



TRAINING TOOLS

To Pump or Not to Pump: Blood Flow Restriction - A Case Study

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WHAT YOU NEED TO KNOW

- BFRT is exercising while wearing a pneumatic cuff or strap around the proximal limbs to partially occlude arterial blood inflow to the muscles, yet completely occlude venous outflow.
- The cuffs are placed on the upper and lower extremities as proximal to the torso as comfortable and inflated to a pre-determined pressure.
- BFRT is perfect for patients who would benefit from strength training, yet cannot lift heavier loads.

Blood flow restriction training (BFRT) is a rehabilitation and performance-enhancement technique to improve strength, endurance and aerobic capacity using low-level loads in short intervals (10 minutes), making it ideal for the chiropractic office. However, as with any modality it requires consideration of the patient's specific needs, awareness of the indications and contraindications, and proper application.

BFRT: The Basics

Specifically, BFRT is exercising while wearing a pneumatic cuff or strap around the proximal limbs to partially occlude arterial blood inflow to the muscles, yet completely occlude venous outflow. Originally developed in Japan by Yato in the 1960s, the restrictive bands have continued to evolve in material (stiff vs. rigid), width and automation. It is synonymous with *Kaatsu*, occlusion training and hypoxic training; and to date, no one style of band has been shown to be the most effective.

Clinical Tip: Stiff bands are similar to blood pressure cuffs, whereas elastic cuffs are a series of

inflatable chambers that enable the cuff to contour to the muscle beneath it as it is exercised. Cuff width ranges from 5 cm to over 12 cm, with wider cuffs enabling the use of lower pressures to obtain the desired arterial restriction. However, wider cuffs may also impede movement of the limb.

The cuffs are placed on the upper and lower extremities as proximal to the torso as comfortable and inflated to a pre-determined pressure. The inflation pressure can be based on the patient's limb girth and fitness level; or as a percentage of the limb occlusion pressure (LOP) – the amount of pressure required to completely stop arterial blood flow. Using 40%-80% of the LOP is a common starting inflation pressure; however, most cuff systems come with recommendations by the manufacturer, as well as apps that guide the initial inflation pressure. Using systolic pressure as the LOP is not advised.

Clinical Tip: The initial inflation pressure is only a guideline until the patient performs a few BFRT sessions to determine the optimal inflation pressure. The inflation pressure needs to be high enough to achieve volitional failure, yet low enough to be comfortable. Obviously, the inflation pressure can change as the patient's fitness level improves. *Even when using LOP, there is no perfect initial inflation pressure; it is based on comfort and performance.*

Clinical Applications

BFRT is perfect for patients who would benefit from strength training, yet cannot lift heavier loads. For example, the deconditioned patient, the patient wishing to prevent atrophy after a musculoskeletal injury (including immobilization or surgery), or the elderly patient with sarcopenia would be a candidate for BFRT.

Considered safe for healthy individuals, the contraindications include patients with hypertension, on anticoagulant drugs, at risk for DVTs/emboli, history of thrombophlebitis, pregnancy, cancer, or chronic kidney disease. *Before starting BFRT, be sure the patient is cleared to exercise.*

The load used for BFRT is also based on the patient's overall fitness level and is set between 20%-40% of the patient's maximal strength level, or 1 repetition maximum (1RM). To estimate the 1RM, the strength of the non-injured limb can be used; or for the deconditioned patient, a load that allows at least 20 repetitions but no more than 40-50 repetitions to be performed in the first set.

For strength and hypertrophy, the guidelines for BFRT are 45-75 total repetitions of each exercise divided into 2-4 sets with a 30-second rest interval between sets. The initial set is 30, followed by sets of 15. *The goal is to attain a sense of fatigue and then move on to the next exercise.* Continue to add exercises following the same parameters for 10 minutes.

Clinical Tip: Exercises that isolate a specific target muscle are indicated for an isolated MSK injury / weakness. For overall conditioning or to maximize efficiency, select whole-body, multi-joint exercises (for example, squats). Another good choice is to cycle back and forth between upper- and lower-body exercises within the workout.

The tempo of each repetition is also based on the level of conditioning of the patient. For deconditioned patients and those with an acute MSK injury, a two-second contraction, two-second

isometric hold and four-second eccentric contraction is appropriate. As the patient approaches the return-to-activity /play phase of care, the tempo can be increased to a one-second contraction, isometric hold and eccentric release.

BFRT training is appropriate for 4-8 weeks, 2-3 times per week. Higher frequency and longer duration are acceptable as long as the patient is monitored for overtraining.

Studies are clear that BFRT outperforms low-load exercise without BFR, yet the exact mechanism is unclear. The proposed mechanisms include that the hypoxic state created by BFR creates a buildup of exercise-induced metabolites, which signal the body to build muscle as it would with heavy-load exercise.

In addition, this temporary hypoxia may be compensated by the recruitment of additional motor units during exercise, increase growth hormone, and stimulate angiogenesis through proliferation of vascular endothelial growth factors. These are the same systemic effects created by high-load resistance training.

Clinical Tip: When possible, wearing bands on all four limbs is recommended, even if the motor weakness is in an isolated limb. This maximizes the systemic metabolites that, in turn, simulate hypertrophy and strength, even in muscles proximal to the bands.

The Case Study

Larry is a 45-year-old male, 6'1", weighing 202.1 lbs. His body fat based on bioelectric impedance testing was 22.4% and lean body mass was 87.7 lbs. He presented to the office with a primary complaint of low back pain aggravated by prolonged sitting and hiking with a 20 lb. rucksack.

There were no radicular symptoms, comorbidities, or significant health history including medications. His goal was to be able to hike over minimally groomed trails with his young adult children on vacation with an expectation of 4-8 miles per day.

He responded well to care and when he was three weeks away from vacation, he mentioned he was concerned that he would be "strong enough" to keep up on the daily hikes. Therefore, BFR was recommended as an adjunct to care.

Larry's strength testing revealed push-up endurance: 16 reps; side plank: 20 seconds right, 15 seconds left; seated curl-up endurance: 14 seconds; low back extensor endurance: 22 seconds; and 30 second sit-to-stand: 29 repetitions.

The limb pressures were set at 275 for the arms and 325 for the legs based on the manufacturer's recommendation using limb girth, resting BP and fitness level. His workout was to volitional failure. (Exact exercises are listed in the Table.)

After three weeks, Larry's weight increased one pound to 203.1 lbs., body fat percent dropped 1.5% to 20.9%, and lean muscle mass increased 2.7 lbs. to 90.4 lbs. His side plank endurance increased to 23 seconds right and 21 seconds left; seated curl-up endurance time increased to 21 seconds; low back extensor endurance increased to 25 seconds; and the 30-second sit-to-stand score was 35.

He hiked on vacation with his day pack for five days without any incidence, and no additional complaints of low back pain have been reported.

BFRT is a valuable tool for patients who need to rebuild muscular strength and endurance, but cannot perform high-load exercise; however, as observed in this case, it can be used for any patient cleared to exercise who needs to build muscle for fitness and well-being. Put BFRT on your list of multimodal interventions.

Exercise	Reps	Rest Interval
Bent-Over Rows (15 Lb. dumbbells)	30 for one set; 15 for two sets	30 seconds
Front Lunges (body weight)	15 for three sets	30 seconds
Dumbbell Curls (10 Lb. weights)	30 for one set; 15 for three sets	60 seconds
Standing ¼ Squats (body weight)	15 for three sets	30 seconds
Eccentric Pushups (body weight)	To failure, max 30; two sets	60 seconds

Resources

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