Personalized Blood Flow Restriction

FX PHYSICAL THERAPY

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This presentation is a review of the Owens Recovery Science Course. We strongly encourage taking the course to become FDA certified and have a further understanding of the research and use of the device.

FX Physical Therapy will be hosting the Owens Recovery Science Course on May 18, 2019 We encourage you to sign up!

https://www.owensrecoveryscience.com/certification/baltimoremdmay2019/

What is PBFR?

- The Delfi Personalized Tourniquet System for Blood Flow Restriction (BFR) is an FDA approved tourniquet system made specifically for BFR use.
  - Built in instrument to measure individual's limb occlusion pressure, similar to a Doppler.

Results With Personalized Blood Flow Restriction

Personalized blood flow restriction rehabilitation training (PBFR) is a game-changing injury recovery therapy that is producing dramatically positive results

- Diminish atrophy and loss of strength from disuse and non-weight bearing after injuries or surgeries
- Increase strength with only 20-30% of 1 RM
- Increase hypertrophy with only 20-30% of 1 RM
- Improve muscle endurance in 1/3 the time
- Improve muscle protein synthesis in the elderly
- Improve muscle activation
- Increase growth hormone responses

Parameters:

50% of PLOP (personalized limb occlusion pressure) for the upper extremities

80% of PLOP for the lower extremities

Training 2-3 days per week with the following set/rep scheme:

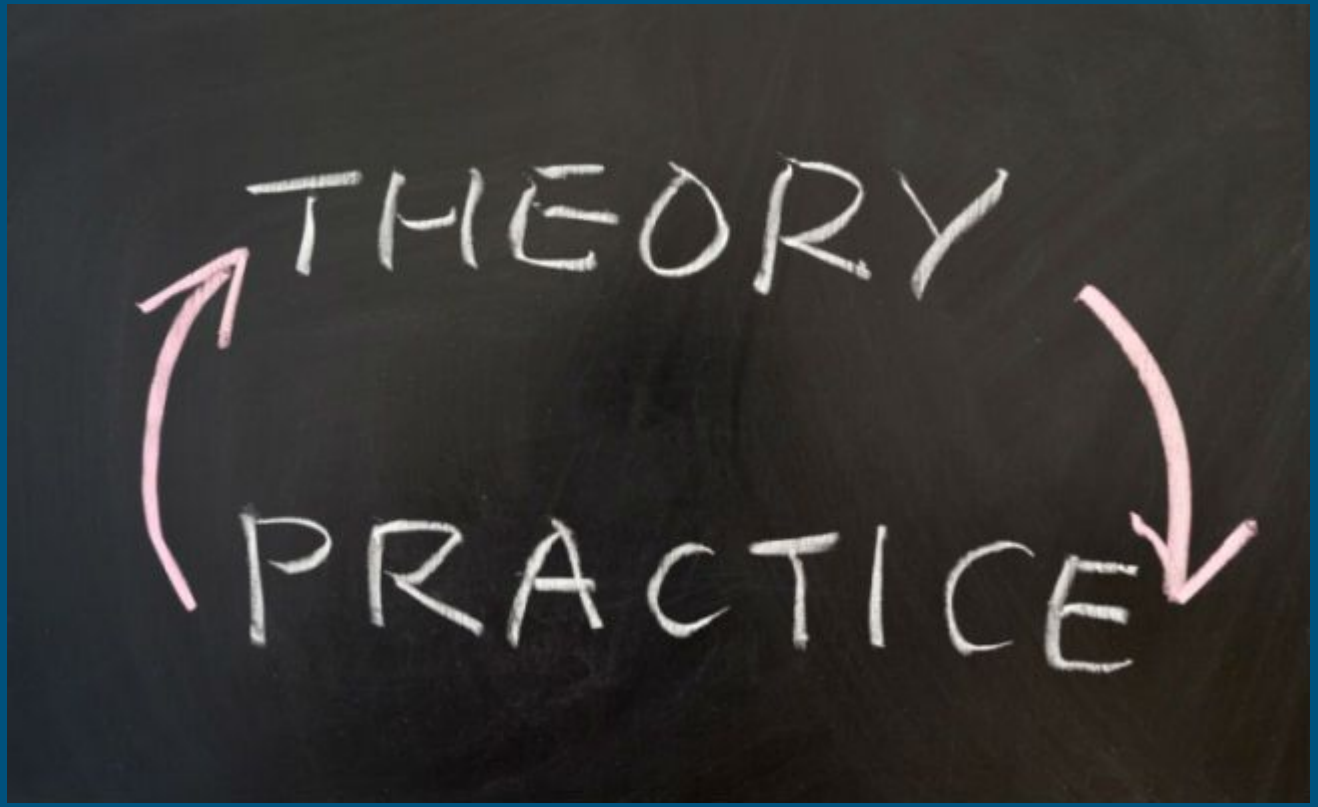
~Set/Rep Scheme: 30/15/15/15 with a 30 second rest between each set

-1st set of 30 flushes out the existing oxygen from the Krebs cycle

- Forces the body to use fast twitch muscle fibers over slow twitch

- Build up lactate molecules and hydrogen ions during rest period

- By the last set of 15 the patient should reach failure


THEORY
PRACTICE

How does PBFR work?

Metabolite Theory

- Creates hypoxic environment in muscle → stimulate anaerobic metabolism → recruits fast twitch motor units → combined with low load → similar response as high intensity training (HIT)

Metabolite Theory

- Lactate production following BFR is similar to that of HIT (Takarada 2000)
- BFR increases large motor unit recruitment through decr'd O2 and incr'd metabolic accumulation (Yasuda 2010)
- Growth Hormone stimulated from build up of lactate within the muscle tissue during BFR **AND** low intensity exercise. (Takarada 2000) GH is important for healing involved with collagen formation (Doessing 2010) Up to 300x baseline GH is seen in BFR studies (Schoenfeld 2013)
- Insulin like Growth Factors (IGF-1) are stimulated by GH, IGF-1 stimulated by mechanical loading and have direct correlation to strength gains (Hammed 2004, Kostek 2005). IGF-1 helps convert satellite cells (stem cells for muscles) into muscle fibers.
- Mechanistic/Mammalian target of rapamycin complex (MTORC-1) is the switch to turn cell growth on/off for protein synthesis and hypertrophy following HIT or BFR low intensity exercise

Strength and Hypertrophy

VS

Hypertrophy

Low intensity exercise vs low intensity exercise with BFR

- Only low intensity exercise with BFR increased muscle cross sectional area (Takarada 2004)
- Significant increase in hypertrophy using tourniquet (Loenneke 2012)
- Low intensity concentric BFR vs low intensity eccentric BFR both induce strength and hypertrophy in 0-4 weeks (Hill et al 2018)

Strength

HIT vs low intensity vs low intensity BFR

- HIT (80% 1RM) and low intensity (30% 1RM) BFR demonstrate similar strength and hypertrophy increases (Takarada 2000)
- Low intensity BFR is an important alternative to HIT to increase strength and CSA in elderly adults (Vechin et al 2015)
- HIT and low intensity BFR effectively down-regulate myostatin levels and are associated with increased muscle mass and strength. (Day 2018)

Protein Synthesis

Muscle protein synthesis is seen within 24 hours after heavy resistance exercise (Bickel 2005)

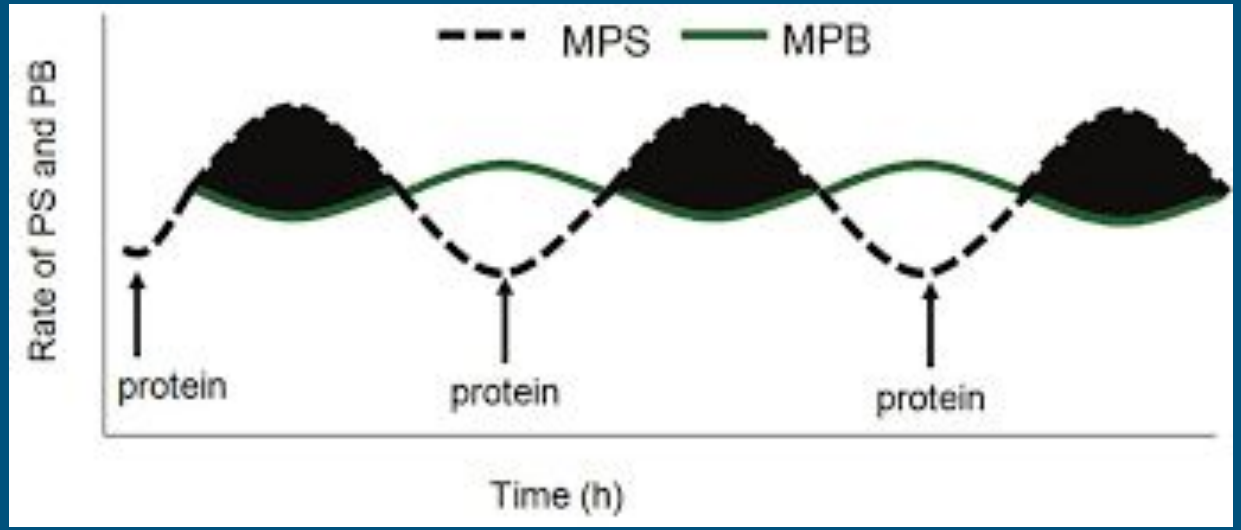
MPS is stimulated by MTORC1, cell swelling & the ingestion of amino acid Leucine

- Acute cell swelling induces MPS → Cell Swelling Theory aka “Pump Effect”
- Without Leucine there is a blunted response to MPS process

Recommended source of Leucine is through whey protein

- 20g of protein for healthy young individuals
- 40g of protein for older adults
- Ingest every 4 hours for 24 hours

Protein Synthesis



Dr. Stuart Phillips Sports Science Exchange (2013) Vol. 26, No. 107, 1-5

Myostatin

Myostatin is a protein involved in limiting the growth of muscle and allowing for fibrosis to occur in damaged tissue.

- Increased levels of myostatin are found in early post-op periods following ACL reconstruction (Mendias et al 2013)
- HIT training (85% of 1RM) for 9 weeks demonstrates down regulation of myostatin (Roth 2003)
- BFR low intensity exercise has been found to down regulate myostatin similar to HIT (Laurentino 2012)

Other Benefits of PBFR

- Proximal gains
  - Analgesic effect: endogenous opioid response
  - Despite distal occlusion, proximal gains may result from fatigue of musculature below the cuff requiring more recruitment of synergistic proximal muscles, a backflow effect into musculature above the area of restriction, or a potential systemic effect secondary to the anabolic cascade created by BFR
- Corticomotor excitability
  - Increased excitability of corticospinal circuits resulting in long-lasting adaptations similar to those which occur following heavy-load resistance training (Brandner et al.)
- Endurance
  - Cycling at low intensity with BFR increased strength, hypertrophy, and VO2max
  - Walking at low intensity with BFR increased VO2max in highly trained athletes (Park 2010) and increased strength, hypertrophy, timed up and go, and sit to stand tests in elderly (Ozaki 2011, Abe 2010)
- Bone
  - BFR increases vascular endothelial growth factor (VEGF) (Takano 2005)
  - BFR increases bone markers of osteoblastic activity (Beekley 2005)

Safety Considerations

- Surgical-grade tourniquet equipment used by a trained practitioner
  - Wide tourniquet, doppler technology, partial occlusion, short duration
- Risk for Thrombosis
  - Research examining LL-BFR training with healthy individuals and older adults with heart disease found no change in blood markers for thrombin generation or intravascular clot formation
- Peripheral blood flow hemodynamics and central cardiovascular responses
  - Elevated cardiac markers (blood pressures, heart rate) and changes in blood flow in occlusive protocols compared to control groups; however, these values are still far less than those performing high intensity exercise (Lida et al)
- Rhabdomyolysis
  - Myoglobin leakage and elevated CK levels have not been seen with blood work after PBFR
  - Reported occurrences (<0.004-0.01%) appear to be directly correlated to other patient-specific factors/comorbidities

Safety Considerations

- Possible Precautions:
  - Poor circulatory system, obese (tourniquet shifting), arterial calcification, abnormal clotting times, diabetes, sickle cell trait, tumor, general infection, hypertension, cardiopulmonary conditions, renal compromise, clinically significant acid-base imbalance, atherosclerotic vessels, anti-hypertensive, creatine supplements, status of post-op incision (e.g. s/p TKA)

- Possible Contraindications:
  - Open fractures, severe crushing injuries, severe hypertension, compromised vascular circulation (diminished venous return), nerve injury/damage

*** These are possible Precautions & Contraindications due to many studies and current research are done with patients with some of these conditions ***

Clinical Uses

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Clinical Considerations

- Owens Recovery Science considerations for PBFR with Estim
  - UDel NMES post-op quad protocols
  - Proximal pad placement is safe under PBFR Cuff
  - PLOP 3 visit ramp up when using Estime (60%, 70%, 80%)
  - Must adjust Estim timers to match Delfi timer
  - Cuff stays inflated entire treatment
- Protein Supplementation Pre/Post surgery (Dreyer et al. 2018)
- Protein intake timing pre/post workouts or PBFR sessions (ORS Protein Guide)
- Wider cuffs restrict arterial flow at significantly lower pressures (Delfi cuff vs KAATSY cuff: CSM 2018)
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