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The Proximal and Distal Effects of Blood Flow Restriction Therapy on the Upper and Lower Extremity Strengthening: A Randomized Controlled Trial

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Summary:

The purpose of this study was to define the clinical efficacy and safety of low-intensity BFR therapy on muscle groups both proximal and distal to tourniquet placement in the upper and lower extremities.

Abstract:

Introduction

Blood flow restriction (BFR) therapy consists of low-intensity exercise performed while wearing an inflatable tourniquet, partially restricting venous return. This technique produces similar physiologic and clinical effects to high-intensity routines with the advantage of less exertion. Proximal and distal effects of BFR on muscle strength have been demonstrated, however, there is a paucity of literature on its use in orthopaedic conditions. Postoperative benefits include earlier and more efficient rehabilitation while limiting stress on surgical repairs. The purpose of this study is to determine the effects of low-intensity BFR therapy both proximal and distal to cuff placement in the upper and lower extremities.

Methods

This was a prospective, randomized control trial of healthy subjects completing a standardized 6-week course of BFR therapy. Subjects were randomized into three groups: upper-extremity with BFR, lower-extremity with BFR, and control group (upper and lower extremity low-intensity therapy without BFR). Subjects were excluded for cardiac, pulmonary, or hematologic disease, or previous surgery in the extremity. Data collected at baseline and completion included: limb circumferences, isokinetic, and manual strength testing.

Results

The therapy protocol was completed by 43 subjects. Average subject age was 27.7 years and 54% were female. For both upper and lower extremity groups, a statistically significant increase in manual strength was seen proximal and distal to the BFR tourniquet when compared to both the non-tourniquet extremity and the control group ($p < 0.05$). Isokinetic testing showed increases in peak torque, total work, and average power in all three groups ($p = 0.04$). Limb circumference significantly increased in both the upper ($p < 0.01$) and lower extremities ($p = 0.02$) compared to the

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control group. A significant increase in manual strength was noted in shoulder abduction and scaption, as well as hip extension and abduction even in the non-tourniquet BFR extremity compared to the control group ($p < 0.05$).

Conclusion

Low-intensity BFR therapy significantly improved manual strength testing and muscle hypertrophy in the upper and lower extremities. BFR therapy had similar strengthening effects on both proximal and distal muscle groups. Strength increases even in the non-tourniquet BFR extremity compared to the control group extremity may corroborate a systemic effect of BFR therapy. This study provides further data to evaluate the effects of BFR therapy on both proximal and distal muscle groups in operative and non-operative orthopaedic conditions.

Level of Evidence: Level I, Randomized Controlled Trial