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ORIGINAL ARTICLE

EFFECT OF BLOOD FLOW RESTRICTION TRAINING PROGRAM ON STRENGTH OF LOWER LIMB IN YOUNG FOOTBALL PLAYERS

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ABSTRACT

Background of the Study: Football is a sport which involve running activities. The strength of the lower limb determines the efficiency of the football player. There are numeral studies that are done to improve the strength of lower limb. This study has been focussing to evaluate the effectiveness of blood flow restriction training program to improve the strength of lower limb in young football players. The intent of the study is to find out the effects of blood flow restriction training programs to improve the strength of lower limb in young football players. **Methodology:** It is an experimental study with 15 football players with age group of 16-21 years were recruited from Dr.M.G.R Educational and Research Institute Velappanchavadi, Chennai. It is a simple random sampling method, collegiate male football players who are not been trained in specific lower limb strengthening program in past 6 months included in this study. Exclusion criteria; Recent fracture of players, Acute inflammation, Hypermobility of joints, any haematological condition. **Results:** In this study the strength of the lower limb 1RM (in kg) has increase with mean difference of 17.60 by BFR training with P VALUE > 0.0001. 60m sprint test (in seconds) has reduced with the mean distance of 0.241 by BFR training with P value > 0.0003 both outcomes found effective after BFR training among young football players. **Conclusion:** The study concluded that blood flow restriction training program yield the significant improvement in strength and speed of the young football players.

Key Words: Muscle strength; BFR training; 1RM, 60m sprint test.

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INTRODUCTION

Football is one of the most popular sport which is played by professional leagues in most of the counties in the recent years. It is the game where players encounter the challenging situations where they have to run fast and tackle the opponent players [1].

During sprinting the hip flexors and knee extensors torque are produced and is opposed by hamstring muscles, hence there are numerous studies done on the muscle strength training to prevent the hamstring and quadriceps strain injury it is statistically state as the highest rate involved injury in the sprinting swing-stance transition[2].

In several years BFR has become popular in Japan and states that BFR training in variety of population should increase in strength and hypertrophy. Recent studies have explored the use of BFR training with low resistance (30% of 1RM) in individuals who cannot tolerate high load resistance training [3].

Football is considered as a physically demanding sport that requires a basic element of strength and power. It involves running, jumping, lower limb strength determines efficiency of football players. Players tend to follow different types of strength training to improve lower limb strength[12]. Different types of strength training include traditional strength training aerobic resistance having at 70% of 1RM. In order to achieve strength and hypertrophy. However, athletes busy in their training and match are unable to withstand high intensity training therefore they sort out for low intensity training alternatives. One such alternative method of training is blood flow restriction training also known as KAATSA[4, 9].

Hughes et al hypothesized that and ischemic and hypoxic muscular environment is generated during blood flow restriction training that causes high level of metabolic stress and mechanical tension when combined with exercise. Low intensity training with BFR can lead to significant improvement in muscle strength and hypertrophy [5, 7, 8].

Research in recent years has highlighted that low load exercise can result in muscular hypertrophy and strength gain when it performed using BFR cuffs. This method involves applying an inflatable tourniquet, elastic wraps at the proximal position of limb. In which aim of maintaining arterial inflow and occluding venous outflow from limb during exercise. As arterial walls are rigid and thicken and more resistant to compressive forces and also blood pressure in arteries is more than in veins meaning that higher restrictive pressure is required to occludes arterial blood than venous blood flow [6, 10, 11].

Aim of the study: To study the effect of blood flow restriction training program on strength of lower limb in young football players.

Need of the Study: Football is a sport which include running as a major part, lower limb plays a vital role in Football. The purpose of this study is to find out the effect of blood flow restriction training program on strength of lower limb in young football players. This study is also important to prove the performance level of footballers after blood flow restriction training program.

METHODOLOGY

It is an experimental study with 15 football players with age group of 16-21 years were

recruited from Dr. M.G.R Educational and Research Institute Velapanchavadi, Chennai. It is a simple random sampling method, collegiate male football players who are not been trained in specific lower limb strengthening program in past 6 months were included in this study.

Exclusion criteria: Recent fracture of players, Acute inflammation, Hyper mobility of joints, Any hematological condition

Material used: BFR cuff, Barbells, Stopwatch were the materials used for the study.

Outcome Measure: Both groups were assessed for pre and post-test for speed and strength using 60m sprint test and 1RM respectively.

Procedure: A total of 15 football players were selected, the subjects were instructed in case any subjects discontinued the exercise program or if he develops any pain or injury during exercise intervention they would be excluded from the study. A total of 4 weeks (16 Sessions) consists of 4 sessions per week. Pre and posttest measurement were recorded.

Hamstring curl exercise: Subjects were asked to lie in prone on quadriceps table a small towel roll was placed under the femur just proximal to the patella to avoid compression of patella between the treatment table and the femur. Before starting out with protocol the 10RM for both legs of the subject were identified. In prone lying with the resistance of 10RM against the ankle in quadriceps table the subjects flexed the knee to only 90degree as fast as possible in their comfortable pace.

The 10 RM of the subjects were re-checked every week and the percentage of the exercise load was adjusted according to training protocol.

Quadriceps curl exercise: The subjects were asked to sit in leg extension machine before starting the training protocol. The 10RM of the subjects were identified the percentage of the load were given to the subject based on the sets and repetition which is given in the table.

Nordic exercise: The subject was in kneeling position on exercise mat and attempted to resist a forward-falling motion using the hamstring to maximize loading in the eccentric phase. The subjects kept their hips fixed in a slightly flexed position throughout the range of motion, and to break forward fall for as long as possible using their hamstring and to let go they had to use arm and hands to buffer the fall let the chest touch forward and immediately get back to the starting position by forcefully pushing with their hands to minimize loading in the concentric phase.

Barbell Squat with BFR Cuff:

- Set a bar in a rack just below shoulder height and load the weight plates.
- Grab the bar with hands just outside shoulder width, step under and rest the barbell on your back.
- Lift the bar off the rack by pushing up with the legs and take a step back from the rack. Set your feet shoulder-width apart, bend at the knees slightly, pull in your lower abs, and set your head in line with your spine, keeping eyes forward.
- Once positioned correctly begin the squat by bending at the knees and hips together to lower your body. Keep your heels flat on the floor
- Strongly push yourself back up to the starting position mirroring the descent.

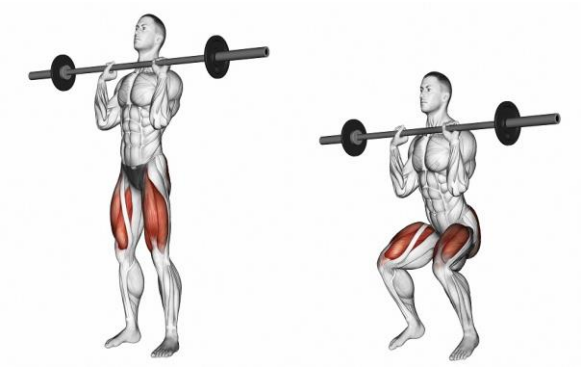


Fig. 1 Barbell Squat with BFR Cuff

Lunges With BFR Cuff

- Stand up straight with a dumbbell in each hand. Hang your arms at your sides. Palms should face the thighs (hammer grip). Feet should be a little less than shoulder-width apart.
- Take a big step forward with either leg, bending at the knee until the front thigh approaches parallel to the ground, landing on the heel. Inhale as you go down. The rear leg is bent at the knee and balanced on the toes. For the leg you step forward with, don't let the knee go past the tip of the toes.
- Step back to your standing starting position while exhaling.
- Repeat the motion with the other leg. Alternate legs until the exercise program set is complete. A number to aim for is eight to 12 lunges per set and two to three sets in a workout.

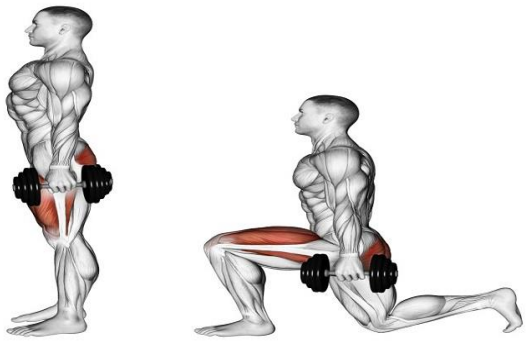


Fig. 2 Lunges with BFR Cuff

Hamstring Curl with BFR Cuff

- Adjust the seated leg curl machine to position the footpad just above your heels.
- Sit upright and engage your abs as you position your legs in front of you.
- Begin to curl your legs back slowly towards you and flex your calf muscles as you do so.

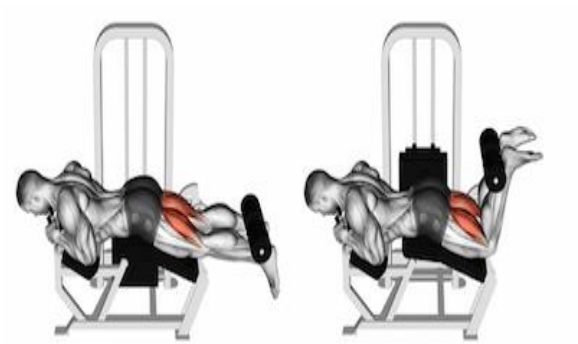


Fig. 3 Hamstring Curl with BFR Cuff

Leg Press with BFR Cuff

- Brace your abdominal muscles and push the platform away with your heels and forefoot. Your heels should remain flat on the footplate. The front of your foot or toes should never be used exclusively to move the pad forward.
- While exhaling, extend your legs and keep your head and back flat against the seat pad. Extend with slow control rather than with an explosive movement.
- Pause at the top of the movement. Do not lock out your knees and ensure that they are not bowing out.
- While inhaling, return the footplate to the starting position by gradually bending the knees. Keep the feet and back flat throughout.
- If you have never done leg presses before, start modestly with three sets of 10 leg presses. You can advance from there as you build strength.

Fig. 5 Leg Press with BFR Cuff

Exercise Intervention

Weeks	Sessions	No. ofsets	No of repetitions	Load (% of 10RM)
WEEK 1	1	1	15	20
	2	1	15	
	3 4	1 1	15 15	
WEEK 2	5	1	15	20
	6	1	15	
	7 8	2 2	10 10	
WEEK 3	9	2	12	30
	10	2	12	
	11 12	2 2	15 15	
WEEK 4	13	3	10	40
	14	3	12	
	15 16	3 3	12 12	

Test Procedure: Prior to Pre-test Measurements subjects under gone 8 minutes of warm up protocol includes 5 minutes of stretching (lower limb group muscles) and 3 minutes of jogging. The Subjects instructed to wear comfortable clothing during the test. Pre-test was conducted in 2 sessions. The First session included an Introduction of

the testing protocols to the subjects. The Second session included the Measurements of speed and strength. Pre-test measurements was measured a week before commencement of the 1st training session for both the Post-test measurements were recorded after 3 days of the16thsession.

Test measurements

Dependent Variable: 1RM in kg is used to measure the strength of the lower limb in young football players. 60m sprint test is used to test the speed of the football players.

Measurements Technique and Test Procedure: 1RM strength test in kg: subject was asked to perform the barbell squat of their maximum weight capacity. 1RM of subject were measured.

60M strength test: subject was asked to sprint for the distance of 60m and the timing in seconds were noted using the stopwatch.

Training protocols: Subjects was given 5minutes of warm-up exercise every day prior to the session warm up, session included free exercise & stretching for lower limb muscles. After every set of repetitions in both techniques, 2 minutes of rest interval was given to all the subjects. Post strengthening session, cool down exercise in the form of stretching for lower extremity muscle was given to all subjects.

Data Analysis and Interpretation

Strength Test

Strength of Lower Limb 1RM in kg	Mean	Number of Pairs	Mean Diff.	SD, SEM	df	T	P value	Sig. Diff. (P < 0.05)
Pre-Test	44.73	15	17.60	3.312	14	20.58	<0.0001	****
Post Test	62.33			0.855				

Table 1: Paired t test on blood flow restriction training program within the Group on the effectiveness of blood flow restriction training in young footballers.

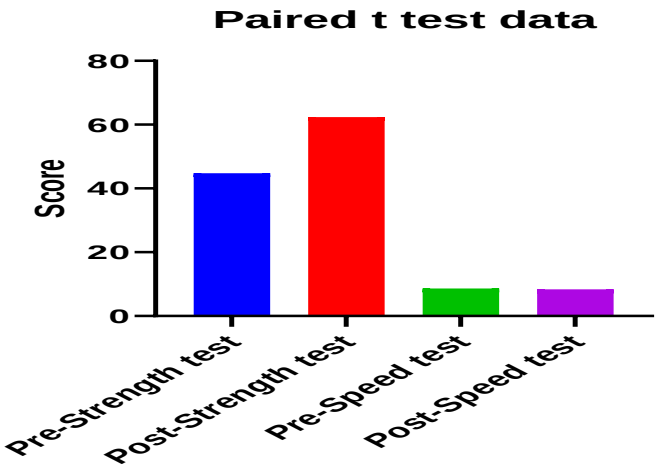
The above table 1 shows significant difference in Strength of Lower Limb muscles on effectiveness of blood flow restriction training with P value >0.0001.

Speed test

Speed 60m sprint in seconds	Mean	Number of Pairs	Mean Diff.	SD, SEM	df	T	P value	Sig. Diff. (P<0 .05)
Pre-Test	8.630	15	0.2413	0.1952	14	4.789	0.0003	***
Post Test	8.389			0.0504				

Table 2: Paired t test on blood flow restriction training program within the Group on effectiveness of blood flow restriction training in young footballers.

The above table 2 shows significant difference in Speed test on effectiveness of blood flow restriction training in young footballers with P value >0.0003.



Graph 1: Presentation of muscle strength increased and speed 60m per second has reduced within the Group by blood flow restriction training in young Football.

RESULT

In this study Strength of Lower Limb 1RM in kg has increased with mean difference of 17.60, by blood flow restriction training among young footballers with P value >0.0001. Speed 60m sprint in seconds has reduced with mean difference of 0.241, by blood flow restriction training among young footballers with P value >0.0003.

Both outcomes found effective after blood flow restriction training among young footballers. The study was performed to study the effectiveness of blood flow restriction training program to improve the strength of lower limb in young football players. A total of 15 players were included in this study. There was significant improvement in lower limb muscle strength than the speed.

But the study shows overall improvement in both the strength and speed of young football players. On pre and post-test analysis, there is significant difference between the p value of pre and post-test measurement indicates that the blood flow restriction training program on 4 weeks of intervention.

The sport which involves running and jumping activities it's important to improve muscle strength. Hence, the low load intensity training with blood flow restriction cuffs can enhance the lower limb strength and speed of players.

Therefore, the blood flow restriction training program plays a significant role in improving muscle strength and speed in young football players. On comparing the mean value of speed and strength test shows significant improvement in post-test mean values.

DISCUSSION

A total of 15 players were included in this study. There was significant improvement in lower limb muscle strength than the speed. The study shows overall improvement in both the strength and speed of young football players. On pre and post-test analysis, there is significant difference between the p value of pre and post-test measurement indicates that the blood flow restriction training program on 4 weeks of intervention.

The sport which involves running and jumping activities it's important to improve muscle strength. Hence, the low load intensity training with blood flow restriction cuffs can enhance the lower limb strength and speed of players. Therefore, the blood flow restriction training program plays a significant role in improving muscle strength and speed in football players.

Ethical clearance: Ethical clearance was obtained from the ethical Institutional Review Board of Faculty of Physiotherapy, Dr. MGR. Educational and Research Institute, Chennai with reference No: B-39/PHYSIO/IRB/ 2019-2020 approval letter dated 07/01/2020.

Conflicts of Interest: There is no conflict of interest to conduct and publish this study.

Fund for the study: The research scholars declared that the expense towards conduct of this study was taken care by them only

CONCLUSION

The present study concluded that blood flow restriction training program yield the significant improvement in strength and speed of the young football players. Superiorly the strength of the lower limb muscles shows significant improvement that the speed the result suggest that the blood flow restriction training is effective in improving the strength and speed of the young football players. The most important finding of the study is blood flow restriction training program can significantly improve the players performance.

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