

Blood Flow Restriction Training: Bridging the Gap in Post-Operative Knee Management

Mercy Health Sports Symposium

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Rehab Conundrum

- Injury/surgery → Neurologic inhibition, Atrophy, weakness
- Inhibition of “fast twitch” muscle fibers
- Imbalance of protein synthesis & protein degradation
- Protect repair tissues from heavy loads
- Weight-bearing status
- Pain



Current Rehab Management

- NMES
- Low load/High reps
- Time

Are these Effective?



How Can We Bridge The Gap?



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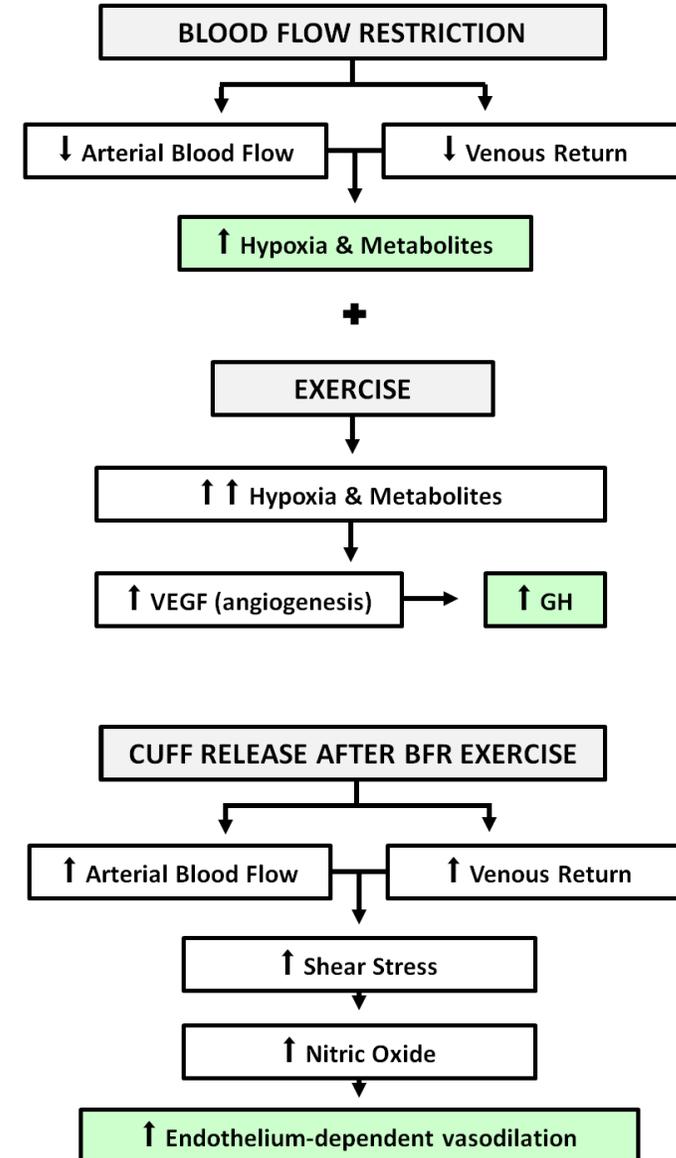
What is BFR?

- BFR is a training method partially restricting arterial inflow and fully restricting venous outflow in working musculature during exercise (Scott, 2015)
- Originally out of Japan in the 1960's (KAATSU)
- Johnny Owens and Delfi Unit



How does BFR work?

- Decrease in arterial blood flow → hypoxia
- Hypoxia → increase in motor unit recruitment
- Increased motor unit recruitment → Use of larger motor units and “fast twitch fibers”
- Hypoxia → increase in GH & VEGF release
- GH & VEGF release → improvements in protein synthesis
- Hypoxia → Increased stress and exercise induced hypoalgesia



BFR's Effect on the Rehab Conundrum

- Atrophy ✓
- Weakness ✓
- Inhibition of “fast twitch” muscle fibers ✓
- Imbalance of protein synthesis & protein degradation ✓
- Protect repair tissues from heavy loads ✓
- Weight-bearing status ✓
- Pain ✓



Indications

- Non-Surgical cases
 - Healing tissues
 - Low tolerance to high loads
 - Chronic pain
 - Muscle atrophy/ weakness
- Post-surgical cases
 - Healing tissue
 - WB status
 - Low tolerance to high loads
 - Muscle atrophy/weakness
 - Post-operative pain (ACL graft site)



Contraindications

- Absolute Contraindications:
 - Severe cardiovascular conditions
 - Peripheral vascular disease
 - Severe metabolic disorders
 - Recent or current infections in the affected limb
 - Sickle Cell Anemia
- Relative Contraindications:
 - Mild to moderate hypertension
 - History of deep vein thrombosis
 - Pregnancy

Precautions

- Ensure proper cuff application and pressure settings to avoid excessive restriction
- Monitor patient response during and after sessions
- Start with lower pressures and gradually increase based on tolerance and response



Summary of Application

- 40–80% LOP is safe and effective at eliciting response depending on extremity
 - 40–50% for upper extremity
 - 60–80% for lower extremity
- 15–20% of 1 RM, recheck 1 RM consistently or RPE
- 45–75 reps per exercise
- 2–4 exercises per session, however will vary based on patients tolerance
- Rest 30 sec between sets, 1 min between exercises
- Frequency: 2–3x a week



How Can We Apply BFR?



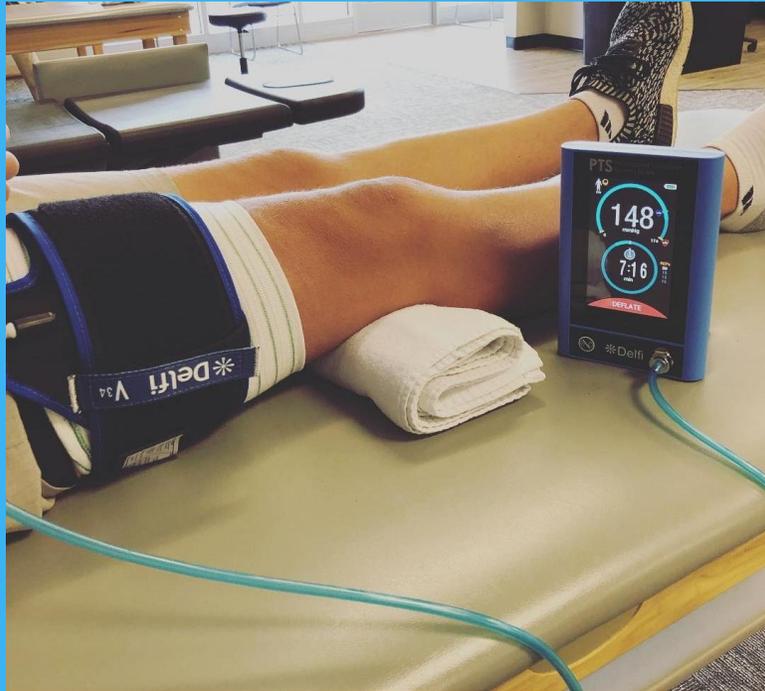
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Case Study

- Patient is a 19-year-old female collegiate soccer player
- 1 week s/p ACL and meniscus repair with BTB auto graft
- Surgeon protocol:
 - ROM limited to 90 of flexion
 - NWB for 4 weeks
 - PWB from week 4-6



Phase 1 (0-6 weeks)



- Purpose: Increase motor unit recruitment, pain modulation, minimize atrophy
- Initiated at 2 weeks Post-Op
- Week 2 BFR:
 - Quad sets
 - Alternating straight leg ankle pumps and knee bent ankle pumps (4x15 each)
- Week 3-4 BFR:
 - Quad sets
 - Alternating straight leg ankle pumps and knee bent ankle pumps (4x15 each)
 - Prone hip extension
 - LAQ 90-30
- Week 5-6
 - SAQ
 - Physioball straight leg bridge
 - LAQ 90-30



Phase 2 (6–16 weeks)



- Purpose: increase muscle strength and hypertrophy while adding resistance to movements
- Introduction of closed chain exercises
- Increased load and occlusion
- BFR exercises:
 - Wall sits
 - Mini squats
 - Alternating Box squats/Bridging
 - Step up/Step down
 - Split squats
 - RFE SS
 - Leg press
 - OKC leg extensions
- NOT a replacement for HEAVY resistance training (60–80% 1 RM)
- When you can load, load
 - Heavy resistance training is still key

Phase 3-4 (4+ months)



- Purpose: single leg strengthening, management of training volume, pain modulation (anterior knee pain)
- Done at start of session for pain modulation (isometrics and SL leg extensions)
- BFR exercises:
 - SL Wall sit with isometric hold
 - SL leg extension
 - SL anterior step down with back on wall
 - RFE split squat
 - Front heel elevated split squat
 - SL seated calf raise
- Was used to mitigate high volumes at close to return

Thank you!
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