# The Effects of Blood Flow Restriction Therapy on Physical Performance in Adults as Compared to Standard Physical Exercise and Control Groups: Systematic Review


OMAR AMER SPT

BERTA CARMO SPT

JONATHAN MAYES SPT

DANNYLYN MANABAT SPT

PETER LEININGER PT, PHD, BOARD-CERTIFIED CLINICAL SPECIALIST IN ORTHOPEDIC PHYSICAL THERAPY

# Overview

Introduction

# Introduction

# What is blood flow restriction (BFR)?[1-3]

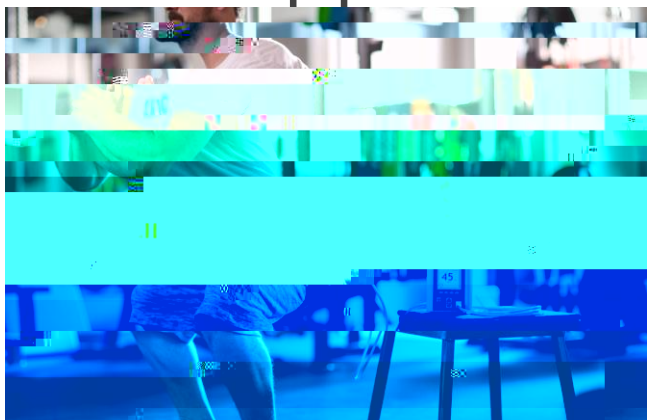
- Pressure applied via the tourniquet device is sufficient to limit arterial inflow while occluding venous outflow
- The goal is to enable patients to achieve greater strength gains while lifting lighter loads
- Muscle hypertrophy has been demonstrated to occur within two weeks VS the typical 9-12 weeks

# How does BFR work?[1,2,4]

BFR creates increased protein synthesis due to the hormonal responses the body has to BFR training

Typical protocol is for - UE occlusion: 50% & LE occlusion: 80%* of arterial blood flow

Electrical stimulation and/or biofeedback can be applied simultaneously



*Owens Recovery System with *Delfi* BRF unit

# Contraindications to BFR[2]

- Venous thromboembolism
- Open fracture
- Severe HTN
- Extremity infection
- Cancer
- Sickle cell anemia
- Previous revascularization of the extremity
- Acidosis
- Severe crush injuries
- Open soft tissue injuries
- Vascular grafting
- Lymphectomies
- Extremities with dialysis access
- Tumor distal to tourniquet
- Medications that increase clotting risk
- Increased ICP

# Potential Side Effects/Risk of use of BFR[2]

Potential Side Effects

- Muscle soreness
- Tenderness
- Bruising at site of cuff
- Numbness
- Cold feeling
- Fainting/dizziness

Risks

- Bruising
- Nerve injury
- Skin injury
- Pain
- Arterial injury

# Search Terms

(Blood Flow Restriction OR BFR OR Blood Flow Occlusion OR Blood Flow Restriction Therapy OR BFRT) AND (older adults OR elderly OR adults) AND (walking OR ambulating OR ambulation OR gait)

# Databases

ProQuest

# Inclusion & Exclusion Criteria

Inclusion Criteria

- Peer Reviewed Journals
- In English language
- Human Subjects
- Randomized Controlled Trials (RCTs)
- Age of subjects ≥45[5]
- 2008 - 2018

Exclusion Criteria

- No outcome measures of functional performance, mobility, or strength
- Not RCTs

# Methods

- Total of 121 men and women between 5 studies[6-10]
  - Ages: 57-80
- Treatment parameters [6-10]
  - 6 to 8 weeks
  - 4 to 5 sessions per week

# Results

# Results

- Four out of 5 studies used the TUG as an outcome measure[6-8,10]
- Three out of 5 studies used 30STS and 1 study utilized 5x STS [6-8,10]
- Two out of 5 studies also used maximum voluntary isokinetic and isometric strength of both knee flexors and extensors[6,10]
- One study examined 1 rep max (1RM)[9]

# Results

- All 4 studies using TUG showed statistically significant improvement with BFR ($p<0.001$, $p=0.016$, $p<0.01$, $p<0.01$)[6-8,10]
- One study noted greater improvements in TUG for BFR vs control after 6 weeks ($p=0.14$)[8]
  - Both control and BFR groups showed statistically significant improvements at week 6 ($p<0.01$)[8]
  - Statistically significant improvement noted at week 3 for BFR ($p<0.001$)[8]

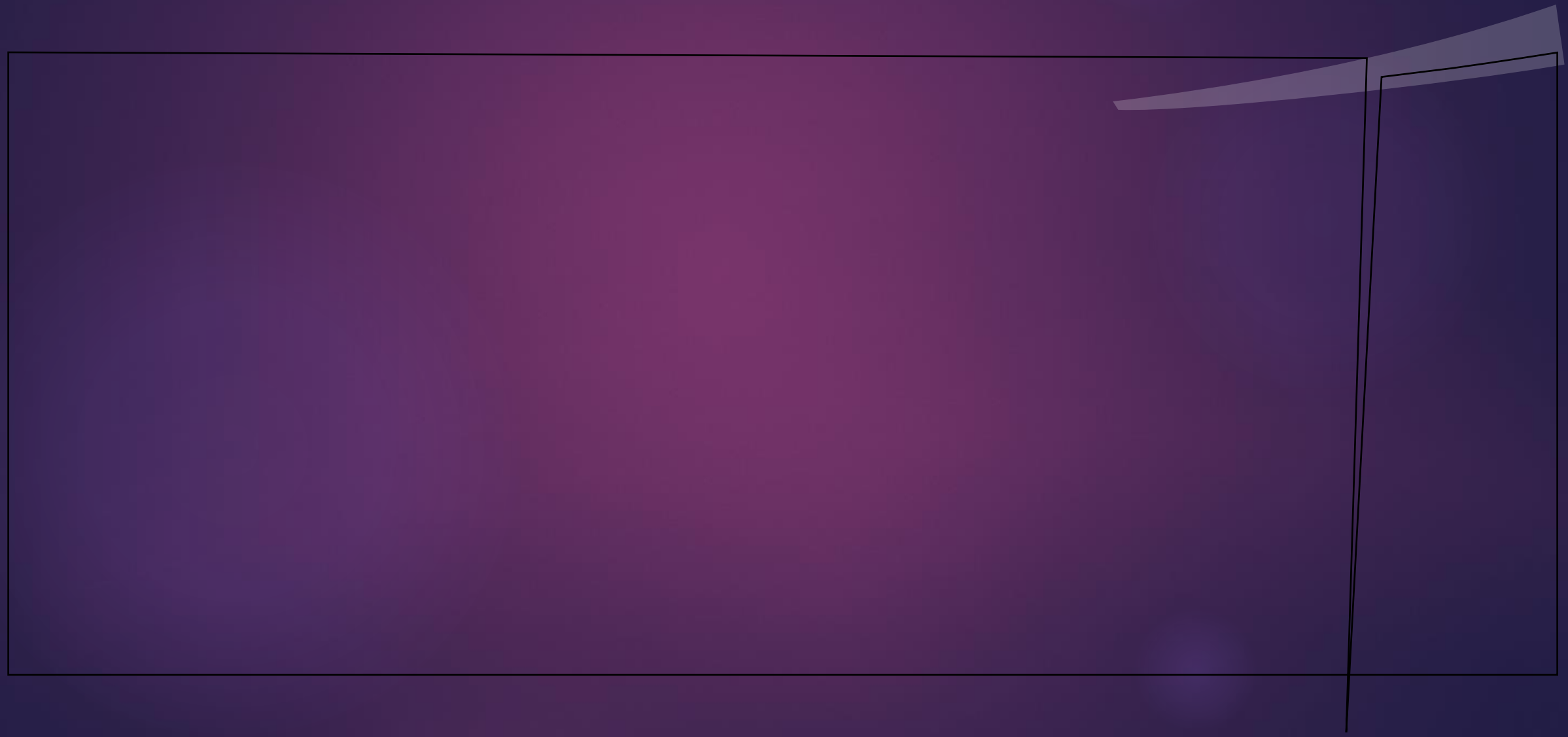
# Results

- Both water exercise with BFR and water exercise groups increased in 5x STS ($p=0.0001$)[7]
- All 3 studies using 30STS showed improvements with BFR ($p<0.05$, $p<0.001$, $p<0.05$)[6,8,10]
- One study revealed statistically significant improvements in BFR and control groups at week 6 for 30STS ($p<0.005$)[8]
  - Statistically significant improvement in BFR group continued from weeks 3 to 6 ($p<0.001$), but not in the control group[8]
- One study noted higher percent change in BFR group vs control for repetition performed (20.5% vs. 7.8%)[10]

# Results

- Two studies showed statistically significant improvements in maximal isokinetic knee flexion and extension ($p<0.05$, $p<0.01$)[6,10]
- Statistically significant improvement in maximal isometric knee extension strength in 1 study ($p<0.05$)[6]
- One rep max[9]
  - Significant improvements in lat pulldown, bicep curl, leg press, and knee extension strength with low intensity (20% 1 RM) BFR vs. high intensity (80% 1RM) resistance training[9]
  - Both groups increased in shoulder press with no difference noted between groups[9]

# Discussion



# Future Research

- Future RCTs focusing on determining the optimal parameters (frequency, duration, intensity) and long-term effects of BFRT, would prove enlightening
- Future research is needed to identify the optimal protocol of BFR training to improve overall functional mobility and strength
- Future RCTs should include larger sample size

# References

7. Araujo JP, Neto GR, Loenneke JP, et al. The Effects of Water-based Exercise in Combination with Blood Flow Restriction on Strength and Functional Capacity in Post-menopausal Women. . 2015; 37(6): 110-118. doi: 10.1007/s11357-015-9851-4.

8. Clarkson MJ, Conway L, Warmington SA. Blood Flow Restriction Walking and Physical Function in Older Adults: A Randomized Control Trial. 2017; 20(12):1041-1046. doi:10.1016/j.jsams.2017.04.012.

9. Karabulut M, Abe Takashi, Sato Y, Bemben MG. The effects of low-intensity resistance training with vascular restriction on leg muscle strength in older men. . 2010; 108: 147-155. doi: 10.1007/s00421-009-1204-5.

10. Ozaki H, Sakamaki M, Yasuda T, et al. Increases in Thigh Muscle Volume and Strength by Walk Training with Leg Blood Flow Reduction in Older Participants. 2011; 66a(3): 257-263. doi: 10.1093/gerona/glq182.

11. McEwen JA, Owens JG, Jeyasurya J. Why is it Crucial to Use Personalized Occlusion Pressures in Blood Flow Restriction (BFR) Rehabilitation? . 2018; https://doi.org/10.1007/s40846-018-0397-7. Accessed October 12, 2018.

# Thank you!
# Questions?

# Appendix

# How Occlusion Was Determined

Effects of Low-Intensity Walk Training with Restricted Leg Blood Flow on Muscle Strength and Aerobic Capacity in Older Adults

# How Occlusion Was Determined

The Effects of Water-based Exercise in Combination with Blood Flow Restriction on Strength and Functional Capacity in Post-menopausal Women[7]

A vascular Doppler probe (DV-600; Marted, Ribeira o Preto, Sa o Paulo, Brazil) was placed over the tibial artery to capture its auscultatory pulse. For the determination

# How Occlusion Was Determined

Blood Flow Restriction Walking and Physical Function in Older Adults: A Randomized Control Trial[8]

- Did not state

The effects of low-intensity resistance training with vascular restriction on leg muscle strength in older men[9]

- The pressure for vascular restriction pressure was decided based on the protocol used in the previous studies investigating the changed in lower body strength in young adults
- Selected for the occlusive stimulus as this pressure has been suggested to restrict venous blood flow and cause pooling of blood in capacitance vessels distal to the belt, and ultimately restrict arterial blood flow

# How Occlusion Was Determined

Increases in Thigh Muscle Volume and Strength by Walk Training with Leg Blood Flow Reduction in Older Participants[10]

- The air pressure of 140–200 mm Hg was selected for the BFR stimulus based on a review of the data in elderly participants
- The restriction pressure of 160–230 mmHg was selected for the occlusive stimulus, as this pressure has been suggested to restrict venous blood flow and cause pooling of blood in capacitance vessels distal to the belt, as well as restricting arterial blood flow