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Original Article

Mechanical instability after acute ankle ligament injury: randomized prospective comparison of two forms of conservative treatment[★]

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Objective: This trial has the objective to investigate the incidence of mechanical ankle instability after the conservative treatment of first episode, severe ankle ligamentar lesions. This common lesion affects young, professional and physical active patients, causing important personal and economic consequences. There are difficulties related to adequate diagnosis and treatment for these lesions. **Method:** 186 patients with severe ankle ligament lesions were included in this trial. They were randomized in two treatment options. In group A patients were treated using ankle long orthosis, weight bearing allowed as comfortable, pain care, ice, elevation with restricted joint mobilization for three weeks. After that they were maintained in short, functional orthosis (air cast), starting the rehabilitation program. In group B patients were immobilized using a functional orthosis (air cast), following the same other sequences that patients in group A. **Results:** We did not find significant differences in relation to the residual mechanical ankle instability between both groups. We did not find differences in the intensity of pain, but the functional evaluation using AOFAS score system showed better results in the functional treatment group. **Conclusion:** The functional treatment (Group B) had better AOFAS score and few days off their professional activities, comparing with patients treated with rigid orthosis (Group A), without increased chance in developing ankle mechanical instability.

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Instabilidade mecânica pós-lesão ligamentar aguda do tornozelo. Comparação prospectiva e randomizada de duas formas de tratamento conservador

R E S U M O

Palavras-chave:

Articulação do tornozelo
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Objetivo: O presente trabalho tem como objetivo a avaliação da incidência da instabilidade articular mecânica resultante do tratamento conservador de lesões ligamentares agudas graves do tornozelo em pacientes sem antecedentes de traumas nessa articulação. Métodos: Foram incluídos neste estudo 186 pacientes portadores de lesão ligamentar aguda grave do tornozelo. A amostra foi randomizada em dois grupos de tratamento. Os pacientes incluídos no grupo A foram tratados com imobilização suropodálica imediata, carga permitida conforme tolerado, analgesia, gelo, elevação e mobilização leve da articulação do tornozelo por três semanas. Em seguida os pacientes foram imobilizados com ortese curta funcional (tipo air cast esportivo) e encaminhados para programa de reabilitação fisioterápica. No grupo B os pacientes foram imobilizados no primeiro atendimento com ortese curta funcional, carga permitida conforme tolerado, analgesia, gelo, elevação e mobilização leve da articulação por três semanas e em seguida encaminhados para programa de tratamento fisioterápico, como no outro grupo. Resultados: Não encontramos diferença significativa com relação à evolução para instabilidade mecânica entre os grupos. Da mesma forma não houve diferença na incidência de dor, mas a avaliação por meio do método de pontuação da Associação Americana dos Cirurgiões de Pé e Tornozelo (AOFAS) mostrou melhores resultados nos pacientes submetidos ao tratamento funcional. Conclusão: O tratamento funcional, grupo B, teve melhores resultados na escala de pontuação AOFAS, comparativamente ao grupo tratado com ortese rígida (Grupo A), sem haver maior chance de evolução para instabilidade articular mecânica.

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Introduction

Ankle ligament injuries are among the commonest causes of medical attendance at emergency services and consultation offices.

They most frequently affect young patients who are involved in regularly practicing physical activities and who are professionally active. For this reason, the treatment should have the objectives of normalizing joint function (normal mobility and joint stability) and enabling a return to the professional and physical activities of daily living prior to the occurrence of the injury, as early as possible.

Ligament injuries are classically categorized in accordance with their severity, as grade 1, spraining of the ligament affected; grade 2, partial injuries, without joint instability; and grade 3, complete injury, with compromised joint stability. Cases of partial ligament injury are basically treated in a conservative manner, with an early return to the activities prior to the injury. Acute ligament injuries with joint instability were the focus of the present study, given that the incidence of residual mechanical instability after this type of injury is still a matter of discussion in the literature. There are situations in which functional instability is confused with mechanical instability.

Uniformization of treatment methods, with use of commercially accessible orthoses, makes it possible to compare the results from such procedures more adequately and makes it easier to reproduce them. In the literature, this matter is imperfectly addressed, given that many treatment methods

for ankle ligament injuries that are not easily reproducible are described.

We found discussions on treatment methods in the literature, but there is a consensus that in cases of severe acute injuries without previous chronic instability, the treatment should be conservative. Surgical treatment is reserved for patients who evolved into situations of chronic mechanical joint instability.

Lack of immobilization in half of the patients with acute ankle ligament instability and a rapid return to activities may interfere with the healing process, with consequent greater chance of developing chronic mechanical instability.

Despite adequate description of the mechanism of such injuries, the physical examination and the diagnostic criteria, a recent Brazilian study¹ showed that orthopedists and residents have difficulties in making a proper diagnosis and in classifying acute ankle ligament injuries, and that there is no consensus regarding the ideal treatment.

The present study had the objective of evaluating the incidence of mechanical joint instability resulting from conservative treatment of acute ankle ligament injuries, by means of clinical and radiographic evaluations, among patients without histories of trauma in this joint, divided randomly into two groups. In the first group, the patients were initially immobilized using a long orthosis from the calf to the foot for three weeks, followed by a functional orthosis for another three weeks. In the second group, after making the diagnosis,

the patients were immediately immobilized using a functional orthosis, which was maintained for six weeks.

The present authors' expectation was that the results from the two forms of treatment would be equivalent. Through this, it would be possible to treat patients with severe ankle ligament injuries and allow an earlier return to activities of daily living and professional activities with the same security as in forms of treatment involving longer periods of rigid immobilization. The possibility of treating severe ligament injuries using only one type of orthosis would make the treatment less expensive and might accelerate patients' return to their activities of daily living and professional activities, which would diminish the economic consequences of this extremely common injury.

Sample and methods

This study included 186 patients with severe acute ankle ligament injury who were attended at the emergency unit of Hospital Israelita Albert Einstein and at the first author's consultation office.

The sample size calculation started from the assumption that there would be a 15% difference between the Air and Robot groups. We used an alpha error < 0.05 and study power > 0.80 . Thus, the calculation resulted in 76 patients for each group (with 15% losses, we would have 90 patients in each group). The sample was sufficient to allow adequate analysis of the results.

The Research Ethics Committee of Hospital Israelita Albert Einstein gave prior approval for this study.

The initial diagnosis was based on the history, given that the sensation of cracking at the time of the trauma and the incapacity to bear weight either immediately or some hours after the episode suggested that this was a more severe injury;² on physical examination, with investigation of painful points; and on joint stability, by means of tests on anterior drawer stability and varus talar tilt, in comparison with the normal contralateral side.

Patients whose ankles presented clinical instability, with signs of complete ligament injury, underwent magnetic resonance imaging to confirm and stage the injury (by identifying which of the ligaments were involved in the injury) and search for any associated injuries. We also used magnetic resonance imaging to assess the presence of any anatomical variations that might interfere with the final result from the treatment, through provoking any situation of ankle joint overload, such as cases of complete or functional tarsal bars, or signs of pathological conditions that would cause subtalar stiffness. The posture of the feet was taken into consideration in evaluating the patients included in this study, since a meta-analysis conducted by Morrison and Kaminski³ found a correlation between the incidence of ankle twisting and the presence of a high medial longitudinal arch and cavovarus foot.

The presence of generalized ligament laxity was investigated by evaluating the following signs: passive extension of the fingers beyond 90°; apposition of the thumb to the flexor face of the respective forearm; elbow hyperextension beyond 10°; knee hyperextension beyond 10°; and trunk flexion with the knees completely extended such that the palms of the hand rested on the floor.⁴

Inclusion criteria

The patients included in this study presented complaints of a first episode of ankle joint twisting, with a history and clinical signs that would indicate a severe injury. These patients were attended either at the first-attendance unit of Hospital Israelita Albert Einstein or at the first author's consultation office.

Each individual thus selected was properly informed regarding the experiment and was asked to sign the consent statement for participation in the study. The patients underwent magnetic resonance examination on the affected ankle in order to confirm the presence of the ligament injury that had been noticed in the physical examination, and to rule out any presence of associated injuries that might interfere with the result from the conservative treatment that would be implemented. Some authors⁵ have observed high incidence of such injuries, with up to 66.7% presenting cartilage injuries of the talar dome.

Exclusion criteria

Presence of any of the following conditions was considered to be a patient exclusion criterion in this study: history of previous twisting of the ankle; history of fractures in the extremity affected; association with major fractures (with the need for treatment differing from what was proposed); syndesmosis injuries; burns; lacerations; stabbing-bruising wounds; presence of an open growth plate; age under 15 years or over 65 years; pregnancy or plans to become pregnant; chronic pathological conditions; incapacity to follow the proposed treatment;⁶ clinical signs of generalized ligament laxity (hyperextension of the thumbs, elbows and knees)⁴; and histories of neurological or vestibular impairment.

Fifteen patients were excluded from this study because they presented the following situations: fracture without displacement of the talus (four cases); fracture of the posterior portion of the tibia without displacement (three cases); fracture of the anterior tuberosity of the calcaneus (three cases); syndesmosis ligament injuries (two cases); associated burns (one case); and failure to return for reassessment (two cases).

Patients with single fractures related to ligament injury were maintained within the protocol.⁷

The patients were randomly divided into two groups (A and B) to undergo one of two types of treatment. The draw was done previously, such that a token indicating the form of treatment was drawn in the order of patients' inclusion in the study.

The patients included in group A were treated using immediate immobilization from the calf to the foot, with weight bearing as tolerated, analgesia, ice, elevation and mild ankle joint mobilization for three weeks. They were then immobilized using a short functional orthosis (a sports air cast) and were referred to a physiotherapeutic rehabilitation program.

In group B, the patients were immobilized at the first attendance using a short functional orthosis, with weight bearing allowed as tolerated, analgesia, ice, elevation and mild ankle joint mobilization for three weeks, and were then sent to a physiotherapeutic treatment program, like in the other group.

The rehabilitation program started in the third week after the trauma. The phases of the rehabilitation are described below, according to the week.

Week 4 after the trauma: analgesia, edema control and mild kinesiotherapy, with mobilization of the ankle without doing inversion or forced plantar flexion (limit set according to discomfort), gait training, mild proprioception and muscle strengthening by means of isometric exercises.

Weeks 5 and 6: progression of the muscle strengthening, proprioception exercises and gait exercises, with care in relation to limitations on inversion and forced plantar flexion.

Week 7: mobilization of the ankle in all directions, strengthening exercises and proprioception gradually becoming more advanced.

Week 8: progression of the proprioception exercises with an elastic bed and spring balance.

Week 9: start of exercises involving change of direction and abrupt interruption of movement.

Weeks 10 to 12: resumption of specific exercises and habitual physical activities.

The patients were kept in the rehabilitation program until their normal muscle strength and normal proprioception returned, in comparison with the normal contralateral side.

The patients were evaluated after one, three and six weeks, through a questionnaire evaluating their degree of pain, limitations on daily activities, general state of satisfaction and physical examination.

In the third month, we produced radiographs using manual stress (anteroposterior radiograph of the ankle with varus stress and lateral radiograph of the ankle with anterior drawer stress). The evaluators responsible for the technical examinations were trained by the first author to compare the efficiency of these examinations with that of the physical examinations, with regard to determining the presence of mechanical joint instability. We took joint instability to be situations of variation of more than 5 mm of anterior displacement of the talus under the tibia on x-rays with anterior drawer stress or variation greater than 5° on x-rays with varus stress.⁸

This evaluation was done by means of two different measurements, using digital imaging software, with an interval of two weeks between the measurements. The radiograph evaluators were two doctors who were unaware of the treatment method that had been used. This evaluation in double-blind format on the results from the stress radiographs made it possible to validate the inter and intra-observer variability of the angle measurements on digital radiographs produced with ankle stress, as well as ruling out the possibility that knowledge of the treatment method might influence the results from the measurements.

Results

In evaluating the baseline data on the patients included in this study, we noted that the distribution was homogenous, as shown in Table 1.

Table 1 – Database on the patients included in the two treatment groups.

Evaluation database	Group Air cast (n = 92)	Group Robot foot (n = 94)	p	Test used
Sex (female, %)	38	42	NS	X ²
Side (right, %)	42	51	NS	X ²
Age (years, mean ± SD)	32.8 ± 21.2	32.6 ± 12.1	NS	Kolmogorov Student's t test
Location of the pain/edema (AL/AL and SML/Al, SML and PL/AL, SML, PL and MM)	9/27/24/32	5/15/23/51	0.030	X ²
Support capacity (no, n/%)	57/62	74/78.5	0.012	X ²
Incapacity for immediate weight-bearing (yes, n/%)	92/100	93/99	NS	X ²
VAS pain (mean ± SD)	6.6 ± 1.4	7.1 ± 1.3	0.013	Kolmogorov Student's t test
Other pains (no, n/%)	89/97	86/92	NS	X ²
Drawer test (yes, n/%)	92/100	94/100	NS	X ²
Associated lesions (no, n/%)	91/99	91/97	NS	X ²
Type of foot (Plantigrade, n/%)	88/96	88/94	NS	X ²
Subtalar mobility (normal, n/%)	92/100	94/100	NS	X ²
Midtarsal mobility (normal, n/%)	90/98	94/100	NS	X ²
Ligament laxity (no, n/%)	92/100	94/100	NS	X ²

Table 2 - Trauma mechanism relating to the injury.

Trauma mechanism	Frequency	Percentage
Soccer	59	31.72
Irregular ground	50	26.88
Running	15	8.06
Stairs	13	6.99
Volleyball	10	5.38
Tennis	9	4.84
Small height	8	4.30
High jump	6	3.23
Ballet	2	1.07
Basketball	2	1.07
Handball	3	1.72
Jumping	2	1.07
Car	2	1.07
Run over	1	0.54
Boat	1	0.54
Badminton	1	0.54
Horse	1	0.54
Squash	1	0.54
Numb foot	1	0.54
Total	186	100.0

This situation of similarity between the treatment groups showed the efficiency of the randomization process. The trauma mechanisms associated with the injury are listed in Table 2.

Table 3 shows the evaluation made one week after the injury. At this phase of the evaluation, we noted that there was only a difference between the two forms of treatment in relation to the comfortableness while walking and the AOFAS score, such that greater numbers of patients in the group treated with a sports air cast orthosis felt comfortable while walking, and this group also had higher AOFAS scores. The ligaments affected were as shown in Table 4.

We observed that 100% of the patients presented injuries to the anterior talofibular ligament; 82.5% and 87.2% to the calcaneofibular ligament; and 43.5% and 49% to the deep deltoid.

At the next evaluation, three weeks after the treatment started, all the patients in this study presented stability in the physical examination, which was demonstrated by disappearance of the anterior drawer signal, except in patient 69, who continued to present a clinically unstable ankle. Table 5 shows our results at this point in the evaluation. Here, we observed greater mean pain (although the difference was insufficient to configure a clinical variation) and AOFAS score in the group treated with a long orthosis. The number of days off work was significantly different such that it was greater in the group treated with the long orthosis. The results from the evaluation after six weeks are shown in Table 6.

At this point, when orthosis use was discontinued, we observed greater AOFAS scores in the group treated with a functional orthosis, without any difference in relation to pain, limitation on activities of daily living or joint mobility. The AOFAS score was significantly different only in the evaluation in the first week, according to the number of ligaments injured, and it was worse when three ligaments were injured, in comparison with one or two. These results are in Table 7.

Twelve weeks after the trauma, we were no longer able to see any differences between the two groups, as shown in Table 8.

The clinical evaluation on joint stability by means of the anterior drawer test did not show any difference between the

Table 3 - Data evaluated one week after the injury.

After one week of treatment	Group Air cast (n = 92)	Grupo robot foot (n = 94)	p	Test used
Location of the pain/edema (AI/AL and SML/AI, SML and PL/AL, SML, PL and MM)	5/29/28/30	3/17/29/45	NS	X ²
Intensity of edema (1+/2+/3+/4+ in 4)	10/57/24/1	6/50/33/5	NS	X ²
VAS pain (mean ± SD)	3 ± 1.4	3.3 ± 1.5	NS	Kolmogorov Teste U de Mann-Whitney
Comfortable when walking (yes/no/partially)	53/14/25	37/26/31	0.029	X ²
Weight-bearing capacity (yes, %)	71/77	58/62	NS	X ²
AOFAS (mean ± SD)	67 ± 10.8	61 ± 11.2	0.00003	Kolmogorov Teste U de Mann-Whitney
Is the associated injury an anatomical abnormality?				

Table 4 - Ligaments affected.

LIGG injury	Air group (n = 92)	Robot group (n = 94)
FTA (n/%)	92/100	94/100
CF (n/%)	76/82.5	82/87.2
FTP (n/%)	0	0
DPROF (n/%)	40/43.5	46/49
DSUP (n/%)	0	0

groups, with the exception of one case that evolved with joint instability, in the group initially treated with a long orthosis. There was no difference in the values for the angles measured on the radiographs with stress, between the two groups.

By defining instability as variation of 5° in the varus test and 5 mm in the anterior drawer test and comparing the values with those of the normal contralateral ankle, we observed that there was no difference with regard to radiographic evaluations with stress and the clinical examination (Table 9).

Table 5 - Data evaluated three weeks after the injury.

After three weeks of treatment	Air cast group (n = 92)	Robot foot group (n = 94)	p	Test used
Location of the pain/edema (without edema/Al/AL and SML/AL, SML and PL)	8/65/19/0	2/65/26/1	NS	X ²
VAS pain (mean ± SD)	1.4 ± 1.2	1.7 ± 1.2	0.034761681	Kolmogorov Mann-Whitney U test
Capacity for weight-bearing (yes, %)	88/96	86/92	NS	X ²
AOFAS (mean ± SD)	84.8 ± 8.8	79.5 ± 9.2	0.00004	Kolmogorov Mann-Whitney U test
Number of days off work (mean ± SD)	3.90 ± 2.66	7.00 ± 3.78	< 0.01	Kolmogorov Mann-Whitney U test

Table 6 - Evaluation six weeks after the injury.

After six weeks of treatment	Group air cast (n = 92)	Group robot foot (n = 94)	p	Test used
VAS pain (mean ± SD)	0.5 ± 0.75	0.75 ± 0.93	NS	Kolmogorov Mann-Whitney U test
AOFAS (mean ± SD)	94.3 ± 6.6	90.5 ± 10.6	0.02754	Kolmogorov Mann-Whitney U test
ROM (normal/moderate/severe)	83/7/2	81/11/2	NS	X ²
Limitation on ADLs	87/0/5/0	83/4/6/1	NS	X ²
None/Driving/Proprioception/Work).				

Table 7 - Variation of pain according to number of ligaments injured.

Number of ligaments affected	AOFAS		
	1 week	3 weeks	6 weeks
1 (mean ± SD)	67.38 ± 9.42	96.24 ± 6.88	98.26 ± 4.16
2 (mean ± SD)	66.06 ± 9.73	98.77 ± 3.7	99.55 ± 2.2
3 (mean ± SD)	60.7 ± 12.76	97.44 ± 5.47	98.84 ± 3.18
Anova	p = 0,002	NS	NS
post hoc Bonferroni	3 ligaments affected differed from individuals with 1 or 2 ligaments affected		

Table 8 - Data observed in evaluation three months after the injury.

After 12 weeks of treatment	air cast Grup (n = 92)	robot foot Grup (n = 94)	p	Test used
Clinical condition?			NS	X ²
AOFAS (mean ± SD)	98.4 ± 4.4	97.4 ± 5.5	NS	Kolmogorov Mann-Whitney U test
Limitation on ADLs (None/Driving/Proprioception/Work)	87/2/3/0	80/4/9/1	NS	X ²
Varus nl (degrees, mean ± SD)	3.05 ± 2.93	3.45 ± 2.50	NS	Kolmogorov Student's t test
Varus affected (degrees, mean ± SD)	3.3 ± 2.2	3.45 ± 2.93	NS	Kolmogorov Teste t de Student
Drawer nl (mm, mean ± SD)	4.63 ± 1.35	4.76 ± 1.46	NS	Kolmogorov Student's t test
Drawer affected (mm, mean ± SD)	4.74 ± 1.45	4.82 ± 1.46	NS	Kolmogorov Student's t test

Table 9 - Instability observed on radiograph with stress, according to treatment group.

After six weeks of treatment	Group Air (n = 73)	Grupo Robot (n = 81)	p value	test used
No (n/%)	73/100	80/99	NS	X ²
Yes (n/%)	0	1/1		

Discussion

The commonest trauma mechanism for ankle ligament injuries consists of twisting the ankle with inversion, plantar flexion and internal rotation. The lateral ligaments are the structures most frequently injured in trauma involving twisting of the ankle, particularly the anterior talofibular and calcaneofibular ligaments.⁹ The findings from our cases are concordant with the literature, since all the patients presented injury to the anterior talofibular ligament and more than 80% of them presented associated injury to the calcaneofibular ligament and 43% and 49% (two treatment groups) to the deep deltoid.

Injury to the deep deltoid ligament is related to abnormal variation of the talus inside the malleolar pincer, with consequent impact between the talus and the internal face of the medial malleolus, leading to contusion of the ligament at this locality.

The incidence of severe ligament injuries is around 15% of all sprains of this joint,⁶ and among these patients, 71% suffer the injury during physical activity, 26% in domestic accidents and 3% at work. We observed anterior talofibular ligament injuries in 100% of the patients, calcaneofibular injuries in 82.5% and 87.2%, and deep deltoid injuries in 43.5% and 49%.

Through evaluating the patient distribution in this study between the treatment groups, we observed small variations in the capacity for weight-bearing soon after the trauma, which were more frequent among the patients treated with the functional orthosis initially, and in the intensity of pain evaluated according to the visual analogue scale. We consider that this variation was of little importance, since the difference observed between the groups was less than 2 (0.5), and this value is considered to be insufficient to determine differences in pain intensity.¹⁰ We also observed a difference between the treatment groups regarding the location of the pain, but we did not consider this to be important.

In São Paulo (a city with a population of 10 million people), 1,000 lateral ankle ligament injuries occur every day, thus affecting 500 economically active individuals (half of the population between the ages of 20 and 65 years).¹ If it is considered that the consequence for each individual is 14 days without working, this means 1,750 absences from work per day and 1,277,500 absences per year, in relation to this pathological condition. Since the average salary among these workers was R\$ 818.00 per month this year, this leads us to an annual cost of R\$ 34 million. This confirms the need for adequate standardization of approaches, based on the effectiveness, cost and safety of the treatment.

We classified the acute ligament injuries in accordance with Chart 1 (West Point grading system for ankle ligament injuries), since we agree that what differentiates the injuries is basically the presence of joint instability as a consequence of the injury, which occurs in cases of complete injuries, even if only one ligament is affected (anterior talofibular).

Proper history-taking and detailed physical examination are the keys to adequate diagnosing of severe acute ankle ligament injuries.¹¹ Making the clinical diagnosis is dependent on the experience of the surgeon who performs the stability tests, and this presents variation between observers.¹²

In our opinion, based on observation of the sample of this study, an initial clinical evaluation performed delicately

enables identification of joint instability through a positive anterior drawer test.¹³ This test is performed starting with the knee flexed at 90 degrees and the ankle in the neutral position. One hand is then placed on the distal tibia and palm of the other hand on the calcaneus. Pressure is then applied in opposing directions. The anterior displacement of the talus can be viewed, felt and palpated by the examiner. Presence of pain, a perception of subluxation and the suction sign (depression of the skin on the anterolateral face of the ankle at the time of the test) are described as positive findings.¹⁴

The evaluation one week after the trauma showed that the AOFAS score was greater among the patients treated with the functional orthosis, thus indicating that the patients were better off with the functional immobilization. This had been expected, but the greater comfortableness when walking and the fact that there was no difference in reported pain were contrary to our initial expectation that the orthosis that provided greater stability would also provide greater comfort for patients during the initial stages of the clinical treatment.

In the evaluation conducted three weeks after the trauma, we observed that there was greater mean pain (although the difference was insufficient to configure clinical variation) and higher AOFAS scores among the patients in the group immobilized with the long orthosis. At this evaluation, all of the patients except number 69 (who evolved with chronic joint instability) had already ceased to present clinical signs of joint instability.

The number of days off work was significantly greater in this group. After six weeks of treatment, when the orthosis was removed for activities of daily living, and when the patient returned to physical activities (with protection using the functional orthosis), only the AOFAS scoring was different between the groups, such that it was higher among the individuals immobilized with a functional orthosis.

At the three-month evaluation, there was no longer any difference between the groups (Table 8). At this point, the stability was evaluated by means of radiographs using manual stress. The x-ray with varus stress on the ankle was done using the anteroposterior or pincer position while forced inversion was performed on the ankle in a position of slight plantar flexion. The angle between the tibial pilon and the proximal portion of the talar dome was measured (Fig. 1).

The anterior drawer test was performed by means of a lateral radiograph on the ankle while attempts were made to perform anterior translation of the talus in the malleolar pincer.¹⁵ The measurement of the perpendicular between the most posterior point of the joint surface of the distal tibia and the adjacent talar dome corresponds to the anterior translation of the talus in the malleolar pincer¹⁶ (Fig. 2).

We took the normal values to be up to 5 mm of anterior translation and 5° of talar tilt, in conformity with data in the literature.⁸

We did not observe any difference between the radiographic findings under stress and the physical examination. Magnetic resonance reliably confirms the presence of lateral ligament injury and helps in identifying injuries associated with ankle ligament injuries, particularly the presence of fibular and posterior tibial tendon injuries, osteochondral lesions of the talus and contusional edema of the talus, among others.¹⁷



Figure 1 - Stress in radiographic varus.



Figure 2 - Stress in radiographic anterior drawer.

We used this examination to rule out the presence of associated injuries that might necessitate specific treatments. This was the situation of 15 patients who were initially enrolled for the study presented here.

Three weeks after the injury, the phase of scar tissue maturation begins. At this time, the collagen fibers mature and become fibrous scar tissue.¹⁸ Muscle stretching movements and controlled joint mobilization not only favor orientation of the collagen fibers along the stress lines but also prevent the deleterious effects of immobilization on the joint cartilage, bone tissue and muscles and tendons. After six to eight weeks, the new collagen fibers already tolerate normal demands. However, the remodeling process on ligament injuries lasts for 6 to 12 months.¹⁹ These facts form the basis for the initial protection period of three weeks without any major mechanical demands; the presence of joint stability observed three weeks after the injury through physical examination; and the start of the motor rehabilitation process, with limitation of inversion or forced plantar flexion of the ankle (so that no demands are placed on the scar tissue before this attains normal resistance).

A survey of Brazilian orthopedists¹ showed that severe acute ankle ligament injuries were treated conservatively, with rigid immobilization, by 63.7% of the interviewees, surgically by 40.5%, using physiotherapy by 24.3% and using functional immobilization by 16.2%. We have noticed that there is no homogeneity in diagnosing or treating severe ankle ligament injuries and, moreover, that there is uncertainty regarding the real incidence of residual instability of the ankle joint, since this situation is not differentiated from other forms of unsatisfactory results after this injury.

The most recent meta-analysis, which included 16 randomized or quasi-randomized studies that compared the results from conservative and surgical treatment for ankle ligament injuries,²⁰ concluded that there was insufficient evidence regarding the best form of treatment for these injuries. The recommendation was that the complications and high cost relating to the surgical procedure should be taken into consideration. The best option for most patients is conservative treatment with careful follow-up, in order to identify individuals who continue to show symptoms.

Another meta-analysis²¹ allowed the conclusion that functional treatment has more favorable results, with a higher percentage of patients who return to sports, shorter time taken to return to work, lower levels of residual edema, smaller limitations on mobility, less sensation of instability and greater satisfaction.

The intension in the present study was to use orthoses that are easily found on the market, so that it becomes possible to adequately reproduce this study and facilitate future papers involving larger numbers of patients, in multicenter studies.

Our study showed that both of the proposed methods produced very good results regarding mechanical stabilization of ankle ligament injuries that were treated conservatively. The differences observed related to greater pain in the three-week evaluation in the group with the long orthosis and, also in this group, greater functional incapacity (AOFAS score) in the evaluations after one, three and six weeks. After three months, there were no differences between the groups.

Several authors have agreed that conservative treatment is ideal. In cases of residual mechanical instability, a secondary ligament reconstruction procedure can be implemented, even if years have elapsed since the injury, with excellent results.^{22,23}

Occurrences of repeated spraining and persistent symptoms (pain during physical activity, recurrent edema, weakness and feelings of instability) have been considered to represent chronic instability of the ankle. The mechanical factors included pathological laxity (understood to be greater mobility in relation to normal and on the normal contralateral side, caused by failure of the ligament structures), alteration of the kinematics of the elbow and degenerative synovial alterations. The functional factors include altered proprioception, altered neuromuscular control, strength deficits and deficient postural control.^{24,25}

We consider that the presence of functional instability (feelings of instability without mechanical instability of the joint) is responsible for recurrence of the injury and for the consequent poor results observed by several authors. This situation can be prevented and treated by means of an appropriate rehabilitation program, with the aim of restoring muscle strength, normal gait, balance and proprioception.

Conclusions

1. Conservative treatment of severe acute ankle ligament injuries leads to mechanical stability of this joint in a large proportion of the cases.

2. There was no difference in the joint stability results, comparing between the two conservative treatment groups.

3. The patients who underwent initial treatment using a functional orthosis (sports air cast) presented less pain and better functional results than seen in the group initially immobilized using a long orthosis (robot boot).

4. The clinical examination was equivalent to the x-ray examination with regard to manual stress in evaluating ankle joint stability.

Conflicts of interest

The authors declare no conflicts of interest.

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