REVIEW ARTICLE

Blood Flow Restriction Rehabilitation

Dhivagar Subbarayan[1], Santhiya Veerappana[2]

Abstract

Blood flow restriction (BFR) training is an aerobic exercise is performed by using a tourniquet, which is applied to the proximal aspect of the muscle. In this unique method, limb blood flow is restricted by using a cuff throughout the contraction cycle and rest period. It is highly effective shown by partial restriction of arterial inflow to muscle, but it restricts venous outflow from the muscle. It produces less load nature and strengthening capacity of muscles by using BFR training. It can provide an effective clinical rehabilitation stimulus without the high levels of stress and circulatory system risk associated with heavy-load training. BRF can reduce the loss of muscle mass and increase the bony healing process during the early immobilization of patients. It improves both muscle size and strengthening the muscles without stress of heavy lifts on soft tissue healing. Blood flow restriction rehabilitation is a safest and effective method to improve the muscle strength among patients who are unable to perform high-resistance exercise.

Keywords: Blood flow restriction training, Occlusion training, Rehabilitation.

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Introduction

Blood flow restriction rehabilitation (BFRR) is a unique and significant way to rehabilitate muscle injuries, especially those who underwent orthopedic surgeries. The restriction of venous outflow among the extremity during decreased load resistance exercises is a safe and effective method for the patients to strengthen their muscles.[1,11]

Historical View

Blood flow restriction therapy was firstly originated in Japan in 1966 historically is called as KAATSU training. KA means "additional" and ATSU means "Pressure". It is proven by the significant research, intensive protocols, and patented procedures in sports, exercise, and rehabilitation, and wellness supports KAATSU training's effectiveness.[2,13]

What is Blood Flow Restriction Rehabilitation?

In BFR training, a person works out by using narrow, elastic band around the upper part of the arm or leg. The methods of banding will help in partial restriction of venous blood flow and it never affects the arterial inflow to the extremity.[1,10] Repetition of a particular exercise by using this elastic band will help the person to strengthening the muscles; while person lifts heavy weights it will reduce the stress to muscle tissues that may help to improve the healing process of recent injury or surgery.[3,14]

How Does it Works?

This is a noninvasive procedure; hence the elastic cuff is placed on the injured arm or leg to gradually reduce blood flow to the extremity during specific exercise. The process of limiting the blood flow to the muscles is called occlusion; BFR is otherwise called occlusion therapy. It helps to facilitate the person to workout the muscles without placing more weight on the extremity. BFR focuses the person to activate all muscles of the limb while the blood flow is restricted. It can be incorporated into traditional physical therapy. BFR is a part of rehabilitation efforts. Follow-up of anterior cruciate ligament (ACL) surgery appears to preserve the bone recovering muscle loss and strengthened the bones and improve fast muscle function.[9] BFR is a perfect additive therapy for ACL patients for the purpose of reducing the loss and fasten the recovery of muscle, bone, and physiological function.[2,12,20]

[1]Department of Mental Health Nursing, Kasturba Gandhi Nursing College, Sri Balaji Vidyapeeth, Puducherry, India

[2]Department of Mental Health Nursing, Sri Manakula Vinayakar Nursing College, Puducherry, India

Corresponding Author: Dhivagar Subbarayan, Department of Mental Health Nursing, Kasturba Gandhi Nursing College, Sri Balaji Vidyapeeth, Puducherry, India, Phone: +91 8754733698, e-mail: dhivagalaxy@gmail.com

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Who Benefits?

BFR training is accessed for regular fitness, and also useful for patients in initial phase of rehabilitation during limb surgeries. It includes ACL reconstructions, meniscectomy, hip/knee replacements, rotator cuff repair or tendon repair surgeries.[4,15,30]

Research evidences showed that, BRF could reduce the loss of muscle mass and increase the bony healing process during the early immobilization of patients. It improves both muscle size and strengthening the muscles without stress of heavy lifts on soft tissue healing.[3] Persons with osteopenia, rheumatoid arthritis, osteoarthritis, etc. may also exclusively benefited from BFR training and also it is highly recommended for patient with spinal cord injuries or strokes.[3,14]

Is BFR Safe?

Traditional research evidences have shown that BFR not only provides comfort to the patients, but also it is safest and effective method of training while performing certain exercise appropriately. Trained blood flow restriction professionals will monitor the equipment continuously.

- Clot risk is minimal in BFR
- No evidences of damaging the blood vessels and cardiac muscles
- During BFR training the targeted limb occlusion pressure of the equipment is maintained under the pressure of 40–80% and is safe and effective. Therefore, Its lower pressure may provide less risk to reduce the need for higher pressure. Risk factors of BFR such as improper tourniquet width, excessive tourniquet pressure and improper placement of tourniquet will lead to muscle injury and it can cautiously seen in safety system measures.[5,17]

BRF Device

Gold standard blood flow restriction device formulated by Delphi Personal Tourniquet System from Owens Recovery Science. Food and Drug Administration (FDA) approved this device. It contains a Doppler ultrasound with blood flow restriction cuff and gives most accurate way to measure blood flow in the limbs and safely occludes the appropriate blood flow (Fig. 1).[3,16,29]

Cuff Width and Material

- Cuff width and material is significant to determine the successful completion of BFR.
- While measuring blood pressure, accurate prefixed pressure is essential.
- Narrow cuffs are totally blocked by blood flow, so these are best to be avoided. Using of wide cuff will provide comfort to the patients. Research evidences coats range of 3–5 cm width cuffs is very useful.
- Nylon cuff materials or a regular blood pressure measuring cuffs are safe and most effective.[6] In arterial occlusion pressure, limb circumference is next factor that affects the muscles. A large extremity requires higher cuff pressure to occlude than a smaller extremity to maintain appropriate pressure.[7,19,28]

Cuff Placement

The placement of cuff should be as high as possible on affected limbs. For the upper extremity, the cuff should be placed as proximal on the biceps area. For the lower extremity, cuff is place just below the gluteal fold. If the cuff is too loose and low placement, we cannot achieve optimal occlusion, thereby effectives of BFR will reduced.[21]

Duration of BFR

- Blood flow restriction therapy differs from each individual's muscle strength. Based on the patient needs, duration has been determined; the duration of exercise is 1 or 2 session per day from 4 to 7 days per week.
- The initiation of BFR postoperatively ranges from postoperative surgery such as day 1–2 weeks.[9]

Fig. 1: Blood flow restriction apparatus

Types of Exercise under BFR

- The range of exercise starts from isolated joint to total extremity
- Different types of muscle contractions
- Combination of the concentric/eccentric exercises[6,18,27]

Benefits of BFR in Elderly

- Muscle mass will be improved
- Increase the muscle strength
- Normalized the cardiovascular status
- Increase the positive bone density and increased functional outcomes
- Self efficacy improved[8]

Results with BFR

Blood flow restriction rehabilitation is a highly recommended for patient with orthopedic surgeries and is an injury recovery therapy that is producing dramatically positive results to the healing process.

- Reduce the loss of strength and atrophy of the muscles and non-weight bearing during post injuries
- 30% loads will increase strength and reduce hypertrophy
- Improved muscle endurances in 1/3 the time
- Improved muscle protein synthesis among elder individuals
- Improved muscle activation
- Increased growth hormones responses, it increases collagen synthesis
- Important for the tissue regeneration phase after injury.[7,24,27]

Risk Associated with BFR

Rhabdomyolysis cases have been identified while using narrow belts and lifting straps of tourniquet; the amount of pressure on the vasculature was unable to be controlled.[3,23,25]

Relative Contraindication—BFR

- Shiny or scaly skin and varicose veins
- Venous thromboembolism
- Infected extremity
- Vascular grafting process
- Open fracture
- Lymphectomies
- Clinically diagnosed cancer[7,22,26]

Conclusion

Blood flow restriction rehabilitation is a safest and effective method to improve the muscle strength among patients who are unable to perform high-resistance exercise and patients who have persistent weakness of the extremity will have despite traditional therapy.

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