

Effect of joint mobilization on chronic instability of the ankle: a systematic review with meta-analysis

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Summary

The present work aims to analyze the effect of joint mobilization in patients with chronic ankle instability on the outcomes of pain and dorsiflexion range of motion of the ankle after systematic review study with meta-analysis. The period for developing the research and collection was from August 2022. The databases used for collection were CENTRAL, MEDLINE/PUBMED, EMBASE, CINAHL, PEDro and SPORTDiscus, and only randomized controlled trials were included. Studies that included the clinical question by PICO (P = chronic ankle instability; I = joint mobilization; C = placebo and minimal intervention; O = pain and range of motion). The analysis was performed using the Review Manager 5.4.1. The I² test was used for heterogeneity of the studies. A total of 6 studies were selected for the meta-analysis in which they measured the range of motion. The findings were statistically significant for range of motion of dorsiflexion (mean difference – MD = 0.86, 95%CI = 0.06;1.66, p = 0.04), however the findings became insignificant after the sensitivity analysis (MD = 0.58, 95%CI = -0.07;1.23, p = 0.08). There was not enough literature for the pain outcome. The study obtained a satisfactory result for joint mobilization when all studies in the literature were grouped, but the result did not obtain statistical significance using better quality studies. Therefore, there is a need for better quality of evidence for the joint mobilization technique, as well as studies with better methodological quality so that we can more accurately state the real effects of this technique. Systematic Review Registration: Prospectively registered with PROSPERO (CRD42020193292).

Key words:

Ankle Injuries. Ankle Joint. Pain.
Range of Motion.

Efecto de la movilización articular sobre la inestabilidad crónica del tobillo: una revisión sistemática con metaanálisis

Resumen

El presente trabajo tiene como objetivo analizar el efecto de la movilización articular en pacientes con inestabilidad crónica del tobillo sobre los resultados del dolor y el rango de movimiento de dorsiflexión del tobillo después de un estudio de revisión sistemática con metaanálisis. El período para el desarrollo de la investigación y la colección fue de Agosto de 2022. Las bases de datos utilizadas para la recopilación fueron CENTRAL, MEDLINE / PUBMED, EMBASE, CINAHL, PEDro y SPORTDiscus, y solo se incluyeron ensayos controlados aleatorios. Estudios que incluyeron la pregunta clínica por PICO (P = inestabilidad crónica del tobillo; I = movilización articular; C = placebo e intervención mínima; O = dolor y rango de movimiento). El análisis se realizó utilizando Review Manager 5.4.1. Se utilizó la prueba de I² para determinar la heterogeneidad de los estudios. Se seleccionaron un total de 6 estudios para el metaanálisis en el que midieron el rango de movimiento. Los hallazgos fueron estadísticamente significativos para el rango de movimiento de la dorsiflexión (diferencia de medias - DM = 0,86, IC del 95% = 0,06; 1,66, p = 0,04), sin embargo, los resultados se volvieron insignificantes después del análisis de sensibilidad (DM = 0,58, IC del 95% = -0,07; 1,23, p = 0,08). No hubo suficiente literatura sobre el resultado del dolor. El estudio obtuvo un resultado satisfactorio para la movilización articular cuando se agruparon todos los estudios de la literatura, pero el resultado no obtuvo significación estadística utilizando estudios de mejor calidad. Por lo tanto, se necesita una mejor calidad de evidencia para la técnica de movilización articular, así como estudios con mejor calidad metodológica para que podamos enunciar con mayor precisión los efectos reales de esta técnica. Registro de revisión sistemática: PROSPERO (CRD42020193292).

Palabras clave:

Lesiones de Tobillo.
Articulación del Tobillo. Dolor.
Rango de Movimiento.

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Introduction

Ankle sprains are among the most recurrent injuries in emergency care levels. The loss of time and initial recovery from ankle ligament sprains is less threatening than that of internal knee disorders, for example, but the high frequency and recurrence rate establish it as one of the main clinical and health system concerns, which despite being common, can cause chronic problems and recurrent injuries^{1,2}.

According to Doherty *et al.*³, ligament injury presents high social economic costs associated with diagnosis, treatment and loss of work productivity, depending on the severity of the injury, and covers several spheres of the individual. This calls attention to a faster recovery, avoiding the chronicity of the injury and consequently chronic instability. According to Braun⁴, symptoms which limit functional capacity and lifestyle are common from 6 to 18 months after an ankle sprain, and if the individual does not seek help, the condition may evolve with constant sprains and become more and more serious.

Some risk factors are cited by Martin⁵, such as low amplitude of dorsiflexion ankle, history of previous injuries, not warming up before physical activity or not participating in a preventive program aimed at balance and proprioception. A portion of individuals who suffer from an acute ankle sprain have significant disability due to pain, functional instability, mechanical instability or recurrent sprain after the recovery plateaus 1 to 5 years after the injury⁶. The lower limbs have great functionality, and their immobilization due to injuries presents biomechanical, occupational, and psychological reduction, and consequently compensatory mechanisms to supply the absence of the injured joints.

Bialosky *et al.*⁷ states that manual therapy interventions are generally one of the first choices among healthcare professionals and patients; however, systematic reviews have found relatively small effects in relation to their popularity. Also highlights the neurophysiological effects of joint mobilization, in which the proposed model categorizes neurophysiological stimuli originating from a peripheral mechanism (manual therapy), in which there will be control of pain, inflammation and even temporal summation due to spinal cord responses after the technique⁸. Furthermore, gains in relation to the range of motion are achieved after mechanical stimuli directly in the joint, decreasing spasm and exciting pro-inflammatory mediators.

It is worth mentioning that measurement before and after medical or physiotherapeutic interventions is important to define the real loss and some gain in joint function in the future. In the study by Powden *et al.*⁹, they observed that the Weight Bearing Lounge Test (WBLT) is a highly reliable test for measuring the dorsiflexion range of motion of the ankle (ROM), since it provides consistency and repeatability among the evaluators, thus making it a validated instrument for clinical practice. In addition, the Visual Analog Pain Scale is validated to assess the intensity of local pain and used worldwide in diversified assessment systems¹⁰⁻¹².

Wright, Lines and Caim¹³ report that due to the high frequency of patients with chronic ankle instability and the problems associated with pathology, knowledge of prevention and treatment approaches are of paramount importance for professionals working in the area. Despite medical, physiotherapeutic and outpatient care, poor recovery can offer an opportunity for chronic instability, with an injury cycle occurring to the individual. There is a need to seek better conducts and scientifically

based treatment alternatives in order to bring about greater standardization regarding joint mobilization, better recovery of the individual and less repercussions, to prevent disabilities and improve their functionality.

Therefore, the aim of this study is to analyze the effect of joint mobilization in patients with chronic ankle instability on the outcomes of pain and dorsiflexion range of motion of the ankle after reviewing the current literature.

Material and method

Type of research

This is a systematic review with meta-analysis and followed the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses – PRISMA¹⁴ and the Cochrane Handbook for Systematic Reviews of Interventions version 6.2¹⁵. The period for developing the research and collection was from August 2022. The databases used for collection were CENTRAL (Cochrane Central Register of Controlled Trials, The Cochrane Library), MEDLINE/PUBMED, EMBASE (ELSEVIER), CINAHL (Cumulative Index to Nursing and Allied Health Literature, EBSCO), PEDro (Physiotherapy Evidence Database) and SPORTDiscus (EBSCO), and only randomized controlled trials (RCT) were accepted; there were no language restrictions or publication date. The review was submitted a priori by the International Prospective Register of Systematic Reviews (PROSPERO) platform, with the following credential ID = CRD42020193292 in order to preserve the study data and avoid possible manipulation of study outcomes and/or results.

Inclusion criteria

Studies which included the clinical question by PICO for the purposes of inclusion criteria in the review followed: P = patients with chronic ankle instability; I = joint mobilization; C = placebo and minimal intervention; O = pain and range of motion. Studies were selected that included male or female individuals aged 18 years or older, who had chronic ankle instability and received isolated joint mobilization treatment compared to minimal or false treatment (placebo).

Exclusion criteria

Studies were excluded from the review if: it was clear in the summary that they did not meet the above criteria; if the selected criteria were not clear in the summary, the full article was read and it was then decided to include or exclude it. The reasons for excluding studies after reviewing the full text are detailed in the table “Characteristics of excluded studies” (Figure 4).

Measured outcomes

Pain outcomes were measured by VAS (Visual Analogue Scale) and ROM by Weight Bearing Lounge Test (WBLT).

Collection of studies

The relevant studies were found through a computer-aided search through the PUBMED and PEDro databases. The search terms used were: ankle sprain, ankle instability, chronic, joint mobilization, manual therapy,

MWM, Maitland, Mulligan, Pain, range of motion, and dorsiflexion. The terms were searched alone and in combinations in the search, with a search filter for Randomized Controlled Trials. Two reviewers (IS and FS) independently selected studies with the research terms selected a priori and with PICOT. The data selection was not blinded to the authors.

Data extraction

Two reviewers (IS and FS) independently extracted data about the study design, participants, interventions and results. Data extraction was not blinded to the authors. Disagreements about the results of the data extraction were resolved by consensus among the team. If the disagreement persisted, a third reviewer (CK) was consulted.

Methodological analysis

Two reviewers who were not blinded to the work in question (IS, FS) independently assessed the methodological quality of each RCT. Disagreements were addressed by discussion and consensus in the review team (IS, FS AND MK). The 11 criteria recommended by the PEDro Scale were used to assess the methodological quality of randomized clinical trials, each criterion was scored as “Yes” or “No”, according to the recommendation of the scale itself, which is from 0 to 10.

Data analysis

The Review Manager 5.4.1 software program (RevMan 5.4.1 – The Collaboration Cochrane) was used to perform the meta-analysis of this review, to calculate the average size of the combined effect of the mean differences (MD) for all group comparisons and the 95% confidence interval (95% CI). The significance value $p = 0.05$ and 95% CI was observed in all studies, with a value less than or equal to 0.05 indicating a statistically significant difference or correlation. The I2 test was performed to identify possible heterogeneity between studies. The Kappa index was performed to obtain reliability between the two reviewers independently, where the score by PEDro Scale given by the two reviewers of the included studies was compared in the SPSS (Version 22) in relation to the assertiveness between the reviewers; 70% of the times there was the same score, showing good reliability and homogeneity of the reviewers’ methodological criteria.

Results

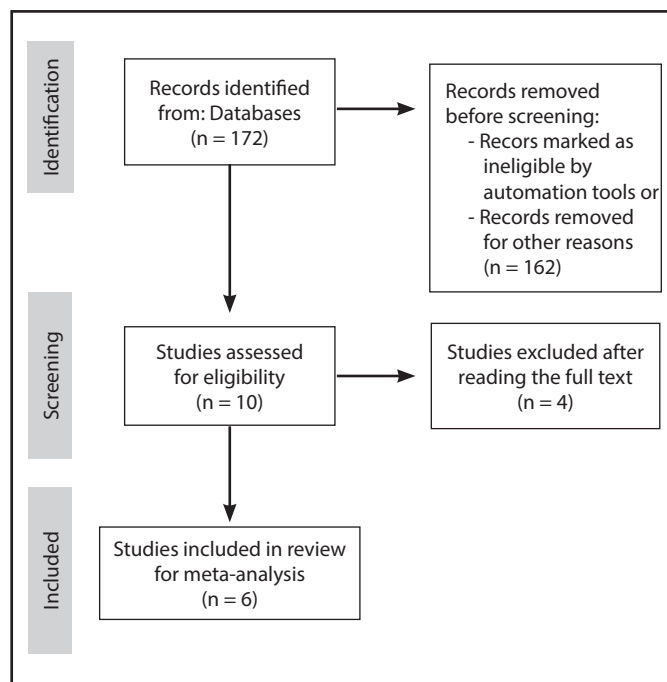
Of 172 study abstracts, 10 were selected for full reading. However, 4 studies were excluded with common reasons for exclusion including wrong intervention, wrong patient population and incorrect study design (Table 1). Thus, 6 studies were selected for the current meta-analysis, which analyzed the following outcomes: ROM and Pain in female or male patients aged 18 or over with chronic ankle instability. ROM was reported in the 6 selected studies, pain was measured in only 1 study, so only ROM was exposed in the meta analysis (Figure 1).

The reliability analysis showed a Kappa’s quotient equal 0.714 and 95% CI was between 0.168;1.260 ($p = 0.010$), showing good agreement.

Table 1. Studies excluded and justification after reading the full text.

Author, Year	Title	Justification
Gilbreath <i>et al.</i> 2014 ¹⁶	The effects of mobilization with movement on dorsiflexion range of motion, dynamic balance and self-reported function in individuals with chronic ankle instability	There was no randomization of patients in the study.
Yeo <i>et al.</i> 2011 ¹⁷	Hypoalgesic effect of a passive accessory mobilization technique in patients with lateral ankle pain	There were sub-acute injuries in the study.
Wikistrom <i>et al.</i> 2017 ¹⁸	Predicting successful treatment with manual therapy in patients with chronic ankle instability: improving self-reported function	It was not compared to placebo or minimal intervention.
Ardèvol <i>et al.</i> 2002 ¹⁹	Treatment of complete rupture of the lateral ligaments of the ankle: a randomized clinical trial comparing plaster cast immobilization with functional treatment	The duration of the disease was not chronic

Figure 1. Selection of studies for the meta-analysis.



The 6 selected studies assessed ankle mobility before and after treatment, using the WBLT test with or without weight support and comparing minimal intervention or false treatment. The Table 2 shows data extraction from these studies.

All selected studies were methodologically evaluated by 2 non-blinded evaluators following the PEDro methodological quality scale (Figure 2).

The pooled data from four studies with 220 participants with chronic ankle instability were pooled to analyze the effects of joint mobilization on DFROM (MD = 0.86, 95% CI = 0.06;1.66, p = 0.03) and the analysis confirmed significant improvements immediately after treatments (Figure 3).

The results become statistically insignificant after the meta-regression by sensitivity analysis with at least or less studies 07 on the PEDro scale, with 121 patients for analysis of the effects of joint mobilization on DFROM (MD = 0.58, 95% CI = -0.07;1.23, p = 0.08) (Figure 4).

There was not enough data to elaborate the meta-analysis or make a conclusion on the efficacy for the pain outcome using the EVA scale. The certainties of the evidence and the results presented were analyzed as low-quality evidence (downgraded due to imprecision and inconsistency), for is analyzed was performed the recommendations of the The Grading of Recommendations Assessment, Development and Evaluation - GRADE²⁶ (Table 3).

Figure 2. Risk of bias - PEDro Scale: review authors' judgements about each risk of bias item for each included study.

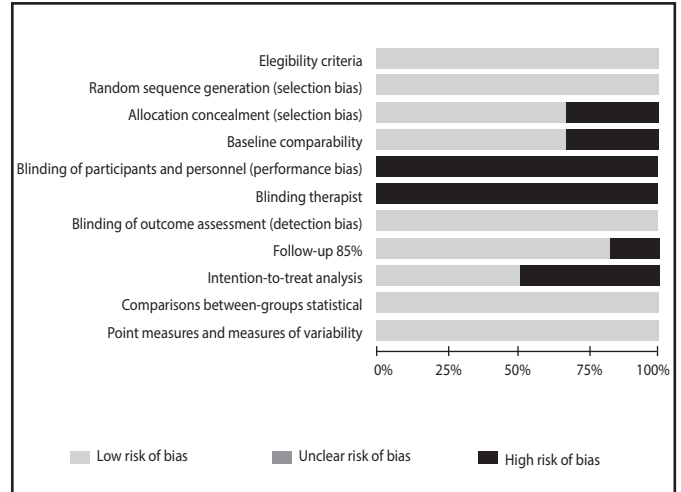
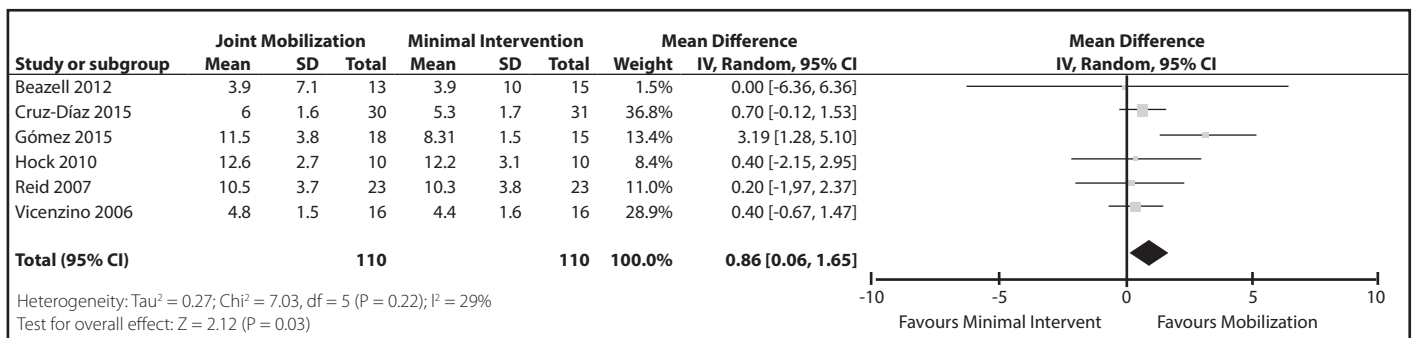


Table 2. Characteristics of the selected studies.

Author, Year	Subjects	Experimental Group	Control Group	Results
Cruz-Díaz <i>et al.</i> 2015 ²⁰	n = 57	Ankle joint mobilization	Sham Mobilization	WB and DFROM Statistically significant improvements (p < 0.01)
Vincenzino <i>et al.</i> 2006 ²¹	n = 16	Ankle joint mobilization	No intervention	WB and DFROM Statistically significant improvements (p = 0.02)
Reid <i>et al.</i> 2007 ²²	n = 23	Ankle joint mobilization	Simulated intervention	WB and DFROM Statistically significant improvements (p = 0.02)
Beazell <i>et al.</i> 2012 ²³	n = 43	Manipulation of the proximal and distal tibiofibular	No intervention	WB and DFROM No significant differences were observed over time, however, there was a significant increase (p < 0.001) after intervention.
Hoch <i>et al.</i> 2010 ²⁴	n = 20	Maitland Grade III of the ankle joint mobilization	Rest	WB and DFROM The results indicated that the treatment of joint mobilization was associated with significantly higher ROM (p = 0.01).
Marrón-Gomez <i>et al.</i> 2015 ²⁵	n = 52	Ankle joint mobilization	Sham Intervention	WB and DFROM Statistically significant improvements compared to placebo (p < 0.05).

DFROM: Dorsiflexion Range of Motion; WBLT: Weight Bearing Lounge Test.

Figure 3. Forest Plot contemplating the studies included in the meta-analysis of the immediate effect of joint mobilization on the range of motion of dorsiflexion with weight support, gathering data from six studies (n = 220).



95% CI: 95% confidence interval; SD: standard deviation; MD: mean difference.

Figure 4. Forest Plot contemplating the studies included in the meta-analysis of the immediate effect of joint mobilization on the range of motion of dorsiflexion with weight support gathering data from three studies with at least 07 on the PEDro scale (n = 121).

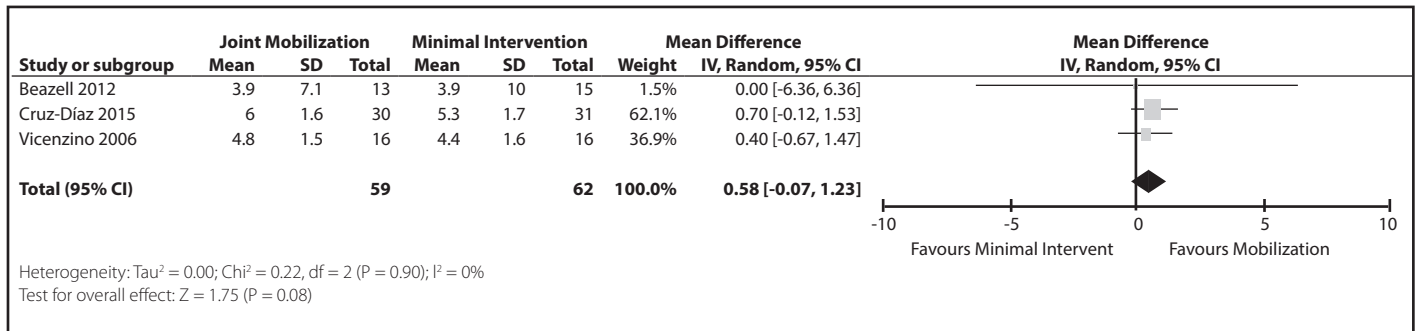


Table 3. Explanations of downgrade.

Range of motion (follow up: median 1 week; assessed with: cm)						
Nº of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations
6	Randomised trials	Not serious	Serious ^a	Not serious	Serious ^b	None
Nº of patients		Effect		Certainty		
Joint mobilization	Anyother Intervention	Relative (95% CI)	Absolute (95% CI)	⊕⊕○○ Low		
110	110	--	MD 0.86 more (0.06 more to 1.66 more)			

CI: 95% confidence interval; SD: standard deviation; MD: mean difference.

a. All studies have inconsistency in the confidence intervals, where there is no overlap between them, proving statistical inconsistency. b. Optimal information size was not met because the number of study participants was low (n < 400).

Discussion

The present study hypothesizes the improvement in DFROM and pain in patients with chronic ankle instability after the intervention suggested from a systematic review and meta-analysis. The results revealed that the data are statistically significant and that there was a clinically relevant improvement for DFROM when all studies were evaluated, without a methodological quality filter. However, the result was statistically insignificant after the meta-regression by sensitivity analysis (n = 03).

It was observed that all 6 studies failed to blind patients and therapists and may contain bias in the data measurement results and in the perception of treatments by patients. Nevertheless, it is known that blinding a therapist is something rare, especially with manual procedures, making it difficult for the authors to obtain the maximum grade. Only two^{21,25} failed in the Hidden Allocation item, while two^{22,23} failed in the Baseline Comparison. Only one study²⁴ failed in evaluator blinding, three failed to analyze by intention-to-treat^{22,24,25}, where patients who did not complete the treatment needed to be followed-up and have all their data collected, even without completing the treatment. All scored in the items Follow-up, appropriate, difference between groups and estimated point and variability.

Only Hock and McKeon²⁴ did not use Mulligan in his study; in contrast he used the Maitland technique, in which joint mobilization is performed through speed and range of motion degrees.

Low quality evidence observed an increase in ROM between mobilization and control, however, we noticed a deviation in results. We performed a downgrade and lowered the evidence to a high risk level of inconsistency, although the I² was low, there was little overlap in the confidence intervals showing different results between studies, and we lowered a level in inaccuracy due to the low number of subjects when grouping all studies.

A systematic review of the quality of clinical practice guidelines for treating ankle sprains carried out by Green²⁷ shows disparities in relation to graduated joint mobilizations or mobilization with movement, where they are not recommended by Dutch clinical practice guidelines, but are recommended by the American guidelines, and points out that the interpretation of the evidence between the two groups for developing the guidelines is not consistent. More research and robust studies are needed on joint mobilization recommendations for outcomes. Also concludes that most of the guidelines related to ankle sprain treatment are bad or outdated, and the absence of good methodologies is one of the main barriers to implementation.

Doherty *et al.*²⁸ disclosed in his review on the treatment of recurrent ankle sprains that there was moderate evidence of neuromuscular training for patients with chronic instability, while manual therapy had moderate evidence for acute injuries, acting to control inflammation and pain.

Following the review by Weerasekara *et al.*²⁹, the current literature lacks standardization regarding joint mobilization as well as its real effects, considering that the DFROM can be modified by external factors which are not only the studied technique, but by simply applying the WBLT test (for example).

Based on the concept, joint mobilization mainly has its effects on range of motion blocks and joint pain or immediate periods³⁰. From the results of the present study, mobilization does not seem to be effective for DFROM in chronic ankle instabilities, however due to the number of studies and their quality, future studies will help to more accurately express the confidence interval and the size of the studied technique's effect. Studies are also needed for other outcomes and with higher methodological quality so that there is no deviation from the real effects caused by low quality studies.

Pain measures have not been properly evaluated, thus suggesting that other resources with proven efficacy should be applied for local pain relief, taking into account the low quality of available evidence of the effectiveness of joint mobilization on pain.

Our review provides healthcare professionals with guidance on the technique of joint mobilization in patients with chronic ankle instability, emphasizing that decision-making is by the professional in conjunction with the patient and with their professional expertise.

Study limitations

The limitations of the review were the non-blinding of the reviewers, as well as the search only being conducted in two databases, although it is acceptable, it is possible that more studies from other databases could be included using the review filtering. The study samples are small, the short-term results varied between days and months, and it was not assessed whether the results were clinically relevant, only statistically significant, expanding the margin of clinical relevance depending on the professional. We planned to make a funnel plot to evaluate the publication bias if there were at least 10 studies in the meta-analysis. As we did not reach the desired quantity, the interpretation of the graph could have been biased due to the small number of studies.

Conclusion

This study was able to summarize the current efficacy of joint mobilization and pain in patients with chronic ankle instability, as well as its statistical significance and clinical relevance in the best- and worst-case scenarios.

Low-quality evidence suggests that joint mobilization may improve clinical ROM for patients with chronic ankle instability compared with placebo or non-treatment. Thus, there is a need for better quality of evidence for the joint mobilization technique, as well as studies with

better methodological quality so that the real effects of the technique can be stated with greater precision.

Conflict of interest

The authors do not declare a conflict of interest.

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