

**A critical appraisal of “Applications of vascular occlusion diminish
disuse atrophy of knee extensor muscles”**

By

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Abstract

This paper serves as a critical appraisal of the study “Applications of vascular occlusion diminish disuse atrophy of knee extensor muscles”. The strengths and weaknesses of the introduction, methods, results and conclusion were assessed to determine whether the research could be considered a valid and reliable answer to the clinical question raised.

Key words**DISUSE ATROPHY, OCCLUSION, ACL**

Introduction

After ACL reconstruction it is common to see significant atrophy of all the muscles of the thigh, especially in the extensor group. This atrophy is due to arthrogenic inhibition and disuse of the muscles. A large focus in many ACL rehabilitation protocols is strengthening and hypertrophy of the quadricep muscles to address the weakness that results from the disuse atrophy. I set out on a literature review to determine if occlusion stimulus applied immediately post ACL surgery would be effective in reducing the severity of the usual disuse atrophy seen.

Methods

I began my search for literature relevant to my clinical question on the U.S. National Library of Medicine: PubMed. I searched for the terms ACL Blood Flow occlusion and set a limit of full text articles in English. I wanted to be presented with articles that I would be able to read in full without having to translate them using outside software. I did not put any exclusions on my search as I did not believe there would be an overbearing amount of research already present on the topic. My first search returned around 20 total hits and I found 15 that were relevant to my clinical question.

Results

Summary of the study

The researchers in this study set out to determine if moderate vascular occlusion could be effective in mitigating the disuse atrophy normally seen in the muscles of the thigh after ACL

reconstruction. The researchers obtained sixteen volunteers (8 male and 8 female) to participate in the study. The participants were split into experimental and control groups with each group consisting of 4 males and 4 females. The researchers found no significant difference in the age, height and weight of the individuals in each group. MRIs were taken on the injured lower extremity of each participant on the 3rd and 14th day after surgery. In the experimental group a pneumatic occlusion was placed on the proximal end of the thigh during the 3rd to 14th day post-surgery period. The subject's upper bodies were kept at an incline of 45° during the occlusive stimuli. Each session of occlusive stimuli consisted of 5 sets of 5 minutes of occlusion followed by 3 minutes of rest. The subjects underwent this stimulus twice a day. The pressure of the pneumatic cuff was set at 180mm Hg to start and then increased by 10 mm Hg each session depending on the degree of recovery of each individual patient. The subjects in the control group followed the same schedule as those in the experimental group except for a cuff was placed on their thighs for 37 minutes without inflation. The control group had a CSA (cross sectional area) decrease of 20.7 ± 2.2 % in the extensor muscles while the experimental group saw a 9.4 ± 1.6 % decrease in CSA in the extensor muscles. This difference between the experimental and control group was found to be significant with a P value of 0.046. The difference in the CSA decrease of the flexor muscles between groups was found to be insignificant with a P-value of 0.69. The researchers concluded that occlusive stimuli were indeed effective in mitigating the disuse atrophy seen in the extensor muscles of the thigh post ACL reconstruction.

Appraisal of the study introduction

The researchers did an adequate job of providing background on the importance of regaining extensor muscle strength and size post knee surgery and cited previous research that had been done using occlusion stimuli to improve strength and size in the elbow flexor groups. They used the results of that previous study for the basis of the purpose of their study. They clearly stated their dependent (muscle atrophy) and their independent (occlusion stimulus) variables in the introduction as well.

It is of note though that the prior research studies cited on occlusion stimulus had been conducted the same researches of this study. This could be viewed as negative, but after looking into it further I found that up to that point there had not been any other research done on the effect of occlusion stimulus and these researchers were the first to tackle the topic.

Appraisal of the study methods

The researchers used a prospective longitudinal single blind design. Each group had 4 women and 4 men, and the two groups had similar demographics. One group received the occlusion stimulus and the other group received a sham operation which consisted of the same cuff being placed on them without it being inflated. Outside of the occlusion stimulus the two groups followed the daily schedule as well as the same dietary protocols. Great detail was given on the method of application of the occlusion stimuli and the protocol used to keep all conditions the same except for the intervention given. The exact location and methods used with MRI to gather the outcome measures were given which lends to ease of replication for future studies.

The group assignments were not concealed from the people enrolling individuals in the study and the outcome assessors were not masked to the subjects' group assignment. However,

the outcome tool used was an MRI, so it seems like it would be difficult for the outcome assessors to apply their bias to the results.

Appraisal of the study results

The authors addressed the research question as well the aim. The results compared the cross-sectional area of the extensor and flexor muscle groups of the thigh 3 days post op and 14 days op and looked at the differences between the control group and experimental group. Every outcome measure mentioned in the methods was reported on and included in a table or graph in the results. The tables were organized clearly with the units of measure, standard deviation and the significantly different data.

This article did a good job of writing out a well written and organized results section, but one thing I would have liked to see were numbers or references to a minimal clinically important difference range.

Appraisal of the study discussion

The authors concluded that based on the results of the study, use of occlusion stimuli could be effective immediately post ACL surgery to reduce the disuse atrophy usually observed. The authors admitted that due to their study only being two weeks long, they were not able to observe the affect that the stimulus would have on the complete healing process of the ACL.

The authors did suggest future studies into the physiological effects of the stimulus on protein metabolism as well as studies to clarify any side effects of the stimuli.

Discussion

This study shows that occlusion stimuli can be effective in decreasing atrophy seen post ACL surgery due to disuse. Utilizing this intervention immediately post-surgery in the hospital could possibly improve the prognosis and outcome of patients as quadriceps size and strength deficits can be seen even after patients have been discharged from therapy. According to this study the answer to my clinical question of whether occlusion therapy could be effective in limiting the amount of disuse atrophy in the quadriceps post ACL surgery is yes.

Using occlusion stimulus could potentially reduce the amount of atrophy after surgery would make getting the size and strength of the quad to pre-surgery conditions easier to achieve. This could potentially decrease the amount of time and money the patient must spend in the clinic and rehabilitating. In 2006 a large survey was done of Japanese facilities that utilized occlusion stimuli in their treatment¹. The highest reported side effects seen were subcutaneous hemorrhage and numbers, occurring in 13.1% and 1.3% of participants respectively. These side effects are mild and were not seen often so there would not be much risk if any in using this intervention for your patients.

Based on my appraisal of this study I would be confident in using occlusion stimulus with my patients in the future. The researchers were detailed and thorough in their methods and outcome assessments and did not seem to show any bias or skewing of information. The low risk of adverse effects coupled with the intervention also lend to my confidence in using occlusion therapy. The parameters used for applying the intervention were well listed and explained in the study, so I believe I would be able to safely implement occlusion stimuli with my patients in the future.

After reviewing the quality of this study, I believe that it reasonable to keep occlusive stimuli as a tool in your toolbox for patient management. While there were some issues with the

study no research design is flawless, and this study did enough well for me to trust in its results and implement this intervention with patients.

References

1. Nakajima T, Kurano M, Iida H, et al. Use and safety of KAATSU training: results of a national survey. *Int J KAATSU Train Res.* 2006;2(1):5-13.

Takarada, Y., Takazawa, H., & Ishii, N. (2000). Applications of vascular occlusion diminish disuse atrophy of knee extensor muscles. *Medicine and Science in Sports and Exercise*, 32(12), 2035-2039. doi:10.1097/00005768-200012000-00011