

Wilk- Blood Flow Restriction (BFR):
Science & Clinical Application in 2017



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Blood Flow Restriction (BFR)
Introduction – Goals of Presentation

- Describe Blood Flow Restriction (BFR) Training
- History
- Review the literature
- Discuss clinical application
- Provide examples of clinical use




What is Blood Flow Restriction (BFR) Training

- Use of proximal limb occlusion during exercise
 - » Low load/High Volume exercise
- Arterial blood is restricted to active muscle
- Venous blood return is restricted from muscle



BFR

What is Blood Flow Restriction (BFR) Training

- ✓ Causes venous blood to pool distal to the occlusion
 - » Creates Hypoxic environment
 - » Metabolites accumulate
- ✓ Utilizes 20-30% 1RM and provides similar gains in muscle hypertrophy & strength
 - » Compared with standard ACSM guidelines
 - 70-85% 1RM

Wilk- Blood Flow Restriction (BFR): Science & Clinical Application in 2017

Blood Flow Restriction (BFR) Training *Evidence*

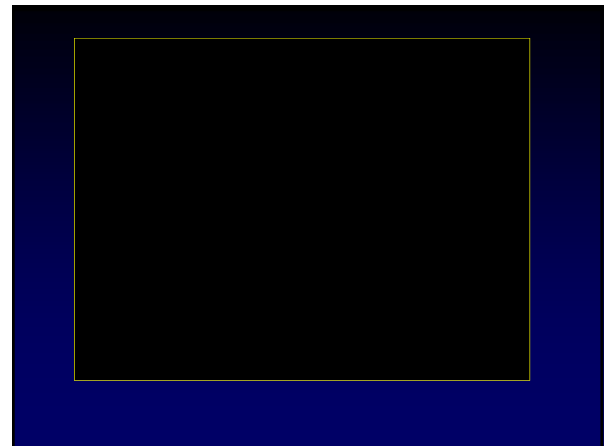
- Documented Positive results:
 - ✓ Combating muscle disuse atrophy
 - ✓ Increasing muscle hypertrophy
 - ✓ Improving aerobic capacity
 - ✓ Increasing strength
 - ✓ *Weightlifters' love "the pump"*





EVIDENCE

Journal of Science and Medicine in Sport
Blood flow restricted exercise for athletes: A review of available evidence
Brendan R. Scott¹, Jeremy P. Loenneke¹, Katie M. Slattery^{1,2}, Ben J. Dascombe¹



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Review
Blood flow restricted exercise for athletes: A review of available evidence

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ARTICLE INFO ABSTRACT

Objective: This study aimed to collate current evidence regarding the efficacy of various blood flow restriction (BFR) strategies for well-trained athletes, and to provide insight regarding how such strategies can be used for their optimization.

Results: Twelve papers were identified from 11 separate investigations that had assessed acute and adaptive responses to BFR in athletic cohorts. Of these, 7 papers observed enhanced hypertrophic and/or strength responses and 2 reported alterations in the acute responses to low-load resistance exercise when combined with BFR. One paper had examined the adaptive responses to moderate-load resistance training with BFR. 1 noted improved training responses to low-work rate BFR cardiovascular exercise, and 1 reported on a case of injury following BFR exercise in an athlete.

Conclusions: Current evidence suggests that low-load resistance training with BFR can enhance muscle hypertrophy and strength in well-trained athletes, who would not normally benefit from using light loads. For healthy athletes, low-load BFR resistance training performed in conjunction with normal high-load training may provide an additional stimulus for muscular development. As low-load BFR resistance exercise does not appear to cause measurable muscle damage, supplementing normal high-load training using this novel strategy may elicit beneficial muscular responses in healthy athletes.

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What is Blood Flow Restriction (BFR) Training-How Does it Work?

- Actual mechanism remains unclear
 - » Localized hypoxic stimulus may play important role in BFR training with low load resistance
 - » Hypoxic stimulus may cause greater accumulation of metabolites that increase muscle cell swelling, intramuscular anabolic /anti-catabolic signaling, and muscle fiber recruitment (Type-II)
 - All thought to be beneficial for muscular adaptation
 - » Hypoxic environment may increase the activation and proliferation of myogenic stem cells leading to enhancing hypertrophic response


Scott et al: Sports Med '15

Blood Flow Restriction (BFR) *History*

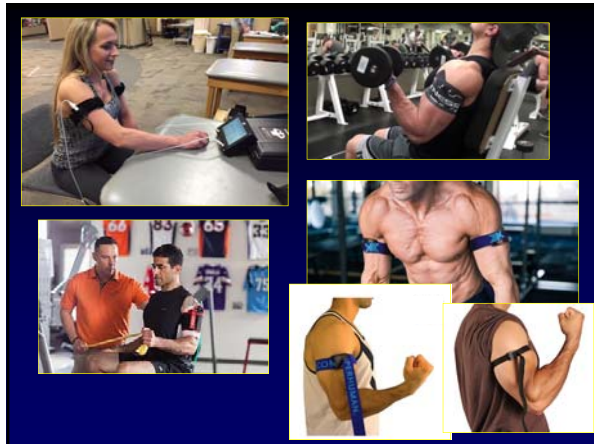
- Yoshiaki Sato began occlusion training
 - » BFR adapted from this
- 1966: While at Buddhist Memorial High School
 - » Noted similarities in calf sensation after kneeling and after working out
- Theorized swelling and discomfort may be due to LE ischemia

Blood Flow Restriction (BFR) *History*

- BFR is now used widespread across United States and Japan for various ages, genders, clinical populations, and athletic populations



Wilk- Blood Flow Restriction (BFR): Science & Clinical Application in 2017



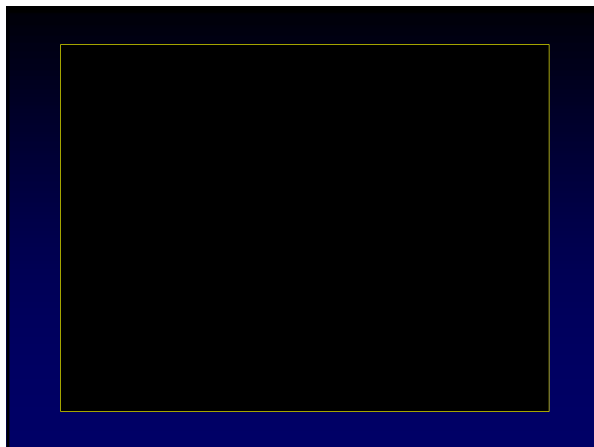
Organizations Using Blood Flow Restriction

- Anaheim Angels
- Arizona Cardinals
- Baltimore Ravens
- Buffalo Bills
- Calgary Flames
- Carolina Panthers
- Chicago Bears
- Cincinnati Reds
- Cleveland Browns
- Cleveland Indians
- Denver Broncos
- Detroit Lions
- Detroit Redwings
- Houston Astros
- Houston Rockets
- Houston Texans
- Jacksonville Jaguars
- Los Angeles Dodgers
- Los Angeles Rams
- Memphis Grizzlies
- Miami Dolphins
- New England Patriots
- New Orleans Saints
- New York Giants
- New York Yankees
- Oklahoma City Thunder
- Pittsburgh Steelers
- Portland Trail Blazers
- San Antonio Spurs
- San Diego Chargers
- San Diego Padres
- St. Louis Cardinals
- Tampa Bay Buccaneers
- Tennessee Titans
- Toronto Blue Jays
- Utah Jazz
- Vancouver Canucks
- Vancouver Whitecaps
- University of Florida
- University of Nebraska
- University of Missouri
- University of Memphis
- University of Southern California
- Ohio State University
- University of Michigan
- University of California Los Angeles
- University of Alabama
- Tulane University
- Loyola Marymount University
- University of Miami
- Arkansas State University
- Florida State University
- University of Jacksonville
- Eastern Kentucky University
- Western Kentucky University
- University of Louisville
- University of Arkansas
- University of Georgia
- Marshall University
- Rutgers University
- North Carolina State University
- University of North Carolina
- Mississippi State University
- University of Mississippi
- University of Texas

2015 Systematic Review and Meta-Analysis



- Cuff size considerations:
 - » Wider cuff results in more occlusion
 - » Narrow cuffs results in increased pressure to reach same level of occlusion
 - » Increased limb size results in increased pressure to occlude
- Pressures:
 - » Leonneke compared 40% to 90% and saw no difference
 - » Make sure they can get prescribed sets and reps

Slysz: J Sci Med Sport '15



2015 Systematic Review and Meta-Analysis

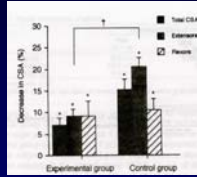
- Cuff pressure recommendations:
 - » 50-80% of resting systolic blood pressure
 - » Pressure >150mmHg is enough to create positive changes

Slysz et al, 2015

Takarada et al: J Appl Phys 2000

- Application during bed rest s/p ACLR
- Examined the effects on atrophy
 - » Control:
 - CSA ↓ Knee Ext: $20.7 \pm 2.2\%$
 - CSA ↓ Hamstrings $11.3 \pm 2.6\%$
 - » BFR
 - CSA ↓ Knee Ext: $9.4 \pm 1.6\%$
 - CSA ↓ Hamstrings $9.2 \pm 2.6\%$



- *Taylor et al: Exp Physiology 2016*
 - » 28 healthy cyclists (~75 miles/week)
 - » BFR with Sprint Interval Training (cycle) can improve VO_2 Max in trained cyclists.
 - Although no improvement in performance was observed
- *Abe et al: J Appl Physiology 2005*
 - » 18 healthy men with active lifestyles
 - No regular resistance training
 - » Walking w/BFR showed increased:
 - ↑ Serum GH
 - ↑ Muscle bone CSA
 - ↑ Muscle CSA Quad/Hamstrings
 - ↑ 1RM Leg Press/Curl

- *Yamanaka et al: JSCR 2012*
 - » 32 NCAA D1 Athletes
 - » + changes in both groups
 - BFR group had sig. greater increase in 1RM Bench press & Squat; along with chest girth compared to control
- *Luebbers et al: JSCR 2014*
 - » 72 NCAA D2 Football Players
 - » BFR Training effective in increasing 1RM squat when added to High Intensity Off-Season S&C Program utilizing elastic knee wraps

Blood Flow Restriction
Safety

- Pay attention to:
 - » Subjective comments
 - » Physical condition
 - Exercising
 - Size
 - » History/Family History
 - » Lifestyle habits
 - Meds, drugs, supplements



Remove/Discontinue if Red Flags are noted

Blood Flow Restriction
Clinical Application

- Improvement of size and strength typically requires heavy loading
 - » (>75% 1 RM)
 - » Comes with high mechanical strain
- Not all populations can tolerate high intensity loads
 - » Post-operative
 - » Injured
 - » Adolescents




Blood Flow Restriction
Clinical Application

- High intensity loading should not be year round
 - » Can use BFR during maintenance phase in season
 - » Can be used in the off-season to make gains while still providing “relative unloading”



Blood Flow Restriction
Clinical Application

- UE Band:
 - » Just distal to the deltoid tubercle
- LE Band:
 - » Anterior :
 - Just distal to the inguinal fold
 - » Posterior:
 - Just distal to the gluteal fold
- 50-80% occlusion
 - ✓ Assess distal pulses and capillary refill




UE: 200-275
LE: 250-325

Blood Flow Restriction
Clinical Application – UE Program

- Warmup
- PROM & stretch
- Manually Resisted ER/IR
- BFR Application:
 - » Tubing IR/ER bilaterally (3x25)
 - » Full Can and Lateral Raises bilaterally (3x25)
 - » Biceps Curls (3x25)
 - » BFR Removed
- Side-lying ER dumbbell (2x10)

Blood Flow Restriction
Clinical Application- UE Program

- Scapular Neuromuscular Drills
- Prone Exercises:
 - » Rows (2x10)
 - » T's/Y's/I's/W's (2x10 ea)
- Seated Tubing Exercises:
 - » Low Row/High Row (2x10)
 - » Shoulder Extension (2x10)
 - » Bilaterally 90/90 ER (2x10)
 - » Modified Robbery (2x10)



Blood Flow Restriction
Clinical Application- UE Program

- Triceps Push down (2x10)
- Ball on Wall Rhythmic Stabilization
- Wrist Isotonics:
 - » Flexion/Extension (2x10)
 - » Pronation/Supination (2x10)
- PROM
- Laser
- Ice

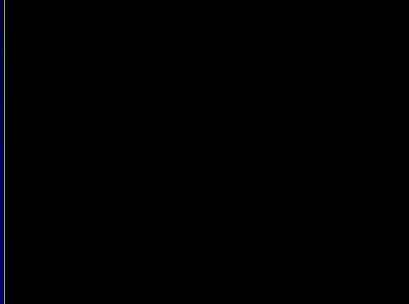
Blood Flow Restriction
Clinical Application – LE program

- Heat
- PROM/Stretch
- Bike 7-10 minutes
- Bilateral Leg Press (2x10)
- Multi-Hip Machine:
 - » Abd/Add/Ext: (2x10 ea)

Blood Flow Restriction
Clinical Application – LE Program

- BFR Application:
 - » Unilateral Leg Press (3x25)
 - » Hamstring Curls (3x25)
 - » Eccentric Front Step downs (3x25)
 - » BFR Removal
- Wall Squats (2x10:10")
- Split Squats

BFR with MR Squat Machine



Blood Flow Restriction *Clinical Application – LE Programs*

- Calf Raises (2x10)
- Lateral Step-ups (2x10)
- Seated Hip ER/IR with CLX Band (2x10)
- Manually Resisted Clams (2x10)
- RDLs (2x10)

Blood Flow Restriction *Clinical Application – LE Programs*

- Lateral Slides with Theraband
- Unilateral Stance on Foam w/ball toss (2x10)
- Unilateral Stance on Foam star drill
- Unilateral Stance on Tilt Board w/perturbation
- Stretch
- Laser
- Ice

Blood Flow Restriction *Conclusions*

- Relatively new treatment in the USA
- Utilized by numerous pro teams & colleges
- Goal of treatment is to accelerate & promote muscle hypertrophy
- Able to accomplish this with lighter weights and higher reps
- May be easier for the joint



More Research Needs to be Done

