A critical appraisal of "Comparing the Effectiveness of Blood Flow Restriction and Traditional Heavy Load Resistance Training in the Post−Surgery Rehabilitation of Anterior Cruciate Ligament Reconstruction Patients: A UK National Health Service Randomised Controlled Trial"

By

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Abstract

I critically appraised an article examining an 8-week rehabilitation intervention comparing the use of Blood Flow Restriction resistance training and heavy-load resistance training in a group of individuals that underwent ACL reconstructive surgery. The appraisal was performed to determine the overall quality of the study, clinical significance of the data collected, and provide evidence to address the clinical question presented. Each section of the article was assessed, with strengths and weaknesses discussed for each. The study utilized effective outcome measures, high quality sources, and provided support for the clinical use of Blood Flow Restriction.

Key words

Blood Flow Restriction (BFR), ACL reconstructive surgery, Resistance Training

Introduction

Due to the high incidence of ACL tears in active populations and my interest in sports rehabilitation, I wanted to research an intervention that could potentially change the way post-operative ACL reconstruction treatment is addressed. Blood flow restriction (BFR) has recently caught my attention as its popularity has grown in the Physical Therapy and Sports Medicine fields. Blood Flow Restriction is the use of a pressure cuff—much like when you have your blood pressure taken by a nurse or physician—at a specific pressure that restricts venous blood flow while permitting arterial flow. The concept behind using the occlusion cuff is to provide a similar workload to the lower extremity muscles as seen with traditional heavy-load resistance training while keeping the resistance at a low level. In this critical appraisal, I will discuss an article that has compared the effects of BFR training vs. traditional HL-RT in a group of subjects that underwent ACL repair surgery. The study provides supportive evidence for the implementation of BFR in this population and addresses my clinical question, which is as follows: Does the implementation of Blood Flow Restriction (BFR) promote greater strength gains in the early phases of post-op ACLR compared to a comparable program without the use of BFR? I will further discuss the article as well as how it pertains to my question and the potential clinical implications of the Blood Flow Restriction intervention.

Methods

I utilized the databases PubMed and CINAHL Plus to search for Randomized Controlled Trials incorporating Blood Flow Restriction into ACLR treatment. With the keywords Blood Flow Restriction (BFR), post-op ACLR, and athletes, I received only a few hits. In order to expand my search results, I removed ‘athletes’ and was able to find additional articles that fit the criteria. I

included studies that had a BFR group and a control group that used a comparable resistance training program in order to test the effects of BFR on post-op ACLR rehab. After finding 10 articles that fit my search criteria, I began the review process.

The study was conducted in the UK by authors Luke Hughes, Benjamin Rosenblatt, Fares Haddad, Conor Gissane, Daniel McCarthy, Thomas Clarke, Graham Ferris, Joanna Dawes, Bruce Paton, and Stephen David Patterson and was published in the Sports Medicine journal in 2019. I decided on this article because, based on the criteria discussed in class, it seemed to be the most credible. The study was a randomized controlled trial with a single-assessor blind. The randomization and assessor-blinding limits bias and improves legitimacy of results. Additionally, the study met the meaningful sample-size criteria and had appropriate exclusion criteria to ensure accuracy of between-group comparison. The exclusion criteria also ensured that there were no differences between sample groups in baseline variables, pre-surgery, or post-operative changes. Each subject underwent a hamstring autograft ACLR surgery and completed an 8-week (16 sessions) resistance training program. The RT intervention for both BFR-RT and non-BFR (Heavy-load RT without BFR) groups was properly matched to limit factors—other than BFR-RT, HL-RT—from eliciting changes across groups.

Results

Summary of the study

An 8-week blood flow restriction resistance training program was utilized in one half of a group of subjects that underwent hamstring autograft ACL reconstructive surgery. Their results were compared to the other half of the subjects that participated in traditional heavy-load resistance

training rehabilitation of 8 weeks in duration. The participants were evaluated pre-and-post-operatively, as well as at 4 weeks and after completing the 8 week program, to compare the BFR-RT intervention to the HL-RT in affecting muscle hypertrophy and strength, function, pain and swelling. The single-assessor blinded, RCT of the 24 subjects that met the inclusion criteria followed closely with the standard protocols for ACLR rehabilitation. The training programs consisted of 16 total sessions (2x/week) of single-leg leg press with each leg in addition to the standardized hospital rehabilitation. After each group completed the 8 week RT program, the results indicated that the BFR- RT group and HL-RT group had comparable increases in muscle hypertrophy and strength in the involved and uninvolved limbs, and the BFR-RT group self-reported an increase in function and decrease in pain and joint effusion. These findings support the effectiveness of BFR-RT in promoting similar gains in muscle strength and hypertrophy while improving functionality and decreasing pain to greater degrees than in traditional HL-RT.

Appraisal of the study introduction

The introduction is comprehensive as it provides details about the intervention and why it is being studied, background information about the population in the study, and other definitions and descriptions that are necessary to understand the study. It also includes literature from related studies that provides evidence of a sound rationale. The extensive literature provided were from primary, credible journal sources. The introduction was clear and concise and provided discussion of the critical variables and necessary background information.

The weaknesses of the introduction are that some of the references would not be considered current, and one of the critical variables, Y-balance performance, was not discussed.

Appraisal of the study methods

The strengths of the methods section: research design was a single-assessor blinded, RCT, with a meaningful sample size (28 subjects) and a control group (HL-RT); no clinically significant between-group differences; intervention was the only difference in group management; interventions were described in detail for accurate replication; instruments/outcome measures were discussed in detail with support from literature; data collection and analysis was detailed and accurate.

Although the methods section was strongly written/supported, a few weaknesses were found. In the control (HL-RT) group, there were 10 males and 2 females whereas the intervention (BFR-RT) group had 7 males and 5 females. The warmup exercise was at a self-selected weight, thus, a potential decrease in accuracy of results and replicability could result. Additionally, the main source of intervention, the BFR tourniquet, can be a limitation because not all tools are the same. There can be differences in brands and in automatic vs. manual occlusion cuffs. Because the data was either self-reported by the subject or measured by a human assessor, human error can occur resulting in decreased accuracy of results and reproducibility in subsequent studies. Lastly, the tools, outcome measures, and programs used for analysis can differ and provide potential errors in replication.

Appraisal of the study results

The results section was well-written, organized in the same order as in the methods, and the outcome measures were discussed in the text and supported with accurate and easily-read figures/tables. The charts also included a key that denoted the statistically significant values

making it easier to locate and analyze the data. The threshold of *p* value for statistical significance (*p<.05)* and confidence intervals (CI=.95) were noted, providing a reference for interpretation of the data collected. The results also addressed the research question and discussed each aspect of the aim of the study in sufficient detail.

Although the figures and tables help illustrate the data, the x-axis labels in Figure 2 do not explicitly state 'post-surgery' and 'post-intervention,' instead the graphs that should say that are both labelled 'post' which can lead to misinterpretation of data. A significant portion of the data presented was labelled as, and can be considered, statistically significant based on the *p* value; however, not all of the results could be considered clinically meaningful. To be considered clinically meaningful, the results would need to have an even more significant change in comparison to the control group and the pre-surgery values. Additionally, the authors never mentioned MCID or NNT values; thus, clinical significance of the results could be in question.

Appraisal of the study discussion

The authors expanded on the findings from the results in the discussion section and utilized previous literature and studies to compare their results. The limitations were mentioned and are as follows: muscle hypertrophy was measured in only one plane, factors like tendon stiffness were not accounted for in ROM measurements, warm-up weight was not standardized, and they used a small sample size for a specific phase of ACLR rehabilitation. The conclusions stated by the authors were reflective of the results. The authors noted that clinical significance of the study was that BFR-RT may yield more benefits in the progressive loading phase of rehabilitation following ACLR surgery.

I don't believe the authors incorporated any truly weak evidence. The literature was from credible journals, but some were slightly older. References: 33, 52, 59 were all published prior to 2000. An additional weakness of the discussion section was the failure by the authors to suggest any future studies. It could have been better had they included how they could utilize the data collected in the current study to enhance future research.

Discussion

Although the findings do not support the hypothesis of greater strength gains with the use of Blood Flow Restriction compared to a similar program without BFR, it does support the use of BFR for post-operative ACLR treatment. The strength gains achieved with BFR were comparable to those with heavy-load RT and resulted in lower levels of pain and joint effusion. These findings indicate that BFR could be a more suitable treatment in the early phases of ACLR rehabilitation as pain and swelling often delay recovery.

Blood flow restriction training would be extremely beneficial in the clinical setting, not only in ACLR rehabilitation, but in the majority of treatment of musculoskeletal impairments. Early BFR intervention has the potential to mitigate muscle atrophy and bone density loss following surgery without compromising surgical repair or healing. This can set patients on the path to full recovery with fewer setbacks—i.e. increased pain and joint effusion delaying treatment—that often arise following more intense therapeutic exercise. Although the benefits of blood flow restriction outweigh the risks, some potential risks of BFR implementation in the clinic are as follows: not reaching the same magnitude of strength increment and having a negative reaction

to BFR, like orthostasis or bruising. A larger sample size would provide greater evidence for the benefits of BFR, potentially increase clinical significance, and improve the current study.

As mentioned above, blood flow restriction could be utilized with many future patients to elicit muscle hypertrophy and increase strength without decreasing function. I would be comfortable and confident in implementing BFR based on the results seen in this and numerous other studies as well as the ease of incorporating the intervention. The data from Hughes et. al. provides substantial evidence for BFR application, particularly in self-reported function measures of pain, effusion, and ROM which are all critical for patient/client treatment adherence.

Overall, the article was well written with high quality sources, proper organization, and few weaknesses throughout. The study was well designed, presented few limitations, and gathered statistically significant data with some clinical significance for several variables as well. There were far more strengths than weaknesses, and the weaknesses that were present were recognized by the authors.