Blood Flow Restriction (BFR)

Overview and Application in Outpatient Rehab and Performance

By: Ray Yumang, PT

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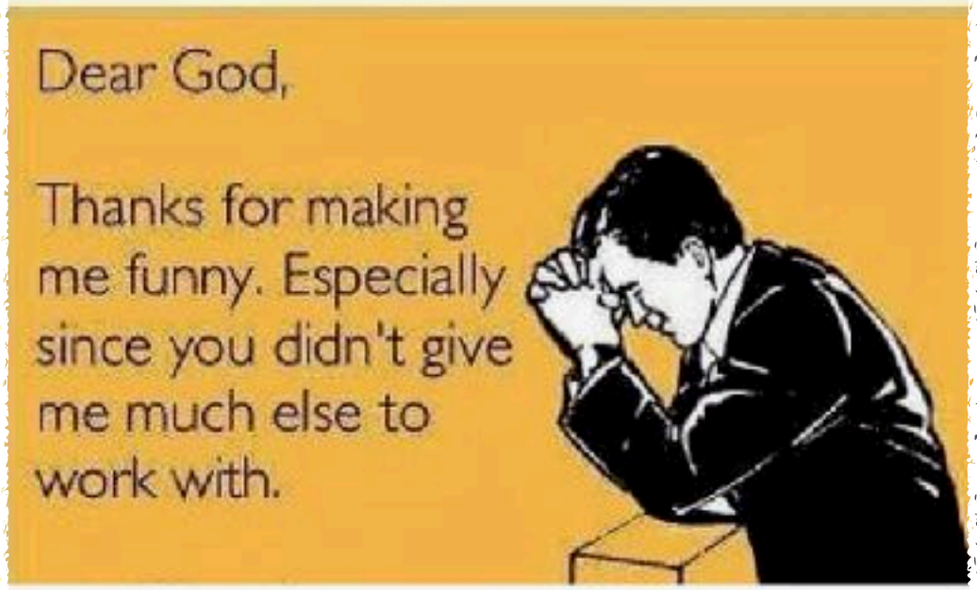

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hartungproductions Pretty much how I start off all of my prayers. Kind of awkward when praying outbound at church & over dinner but oh well. Lol

3 DAYS AGO

About Me

- From the Philippines
- PT for 28 years
  - Fayetteville and Springdale
  - Variety of patients
    - Elderly, adult, young adults, younger kids (8-16)

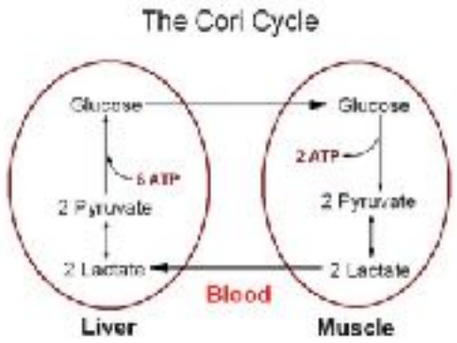
- Objectives (What you should get out of this presentation)
  - Have an idea what BFR is about
  - Know the use in rehab setting
  - Know the use in performance setting
  - Know who would benefit from it

Perspective

Physiology:

Metabolite Theory

- Forced anaerobic metabolism (Cori cycle)



The forced use of anaerobic metabolism (the Cori Cycle) has metabolic byproducts of lactate and hydrogen. Type III and IV afferents in the muscle measure this increase acidity and take a signal to the pituitary to stimulate Growth hormone production. Growth hormone then stimulates the liver to release IGF1 (Insulin-like Growth Factor 1).

Studies:

STRENGTH AND HYPERTROPHY

- ACSM guidelines
- BFR training has consistently demonstrated strength and hypertrophy gains vs controls and comparable gains to heavy load lifting.
  - Comparing high intensity training (80% 1 RM) to low intensity with BFR (30% 1 RM) and low intensity without BFR (30% 1 RM) demonstrated similar increases in strength between HIT and BFR and both were significantly higher than the low intensity group. (Takarada 2000)

- Johnny Owens, MPT
- Worked in the Military
- Interested in research and science
- Sports medicine and total joint arthroplasties

History of BFR

- Wounded Warrior
- Limb Salvage
- 2012 Used in Clinical Settings

History of BFR

- Currently performing studies effectiveness in the clinical setting for Knee Arthroscopy, ACL repair, Fractures of the Wrist and Femur, Achilles Repairs and Shoulder Pathologies

- "This is a modality with a very large amount of scientific literature to support it and its potential in the clinical setting is tremendous" - Johnny Owens, MPT

What is it??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Physiology

- Lactic Acid
- Growth Hormones
- IGF-1
- Myostatin

Physiology

- Mechanical Tension Model
- "To obtain substantial hypertrophy from a resistance training program, the target muscles must be subjected to substantial increased load." (Meyer 2006)

Physiology

- Mechanical Tension Model
  - Therefore American College of Sports Medicine (ACSM) recommended that during resistance training, the load should exceed 70% of the one repetition maximum to achieve maximum hypertrophy.

Physiology

- Mechanical Tension Model
- Muscle damage from subsequent powerful muscle contraction

Physiology

- Metabolite Theory
  - BFR Uses this model

Physiology

- Study that compared a low intensity exercise with BFR, only the group using a tourniquet demonstrated a significant increase in muscle cross sectional area and strength (Takarada 2004)

Physiology

- Low Intensity (30% 1 RM) uses the Kreb's cycle (Aerobic Cycle)
- Slow Twitch fibers
- Aerobic Fibers

Physiology

- Metabolite Theory
  - Cori Cycle
    - Limits the oxygen supply to the muscle which switches from aerobic to anaerobic metabolism
    - Lactic Acid is the byproduct
    - Triggers the Pituitary gland to release Growth Hormones and IGF-1

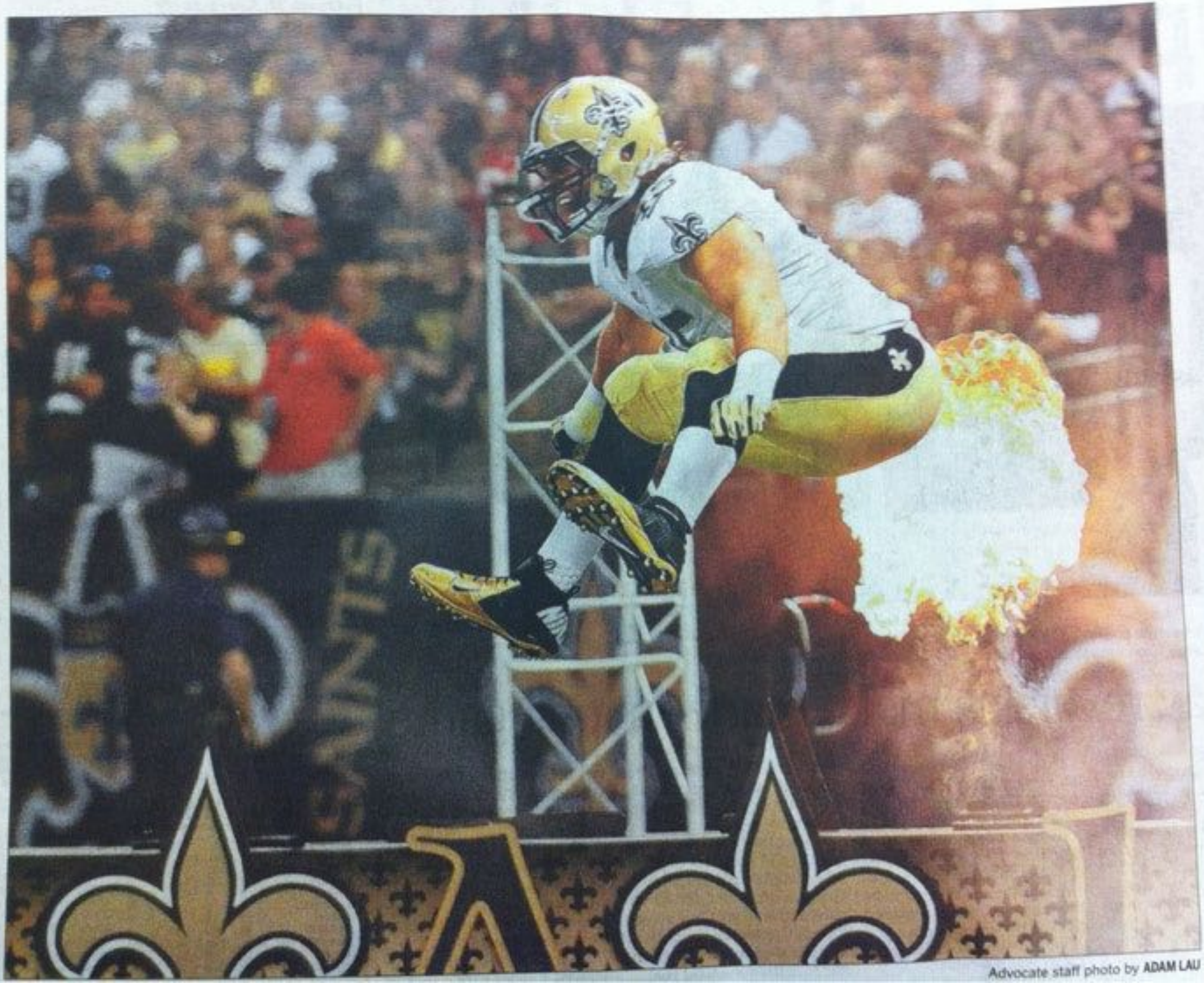
Lactic Acid

- The more hypoxic the muscle becomes the more need for anaerobic metabolism.
- When a tourniquet occlusive pressure is increased, lactate concentration also increases (Takarada 2000)

Lactic Acid

- Multiple studies that have measured blood lactate after BFR have demonstrated subsequent rise in lactate. For instance, when comparing a load of 20% 1 RM low load exercise with and without a tourniquet group demonstrated a significant rise in lactate. (Takarada 2000)

CHIEFS 27, SAINTS 24, OT



Advocate staff photo by ADAM LAU

Growth Hormones

- As Lactate builds up in the muscle, group III-IV afferents stimulate the pituitary gland to release Growth Hormones (Gosselink 1998)

Growth Hormones

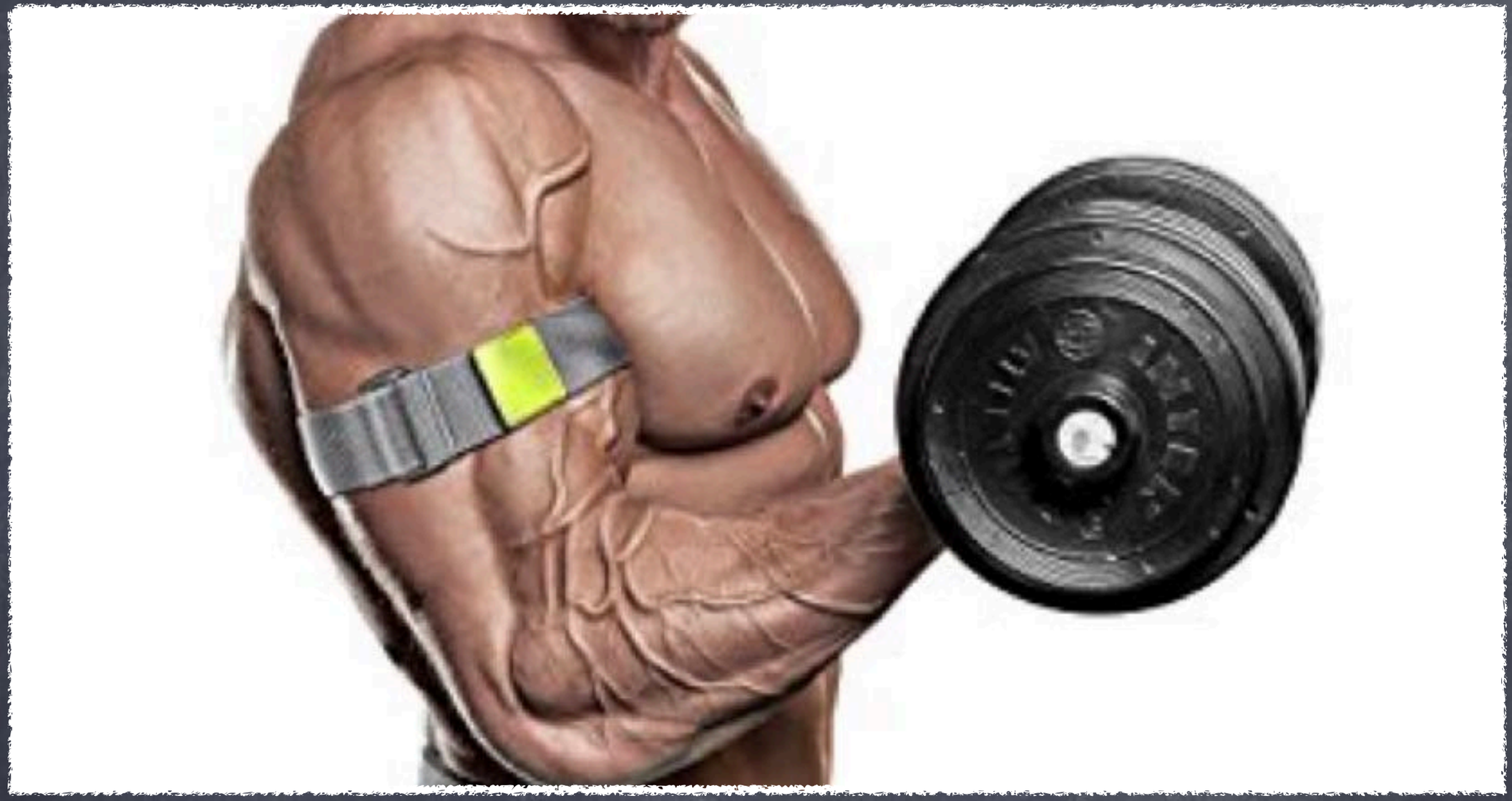
- Collagen Synthesis
- Healing and Recovery
- Healing environment with soft tissue, joints, tendon, muscle and bone.
- Doesn't get you bigger, but helps with tissue breakdown and damage.

Growth Hormones

- Growth Hormones played a direct role in increased collagen synthesis after exercise (Doessing 2010)

Growth Hormones

- The findings with BFR compared to HIT training was 1.7x higher with Growth Hormones (Takarada 2000, Kraemer 1990)



IGF-1

IGF-1

- Insulin like Growth Factors
- Protein linked to muscle growth
- Responsible for hypertrophy
- Links with Sattelite cells and muscle fibers and muscle growth occurs

IGF-1

- BFR Studies show significant increased in IGF-1 vs. control group (Abe 2005, Taken 2005, Fujita 2007)

IGF-1

- The anabolic effects of IGF-1 appear to be increased with mechanical loading and increases in IGF-1 have been correlated with subsequent strength gains (Hammed 2004, Kostek 2005)

Myostatin

- After 9 weeks of Heavy Lifting (up to 85% of 1 RM) there was a down regulating of myostatin and hypertrophy and strength occurred (Roth 2003)

Myostatin

- Blocks myogenesis or muscle growth
- The switch that allows proliferation of myogenic stem cells to proliferate and allow muscle hypertrophy

Belgian Blue

Deficient in Myostatin

Belgian Blue

Deficient in Nutrients

Myostatin

- Inhibiting myostatin after injury reduces the fibrosis seen in the muscles (Wagner 2005)

Myostatin

- Myostatin belongs to the TGF-Beta Superfamily
- These are released upon damage to the cell
- BFR helps reduce the production of myostatin if used immediately post injury

Is it Safe?

Safety

Ultrasound (22 Risk Factors)

- DVT or Thrombosis
- Hemmorrhagic conditions
- Pregnancy
- Eyes,anterior neck, carotid sinus, head, reproductive organs
- Impaired Cognition or communication
- Regenerating Nerves
- Damaged or at risk skin (local)
- Infection
- Tuberculosis
- Malignancy (local)
- Recently radiated tissue (local)
- Electronic Device
- Impaired sensation (local)
- Active epiphysis
- Skin disease
- Impaired Circulation
- Chest, heart
- Pain Skin irritation
- Surge
- Acute injury or inflammation
- Plastic or Cement Implants
- Pain

Electrical Stimulation (20 Risk factors)

- DVT or Thrombosis
- Hemmorrhagic conditions
- Pregnancy
- Eyes,anterior neck, carotid sinus, head, reproductive organs
- Impaired Cognition or communication
- Regenerating Nerves
- Cardiac Failure (local)
- Damaged or at his skin (local)
- Infection
- Tuberculosis
- Malignancy (local)
- Recently radiated tissue (local)
- Electronic Device (local)
- Impaired sensation (local)
- Active epiphysis
- Skin disease
- Impaired Circulation
- Chest, heart
- Pain Skin irritation
- Surge

Safety

Hot Pack (20 Risk Factors)

- DVT or Thrombosis
- Hemmorrhagic conditions
- Pregnancy
- Impaired Cognition or communication
- Acute Injury or Inflammation
- Impaired sensation (local)
- Eyes, anterior neck, carotid sinus
- Metal (staples/bullets)
- Topical irritants
- Burn
- Bleeding and open wounds
- Cardiac Failure (local)
- Damaged or at his skin (local)
- Infection
- Tuberculosis
- Malignancy (local)
- Recently radiated tissue (local)
- Active epiphysis
- Skin disease
- Impaired Circulation

Blood Flow Restriction (21 Contraindications and Risk Factors)

- DVT or Thrombosis
- Impaired Circulation
- Previous Revascularization of the extremity
- Infection
- Extremities with Dialysis Access
- Acidosis
- Sickle Cell Anemia
- Tumor distal to the tourniquet
- Medications and supplements know to increase clotting risks
- Open Fracture
- Increased intracranial pressure
- Open Soft Tissue Injuries
- Post traumatic Lengthy hand reconstructions
- Severe crushing injuries
- Severe hypertension
- Elbow surgery (where there is concomitant excess swelling)
- Skin Grafts in which all bleeding points must be readily distinguished
- Secondary or delayed procedures after immobilization
- Vascular grafting
- Cancer
- Lymphectomies

Safety

- Thrombus
- Cardiac Response
- Peripheral Vascular Changes

Safety (Thrombus)

- Tourniquets in and of themselves used for a short duration do not seem to pose an increased thrombus risk (Noordin 2009)

Safety (Thrombus)

- Acute bouts of tourniquet use have fibrinolytic potential (Holemans, 1963; Hozknecht et al., 1969; Robertson et al., 1972; Shaper et al., 1975; Stegnar & Pentek, 1993)

Safety (Thrombus)

- Resistance Exercise has also been shown to stimulate the fibrinolytic system (deJong et al., 2006)

Safety
(Central Cardiac Response)

- Based on the ACSM guidelines suggest loads of 75-85% of an individuals 1 RM are needed to induce a strength and hypertrophy response.

Safety (Central Cardiac Response)

- MacDougal et al have reported elevations in BP as high as 480/350 mmHG when exercising at 80-100% 1 RM and Heart Rate at 170 BPM.

Safety (Central Cardiac Response)

- BFR at 20% 1 RM had BP at 182/105 mmHg and 109 BPM.
- Authors Concluded that these values are all below what was seen with traditional HIT training (Takano 2005)

Safety (Peripheral Vascular Changes)

- "What we can say is that BFR training including resistance exercise and walking may nor worsen arterial compliance." (Horiuchi 2011)

Safety (Peripheral Vascular Changes)

- Use your judgment as you would with all other modalities and procedures in therapy- Ray Yumang 2018.

Safety

- There has been quite a bit of research exploring the safety of BFR
- Sound clinical judgment is key

Perspective

Rehab Use

- Acute Injury
- Post Surgery
- Strengthening Phase of therapy

Acute Injury

- Acute Sprain/ Strain
  - Ankle, Knees and Shoulders
  - Growth Hormones and Collagen Synthesis

Acute Injury

- Hamstring Pull/Strain
- Down regulating Myostatin
  - Helps Slowing down fibrosis

Acute Injury

- Researchers at John Hopkins found that lowering myostatin reversed muscle fibrosis (Bo 2012)

Post Surgery

- BFR without exercise did not cause hypertrophy but it significantly reduced atrophy to the control group (Takarada 2000)

Post Surgery

- Post ACL surgery
- Post Achilles tendon surgery
  - Goal is decrease the rate of atrophy

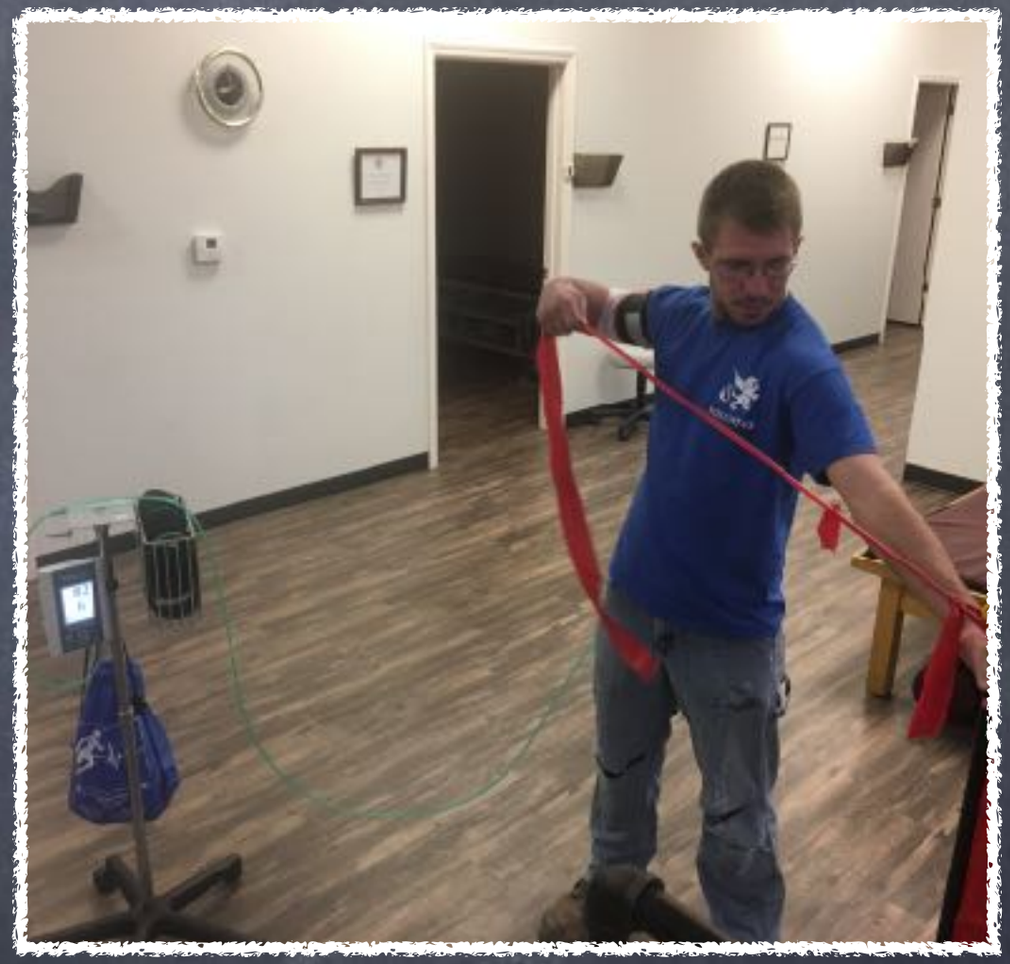
Post Surgery

- Cell Swelling
  - Using tourniquet without exercise
- Protocol
  - 5 min bouts for 5 x with a 3 min rest period

Post Surgery

- As lactate builds up in the muscle, it inhibits the surrounding contraction of working muscle fibers and consequently additional motor units need to be recruited to maintain muscle force production. (Mortani 1992, Sundberg 1994, Miller 1996)

Strengthening Phase



Strengthening Phase

- Past the pain goal
- Strengthening training
- Increase in IGF-1 thus hypertrophy is increased

Strengthening Phase

- Good with rotator cuff strengthening
- Quad Strengthening
- Calf Strengthening

Strengthening Phase


VOLUNTAS

Performance

- Strength training
- Endurance training (VO2 max)

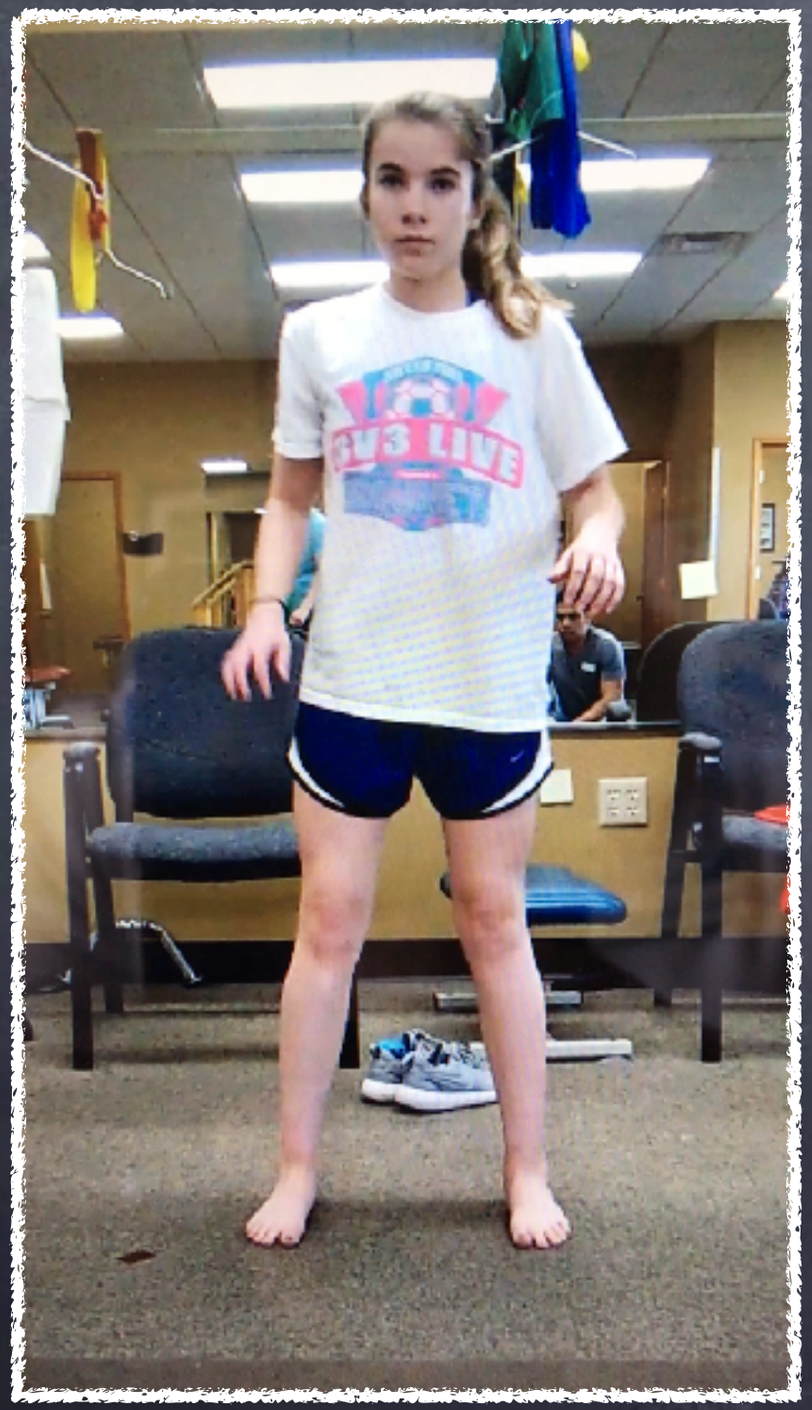
Performance

- Strength Training
  - Stabilizers
    - Rotator cuff , Hip external rotators, hip abductors
  - Antagonist
    - Posterior muscles (hip extensors, hamstring, posterior deltoids)
  - Agonist
    - Power muscles (Hip flexors, quads, calf, pecs)

Performance (Strength training)

- Competitive Edge

Performance (Strength Training)



Performance (Endurance Training)

- Walking
- Cycling

Performance (Endurance Training)

- Walking
- Study reported increase in VO2 Max after 6 days a week (2 weeks) of 2x a day walking. (Park 2010)
- The authors concluded that BFR walk training might be used as a low intensity alternative for athletes to maintain or improve endurance.

Performance

(Endurance training)

Performance (Endurance training)

- Cycling
- At the conclusion of training and studies thigh and quadriceps muscle volumes increased by 3.8 and 5.1% with BFR training group (Abe 2010)

Performance
(Endurance training)


SCIFIT

Who is using it? (Name Drop)

- NFL
- NBA
- MLB
- MLS
- Major Colleges
- A. Yumang Rehab Services..

Conclusion

- Modality/ Procedure
- Analysis
- When
- Why
- Purpose

Tools

Graston Technique


Dynatronics
SOLARIS

Questions?

- " In Pursuit of helping People, be willing to change"- Ray Yumang, PT

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Thank you

-Ray Yumang, PT