INPLASY

EFFECTIVENESS OF THE USE OF BLOOD FLOW RESTRICTION IN LOWER LIMB TENDONS. A REVIEW SYSTEMATICS

INPLASY202520087
doi: 10.37766/inplasy2025.2.0087
Received: 19 February 2025
Published: 19 February 2025

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ADMINISTRATIVE INFORMATION

Support - No funding sources.

Review Stage at time of this submission - Formal screening of search results against eligibility criteria.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202520087

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 19 February 2025 and was last updated on 19 February 2025.

INTRODUCTION

Review question / Objective Determine if there is scientific evidence supporting the effectiveness of BFR use in lower limb tendons."scientific evidence that supports the effectiveness of the use of BFR in the tendons of lower extremity.

Rationale Blood flow restriction (BFR) is a rehabilitation modality that uses a cuff or strap around the limb to partially reduce arterial blood flow. Initially, BFR or Kaatsu training was used for strength and muscle hypertrophy gains.
It is now used as a rehabilitation tool in various musculoskeletal dysfunctions. The physiological benefits are attributed not only to the musculoskeletal system but also to the cardiovascular, endocrine systems, and psychosocial components.
There are various theories regarding the mechanism of action. It is currently believed that the metabolic stress from vascular occlusion and the mechanical tension from exercise and/or training lead to greater muscle hypertrophy and strength.
At the cellular level, metabolites, hormonal differences, cellular signaling pathways, and cellular inflammation are involved. It is believed that the hypoxic condition leads to early fatigue, resulting in greater motor unit recruitment. Additionally, there is a greater recruitment of type II fibers. Lastly, there is increased proliferation of satellite cells, with associated increases in muscle protein synthesis, myofiber size, and muscle strength.

It has been demonstrated that BFR training induces exercise-induced hypoalgesia through endocannabinoid and endogenous opioid mechanisms. This could be an alternative for managing acute pain in musculoskeletal dysfunctions.

The evidence is limited regarding the effects that low-load training with BFR may have on the

tendons of the lower limb. Muscle gains may facilitate tendon repair through their morphological and mechanical properties however, this is not clear.

Despite the clinical benefits found from BFR training in other musculoskeletal dysfunctions, little attention has been given to its actual effect on tendons.

Therefore, the aim of this review is to determine whether there is scientific evidence supporting the effectiveness of BFR use in lower limb tendons.

Condition being studied Tendinopathy is a common condition of the lower limb. One of its limitations is functionality and pain. The societal costs are high due to absenteeism and medical care.
The prevalence of tendinopathy is higher in athletes who participate in running, speed changes, and jumping. About 30% of musculoskeletal injuries are tendinopathies.
Lower limb tendinopathies often involve morphological changes over time. These may include increased tendon thickness, disorganization of collagen fibrils, and neovascularization.
One of the challenges in clinical practice is the initial pain in the tendon when subjected to external load. High-load exercises promote adaptive responses in the mechanical properties of the tendon. On the other hand, high traditional loads in the early stages of rehabilitation could be counterproductive to tendon healing.
Traditional high-load training for tendons uses around 70% of one-repetition maximum (1RM). In contrast, low-load training uses between 20-40% of 1RM. For this reason, low-load exercises are suggested for patients who cannot tolerate high training loads due to pain.
Progressive loads and precise dosing parameters during rehabilitation are essential for tendon repair. These training regimens have shown positive clinical effects, both in improving symptoms and tendon structure and strength.

METHODS

Search strategy The systematic review will be conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement and following the recommendations of the Cochrane Collaboration Handbook.

The search included keywords from two main concepts: Blood Flow Restriction ("Kaatsu," "Occlusion Training") and Tendon ("tendon," "tendinopathy," "lower limb tendinopathy," "tendon rupture"). The Boolean operators "OR" and "AND" were used to link the keywords of each concept and to link the concepts themselves, respectively.

Study selection. One reviewer will independently examine the titles and abstracts. Full-text articles of potentially eligible studies will be analyzed. Any disagreement will be resolved by a second reviewer.

Data collection process. One reviewer will independently perform data extraction. A second reviewer will compare the extracted information, resolving disagreements, and the information will be synthesized into a table. The following data will be extracted: population (sample size, age, and diagnosis), intervention (temporal frequency, type, and dosage of exercise), training dosage (number of sets, repetitions, and % of 1RM), cuff parameters (location and % of occlusion pressure), and the effect on tendon morphological properties, cross-sectional area, and maximum voluntary contraction strength.

Participant or population Subjects over 18 years old with tendon injury of any duration or healthy lower limb tendons.

Intervention Low-load exercise intervention with BFR.

Comparator Any High or low-load exercise intervention or no intervention.

Study designs to be included Controlled Clinical Trials (CCT) or Randomized Clinical Trials (RCT), published in English or Spanish.

Eligibility criteria Studies were eligible if they met the following inclusion criteria:

Population: subjects over 18 years old with tendon injury of any duration or healthy lower limb tendons; Intervention: low-load exercise intervention with BFR; Comparison: any high or low-load exercise intervention or no intervention,
Outcomes: changes in the mechanical and morphological properties of the tendon, tendon cross-sectional diameter, and assessment of maximum voluntary contraction strength; Study type: Controlled Clinical Trials (CCT) or Randomized Clinical Trials (RCT), published in English or Spanish. The exclusion criteria are as follows: studies that included participants with other concurrent injuries or medical conditions unrelated to tendons, studies conducted in

experimental models, unpublished reports, reviews, and scientific posters.

Information sources To identify potentially relevant articles, searches will be conducted in five databases from the beginning until March 2025. The databases to be used will be Medline (via Pubmed), Web of Science, Scopus, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Physiotherapy Evidence Database (PEDro).

Main outcome(s) Changes in the mechanical and morphological properties of the tendon, tendon cross-sectional diameter, and assessment of maximum voluntary contraction strength.

Quality assessment / Risk of bias analysis The risk of bias of individual studies will be assessed by the investigator independently, according to the recommendations suggested by the Cochrane Handbook for Systematic Reviews (Cochrane Handbook of Systematic Reviews of Interventions). In this way, the existence of selection, performance, detection, attrition, and reporting bias in the included studies will be determined. Each domain could be classified as 'low' RoB, 'some concerns,' or 'high.' A second reviewer (RV) will be involved if consensus cannot be reached.

Strategy of data synthesis Descriptive analyses will be conducted for studies that present insufficient data for overall grouping, and a descriptive synthesis will be performed following the guidelines of the Cochrane Collaboration.

Subgroup analysis Subgroups will be considered as differences in treatment methods between traditional treatment groups and intervention with BFR.

Sensitivity analysis Sensitivity analysis will be performed using case-by-case exclusion analysis.

Country(ies) involved Chile.

Keywords Blood flow restriction; Kaatsu; Tendon; Lower extremity tendinopathy; Tendinopathy.

Contributions of each author

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