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Blood Flow Restriction Training in Achilles Tendon Rupture Rehabilitation: A Scoping Review of Intervention Parameters, Clinical Outcomes, and Research Gaps

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ADMINISTRATIVE INFORMATION

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Conflicts of interest - None declared.

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INTRODUCTION

Review question / Objective To map and synthesize the available evidence regarding the use of Blood Flow Restriction Training (BFRT) in the rehabilitation of Achilles tendon rupture (ATR), including intervention characteristics, rehabilitation phases, clinical and functional outcomes, safety considerations, and current research gaps in both surgically and conservatively managed patients.

This scoping review also aims to identify the methodological characteristics of the existing literature, describe BFRT application parameters, and explore areas requiring further investigation in the context of Achilles tendon rupture rehabilitation.

Background Achilles tendon rupture (ATR) is one of the most clinically significant tendinous injuries affecting the physically active adult population. The condition is associated with substantial functional impairment, prolonged rehabilitation timelines, and persistent deficits in plantar-flexion strength, muscle performance, and return-to-sport capacity. Regardless of whether treatment is surgical or conservative, the initial rehabilitation phases commonly require partial unloading and activity restriction, which contribute to rapid triceps surae muscle atrophy and reduced functional capacity.

Blood Flow Restriction Training (BFRT), also referred to as occlusion training or Kaatsu training, has emerged as a rehabilitation strategy capable of promoting muscular adaptations using low external loads while minimizing mechanical stress on healing tissues. This approach may be particularly relevant during the early stages of ATR rehabilitation, when high-load resistance training is contraindicated.

Current evidence regarding BFRT in ATR rehabilitation remains limited and heterogeneous, including randomized trials, feasibility studies, rehabilitation protocols, and observational designs. Existing studies have explored outcomes related to muscle preservation, tendon morphology, strength

recovery, functional performance, pain, and return to sport; however, the characteristics of BFRT protocols and reported outcomes vary considerably across studies.

Given the emerging nature of this field and the diversity of study designs and rehabilitation approaches, a scoping review is considered the most appropriate methodology to comprehensively map the available evidence, summarize intervention characteristics, identify knowledge gaps, and guide future research in the rehabilitation of Achilles tendon rupture.

Rationale Blood Flow Restriction Training (BFRT) has gained increasing attention in musculoskeletal rehabilitation due to its potential to induce muscle hypertrophy and strength adaptations while using low mechanical loads. This characteristic may be particularly beneficial during Achilles tendon rupture (ATR) rehabilitation, where high-load resistance exercises are often contraindicated during the early healing phases.

Although BFRT has been widely investigated in other orthopedic and sports rehabilitation conditions, the evidence specifically related to ATR rehabilitation remains emerging and methodologically heterogeneous. Existing literature includes randomized trials, feasibility studies, rehabilitation protocols, and observational investigations with considerable variability in intervention parameters, rehabilitation timing, and reported outcomes.

To date, no comprehensive synthesis has mapped the characteristics of BFRT protocols, clinical applications, functional outcomes, safety considerations, and existing research gaps in ATR rehabilitation. Given the evolving and exploratory nature of the evidence, a scoping review is considered the most appropriate methodological approach to summarize the available literature, identify knowledge gaps, and support the development of future research and clinical rehabilitation strategies.

METHODS

Strategy of data synthesis A descriptive and narrative synthesis of the included studies will be conducted following the methodological recommendations for scoping reviews and the PRISMA-ScR reporting guideline. Extracted data will be summarized in tables and organized according to key domains, including study characteristics, participant profiles, rehabilitation phase, BFRT intervention parameters, outcome measures, safety considerations, and main findings.

The evidence will be grouped thematically to map the current landscape of BFRT use in Achilles tendon rupture rehabilitation. Particular attention will be given to the variability of intervention protocols, timing of BFRT initiation, rehabilitation contexts (surgical and conservative management), and reported clinical and functional outcomes.

No meta-analysis or quantitative pooling of results will be performed, as the objective of this scoping review is to explore and map the breadth and characteristics of the available evidence rather than determine intervention effectiveness.

Eligibility criteria This scoping review will follow the Population–Concept–Context (PCC) framework recommended by the Joanna Briggs Institute (JBI).

Population: Adults (≥18 years) diagnosed with Achilles tendon rupture, including both surgically and conservatively managed patients during any phase of rehabilitation.

Concept: Blood Flow Restriction Training (BFRT), also referred to as occlusion training or Kaatsu training, applied as part of rehabilitation or exercise interventions. Studies investigating active BFRT exercise protocols, passive BFRT approaches, or BFRT combined with neuromuscular electrical stimulation (NMES) will be considered.

Context: Rehabilitation settings related to Achilles tendon rupture recovery, including clinical, sports medicine, orthopedic, physiotherapy, and exercise-based rehabilitation contexts.

This review will consider randomized controlled trials, non-randomized studies, feasibility studies, pilot studies, observational studies, case series, rehabilitation protocols, and conference proceedings published in English or Spanish. Studies involving animals, in vitro models, pediatric populations, or conditions unrelated to Achilles tendon rupture will be excluded.

Source of evidence screening and selection All identified records will be exported to a reference management software and duplicates will be removed prior to screening. Two independent reviewers will perform the screening process in two stages: (1) title and abstract screening and (2) full-text review of potentially eligible studies. Disagreements between reviewers will be resolved through discussion and, when necessary, consultation with a third reviewer.

The study selection process will follow the PRISMA-ScR recommendations and will be summarized using a flow diagram detailing the number of records identified, screened, assessed for eligibility, and included in the final synthesis.

Data management All records identified through the search strategy will be exported to reference management software for organization and duplicate removal. Following deduplication, records will be transferred to a screening platform to facilitate title, abstract, and full-text review.

Data extracted from the included studies will be organized using a standardized data extraction form developed by the review team. Extracted information will include study characteristics, participant demographics, rehabilitation context, BFRT intervention parameters, outcomes assessed, and key findings. Data management procedures will be conducted collaboratively among reviewers to ensure consistency and accuracy throughout the review process.

Language restriction Studies published in English and Spanish will be included in this scoping review. No restrictions regarding publication year will be applied. Articles published in other languages without an available English.

Country(ies) involved Chile.

Keywords Blood Flow Restriction Training; BFRT; Achilles Tendon Rupture.

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