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Evidence-based treatment choices for acute lateral ankle sprain: a comprehensive systematic review

D. ALTOMARE[1,2], G. FUSCO[1,2], E. BERTOLINO[1], R. RANIERI[1,2], C. SCONZA[1,2], M. LIPINA[3], E. KON[1,2], M. MARCACCI[1,2], L. BIANCHINI[1], B. DI MATTEO[2,3]

[1]Department of Biomedical Sciences, Humanitas University, Pieve Emanuele, Milan, Italy
[2]IRCCS Humanitas Research Hospital, Rozzano (MI), Italy
[3]Department of Traumatology, Orthopaedics and Disaster Surgery, Sechenov First Moscow State Medical University (Sechenov University), Moscow, Russia

Abstract. – OBJECTIVE: Lateral ankle sprains are very common injuries that can be treated with different strategies. The aim of the present systematic review was to provide a comprehensive analysis on the treatment of acute lateral ankle sprains to clarify the possible differences in outcome between surgical and conservative management, different external supports, and different rehabilitation protocols.

MATERIALS AND METHODS: A literature search on three different topics was carried out on PubMed, Scopus, and Web of Science databases on June 25th, 2021. The main objective of the literature search was to identify the randomized trials comparing: (1) surgery to conservative management, (2) different external supports, and (3) different rehabilitation protocols for the treatment of acute lateral ankle sprains. Two investigators extracted independently relevant data from each paper and assessed the quality of the trials using the Cochrane Risk of Bias Assessment.

RESULTS: A total of 12 studies for the first topic, 8 for the second one and 4 for the last one were included in this review. 8 out of 12 RCTs demonstrated a superior outcome and better socio-economic impact of conservative treatment compared to surgical management. In the other two comparisons, due to the wide variety of braces used and the different rehabilitation protocols, inconclusive results were obtained.

CONCLUSIONS: Conservative treatment should be the first choice for severe acute lateral ankle sprains, as it provides satisfactory functional outcomes without the risks and costs of surgery. It was not possible to identify the best external support, but a preference toward flexible braces emerged since they allow an earlier return to daily activities. The paucity of studies comparing different rehabilitation protocols precluded the possibility of defining the ideal one.

Key Words:
Acute lateral ankle sprain, Surgery, Conservative, External support, Bracing, Rehabilitation.

Introduction

Ankle sprains are the most common injuries that lead to visiting the Emergency Department. Acute lateral ankle sprains (ALAS) are the most frequent type of ankle sprains and are associated with a high recurrence rate and risk of developing chronic ankle instability (CAI). In the U.S. around 2 million ALAS occur annually. An incidence rate of 2 to 7 acute ankle sprains/1000 person-years has been reported from Emergency Departments. In athletes it is estimated an incidence rate of 0.93/1000 athlete-exposures (1 athlete exposure is equal to 1 athlete participating in 1 competition or practice)[1].

ALAS are classified based on the gravity of injury of the ligamentous complexes involved. Hamilton differentiates lateral ankle sprains in 3 grades. Grade I lateral ankle sprain is characterized by partial rupture of the anterior talofibular ligament, inconclusive anterior drawer test and negative talar tilt test. Grade II lateral ankle sprain presents with complete rupture of the anterior talofibular ligament, sprained calcaneofibular ligament, positive anterior drawer test and normal talar tilt test. Grade III lateral ankle sprain indicates complete rupture of all 3 lateral ankle ligaments, significantly positive anterior drawer test and talar tilt test and presence of ankle instability[2].

Corresponding Author: Gerardo Fusco, MD; e-mail: gerardo.fusco93@gmail.com

Either surgical or conservative approaches can be proposed for treating ALAS. Conservative treatment usually includes restriction of movement through appropriate devices followed by a gradual program of functional exercises. The most common devices used to limit ankle movement are braces and tapes. In certain instances, paster or soft casts can be also employed to provide a more rigid immobilization[3]. However, many different options exist, based on the rigidity of the devices: elastic bandages, tapes, lace-up ankle supports and semirigid ankle supports[4]. Moreover, under a therapeutic point of view, initial rest reduces metabolic demand of the injured site, avoiding the increase in blood flow and any mechanical impairment to the newly forming fibrin bonds. The application of gentle tension to the joint seems to have the ability to correctly align newly growing ligament fibers into compact parallel strands. In this phase, cryotherapy may be useful to drop metabolic demand, vasodilation, nerve conduction speed and it increases threshold levels in free nerve ending. Compression decreases the number of inflammatory cells by limiting hemorrhage and swelling of the site and elevation diminishes local blood pressure minimizing bleeding and at the same time increasing lymphatic drainage. Early protected return to activity stimulates afferent somatosensory pathways of the foot and ankle and is, therefore, able to refine proprioception of the injured area[5-7]. Functional treatments include dorsiflexion, plantar flexion, rotation, inversion and eversion exercises in the form of range-of-motion, strengthening and proprioceptive training. Adequate strength is fundamental to perform normal movement patterns and therefore strengthening exercises should be performed before proprioceptive training. Furthermore, range-of-motion, isometric and isotonic exercises are required to counteract the tissue's tendency to contract after trauma, prevent re-injury and realign newly forming collagen fibers in the ligament. Proprioceptive training is instead aimed at increasing the sensorimotor speed and precision in response to a loss of balance[8,9].

In regard to surgical treatments, they are usually performed in case of severe sprains (grade II-III), even though different approaches are applied worldwide. Several procedures have been described and they can be grouped into three categories: anatomic repair, non-anatomic reconstruction, and anatomic reconstruction. Anatomic repair restores normal anatomy and joint function through the re-fixation of the torn ligaments to the bone or by augmenting them with local structures, ultimately repairing the ligament. Anatomic reconstruction surgeries restore the ligaments' original anatomical positions to replicate the physiological ligamentous complex [10]. Non-anatomic reconstructive procedures restore overall function and stability using tendon grafts but without replicating the original anatomy of the ligaments.

The present systematic review was performed to provide a comprehensive analysis on the treatment of acute lateral ankle sprains, focusing exclusively on randomized controlled trials, with the aim of elucidating the following relevant clinical questions:

1. Is there any outcome difference between surgical and non-operative management of severe lateral ankle sprains?
2. Is there any evidence to prefer a specific external support over another?
3. Is there any difference among the rehabilitation strategies following lateral ankle sprains?

Materials and Methods

The present systematic review was performed according to "PRISMA guidelines" [Preferred Reporting Items for Systematic Reviews and Meta-analyses]. The literature searches for the three comparisons (1. surgical *vs.* conservative management, 2. different types of external support, 3. different types of rehabilitation programs) were performed on PubMed, Scopus, and Web of Science databases, on June 25th, 2021, using the following keywords, that were combined together to obtain all relevant papers on the topics of interest: 1. (ankle) AND (lateral ligament OR fibular ligament OR lateral ligament complex OR lateral collateral ligament) AND (surgical OR operative OR suture OR reconstruction OR repair OR conservative OR functional treatment OR plaster immobilization); 2. (ankle) AND (lateral ligament OR fibular ligament OR lateral ligament complex OR lateral collateral ligament) AND (functional treatment OR elastic bandage OR external support OR brace OR tape); 3. (ankle) AND (lateral ligament OR fibular ligament OR lateral ligament complex OR lateral collateral ligament) AND (functional treatment OR early mobilization OR physiotherapy OR rehabilitation OR exercise OR physical therapy).

PRISMA flowcharts of the selection and screening methods are provided in Figure 1A, 1B and 1C.

Firstly, articles were screened by title and abstract, using the following criteria for selection: (1) clinical reports with randomized design (level I or II) comparing conservative management *vs*. surgery OR different types of external support OR different rehabilitation programs; (2) published in the last 30 years; (3) written in the English language; (4) dealing with treatment of patients affected by acute injury of lateral ankle ligaments. Exclusion criteria were: (1) non-randomized trials; (2) papers written in other languages than English; (3) data not dealing with the treatment of acute injury of the lateral ankle ligaments.

Two investigators (LB, GF) extracted independently relevant data from each paper, and collected them in a Microsoft Excel 2013 sheet. The following data were extracted from each included study: (1) demographic data, (2) study design and level of evidence, (3) treatment groups, (4) follow-up times, (5) evaluation scores adopted, (6) overall clinical findings.

The quality of the randomized controlled trials (RCTs) was assessed independently by two reviewers (LB, GF) using the Cochrane Risk of Bias Assessment. Risk of bias was assessed as a judgment (high, low, or unclear) for individual elements from seven domains, as detailed in Tables I, II, III.

Subsequently, the results of this assessment were converted to AHRQ (Agency for Healthcare Research and Quality) standards, which ultimately rank the RCTs in "Good quality", "Fair quality" and "Poor quality". Discrepancies between the two reviewers were resolved by discussion and consensus, and the final results were reviewed by the senior investigator.

Results

Surgical vs. Conservative Treatment in Severe Acute Lateral Ankle Sprains

A total of 2.398 related articles were identified through databases' searching. After title and abstract screening, 35 studies were included. As shown in Figure 1A, 23 articles were excluded for not meeting the inclusion criteria. A total of 12 RCTs published from 1981 to October 2010 dealing with surgical *vs*. conservative treatment for severe acute lateral ankle sprains were included, currently representing the largest number of RCTs analyzed on this topic in the literature.

Only 2 studies out of 12[11,12] favored the choice of the surgical treatment, consisting in ligament

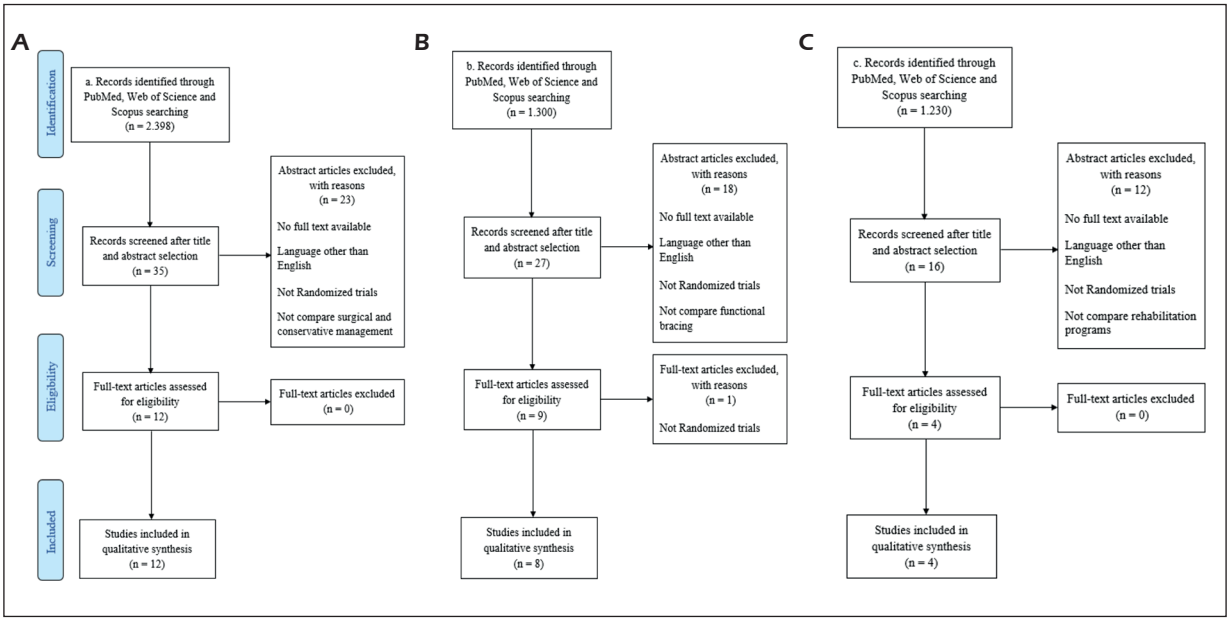

Figure 1. A, PRISMA Flowchart resuming the papers' selection process for the comparison between surgical and conservative management. **B,** PRISMA Flowchart resuming the papers' selection process for the comparison of different external supports; **C,** PRISMA Flowchart resuming the papers' selection process for the comparison of different rehabilitation protocols.

Table I. Cochrane Risk of Bias assessment for all the studies comparing surgical and conservative management.

	Selection bias Random sequence generation	Selection bias Allocation concealment	Performance bias Blinding (participants and personnel)	Detection bias Blinding (outcome assessment)	Attrition bias Incomplete outcome data	Reporting bias Selective reporting	Other bias
Niedermann et al[15]	+	+	-	?	-	+	-
Evans et al[16]	+	+	-	+	+	+	+
Korkala et al[11]	+	+	-	?	-	+	-
Møller-Larsen et al[22]	+	+	-	?	+	+	-
Sommer et al[17]	+	+	-	?	?	-	+
Zwipp et al[18]	+	+	-	+	+	-	+
Munk et al[14]	+	+	-	?	-	+	+
Kaikkonen et al[20]	-	+	-	?	+	+	+
Povacz et al[21]	+	+	-	+	+	+	+
Specchiulli et al[19]	-	+	-	?	+	+	+
Pijnenburg et al[12]	-	-	-	+	+	+	+
Pihlajamaki et al[13]	+	+	-	+	-	+	+

+ Low risk of bias; - High risk of bias; ? Unclear risk of bias.

suture/reconstruction, over the conservative one. In particular, Korkala et al[11] recommend surgery for severe ALAS, especially if approaching young or physically active patients, because at 2 years of follow-up it guarantees a greater subjective stability compared to the conservative management based on immobilization with a plaster cast or a semi-elastic bandage. Pijnenburg et al[12] stated the superiority of surgical treatment at long-term follow-up (average 8 years) in terms of residual ankle instability and pain. The study also highlighted how, given the high socio-economic cost of surgery, this treatment should be reserved for highly active patients.

Two studies[13,14] found similar outcomes between surgical and conservative treatment at a long-term follow-up. Pihlajamaki et al[13] reported lower re-injury rate in a group of 11 patients affected by isolated anterior talofibular ligament tear and in 14 patients suffering anterior talofibular ligament tear combined with calcaneofibular ligament tear, treated with a surgical intervention. Nonetheless, return to pre-injury activity level was comparable in both surgical and non-surgical

Table II. Cochrane Risk of Bias assessment for all the studies comparing different external supports.

	Selection bias Random sequence generation	Selection bias Allocation concealment	Performance bias Blinding (participants and personnel)	Detection bias Blinding (outcome assessment)	Attrition bias Incomplete outcome data	Reporting bias Selective reporting	Other bias
Boyce et al[24]	+	+	-	?	-	+	+
Beynnon et al[23]	+	+	-	?	-	+	+
Lamb et al[30]	+	+	-	+	+	+	+
Lardenoye et al[28]	+	+	-	?	-	+	+
Sultan et al[25]	+	+	-	+	+	+	+
Prado et al[26]	+	+	-	+	+	+	+
Van den Bekerom et al[29]	+	+	-	+	+	+	+
Louwerens et al[27]	+	+	-	+	+	+	+

+ Low risk of bias; - High risk of bias; ? Unclear risk of bias.

Table III. Cochrane Risk of Bias assessment for all the studies comparing different rehabilitation protocols.

	Selection bias Random sequence generation	Selection bias Allocation concealment	Performance bias Blinding (participants and personnel)	Detection bias Blinding (outcome assessment)	Attrition bias Incomplete outcome data	Reporting bias Selective reporting	Other bias
Van Rijn et al[31]	+	+	-	+	+	+	+
Van Mechelen et al[33]	+	+	-	+	+	+	+
Bleakley et al[34]	+	+	-	+	+	+	+
Brison et al[32]	+	+	-	+	+	+	+

+ Low risk of bias; - High risk of bias; ? Unclear risk of bias.

group. Munk et al[14] reported comparable results between surgical and conservative treatment with a walking cast or with an elastic bandage, concluding that the choice of the treatment should be tailored to the needs of the single patient.

Among the 8 studies recommending conservative treatment over surgery, Niedermann et al[15] reported greater stiffness and more complications, as infections and dysesthesia, in patients treated with surgery. Evans et al[16] stated the superiority of conservative treatment in terms of residual ankle instability, time needed to return to work and attrition rate of sports activities. Sommer et al[17] reported similar results at 1 year of follow-up for both surgical and conservative treatment, but conservative treatment led to early recovery of ankle's mobility and stability. Zwipp et al[18] reported similar results for the conservative treatment as well. Specchiulli et al[19], Kaikonnen et al[20], and Povacz et al[21] reported better functional outcomes and quicker return to pre-injury activities in patients treated with the conservative management. Moller-Larsen et al[22] validated the use of conservative treatment based on tape bandage because it led to early restoration of the pre-injury ankle state and to less symptoms at 1 year of follow-up.

Cochrane Risk of Bias assessment for each included study is presented in Table I.

The main findings of each included study are presented in the synoptic **Supplementary Table I**.

Comparison of Different External Supports for the Conservative Treatment of Acute Lateral Ankle Ligaments Injuries

As mentioned above, the majority of papers highlighted the effectiveness of a conservative approach as first choice for treating ALAS.

A total of 1.300 related articles were identified through databases' searching. After title and abstract screening, 27 studies were included. As shown in Figure 1B, 19 articles were excluded for not meeting the inclusion criteria. Ultimately, a total of 8 RCTs published from 2005 to August 2019 comparing different external supports for conservative treatment of acute lateral ankle sprains were included in this review.

It must be said that a universal consensus regarding the best bracing approach was not reached. Several studies showed better results for patients treated with flexible braces, whereas some studies demonstrated the effectiveness of more rigid options. Overall, a preference toward flexible supports emerged, but high-level evidence is still needed to confirm these findings.

Analyzing the available studies, Beynnon et al[23] suggested the use of elastic bandages or flexible braces rather than rigid supports to anticipate the recovery, but, in terms of ankle's mobility and re-injury incidence, the results were comparable. Boyce et al[24] showed evidence in favor of flexible braces, which seemed to be more effective than traditional elastic bandages in improving ankle function, evaluated by Karlsson Score. Sultan et al[25] reported better functional outcomes, higher quality of life and quicker return to daily activities in patients treated with elastic stockings. Prado et al[26] supported a more flexible bracing option in order to improve short-term ankle function, evaluated by American Orthopedic Foot and Ankle Score (AOFAS), and allow earlier return to work activities.

Louwerens et al[27] reported comparable functional results between a semi-rigid non-removable cast and a removable one, but patients were more satisfied with the removable option.

Lardenoye et al[28] and Van den Bekerom et al[29] reported similar outcomes in terms of ankle function between taping and semi-rigid brace but the first one led to more complications, such as dermatitis or blisters.

Lamb et al[30] were instead able to provide evidence in favor of a short period of immobilization with a rigid cast, showing better functional outcome at short-term follow-up rather than conservative treatments with bandages or flexible braces.

Cochrane Risk of Bias assessment for each included study is presented in Table II.

The main findings for each included study are presented in the synoptic **Supplementary Table II**.

Comparison of Different Rehabilitation Protocols for Conservative Treatment of Acute Lateral Ankle Ligaments Injuries

A total of 1.230 related articles were identified through databases' searching. After title and abstract screening, 16 studies were included. As shown in Figure 1C, 12 articles were excluded for lacking the inclusion criteria and, ultimately, a total of 4 RCTs published from 2007 to November 2016 comparing different rehabilitation protocols for conservative treatment of ALAS were included in this review. A population of 1228 patients (mainly grade I and grade II ankle sprains) was examined. Due to different rehabilitation protocols, inconclusive results were obtained. Two different studies[31,32] compared "conventional treatment" (early active mobilization, home exercises, ankle protection, rest, cryotherapy, application of a compression bandage, elevation, use of analgesics and progressive weight bearing activities) with "conventional treatment" + supervised physiotherapy sessions based on strengthening and proprioceptive exercises. No superiority of supervised physiotherapy was observed by Brison et al[32]. Van Rijn et al[31] noticed a significant difference in patient satisfaction in favor of the supervised exercises but no significant difference in other clinical outcomes measured at any follow-up. Van Mechelen et al[33] showed lower incidence of injury recurrence at 1 year of follow-up in athletes with ankles sprains treated with "conventional treatments" + unsupervised home-based proprioceptive training program consisting of 3 half an hour sessions per week with a balance board for 8 weeks (relative risk 0.63, 95% confidence interval 0.45 to 0.88). Bleakley et al[34] demonstrated that an accelerated rehabilitation program (20-minutes exercises three times a day, during the first week of injury, focused on increasing ankle range of movement, activation and strengthening of ankle muscles, and restoring normal sensorimotor control) produced significant improvements in short term ankle function evaluated by Lower Extremity Functional Scale score, if compared with the "standard treatments".

Cochrane Risk of Bias assessment for each included study is presented in Table III.

The main findings for each included study are presented in the synoptic **Supplementary Table III**.

Discussion

The main clinical findings of the present review are:

1. The great majority (8/12) of RCTs comparing surgical *vs.* conservative treatment for severe ALAS (acute lateral ankle sprains) demonstrated that the non-operative treatment was not inferior to the surgical option, both in terms of outcomes and socioeconomic aspects;
2. No significant difference was found between rigid and semi-rigid/flexible casting when analyzing post-injury symptoms and ankle stability. Time to return to daily activities was found to be shorter for flexible casting;
3. No significant difference was observed between "conventional" conservative treatment *vs.* early rehabilitation protocols.

Under a methodological point of view, the overall quality of the available evidence showed many critical issues. First of all, the reduced size and the lack of homogeneity of the sample sizes did not allow a meta-analysis. Moreover, all the included studies showed performance bias since none of them could be blinded both for patients and examiners. Many of the studies, and especially those comparing surgical to conservative treatments, occasionally presented incomplete results or selection bias. Nevertheless, despite higher level evidence should always be encouraged, it was possible to sum up the results regarding the topics of interest.

This review is focused on three main topics regarding the management of lateral ligamentous ankle injury, which will be discussed separately in order to elucidate the most relevant findings to be applied in everyday clinical practice.

Are there Any Outcome Differences Between Surgical and Non-Operative Management of Severe Lateral Ankle Sprains?

The majority of included papers dealing with surgical *vs.* conservative treatment suggested that a conservative treatment should be the first choice for severe ALAS since it is able to provide satisfactory functional outcomes without the risks related to surgery. A conservative approach is indicated especially in cases not related to previous chronic instability and in patients without high functional demand.

Eight studies out of 12[15-22] demonstrated the superiority of conservative treatment, 2 papers found similar outcomes for both surgical and conservative treatment[13,14], and only 2 trials reported a better outcome for the surgical treatment[11,12]. Thus, in 83.3% of the included RCTs surgical treatment did not provide any clinical advantage over conservative treatment. It must be highlighted that surgical studies reported greater ankle stiffness, longer recovery time to resume everyday activities, and post-op complications such as sensibility loss, neuromas, and even persistent subjective instability in operated ankles. Therefore, taking into consideration the higher cost of surgical intervention and the risks associated with the surgical procedure, surgery should not be regarded as the first option in ankle sprain with a severe ligamentous injury.

Is There Any Evidence to Prefer a Specific External Support Over the Others?

The second topic analyzed investigated the possible superiority of a specific type of brace to restrict ankle movement following ALAS. Of the 8 RCTs included, a broad variety of different external supports were compared. Based on the results obtained, it is not possible to draw definitive conclusions about the superiority of a cast *vs*. another.

Current literature seems to be supporting flexible braces rather than rigid ones in order to prevent complete immobilization of the affected ankle[23]. Flexible supports seem to be even superior to traditional bandages[24]. Avoiding complete immobilization after an acute ankle sprain could prevent the loss of muscular strength around the ankle, allow an early proprioceptive feedback, speed up swelling reduction in the injured limb, and reduce the risk of developing kinesiophobia[25,26,35].

On the other hand, rigid immobilization could lead to a better, more fibrotic and sturdier healing of the ligamentous complex of the ankle. Nonetheless, immobilization could also lead to a weaker extrinsic stability due to muscle mass loss and proprioceptive impairment. More rigid casts did not provide superior ankle stability over more flexible options, the latter were instead able to decrease the period of convalescence and the time needed to resume daily activities. Nonetheless, Lamb et al[30] demonstrated a better healing of the ligamentous complex in the immobilized *vs.* non immobilized ankle and recommend below-knee casts for severe ALAS.

The majority of the RCTs included in the present review[23,27-29] recorded a similar stability for the ankles treated either with a rigid cast or with a flexible whereas, in some studies[23,25,26], shorter healing time and a faster resumption of daily activities were demonstrated for flexible bracings.

Are there Any Differences Among the Rehabilitation Strategies Following Lateral Ankle Sprains?

The third topic investigated was the type of rehabilitation protocol for patients who suffered from ALAS. The results were inconclusive. Supervised physiotherapy protocols did not show any significant difference when compared to conventional treatments in regard to time required to resume daily activities, symptoms, ankle stability and function[31,32]. Nevertheless, when unsupervised proprioceptive training or an accelerated rehabilitation program were administered, quicker recovery and greater ankle stability were documented[33,34].

It must be taken into account that a few RCTs were retrieved in the available literature, and only 4 papers were eventually included. The paucity of studies thus precludes the possibility of drawing proper conclusions on the ideal rehabilitation protocol that should be tailored to the type of injury and functional needs of the patient.

Limitations

Some limitations of the present study must be acknowledged: firstly, no quantitative analysis was performed due to the high variability in outcomes and time-points in the included papers. Secondly, the inclusion of different grades of lateral ankle sprains in the studies is a bias, because such a broad spectrum of injuries plays a confounding role in the interpretation of results. Finally, the wide range of different casts

used prevented us from identifying the best one to opt for.

Conclusions

The available evidence on acute lateral ankle sprain treatments lacks high quality standards and it is, therefore, not possible to define clear indications. However, based on the findings of the present review, conservative treatment should be the first choice for severe acute lateral ankle sprains since it provides satisfactory functional outcomes without the risks related to surgery. It was not possible to identify the best external support, but a preference toward flexible braces emerged since they allow earlier return to daily activities. The paucity of studies comparing different rehabilitation protocols precluded the possibility of defining the ideal one.

Conflict of Interest
The Authors declare that they have no conflict of interests.

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Ethical Statement
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