


Can Blood Flow Restriction Therapy Augment Rotator Cuff Strength?

Stephen Alterado, Tyler Berg, Carsten Neumiller, BP Nguyen, Robert Reynoso and Jacob Stickell
Advisor: Dr. Brumitt, PT, PhD, ATC, CSCS



What is Blood Flow Restriction Training?

- Blood flow restriction (BFR) is an **occlusion** training program that utilizes a **inflatable** or **mechanical** tourniquet that limits blood flow in the **arterial and venous system**
- There are several proposed mechanisms associated with strength gains achieved during BFR training:
 - Metabolite accumulation, growth hormone release, down regulation of myostatin, MTORC1 activation, and cellular swelling.
- Current protocols recommend low resistance (~30% 1RM) to achieve similar strength and hypertrophy results that you would obtain doing 70-80% 1RM.



Previous Research with BFR

Muscle proximal to cuff application may benefit

- Cross-Transfer effects of resistance training with blood flow restriction - (Madarama et al. 2008)
- Proximal, Distal, and Contralateral effects of blood flow restriction training on the lower extremities: a randomized controlled trial - (Bowman et al. 2019)
- Upper-extremity blood flow restriction: the proximal, distal, and contralateral effects - a randomized controlled trial - (Bowman et al. 2020)

What is Currently known about BFR for RC

UE's BFR: The Proximal, Distal, and Contralateral Effects (RCT) (Bowman et al. 2020)

Training Program: Low Wt. Training + BFR/Non-BFR

Exercises: external rotation in side lying, internal rotation in standing, bicep curls, tricep extension, prone horizontal abduction.

Outcomes: Compared both Non-BFR & BFR to Control group (<0.05)

- Arm and forearm circumferences increase w/BFR group
- Significant strength gains in both proximal and distal muscles in BFR group compared to non BFR

BFR Training for the RC (RCT) (Brumitt et al. 2020)

Training Program: Sidelying ER exercises BFR/Non-BFR → RC + Tendon size changes

Exercises : Sidelying external rotation

Outcomes:

- Both groups experience strength gain w/ supraspinatus+Ext Rotators (no difference b/w group)
- Increase supraspinatus thickness (no difference b/w group)

Purpose of Study

The purpose of the study is to determine if BFR therapy applied to the lower extremity can have a systemic effect and augment strength gains in the muscles of the rotator cuff for people who are not participating in a regular weight lifting training program.

Methodology

- Randomized Controlled Trial
 - Random number generator
- 35 total subjects (mean age 23.5 y +/- 2.9)
 - BFR group = 18 subjects
 - Non-BFR group = 17 subjects
- Pretest/Posttest:
 - Blinded co-investigator performed all MMT using hand-held dynamometer
 - Supraspinatus, ER, Knee extension (quads), knee curl (hamstrings)

Methodology

- (Pre/post test continued)
- Ultrasound imaging (rectus femoris):
 - Performed by a co-investigator - blinded to group assignment
 - Cross-sectional area of the rectus femoris was measured using B-mode ultrasonography.
 - With the knee in passive extension, subjects were asked to produce quad contraction to determine margins of rectus femoris (average of 3 measurements were used for CSA results).

Methodology

- 1 Repetition Max testing
 - Testing for 1 rep max was carried out for each of the 4 exercises
 - Seated knee extension and flexion machines were used for lower extremity exercises
 - Dumbbells used for shoulder scaption and external rotation exercises
 - Load for each exercise was sufficient for subjects to find true 1 repetition maximum

Methodology

Study Design:

- Two days a week for eight weeks
 - BFR was applied to the dominant lower extremity at 80% occlusion (BFR group)
 - Two exercises for the dominant lower extremity: knee extension, standing knee curl
 - 30% 1RM: 30/15/15/15
 - Two exercises for the dominant upper extremity: scaption, side lying external rotation
 - 30% 1RM: 3 sets x 15
- Metronome used to pace concentric and eccentric phases

Lower Extremity Exercises



Standing Knee curl



Seated knee extension

Upper Extremity Exercises



Side-lying External rotation



Standing Scaption

Results

Total Subjects: n = 35; Mean age: 23.5 years \pm 2.9

	Pretest (Mean \pm SD)	Posttest (Mean \pm SD)	Within Groups p-value	Between Groups p-value
Strength (lbs.)				
Supraspinatus				
BFR	44.26	49.38	0.000	0.475
Non-BFR	41.94	45.00	0.029	
Shoulder ER				
BFR	24.96	33.46	0.000	0.086
Non-BFR	25.41	30.49	0.000	
Quadricep				
BFR	54.59	67.34	0.000	0.085
Non-BFR	49.39	55.68	0.000	
Hamstrings				
BFR	38.13	44.66	0.000	0.489
Non-BFR	36.97	40.91	0.000	
Thigh CSA				
BFR	9.05	9.04	0.974	0.986
Non-BFR	8.96	9.14	0.607	

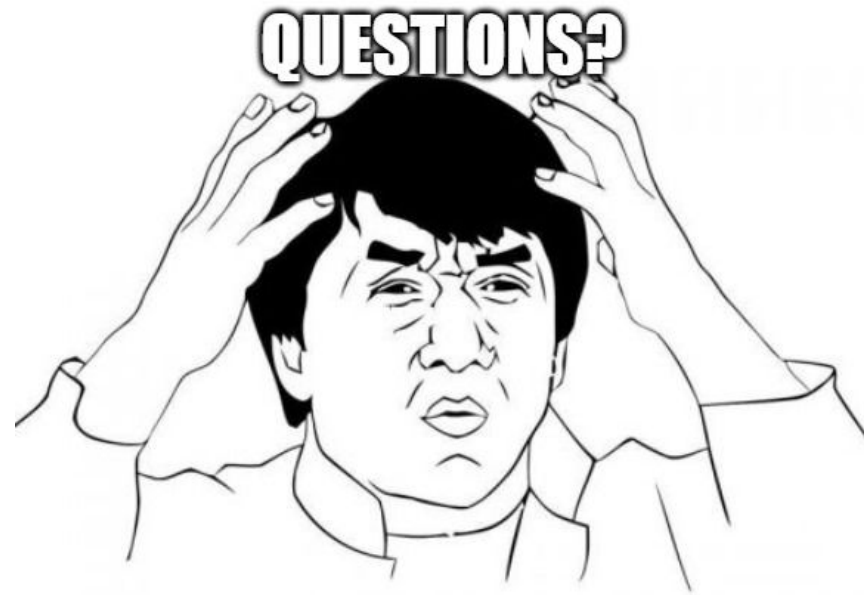
Table. Within and Between Group Comparisons for Strength Changes (Dynamometry) and Cross-Sectional Area Changes (Diagnostic Ultrasound)

Discussion

- Previous studies (Bowman et al and Brumitt et al)
 - Unable to report strength gains of the rotator cuff muscles (particularly with shoulder external rotation) when BFR was directly applied to the upper extremity.
- Madarama et al reported improvements in strength and size of the biceps when BFR was applied to bilateral lower extremities over 10 weeks. Attributed gains to Cross Transfer and Systemic Effects of BFR.
- Our current study was unable to demonstrate similar results as Madarama for the rotator cuff.
 - Exercise Parameters and Occlusion? → The frequency and intensity of occlusion may have not been sufficient enough to induce a systemic effect promote proximal strength gains for the rotator cuff
 - BFR for 1 LE vs BFR for 2 LE's
 - 80% of Occlusion Pressure Consistently vs Progressive Increase in Occlusion Pressure
 - 8 weeks vs 10 weeks
 - Constant Load vs Progressive Increase Load

Conclusion

- Application of BFR to the dominant lower extremity **DID NOT** augment rotator cuff strength compared to the Non-BFR group.
- Limited studies have been able to show that BFR therapy augments rotator cuff strength, particularly with shoulder external rotation for healthy individuals.
- The use of BFR Therapy in PT related settings for the rotator cuff lack evidence in the literature. Studies are underway looking at BFR application for post-op shoulder populations.
- Future Studies:
 - Manipulate variables related to the number of exercises under occlusion, the number of extremities occluded, the frequency of training sessions, and the training load.



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References

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