



# “EFFECTIVENESS OF BLOOD FLOW RESTRICTION TRAINING WITH THERABAND EXERCISES V/S HEAVY LOAD RESISTANCE TRAINING ON STRENGTH AND HYPERTROPHY OF QUADRICEPS MUSCLE IN YOUNG HEALTHY ADULTS: A Randomized Control Trial”

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## ABSTRACT

**BACKGROUND:** Muscular strength refers to the amount of force a muscle can produce and is usually measured by the maximum amount of force a muscle can produce in a single effort.

The key elements of muscle performance are strength, power, and endurance. If any one or more of these areas of muscle performance is impaired, activity limitations and participation restriction or increased risk of dysfunction may ensue. Strength training is defined as the practice of systematic repetitions capable of altering the shape and function of tissues. Strength training (strengthening exercise) is defined as a systematic procedure of a muscle or muscle group lifting, lowering, or controlling heavy loads (resistance) for a relatively low number of repetitions or over a short period of time.

Blood flow restriction (BFR) training is a new technique for either the prevention of muscle atrophy or possibly the inducement of muscle hypertrophy. The procedure involves placing an inflatable cuff or tourniquet on the proximal end of an extremity while progressively increasing the internal pressure to the point of limiting arterial blood flow influx and the venous efflux. BFR combined with low-intensity resistance training (LIRT) elicits comparable muscle adaptations seen with higher intensity resistance training (HIRT).<sup>5</sup> low load resistant training refers to 20-50% of 1RM which when combined with BFR elicits the results of HIRT.

**AIM OF THE STUDY:** The aim of the study is to check if blood flow restriction training combined with Thera band is equally effective as heavy load resistance training in increasing strength and hypertrophy of quadriceps muscle of young healthy adults.

**OBJECTIVE OF THE STUDY:** To find if Thera band resistance exercise combined with BFR-RT is giving equivalent results as compared to heavy load resistance training (HIRT) on the strength and hypertrophy of quadriceps muscle in young healthy individuals.

**TYPE OF STUDY DESIGN:** Randomized Controlled Trial

**METHODOLOGY :** A Randomized control trial (RCT) was conducted on 52 young healthy individuals for 2-3 months. Subjects were randomly sampled and sequentially allocated to Group A (Experimental group) and Group B (experimental group) has continued their daily activities. Group A, performed Thera band exercises with blood flow restriction cuff for 3 days a week for a period of 5 weeks. Group B was trained with heavy load resistance technique. Changes were measured using 1RM for strength of muscle and girth measurement using inch tape for hypertrophy of muscle.

**CONCLUSION:** Both the Exercise programme were found to be effective in increasing the strength and hypertrophy of quadriceps muscle

**KEYWORDS:** blood flow restriction training, heavy load resistance training, elastic resistance training, hypertrophy, strength.

#### INTRODUCTION:

##### MUSCLE WEAKNESS and BLOOF FLOW RESTRICTION TRAINING

Muscle cells work by detecting a flow of electrical impulses from the brain which signals them to contract through the release of calcium by the sarcoplasmic reticulum. Fatigue (reduced ability to generate force) may occur due to the nerve, or within the muscle cells themselves. New research from scientists at Columbia University suggests that muscle fatigue is caused by calcium leaking out of the muscle cell. This causes there to be less calcium available for the muscle cell. In addition an enzyme is proposed to be activated by this released calcium which eats away at muscle fibres. Substrates within the muscle generally serve to power muscular contractions

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Strength training also provides functional benefits. Stronger muscles improve posture, provide better support for joints, and reduce the risk of injury from everyday activities. Older people who take up weight training can prevent some of the loss of muscle tissue that normally accompanies aging—and even regain some functional strength—and by doing so

become less frail.<sup>[15]</sup> Progressive resistance training may improve function, quality of life and reduce pain in people at risk of fracture, with rare adverse effects <sup>[18]</sup>Weight-bearing exercise also helps to prevent osteoporosis and to improve bone strength in those with osteoporosis.<sup>[19]</sup> The benefits of weight training for older people have been confirmed by studies of people who began engaging in it even in their 80s and 90s

#### Increased sports performance

Stronger muscles improve performance in a variety of sports. Sport-specific training routines are used by many competitors. These often specify that the speed of muscle contraction during weight training should be the same as that of the particular sports.

#### Need of the study

1. To perform heavy load resistance training (HIRT) and blood flow restriction training BFR-RT expensive equipment's are required for example bench press, quadriceps chair etc. which makes them less feasible for many individuals as well as therapists to access them.
2. Thera band is easily assessable, light weight and cost effective so combined with BFR-RT it can be a better substitute to the heavy exercising equipment's.

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#### INCLUSION CRITERIA:

- Both genders
- Age 20-30
- Not involved in any fitness training for at least 6 months
- Able to understand Hindi/English

#### EXCLUSION CRITERIA:

- Recent lower limb injuries/ fractures (hip knee ankle and lower back) (2 yrs. gap)
- Any neuromuscular condition
- Vascular diseases
- Cardiopulmonary diseases
- Unable to follow instructions

MATERIALS USED :

- Thera band
- Weight plates
- Quadriceps chair
- Occlusion cuff/Band
- Inch tape

METHODOLOGY :

Study Design: Experimental study design

Study Sample Period: 1<sup>ST</sup> JAN/ 2022 TO 21<sup>ST</sup> FEB /2022

Sampling Method: Simple Random sampling Type of sampling: SNOZE Randomization Sample Size: 52

Source of data: The oxford college of Engineering, Bangalore. Study Duration: 5 WEEKS

Test procedure:

- Subjects were allotted into two groups (A & B)
- 26 subjects was allotted in Group A(Experimental Group) and 26 subjects in Group B (Control Group)
- Both group participants continued with their normal activity.
- Group A received a detailed explanation of Thera band exercise with blood flow restriction as given below, for 5 week consecutively.

Exercise Intervention:

- This exercise programme general frame work and it was designed based on ACSM guidelines for strength training.

Control group

Heavy load resistance training INTENSITY: Load applied- 60-80% of 1RM VOLUME : 3x12

sets

- FREQUENCY: 3DAYS/ WEEK
- DURATION: 5 WEEKS
- REST TIME: 1 MINUTES AFTER EVERY SET

- MODE OF EXERCISE:
  1. Type of muscle contraction- concentric and eccentric contraction
  2. Position of exercise- non weight bearing (open kinematic chain exercise). The patient will be seated on the quadriceps chair with hip and knee at 90° flexion and with the resistance bar at the ankle.
  3. Form of resistance- mechanical resistance (the resistance given with the means of external weights e.g., weight plates, kettle bell etc.)

Experimental group

2. Blood flow restriction training with Thera band (elastin resistance training)

**INTENSITY** : Load applied (Colour of band) Black 7.3lbs , Grey 10.2lbs, Golden 14.2lbs **VOLUME** : 3x12 sets

- FREQUENCY: 3DAYS/ WEEK
- DURATION: 5 WEEKS
- REST TIME: 1 MINUTES AFTER EVERY SET
- MODE OF EXERCISE:
  1. Type of muscle contraction- concentric and eccentric contraction
  2. Position of exercise- non weight bearing (open kinematic chain exercise). Subject will be seated on chair with hip and knee at 90 flexion and foot resting on the ground. The Thera band will be tied at the ankle and the subject will be asked to perform knee extensions.
  3. Form of resistance- mechanical resistance
- RESTRICTION TIME: 30 seconds
- CUFF SIZE: small – 5cm (for lean body built), medium – 10-12 cm (for moderate body built), large – 17-18 cm (for well-nourished individuals)
- REPETITION PRESSURE: 70-80% AOP (arterial occlusion pressure)
- RESTRICTION FORM: continuous restriction

Dynamic quadriceps exercise

- • Subject in sitting position with both the legs firmly on ground with all the lower limb joints in 90 degree angle (hip knee and ankle).
- • Attach the one end thera band to the ankle of one leg and tie other end with a stable surface.
- • The subject performs knee extension with the thera band attached leg the other leg stays firmly supported on the ground.
- • Continue the same for other leg as well.

## OUTCOME MEASURE :

- Circumference (girth) measurements of thigh (quadriceps muscle) Reliability: ICC= 0.75 (annexure VIII)
- 1RM (EQUATION:  $(4.6RM \times 1.1307) + 0.6998$ ) To measure the strength of the muscle (quadriceps muscle)<sup>7</sup>

Reliability: ICC= 0.97 (annexure VIII)

## STATISTICAL ANALYSIS :

A sample of 52 subjects, between 25 years to 35 years of age, was selected for the study. A participant's flowchart is shown in Fig. 1. After the enrolment phase, subjects were excluded due to different reasons. Forty satisfied the inclusion criteria, agreed to participate, and were allocated to Group A (Experimental) and Group B (Control). The data was carefully collected and calculated. In this study independent student t- test, Chi square test and Student Paired t Test were used a statistically tool for detecting the significant difference within and between the Group A and Group B. Descriptive statistics (mean and standard deviation) were also calculated for all the measurements consideration for the study. Statistical Package for Social Sciences [SPSS] for macintosh Version M1 Released 2020. Armonk, NY: IBM Corp., was used to perform statistical analyses.

Sample size formula:n=

$$1. n = (z_{1-\gamma/2})^2 \times (SD)/(D)^2$$

$$z_{1-\gamma/2} = 1.96$$

$$SD = 3.4 \quad (d) = 0.5$$

$$n = (1.96)^2 \times (3.4) / (0.5)^2$$

$$n = 13 / 0.25 = 52$$

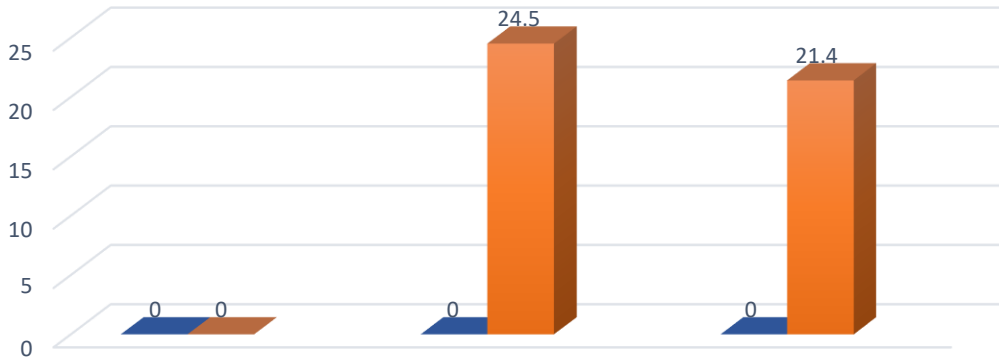
**Table no. 1 age and gender distribution among 2 groups**

Variable	Category	Group A		Group B		P-value
		Mean	SD	Mean	SD	
Age	Mean& SD	24.85±	0.99	23.93	0.85	0.51
	Range	20-30		20-30		
		N	%	N	%	
Gender	Males	9	35%	12	46%	0.75
	Females	17	65%	14	54%	

**Table no. 2 Comparison of mean values of different study parameters between 2 groups during Pre Intervention period using Independent Student t Test**

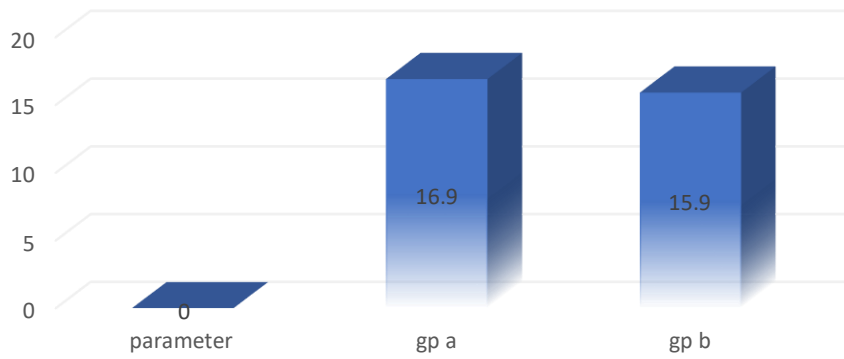
Parameters	Group	N	Mean	SD	Mean difference	p-value
1RM	Group A	24	24.5	3.55	3.1	0.47
	Group B	24	21.4	2		
Girth measurement	Group A	24	16.9	2.7	1	0.56
	Group B	24	15.9	2.5		

### PRE-INTRVENTION 1 RM MEASUREMENT WITHIN GROUP DIFFERENCE



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### PRE INTERVENTION GIRTH MEASUREMENT WITHIN GROUP DIFFERENCE

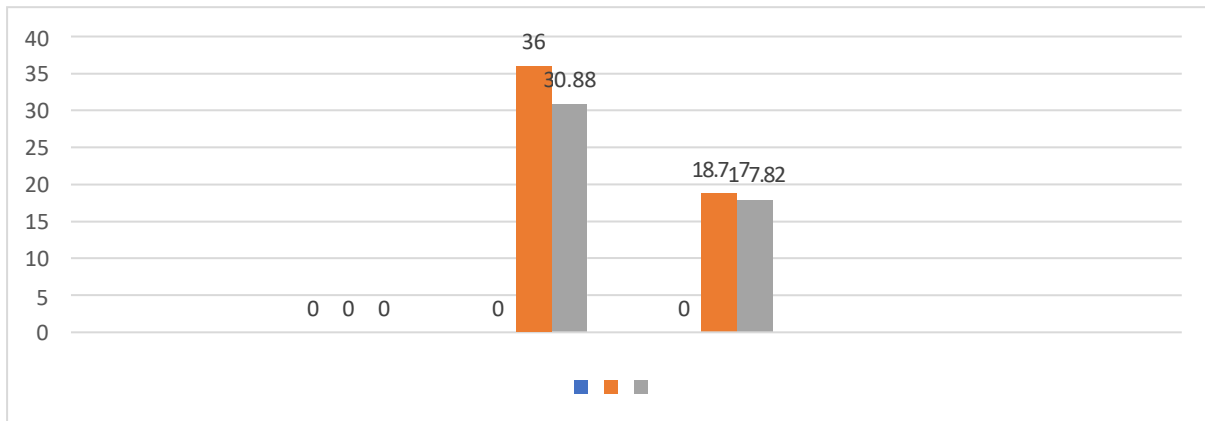


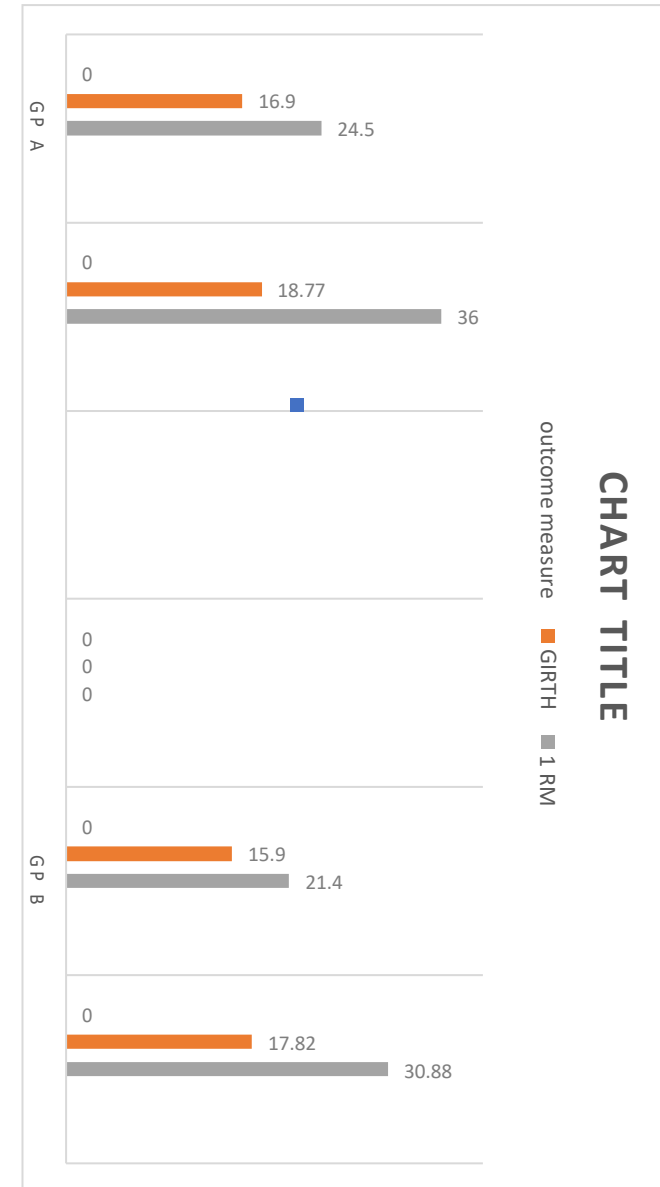
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**Table no.3 Comparison of mean values of different study parameters after 5 weeks postIntervention period in both Groups using Student Paired t Test**

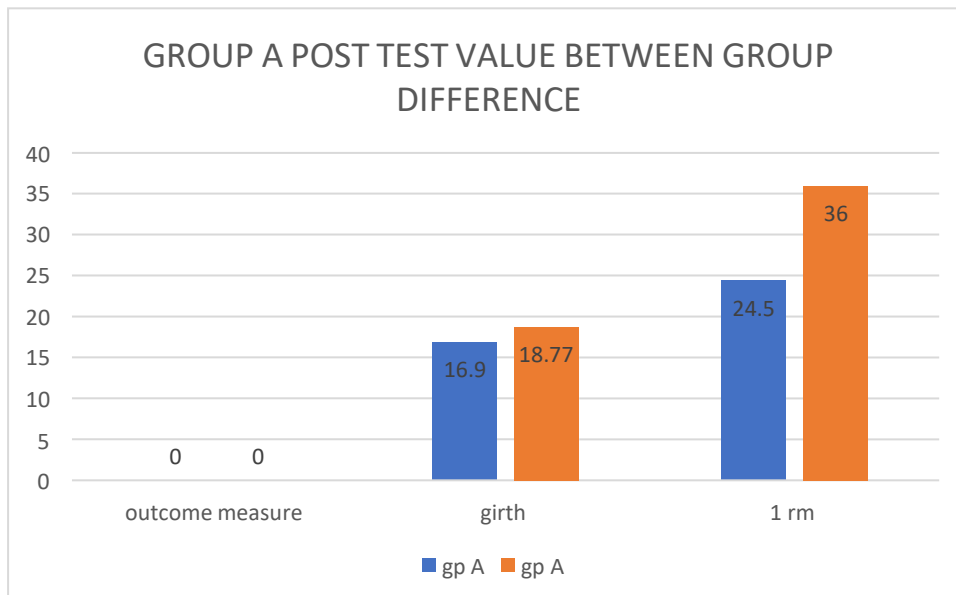
Parameters	Groups	N	Mean	Difference	P value
1RM	Group A	24	36	5.12	0.278042
	Group B	24	30.88		
Girth measurement	Group A	24	18.77	0.95	0.206376
	Group B	24	17.82		





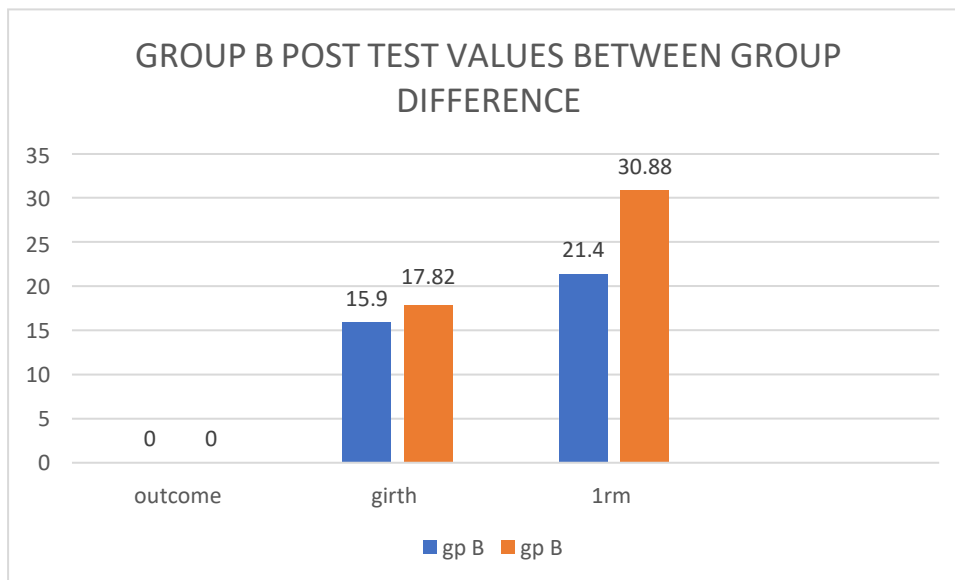
**Table no. 4 Comparison of mean values of different study parameters between Pre Intervention and 5 weeks post Intervention period in Group A using Student Paired t Test**

Parameters	Time	N	Mean	SD	Mean difference	P-value
1RM	Pre intervention	24	24.5	8.59	11.5	0.278042
	Post intervention	24	36	6.53		
Girth measurement	Pre intervention	24	16.9	3.52	1.87	0.206376
	Post intervention	24	18.77	4.16		



**Table no.5 Comparison of mean values of different study parameters between Pre Intervention and 5 weeks post Intervention period in Group B using Student Paired t Test**

Parameters	Time	N	Mean	SD	Mean difference	P-value
1RM	Pre intervention	24	21.4	5.09	9.48	0.278042
	Post intervention	24	30.88	5.18		
Girth measurement	Pre intervention	24	15.9	1.15	1.92	0.206376
	Post intervention	24	17.82	1.03		



## DISCUSSION

present study, focused on the effects of blood flow restriction training exercise along with elastic resistance training, administered healthy young adults to check if the response is similar to that of heavy load resistance training. There was no pre-treatment difference in age and gender data between the groups, however, studies with non-sedentary individuals do not show a significant change

heavy load resistance training 3 The days a week (30 min/day) for control group on quadriceps chair performing knee extension with weight plates according to ACSM GUIDELINES that is 70-80% of 1 RM

Theraband exercise WITH BLOOD FLOW RESTRICTION TRAINING 3 days a week (30 min/day) for experimental group was to perform knee extension with occlusion cuff of 80% occlusion pressure and theraband at the ankle

This study was the first to examine the effect of BFR-RT combined with theraband exercises on hypertrophy and strength of quadriceps muscle of young healthy individuals. The main findings of this clinical study were that: (1) BFR-RT combined with theraband exercises and HL-RT elicited comparable increases in skeletal muscle hypertrophy and strength; (2) BFR-RT combined theraband exercises resulted in improvements in strength of quadriceps muscle; (3) there were no adverse events or effects on knee joint laxity with either intervention. These findings have important implications for strength training.

The baseline characteristic mean age (in years) was calculated for group A  $24.85 \pm 0.99$  and group B  $23.93 \pm 0.85$  respectively. Both the groups showed almost similar result on 1RM (p value= 0.27) and circumference (p value=0.206) with p-value < 0.0001. Hence exercise both intervention was found to be effective in increasing the strength and hypertrophy of quadriceps muscle.

#### CONCLUSION:

The study concludes that, the exercise programme intervention was found to be effective in improving the skeletal muscle strength and hypertrophy using BFR-RT + ERT which is similar to the effect induced through HLRT.

This study hereby accepts the alternative hypothesis that BFR-RT +ERT is inducing similar effect in strength and hypertrophy of skeletal muscle as that of HLRT.

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