle ligament for chronic lateral ankle instability: A systematic review and meta-analysis. *J Orthop Surg Res*. 2020;15(1):1–12. DOI: 10.1186/s13018-020-01886-1
35. Attia AK, Taha T, Mahmoud K, Hunt KJ, Labib SA, d'Hooghe P. Outcomes of Open Versus Arthroscopic Broström Surgery for Chronic Lateral Ankle Instability: A Systematic Review and Meta-analysis of Comparative Studies. *Orthop J Sports Med*. 2021;9(7):1–12. DOI: 10.1177/23259671211018196
36. Li H, Zhao Y, Hua Y, Li Q, Li H, Chen S. Knotless anchor repair produced similarly favourable outcomes as knot anchor repair for anterior talofibular ligament repair. *Knee Surgery, Sports Traumatology, Arthroscopy* [Internet]. 2020;28(12):3987–93. Available from: <https://doi.org/10.1007/s00167-020-05998-3>
37. Guelfi M, Zamperetti M, Pantalone A, Uselli FG, Salini V, Oliva XM. Open and arthroscopic lateral ligament repair for treatment of chronic ankle instability: A systematic review. *Foot and Ankle Surgery* [Internet]. 2018;24(1):11–8. Available from: <http://dx.doi.org/10.1016/j.fas.2016.05.315>
38. Rigby RB, Cottom JM. A comparison of the “All-Inside” arthroscopic Broström procedure with the traditional open modified Broström-Gould technique: A review of 62 patients. *Foot and Ankle Surgery* [Internet]. 2019;25(1):31–6. Available from: <http://dx.doi.org/10.1016/j.fas.2017.07.642>