THE LIFTERS CLINIC

BLOOD FLOW RESTRICTION TRAINING MANUAL

BLOOD FLOW RESTRICTION TRAINING MANUAL

BY: DR. MARIO G. NOVO, DPT, PT

COPYRIGHT 2016 LIFTERSCLINIC.COM

LEGAL DISCLAIMER:

Information provided in this guide is in no way intended to substitute medical guidance or counselling. This information should be consulted with the guidance and care from your physician. As with any training or nutritional program please consult with your physician before starting. If you decide to not obtain physician consent and/or decide to not work with your physician throughout the duration of applying the recommendations within the program, you are agreeing to accept full responsibility for your actions.

Continuing with execution of the program concepts included in this training manual, despite precautions on the part of Dr. Mario Novo, confirms your recognition of risks associated with injury or illness which can occur because of your use of the aforementioned information which you expressly assume such risks and waive, relinquish and release any claim which you may have against Dr. Mario Novo, as a result of any future physical injury or illness incurred in connection with, or as a result of, the use or misuse of the program.

THE LIFTERS CLINIC
BFR TRAINING MANUAL

INTRODUCTION

This EBook is designed to take you the trainer to the next level in evidence based training methods within the application of Blood Flow Restriction (BFR). Following this EBook you will further understand the current scientific evidence behind blood flow occlusion training, the various methods of application, the safety/efficacy and how to realistically apply it in the training environment for increased hypertrophy/strength gains.

AUTHOR

Dr. Mario Novo, DPT, PT is a results driven sports orthopedic physical therapist who specializes in strength and conditioning. Known well by his clients/patients as a mentor and educator, Mario's passion is to unify the highest levels of rehab science with successful mind and body strength coaching. With Mario's research having focused on new advancements in muscle hypertrophy periodization and joint health, his goals are to share his knowledge and improve on the human condition through personalized cutting edge program design. Mario currently resides in middle TN where he plans on integrating his skills and knowledge in resistance exercise and rehab to empower and inspire those individuals ready to make a change in their lives through health and fitness.

THE LIFTERS CLINIC
BFR TRAINING MANUAL

MAIN CHAPTERS

GUIDE TO BFR APPLICATION

CHAPTER 1	The Science of Blood Flow Restriction
CHAPTER 2	BFR Training Methods

CHAPTER 1

THE SCIENCE OF BFR

WHAT IS BLOOD FLOW RESTRICTION (BFR) TRAINING?

Blood Flow Restriction (BFR) training is a form of safe low intensity resistance exercise (LIRE) that when applied has demonstrated enhanced muscle growth, muscle strength, oxygen delivery and utilization (VO2Max).

Currently two methods of BFR training exist, one of which is known as practical blood flow restriction (PBFR), with the second being pneumatic controlled BFR.

Both methods employ wrapping and systematically compressing a working limb, in order to restrict the clearance of blood flow away from a working muscle during rest periods. The restriction and subsequent buildup of metabolic muscle byproducts are what lead to the enhanced activation of specific muscle growth pathways. These pathways traditionally have only been seen to activate and achieve muscle adaptation with repeated bouts of High Intensity training (HIT).

HIT style training via the American Sports College of Medicine (ACSM) has been defined as intensity levels of 65% up to 85% of a single repetition maximum (1RM). BFR training can achieve similar if not better results for inducing muscle growth when compared to what has been traditionally observed with higher intensity training (HIT). Historically muscle adaptations such as Muscle Hypertrophy (muscle cell growth), Muscle Strength (increased motor unit recruitment of higher threshold motor units), and VO2Max (Functional measure of oxygen deliver and oxygen uptake), have been seen with high intensity bouts of exercises repeated over a duration of time. What BFR training has shown, is that similar if not enhanced effects of muscle hypertrophy, muscle strength, and

VO2Max, can be achieved with as little 20-35% of 1 RM and 40% VO2Max settings respectively.

BFR training is well established in the research literature to be a safe for the general population with similar responses seen in blood pressure (BP), blood coagulation, delayed onset of muscle soreness (DOMS) and oxidative stress that has been observed during regular resistance training.

Certain populations should consult with a physician before application as contraindications include:

- History of deep-vein thrombosis
- pregnancy
- varicose veins
- high blood pressure
- Cardiac disease

When appropriate, BFR is an effective exercise modality that has demonstrated never before seen combined increases to performance adaptations and may yield more undiscovered positive results.

HOW DOES BFR WORK?

Blood flow restriction training research has been around for the last decade and has looked at everything from using BFR in individuals that are immobilized to reduce atrophy (Kubota et al. 2008) all to way to NASA investigating how to use BFR in order to protect skeletal muscle integrity while in the confines of zero G (Hackney et al. 2012).

BFR has some known mechanism and they are as follows.

Lactic acid – metabolite mechanism: Simply stated, applying a compression band or tourniquet around a limb will stave off muscle atrophy by means of metabolic accumulated chemical stress. BFR training works by enhancing the production of muscle metabolic byproduct or waste such as lactic acid, and hydrogen ions (H+). These metabolites are chemical irritants to the muscle which

stress muscle tissue and surround tissues to respond by adaptation known as super compensation. Protein synthesis is one adaptation that yields the formation of newly formed muscle proteins which can increase the storage of more muscle glycogen.

These byproducts occur in normal physiology during bouts of high intensity training (HIT) and were observed to not occur in low intensity training methods until now.

Low oxygen mechanism: During bouts of high intensity training (HIT), working muscles will convert stored muscle sugar know as glycogen into a different configuration which will yield the byproduct lactic acid. During bouts of HIT, lactic acid will form and lead to a local decrease in tissue pH which is what leads to the characteristic burning sensation. The accumulation of these byproducts limits the working muscles ability to use oxygen and thereby creates fatigue. The induced fatigue and low oxygen environment will force higher threshold motor units in the muscle to become active until the muscle must rest, to permit clearance of the byproduct waste.

By having longer exposure times to these chemical irritants and lower oxygen levels there is an increased recruitment of specialized muscle fibers that are best suited for power based activities. These specialized muscle fiber types known as the type 2 or type IIx are called into action for activities requiring explosive power and strength. For completeness our muscles are also made up of another fiber type, type 1. The type 1 muscle fibers are more associated with tasks that are lower in force production but have an advantage to continue prolonged contraction as compared to the type 2 which are again suited for short explosive contractions.

The current research demonstrates that when a muscle is exposed to HIT (70% to 85% 1 RM), the normal occurrence of reduced blood flow out and lactic acid production accumulation leads to the recruitment of these type 2 muscles which lead to increased muscle growth and muscle strength but training at higher loads requires recovery. Training is micro trauma to our muscle tissue which

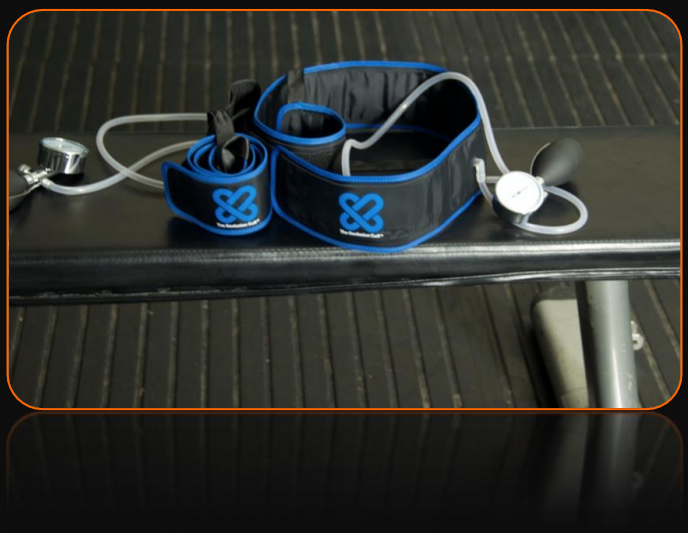
THE LIFTERS CLINIC
BFR TRAINING MANUAL

The bridge between low intensity training and high intensity training results is one of many reasons to implement BFR training into your current program.

Cell swelling mechanism: As a direct result of venous blood flow occlusion, there continues to be an increase in fluid into the working muscle. This leads to a characteristic swelling or pump. While muscles are contracting they push fluid away from themselves much like a sponge being squeezed. As the fluid pressing decreasing in the working muscle, upon relaxation of the contraction, fluid rushes inward. As there is an accumulation of fluid and metabolite build up which attracts more fluid, the muscle cells begin to engorge. As they increase in size there is a stress placed on the cellular walls. This stress leads to a protective response again leading to adapt and grow.

	HIGH INTENSITY (HIT)	(BFR) +LOW INTENSITY	LOW INTENSITY
Training range	70 – 85% %1 RM	20 – 35% 1 RM	20 – 35% 1 RM
Strength	Recruitment of fiber II	Recruitment of fiber II	Recruitment of fiber I
Muscle Damage requiring recovery (Creatine Kinase)	Present	Not significant	Not significant
Lactate production (mmol)	Similar	Similar	Not present
Neuromuscular (Type II recruitment)	Type II activation near maximal effort	Type II activation at sub max effort	No additional recruitment
Growth Hormone	100 fold increase	1.7 X greater than HIT	No change from baseline
IGF-1	Increase	Significant Increase	No change from baseline
MTOR1C	Increase	Significant Increase	No change from baseline
Myostatin	Down regulation	Down regulation	No change from baseline
Time to adaptation	12 weeks	2 weeks	

HOW DO I PROGRAM BFR TRAINING?



BFR training, has demonstrated to have no adverse effects to muscle tissue breakdown as seen with bio markers of creatine kinase (CK) and other inflammatory markers. Therefore, BFR training can be programmed as a complimentary add on to your current program.

BFR training can be safely added to the end of a workout session to promote further muscle protein synthesis, with no additional hit to recovery, and may even play a role with recovery itself.

BFR training can also be programmed on your off days, as a complimentary or accessory based muscle building session.

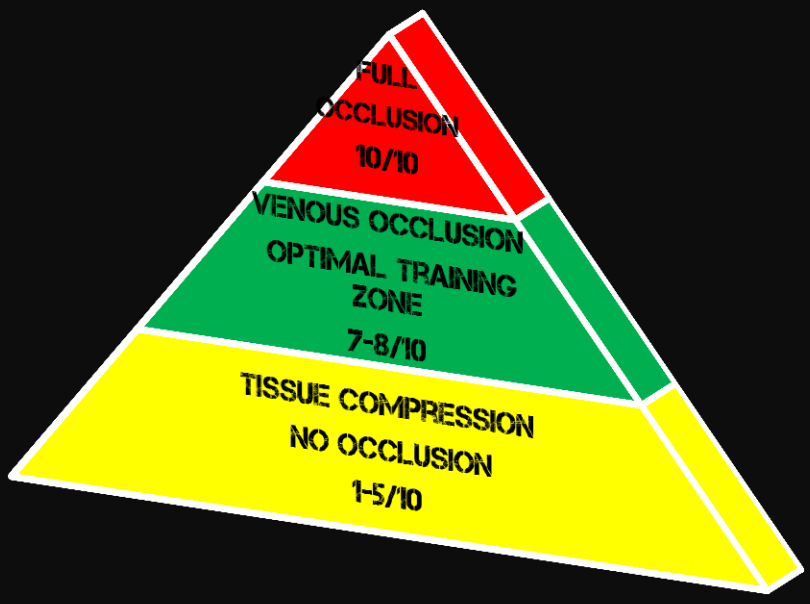
HOW DO I APPLY BFR TRAINING?

Below will be a detailed approach towards practical BFR (PBFR) for both upper and lower extremities.

COMPRESSION SCALE

Establish the compression scale with your clients before application. The compression scale uses a 10 point numerical system to establish a safe training zone.

1) 1-5/10: Tissue compression is present but no venous occlusion is seen via prior Doppler exams at these levels.
2) 7-8/10: Optimal training zone. At this level of compression Arterial blood flow is still occurring (validated by distal pulse check) and Venous blood flow is near complete to complete occlusion. Compression may slightly rise throughout training but following the additional steps will ensure safety at this level of compression.
3) 10/10: Complete occlusion of both Arterial and Venous blood flow. This training zone is dangerous and must be avoided. Signs and symptoms are: Loss of distal radial pulse, distal numbness, severe pain, and a blanching of skin color. This level must be avoided.



PNEUMATIC COMPRESSION SCALE

Establish the pneumatic compression scale with your clients before application. The compression scale combines the 10 point numerical system along with the validated ranges of compression. The Pneumatic compression varies between the upper extremity and the lower extremity. Follow the validated ranges to establish a safe training zone.

- UPPER EXTREMITY PRESSURE: 100-220MMHG
- LOWER EXTREMITY PRESSURE: 150-250MMHG

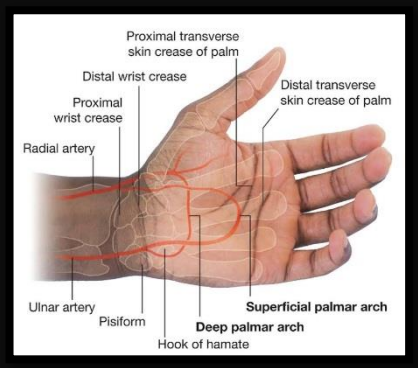
TRAINING PROTOCOL

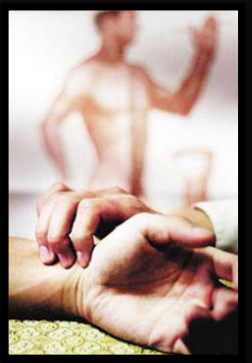
The establish protocol looks at specific intensity, sets, reps, tempo, and concentric lifting.

PROTOCOL		REPS	TEMPO	REST
COMPRESSION LEVEL	7-8/10			
SET INTENSITY	20-35% 1 RM			
SET 1		30	1100	30
SET 2		15	1100	30
SET 3		15	1100	30
SET 4		15	1100	30

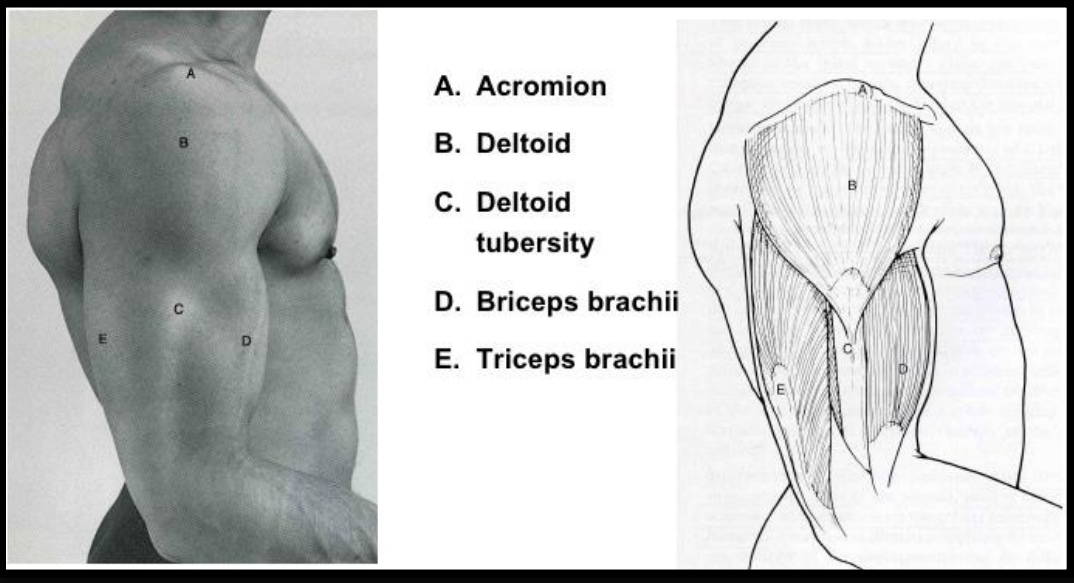
UPPER EXTREMITY APPLICATION

1) Find and establish the distal radial pulse. This step is important as it will allow you to accurately gauge if you have applied to much external compression and have occluded arterial blood flow in. Working a completely occluded muscle will lead to decreased positive outcomes and thus should be monitored to ensure proper application.

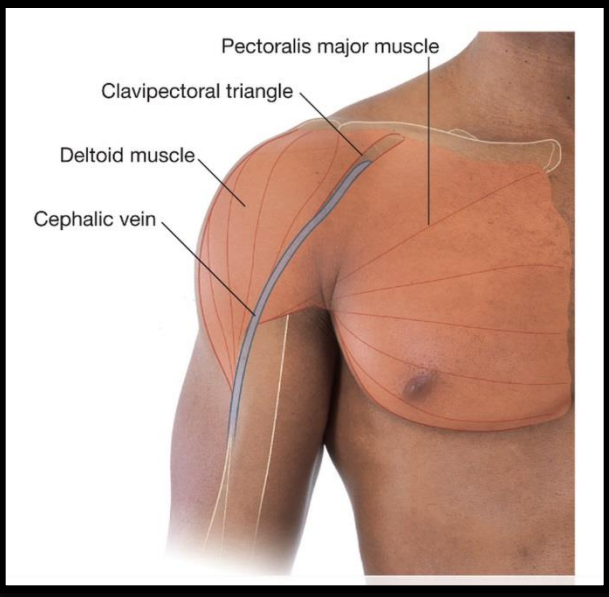




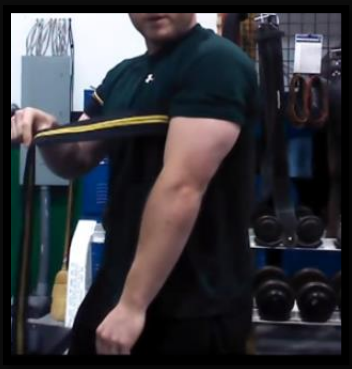
2) Establish the point to wrap just under the deltoid tuberosity, which is an anatomical insertional landmark.

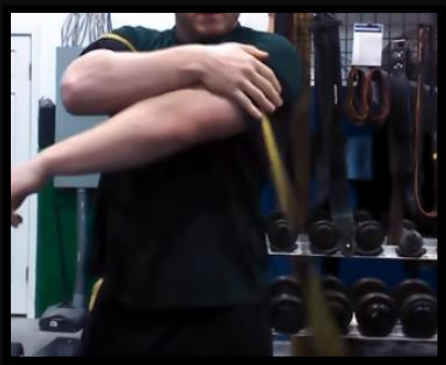


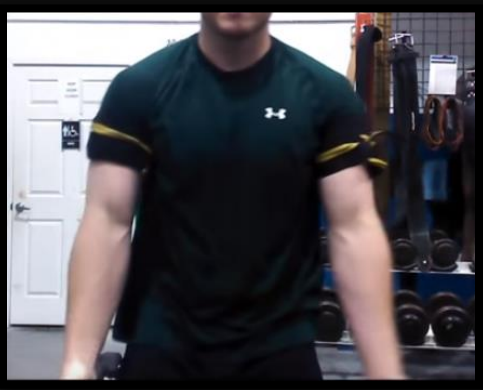
The importance of locating the band location is related to the cephalic vein being one of the largest veins that exit the upper extremity.



3) Apply knee wrap to upper extremity with an assistant for the best fit or use a plastic self-locking system.
    a. Knee wrap: Apply each wrap with equal pressure and ensure no wrinkles to start with. Take the wrap to its completion.
    b. Distal Pulse: Check for the distal radial pulse. If the pulse is not present, begin to unwind the wrap until the pulse is present.
    c. Compression scale: Ask the athlete for their subjective level of compression and ensure you are within 7-8/10 training zone.







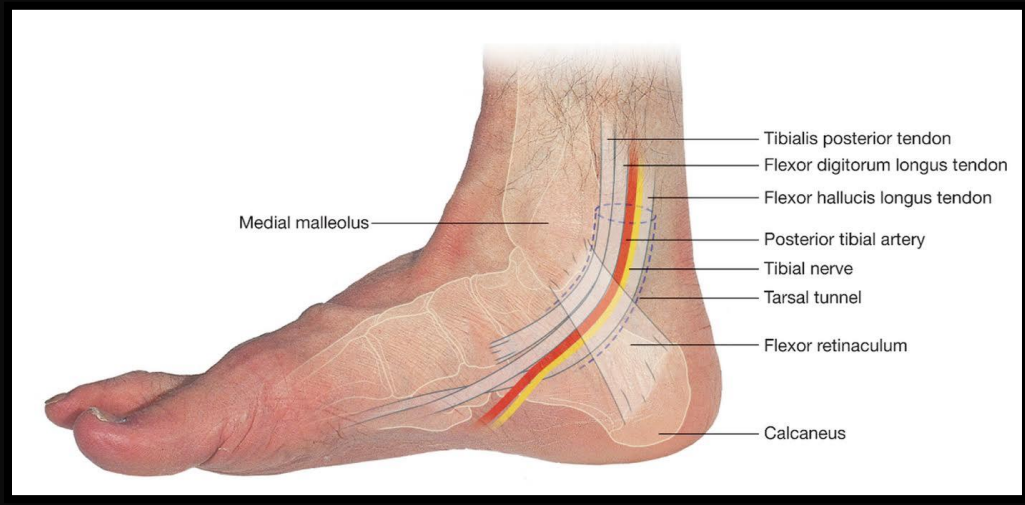
PNEUMATIC CUFF APPLICATION

Application of a pneumatic device such as The Occlusion Cuff® will require purchase of the system.

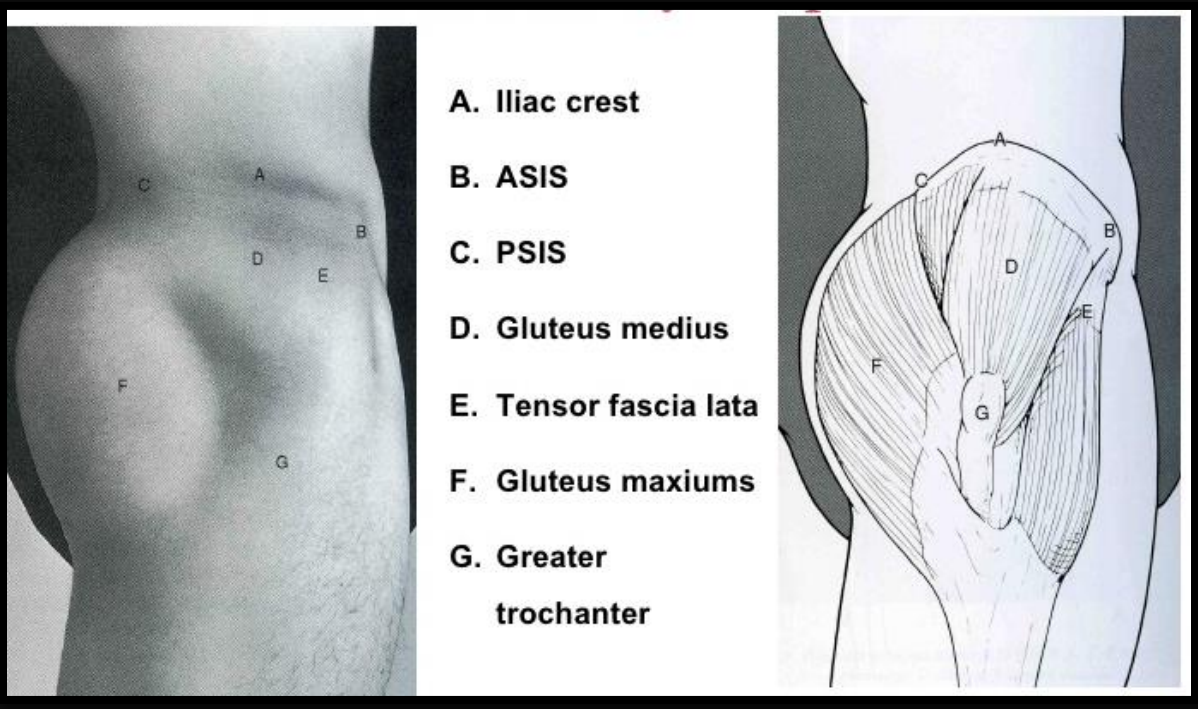
1) Before application ensure that the cuff is fully deflated by turning the valve anti-clockwise to allow the release of any air within the bladder.
    a. Open the cuff and place it logo side down. Orient the cuff by locating the end furthest away from the tube connection. This end will wrap around the limb as high as possible. The cuff should start with medium tightness and be wrapped neatly.
    b. Close the valve by rotating clockwise. Begin pumping until you reach the starting pressure of 100 mmHg.
    c. Distal Pulse: As you inflate the cuff within the established range of 100-220mmHg, check for the distal radial pulse. If the pulse is not present, turn the valve counter clockwise until the pulse is present.
    d. Compression scale: Use the subjective level of compression to ensure you are within 7-8/10 training zone.
    e. You may require time to adapt to higher compression levels but always work within the established target range.

LOWER EXTREMITY APPLICATION

1) Find and establish the distal Posterior Tibial pulse. This site will act as a simple way to establish continued arterial flow into the working muscle.

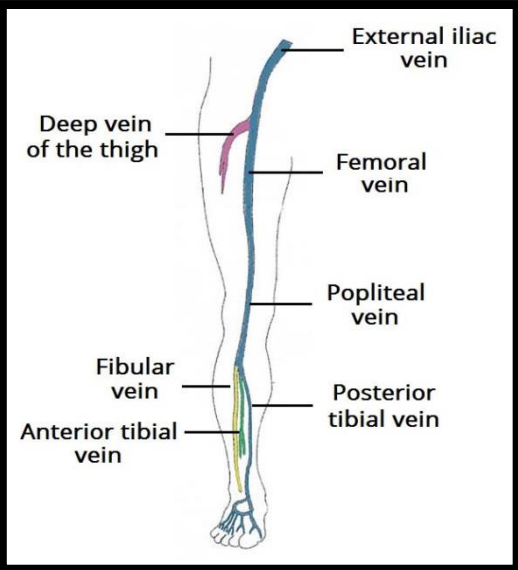


2) Establish the location of the wrap by finding the greater trochanter, which is a bony protuberance of the lateral aspect of the femur. Much like the deltoid tuberosity this site will allow us to reproduce the application correctly each time.



Application of this site is important for occluding the deep vein and femoral vein of the lower extremity. These are the main veins that clear the metabolic byproduct thus, occlusion would enhance distal as well proximal tissue adaptation.

3) Apply knee wrap to lower extremity can be performed independently.
    a. Knee wrap: Apply each wrap with equal pressure and ensure no wrinkles to start with. Take the wrap to its complete length.
    b. Distal Pulse: check for the distal Posterior Tibial pulse. If the pulse is not present, begin to unwind the wrap until the pulse is present.
    c. Compression scale: Ask the athlete for their subjective level of compression and ensure you are within 7-8/10 training zone.



PNEUMATIC CUFF APPLICATION

Application of a pneumatic device such as The Occlusion Cuff® will require purchase of the system.

1) Before application ensure that the cuff is fully deflated by turning the valve anti-clockwise to allow the release of any air within the bladder.
    a. Open the cuff and place it logo side down. Orient the cuff by locating the end furthest away from the tube connection. This end will wrap around the limb as high as possible. The cuff should start with medium tightness and be wrapped neatly.
    b. Close the valve by rotating clockwise. Begin pumping until you reach the starting pressure of 100 mmHg.
    c. Distal Pulse: As you inflate the cuff within the established range of 150-250mmHg, check for the distal radial pulse. If the pulse is not present, turn the valve counter clockwise until the pulse is present.
    d. Compression scale: Use the subjective level of compression to ensure you are within 7-8/10 training zone.
    e. You may require time to adapt to higher compression levels but always work within the established target range.

RESOURCES

Pneumatic BFR Training personal unit purchase

The Occlusion Cuff®

www.occlusioncuf.com

Medical provider certification and FDA compliant BFR pneumatic unit

Owens Recovery Science

http://www.owensrecoveryscience.com/

REFERENCES

Kacin A, & Strazar K (2011). Frequent low-load ischemic resistance exercise to failure enhances muscle oxygen delivery and endurance capacity. Scand J Med Sci Sports, 21, e231-241.

Wilson JM, Lowery RP, Joy JM, Loenneke JP, & Naimo MA (2013). Practical Blood Flow Restriction Training Increases Acute Determinants of Hypertrophy Without Increasing Indices of Muscle Damage. J Strength Cond Res, epub ahead of print.

Loenneke JP, Abe T, Wilson JM, Ugrinowitsch C, & Bemben MG (2012) Blood flow restriction: how does it work? Front Physiol, 3, 392.

Loenneke JP, Wilson JM, Marin PJ, Zourdos MC, & Bemben MG (2012). Low intensity blood flow restriction training: a meta-analysis. Eur J Appl Physiol, 112(5), 1849-1859.

Loenneke JP, Fahs CA, Wilson JM, & Bemben MG (2011). Blood flow restriction: the metabolite/volume threshold theory. Med Hypotheses, 77(5), 748-752.

Loenneke JP, Fahs CA, Rossow LM, Abe T, & Bemben MG (2011). The anabolic benefits of venous blood flow restriction training may be induced by muscle cell swelling. Med Hypotheses, 78(1) , 151-154.

Loenneke JP, Wilson GJ, & Wilson JM (2010) A mechanistic approach to blood flow occlusion. Int J Sports Med, 31(1) , 1-4.

Schoenfeld, BJ (2013). Potential mechanisms for a role of metabolic stress in hypertrophic adaptations to resistance training. Sports Med, 43(3), 179-194.

Loenneke JP, Abe T, Wilson JM, Thiebaud RS, Fahs CA, Rossow LM, & Bemben MG (2012) Blood flow restriction: an evidence-based progressive model. Acta Physiol Hung, 99(3) , 235-250.

Thiebaud RS, Yasuda T, Loenneke JP, Abe T (2013). Effects of low-intensity concentric and eccentric exercise combined with blood flow restriction on indices of exercise-induced muscle damage. Interven Med Appl Sci, 5, 53-59.

Lowery RP, Joy JM, Loenneke JP, Oliveira de Souza E, Weiner S, McCleary S, & Wilson JM (2013). Practical blood flow restriction training increases muscle hypertrophy during a periodized resistance training program. National Strength and Conditioning Conference, J Strength Cond Res supplement.