Glutes for Rehab and Performance

"Building a Bigger, Better Butt"

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Encore Rehabilitation, Inverness

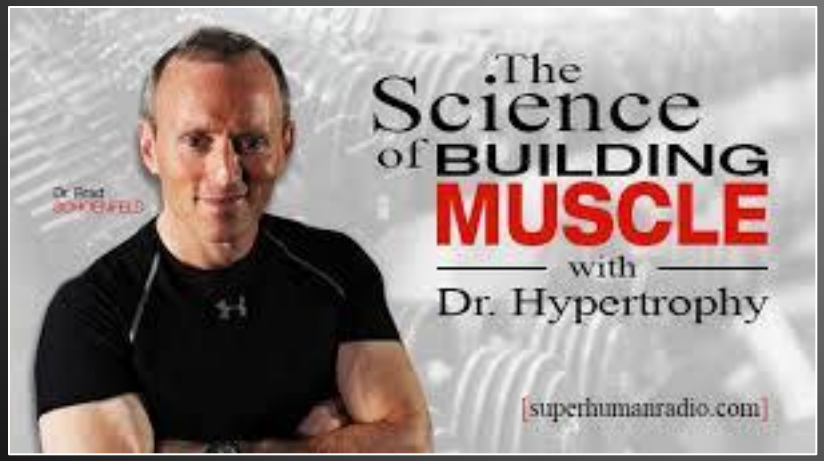
Team Physical Therapist, Legion FC

“Conflict of Interest Disclosure”

“So, I’m the only one who sees a conflict of interest here?”

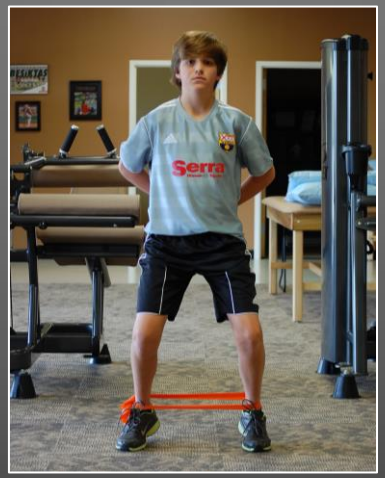
"The way I see it, if you don't have a conflict of interest, you're not really doing your job."

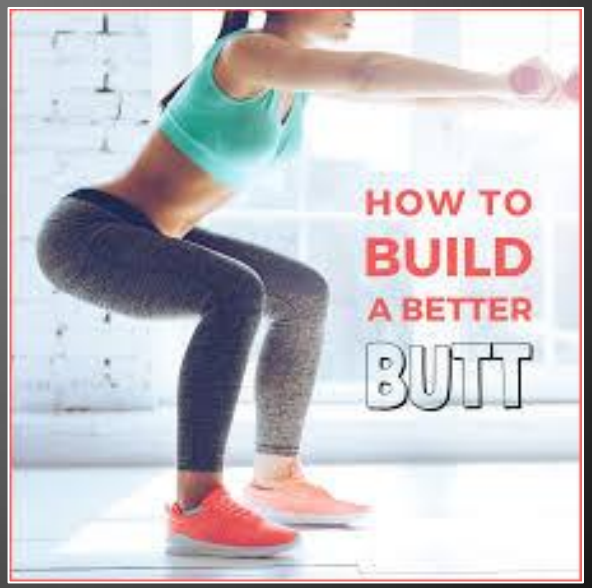
Bret Contreras, PhD, CSCS
Brad Schoenfeld, PhD, CSCS, CSPS, FNSCA



Goals of Training?

- Performance
  - ↑ explosive power in athletes (Crow, ‘12)
- Rehabilitation
  - LE pathologies (Fredericson ‘00, Khayambashi ‘12, etc.)
  - LBP (Nelson-Wong ’10)
- Aesthetics





Gluteus Maximus

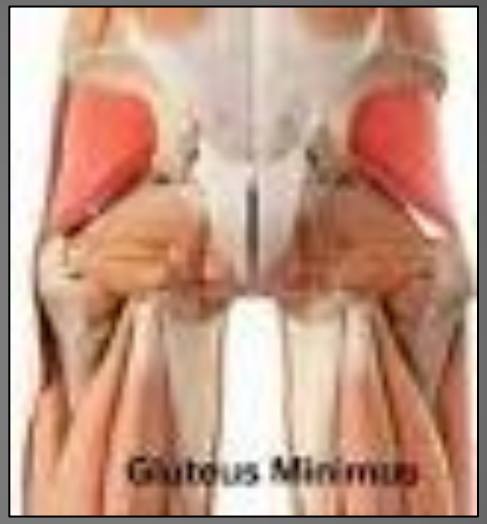
- Largest, most powerful muscle in body
- Extension, abduction, ER
- Pelvic/trunk stability

Gluteus Medius

- Hip abduction
- Fiber orientation
  - Anterior: Flexion & IR
  - Posterior: Extension and ER
- Frontal/transverse plane stability

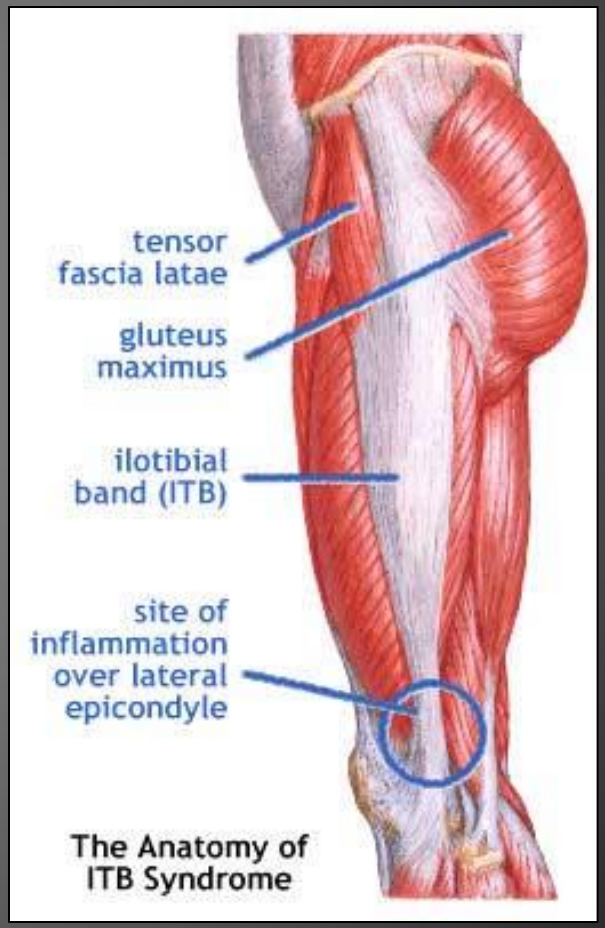
Gluteus Minimus

- Hip abduction
- Fiber orientation
  - Anterior: Flexion & IR
  - Posterior: ER (in extension)
- Flexion
- Hip stabilization



Tensor Fascia Latae (TFL)

- Primary: Hip IR
- Assist: Abduction, flexion
- Stabilization (via ITB)
  - Hip
  - Knee / Patella (?)



Physiology of Hypertrophy

- Muscle cross-sectional area = Muscle strength
- Training Goal = ↑ muscle size/mass

Hyperplasia

Increase # of Muscle Fibers

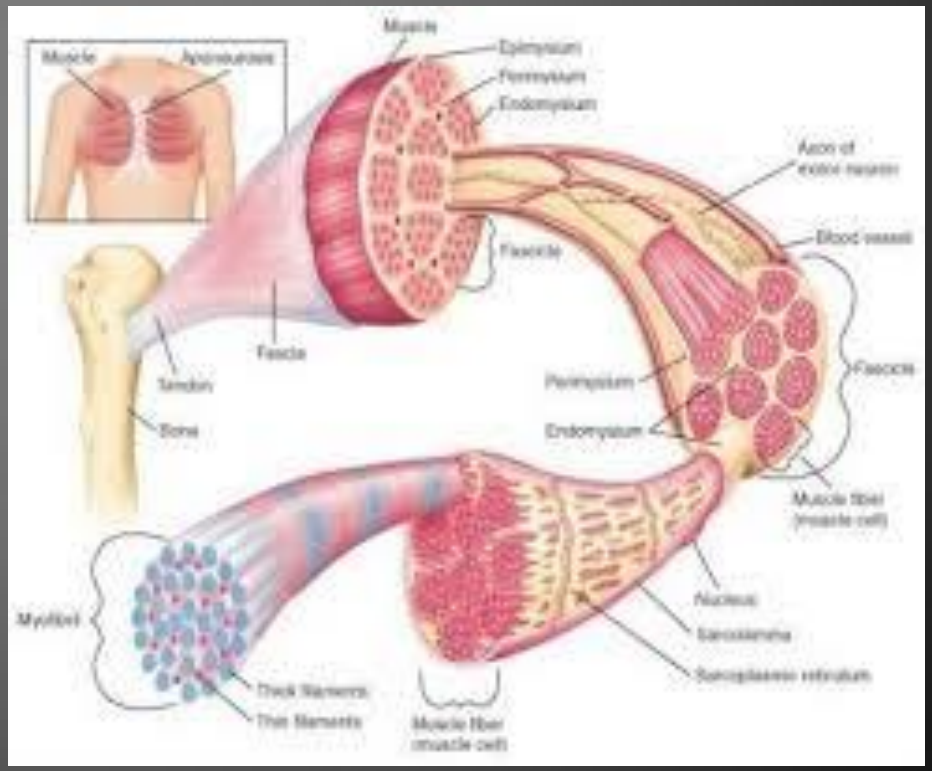
Hypertrophy

Increase #/size of:

-Extracellular matrix

- Myofibrils

- Sarcomeres

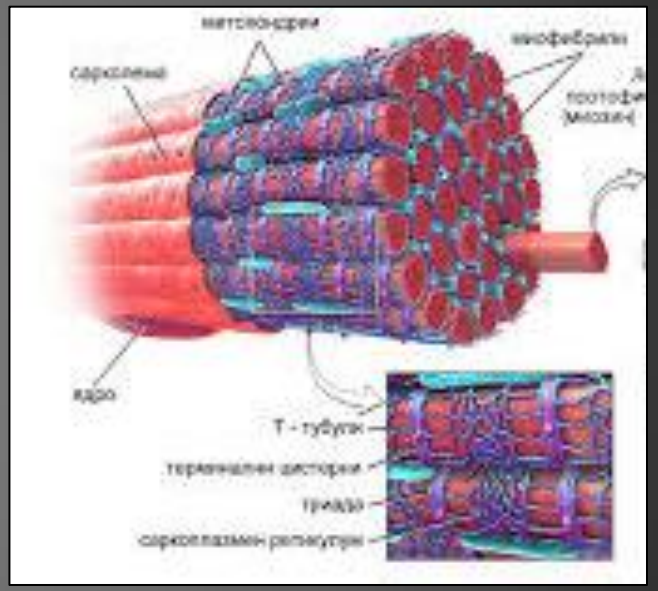


Physiology of Hypertrophy

- Human muscle = “Post-Mitotic” tissue
- Mechanism needed to avoid apoptosis
- Hypertrophy
  - Muscle protein synthesis > protein degradation
  - Balance between
    - Mechanical stimulus
    - Rest/recovery
    - Nutrition

Physiology of Hypertrophy

- Satellite Cells
  - "Mediators of Hypertrophy"
  - Normal state: Quiescent
  - Mechanical stimulus
    - "Activate"
      - Fuse to existing cells
        - » Creation of new myofibers
    - Precursor for repair/regrowth of muscle tissue

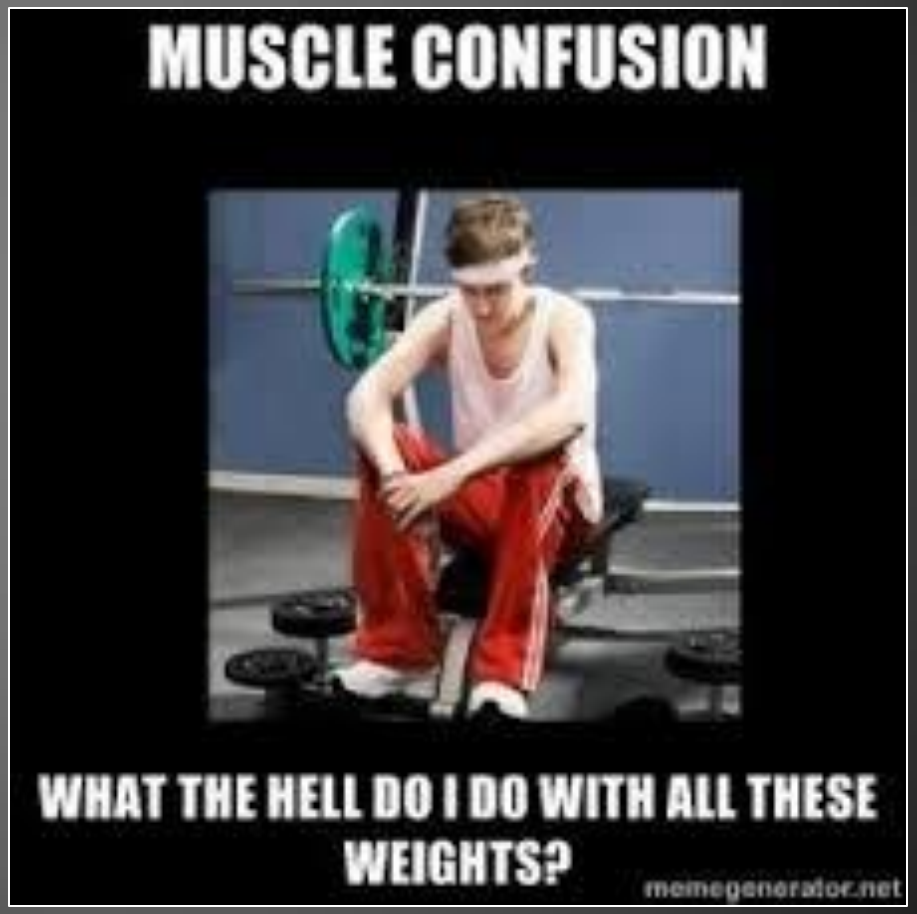


Research on Strength/Hypertrophy

- Inexperienced vs "Trained" Subjects?
- Differences in Methodology
- Conflicting results

“Drivers” of Hypertrophy

- Muscle Tension
- Metabolic Stress
- Muscle Damage



“Drivers” of Hypertrophy

- Mechanical Tension
  - Force placed on a muscle
  - Types
    - Active
    - Passive
  - Mechanism
    - Disturbs skeletal muscle integrity
    - Causes mechanical/chemical response within myofibers and satellite cells
    - Triggers increased rate of muscle protein synthesis

“Drivers” of Hypertrophy

- Metabolic Stress
  - Cell swelling: metabolite build up
  - Achieve via “training to fatigue”
    - ↑ metabolite accumulation
    - Light load = heavy load
    - ↑ activation of higher-threshold motor units
  - Lighter loads, higher reps, slower pace, short rest
    - Bodybuilders vs Powerlifters
    - Moderate intensity vs High intensity programs
    - Higher metabolic stress
  - Theory behind “Blood Flow Restriction” Training

“Drivers” of Hypertrophy

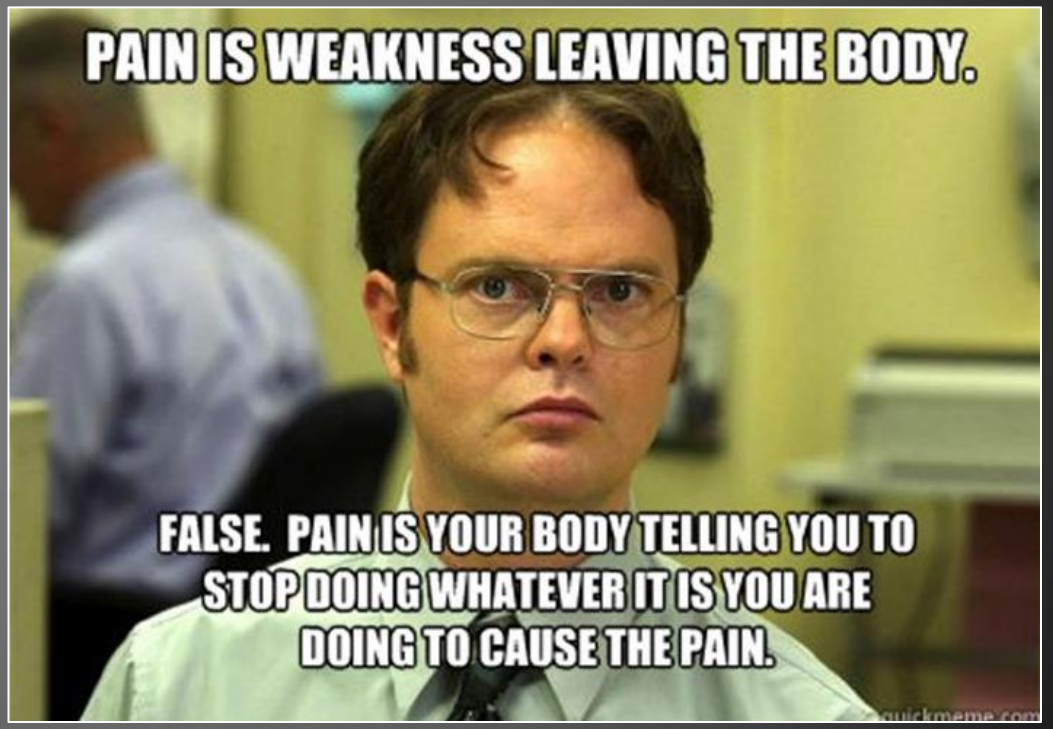
- Muscle Damage
  - Initial theory
    - Eccentrics → greater cell damage → greater soreness
    - Eccentrics → “Greater strength gains”
    - Cell damage: must be important mechanism behind strength/hypertrophy gains

“Drivers” of Hypertrophy

- Muscle Damage
  - Recent theories/findings (Beardsley, ‘18)
    1. Muscle damage repair probably does not enhance growth
    2. Reducing damaging effects of eccentrics → limited impact on growth
  - Eccentric vs. Concentric
    - Eccentric: ↑ mm fiber length
    - Concentric: ↑ fiber diameter
  - Benefit of eccentrics
    - Amount of mechanical tension generated

“No Pain No Gain”

- Excessive pain
  - Pain inhibition
  - Impairment of growth?
  - Limits workout ability

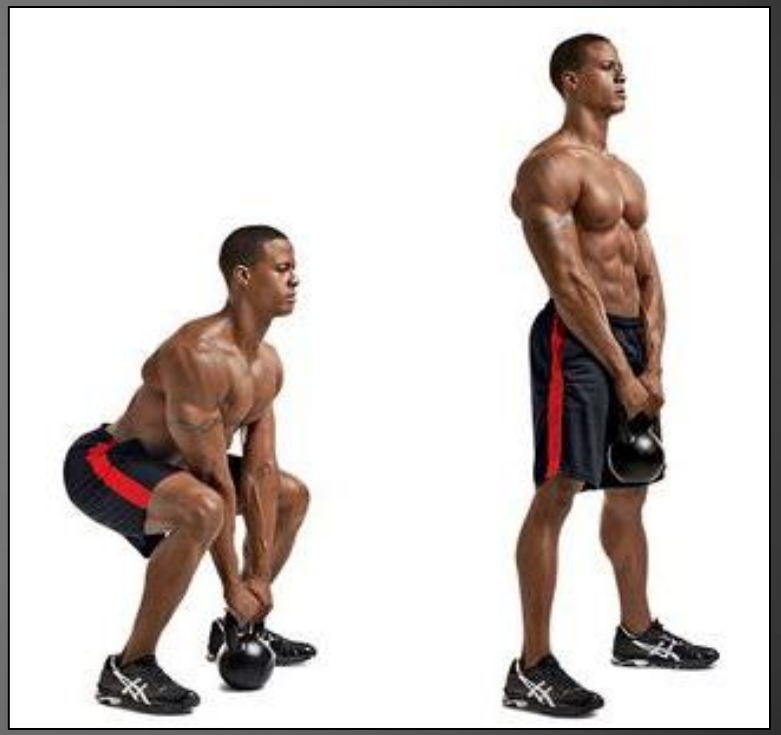


Training Variables
Intensity/Repetitions

<u>Training goal?</u>
Strength
Hypertrophy

Training Variables
Intensity/Repetitions

- High Reps (15+)
  - Low loads
  - Generation of high metabolic stress (to fatigue)
  - Insufficient loading to recruit highest number of motor units
  - Neural adaptation instead of strength?



Training Variables
Intensity/Repetitions

- Low reps (1-5)
  - High loads
  - Highly dependent upon mechanical tension
  - Optimizes strength potential
  - Joint stress

Is there a max threshold for mechanical tension-induced hypertrophy, resulting in metabolic stress becoming increasingly important for further hypertrophy?

Training Variables
Intensity/Repetitions

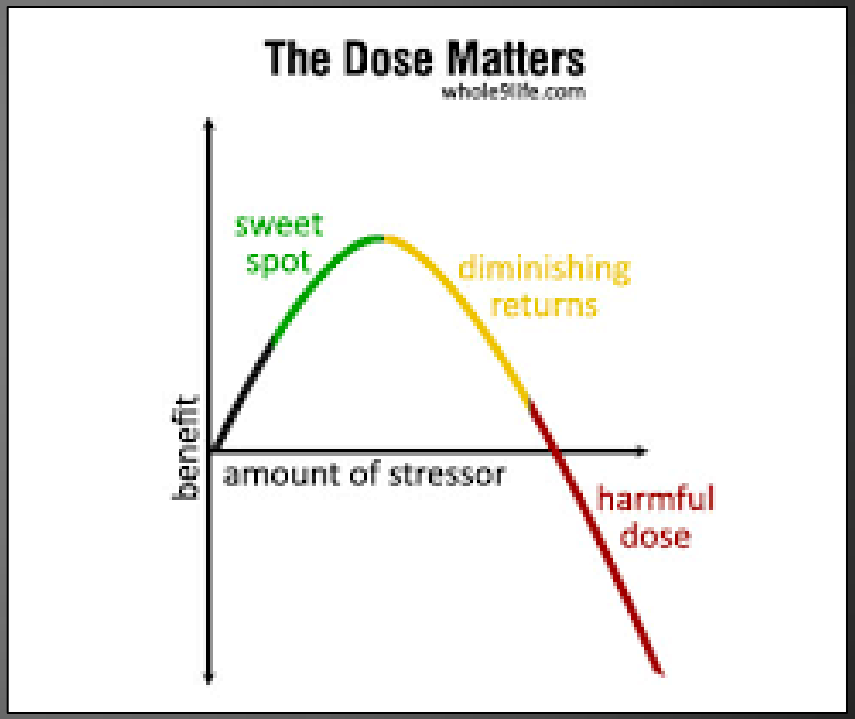
- Moderate Reps (6-12)
  - Optimal range for hypertrophic response?
  - Higher metabolic stress than low reps
  - Anaerobic glycolysis = ↑'d metabolite build up
  - Elevated GH/testosterone
    - Facilitates remodeling of muscle tissue
  - Increased time under tension
    - ↑'d potential for microtrauma and fatigueability
  - ↓'d joint stress
  - Smilios '03
    - Greater GH levels after 4th set compared to 2nd set in "Max Hypertrophy" group vs "Max Strength" group

Training Variables
Training Experience

- "Trained" Lifters
  - Require higher load/lower reps for optimal strength/hypertrophy gains
  - "Ceiling effect"
    - Progressively more difficult to increase mass
    - Require more demanding resistance training programs

Training Variables
Volume

- Total reps/set performed
- Higher volume better than single set program
  - Greater total mechanical tension?
  - Greater muscle damage?
  - Greater metabolic stress?
- Greater testosterone response
  - Schwab '93
    - Testosterone levels did not increase significantly until after the 4th set



Training Variables
Exercise Selection

- Multi joint
  - Greater mm mass recruitment
  - Greater stabilization
- Single joint
  - Can selectively target underdeveloped mm
  - ↓ possibility of synergistic mm compensation

Training Variables
Exercise Selection

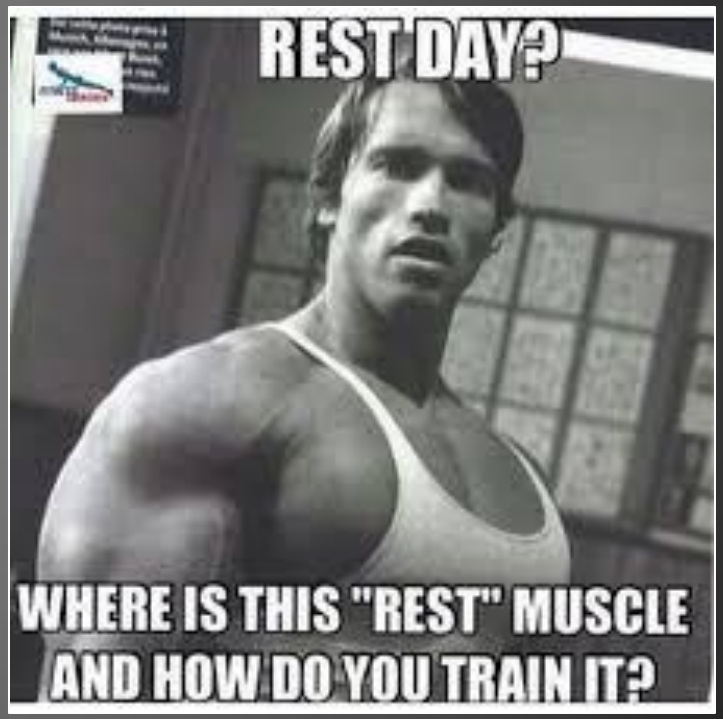
- Directional loading (Contreras)
  - Axial (Squats)
    - ↑ Vertical power
    - Lower glutes > upper glutes
    - Aesthetic benefits
  - Horizontal (Thrusts)
    - ↑ Anterior / forward power (sprinting)
    - Equal lower and upper glutes
  - Frontal plane (Lateral)
    - Upper glutes

Training Variables
Stable vs Unstable

- Unstable Surface Training
- McBride, ‘06
  - Squatting on dynadisc
  - Peak force: ↓ 45.6%
  - Rate of force development: ↓ 40.5%
  - ↓’d mechanical tension development
- Best utilized for core
  - Sternlicht ’07, Vera-Garcia ‘00
  - ↑’d activation of RA and external oblique on physioball

Training Variables
Muscular Failure

- "Necessary to maximize the hypertrophic response"
- Recruitment of greater # of motor units
- Increases metabolic stress
  - Maximizes hypertrophic response
- Linnamo, '05
  - 10RM set to failure = greater elevation in GH secretion than set not to failure
- Concern: overtraining/burnout



Putting it all together…

- Hypertrophic gains
  - Volume dependent
  - Maximized with moderate intensity (6-12 reps)
  - Maximized with higher metabolic stress
  - Integrate “sets to failure”
  - “Vary the Variables” (Intensity, speed, rest , ecc vs conc, specific exercises)
- Strength gains
  - Load dependent (heavy)

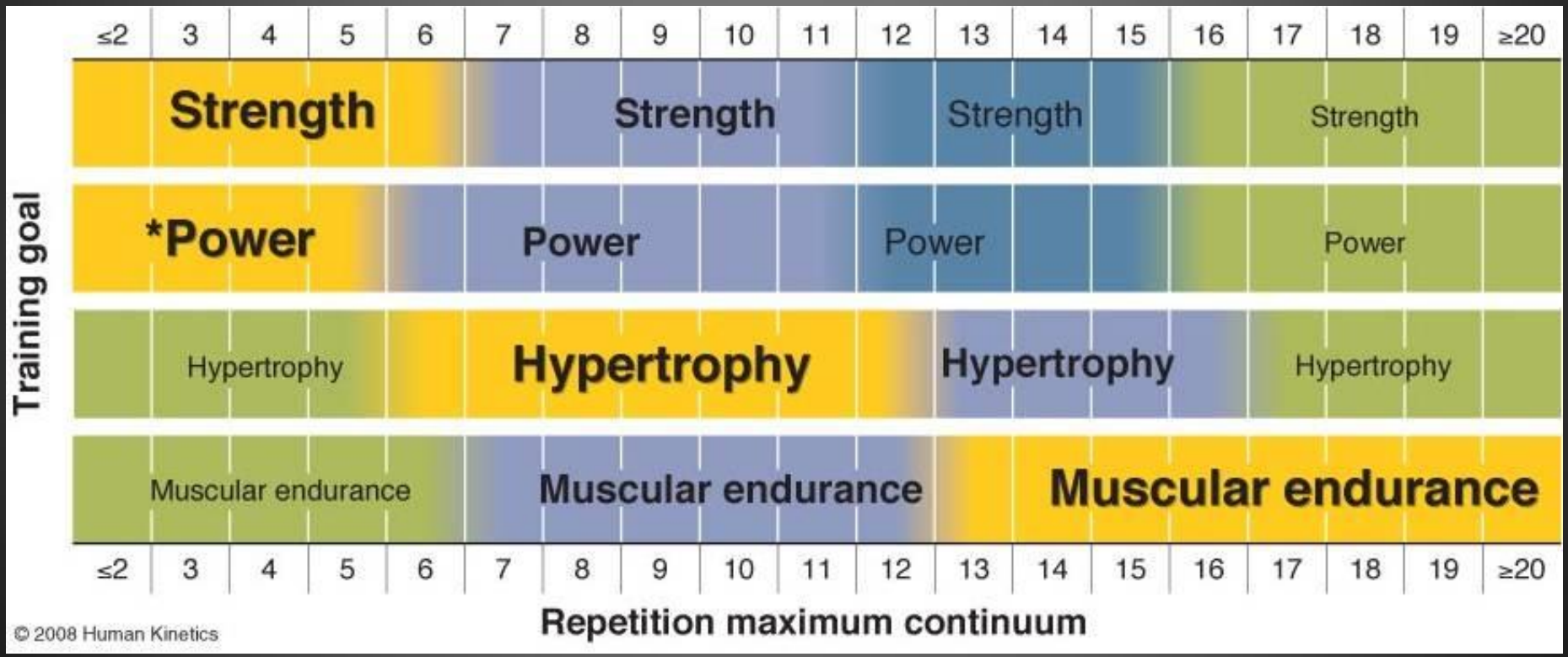
But……

- Schoenfeld ’17 (Meta-Analysis)
  - Untrained subjects
  - Effects of high vs. low load
    - High load = 35.4% increase in 1RM
    - Low load = 28% increase in 1RM

- Schoenfeld ‘16
  - Trained subjects
  - Squat 1RM
    - High load: ↑ 30%
    - Low load: ↑ 16.8%
  - Bench 1RM
    - High load: ↑ 14.4%
    - Low load: ↑ 10.5%

“There is significant flexibility in the loading ranges that can be prescribed to promote muscular strength and mass (hypertrophy).” Schoenfeld, 2017

Schoenfeld Strength-Endurance Continuum



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TRAINING STYLES

SCOTT MURRAY
NUTRITION TRAINING LIFESTYLE

GET STRONG	GET BIG	GET FIT
1-5 REPS	6-12 REPS	12-20+ REPS
80-90% 1RM	60-80% 1RM	40-60% 1RM
3-5min REST	1-3min REST	<60sec REST

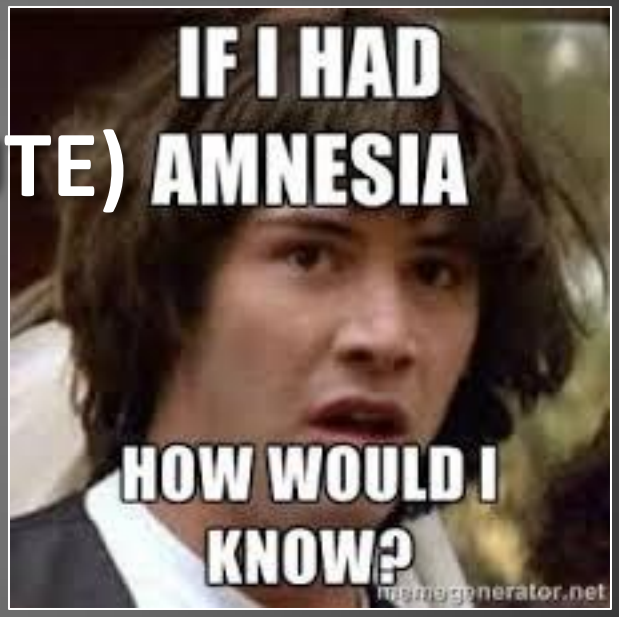
wearegymaddict @smurray_323
ways to train👇

But…… (Part II)

- Untrained individuals
  - Initial apparent increases in strength are probably not due to true "strength" gains
  - "Neural Adaptation," "Neuromuscular Re-ed"
    - Improvements in the ability of the CNS to efficiently coordinate muscle activity
- Rehab Considerations?
  - Are we truly "strengthening" our patients?
  - What happens after neural adaptation phase is completed?

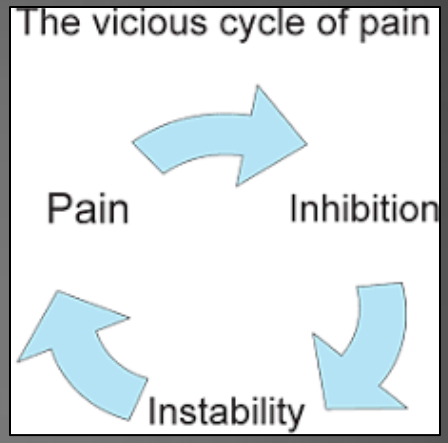
Glute Weakness….or Inhibition?

"Glute Amnesia"
-Stuart McGill



“Glute Killers”

- Pain / Injury
  - Reflex inhibition
  - May require “waking up”
- Synergistic Dominance
  - TFL
  - Hamstrings
- Quad Dominance
  - Running/sprinting
  - Squatting

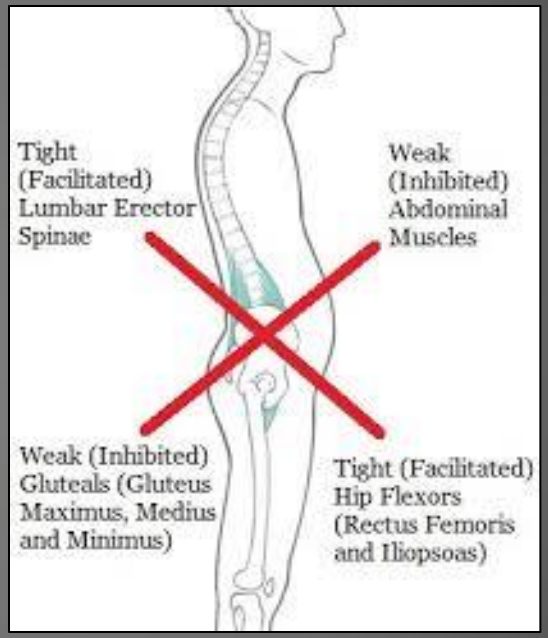


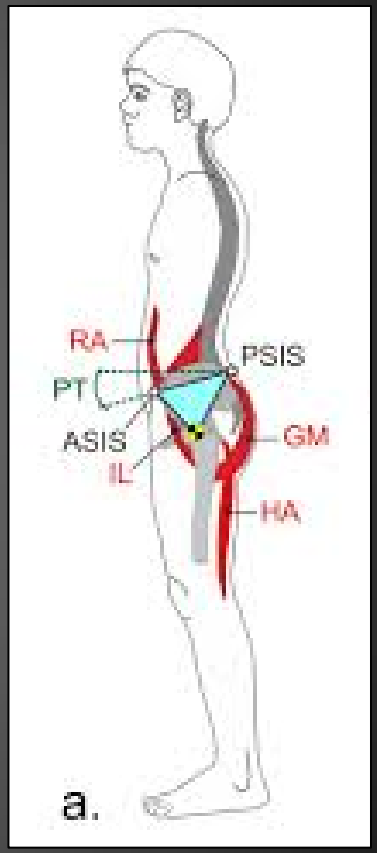
“Glute Killers”

- Postural: Sitting
  - Compression
    - ↓’d vascular function
    - Inhibits nerve function
  - Hip flexor tightness
  - Inactivity
    - ↓ activation
- Postural: “Stretch Weakness”

Hip flexor tightness
"Lower Cross Syndrome"

- Tight / Overfacilitated
  - Thoraco-lumbar muscles
  - Hip flexor complex
    - Iliopsoas
    - Rectus femoris
  - QL, TFL
- Reciprocal Inhibition
  - Glute Max, Med, Min
  - Rectus abdominus



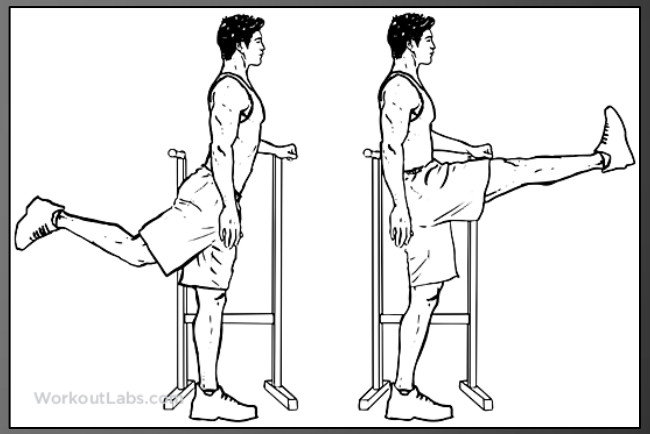


Result: Anterior Pelvic Tilt

Length-Tension Issues

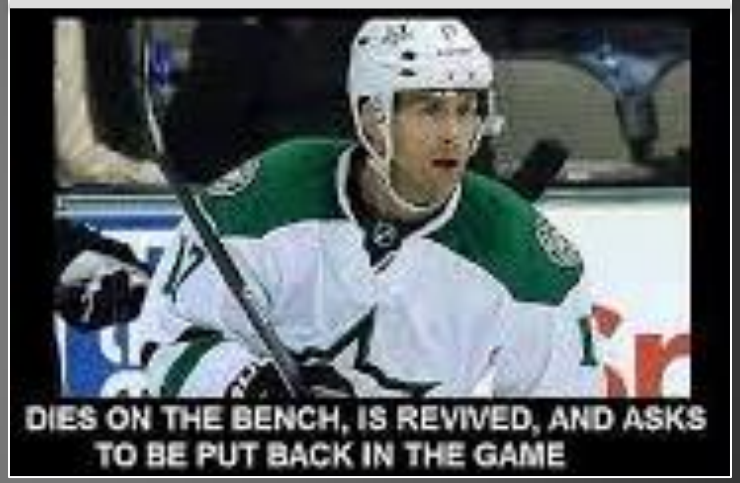
Rehab Programming

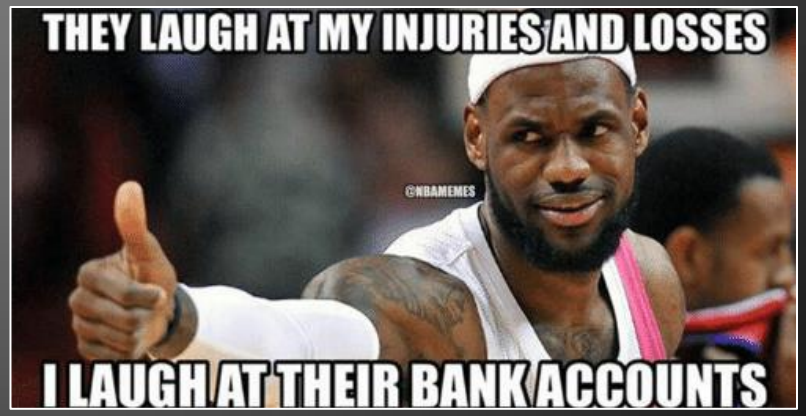
- Inhibit overactive mm
  - STM
- Stretching
  - Dynamic
  - Static
- Glute Activation Drills
- Strengthening



Glute Weakness
Injury Considerations

- Multiple implications
  - Lumbo-sacral spine
  - Hamstrings
  - Lower extremity
    - ACL
    - PF
    - Ankle/foot
  - Upper extremity





Glute Weakness
Lumbo-Sacral Spine Injury

- ↓ Stabilization of SI joint
- ↓ Control of frontal plane (via pelvic control)
- ↓ Control of anterior pelvic tilt
  - Lumbar extensor hypertonicity/spasm
  - Reflex inhibition of glute max, abdominals
- Spondylolysis/Spondylolisthe ?

Glute Weakness
Hamstring Injury

- Synergists
- Glute weakness / fatigue
  - Compensatory HS over-activation
    - Micro-damage
    - Higher metabolic output
    - Higher mechanical loadng
  - Fatigue
    - ↓ energy absorption capability

FATIGUE!

Glute Weakness
Hamstring Injury

- Hamstring tightness = ↑ "Irritability Threshold"
  - Stretch reflex
- Tightness vs Active Tension
  - Wagner '10
    - Case report: triathlete with HS cramping
    - Failure of previous HS rehab
    - Glute focus
    - ↑ hamstring "flexibility" despite no stretching

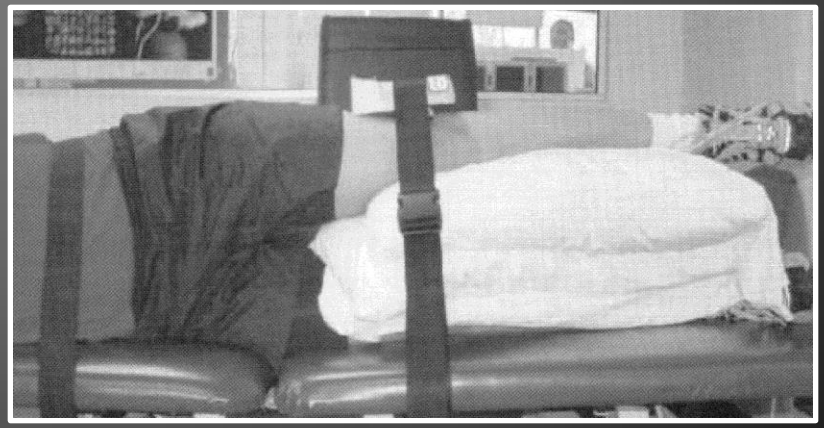
Glute Weakness
Patello-Femoral Pain

Patients with PFP may have altered glute med/max activation during functional activities such as running, jump landing, stair climbing and squatting.

Aminaka, J Electromyogr Kinesiol ’11
Bolgla, Int J Sports Phys Ther ’11
Brindle, Knee Surg Sports Traum Arthr ’03
Cowan, Br J Sports Med ’09
Souza, JOSPT ’09
Wilson, Clin Biomech ’11

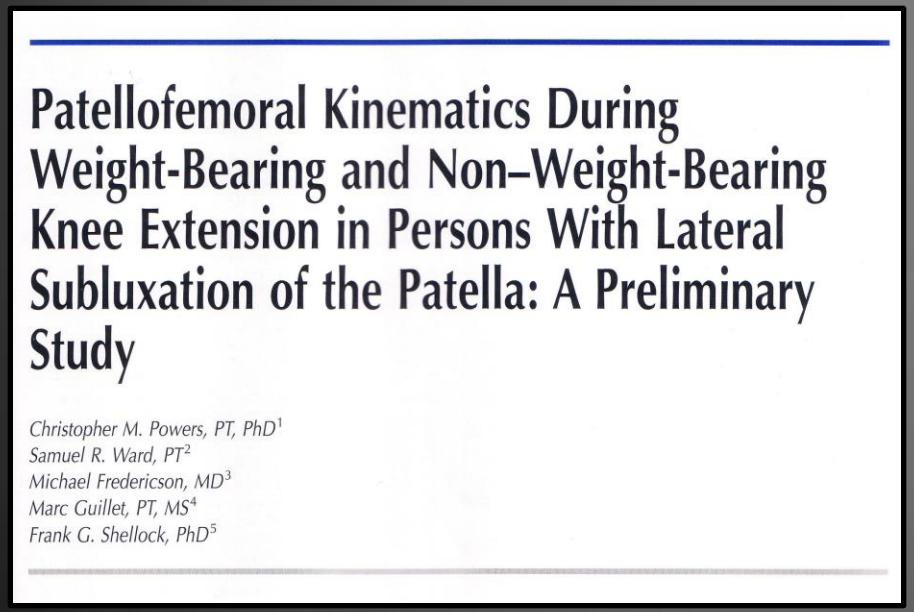
Glute Weakness
Patello-Femoral Pain

JOSPT ’03



Proximal Influence on P-F Joint

Powers, JOSPT '03

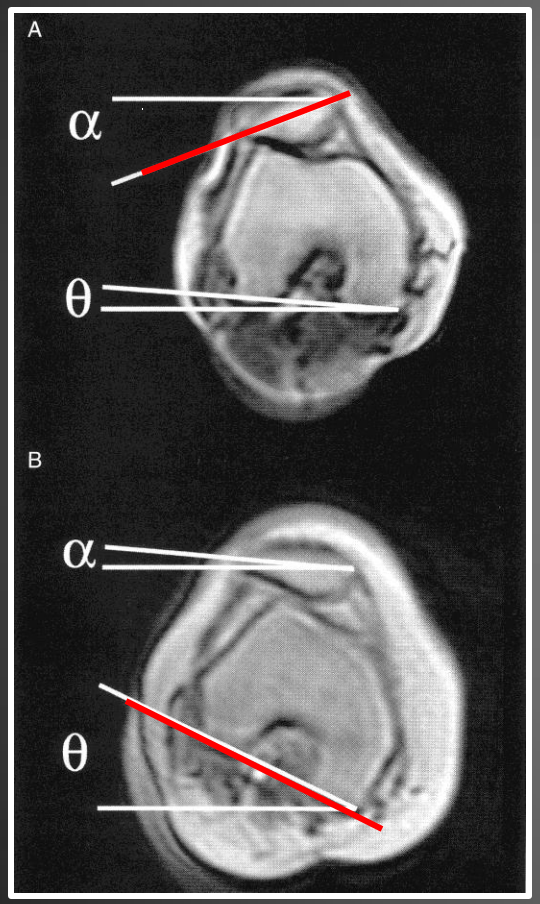


Patellofemoral Kinematics During Weight-Bearing and Non–Weight-Bearing Knee Extension in Persons With Lateral Subluxation of the Patella: A Preliminary Study

Christopher M. Powers, PT, PhD[1]
Samuel R. Ward, PT[2]
Michael Fredericson, MD[3]
Marc Guillet, PT, MS[4]
Frank G. Shellock, PhD[5]

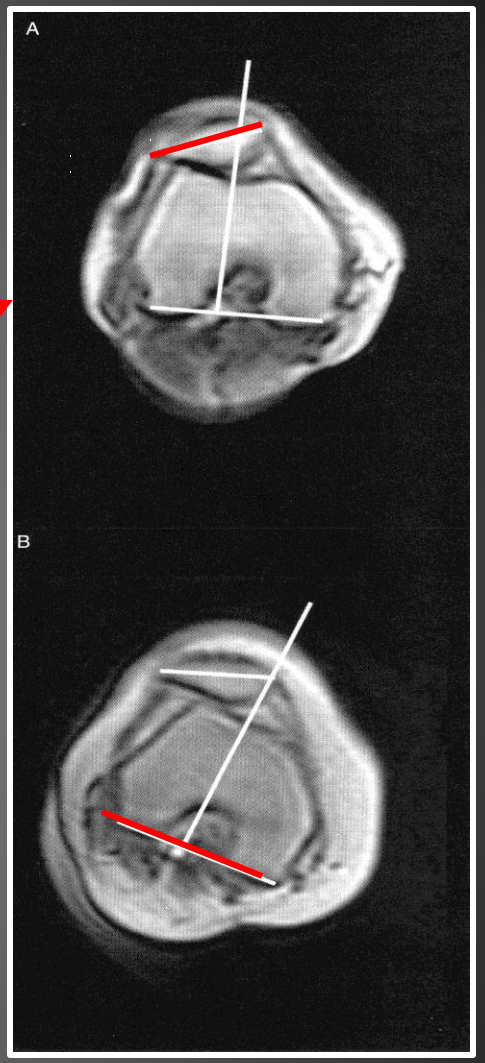
- NWB
  - Patella rotates and displaces on femur
- Weightbearing
  - Femur rotates under patella

Powers, JOSPT ’03



NWB

WB



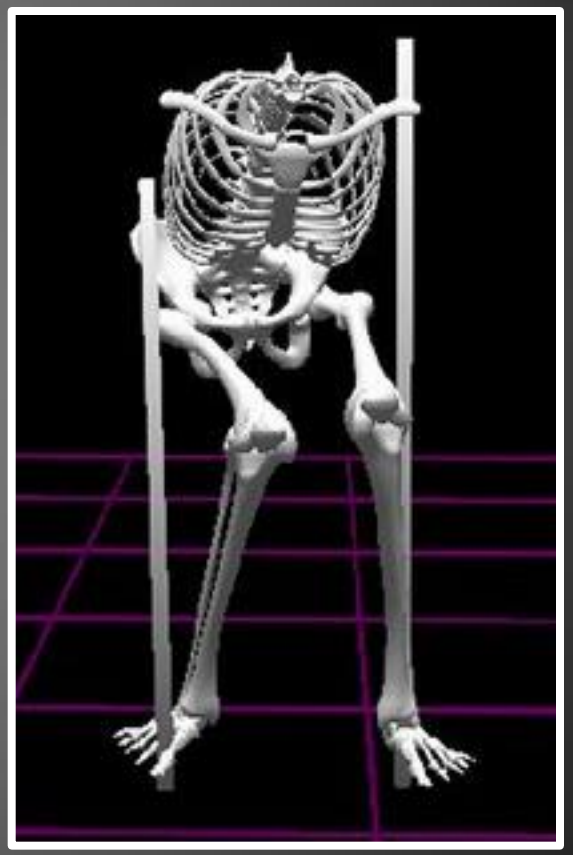
Patellar Tilt

Patellar Displacement

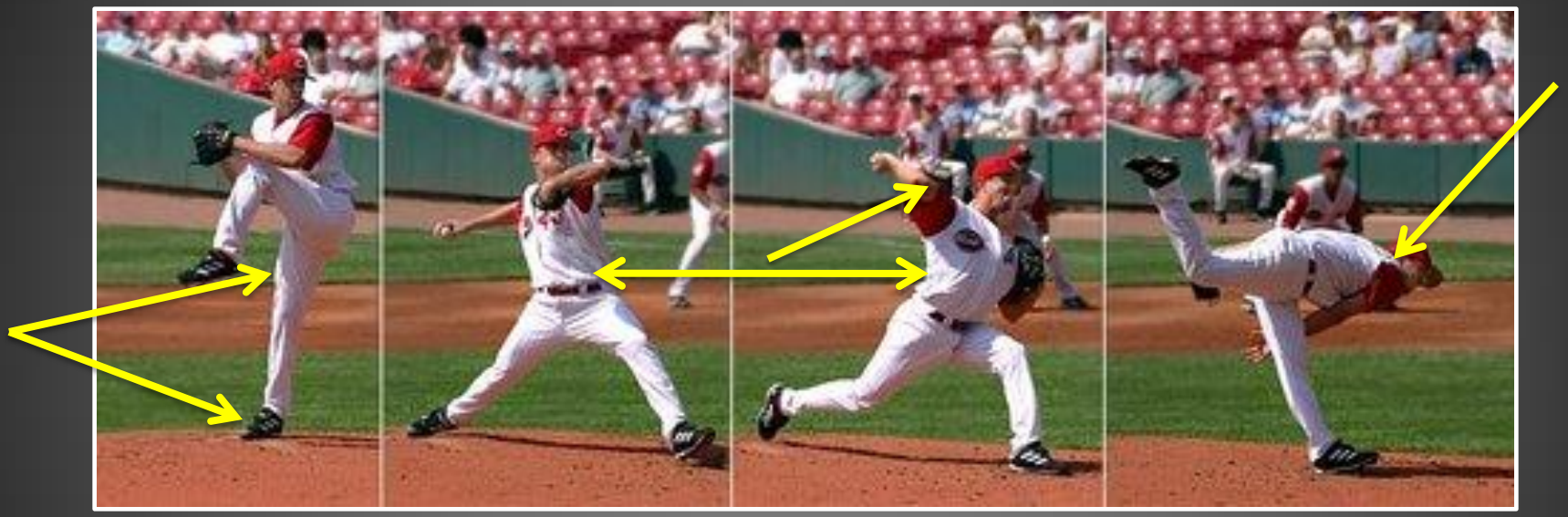
Pathomechanics

Valgus Posture

- Dynamic valgus collapse
  - Most common MOI in females
- Hewett, AJSM ‘05
  - Female ACL subjects
  - Valgus moments 2.5x non-injured subjects
  - Primary predictor of ACL injury risk
    - Valgus angles
    - Valgus moments



Upper Extremity Injuries
Kinetic Chain Principle



Development of pitching velocity begins at the ground

Goals of Kinetic Chain

- Shoulder does not function in isolation
- Lower extremity force production vital for increased ball velocity
- Alterations in previous links can significantly affect shoulder

Must assess core/glute strength!!!

Upper Extremity Injuries

SPORTSMETRICS™ USA

Cincinnati SportsMedicine & Orthopaedic Center

Noyes, Hewett; Cincinnati Sports Medicne

- Hewett, AJSM ’96; AJSM ’99
  - Jump retraining/plyometrics
    - ↓ peak GRF
    - ↓ hip abd/add moments
    - ↑ LE mm power
    - ↓ incidence of knee injury
  - Dynamic warmup
  - Strength training
  - Flexibility training

Initial strength levels?

“Glute Activation Drills”

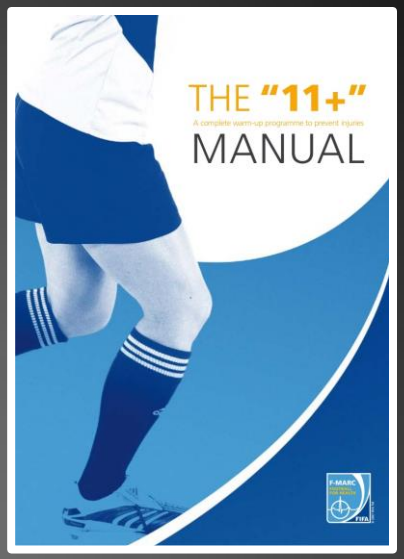
Mandelbaum, Santa Monica Sports Medicine

- Pre-game program (on-field), 15-20 minutes
- Program components
  - Warm-up
  - Stretching
  - Strengthening
  - Plyos
  - Agility
  - Jump education

Downloadable PDF of Program: http://smsmf.org/smsf-programs/pep-program

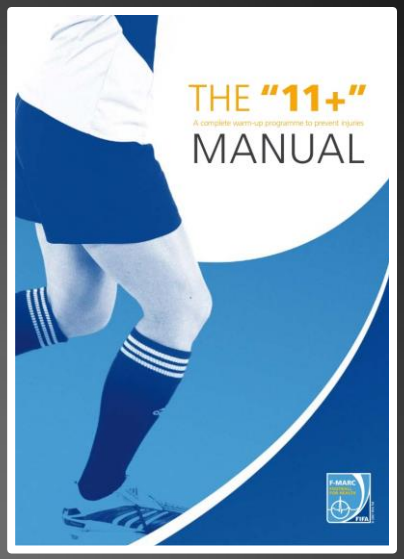
Mandelbaum, '05
Santa Monica
Sports Medicine

- 2 year study
- Trained Group: 6 ACL tears / 67,860 exp
- Untrained Groupd: 67 tears / 137,448 exp
- Overall
  - Year 1: 88% ↓ risk of ACL injury
  - Year 2: 75% ↓ risk of ACL injury

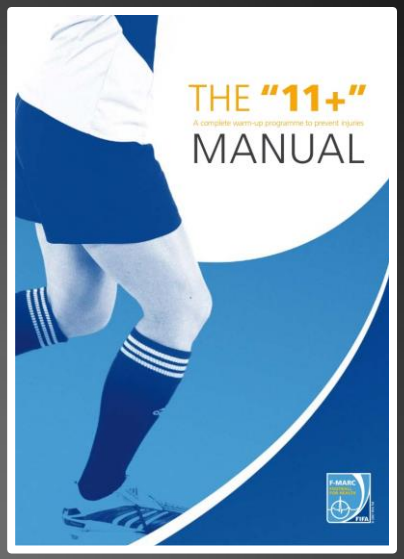


- FIFA 11+ = "Activation Drills"
  - Rectus abd, glute complex
- Running/jumping technique
- Strengthening: Core and Legs
- Plyos, agility, balance

Proper N-M control at all times!

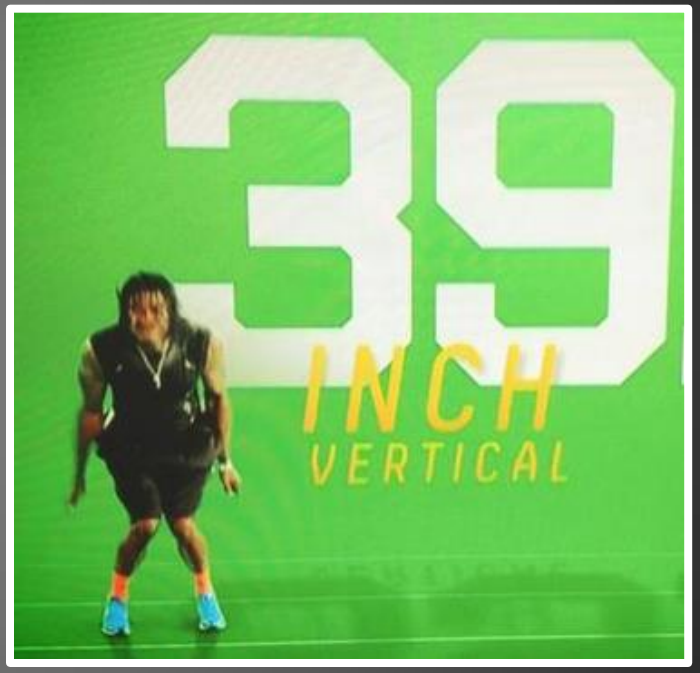


- FIFA 11+ = "Activation Drills"
  - Rectus abd, glute complex
- Performance benefits
  - Daneshjoo '13
    - Quad peak torque: ↑ 27.7%
    - Ham peak torque: ↑ 22%



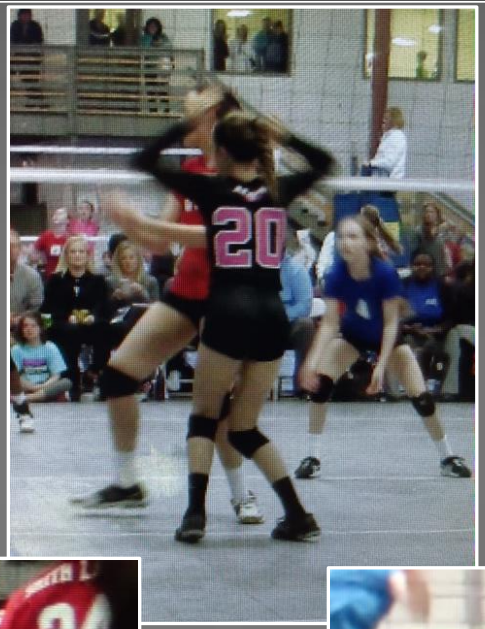
- Injury Prevention
  - Silvers ‘15
    - ↓ injury rate by 46.1%
  - Grooms ’13
    - 72% ↓ injury risk
  - Owoeye ‘14
    - ↓ injury rate by 41%
- Compliance
  - Inversely correlated with injury rate

Strengthening…



…or technique?

The Best for Last…



Glute Strengthening

- More confused now than before!!!
- “I heard the best exercise is…””But I just read the best exercise was…”
  - both may be correct!
- Bishop ‘18
  - Clams with and without resistance displayed most optimal Glute Med/TFL ratio
- McBeth ‘12
  - “…the rationale for performing the clam exercise is not supported by anatomical or EMG data; therefore we question the relevance of the exericse.”

Glute Strengthening

- Many problems with interpreting research
  - Methodology
  - "Standardized" exercise techniques?
  - Variables affecting glute activation/EMG
    - Exercise
    - Body position
    - Complexity
    - Surface
    - Electrode placement (surface)
    - Cuing
    - "Conscious" activation

Glute Strengthening

- Many problems with interpreting research
  - Most functionally pertinent info?
    - Absolute glute EMG?
    - Glute/Synergist ratio?
      - Hamstrings
      - TFL
  - Subjects
    - Male vs female
    - Trained vs untrained
    - Unidentified weaknesses
    - Symptomatic or asymptomatic subjects
    - Level of cuing by investigators

Glute Strengthening

- Factors that can affect activation patterns
  - Underlying glute weakness
  - Hamstring dominance
  - TFL dominance
  - Quad dominance
  - Hip flexor tightness
  - Subtle technique flaws

Glute Strengthening

- EMG Thresholds
  - Strength: ≥ 40% MVIC
  - Endurance: < 25% MVIC
- Benefits of < 40% MVIC
  - Treatment goals?
    - Initial strength level?
    - NM activation/motor control
    - Muscular endurance
  - Baseline for graduated loading program

Glute Medius EMG Results
“Low” Activation

Ebert JR, Edwards PK ‘17 (Meta-Analysis)

Standing:
20% MVIC

Gluteus Medius EMG
"Moderate" Activation

Ebert JR, Edwards PK '17 (Meta-Analysis)

Exercise	% MVIC
Front lunge	19-42%
Side Lunge	39%
Standing hip circum – WB/Unstable	38%
Prone hip extension – Knee flexed	38%
Standing hip abduction - NWB	28-33%
Supine bridge	15-28%
Prone plank – Double leg	27%
Single leg stance - Unstable	25%

Gluteus Medius EMG
"High" Activation

Ebert JR, Edwards PK '17 (Meta-Analysis)

Exercise	% MVIC
Single limb deadlift / hinge	56-58%
Single leg bridge – Stable	47-55%
Standing Glute set	48%
Transverse lunge	48%
Single leg bridge – Unstable	47%
Quadruped bent knee hip ext – NWB	31-47%
Clamshell	27-47%
Standing hip abduction – WB	42-46%

Gluteus Medius EMG
"High" Activation

Ebert JR, Edwards PK '17 (Meta-Analysis)

Exercise	% MVIC
Single leg squat - Unstable	60%
Single limb skater squat	60%
Lateral band walk	15-58%
Pelvic drop	38-58%
Standing hip swing - WB	57%
Standing hip circum – WB / Stable	57%
Single leg wall squat	52%

Gluteus Medius EMG
"Very High" Activation

Ebert JR, Edwards PK '17 (Meta-Analysis)

Exercise	% MVIC
Sidelying abduction	42-100%
Single leg squat - Stable	42-82%
Clamshell IR	63-77%
Front step-up	44-63%
Lateral step-up	38-61%

Gluteus Medius EMG
"Very High" Activation

Ebert JR, Edwards PK '17 (Meta-Analysis)

Exercise	% MVIC
Side plank w/abduction – WB	103%
Prone plank w/bent knee hip ext – WB	103%
Side plank w/abduction – NWB	89%
Prone plank w/bent knee hip ext - NWB	75%
Side plank – WB	74%

WB vs. NWB Leg

- Stabilization of pelvis
- Lateral force generation
  - Sidestepping
  - Pelvic hiking
- Stabilization for contralateral hip movement
- Control of lower extremity posture
- Contralateral carrying load

Lateral Trunk Lean

Hip Thrusts

Points to Ponder

- Activation pattern highly “pt dependent”
- “Mind – Glute Connection”
- Benefits of extension to exercise technique?
- Functional difference of 10-15% EMG?
- Rotation with SLR-Abduction?
- Hip flexion angle with clams?
- Bridges: Benefit of anterior resistance
- Significance of Glute/TFL or Hamstring ratio?

“Play” with the technique!

Most important considerations…

Where does the patient “feel” the exercise?

Volitional Glute Activation

Video Analysis

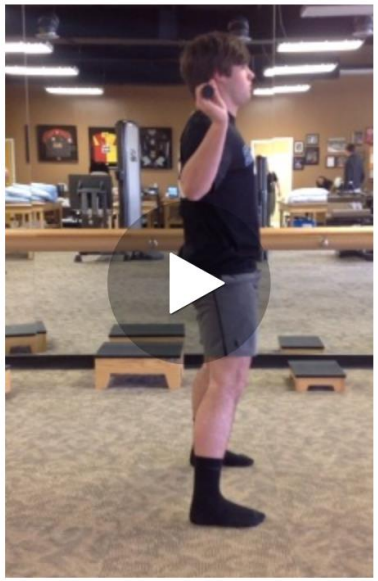
hudl

Video Analysis

hudltechnique
FORMERLY ubersense

This is a reminder that I shared a video with you. You can watch this video online or play in slow-motion using the free Hudl Technique app. Click below before the link expires:

View Your Video



This video was made using Hudl Technique.

Get the free app to analyze your sports technique in slow-motion, draw on videos, and compare yourself to downloadable pro videos.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THANK YOU!


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