ISSN : 2456 - 4087(0)

VIMS Journal of Physical Therapy

[ORIGINAL ARTICLE]

Comparison of Blood Flow Restrictiontraining Versus Traditionalstrengthening On Handgrip Strengthand Forearm Girth In Young

Uttamchandani Sakshi[1], **Neve Chaitali**[2]

[1] Intern, [2] Assistant Professor,
Dr.Ulhas Patil College of Physiotherapy, Jalgaon

ABSTRACT :

Background: Blood flow restriction, a form of low intensity resistance exercise that when applied on body it demonstrates physiological changes that give positive outcomes like increased muscle growth, oxygen delivery and utilization of maximal oxygen. The purpose of this study was to examine effects of 4-week Blood flow restriction training protocol on forearm girth on grip strength in young adults.

Methods: A comparative study was carried out in 80 normal individuals (divided in two groups) after examining inclusion and exclusion criteria with pre assessment of forearm girth and grip strength of both right and left hand.

Results: Blood flow restriction training group has shown more significant results than traditional training group.

Conclusion: This study concludes that both the groups were effective post intervention. But BFRT has shown more significant results as compared to traditional training on handgrip strength and forearm girth.

Keywords: *BFRT, KAATSU training, atrophy, elastic blood flow restriction bands, conventional therapy*

Introduction

Blood flow restriction a form of low-intensity resistance exercise that, when applied on the body it demonstrates physiological changes that give positive outcomes like increased muscle growth, oxygen delivery, and utilization of maximal oxygen.[1] It is a training strategy that restricts arterial blood flow to a limb as well as prevents venous return of blood while performing resistive training at lower loads of a person's 1 repetition maximum.[2]

Initially developed in the 1960s in Japan, it is also called KAATSU TRAINING, which means additional pressure. It has been used by gym trainers but now is gaining fame in clinical settings also.[3] The goal is to enable patients to achieve greater strength with lighter loads.[4] It means blood flow restriction training [BFRT] will be a better intervention for those who can't bear high-intensity loads.[4]

Strength training is recommended in older adults to improve physical function.[15] However, muscle power has emerged as an important factor in physical function. During the aging process, muscle power decreases at a faster rate than strength[11], and several reports suggest that muscle power is more highly correlated with physical function than strength or muscle mass.

Blood flow restriction is contraindicated in conditions like severe hypertension, infection, cancer, increased intracranial pressure, tumor distal or proximal to a tourniquet, open soft tissue injuries, vascular grafting, open fracture, severe hypertension, and medications that increase clotting risk.[2]

While performing this, specific precautions in conditions like crush injury, infection, tumor, diabetes mellitus, arterial calcification, and clinically significant acid -base imbalance are to be considered.[2] Some side effects may be observed, such as muscle soreness, numbness, feeling cold, bruising at the site of cuff, fainting, and dizziness.[4] Known risks include nerve injury, skin injury, pain or arterial injury.4 Recent studies have provided some

*Corresponding author
Uttamchandani Sakshi
Email : sakshiuttamchandani1209@gmail.com
Dr.Ulhas Patil College of Physiotherapy, Jalgaon

insight that both low-load training to volitional fatigue and blood flow restriction training can produce an increase in muscle size comparable to high-load training.[5] Most research on blood flow restriction treatment has focused on post-operative patients, but there are promising results for non-surgical, physically active populations as well.[6]

Blood flow restriction promotes metabolite accumulation in muscle cells , leading to an increase of serum growth hormones, this increases insulin-like growth factor-1 production and, hence muscular hypertrophy.[6] These metabolites in muscle ultimately produce collagen for greater tissue repair and recovery.[6]

A variety of devices have been used to restrict blood flow during exercise, which includes elastic knee wrap, elastic belts with pneumatic bag, nylon pneumatic cuffs, and non-pneumatic bands.[7-8]

Blood flow restriction can be coupled with resistance training or aerobic training. For resistance training it is given as body weight exercises, elastic band resistance that causes a combination of mechanical and metabolic loads that help in increment of strength and muscle mass. Blood flow restriction with an external pressure cuff applied to the upper legs can be combined with aerobic exercise like low-intensity walking or cycling (20-40% of maximum oxygen consumption).[6]

Most studies with Blood flow restriction training have been conducted using different devices to regulate restriction pressure like pneumatic cuffs elastic cuffs.

Then after, researchers began to use hand held Doppler probe with a pneumatic cuff to find Arterial Occlusion Pressure [AOP] at rest.[11] Currently, elastic wraps are also validated for complete vein occlusion when it is tightened on the thigh or upper arm based on a perceptual response of 7 (moderatepressure without pain) on a tightness scale with 11 descriptors (0-11). The pressures found were equivalent to 92% and 73% of AOP for the upper limb, and lower limb , respectively.[11]

Blood flow restriction therapy encounters an ischemia state, which imposes greater metabolic stress on working muscles. This additional metabolic stress increases muscle cell swelling and hence increases in muscle volume.13 The mechanisms involved here are intra-cellular anabolic pathways & fast twitch fiber recruitment that helps in muscular adaptations. The outcomes or adaptations dependon various forms of factors like pressure of occlusion (partial/complete), intensity of exercise (low/moderate/high), and volume of exercise with blood flow restriction therapy.[13]

Common concerns raised with blood flow restriction include the potential for increased risk of blood clots, muscle damage, and negative effects on the cardiovascular system. Nevertheless, safety and steps to decrease riskshould be at the forefront of every therapist when applying.[14]

The purpose of this study was to examine the effects of 4-week BFRT protocol on forearm girth on grip strength in young adults. This study was a comparative study i.e, BFRT versus traditional strengthening with the exercise protocol.

Methodology

In this comparative study, 80[sample size was calculated by G Power software version 3]. The sample size was calculated using the following formula with a 5% precision level at a 95% confidence level.

Where

$$n = \frac{z^2 p(1-p)}{e^2}$$

n is the sample size

z is the selected critical value of the desired confidence level (CL95%=1.96)

p is the estimated proportion of an attribute that is present in the population (50%=0.5)

e is the desired level of precision (0.01)

So, the final calculated sample size is 80

Normal young adults were randomly assigned in two groups; group A was given blood flow restriction therapy (n=40), and group B (n=40) was given traditional strengthening. The Institutional Ethical Committee of Dr.Ulhas Patil College of Physiotherapy, Jalgaon approved the study. The study was conducted at Outpatient Department (OPD) of Dr.Ulhas Patil College of Physiotherapy. The duration of the protocol was 4 weeks, thrice per week. To assess forearm girth, measuring tape was used, and for measuring grip strength, a dynamometer was used.

Subjects included were males and females of 18-25 years of age, who has not done any workout in the past 6 months.Exclusion criteria were participants with history of upper limb surgery, neuromuscular diseases,sickle cell anemia,etc

Procedure

For BFRT group, participants were pre assessed for forearm girth and grip strength of right and left hands.Wrist curls with dumbbell and dynamometer contractions were the exercises performed with bfr bands.3 sets and 15 reps thrice a week was given. Post assessment of grip strength and forearm girth were noted.

Fig 1: BFR group participant doing dynamometer contractions.

Fig 2: BFR group participant doing biceps curls with dumbbell

Fig 3: TRAD group participant doing bicep curls with a dumbbell.

For TRAD group,participants were pre assessed for forearm girth and grip strength of right and left hands.Wrist curls with dumbbell and dynamometer contractions were the exercises performed without bfr bands.3 sets and 15 reps thrice a week was given. Post assessment of grip strength and forearm girth were noted.

Fig 3: TRAD group participant doing bicep curls with dumbbell.

Fig 4: TRAD group participant doing dynamometer contractions.

Statistical Analysis

Statistical analysis was carried out using SPSS program version 24.Shapiro Wilk test was used to check normality.Parametric tests for comparison and equal distribution used were a paired t-test for within the group comparison, and an unpaired t-test was used for between-group comparison [Group A and Group B]. Non-parametric tests was used for data that is not equally distributed i.e. Wilcoxon signed rank test for within group comparison and Mann Whitney test for between group comparison.

Results

Table 1 - Age distribution of both groups

Sr.No	Variable	Group	Mean ± SD
1	Age	BFRT	21.93+1.388
		TRADITIONAL	22.63+1.608

Interpretation Out or 30 participants, maximum were of 22 age group in traditional group.

Table 2:- Gender distribution of BFRT group

Gender	Frequency	Percentage
Male	4	13.3%
Female	26	86.7%

Interpretation - Out of 30 Participants of BFR group, 86.7% were females, 13.3% were males.

Table 3: Gender distribution of traditional group

Gender	Frequency	Percentage
Male	4	13.3%
Female	26	86.7%

Interpretation - Out of 30 Participants of BFR group, 86.7% were females, 13.3% were males.

Table 4: Intra group comparison of pre and post forearm girth for traditional training group by Paired t test

Variable	Side	Pre Mean + SD	Post Mean + SD	P-value	T-value	Significance
Grip strength	Right	19.50+14.507	24.67+17.042	<0.0001	-4.387	Significant
	Left	19.43+14.729	24.07+17.290			

Interpretation:- Traditional training was equally effective on both right and left forearm girth

Table 5:- Intra group comparison of pre and post grip strength for traditional training group by Paired t test

Variable	Side	Pre Mean + SD	Post Mean + SD	P-value	T-value	Significance
Grip strength	Right	25.03±17.00	29.57±19.21	<0.0001	-4.203	Extremely significant
	Left	23.17±15.15	28.27±18.68			

Interpretation:-Traditional training had more effect on left hand grip as compared to right hand grip.

Table 6:-Intra group comparison of pre and post forearm girth for BFR training group by Wilcoxon signed rank test

Variable	Side	Pre Mean + SD	Post Mean + SD	P-value	T-value	Significance
Forearm girth	Right	22.13+2.345	23.43±2.315	0.0001	-10.140	Extremely significant
	Left	22.13+2.345	23.43 ±2.315			

Interpretation- BFRT had more results on left forearm circumference as compared to right.

Table 7:-Intra group comparison of pre and post grip strength for BFR training group by Wilcoxon signed rank test

Variable	Side	Pre Mean + SD	Post Mean + SD	P-value	T-value	Significance
Forearm girth	Right	23.40±2.343	24.40±2.444	<0.0001	-4.524	Extremely significant
	Left	*23.27±2.333*	*24.33±2.440*			

Interpretation- BFRT had more effect on right handgrip strength as compared to left handgrip strength.

Table 8:- Inter group comparison of forearm girth for BFRT and traditional training group by Unpaired t test

Forearm girth	Right	Left
BFR	24.40	24.33
TRAD	23.43	23.43
P-value	0.001	0.001

Interpretation- BFRT has more significant results on forearm circumference as compared to traditional training group.

Table 9:-Inter group comparison grip strength for BFR and traditional training group by Unpaired t test

Grip strength	Right	Left
BFR	29.57	28.27
TRAD	24.64	24.07
P-value	0.001	0.001

Interpretation- BFRT has more significant results on forearm circumference as compared to traditional training group.

Discussion

The objective of the study was to compare blood flow restriction training with traditional strengthening on handgrip strength and forearm girth in young adults. The results demonstrated that group A [BFRT] has more significant effects than group B [traditional] for both outcome measures- forearm girth and grip strength. For the traditional group, forearm girth was equally effective on both hands. BFRT had a great effect on right forearm girth as compared to left forearm girth. BFRT had significant results on left forearm girth as compared to right forearm girth. Both BFRT and traditional were more effective on right-hand grip strength than left-hand grip strength. The findings of the present study are in accordance with the literature, in which a similar strength gain between BFRT and traditional has been observed in several populations [e.g., healthy young, middle-aged, injured adults]. The changes in the mean of the BFR group, when compared with the traditional training group, can be justified by adaptations that muscle fibers suffered. Some studies show that metabolic changes, which occur in target muscles and near the occluded part, play an important role in volume and strength gains. When considering the results from a strengthening perspective, Cook et al.. was the only study to report significant between-group differences. The participants in the BFR training group after 3 weeks had improvements in strength, power, and speed compared to the traditional strengthening group.[5] Several mechanisms have been proposed to explain positive outcomes in muscle volume and strength. Among all, accumulation of metabolites and reactive oxygen species, elevation of anabolic hormones, and activation of tracts related to muscle remodeling and angiogenesis, cell swelling, and lactic acid have been suggested.[8] Research has shown that BFR demonstrates a positive effect on hypertrophy, strength, and power. Yasuda et al.. demonstrated that 6 weeks of BFR in the bench press, using 30% of 1RM, increased triceps strength by 8.3% and of pectoralis major by 8.10%. Nevertheless, in a group with no blood flow restriction, there were higher increases in triceps and pectoralis strength [17.6% and 8.6%], respectively.[11] Regarding the significant increase in forearm strength in the non-dominant hand, it may be justified by fact that BFR is able to generate adaptations in distant limbs or muscles near occluded part. In addition, greater use of the dominant hand for daily tasks may decrease the effectiveness of resistance training under different contexts because initial strength gains are mostly responsive to neural changes.[11].Another study that used an intra-subject design (one leg vs. the other) and compared BFR training (>250mmHg) with traditional training (40% of maximal voluntary contraction) found an increase in strength of 9% after two weeks and 26% after four weeks for the occluded leg, while for the non-occluded leg there were no significant gains.[12] Moreover, a recent meta-analysis concluded that the benefits in muscular volume and strength are greater when low-intensity training is performed in combination with BFR, given that traditional training requires higher intensities. These results suggest that resistance training of low to moderate intensity, without occlusion, does not alter the magnitude of muscle strength in the same way as BFR.[14] Hence, this study suggests that BFRT can be used as a strengthening tool as it is easy to administer and does not have adverse effects. Future research can be done with applied populations or those with pain.

Conclusion

This study concludes that both the groups were effective post-intervention [BFRT and traditional training] in increasing handgrip strength and forearm girth in young adults. However, BFRT has shown more significant results as compared to traditional training for increment of handgrip strength and forearm girth in young adults.

Funding None

Conflict of Interestno Conflict of Interest.

Acknowledgement

I would like to thank Dr. Jaywant Nagulkar, Principal of Dr. Ulhas Patil College of Physiotherapy, Jalgaon for allowing me to conduct this study. I am highly

grateful to Dr.Chaitali Neve Assistant Professor, Dr. Ulhas Patil College of Physiotherapy, Jalgaon for her guidance, encouragement, and support. I would like to thank all my teachers for their immense support and guidance. Lastly, I would like to devote my hearty gratitude towards my friends and family for their love and support, without which this effort won't be fruitful.

References

1) Dr. Mario g. Navo, DPT, PT Lifters clinic BFR training manual,Science of BFR,USA,2016:6.

2) Andrews institute, Tyler Optiz, DPT, Gulf Breeze ,FL BFR Training-Integration into physical therapy Practice,Greece,2018,4.

3) Vanwye WR, Weatherholt AM, Mikesky AE. Blood flow restriction training: implementation into clinical practice. International journal of exercise science. 2017;10(5):649.

4) Omar amer SPT,Berta Carmo SPT. Effects of BFR on physical performance in adults as compared to standard physical exercise and control groups:Systemic Review, Scranton, 2019,7-9.

5) Dankel SJ, Jessee MB, Abe T, Loenneke JP. The effects of blood flow restriction on upper-body musculature located distal and proximal to applied pressure. Sports Medicine. 2016 Jan;46(1):23-33.

6) Sydney Fournier,MacaylaLaChance. Does BFR training improve functional outcomes in physically active young adults with anterior knee pain.,2021,America, 2-3.

7) McEwen JA, Owens JG, Jeyasurya J. Why is it crucial to use personalized occlusion pressures in blood flow restriction (BFR) rehabilitation?.Journal of Medical and Biological Engineering. 2019 Apr;39(2):173-7.

8) Loenneke JP, Fahs CA, Rossow LM, Sherk VD, Thiebaud RS, Abe T, Bemben DA, Bemben MG. Effects of cuff width on arterial occlusion: implications for blood flow restricted exercise. European journal of applied physiology. 2012 Aug;112(8):2903-12.

9) Loenneke JP, Fahs CA, Rossow LM, Thiebaud RS, Mattocks KT, Abe T, Bemben MG. Blood flow restriction pressure recommendations: a tale of two cuffs. Front Physiol. 2013 Sep 10;4:249. doi: 10.3389/fphys.2013.00249. PMID: 24058346; PMCID: PMC3767914.

10) Zhang XZ, Xie WQ, Chen L, Xu GD, Wu L, Li YS, Wu YX. Blood Flow Restriction Training for the Intervention of Sarcopenia: Current Stage and Future Perspective. Front Med (Lausanne). 2022 Jun 13;9:894996. doi: 10.3389/fmed.2022.894996. PMID: 35770017; PMCID: PMC9234289.

11) Aniceto RR, da Silva Leandro L. Practical Blood Flow Restriction Training: New Methodological Directions for Practice and Research. Sports Med Open. 2022 Jun 28;8(1):87. doi: 10.1186/s40798-022-00475-2. PMID: 35763185; PMCID: PMC9240154.

12) Luebbers PE, Fry AC, Kriley LM, Butler MS. The effects of a 7-week practical blood flow restriction program on well-trained collegiate athletes. J Strength Cond Res. 2014 Aug;28(8):2270-80. doi: 10.1519/JSC.0000000000000385. PMID: 24476782

13) Amani-Shalamzari S, Rajabi S, Rajabi H, Gahreman DE, Paton C, Bayati M, Rosemann T, Nikolaidis PT, Knechtle B. Effects of Blood Flow Restriction and Exercise Intensity on Aerobic, Anaerobic, and Muscle Strength Adaptations in Physically Active Collegiate Women. Front Physiol. 2019 Jun 26;10:810. doi: 10.3389/fphys.2019.00810. PMID: 31297065; PMCID: PMC6607282.

14) Mattocks KT, Jessee MB, Mouser JG, Dankel SJ, Buckner SL, Bell ZW, Owens JG, Abe T, Loenneke JP. The Application of Blood Flow Restriction: Lessons From the Laboratory. Curr Sports Med Rep. 2018 Apr;17(4):129-134. doi: 10.1249/JSR.0000000000000473. PMID: 29629973.

15) Balachandran AT, Steele J, Angielczyk D, Belio M, Schoenfeld BJ, Quiles N, Askin N, Abou-Setta AM. Comparison of Power Training vs Traditional Strength Training on Physical Function in Older Adults: A Systematic Review and Meta-analysis. JAMA Netw Open. 2022 May 2;5(5):e2211623. doi: 10.1001/jamanetworkopen.2022.11623. PMID: 35544136; PMCID: PMC9096601.