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Original Article

Peroneus brevis tendon injury in chronic ankle instability. A comparative study

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Abstract

Objective: To compare the surgical outcome of patients with chronic lateral ligament injury of the ankle, with and without an associated peroneus brevis tendon injury.

Methods: This retrospective comparative study was based on epidemiological analysis and the American Orthopedic Foot and Ankle Society (AOFAS) scores of patients diagnosed with chronic ankle instability who were treated surgically with the Broström-Gould technique. The medical records of 50 patients treated in an orthopedics service between January 2012 and January 2020 were analyzed. The patients were divided into two groups: those with and without a peroneus brevis tendon injury. The following data were also collected: sex, age, comorbidities, and AOFAS score in the pre- and postoperative period (between 90-120 days), as well as other epidemiological data.

Results: Sixteen patients (32%), whose mean age was 43 years and 76% of whom were female, presented with a peroneus brevis tendon injury. The right side (54%) was more commonly affected. The main comorbidities were obesity (14%), slight pes cavus (12%), diabetes mellitus (4%) and depression (4%). The mean improvement in AOFAS score was 41 points. There was a marginal difference in final AOFAS score (p=0.03) between the groups.

Conclusion: The Broström-Gould Technique proved effective for treating chronic lateral ligament injury regardless of an associated peroneus brevis tendon injury. However, the final postoperative results were significantly worse in patients with a peroneus brevis tendon injury than in those without one.

Level of Evidence III; Therapeutic Studies; Comparative Retrospective Study.

Keywords: Ankle joint; Joint instability; Ligaments, articular/injuries; Tendon Injuries.

Introduction

Lateral ankle sprain is one of the most common orthopedic injuries[1]. The lateral ligaments limit the ankle's inversion, keeping it firm in its function and balance[2]. The lateral ligament complex of the ankle is also the most frequently injured structure in sports, with an index varying from 13-56% of all injuries that involve running and jumping, such as soccer, basketball and volleyball[2]. Although patients generally do not remember a specific episode of trauma, they often mention symptoms of chronic lateral ankle instability, which persist for years[3].

The mechanism of this type of injury is forced supination of the hindfoot when initial ankle dorsiflexion changes to plantar flexion[1]. The severity of the injury is classified as grade 1, 2, or 3. Grade 1 is a mild damage to a ligament that does not result in joint instability, grade 2 involves a partial tear and mild joint instability, and grade 3 involves a complete ligament tear and joint instability[4].

Ankle injuries can affect the medial and lateral ligament complexes, but lateral ligament injuries are more common (85% of the cases). Problems associated with lateral ligament injuries include: peroneus brevis tendon injuries, hindfoot varus, alignment abnormalities, retinacular pathology, and anterior ankle impingement[5]. These ankle ligament injuries are responsible for up to 25% of orthopedic consultations[6]. Approximately 20% of these injuries can progress to chronic instability, with anterior talofibular ligament damage occurring in 60 to 70% and calcaneofibular ligament damage in 30%[7].

Study performed at the Conjunto Hospitalar do Mandaqui, São Paulo, SP, Brazil.

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Researchers have correlated peroneus brevis tendon injury (PBTI) and chronic lateral ligament injury of the ankle (CLLI). Thus, an ankle inversion injury can not only damage the anterior talofibular and calcaneofibular ligaments, but the peroneal tendons and superior peroneal retinaculum as well. The central portion of the tendon is almost always injured. In foot eversion during the swing phase, the peroneus longus pulls the peroneus brevis tendon into the retrofibular groove, which is on the posterior border of the fibula. This leads to displacement of the most anterior part of the injured tendon and almost invariably to pain in the posterior aspect of the fibula. In most cases, the damaged tendon goes unnoticed and the diagnosis can be delayed or even overlooked. Due to superior peroneal retinaculum damage, peroneus brevis tendon instability, and tendon tissue degeneration, these cases are usually refractory to non-surgical treatment, and tendon rupture progresses[8]. Although considered uncommon, some cases of PBTI with hypertrophied peroneal tubercle have been described in the literature[9]. Acute post-traumatic PBT injuries have also been reported but are rarer than chronic injuries[10].

CLLI of the ankle occurs when the torn ligament regenerates with weak fibrous tissue or in an elongated state, in addition to proprioceptive deficit or weakness of the peroneus brevis muscle[11]. When not treated correctly, it can cause chronic lateral pain, synovitis with recurrent edema, instability, and loss of function (frequent sprains)[12].

Recovery from an ankle sprain depends on the severity of the injury and the concomitant pathology. Although most sprains recover uneventfully, there is a high rate of new injuries after an initial sprain; up to 34% of patients will suffer a second sprain within 3 years of the initial injury[7].

In addition to a physical examination, magnetic resonance imaging is a useful for visualizing the PBT, allowing anterior talofibular ligament injury and other lateral pathologies of the ankle to be ruled out. In addition, it can be used to assess anatomical variations and bone or soft tissue changes before surgery, such as peroneus quartus, convex fibular groove, bone spur and tendon subluxation[13].

Conservative treatment in the acute phase includes anti-inflammatories, physical therapy, or immobilization for an average of three to six weeks[14]. While 80% of acute ankle sprains can be satisfactorily treated with muscle rehabilitation and strengthening, the remaining 20% of patients continue to suffer from chronic ankle instability and new injuries[15]. Moreover, conservative treatment may not be able to prevent recurrent episodes of PBT dislocation or subluxation[16].

In cases where the patient has not responded favorably to conservative treatment (eg, adequate physical therapy and/or orthosis), surgical stabilization may be appropriate for restoring function, depending on the patient's needs and expectations[17].

There are several surgical techniques for recovering ankle stability, including non-anatomical reconstruction (tenodesis), anatomical reconstruction, and anatomical repair, such as Broström-Gould surgery[7,12]. Broström's anatomical repair, later modified by Gould, was described in 1966 and has since become the gold standard for anatomical repair. It restores the original anatomy of the anterior talofibular ligament, which helps stabilize the subtalar region without restricting its movement[18].

Non-anatomical lateral ankle tendon reconstruction involves transposition of the tendon, such as in the Watson-Jones procedure, the Evans procedure, and the Chrisman-Snook procedure, and is often reserved for patients with generalized ligament laxity or as a revision surgery, since it can sacrifice normal tendons and restrict movement in the tibiotalar and subtalar ankle joints. There is also an increased risk of injury to adjacent cutaneous nerves and of medial degenerative joint disease of the ankle[15].

The present study is relevant due to the high prevalence of this pathology in orthopedic practice, as well as the fact that we could find no other studies directly comparing cases of isolated lateral ligament injuries and those associated with PBTI. Therefore, our objective was to determine whether PBTI associated with ankle ligament instability impacts the results of Broström-Gould surgery regarding quality of life, as well as to obtain an epidemiological sample of patients diagnosed with CLLI.

Methods

This study was approved by the Institutional Review Board and registered on the Plataforma Brasil database under CAAE (Ethics Evaluation Submission Certificate) number: 38111120.4.0000.5551. The patients were informed about the purpose of the study and provided written consent prior to enrollment.

The CLLI and PBTI diagnoses were confirmed through magnetic resonance imaging. The medical records of 50 patients treated at a public orthopedic reference service between January 2012 and January 2020 were examined regarding the inclusion/exclusion criteria.

The inclusion criteria were: patients aged 18 years or older with CLLI of the ankle who underwent Broström-Gould reconstruction. The exclusion criteria were: refusal to grant access to the medical records, age under 18 years, cognitive inability to provide informed consent, acute ligament injury of the ankle (up to 30 days after the trauma), or severe foot injury.

The surgical technique (described below) was performed on all participants by the same surgeon (JMN). The patient was placed in the supine position with a cushion under the ipsilateral hip and a tourniquet was applied at the root of the thigh of the affected leg. When a PBTI was not diagnosed, the incision was a 3-4cm curve over the lateral malleolus of the ankle, which was followed by dissection of the distal fibula and the remaining stump of the anterior talofibular ligament. The lateral talus process was then inspected and any free bodies and/or meniscus were removed. The anterior talofibular ligament was then reinserted into the distal fibula with an appropriate anchor and was reinforced with the periosteal flap and the inferior retinaculum of the extensors. Injured calcaneofibular ligaments were inserted into the fibula using an anchor or a transosseous suture.

When there was a previous diagnosis of associated PBTI, the incision was curved approximately 8cm proximal to the tip of the fibular malleolus and 2cm toward the fifth metatarsal. When there was no previous injury, debridement was performed after opening the superior retinaculum, followed by tunneling the PBT. When the lesion was extensive and the tendon was not viable, proximal and distal tenodesis of the PBT with the peroneus longus tendon was performed, including exeresis of the damaged segment. A 2.0mm anchor was used to reinsert the superior peroneal retinaculum.

In the first 4 postoperative weeks, the patients wore a walking boot and were instructed to avoid weight-bearing. From the 30th to the 45th day, partial weight-bearing was allowed with crutches. Afterwards, the orthosis was removed and the patient began physical therapy with gait training and exercise to regain range of motion. Normal activities of daily living were allowed during this period and contact sports and distance running could be resumed 4 to 6 months later.

The study was based on medical record analysis. In addition to sex and age, the following epidemiological data were collected in the preoperative (approximately 7 days prior to the procedure) and postoperative (between 90 and 120 days after the procedure) periods: laterality, comorbidities, clinical signs, complications, and AOFAS score. AOFAS is a standardized system for evaluating treatment results in individuals with foot and ankle disorders. The instrument has been translated and validated for Brazilian Portuguese. The instrument was applied to all patients during regular consultations.

The patients were divided into two groups: those without a peroneus brevis tendon injury (PBTI-) and those with a peroneus brevis tendon injury (PBTI+). The groups were compared regarding pre- and postoperative AOFAS scores and the improvement index (ie, the difference between the scores). In addition to the direct comparison between groups, an age-corrected comparison was performed with cut-offs below the minimum age of the older group and above the maximum age of the younger group.

Data analysis was performed after compilation in a Microsoft Excel spreadsheet. The large number of medical records analyzed was due to the eight-year data collection period. The Shapiro-Wilk test was used to determine normal distribution. The groups were compared using Student's *t*-test for normally distributed values or the Mann-Whitney U test for nonparametric distribution. The significance level was set at $p<0.05$ (95% confidence interval [CI], $\alpha=0.05$). Age and AOFAS scores were rounded to the nearest whole number.

Results

Since all medical records contained sufficient data and met the necessary criteria, no cases were excluded. Table 1 shows the epidemiological data of the 50 patients, of whom 38 (76%) were female. The mean age was 42 years and 9 months, ranging from 21 to 70 years. Regarding laterality, 27 patients (54%) were affected on the right side.

Regarding ligament injuries that resulted in ankle instability: 26 (52%) patients had an isolated anterior talofibular ligament injury, while in 24 (48%) the anterior talofibular ligament injury was associated with the calcaneofibular ligament. It should be pointed out that 34 (68%) of the 50 patients did not have a PBTI.

Among the complications, superficial dehiscence of the surgical wound occurred in one patient, while a deep infection that required debridement and surgical cleaning occurred in another.

As shown in figure 1, the most common comorbidity was obesity (7 patients, 14%), followed by the slight pes cavus (6 patients, 12%), diabetes mellitus (2 patients, 4%), and depression (2 patients, 4%). The other comorbidities occurred in only 1 patient (2%) each: chondral lesion of the talus, fibromyalgia, anterior ankle impingement, breast cancer (2%) and meniscoid lesion of the ankle (2%).

In relation to relevant clinical tests and symptoms: a positive anterior ankle drawer test was present in all participants. All of the patients with a PBTI had pain on palpation of the peroneal tendons and 90% had perimalleolar edema. These findings reinforce the importance of clinical examination during the preoperative phase.

Half of the patients were physically active (Figure 2): 8 (16%) were runners, 6 (12%) played soccer, 6 (12%) were walkers, 2 (4%) played volleyball, 2 (4%) played handball, 2 (4%) were martial artists and 1 (2%) was a circus acrobat. All patients returned to their regular physical activities after the surgical procedure.

The mean AOFAS score in PBTI- patients ranged from 52 (SD, 9) points preoperatively to 95 (SD, 5) points ($P<0.001$) postoperatively (Table 2). The same pattern of improvement was seen in PBTI+ patients, whose mean AOFAS score ranged from 50 (SD, 7) points preoperatively to 92 (SD, 5) points ($P<0.001$) postoperatively. Thus, the scores of both groups improved after Broström-Gould surgery.

As shown in table 3, the mean postoperative AOFAS score was 92 (SD, 5) for PBTI+ patients and 95 (SD, 5) for PBTI- patients. There was a marginally significant difference ($P=0.03$) in final scores between the groups, which shows that the improvement in the PBTI+ group, although good, was less than that of the PBTI- group. Given the high final scores in both groups, this result was not normally distributed.

Regarding variation in AOFAS scores (Table 3), variations of 42 (SD, 8) and 41 (SD, 7) points occurred in the PBTI- and PBTI+ groups, respectively ($P=0.02$). These data were normally distributed. PBTI had a marginally significant negative impact on both the initial and final scores.

The mean age of the PBTI- and PBTI+ groups was 39 (SD, 13) and 49 (SD, 11) years, respectively ($P=0.019$) (Table 3).

Table 1. Patient epidemiological data

Name	Sex	Age	Laterality	Affected Ligament	PBT lesion	AOFAS Score	Comorbidities	Follow-up	Complications
S.A.D	F	54	R	ATL+CF	No	26-79	Obesity	3 years	-
R.D.L.A	F	37	L	ATL	No	57-100	None	3 years	-
L.I.L	F	52	R	ATL	No	48-92	Obesity	3 years	-
D.S	F	62	R	ATL+CF	No	48-92	None	4 years	-
P.B.D	F	33	R	ATL+CF	No	48-100	Slight pes cavus	2 years	Deep suture dehiscence
C.T.S	F	58	R	ATL+CF	No	30-90	None	3 years	-
C.S.A.D.S	F	38	L	ATL+CF	No	57-90	Obesity, depression	4 years	-
L.M.S.S	F	63	L	ATL+CF	No	48-100	Obesity	4 years	-
D.R.D.B	F	57	L	ATL	No	48-100	None	4 years	-
W.B.P	M	35	L	ATL	No	48-100	None	6 years	-
V.L.D.S.O	F	50	L	ATL	Yes	50-95	None	4 years	-
S.N.D.S	F	53	R	ATL	No	58-95	Depression, Fibromyalgia	5 years	
W.I.M	M	53	L	ATL+CF	No	48-100	None	4 years	-
M.S.D.M.A	F	28	R	ATL	Yes	50-95	None	6 years	-
S.M.B	F	26	R	ATL+CF	No	53-100	None	4 years	-
N.M.D.S.B	F	42	R	ATL	Yes	53-95	None	4 years	-
A.D.S.F	F	26	L	ATL+CF	No	48-95	None	4 years	-
N.M.S	F	60	L	ATL+CF	Yes	48-95	Slight pes cavus	5 years	-
J.M.D.S.A.C	F	29	L	ATL	No	49-95	None	5 years	-
M.A.F.S	F	47	R	ATL+CF	No	49-95	None	5 years	-
M.D.A	M	24	L	ATL	No	48-95	None	5 years	-
L.S.D.B	M	33	R	ATL	No	48-100	None	5 years	-
L.M.M	M	24	L	ATL	No	57-100	None	5 years	-
F.H.C	M	48	L	ATL+CF	No	50-100	None	5 years	-
K.F.T	F	46	R	ATL+CF	Yes	26-90	Obesity, Diabetes mellitus	5 years	-
B.R.B	F	30	R	ATL+CF	No	58-95	None	5 years	-
R.D.P.C	M	38	L	ATL	Yes	58-95	Slight pes cavus	1 years	-
A.A.L	F	43	R	ATL	No	50-80	None	2 years	-
M.A.B	F	49	R	ATL	Yes	50-80	Smoking	18 months	-
S.T	F	40	R	ATL+CF	No	58-95	None	9 months	-
T.A.D.C	F	39	L	ATL+CF	No	50-80	Smoking	6 months	Superficial dehiscence
J.A.F	F	57	R	ATL+CF	Yes	50-90	None	6 months	-
M.A.DB.C	F	40	L	ATL	No	58-95	None	4 months	-
R.B.D.D	F	26	L	ATL+CF	No	73-95	None	6 months	-
L.M.P	M	21	R	ATL+CF	No	73-100	Slight pes cavus	6 months	-
B.P	F	23	L	ATL	No	58-100	None	1 year	-
D.G.B.O	F	63	R	ATL	Yes	50-95	None	2 years	-
G.L.R.S	F	38	R	ATL	Yes	58-95	Slight pes cavus	2 years	-
A.M.G.N	F	70	R	ATL+CF	Yes	50-80	Slight pes cavus	3 years	-
N.M	M	43	L	ATL	No	58-95	Anterior ankle impingement	2 years	-
L.P.M.B	F	27	L	ATL+CF	No	58-95	Meniscoid lesion of the ankle	2 years	-
M.S.B.R	F	55	R	ATL+CF	Yes	50-95	None	2 years	-
V.O.N	M	29	L	ATL+CF	No	58-100	None	3 years	-
C.A.F.K	F	51	R	ATL	No	58-95	Breast cancer	3 years	-
J.A.M	F	39	R	ATL+CF	Yes	58-95	Obesity, Slight pes cavus	3 years	-
C.D	F	64	L	ATL	Yes	50-95	None	3 years	-
F.L	M	60	L	ATL	No	50-90	Chondral lesion of the ipsilateral talus	3 years	-
C.C.M.B	F	42	R	ATL+CF	Yes	50-90	None	5 years	-
H.R.D.A	M	25	R	ATL+CF	No	58-95	None	5 years	-
R.C.R	F	50	R	ATL+CF	Yes	50-90	Obesity	5 years	-

* PBT: peroneus brevis tendon; * ATL: Anterior talofibular ligament; * CF: Calcaneofibular Ligament

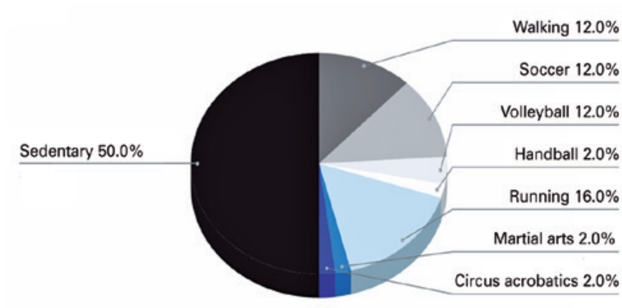

Figure 1. Patient comorbidities.

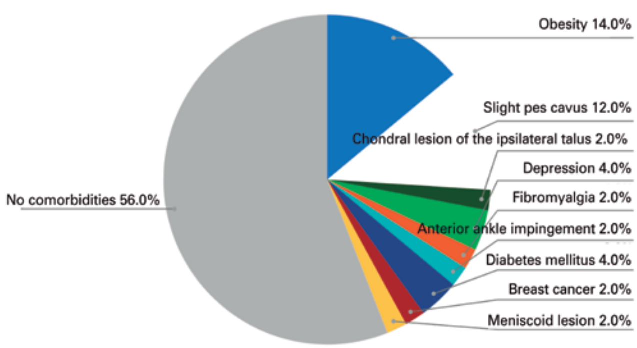

Figure 2. Patient physical activity.

Table 2. Comparison of pre- and postoperative AOFAS scores in patients with or without a peroneus brevis tendon injury; Means and Standard Deviations

	Pre AOFAS	Post AOFAS	P-value
PBTI-	52 ± 9	95 ± 5	<0.001*
PBTI+	50 ± 7	92 ± 5	<0.001*

PBTI-: group without a peroneus brevis tendon injury; PBTI+: group with a peroneus brevis tendon injury; AOFAS: American Orthopedic Foot & Ankle Society score; Pre: preoperative; Post: postoperative.
*: significant P-values for 95% CI.

Table 3. Comparison of AOFAS scores and age between groups of patients with and without a peroneus brevis tendon injury; Means and Standard Deviations

	PBTI-	PBTI+	P-value
Age	39 ± 13	49 ± 11	0.019*
Preoperative AOFAS score	52 ± 9	50 ± 7	0.92
Postoperative AOFAS score	95 ± 5	92 ± 5	0.03*
Score difference (pre vs. post)	42 ± 8	41 ± 7	0.02*

PBTI-: group without a peroneus brevis tendon injury; PBTI+: group with a peroneus brevis tendon injury; AOFAS: American Orthopedic Foot & Ankle Society score.
*: significant P-values for 95% CI.

Discussion

Although the association between PBTI and chronic lateral ligament injury of the ankle has been extensively described in the literature[2,4,14,17], we found no study comparing the effectiveness of Broström-Gould surgery in ligament ankle injuries that specifically assessed the role of PBTI in ankle instability. Due to this lack of data, we developed a comparative study to investigate the impact of associated PBTI in Broström-Gould surgery results.

To calculate the sample size, we initially selected studies by Nery et al.[14] and Gomes-Carlin et al.[18] due to their methodological similarities. However, since the number of cases in our study was higher, we decided to use a convenience sample. We used the AOFAS score to evaluate the results because it encompasses both direct clinical results and the subjective impressions of patients regarding quality of life. Since the final AOFAS scores are quite high, both in the literature and in our study, we used an improvement index based on the difference between the scores, rather than the final scores, to obtain normally distributed values, which did not occur for postoperative period values alone.

Approximately one-third of all assessed CLLI cases had a PBTI, which demonstrates the importance of understanding whether this combination of injuries impacts the final result of the surgical procedure.

Our results corroborate the literature in that Broström-Gould surgery is a very effective treatment for patients with chronic ankle instability. There was important improvement in the mean AOFAS score in all patients, which demonstrates the effectiveness of this surgical technique. The results were good even when there was an associated PBTI[2,4,14,17]. However, more detailed analysis showed that an associated PBTI had a negative impact on postoperative results, since the final postoperative score for the PBTI+ group was significantly lower than that of the PBTI- group. The mean age of the PBTI+ group was approximately 10 years higher than the PBTI- group, which might also explain the difference between groups. Considering that AOFAS scores are sensitive to patient age, analyses that eliminate this confounding factor have become necessary. Although the mean age of the PBTI+ group was higher than that of the PBTI- group, there was a coincident age range of 28 to 63 years old between the groups. The corrected analysis for this age range revealed no difference in score variation or final score between the groups. However, it should be pointed out that there this corrected analysis lost statistical power, since 11 individuals (more than 20% of the initial sample) were eliminated and the PBTI+ score variation data lost normal distribution. Due to this reduction in statistical power, we chose not to publish the age-corrected results. This finding, however, could indicate that age affects the outcome more than a surgically treated PBTI. It should be pointed out that all cases of PBTI received specific treatment for this injury in addition to Broström-Gould surgery to correct CLLI, which may explain the parity of results between the groups.

Without correction for age, the P-values in the AOFAS score comparison between the groups, although significant, were very close to the 0.05 α-value. This study included 50 cases, which is a satisfactory sample compared to previous studies. However, its retrospective observational design reduced the level of evidence. To better understand the role of PBTI in chronic ankle instability, prospective comparative studies (or, preferably, meta-analyses) are necessary, to which this study can contribute.

Conclusion

PBTI associated with chronic lateral ligament instability of the ankle negatively impacts quality of life (AOFAS score) after Broström-Gould surgery. Nevertheless, there was significant improvement in AOFAS scores in both groups, regardless of an associated PBTI.

Authors' contributions: Each author contributed individually and significantly to the development of this article: RSD *(https://orcid.org/0000-0003-2007-2557) Data collection, bibliographic review, formatting of the article, participated in the review process; JMN *(https://orcid.org/0000-0003-2007-2557) Conceived and planned the activities that led to the study, bibliographic review, performed examination, performed the surgeries, survey of the medical records, participated in the review process, approved the final version ; AMO *(https://orcid.org/0000-0003-2364-3183) Statistical analysis, interpreted the results of the study, participated in the review process, approved the final version; CASA * (https://orcid.org/0000-0002-2533-5793) participated in the review process, approved the final version. All authors read and approved the final manuscript. *ORCID (Open Researcher and Contributor ID) iD.

References

1. Bajuri MY, Daun E, Abdul Raof MH, Hassan MR, Das S. Functional Outcome of Modified Brostrom-Gould Procedure Using the PopLok Knotless Suture Anchor Technique in Lateral Ankle Instability. Cureus. 2019;11(6):e4971.
2. Bittar C, Cillo M, Zabeu J, Oliveira M. The functional outcome of operated patients by Broström's technique with chronic lateral ankle instability. Rev ABTPé. 2007;1(2):26-30.
3. Fischetti A, Zawaideh JP, Orlandi D, Belfiore S, SIlvestri E. Traumatic peroneal split lesion with retinaculum avulsion: Diagnosis and post-operative multymodality imaging. World J Radiol. 2018;10(5):46-51.
4. Imoto A, Peccin M, Rodrigues R, Mizusaki J. Translation, cultural adaptation and validation of foot and ankle outcome score (FAOS) questionnaire into Portuguese. Acta Ortop Bras. 2009;17(4):232-5.
5. Chauhan B, Panchal P, Szabo E, Wilkins T. Split peroneus brevis tendon: an unusual cause of ankle pain and instability. J Am Board Fam Med.27(2):297-302.
6. Izquierdo Plazas L, Sanchez Gomez P, Lajara Marco F, Salinas Gilabert J, Aguilar Martinez M, Navarro Gonzalvez F et al. Inestabilidad lateral cronica de tobillo: hallazgos artroscopicos y resultados tras reparacion mediante tecnica de Karlsson. Rev del Pie y Tobillo. 2011;25(1):25-9.
7. Shakked RJ, Karnovsky S, Drakos MC. Operative treatment of lateral ligament instability. Curr Rev Musculoskelet Med. 2017; 10(1):113-21.
8. Karlsson J, Wiger P. Longitudinal split of the peroneus brevis tendon and lateral ankle instability: treatment of concomitant lesions. J Athl Train. 2002;37(4):463-6.
9. Tiwari M, Singh V, Bhargava R. Peroneus brevis attrition & longitudinal split tear without subluxation and associated hypertrophy of peronal tubercle" - treatment of an uncommon lesion. J Orthop Case Rep. 2015;5(1):34-6.
10. Yao L, Tong DJ, Cracchiolo A, Seeger LL. MR findings in peroneal tendonopathy. J Comput Assist Tomogr. 1995;19(3):460-4.
11. Chew CP, Koo KOT, Lie DTT. Periosteal flap augmentation of the Modified Brostrom-Gould procedure for chronic lateral ankle instability. J Orthop Surg (Hong Kong). 2018; 26(1):2309499018757530.
12. 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(2):94-7.
13. Minoyama O, Uchiyama E, Iwaso H, Hiranuma K, Takeda Y. Two cases of peroneus brevis tendon tear. Br J Sports Med. 2002; 36(1):65-6.
14. Nery C, Barroco R, Netto A, Androsoni R, Kalife M. Lesão dos tendões fibulares: avaliação do tratamento cirúrgico. Rev Bras Ortop. 2000;35(1/2):7-12.
15. Shahrulazua A, Ariff Sukimin MS, Tengku Muzaffar TM, Yusof MI. Early functional outcome of a modified Brostrom-Gould surgery using bioabsorbable suture anchor for chronic lateral ankle instability. Singapore Med J. 2010;51(3):235-41.
16. Dangintawat P, Apinun J, Huanmanop T, Agthong S, Chentanez V. New aspect of morphometric study of the superior peroneal retinaculum: pertinent data for surgical repair and reconstruction. Folia Morphol (Warsz). 2019 Nov 14.
17. Vuurberg G, Pereira H, Blankevoort L, van Dijk CN. Anatomic stabilization techniques provide superior results in terms of functional outcome in patients suffering from chronic ankle instability compared to non-anatomic techniques. Knee Surg Sports Traumatol Arthrosc. 2018;26(7):2183-95.
18. Gomez-Carlin LA, Ramirez-Gomez VJ, Torres-Ortega AE, Contreras-Navarro AM, Ortega-Orozco R. [Clinical and functional results of the Brostrom-Gould technique for lateral ankle instability: evaluation with three scales]. Acta Ortop Mex. 2018;32(2):93-7.