



Effectiveness of High-Velocity Low-Amplitude Manipulation in the Treatment of Ankle Joint Dysfunction: A Comprehensive Review

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Abstract

Background. Ankle joint manipulation is a commonly used intervention in orthopedic and rehabilitation settings. Its efficacy in improving the range of motion, reducing pain, and enhancing functional performance is a subject of ongoing research.

Aim. To synthesize the current evidence on the effectiveness of ankle manipulation across various patient populations.

Methods. Four studies have been analyzed, each focusing on different populations including healthy individuals, elite athletes, and those with chronic ankle instability. The interventions varied from high-velocity, low-amplitude (HVLA) manipulations to manual therapy techniques. Outcomes measured included dorsiflexion range, vertical jump height, ankle stability, pain, and functional scores.

Results. The studies presented mixed results. Two studies showed significant improvements in ankle function and pain reduction post-manipulation, while the others reported minimal or no significant changes compared to control groups. Variations in intervention techniques, population characteristics, and outcome measures contributed to the diverse findings.

Conclusions. Ankle joint manipulation shows potential benefits in certain scenarios, particularly in improving functional outcomes and reducing pain. However, the inconsistency in results across different studies highlights the need for more standardized research protocols. This would enable a more definitive understanding of the efficacy of ankle manipulation and guide its application in clinical practice.

Keywords: ankle manipulation, high-velocity low-amplitude (HVLA), manual therapy, rehabilitation, orthopedic intervention

1. INTRODUCTION

The human ankle is not just a hinge joint; it's an intricate assembly of bones, ligaments, and tendons that provide stability and facilitate movement (Kerkhoffs, et al., 2012; Habelt et al., 2011). Its centrality to fundamental actions such as walking, running, and jumping underscores its importance in daily life. Unfortunately, with such frequent use, the ankle is also a common site for injuries and chronic issues (Collins, Teys & Vicenzino, 2004; Morrison & Kaminski, 2007; Nelson et al., 2007). As medical science has advanced, a myriad of treatments and interventions have emerged to manage ankle dysfunctions. Among these, joint manipulation, a practice deeply embedded in the teachings of osteopathy and chiropractic disciplines, has emerged as a noteworthy technique (Green et al., 2001; Vicenzino et al., 2006; Tedeschi & Giorgi, 2023; Tedeschi & Giorgi, 2022). This manual approach, which involves applying a controlled force to the ankle joint, aims to restore mobility, reduce discomfort, and improve

function. Advocates argue that it offers a rapid, non-invasive route to relief. However, its efficacy, when compared to other interventions or even a placebo, remains up for debate. Some studies suggest marked benefits, while others find negligible differences (Fryer, Mudge & McLaughlin, 2002; Hedlund et al., 2014; Marrón-Gómez, Rodríguez-Fernández & Martín-Urrialde, 2015; Shin et al., 2020). This ambiguity in outcomes necessitates a comprehensive review. Thus, this investigation seeks to unravel the threads of evidence, shedding light on the actual benefits and limitations of ankle joint manipulation. As healthcare continues its relentless pursuit of the most efficacious treatments, ensuring an evidence-based approach to such interventions is paramount, ensuring that the promises made to patients align with the outcomes delivered.

2. METHODS

The present scoping review was conducted following the JBI methodology (Peters: Joanna Briggs Institute Reviewer's Manual) for scoping reviews. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) (Tricco et al., 2018). A checklist for reporting was used.

Review question. We formulated the following research question: “How effective is joint manipulation as a treatment modality for improving ankle function and reducing symptoms in individuals with ankle dysfunctions or injuries?”

Eligibility criteria. The eligibility criteria for inclusion of studies in this review were based on the Population, Concept, and Context (PCC) framework. In other words, studies were considered eligible if they met specific criteria related to the following aspects:

Population (P): This criterion focuses on the specific group of individuals targeted in the studies. Eligible studies must involve participants who have experienced ankle dysfunctions or injuries. This can include, but is not limited to, individuals with chronic ankle instability, a history of ankle sprains, or those undergoing rehabilitation for ankle injuries. The age, sex, and athletic status of participants could further specify this criterion.

Concept (C): This pertains to the core intervention or treatment to be investigated. For this review, the concept of the study is joint manipulation of the ankle. Studies eligible for inclusion must primarily investigate the effects of joint manipulation techniques, such as high-velocity, low-amplitude (HVLA) manipulations, on the ankle. The concept criterion filters out studies focusing on other forms of treatment or interventions that do not centrally involve joint manipulation.

Context (C): Context refers to the setting or circumstances in which the intervention is applied. This study can include clinical settings, sports therapy environments, or rehabilitation centers. The context may also consider the treatment's application, whether in acute injury scenarios, chronic conditions, or as a preventive measure. Contextual relevance ensures that the findings apply to real-world settings where ankle joint manipulation is commonly practiced.

Exclusion criteria. Studies that did not meet the specific PCC criteria have been excluded.

Search strategy. An initial limited search of MEDLINE was performed through the PubMed interface to identify articles on the topic and then the index terms used to describe the articles were used to develop a comprehensive search strategy for MEDLINE. The search strategy, which included all identified keywords and index terms, was adapted for use in Cochrane Central, Scopus, and PEDro. In addition, grey literature (e.g. Google Scholar, direct contacts with experts in the field) and reference lists of all relevant studies were also searched. Searches were conducted on 23 September 2023 with no date limitation.

Study selection. After completing the search strategy, the search results were collected and imported into EndNote V.X9 (Clarivate Analytics). To ensure the accuracy of the dataset, duplicates were removed using the EndNote deduplication, resulting in a file containing a unique set of records. This file

was then made available to the reviewers for further processing. The selection process involved two levels of screening using the Rayyan QCRI online software. At the first level, titled “title and abstract screening”, two authors independently reviewed the articles based on their titles and abstracts. Any conflicts or discrepancies between the reviewers’ decisions, were resolved by a third author. The goal of this level was to assess the relevance of each article to the research question based on the provided information. The second level of screening, known as “full-text selection”, also involved two authors independently reviewing the full texts of the selected articles. The purpose of this level was to assess the eligibility of each article based on its complete content. Again, any conflicts or disagreements between the reviewers were resolved, through discussion and, if necessary, consultation with a third author. Throughout the selection process, detailed records were maintained, documenting the reasons for excluding articles that did not meet the inclusion criteria. This documentation followed the latest published version of the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA 2020) flow diagram. The PRISMA flow diagram visually represents the screening process, indicating the number of articles identified, screened, assessed for eligibility, and included in the final analysis. By adhering to these rigorous selection procedures and reporting guidelines, transparency, and reliability, were ensured in the article selection process, enabling a comprehensive and systematic approach to be taken in the scoping review.

Data extraction and data synthesis. Data extraction was conducted using a pre-designed data extraction form, specifically developed, for this scoping review. The form was created based on the JBI (Joanna Briggs Institute) data extraction tool, tailored to capture key information from the selected articles. The extracted data included the following details: authors, country of publication, year of publication, study design, patient characteristics, pertinent findings or outcomes, type of intervention, related procedures, and any relevant additional information. Descriptive analyses were performed on the extracted data to summarize the characteristics of the included studies. The results were presented, in a numerical format, using frequencies and percentages to report the studies identified and included in the scoping review. This approach allowed for a concise representation of the distribution and composition of the included studies. The description of the search decision process, including the number of articles identified, screened, assessed for eligibility, and ultimately included in the review, was systematically mapped. This mapping process provides transparency and clarity in documenting the selection process, allowing for a comprehensive understanding of the article selection flow. Especially, the extracted data were summarized in tabular form, presenting the main characteristics of the included studies. These summary tables provide a structured overview of the key information extracted from each study, facilitating comparison and analysis of the findings across the included articles. Overall, the presentation of the extracted data in this scoping review primarily relies on concise and informative summary tables, providing a clear and organized representation of the main characteristics and results of the included studies.

3. RESULTS

As presented in the PRISMA 2020-flow diagram (Figure 1), from 23 records identified by the initial literature searches, 19 were excluded and, 4 articles were included (Table 1, 2).

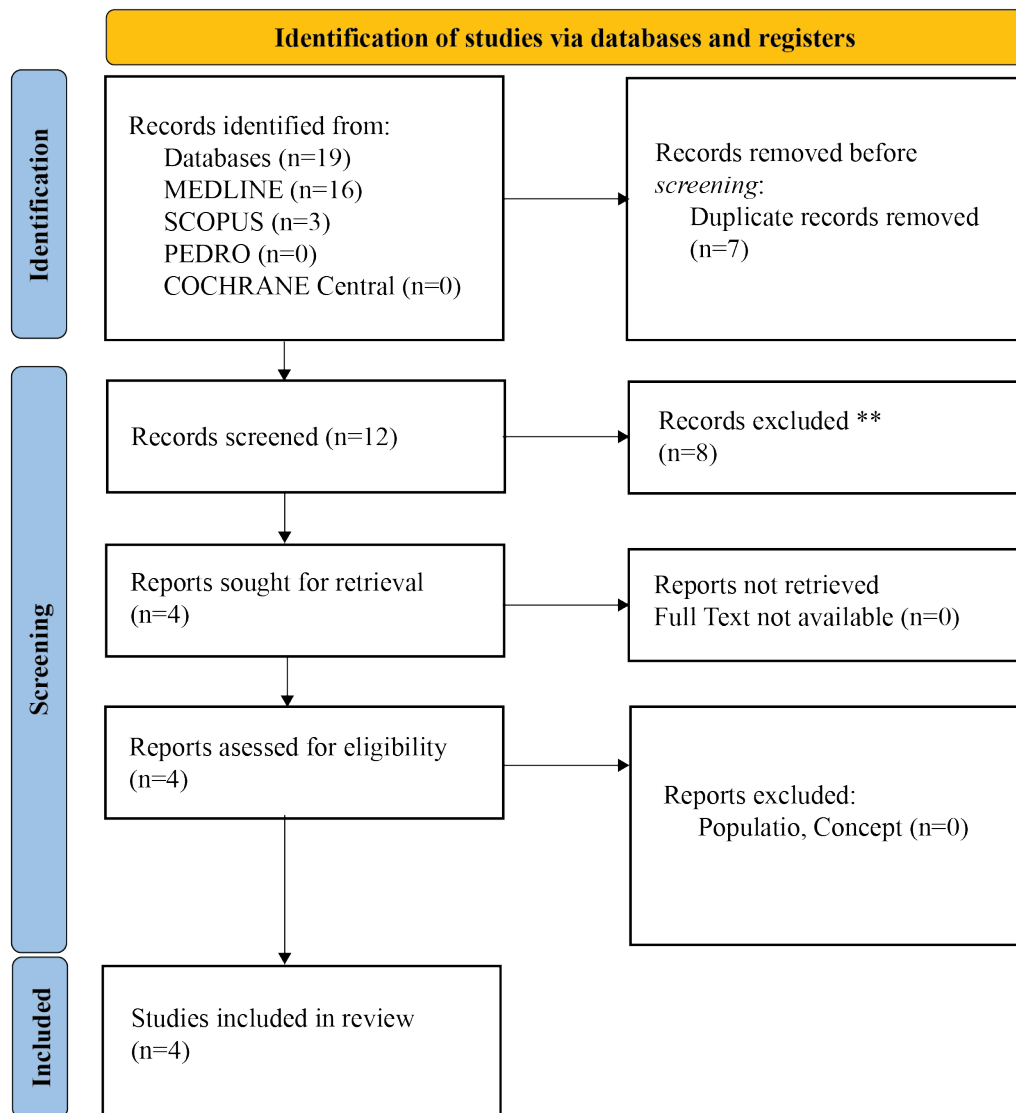


Figure 1. Preferred reporting items for systematic reviews and meta-analyses 2020 (PRISMA) flowdiagram

Table 1. The main characteristics of the included studies

N°	Author	Title	Year	Country	Study design
1	Andersen S et al.	The effect of talocrural joint manipulation on range of motion at the ankle joint in subjects with a history of ankle injury	2003	Australia	RCT
2	Hedlund S et al.	Effect of chiropractic manipulation on vertical jump height in young female athletes with talocrural joint dysfunction: a single-blind randomized clinical pilot trial	2014	Sweden	Pilot Study
3	Marrón-Gómez D et al.	The effect of two mobilization techniques on dorsiflexion in people with chronic ankle instability	2015	Spain	RCT

4	Shin HJ et al.	Manipulative Therapy Plus Ankle Therapeutic Exercises for Adolescent Baseball Players with Chronic Ankle Instability: A Single-Blinded Randomized Controlled Trial	2020	Korea	RCT
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RCT - Randomized Controlled Trial

Table 2. Types of interventions

	Population	Method	Outcome
1	52 healthy individuals (23 males, 29 females), average age 22 years. All had a history of lateral ligament sprain but no recent injuries or current pain.	High-velocity, low-amplitude (HVLA) manipulation on the talo-crural joint performed by an osteopath. The control group received no actual manipulation.	No significant difference in dorsiflexion range (DFR) was observed post-intervention between the control and experimental groups. The group with a palpable joint gap and pop showed the largest DFR increase, but not significantly so.
2	22 Female elite handball players above 16 years with evidence of talocrural joint dysfunction. Excluded those with current ankle injuries, inflammatory symptoms, or past ankle surgeries.	Corrective HVLA manipulation vs sham (non-corrective) manipulation, performed once weekly for 3 weeks. Participants were unaware of the type of manipulation (corrective or sham) they received.	Improvement in vertical jump height in the active treatment group, but not statistically significant compared to the sham group. Suggested need for a larger sample size for more definitive results.
3	52 participants (31 males, 21 females) from a university community and local sports teams in Madrid, aged 15 to 36, were diagnosed with Chronic Ankle Instability (CAI).	Three treatment conditions: weight-bearing mobilization with movement (WB-MWM), HVLA manipulation of the talocrural joint, and placebo.	Both WB-MWM and HVLA treatments showed a significant increase in ankle dorsiflexion compared to the placebo. No significant differences between the effects of WB-MWM and HVLA treatments.
4	31 Adolescent baseball players, with a minimum of 1 year of sports experience, a previous ankle sprain, and a CAIT score ≤ 25 . Excluded recent ankle sprains (past 6 weeks) or history of lower extremity surgery.	HVLA manipulation combined with ankle therapeutic exercises over 4-weeks period, with two sessions per week. The control group received only therapeutic exercises.	Significant improvements in the intervention group in AOFAS-total, AOFAS-pain, AOFAS-function, and AOFAS-alignment scores. Reduction in pain intensity and improvements in dorsiflexion and eversion ROM, especially in uni pedal stance conditions.

Legend: AOFAS: American Orthopaedic Foot & Ankle Society, CAI: Chronic Ankle Instability, CAIT: Cumberland Ankle Instability Tool, DFR: Dorsiflexion Range, HVLA: High-Velocity, Low-Amplitude, ROM: Range of Motion, WB-MWM: Weight-Bearing Mobilization With Movement.

1. Study on Talocrural Joint Manipulation

- **Dorsiflexion Range (DFR) Measurements:** The average improvement in DFR in the treatment group was less than 1 degree. This change was not significantly different from the control group.
- **“Gap” and “Pop” Subgroup:** Within the treatment group, about 30% of participants reported a “gap” and “pop”. This subgroup showed slightly better improvements in DFR, but statistical analysis did not reveal significant differences.
- **Statistical and Clinical Analysis:** While some variations in DFR were present, these did not reach the threshold, of clinical or statistical significance.

2. Study on Elite Female Handball Players

- **Change in Jump Height:** The treatment group showed an average improvement in vertical jump height of about 0.47 cm. The sham group showed an improvement of 0.12 cm.
- **Statistical Significance:** While the HVLA manipulation group showed improvements, statistical analysis did not confirm these improvements as being, significantly superior to the sham group.
- **Implications for Training:** Although the results were not statistically significant, they offer a potential indication that HVLA manipulation might have a positive effect on physical performance.

3. Study on Individuals with Chronic Ankle Instability (CAI)

- **Comparison of WB-MWM and HVLA:** Both groups showed a significant improvement in dorsiflexion, with minor differences between the two, but these were not statistically significant.
- **Results at 48 Hours:** The increase in range of motion and reduction in pain were more pronounced 48 hours post-treatment in the active groups.
- **Clinical Evaluation:** Long-term effects were not analyzed, so it’s impossible to infer the long-term impact of these treatments on CAI.

4. Study on Young Baseball Players

- **Improvement in AOFAS Scores:** Players in the treatment group showed significant improvements in AOFAS scores, which assess ankle functionality, pain, and activity.
- **Reduction in Pain Intensity and Increase in ROM:** There was a significant average reduction in pain intensity measured on a VAS scale and an increase in range of motion (ROM) for dorsiflexion and eversion.
- **Improvements in Balance:** The treatment group exhibited substantial improvements in balance, measured through uni pedal stance tests.

4. DISCUSSION

In young athletes, like the baseball players in one of the studies, significant improvements in ankle range of motion and pain reduction were observed post-manipulation (Fryer, Mudge & McLaughlin, 2002). This finding was echoed in the study focusing on individuals with chronic ankle instability, where improved dorsiflexion was noted (Marrón-Gómez, Rodríguez-Fernández & Martín-Urrialde, 2015; Guiraud, et al., 2023). Particularly notable, is the suggestion from the study involving elite female handball players that manipulation might not only aid in rehabilitation but could also play a role in enhancing athletic performance, as evidenced by improved vertical jump heights (Hedlund et al., 2014). However, the benefits of manipulation are not without caveats. One study pointed out minimal clinical improvements in talocrural joint manipulation, highlighting the variability in the efficacy of different manipulation techniques (Tedeschi & Giorgi, 2023; Shin et al., 2020). This inconsistency raises very important questions about the universal applicability of ankle manipulation across all types of ankle conditions and

patient profiles. Another significant limitation that was identified, is the lack of long-term data in these studies (Shin et al., 2020). Without understanding the duration and sustainability of the benefits, the long-term efficacy of ankle manipulation remains uncertain. This knowledge gap is crucial for assessing the practicality of manipulation as a consistent treatment strategy. Moreover, the review suggests that ankle manipulation, while beneficial, might be more effective when integrated into a comprehensive treatment plan that includes other modalities like therapeutic exercises (Hedlund et al., 2014). This is especially relevant in sports rehabilitation, where a multifaceted approach is often required for optimal recovery (Marrón-Gómez, Rodríguez-Fernández & Martín-Urrialde, 2015). The varying responses to manipulation across different populations also, underscore the need for individualized treatment plans. What works for professional athletes might not have the same effect on individuals with chronic ankle problems, indicating that a one-size-fits-all approach is not feasible (Fryer, Mudge & McLaughlin, 2002; Hedlund et al., 2014). While ankle manipulation shows potential in certain contexts for improving mobility, reducing pain, and enhancing athletic performance, these benefits are not uniformly experienced across all studies or patient populations (Fryer, Mudge & McLaughlin, 2002; Hedlund et al., 2014; Marrón-Gómez, Rodríguez-Fernández & Martín-Urrialde, 2015; Shin et al., 2020). The effectiveness of manipulation varies, and its application should be considered carefully, within the context of a comprehensive, personalized treatment plan (Roberts et al., 2022; Kobza, Lizis & Zięba, 2017). Future research should aim to fill the gaps in long-term efficacy data and explore the varying impacts on different populations to provide a clearer, more comprehensive understanding of the role of ankle manipulation in therapeutic interventions (Bianco et al., 2019; Denegar, Hertel & Fonseca, 2002; López-Rodríguez et al., 2007).

Clinical Implications

- 1. Potential for Improved Mobility and Pain Relief:** Evidence suggests that ankle manipulation can be effective in improving range of motion and reducing pain, particularly in populations such as athletes and individuals with chronic ankle instability. Clinicians might consider ankle manipulation as a viable option for patients presenting with restricted mobility and pain in the ankle.
- 2. Tailored Approach:** The variability in the effectiveness of ankle manipulation across different studies underscores the importance of individualized treatment plans. Clinicians should assess the specific needs and conditions of each patient before opting for manipulation, considering factors such as the type of ankle condition, the patient's activity level, and overall health status.
- 3. Integrative Treatment Strategies:** While ankle manipulation can offer benefits, it may be most effective when used as part of a comprehensive treatment plan. This could include a combination of therapeutic exercises, manual therapies, and possibly other interventions depending on the patient's needs. Such an integrated approach may enhance the overall effectiveness of the treatment and ensure more holistic care.
- 4. Informed Consent and Expectation Management:** Given the varying degrees of efficacy, clinicians need to manage patient expectations regarding the outcomes of ankle manipulation. Providing clear information about the potential benefits and limitations will help in making informed decisions and setting realistic expectations.
- 5. Need for Skilled Application:** The technique and precision in applying ankle manipulation are crucial. Clinicians should be well-trained and skilled in manual therapy techniques to ensure safety and maximize the potential benefits of the treatment.
- 6. Long-term Efficacy and Follow-up:** Considering the lack of long-term data, clinicians should monitor the progress of patients undergoing ankle manipulation over time. Follow-up assessments are essential to evaluate the long-term effectiveness and to make any necessary adjustments in the treatment plan.

- 7. Research and Continuing Education:** Clinicians should stay updated with ongoing research in the field. As new evidence emerges, it's important to integrate these findings into clinical practice also to continually improve the quality of care.

Strengths and Limitations:

Strengths:

- 1. Diversity of Studies:** The inclusion of studies with varied designs and participant demographics enhances the comprehensiveness of the review. This diversity allows for a broader understanding of the effectiveness of ankle manipulation across different populations and settings.
- 2. Focus on Specific Intervention:** The specific focus on ankle manipulation provides detailed insights into this particular treatment modality. This process can be particularly useful, for practitioners specializing in manual therapy or sports medicine.
- 3. Range of Outcomes Assessed:** The reviewed studies evaluated various outcomes, including pain relief, improved mobility, and functional recovery. This multifaceted approach offers a well-rounded perspective on the potential benefits of ankle manipulation.
- 4. Clinical Relevance:** The review addresses a clinically relevant question, providing practitioners with evidence-based information that can inform treatment decisions in real-world settings.
- 5. Highlighting the Need for Individualized Treatment:** The variability in study findings underscores the importance of personalized care in manual therapy, emphasizing the need to tailor treatments to individual patient needs.

Limitations:

- 1. Variability in Study Quality:** The differing quality of included studies might impact the overall reliability and applicability of the review's findings. Higher quality, randomized controlled trials would provide more robust evidence.
- 2. Lack of Long-term Data:** Most studies focus on short-term outcomes, providing limited insight into the long-term efficacy and safety of ankle manipulation. This gap highlights the need for longitudinal studies.
- 3. Limited Generalizability:** The specific focus on ankle manipulation limits the generalizability of the findings to other types of manual therapies or joint manipulations.
- 4. Heterogeneity in Techniques:** The variation in manipulation techniques used across studies makes it challenging to draw definitive conclusions about the most effective approach.
- 5. Risk of Bias:** The presence of potential biases in the reviewed studies, such as selection, performance, and reporting biases, can affect the validity of the conclusions drawn.

5. CONCLUSIONS

This review highlights the potential benefits and limitations of ankle manipulation as a therapeutic intervention. While some studies suggest improvements in pain, mobility, and function, variability in outcomes and methodological differences underscore the need for more standardized, high-quality research. Ultimately, ankle manipulation may be a valuable component in the management of ankle disorders, but its efficacy should be considered, within the context of individual patient needs and evidence-based practice. Further research is necessary to establish clearer guidelines and to understand the long-term effects of this treatment approach.

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Didelio greičio mažos amplitudės manipuliacijos veiksmingumas gydant čiurnos sąnario disfunkciją: išsami apžvalga

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Santrauka

Tyrimo pagrindimas. Čiurnos sąnario manipuliacija yra dažnai naudojama intervencija ortopedijos ir reabilitacijos įstaigose. Jos veiksmingumas gerinant judesių amplitudę, mažinant skausmą ir gerinant funkcinį darbingumą yra nuolatinių tyrimų objektas.

Tikslas. Apibendrinti dabartinius įrodymus apie čiurnos sąnario manipuliacijos veiksmingumą įvairioms pacientų grupėms.

Metodai. Išanalizuoti keturi tyrimai, kurių kiekvienas buvo skirtas skirtingoms populiacijoms, įskaitant sveikus asmenis, elitinius sportininkus ir asmenis, sergančius lėtiniu čiurnos nestabilumu. Taikytos įvairios intervencijos – nuo didelio greičio ir mažos amplitudės (DGMA) manipuliacijų iki manualinės terapijos metodų. Vertinami šie rezultatai: dorsifleksijos diapazonas, vertikalaus šuolio aukštis, čiurnos stabilumas, skausmas ir funkciniai balai.

Rezultatai. Tyrimų rezultatai buvo nevienareikšmiai. Dviejuose tyrimuose nustatyta, kad po manipuliacijos reikšmingai pagerėjo čiurnos funkcija ir sumažėjo skausmas, o kituose tyrimuose pastebėta, kad pokyčiai, palyginti su kontrolinėmis grupėmis, buvo minimalūs arba jų nebuvo. Skirtingi intervencijos metodai, populiacijos charakteristikos ir rezultatų rodikliai lėmė skirtingus rezultatus.

Išvados. Čiurnos sąnario manipuliacijos gali būti naudingos tam tikrais atvejais, ypač gerinant funkcinis rezultatus ir mažinant skausmą. Vis tik rezultatų nenuoseklumas skirtinguose tyrimuose rodo, kad reikia labiau standartizuotų tyrimų protokolų. Tai leistų tiksliau suprasti čiurnos sąnario manipuliacijos veiksmingumą ir vadovautis jos taikymu klinikinėje praktikoje.

Reikšminiai žodžiai: čiurnos manipuliacija, didelio greičio mažos amplitudė (DGMA), manualinė terapija, reabilitacija, ortopedinė intervencija

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