THE EFFICACY OF BLOOD FLOW RESTRICTION THERAPY VERSUS PLATELET-RICH PLASM INJECTION IN THE TREATMENT OF LOWER EXTREMITY TENDINOPATHIES: A CRITICALLY APPRAISED TOPIC

by

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ABSTRACT

Clinical Scenario: Tendinopathy causes pain and functional limits, accounts for 30% of all musculoskeletal conditions. The patellar and Achilles tendons are the most injured. Tendons are made up of highly organized collagen fibers, proteoglycans, and glycoproteins that equip mechanical stability and strength to the tissue. However, the limited blood flow and nutrient supply to tendons make it challenging to heal. Blood flow restriction (BFR) therapy and Platelet rich plasma (PRP) injections are potential treatments that operate differently to improve tendon healing. BFR therapy decreases blood flow during resistance training to stimulate the production of growth factors, while PRP injections target the underlying biology of the healing process by supplying concentrated platelets and growth factors to the affected tissue. Both treatments may improve outcomes for patients with tendinopathy, but additional research is required to confine optimal treatment protocols and factors impacting treatment success. **Focused Clinical Question:** Are current BFR protocols and PRP injection therapy effective treatments for lower extremity tendinopathies? **Summary of Key Findings:** Of the five total studies discovered (two randomized control trials, two systematic review and one meta-analysis of randomized control trials), three supported the efficacy of BFR for tendinopathy, and two focused on PRP injections as an intervention. One of the two PRP injections found that PRP was not superior to placebo, leaving clinical findings unclear. **Clinical Bottom Line:** BFR therapy and PRP injections work differently, targeting the mechanical environment and underlying biology of the healing process. These treatments may improve outcomes for patients by promoting tissue healing and remodeling, reducing the risk of chronic injuries, and improving blood flow and nutrient delivery to the affected tissue. **Strength of Recommendation:** The Oxford Center for Evidence-Based Medicine recommends a grade A for Level 2 evidence or higher with findings.

Clinical Scenario

Tendons comprise collagen fibers, proteoglycans, and glycoproteins arranged in a highly organized manner to provide mechanical stability and strength to the tissue.[9] While this arrangement allows for high tensile strength, necessary for transmitting force and stabilizing joints[10], it also limits the flow of blood and nutrients to the tissue. The limited blood flow and nutrient supply to tendons make them particularly challenging to heal, leading to a high incidence of chronic injuries and prolonged recovery times. As a result, tendons are more prone to injury and slower to heal than other tissues.[11]

Tendinopathy is a disease entity which can cause significant pain and functional limitations for individuals. Tendinopathy can account for up to 30% of all musculoskeletal conditions Tendon injuries in the leg are caused by repetitive movements, especially in sports, and commonly occur in the patellar and Achilles tendons in the lower leg area.[6] Achilles tendinopathy is one of the most prevalent injuries in physical exercise. Still after surgical treatment at a recurrence rate as high as 44%.[7] Patellar tendinopathy is also commonly injured, with a 28.3% prevalence rate within a cohort of 50–79-year-old participants with no history of knee injury.[8]

Blood flow restriction (BFR) therapy is a treatment that uses external compression to reduce the flow of blood to a specific area during resistance exercise[5]. This reduction in blood flow causes the tissue to become hypoxic environment, which stimulates the production of growth factors and signaling molecules that promote tissue healing and remodeling.[14] Additionally, BFR therapy has been shown to improve the delivery of nutrients and oxygen to the affected tissue, particularly during the recovery/post-exercise period, which can also speed up the healing process and reduce the risk of chronic injuries.[3] BFR training provides a safe

alternative for clinical populations that cannot meet exercise guidelines from the American College of Sports Medicine but would still benefit from achieving therapeutic goals to increase muscle strength, power, and hypertrophy.[15]

Platelet-rich plasma (PRP) injection therapy is a mixture of autogenous concentrated platelets and growth factors that utilizes the healing properties of the patient's blood.[1] Platelets possess growth factors and signaling molecules that play a crucial role in healing.[11] The patient's blood is drawn to assemble a PRP treatment, and the platelets are separated and concentrated using a centrifuge.[16] The concentrated platelets are then re-injected into the affected tissue, where they can promote tissue healing and remodeling.[5] The growth factors released by PRP reflect on promoting cell recruitment, proliferation, and angiogenesis.[12]

PRP and BFR both have the potential to facilitate tendon healing, but they work in different ways. PRP injections target the underlying biology of the healing process by improving the delivery of growth factors and signaling molecules to the affected tissue. In contrast, BFR therapy targets the mechanical environment of the healing process by improving nutrient and oxygen delivery to the tissue.[19]

This study investigated the effectiveness of BFR protocols and PRP injections for treating lower extremity tendinopathy, specifically the patellar and Achilles tendons.

Focused Clinical Question

Are current BFR protocols and PRP injection therapy effective treatments for lower extremity tendinopathies?

Summary of Search, “Best Evidence” Appraised and Key Findings

- Literature searches were conducted in PubMed and other databases to identify articles of

level 2 evidence or higher that focused on the therapeutic effects of blood flow restriction (BFR) protocols and platelet-rich plasma (PRP) injections on patients with lower extremity tendinopathies[5].

- Five studies were searched to identify articles that used meta-analysis, systematic review, or randomized control trials. Assessment of methodological quality of the included studies using the checklist for articles from the past five years focusing on the patellar and Achilles tendon. Three of the included studies evaluated the effects of BFR [2, 3, 4] while two studies focused on PRP [1, 5].
- Centner et al[3] compared the effects of LL-BFR and HL-BFR on patellar tendons' mechanical and morphological properties. Their results demonstrated that both modalities produced changes, including increased stiffness, Young's modulus, and improved morphology. The authors suggested that LL-BFR training can be an effective alternative to HL-BFR for inducing adaptation in healthy individuals.
- Burton and McCormack[2] conducted a scoping review that involved thirteen studies using BFR training for tendon rehabilitation. The authors concluded that BFR training outcomes were an effective intervention for patellar and Achilles tendon rehabilitation with benefits such as reducing re-injury risk, improving pain management, and promoting faster recovery.
- Centner et al[4] compared the effects of low-load BFR training (LL-BFR) and high-load BFR training (HL-BFR) on the morphological (cross sectional area) and mechanical properties (stiffness, Young’s Modulus) of the Achilles tendon. Their results showed that both loading protocols resulted in comparable changes in Achilles tendon properties, including increases in cross-sectional area, stiffness, and Young's modulus($p>0.05$). Their

results suggest that LL-BFR are an effective alternative to HL-BFR for inducing tendon adaptation in healthy individuals.

- Dai et al[1] conducted a meta-analysis of 13 randomized controlled trials (RCTs) that compared the efficacy of PRP to placebo in the treatment of tendinopathy. Six of the 13 RCTs involved 228 patients with either Achilles tendinopathy (4 studies) or patellar tendinopathy (2 studies). These authors concluded that PRP injection was not superior to placebo as measured by pain relief and functional improvement at 4 to 6 weeks, 12 weeks, or greater than 24 weeks in the treatment of tendinopathy ($p > 0.05$).
- Filardo and Matteo[5] systematically reviewed 104 clinical studies that utilized PRP in treating tendon-related disorders; 43 of these studies used PRP on patellar or Achilles tendinopathies. The main finding of this work was that PRP injection resulted in different outcomes according to the tendon being treated. The authors concluded that patellar tendons appeared to benefit from PRP injection therapy, while the evidence did not support the use of PRP injection of the Achilles tendon, either as a surgical augmentation or a stand-alone non-operative treatment.

Clinical Bottom Line

Based on the available evidence, blood flow restriction (BFR) therapy and platelet-rich plasma (PRP) injections could potentially be effective treatments for tendinitis and tendinopathy. BFR therapy and PRP injections work differently, targeting the mechanical environment and underlying biology of the healing process, respectively.

These treatments may improve outcomes for patients with tendon injuries by promoting tissue healing and remodeling, reducing the risk of chronic injuries, and improving blood flow and nutrient delivery to the affected tissue. However, further research is needed to determine the

optimal treatment protocols and fully understand the factors influencing treatment success.

A comprehensive search of PubMed, Web of Science, and Journal of Student Research databases were conducted to identify articles of level 2 evidence or higher. These studies examine the combined effects of platelet-rich plasma and blood flow restriction. All studies assessed the mechanical and morphological properties of the effect for tendons.

Strength of Recommendation

Applying the Oxford Evidence-Based Medicine standard, we found dependable evidence Level 2 or higher.

BFR training is a promising intervention for tendon rehabilitation, according to recent literature. Both low-load and high-load BFR training induced similar adaptations in the mechanical and morphological properties of the Achilles and patellar tendons in healthy individuals. Additionally, BFR training may reduce re-injury risk, improve pain management, and promote faster recovery.

However, the clinical evidence for PRP therapy in treating tendinopathy remains mixed. Recent studies found that PRP injection was not superior to placebo in terms of pain relief and functional improvement in patients with Achilles or patellar tendinopathy. Moreover, limited evidence supports the use of PRP injection therapy in the Achilles tendon.

Search Strategy

Terms Used to Guide Search Strategy

- **P**opulation: patients with lower extremity tendinopathy
- **I**ntervention: blood flow restriction (BFR) therapy
- **C**omparison: platelet-rich plasma (PRP) injection

- **O**utcome: Tendon adaptations, individual performance

Sources of Evidence Searched

- PubMed
- Google Scholar
- Web of Science
- Journal of Student Research
- Journal of Science and Medicine in Sport
- Literature references hand-searched for additional resources

Inclusion and Exclusion Criteria

Inclusion

- Protocols adopting blood flow restriction training and platelet-rich plasma treatments
- Assessments of Achilles tendon and/or patellar tendon physical and structural characteristics
- Centre of Evidence-Based Medicine Level 2 evidence or higher
- Articles in English
- Articles published between 2018 and 2023

Exclusion

- BFR and PRP studies involved treatment of upper extremity tendinopathies
- BFR and PRP studies that evaluated changes to muscles, ligaments or cartilage
- Abstracts only
- Research published outside the timeframe of search

Results of Search

Level of Evidence	Study design	Number Located	Reference
1	Meta-analysis of randomized control trials	1	Dai et al., 2023
1	Systematic review or Scoping review	2	Burton & McCormack 2022; Filardo et al., 2018
2	Randomized Control Trials	2	Centner et al. 2022; Centner et al., 2019

Five studies were identified as meeting all inclusion/exclusion criteria and are categories based on the CEBM in Table 1.

Implication for Practice, Education, and Future Research

Blood flow restriction (BFR) therapy and platelet-rich plasma (PRP) injections are two popular interventions currently used in rehabilitation of lower extremity tendinopathy. Based on the reviewed articles. BFR and PRP training are regarded as a possible intervention for promoting tendon adaptation and reducing the risk of re-injury.

Regarding BFR training, Centner et al compared the effects of low-load BFR training and high-load resistance training on the morphological and mechanical properties of the Achilles tendon and patellar tendon. Results have shown that both loads led to similar adaptations in the Achilles tendon properties including increases in cross-sectional area, stiffness, and Young's modulus. The study suggests that low-load BFR is an effective alternative to high-load BFR for inducing tendon adaptation in healthy individuals. Furthermore, Burton and McCormack's scoping review of research on the use of BFR training for tendon rehabilitation found that BFR training outcomes are an encouraging intervention for tendon rehabilitation with potential

benefits such as reducing the risk of re-injury, improving pain management, and promoting faster recovery.

PRP therapy is also a promising intervention. Filardo et al's overview of current evidence on the use of PRP therapy in tendon-related disorders discussed the mechanism of action of PRP, which is believed to promote tissue regeneration and reduce inflammation. The authors reviewed the results, evaluating its effectiveness and concluded that PRP therapy is a promising treatment option, although further research is needed to optimize treatment protocols and determine long-term efficacy. Similarly, Dai et al's meta-analysis of randomized control trials evaluated current evidence on PRP therapy for sport-related injuries. The authors used 13 randomized control trials comparing PRP to placebo in the treatment and found that PRP did not show a significant difference between it and the placebo in terms of pain management and functional improvement. The article suggests that the clinical benefit of PRP in the treatment of lower extremity tendinopathy is limited, based on the available evidence.

Future research should focus on optimizing treatment protocols for both BFR training and PRP therapy. Further research could explore the optimal loading parameters and treatment frequency for BFR training to maximize its effectiveness. Similarly, the need for further research to optimize PRP therapy protocols and determine long-term efficacy is necessary. This includes identifying the optimal concentration of platelets, the best injection site and timing, and determining the effects of PRP therapy on different types of tendons and ligaments.

Healthcare professionals should consider incorporating these treatments into their practice, particularly for patients with tendon injuries. Additionally, healthcare professionals should educate their patients about potential benefits and risks to make informed decisions about their treatment plans. Regarding education, healthcare professionals should stay up to date with

the latest research on BFR training and PRP therapy.

In conclusion, the available evidence suggests that BFR training, particularly LL-BFR, is a promising treatment for lower extremity tendinopathy. In contrast, current evidence supporting the use of PRP injections to treat lower extremity tendinopathy is mixed, with only patellar tendinopathy patients demonstrating significant therapeutic benefits from PRP therapy. Future research is needed to identify optimal treatment protocols and determine longer-term outcomes of BFR and PRP therapies.

TABLE 2. CHARACTERISTICS OF INCLUDED STUDIES					
Study Title	Low-Load Blood Flow Restriction and High-Load Resistance Training Induce Comparable Changes in Patellar Tendon Properties	Blood Flow Restriction Resistance Training in Tendon Rehabilitation: A Scoping Review on Intervention Parameters, Physiological Effects, and Outcomes	Low-load blood flow restriction training induces similar morphological and mechanical Achilles tendon adaptations compared with high-load resistance training	Efficacy of platelet-rich plasma versus placebo in the treatment of tendinopathy: A meta-analysis of randomized controlled trials	Platelet-rich plasma in tendon-related disorders: results and indications
Outcome Measures	Centner et al compared the effects of LL-BFR and HL-BFR on patellar tendons' mechanical and morphological properties.	Burton and McCormack conducted a scoping review that involved thirteen studies using BFR training for tendon rehabilitation. research on the use of BFR training for tendon rehabilitation found that BFR training outcomes are an encouraging intervention for tendon rehabilitation	Centner et al compared the effects of low-load BFR training (LL-BFR) and high-load BFR training (HL-BFR) on the morphological (cross sectional area) and mechanical properties (stiffness, Young's Modulus) of the Achilles tendon.	Dai et al conducted a meta-analysis of 13 randomized controlled trials (RCTs) that compared the efficacy of PRP to placebo in the treatment of tendinopathy. Six of the 13 RCTs involved 228 patients with either Achilles tendinopathy (4 studies) or patellar tendinopathy (2 studies).	Filardo and Matteo systematically reviewed 104 clinical studies that utilized PRP in treating tendon-related disorders; 43 of these studies used PRP on patellar or Achilles tendinopathies. The main finding of this work was that PRP injection resulted in different outcomes according to the tendon being treated.

Results	LL-BFR training is an effective alternative to HL-BFR for inducing adaptation in healthy individuals	The authors concluded that BFR training outcomes were an effective intervention for patellar and Achilles tendon rehabilitation with benefits such as reducing re-injury risk, improving pain management, and promoting faster recovery.	Both loading protocols resulted in comparable changes in Achilles tendon properties, including increases in cross-sectional area, stiffness, and Young's modulus($p>0.05$). Their results suggest that LL-BFR are an effective alternative to HL-BFR for inducing tendon adaptation in healthy individuals.	PRP injection was not superior to placebo as measured by pain relief and functional improvement at 4 to 6 weeks, 12 weeks, or greater than 24 weeks in the treatment of tendinopathy ($p > 0.05$).	Patellar tendons appeared to benefit from PRP injection therapy, while the evidence did not support the use of PRP injection of the Achilles tendon, either as a surgical augmentation or a stand-alone non-operative treatment.
Level of Evidence	2	2	1	1	1
Study Design	Randomized control trial	Scoping review	Randomized control trial	Meta-analysis of randomized control trial	Systematic Review

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