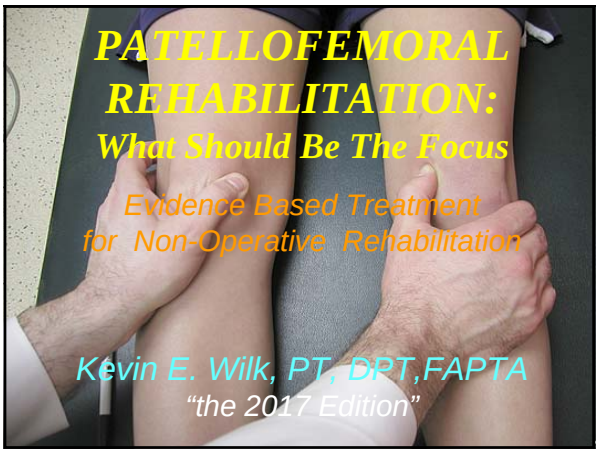


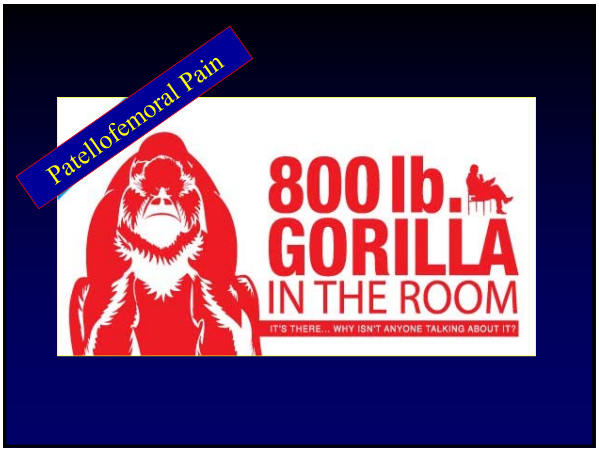
Metcalf/AANA Combined Surgery Seminar 2017

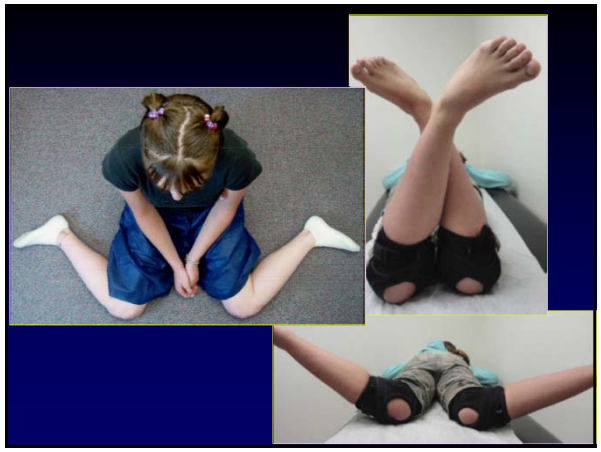
I (and/or my co-authors) have something to disclose.

Detailed disclosure information is available via:
Printed Final Program

or

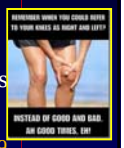
AAOS Orthopaedic Disclosure Program on the AAOS website at
http://www.aaos.org/disclosure





PATELLOFEMORAL DISORDERS
Introduction

- Common knee pathology encountered by orthopaedic / sports medicine clinicians
- In the general population, 1 out of 4 experience PFPS at some time in their lives

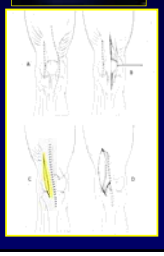


✓ *2007-11: 2,188,753 people Dx with PFPS*
- ✓ *Females 1.2 million cases (common age 50-59*

Giaviano et al: IJSPT '15

Common Problem
Often Difficult to Successfully Treat

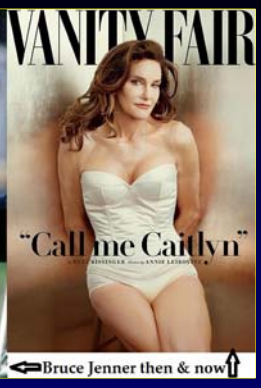
PATELLOFEMORAL DISORDERS
Introduction



- ✓ Vexing clinical challenge
- ✓ "Black hole of Orthopaedics" *Dye:Sports Med Arthro Review* '94
- ✓ No single explanation has clarified this problem
- ✓ No single surgery or therapeutic approach solves all PF dysfunctions

Challenging Patient Population

Patellofemoral Rehabilitation
Then & Now



Patellofemoral Rehabilitation
Then & Now

SLR (?) ***Bridging (!)***

Patellofemoral Rehabilitation
Then & Now



Hip Adduction (?) ***Hip Abd & ER (!)***

Patellofemoral Rehabilitation
Then & Now



VMO Strengthening (?) *Gluts Med & Max (!)*

PATELLOFEMORAL DISORDERS
1980 & 90's Treatments Focused On:

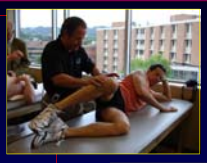
- ✓VMO strengthening
- ✓Patellar taping
- ✓Activation VMO
- ✓Patellar bracing
- ✓Foot orthotics
- ✓Stretching / flexibility

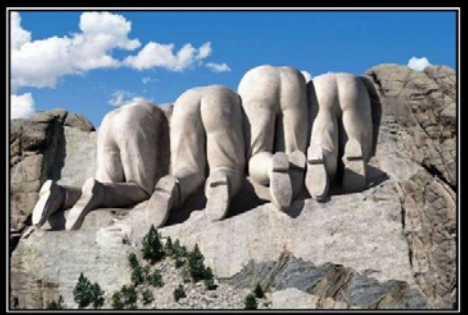


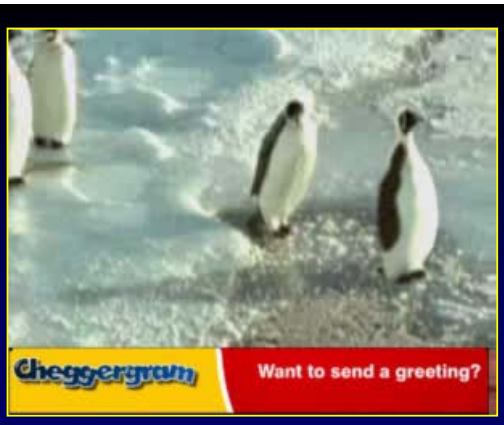


PATELLOFEMORAL DISORDERS
Current Treatments Focuses On:

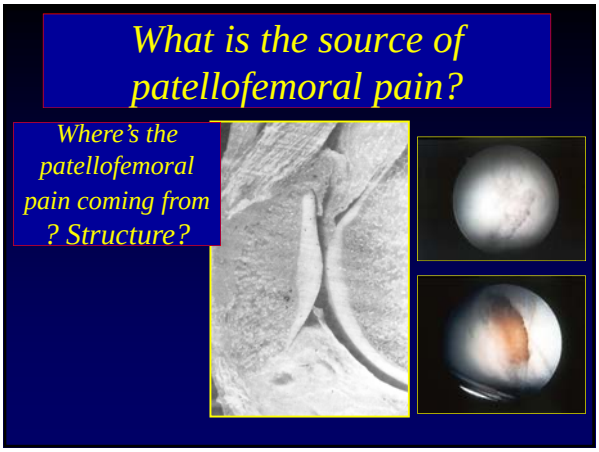
- ✓Hip strengthening
- ✓Pelvic control
- ✓Core strength
- ✓Knee joint proprioception
- ✓Stretching / flexibility
- ✓Orthotics

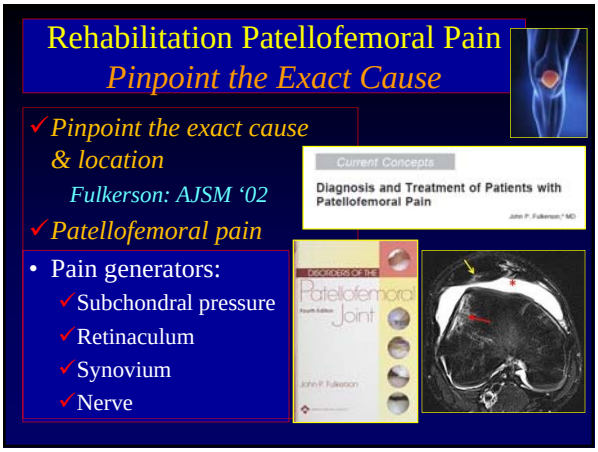


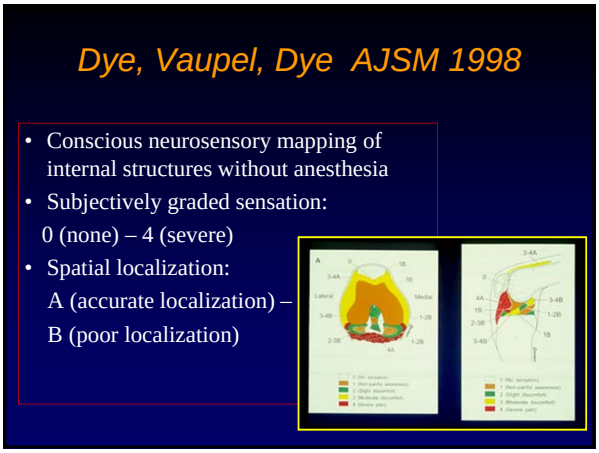

MT. RUSHMORE
The backside

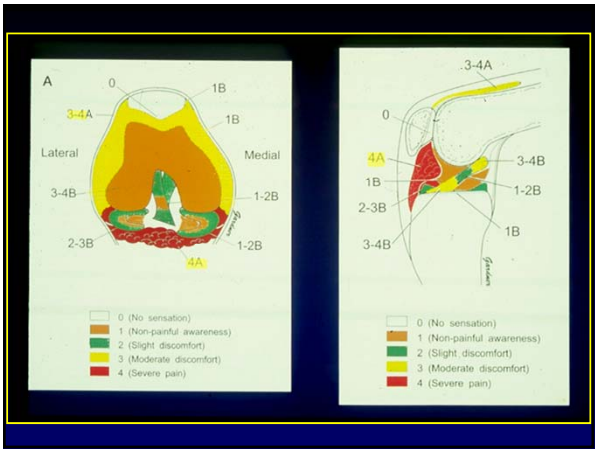



J Tracking


What is the source of patellofemoral pain?
Where's the patellofemoral pain coming from ? Structure?


Rehabilitation Patellofemoral Pain
Pinpoint the Exact Cause
✓Pinpoint the exact cause & location
Fulkerson: AJSM '02
✓Patellofemoral pain
• Pain generators:
✓Subchondral pressure
✓Retinaculum
✓Synovium
✓Nerve
Current Concepts
Diagnosis and Treatment of Patients with Patellofemoral Pain


Dye, Vaupel, Dye AJSM 1998
• Conscious neurosensory mapping of internal structures without anesthesia
• Subjectively graded sensation:
0 (none) – 4 (severe)
• Spatial localization:
A (accurate localization) –
B (poor localization)


Lateral
Medial
0 (No sensation)
1 (Non-painful awareness)
2 (Slight discomfort)
3 (Moderate discomfort)
4 (Severe pain)

Fulkerson, et al Clin Orthop 1985

- Small nerve injuries in the lateral retinaculum
- Nerve fibers appeared enlarged & inflammation present
- Potential source of PF pain – long lasting PF pain

Classification System for Non-Operative Rehabilitation

Wilk, Davies, Mangine, Malone: JOSPT '98

Patellofemoral Disorders: A Classification System and Clinical Guidelines for Nonoperative Rehabilitation

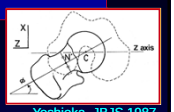
Patellofemoral Pain Syndrome

Clinical Differential Diagnosis

- ✓ Patellar Compression Syndrome
  - » ELPS
  - » GPPS
- ✓ Patellar instability
  - » Chronic instability
  - » Recurrent dislocation
  - » Acute dislocation
- ✓ Mechanical dysfunction
  - Abnormal biomechanics
- ✓ Osteochondritis dissicans
- ✓ Direct patellar trauma
  - » Fracture
  - » Fracture / dislocation
- ✓ Soft tissue lesion
  - » Suprapatellar plica
  - » Fat pad syndrome
  - » IT band friction
- ✓ Overuse syndrome
  - » Tendonitis
- ✓ Neurologic disorders (RSD) Regional Pain Syndrome

Increased Femoral Anteversion

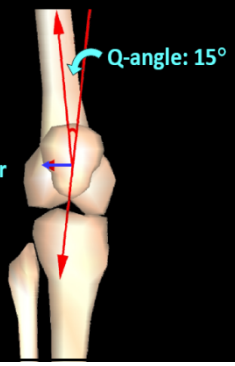
- ↑ femoral torsion
- ↑ forces patellofemoral joint



Yoshioka JBJS 1987

Bob Teitge, MD

Lower limb alignment & lateral forces on the patella

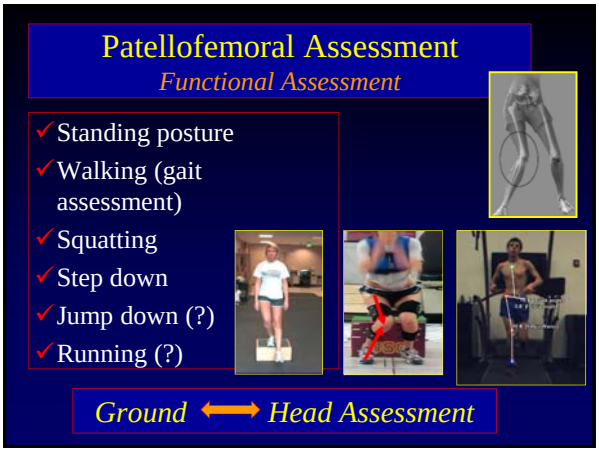


Dynamic Q-Angle

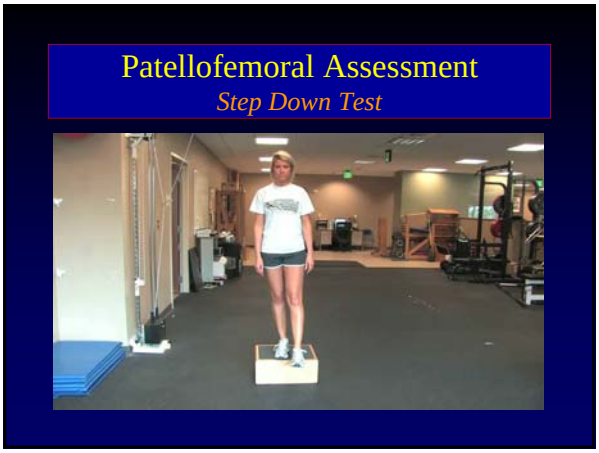
- **Proximal factors**
  - Femoral adduction
  - Femoral internal rotation
- **Distal factors**
  - Pronation
  - Tibial internal rotation

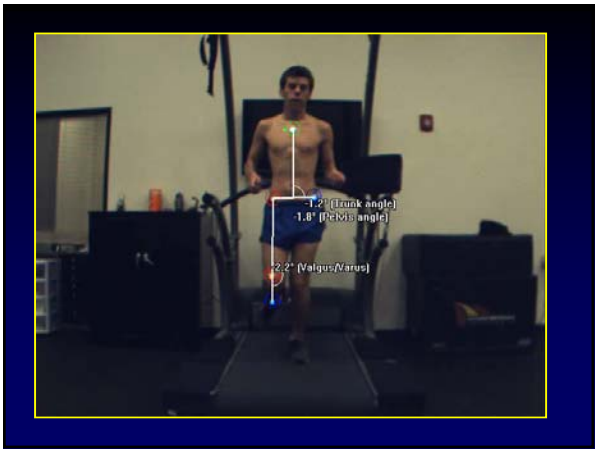

Stabilization From ABOVE & BELOW
the Tightrope of Life


ACL REHABILITATION
Rehab Concepts
• "Stabilization of the knee - occurs from above & below"
» Hip & core stabilization
» Foot & ankle control
Wilk et al: Ortho Clin No Am '03
Powers et al: JOSPT '03
Wilk et al: J Athl Trn '99

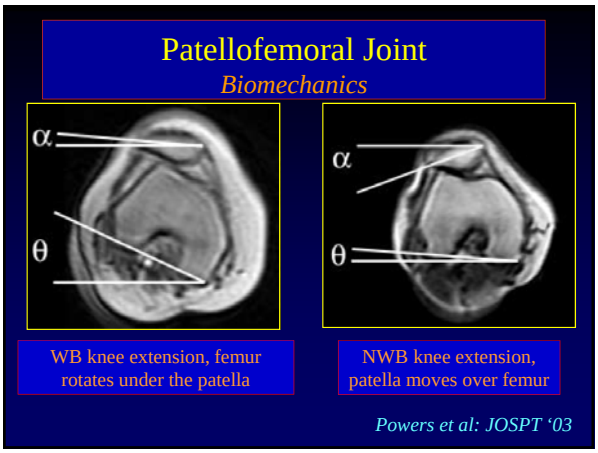

Patellofemoral Assessment
Functional Assessment
✓Standing posture
✓Walking (gait assessment)
✓Squatting
✓Step down
✓Jump down (?)
✓Running (?)
Ground ⟷ Head Assessment

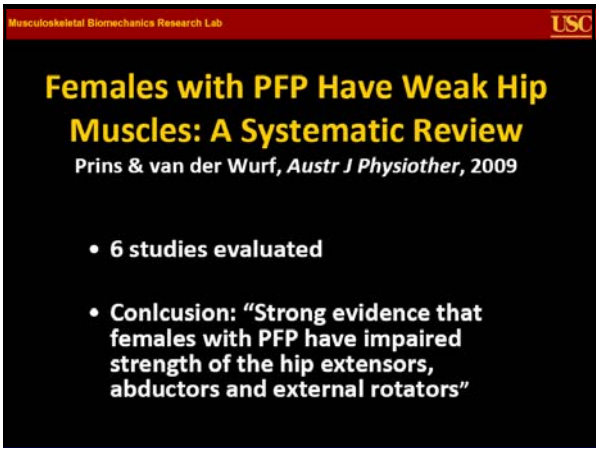

Patellofemoral Assessment
Step Down Test

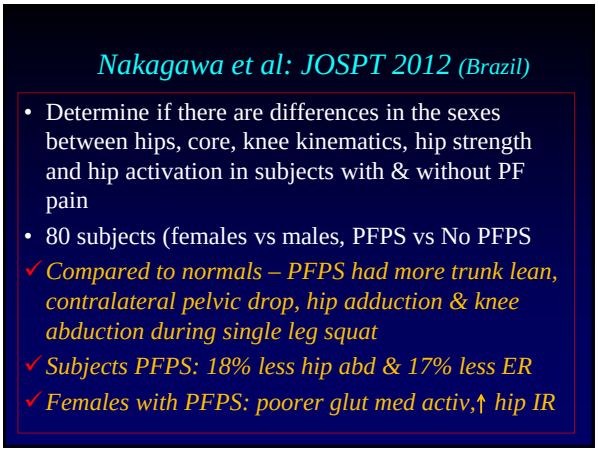

Patellofemoral Assessment
Step Down Test




Train on the Train Tracks


Patellofemoral Joint
Biomechanics
α
θ
α
θ
WB knee extension, femur rotates under the patella
NWB knee extension, patella moves over femur
Powers et al: JOSPT '03

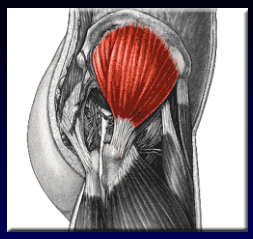

Musculoskeletal Biomechanics Research Lab
USC
Females with PFP Have Weak Hip Muscles: A Systematic Review
Prins & van der Wurf, Austr J Physiother, 2009
• 6 studies evaluated
• Conlcusion: "Strong evidence that females with PFP have impaired strength of the hip extensors, abductors and external rotators"


Nakagawa et al: JOSPT 2012 (Brazil)
• Determine if there are differences in the sexes between hips, core, knee kinematics, hip strength and hip activation in subjects with & without PF pain
• 80 subjects (females vs males, PFPS vs No PFPS
✓ Compared to normals – PFPS had more trunk lean, contralateral pelvic drop, hip adduction & knee abduction during single leg squat
✓ Subjects PFPS: 18% less hip abd & 17% less ER
✓ Females with PFPS: poorer glut med activ,↑ hip IR

Patellofemoral Pain Syndrome
Treatment Approach

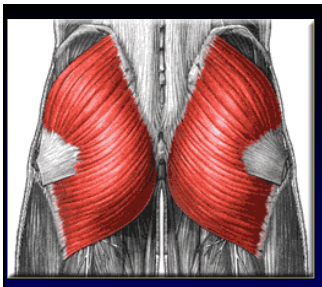
- ***Pain & Dysfunction:***
- Pain:
  - ✓Reduce soft tissue pain/inflammation
  - ✓Laser therapy
  - ✓"trick soft tissue stresses" (tape, hip activation)
  - ✓Ice, NSAIDs, brace
- Dysfunction:
  - ✓Correct biomechanics (hip & foot/ankle)
  - ✓Strengthen hip & core
  - ✓Modify activity level

Correct Altered Biomechanics Through Hip & Core Exercises



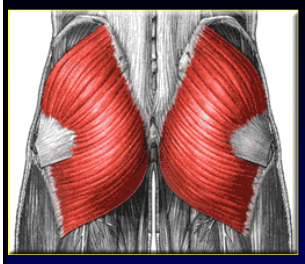
- **Gluteus Medius:**

Functions:
- Abduction
- Anterior fibers: IR & flexor
- Posterior fibers: ER & ext



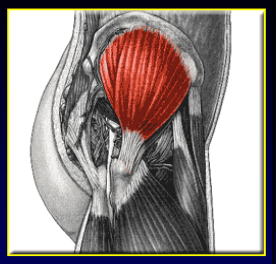
- **Gluteus Maximus:**

Tri-Planar Muscle
- *Extensor*
- *Abductor*
- *ER*



- **Gluteus Maximus:**

Tri-Planar Muscle
- *Extensor*
- *Abductor*
- *ER*



- **Gluteus Medius**

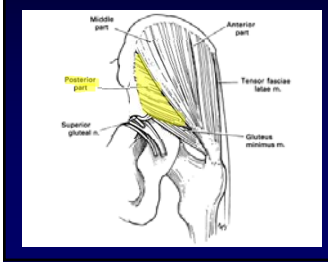
Functions:
- Abduction
- Anterior fibers: IR & flexor
- Posterior fibers: ER & ext

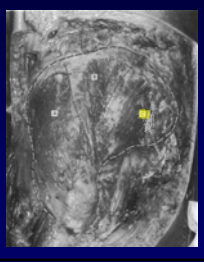
J Anat '89

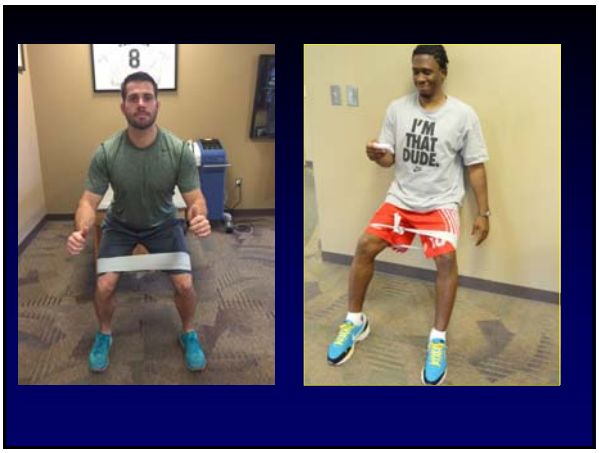
J. Anat. (1989), **166**, pp. 179-189
With 8 figures
Printed in Great Britain

The functional anatomy of tensor fasciae latae and gluteus medius and minimus

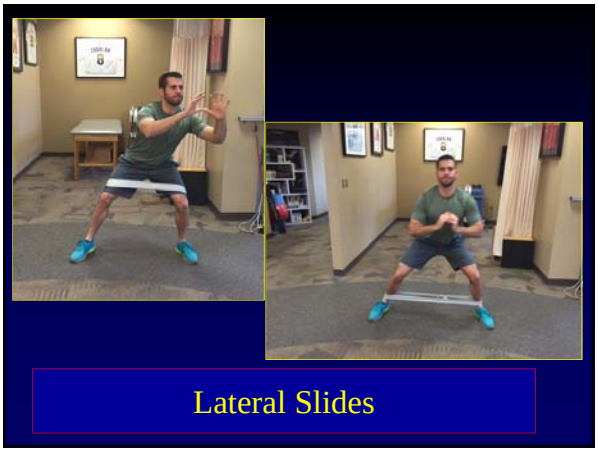
FRANK GOTTSCHALK, SOHRAB KOUROSH AND BARNEY LEVEAU*
*Division of Orthopaedic Surgery and * Department of Physical Therapy, University of Texas Southwestern Medical Center Dallas, 5323 Harry Hines Boulevard, Dallas, Texas 75235, USA*

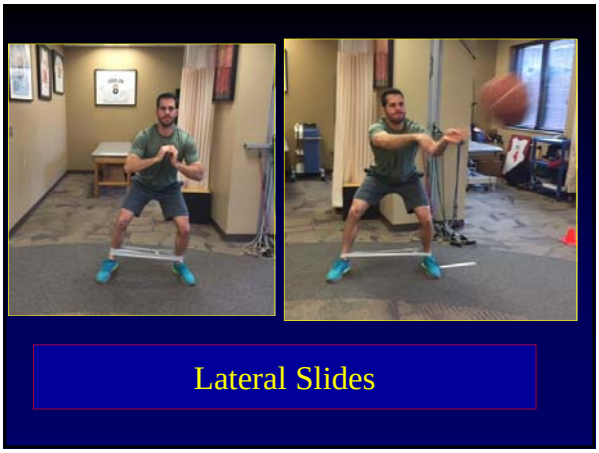




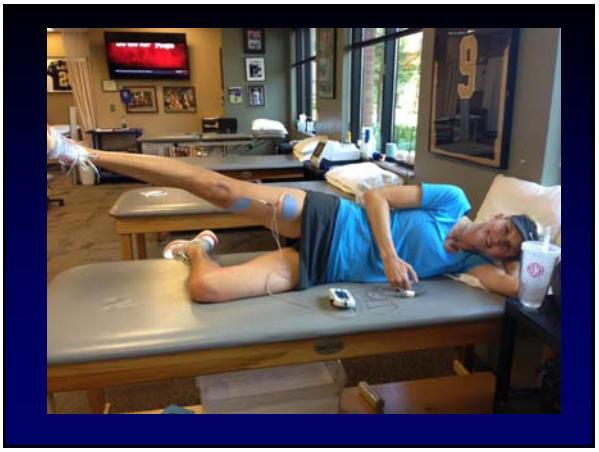

I'M THAT DUDE.


Bridging Exercises


Lateral Slides


Lateral Slides


RDLs



Rehabilitation Exercise Progression for the Gluteus Medius Muscle With Consideration for Iliopsoas Tendinitis

An In Vivo Electromyography Study

Marc J. Philippon,*†‖ MD, Michael J. Decker,§ PhD, J. Erik Giphart,† PhD, Michael R. Torry,† PhD, Michael S. Wahoff,¶ PT, SCS, and Robert F. LaPrade,†‖ MD, PhD

Investigation performed at the Steadman Philippon Research Institute, Vail, Colorado

Philippon:AJSM '11

TABLE 2
EMG Amplitude Ranks and Final Rank Order for Gluteus Medius Muscle Activation and Final Rehabilitation Phase Assignment[a]

Final Rank	Exercise	Concentric Phase PA	Concentric Phase AA	Eccentric Phase PA	Eccentric Phase AA	Rehabilitation Phase
1	Single-leg bridge	1	1	2	2	III
2	SL hip abduction–IR	2	2	3	4	III
3	Prone heel squeeze	5	4	1	1	III
4	SL hip abduction–wall	3	3	4	3	II
5	SL hip abduction–ER	4	5	5	6	II
6	Resisted hip extension	7	6	6	5	II
7	Traditional hip clam	6	7	7	7	II
8	Double-leg bridge	9	9	8	8	I
9	Hip clam–neutral	8	8	11	11	II
10	Stool hip rotations	11	12	9	9	II
11	Resisted knee flexion	13	10	12	10	I
12	Supine hip flexion	10	13	10	13	I
13	Resisted knee extension	12	11	13	12	I

[a]EMG, electromyography; PA, peak amplitude; AA, average amplitude; SL, side-lying; IR, internal rotation; ER, external rotation.

Philippon et al: AJSM '11

[RESEARCH REPORT]

LINDSAY J. DISTEFANO, PhD, ATC† • J. TROY BLACKBURN, ATC, PhD†
STEPHEN W. MARSHALL, PhD† • DARIN A. PADUA, ATC, PhD†

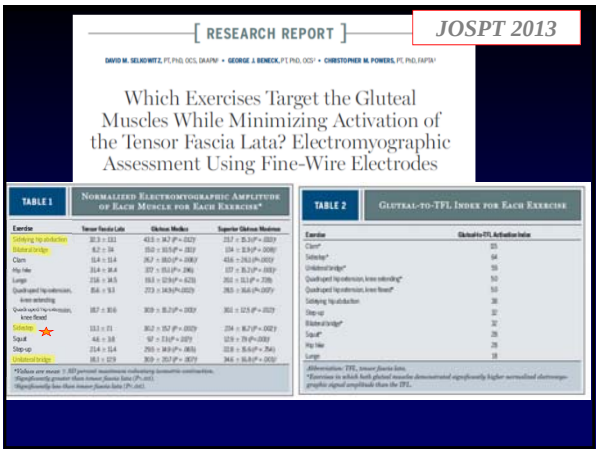
Distefano:JOSPT '09

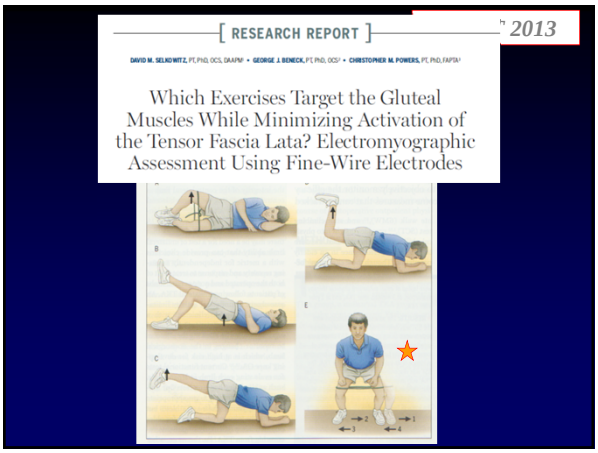
Gluteal Muscle Activation During Common Therapeutic Exercises

TABLE 2 Normalized Gluteus Medius Mean Signal Amplitude (% MVIC)

Exercise	Mean ± SD (95% CI)
Side-lying hip abduction	81 ± 42 (62, 101)
Single-limb squat	64 ± 24 (53, 75)
Lateral band walk	61 ± 34 (46, 76)
Single-limb deadlift	58 ± 25 (47, 70)
Sideways hop	57 ± 35 (41, 73)
Transverse hop*	48 ± 25 (37, 59)
Transverse lunge*	48 ± 21 (38, 57)
Forward hop*	45 ± 21 (38, 57)
Forward lunge*†	42 ± 21 (33, 52)
Clam with 30° hip flexion*	40 ± 38 (23, 57)
Sideways lunge*†	39 ± 19 (30, 47)
Clam with 60° hip flexion*†	38 ± 29 (25, 51)

Abbreviations: CI, confidence interval; MVIC, maximum voluntary isometric contraction.
** Exercises are significantly different than the hip abduction exercise (P<.05).*
† Exercises are significantly different from the single-limb squat (P<.05).





My Favorite Hip Exercises

- ✓ Bridging bilateral &/or single leg
- ✓ Hip abduction (sidelying &/or wall)
- ✓ Single leg balance
- ✓ Step downs (single leg squat)
- ✓ Lateral slides (with resistance bands)
- ✓ Squats with hip abduction
- ✓ RDLs
- ✓ Clams
- ✓ Side Plank with hip abduction
- ✓ Quadruped hip extension
- ✓ Star drill

Hip Exercises
Phase I

- ✓ Bridges (bilateral ⟶ unilateral)
- ✓ Sidelying hip abduction
- ✓ Planks (prone & side)
- ✓ Seated resistance band ER
- ✓ Clams
- ✓ Squats with hip abduction
- ✓ RDLs
- ✓ Quadruped hip extension

Hip Exercises
Phase II

- ✓ Bridges (unilateral)
- ✓ Side plank into hip abduction
- ✓ Front step down with hip abduction
- ✓ RDLs
- ✓ Star drill
- ✓ Single leg balance (foam, Bosu, rocker
- ✓ Clams
- ✓ Wall hip abduction (sidelying⟶ side plank)

Khayambashi, Mohammadkhani, …Powers: JOSPT '12

- 24 females with PF pain
  - » N=12 exercise group (focus on hip exercises)
  - » N=12 control group (focus on quads exercises)
  - » Exercise group- Bil hip abd & ER strengthening
- Results: assessed pain levels, quality of life & hip strength

✓ *Results: pain sign reduced, quality of life improved, and hip strength improved*

Witvrouw et al: AJSM '00

- Risk factors for patellofemoral pain
- 282 students (131 females) age 18 17-21)
- Phys Ed class 2 yr; 14 hours / week
- Evaluated 9 variables prospectively
- 24 students developed PF pain (13 F)

Witvrouw et al: AJSM '00

- Significant differences between PF pain group & others

✓ *Quadriceps / gastroc flexibility*

✓ *Explosive strength (vertical jump)*

✓ *Thumb – forearm flexibility*

✓ *Reflexive EMG response time (VMO /VL)*

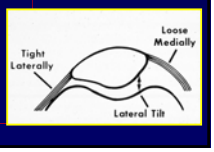
✓ *Psychological "looking for social support" - …*

Who Needs Core Stability ??

Patellar Taping

Patellofemoral Pain
Treatment – Patellar Taping

- Patellar Taping reduces pain in 78 -92% patients
  - *Lan et al: AJSM '10*
  - *Cowan et al: Br J Sports Med '06*
  - *Whittingham et al: JOSPT '04*
  - *Hinman, McConnell: BMJ '03*
  - *Wilson et al: JOSPT '03*
  - *Salsich, Powers: JOSPT '02*
  - *Powers et al: JOSPT '97*



Patellofemoral Pain
Treatment:Patellar Taping (Position)

Larsen et al: AJSM '95
- » 20 healthy subjects (18-35 yrs)
- » Merchant view prior & after taping
- » Taping repositioned patella medially
- » Ineffective at maintaining after ex.

Pfeiffer et al: AJSM '04
- » 18 healthy females (mean age 22 yrs)
- » 4 flexion plain radiographs
- » Taping repositioned patella prior to exercise but after exercise did not maintain

Patellofemoral Pain
Treatment:Patellar Taping (EMG)

Cowan et al: Br J Spts Med '06
- » Effect of patellar taping on EMG amplitude during stair stepping
- » Taping no effect on EMG activity

Salsich, …Powers: JOSPT '02
- » Effects patellar taping on VL EMG during stair ambulation
- » No change in EMG activity with tape

Cerny : Phys Ther '95
- » VMO/VL muscle ratio during exercise
- » No difference in EMG activity w/ taping

Patellofemoral Pain
Treatment:Patellar Taping (Proprioception)

Callaghan et al: J Athl Train '02
- » Effects of taping on knee proprioception
- » 52 healthy subjects (mean age 23 yrs)
- ✓ *Subjects with good proprio – no benefit from taping*
- ✓ *Subjects with poor proprio – did benefit from taping*

Callaghan et al: Man Ther '08
- » 32 subjects with PFPS (mean age 31.9 yrs)
- ✓ *Tape did not enhance proprio – some cases worsened*
- ✓ *Subjects with PFPS with poor proprio – improved proprioception*

Patellofemoral Pain
Treatment:Patellar Taping (Gait)

Powers et al: J Orthop Spts PT '97
- Effects of patellar taping on stride characteristics & joint motion in subjects with PF pain
- *Less pain but only minimal change in stride*
- Increase in stride length during ramp ascent

Patellofemoral Pain
Treatment:PF Bracing

Powers, Shellock, Beering,et al: MMSE '99
- 10 females with PFPS (ages 17-45 yrs)
- Kinematic MRI assessment on lateral tracking
- *Genutrain P3 brace – best of tested bracing**
- No sign diff in med/lateral displacement braced

Powers, Ward, Chan, et al: MMSE '04
- 15 females with PFPS (18-45 yrs)
- Kinematic MRI assessment
- On-Track brace: 50% reduction in pain
- PTO brace: 44% reduction in pain

Rehab Patellofemoral Pain

Conclusions – stay the course

- ✓Numerous causes/reasons for PF pain
- ✓Not all PF pain/dysfunction is the same
- ✓No one single surgery/therapy to solve
- ✓Assess biomechanical factors
- ✓Think hip, core, proprioception
- ✓Improve pain & dysfunction
- ✓Use all your tricks, skills & knowledge