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Revisión

CRYOTHERAPY IN SPORT: AN INTEGRATIVE REVIEW OF ITS USE IN ANKLE SPRAINS

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ABSTRACT

Objective: To develop an integrative review of the results of cryotherapy for ankle sprains. **Methods**: An integrative review was carried out by searching the electronic databases PubMed and LILACS, using the descriptors "Cryotherapy", "Cold therapy", "Ankle trauma", "Ankle injuries", "Ankle sprains", "Syndesmotic injury", "Foot and ankle injuries", "Foot trauma", and "Metatarsophalangeal joint sprain, Ankle" in combination and with MeSH Terms, combined with the Boolean operators "and" and "or". We searched for national and international articles in English and Portuguese published in the last 20 years. A total of 91 articles were found, which were submitted to an evaluation of the abstracts, and 12 met the inclusion criteria. The data was collected in April 2024. **Results**: By analyzing the four studies that made up this review, it was possible to conclude that cryotherapy, despite its commonly known beneficial effects, still has limitations and potential risks when used over the long term or inappropriately. In addition, it was possible to see that there is a lack of consensus regarding its applicability as a treatment for ankle sprain, and little evidence available in the literature to elucidate its benefits. Therefore, there is a clear need for more studies on the subject. As for its use, it is essential to consider a balanced approach, integrating cryotherapy with other treatment modalities, such as early mobilization and functional rehabilitation, to optimize recovery and minimize adverse effects. **Conclusion**: The research has not provided enough solid evidence to support its benefits in a way that clarifies all doubts about its application.

Keywords: cryotherapy; ankle injuries; musculoskeletal pain.

CRIOTERAPIA NO ESPORTE, UMA REVISÃO INTEGRATIVA SOBRE O USO EM ENTORSE DE TORNOZELO

RESUMO

Objetivo: Desenvolver uma revisão integrativa a respeito dos resultados da aplicação da crioterapia na entorse de tornozelo. **Métodos:** Foi realizada uma revisão integrativa com pesquisa nas bases de dados eletrônicas PubMed e LILACS, usando os descritores “Crioterapia”, “Terapia fria”, “Traumatismos do tornozelo”, “Lesões de tornozelo”, “Entorses de tornozelo”, “Lesão Sindesmótica”, “Lesões nos pés e tornozelo”, “Traumatismos do pé”, e “Entorse da Articulação Metatarsofalangeal, Tornozelo” combinadamente e com MeSH Terms, conjugados com os operadores booleanos “and” e “or”. Buscaram-se artigos nacionais e internacionais em inglês e português publicados nos últimos 20 anos. Foram encontrados 91 artigos, os quais foram submetidos à avaliação dos resumos, e 12 atenderam os critérios de inclusão. Os dados foram coletados em abril de 2024. **Resultados:** Através da análise dos quatro estudos que compuseram esta revisão, foi possível concluir que a crioterapia, apesar de seus efeitos benéficos comumente conhecidos, apresenta ainda limitações e potenciais riscos quando utilizada a longo prazo ou de forma inadequada. Além disso, foi possível perceber que há falta de consenso em relação a sua aplicabilidade como tratamento para a entorse de tornozelo, e poucas evidências disponíveis na literatura para elucidar seus benefícios. Portanto, é evidente a necessidade de haver mais estudos sobre o tema. Quanto ao uso, é essencial considerar uma abordagem equilibrada, integrando a crioterapia com outras modalidades de tratamento, como a mobilização precoce e a reabilitação funcional, para otimizar a recuperação e minimizar os efeitos adversos. **Conclusão:** As pesquisas não proporcionaram evidências sólidas suficientes que sustentem quais são seus benefícios de forma que esclareça todas as dúvidas sobre sua aplicação.

Palavras-chave: crioterapia; traumatismos do tornozelo; dor musculoesquelética.

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CRIOTERAPIA EN EL DEPORTE: UNA REVISIÓN INTEGRADORA DE SU USO EN LOS ESGUINCES DE TOBILLO

RESUMEN

Objetivo: Realizar una revisión integradora de los resultados de la crioterapia para los esguinces de tobillo. **Métodos:** Se realizó una revisión integradora mediante búsquedas en las bases de datos electrónicas PubMed y LILACS, utilizando los descriptores "Cryotherapy", "Cold therapy", "Ankle trauma", "Ankle injuries", "Ankle sprains", "Syndesmotic injury", "Foot and ankle injuries", "Foot trauma", y "Metatarsophalangeal joint sprain, Ankle" en combinación y con MeSH Terms, combinados con los operadores booleanos "and" y "or". Se buscaron artículos nacionales e internacionales en inglés y portugués publicados en los últimos 20 años. Se encontraron 91 artículos, cuyos resúmenes fueron analizados y 12 de los cuales cumplieron los criterios de inclusión. Los datos se recogieron en abril de 2024. **Resultados:** Al analizar los cuatro estudios que componían esta revisión, fue posible concluir que la crioterapia, a pesar de sus efectos beneficiosos comúnmente conocidos, sigue teniendo limitaciones y riesgos potenciales cuando se utiliza a largo plazo o de forma inadecuada. Además, fue posible darse cuenta de que hay una falta de consenso en cuanto a su aplicabilidad como tratamiento del esguince de tobillo, y pocas pruebas disponibles en la bibliografía para dilucidar sus beneficios. Por lo tanto, existe una clara necesidad de realizar más estudios sobre el tema. En cuanto a su uso, es esencial considerar un enfoque equilibrado, integrando la crioterapia con otras modalidades de tratamiento, como la movilización precoz y la rehabilitación funcional, para optimizar la recuperación y minimizar los efectos adversos. **Conclusión:** La investigación no ha aportado pruebas suficientemente sólidas para respaldar sus beneficios de forma que se aclaren todas las dudas sobre su aplicación.

Palabras clave: crioterapia; traumatismos del tobillo; dolor musculoesquelético.

INTRODUCTION

Acute ankle sprains are among the most common musculoskeletal injuries, with around 70% of people who suffer an acute injury developing chronic ankle instability, which generates a high number of recurrences. Acute injuries occur mainly in the active population, when performing functional activities and in sports[1,2]. Chronic instability is caused by ligament trauma and changes in spinal and supraspinal motor control, which favors the appearance of osteoarthritis in the talus., meaning that it is very important for the body to be able to repair the ligaments properly, as well as to recover proprioception[1].

Among the therapeutic options, in extreme cases, where there is great instability or permanence of symptoms, the surgical procedure involving anatomical repair of the injured ligaments as well as reinforcement of the extensor retinaculum can be mentioned. However, the results tend to be the same as those of conservative treatment, with regard to function and subjective results. Thus, conservative treatment is generally the first choice, and various procedures can be used, such as: anti-inflammatories and opiates, immobilization, acupuncture, manual therapy, neuromuscular training and electrophysical agents (diathermy, ultrasound, photobiomodulation, electric currents), and initially the treatment considered universal has been rest, cryotherapy, compression and elevation, although the evidence supporting this form of therapy is very limited[4–6].

The PRICE protocol (protection, rest, ice, compression and elevation) is one of the approaches that can be used to treat musculoskeletal injuries during their initial stages. Protection consists of immobilizing the affected area to prevent further damage, while rest enables the body to begin the process of tissue recovery together with the application of ice which reduces the local temperature caused by the inflammatory process, thus reducing inflammation and consequently bringing analgesia, while elevating the affected limb helps to reduce edema[7].

The immediate application of ice is widely adopted to relieve pain and reduce inflammation. It is the first line of treatment for both sports injuries and recovery after intense training/matches and is generally used locally in the former cases and by full body immersion in the latter[8,9]. However, despite its popularity, the long-term effects of this technique on the healing process and functional recovery of the ankle are still not fully understood, as excessive reduction of the inflammatory process can delay recovery or result in incomplete tissue regeneration. The effects of cryotherapy on tissue regeneration, especially with regard to ligament resilience, are also not well understood. The evidence on whether the application of ice improves or impairs the quality and durability of regenerated tissues is limited and conflicting. Clarifying this relationship is fundamental to developing evidence-based treatment protocols that guarantee optimal recovery and long-term tissue integrity[3,10,11].

There is a notorious lack of standardized guidelines on the ideal timing, frequency and duration of ice application for ankle sprains. Variations in these parameters can lead to different results, and the absence of robust guidelines based on scientific evidence adds to the complexity and controversy over the long-term effectiveness of cryotherapy. Establishing clear, evidence-based protocols is essential to maximize the therapeutic benefits of cryotherapy[12].

Thus, despite being widely researched, the use of cryotherapy still has several gaps in terms of its effects on musculoskeletal injuries[13–19]. The importance of cryotherapy for sport and health professionals should be borne in mind, given its widespread use. Therefore, an integrative review that comprehensively and critically analyzes the available evidence on the effects of cryotherapy on ankle sprains is crucial to contribute to clinical practice and sport performance. Therefore, this article proposes to carry out an integrative review of the scientific literature, seeking to consolidate existing knowledge and identify possible gaps and challenges for future research and clinical interventions regarding the use of cryotherapy as a treatment for ankle sprain.

METHODS

The integrative literature review was adopted as a method, which allows a comprehensive analysis of the available literature, providing the consolidation of evidence to support clinical decisions, and is also "a unique tool in the field of health that synthesizes research and guides practice based on scientific knowledge"[20].

This integrative literature review aims to critically evaluate the long-term effects of the use of cryotherapy in the recovery of ankle sprains, considering that, despite its popularity and immediate effectiveness in reducing pain and inflammation, there is still a significant gap in knowledge. Areas of controversy include the impact of ice on the inflammatory response and healing processes, on functional recovery and performance, and on the quality of tissue regeneration, as well as the lack of standardized guidelines on its application. Clarifying these issues is key to developing evidence-

based treatment protocols that maximize therapeutic benefits and ensure optimal recovery and long-term tissue integrity.

Inclusion and exclusion criteria

Studies investigating the use of cryotherapy in the treatment of ankle sprains were included, documenting its long-term effects on pain reduction, inflammation and functional recovery. Studies addressed interventions with immediate application of ice and considered variables such as inflammatory response, tissue healing, ligament resilience and functional performance. We considered studies with participants of both sexes, different age groups, different ethnicities, including both athletes and non-athletes, with a history of sports or non-sports trauma, and studies available in full text in Portuguese and English published in the last 20 years.

Studies that did not exclusively investigate the use of cryotherapy in the treatment of ankle sprains were excluded. Studies that combined this technique with other treatment modalities in addition to immediate ice application were not considered, except those that made it possible to identify cryotherapy as the main intervention and its results were clearly analyzed. Articles that did not address aspects such as pain, inflammation, tissue healing, functional recovery, ligament resilience or long-term performance were also excluded.

The PICO technique (acronym for patient, intervention, comparison and outcomes) was used to draw up the research question for the integrative review[21], as follows: P - patients with ankle sprains; I - cryotherapy; O - pain, performance, edema and hyperemia. The third element - (C) comparison - was not used. Thus, the research question was defined as: "What are the results of the application of cryotherapy in the treatment of ankle sprain?".

To carry out the integrative review, the following stages were followed: 1. Definition of the review topic in the form of a primary question or hypothesis; 2. Selection of the sample, after defining the inclusion and exclusion criteria; 3. Characterization of the studies; 4. Analysis of the results, identifying similarities and conflicts; 5. Presentation and discussion of the findings[22].

The search for published articles was carried out using international databases, Public MEDLINE (PubMed) and Latin American and Caribbean Health Sciences Literature (LILACS). The search strategy was: (Crioterapia) OR (Cryotherapy) OR (Cold Therapy) OR (Cold Therapies) OR (Therapies, Cold) OR (Therapy, Cold)) AND ((Traumatismos do Tornozelo) OR (Lesões do Tornozelo) OR (Injury, Ankle) OR (Injuries, Ankle) OR (Ankle Sprains) OR (Ankle Sprain) OR (Sprain, Ankle) OR (Injury, Syndesmotic) OR (Syndesmotic Injury) OR (Sprains, Ankle) OR (Syndesmotic Injuries) OR (Injuries, Syndesmotic) OR (Foot Injuries, Ankle) OR (Traumatismos do Pé) OR (Ankle Injuries) OR (Entorse da Articulação Metatarsofalangeal, Tornozelo)). They were applied to the PubMed and LILACS tools.

Data was collected in April 2024 and 6,403 articles were found in the two databases. After applying the 20-year time cut-off, 82 articles were obtained from PubMed and 9 from LILACS. To assess the articles found in the search, the titles and abstracts were examined, excluding those that were repeated between the databases and that did not meet the inclusion criteria. Eighteen manuscripts were identified for full-text reading, and in the end twelve articles were included in the study. A Microsoft Excel database was built to systematize the articles collected, and the criteria established by Souza, Silva and Carvalho[20] were used to evaluate the articles.

Summary of data

To synthesize the data extracted in this integrative review, an approach was used that combined both qualitative and quantitative results from the selected studies. Thematic analysis was adopted to organize and integrate the evidence found, allowing the identification of patterns, similarities and divergences in the studies reviewed. The data was grouped according to relevant themes related to the long-term effects of cryotherapy in the treatment of ankle sprains, considering aspects such as inflammatory response, tissue healing, functional recovery, ligament resilience and impacts on patient performance over time.

Limitations of the integrative review

One of the main limitations to be considered is publication bias, where studies with positive results are more likely to be published than those with neutral or negative results, which can distort the general understanding of the results. In addition, the inclusion of studies with different designs, research populations and methodologies can make it difficult to directly compare and synthesize the data. The intrinsic limitations of the studies reviewed, such as variations in diagnostic criteria and outcome assessment, also have a potential impact on the interpretation of the findings. It is essential to address these issues clearly and in detail in the Methods section of the integrative review, thus ensuring transparency, the possibility of replication and the credibility of the results obtained.

Ethical considerations

According to Article 1 of Resolution 510/2016 of the Brazilian National Health Council, research carried out exclusively with scientific texts to review the scientific literature does not require analysis by an ethics committee, as it does not include the collection of new primary data with the direct participation of individuals. However, it was ensured that the conduct and reporting of the research strictly followed ethical standards, such as transparency in the selection of studies, impartiality in data analysis and respect for the intellectual property of the authors.

RESULTS

The final set of this analysis included 12 scientific articles, which were chosen based on the established inclusion criteria, one of which was found in the LILACS database and 11 in PubMed (Figure 1).

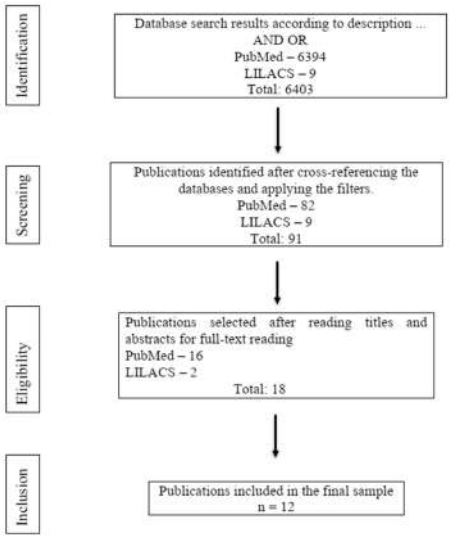

Figure 1. Study selection flowchart.

Table I. Contains the objectives and main results obtained.

Authors and year of publication	**Objectives**	**Design** - participants	**Protocol**	**Main results**
Bekerom et al., 2012	Analyze the RICE protocol within 72 hours of ankle sprain	Systematic review	11 trials involving 868 patients	Insufficient evidence of the RICE protocol in individuals with ankle sprains
Bleakley et al., 2006[23]	To compare the effectiveness of two cryotherapy protocols (intermittent and continuous) in the immediate treatment of mild to moderate ankle sprains.	Systematic review	Eligible randomized clinical trials using cryotherapy for soft tissue injuries, including ankle sprains	Short-term reduction in pain and edema The intermittent protocol (10 minutes of application followed by 10 minutes of rest every two hours) showed better long-term functional recovery
Brison et al., 2016[24]	To evaluate the effectiveness of a supervised physiotherapy program in the recovery of simple ankle sprains grades 1 and 2.	Randomized clinical trial – 503 participants	PRICE	No clinically important benefits were obtained
Chen et al., 2019[5]	To understand the trends in the use of cryotherapy for ankle sprain injuries from 2000 to 2018.	Narrative review	Athletes who suffer an ankle sprain, treatment and rehabilitation, including cryotherapy	Athletes with ankle sprains who underwent immediate cryotherapy showed better functional results
Halabchi & Hassabi, 2020[25]	Literature review to analyze different clinical and therapeutic approaches to lateral ankle sprain in athletes.	Literature review	Presentation of different forms of treatment for ankle sprains in athletes, including cryotherapy	Questioned the effectiveness of cryotherapy alone in reducing the symptoms of an ankle sprain (level 2 on a scale of 1 to 4)
Hawkins & Hawkins, 2016[26]	To identify the current patterns of clinical use of cryotherapy among sports physiotherapists.	Cross-sectional survey – 7283 members of the Sports Physical Therapy Section of the APTA	Application of cryotherapy by professionals	Great variability in the approaches, demonstrating a lack of clear consensus on the choices for treatment with cryotherapy
Klintberg & Larsson, 2021[27]	Systematic review of the long-term effects of cryotherapy.	Systematic review	Eight systematic reviews and 50 randomized clinical trials cryotherapy even in individuals with ankle sprains	The general effects of long-term cryotherapy generated low certainty of evidence, except for the absence of an analgesic effect, which had moderate certainty
Miranda et al., 2021[28]	To investigate the effectiveness of cryotherapy on pain intensity, swelling, range of motion, function and recurrence in acute ankle sprain.	Systematic review	Two randomized clinical trials looking at the effects of cryotherapy on ankle sprains	Uncertain evidence shows that cryotherapy does not increase the effects of other interventions on swelling, pain intensity and range of motion
Mugno & Constant, 2023[29]	To compare different conservative protocols in the treatment of ankle sprains in the general public.			RICE protocol reduces the recurrence rate of ankle sprains and emphasizes the importance of early intervention
Ruiz-Sánchez et al., 2022[6]	To review current clinical practice guidelines on the management and treatment of ankle sprains.	Literature review	Presentation of treatment techniques for ankle sprains, including cryotherapy	Sufficient evidence to be applied in clinical practice – cryotherapy
Thain et al., 2015[30]	To compare the effects of wet ice and cold-water immersion on the reaction time of the peroneus longus and tibialis anterior muscles during a simulated lateral ankle sprain.	Randomized clinical trial – 54 participants	Wet-ice application, cold-water immersion, or an untreated control condition applied to the ankle for 10 minutes	Cryotherapy did not affect muscle reaction time or amplitude
Tittley et al., 2020[10]	To compare the effect of two cryotherapy interventions, neurocryostimulation and traditional ice pack application in the treatment of acute ankle sprain.	Randomized clinical trial – 41 participants	Two bags of crushed ice applied around the injured ankle for 15 min	Reduction in inflammation and pain

DISCUSSION

The aim of this review was to examine the effects of cryotherapy on ankle sprains, based on the evidence available in the literature. However, the scarcity of existing studies on the subject that had a design consistent with the inclusion and critical selection criteria meant that the scope for conclusions on this objective was limited. However, based on the analysis of the included articles in this review, it was possible to identify and suggest some factors such as the ideal application time, evidence of the analgesic effect of cryotherapy, and some non-beneficial factors.

Various treatment methods for ankle sprains have been identified, including the Ottawa rules, manual therapy, functional supports, early ambulation, short-term non-steroidal anti-inflammatory drugs (NSAIDs), rehabilitation and cryotherapy. It was observed that cryotherapy is highly recommended in the acute phase for pain reduction, compared to the use of analgesic drugs. However, there is low effectiveness in the recovery phase of the injury, indicating that it should only be applied to acute ankle sprains to reduce pain, minimize swelling and prevent secondary injuries[6].

These analgesic effects are explained by a series of physiological mechanisms and become of great relevance when applied

immediately after sports injuries, aiming at the rapid recovery of athletes and the reduction of inflammatory signs[8,9]. According to Thain et al.[30], there is an increase in the latency and prolonged duration of sensory action potentials, which leads to a decrease in nerve transmission, inhibiting the sensitivity of nociceptive receptors and effects against irritants, controlling acute pain after soft tissue injury. Regarding the parameters that can be applied, the cooling time is directly related to the thickness of the adipose tissue and the depth of the target tissue[30]. These authors found consistent evidence that applying ice for periods longer than 20 minutes had a negative impact on strength, speed, power and performance in activities requiring agility, and that cooling tissues impairs neuromuscular control, causing changes in the sense of joint position.

According to Hawkins and Hawkins[26], there is still an open debate about the best techniques for applying cryotherapy. If the aim is analgesia, ice massage seems to be the most recommended; however, immersion in cold water can have longer-lasting effects. The authors also comment that, in animals, the temperature of the tissue must reach between 5ºC and 15ºC to achieve the objectives of cryotherapy, but they have found no studies that clarify the ideal temperatures for humans. They also report that there is a great lack of consensus among physiotherapists about the choices or guidelines for ideal treatment using cryotherapy. In the review by Miranda et al.[28], of the 19 texts evaluated by the authors, only two randomized clinical trials were included, with no comparison with placebo or evaluation of function and recurrence. The immediate care protocols were combined with anti-inflammatories, elevation, rest, ultrasound, standardized exercises and support. This makes the analysis difficult, as it does not include studies with adequate follow-up.

More broadly, Klintberg and Larsson[27] investigated the long-term effects of using cryotherapy. They selected 58 articles, including eight systematic reviews and 50 randomized clinical trials. However, only one systematic review focused on the technique applied to ankle sprains[31], the authors point out that cryotherapy is well tolerated and has few adverse events. However, for the long-term effects, the certainty of the evidence was low, except for the absence of pain reduction in the chronic phase, which had moderate certainty. Thus, although cryotherapy is a simple and inexpensive method for reducing immediate pain, the moderate evidence does not support its effectiveness in the chronic phase.

The review by Halabchi and Hassabi[25] analyzed 201 studies with different clinical approaches to lateral ankle sprains in athletes. Traditional conservative treatment prevails, including rest, ice, compression, elevation, non-steroidal anti-inflammatory drugs, analgesics and immobilization. However, they question the effectiveness of cryotherapy alone in reducing the symptoms of an ankle sprain. As for ligament resilience, the results are mixed, with early cryotherapy being able to improve ligament healing by limiting excessive inflammatory reactions[23,32]. On the other hand, there is a need for a balanced approach, as excessive and early cooling can damage the natural healing processes needed for tissue repair and the long-term resilience of ligaments[33].

Brison et al.[24] carried out a study evaluating the effectiveness of cryotherapy in early supervised physiotherapy for the recovery of acute ankle sprains grades I and II. They found that the current evidence on the role of supervised physiotherapy in the acute management of these injuries is limited and that a standard intervention together with the usual care such as rest, cryotherapy, compression and limb elevation, do not provide clinically important benefits for the treatment of simple ankle sprains.

Finally, the comprehensive analysis of these articles was not enough to elucidate all the effects that cryotherapy can provide, and there is a clear need for further research. This research also showed a lack of clear consensus among those responsible for the rehabilitation process about the most appropriate management for the treatment of ankle sprains, which is probably due to the limited evidence.

CONCLUSION

It is concluded that cryotherapy, despite its commonly known beneficial effects, has limitations and potential risks when used inappropriately over the long term. Therefore, it is essential to consider a balanced approach, integrating cryotherapy with other treatment modalities, such as early mobilization and functional rehabilitation, to optimize recovery and minimize adverse effects. Research has not provided enough solid evidence to support its benefits in a way that clarifies all doubts about its application.

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