If you are viewing this course as a recorded course after the live webinar, you can use the scroll bar at the bottom of the player window to pause and navigate the course.

This handout is for reference only. Non-essential images have been removed for your convenience. Any links included in the handout are current at the time of the live webinar, but are subject to change and may not be current at a later date.

No part of the materials available through the continued.com site may be copied, photocopied, reproduced, translated or reduced to any electronic medium or machine-readable form, in whole or in part, without prior written consent of continued.com, LLC. Any other reproduction in any form without such written permission is prohibited. All materials contained on this site are protected by United States copyright law and may not be reproduced, distributed, transmitted, displayed, published or broadcast without the prior written permission of continued.com, LLC. Users must not access or use for any commercial purposes any part of the site or any services or materials available through the site.
Technical issues with the Recording?

- Clear browser cache using these instructions
- Switch to another browser
- Use a hardwired Internet connection
- Restart your computer/device

Still having issues?

- Call 866-782-6258 (M-F, 8 AM-8 PM ET)
- Email customerservice@PhysicalTherapy.com
Management of Patellofemoral Pain

David Nolan, PT, DPT, MS, OCS, SCS, CSCS

Learning Outcomes

After this course, participants will be able to:

- List three contributing factors associated with developing anterior knee pain.
- Identify at least two proximal mechanical influences contributing to Patellofemoral Pain Syndrome.
- Design an evidence-based rehabilitation program for the patient with patellofemoral pain syndrome.
Overview

- Most common knee disorder
  - 25% of all knee diagnoses
- Common complaint following ACL or meniscal injury
- Most frequent injury in runners (Taunton JE, BJSM, 2002)

Etiology

- PFPS Associated with repetitive micro trauma
  - Posture & Alignment
    - Q-Angle, foot pronation
  - LE Biomechanics
    - Hip IR, knee valgus, PFJ stress
  - Neuromuscular Factors
    - Gluteal strength, quadriceps timing
Anatomy

- Bony
  - Lateral femoral condyle provides buttress
  - Trochlear groove more shallow proximally
    - ↓ bony stability in extension

Anatomy

- Patellar Shape
  - Wiberg Classification
Anatomy

- Patellofemoral contact surface
  - Covered with hyaline cartilage
  - Medial facet
    - Superior
    - Middle
    - Inferior
    - Odd
  - Lateral facet
    - Superior
    - Middle
    - Inferior

Anatomy

- Patellofemoral contact surface
  - $0^\circ = \text{minimal contact}$
  - Supratrochlear fossa
    - $20^\circ = 1.5\text{cm}^2$
    - $30^\circ = 2.0\text{cm}^2$
    - $60^\circ = 3.1\text{cm}^2$
    - $90^\circ = 4.7\text{cm}^2$
Anatomy

- Patellofemoral Alignment
    - Systematic review of 15 studies examining 6 alignment measures
      - Sulcus angle (118.7° ±7 - 168°)
      - Femoral trochlear depth (3.4mm ±1.1 – 7.1mm)
      - Patellar tilt angle (0.7° ±4.99 – 17.05° ±4.3)
      - Lateral patellofemoral angle (6.26° ±4.1 – 11.1° ±4.0)
      - Lateral Femoral trochlear inclination (16.3° ±2.8 – 22.1° ± 1.9)
      - Tibial tubercle – trochlear groove distance (9.8mm ±4.6 – 17.3mm ±5.3)

- “Patellofemoral alignment in the healthy knee is extremely variable”

Anatomy

- Soft Tissue
  - Passive stabilizers
    - Patellar tendon
      - Lateral orientation proximal to distal
    - Lateral Capsule
      - Superficial oblique
        - Thin
        - ITB to patella
      - Deep transverse
        - Originates from ITB
Anatomy

- Soft Tissue
  - Passive stabilizers
    - Medial Capsule (Conlan et al. JBJS 1993)
      - Medial PF ligament 53%
      - Medial mensicopatellar ligament 22%
      - Medial retinaculum 11%
      - Medial patellotibial ligament 5%

- Active stabilizers
  - Quadriceps
    - Rectus femoris
    - Vastus lateralis
      - VLO (Hallisey et al)
    - Vastus medialis
      - VMO
      - Intermedius

- Faher H et al. JBJS 1988
  - 20-30 ml of effusion will inhibit quad
Anatomy

- Soft Tissue
  - Active stabilizers
    - VMO
      - Originate from adductor magnus
      - Inserts at angle of 45°-65°

Biomechanics

- Primary function of patella is to facilitate knee extension
- Patella increases functional lever arm of extensor mechanism
- Increases force of extensor mechanism by as much as 50%
Normal Kinematics

- Normal tracking is in a form of a lateral “C”
- Glide
  - Slightly lateral throughout ROM
  - Medially from 45°-18°
  - Laterally from 18°-0°
- Tilt
  - Slightly lateral at rest
  - Medially 5° as knee extends

Pathomechanics

- ↑ Joint stresses & subsequent articular cartilage wear
  - Cartilage innervated?
  - Aneural so why is there pain?
- Traumatic or acquired
  - Think bilateral in absence of trauma
Predisposing Factors

- Gender

- Body weight
- Activity level
- Activity itself
- Biomechanical alignment

Patellofemoral Syndrome

- Risk Factors
  - Excessive Foot Pronation (Barton CJ et al JOSPT 2010)
    - Tibial IR leads to femoral IR (Tiberio D. JOSPT. 1987)
    - Increases contact pressure on lateral facets of patella
  - Muscle Imbalances
      - Dynamic stabilizers of knee
    - Hip Abduction & ER weakness (Powers CM. JOSPT. 2003)
      - Valgus angle increases lateral compressive forces
  - Decreased Knee Flexion Angles (Crossley K et al. J Orthop Res. 2004)

Behrang Amini, MD/PhD [CC BY-SA 3.0 (http://creativecommons.org/licenses/by-sa/3.0)] (image bottom right)
Risk Factors

  - Prospective study
  - 3-D motion analysis of female runners
  - Followed for 2 years
  - Group that developed PFPS
    - 4° more peak hip adduction compared to
    - matched controls

- Hip Muscle Imbalances
  - Bolga LA. et al. JOSPT, 2008
  - Robinson RL. & Nee RJ. JOSPT, 2007
  - Ireland et al. JOSPT, 2003
    - 26% less hip abductor & 36% less hip ER strength in females
    - 90% of PFPS group ↓ hip ER, Abduction & flexor strength
Risk Factors

- Boling MC. et al. *AJSM* 2009
  - 1597 USNA Midshipmen
  - Risk factors for development of PFPS:
    - Decreased knee flexion angle
    - Increased hip IR during jump-landing task
    - Decreased quad strength (12% less in PFPS group)
    - Hip abductor weakness was **not** predictive (3% less in PFPS group)
    - Increased navicular drop
    - Hip ER strength was a predictor of PFPS
      - Compensation to control excessive hip IR ROM
  - Conclusion:
    - Multiple modifiable risk factors for PFPS exist and should be addressed with prevention programs

  - 20 runners with PFPS & 20 matched uninjured runners
  - Variables
    - Hip abduction & ER strength pre/post run
    - Arch height index pre run
    - LE kinematic data beginning & end of run
  - Results
    - Both groups displayed diminished strength at end of run
    - PFPS group had significantly less hip abduction strength
    - Hip abduction weakness was associated with greater peak hip adduction angle
    - Arch height did not differ between groups
  - Conclusion
    - Runners with PFPS displayed weaker hip abductor muscles which became more pronounced at the end of a run
Risk Factors

- Souza RB. & Powers CM. AJSM, 2009
  - 19 females with PFPS & 19 pain-free controls
  - PFPS group
    - ↑ Hip IR
      - (8.2° ± 6.6° vs. 0.3° ± 3.6°; p<.001)
    - ↓ Hip strength
      - 21% deficit in muscle performance overall
      - 49% less hip extension repetitions
      - 40% less pelvic drop repetitions
    - ↑ Femoral inclination
      - (132.8° ± 5.2° vs. 128.4° ± 5.0°; p=.011)

- Hoglund LT et al. IJSPT. 2018
  - (-) Hip Abductor
  - (-) Hip ER
  - (+) Hip Extensor

DO MALES WITH PATELLOFEMORAL PAIN HAVE POSTERIORLATERAL HIP MUSCLE WEAKNESS?
Risk Factors

- Neal BS et al. BJSM. 2018
  - Review of 18 studies (4818 participants)
  - Risk factors to develop future PFP:
    - (+) Quad weakness in military population
    - (-) Age, height, weight, BMI, body fat, Q angle
    - (-) Hip weakness

Risk Factors for Patellofemoral Pain: A Systematic Review and Meta-analysis

Presentation

- Females > Males
- Insidious onset
- Peripatellar pain
- Limited function
- Quad / VMO weakness
Presentation

- Diffuse anterior knee pain
- Pain with prolonged sitting (54%)  
  - Collins NJ et al. JOSPT 2016
- Increased pain with stairs and rising from chair
- Joint crepitus
- Pseudo giving way
- Mild swelling

Examination Findings

- ↑ Q angle
  - Aglietti et al
    - Male = 14°
    - Female = 17°
    - >20° abnormal
  - Genu valgum
  - Femoral anteversion
  - Tibial torsion
  - Lateral tibial tubercle
- Consider changes in Q-angle during dynamic activities
Examination Findings

- Tight musculature
  - Witvrouw E et al. *AJSM* 2000

- Decreased quad strength
  - Lankhorst NE et al. *JOSPT* 2012

- Delayed VMO firing
  - Van Tiggelen D et al. *AJSM* 2009

Examination Findings

- Barton CJ et al. *JOSPT* 2010
  - PFPS group
    - ↑ pronation
    - ↑ foot mobility

Foot and Ankle Characteristics in Patellofemoral Pain Syndrome: A Case Control and Reliability Study
Examination Findings

- Patella Alta
  - High
  - Unstable
  - <0.8

- Patella baja
  - Low
  - Compressive
  - >1.2

Differential Diagnosis

- Tendinitis / Tendinosis
  - Both activity induced
  - Palpation is key

- Osgood-Schlatters Disease
  - Bony deformity at tibial tubercle

- ITB friction syndrome
  - Snapping as ITB crosses Gerdy’s tubercle at 30° flexion thought to be crepitus

- Meniscal or ligament pathology
  - R/O with special testing

- Referred pain L3-L4
  - Vague lateral thigh pain
Patellar Tendinopathy

- Overuse Tendinitis
  - NSAIDs, Ionto, Ice
  - Restore ROM
  - Restore flexibility
  - Improve strength

- Overuse Tendinosis
  - Active warm-up
  - Friction massage
  - Stretch quad
  - Eccentric strengthening

Osgood-Schlatters Disease

- Anterior knee pain
- Increased running / jumping activity
- Adolescents
  - Boys > Girls
Iliotibial Band Syndrome

- **Primary Functions**
  - Stabilize lateral hip & knee
  - Resist hip adduction & knee IR
  - Femoral & tibial attachments
    - Atypical hip & foot mechanics potential causes of ITBS

- **Common cause of lateral knee pain in runners & cyclists**
  - Hip Abductor weakness
  - Increased weekly mileage

---

Iliotibial Band Syndrome

- **Noehren, B. et al. *Clin Biomech.* 2007**
  - Compared running mechanics of females with ITBS with healthy females
    - ITBS group exhibited significantly greater hip adduction & knee internal rotation
    - Result in increased ITB strain & compression against lateral femoral condyle
    - Treatment should focus on controlling secondary plane motions

- **Ferber, R et al. *JOSPT* 2010**
  - ITBS group significantly greater hip adduction angle & knee IR angle
Iliotibial Band Syndrome

- **Distal Mechanism**
  - Greater rearfoot inversion angle at heel strike
  - Greater tibial IR throughout stance phase
    - Ferber R, et al. *JOSPT* 2010
  - Increased peak rearfoot eversion
  - Decreased peak rearfoot eversion
    - Decreased eversion in ITBS group as whole
    - Subgroup of subjects exhibited excessive eversion as well as high tibial and knee internal rotation

Location of Pain

- **Superior**
  - Quad tendinitis

- **Inferior**
  - Infrapatellar fat pad
  - Patellar tendinitis

- **Lateral**
  - Shortening of lateral retinaculum
  - Tight lateral musculature

- **Medial**
  - Excessive stretching of medial retinaculum

- **Retro**
  - Chondromalacia patella
  - Subchondral bone stress
Treatment Considerations for Patellofemoral Pain Syndrome

Treatment

- Conservative Interventions
  - Exercise
  - Bracing
  - Taping
  - Orthotic Therapy
  - Stretching
  - Soft tissue mobilization
  - Activity modification

- Keys to Success
  - Must treat the CAUSE not the SYMPTOMS
  - Accurate diagnosis
  - Controlled activity
  - Education
Treatment

- Comprehensive Approach
  - Strengthening
    - Quad balance
    - VMO:VL ratio
      - Van Tiggelen D et al. AJSM 2009

- VMO Exercise?
  - Cerny Phys Ther 1995
    - Higher VMO activity with QS than any other OKC exercise
    - VMO activity during QS > SLR
  - Simoneau et al Phys Ther 1993
    - Lateral step-up performed in neutral and with ER in normals
    - No significant difference in VMO:VL ratio
  - Wilk et al Phys Ther 1992
    - VMO:VL ratio during squat, leg press & knee extension with and without simultaneous hip adduction
    - No significant difference noted
Treatment

- Comprehensive Approach
  - Stretching
    - Rectus femoris
    - ITB
      - Tensions lateral retinaculum
  - Hamstrings
    - Knee flexion
    - Patella engaged in trochlea
    - Articular cartilage wear
  - Gastroc-Soleus
    - Compensatory pronation

- Biofeedback
  - Improve VMO / VL balance

- Bracing / Orthotics
  - Breg PTO
  - Control pronation
Treatment

- Lake DA & Wofford NH. Sports Health 2011
  - Ice, US, Phono, Ionto, EMG Biofeedback, NMES, E-Stim, Laser
  - 12 RCT met criteria
  - “None of the therapeutic modalities reviewed has sound scientific justification for the treatment of PFPS when used alone”

Effect of Therapeutic Modalities on Patients with Patellofemoral Pain Syndrome: A Systematic Review

- Lumbopelvic Manipulation
  - 50 subjects 18-45 yo (26 m; 24 f)
  - 45% had successful outcome
    - Hip IR ROM asymmetry >14° (Success improved to 80%)

Lumbopelvic Manipulation for the Treatment of Patients With Patellofemoral Pain Syndrome: Development of a Clinical Prediction Rule
Patellar Taping

- Individual approach
- Correct worst symptom first
- Taping should improve symptoms immediately

Patellar Taping

- Patellar taping
  - Larsen et al AJSM 1995
    - Radiographs to determine impact of tape on patellar position
    - X-Rays prior to tape, post tape & post exercise
    - Significant medialization of patella seen
    - Position was not maintained post exercise
    - No change in patellar congruency post taping
    - Patients did note a 50% reduction in pain with taping
Patellar Taping

- Kowall et al. AJSM 1996
  - Group one: standardized exercise program
  - Group two: exercise and taping
  - Variables
    - Isokinetic torque
    - EMG activity
    - Severity of pain
  - Both groups improved
  - No significant difference between groups

Patellar Taping

- Leshner JD et al. JOSPT 2006
  - Which patients with PFPS will benefit from taping?
  - Medial glide technique performed
  - Immediate 50% reduction in pain or moderate improvement on a global rating of change questionnaire was considered a success
  - Two exam items predicted success with taping
    - (+) Patellar Tilt Test (mobility of lateral retinaculum)
    - Tibial Varum > 5°
  - Application of CPR improved probability of success from 52% to 83%
Treatment

- Foot Orthoses
    - 102 subjects diagnosed with PFPS
    - Custom orthoses fabricated with appropriate rearfoot and/or forefoot posting determined by exam
    - Foot orthoses effective in relieving symptoms of PFPS in young people
  - Johnston LB et al. JOSPT. 2004
    - 16 subjects with >9° calcaneal eversion in bilateral weight bearing
    - Custom foot orthoses with 2 week and 3 month F/U
    - Significant improvement in pain, stiffness and physical function for patients with PFPS that demonstrate excessive pronation

Foot Orthoses

- Sutlive TG et al. Phys Ther. 2004
  - Which patients with PFPS will benefit from off-the-shelf foot orthosis
    - 50% reduction in pain was considered a success
  - Best Predictors of Improvement
    - Forefoot Valgus >/= 2°
    - Great Toe Extension </= 78°
    - Navicular Drop </= 3 mm
Proximal Considerations for Patellofemoral Pain Syndrome

magalhaes E et al. JOSPT, 2010

A Comparison of Hip Strength Between Sedentary Females With and Without Patellofemoral Pain Syndrome

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Control (50)</th>
<th>Unilateral PFPS (21)</th>
<th>Bilateral PFPS (29)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abductors</td>
<td>14.6 ± 2.9</td>
<td>11.7 ± 4.2</td>
<td>9.6 ± 2.8</td>
</tr>
<tr>
<td>Adductors</td>
<td>15.1 ± 3.7</td>
<td>14.1 ± 5.7</td>
<td>11.4 ± 3.3</td>
</tr>
<tr>
<td>Extensors</td>
<td>21.8 ± 5.6</td>
<td>19.1 ± 10.0</td>
<td>15.8 ± 9.0</td>
</tr>
<tr>
<td>Flexors</td>
<td>19.4 ± 4.3</td>
<td>16.3 ± 6.0</td>
<td>14.9 ± 4.3</td>
</tr>
<tr>
<td>Lateral Rot</td>
<td>14.5 ± 3.5</td>
<td>12.7 ± 4.1</td>
<td>12.1 ± 3.9</td>
</tr>
<tr>
<td>Medial Rot</td>
<td>14.3 ± 3.1</td>
<td>13.6 ± 4.4</td>
<td>12.7 ± 3.8</td>
</tr>
</tbody>
</table>
Proximal Strength

- Fukuda TY et al. JOSPT, 2012
  - Added hip strengthening exercises to knee strengthening & stretching
    - Improved function (LEFS)
    - Decreased pain

Hip Posterolateral Musculature
Strengthening in Sedentary Women
with Patellofemoral Pain Syndrome: A Randomized Controlled Clinical Trial
With 1-Year Follow-Up

Strengthening

- Earl JE & Hoch AZ. AJSM 2011
  - 8 week rehab program hip and core strength
  - Significant improvements in pain, functional ability, ER and Abduction strength
Strengthening

- Khayambashi K et al. JOSPT 2012
  - 28 women with PFPS
  - Exercise or no exercise control group
  - B Hip Abductor & ER strength 3x/week for 8 weeks
    - Decreased pain
    - Improved health status (WOMAC)
    - Increased B hip strength (HHD)

Strengthening

- Boren K. et al. IJSPT. 2011
  - Gluteus Medius

<table>
<thead>
<tr>
<th>Exercise</th>
<th>%MVIC Glut Medius</th>
<th>Rank Gluteus Medius</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side Plank Abd (DL Down)</td>
<td>103.11</td>
<td>1</td>
</tr>
<tr>
<td>Side Plank Abd (DL Up)</td>
<td>88.82</td>
<td>2</td>
</tr>
<tr>
<td>Single Limb Squat</td>
<td>82.26</td>
<td>3</td>
</tr>
</tbody>
</table>
Strengthening

- Boren K. et al. IJSPT. 2011
  - Gluteus Medius
    - Hip Extension

<table>
<thead>
<tr>
<th>Clamshell Exercise</th>
<th>%MVIC Gluteus Medius</th>
<th>Rank Gluteus Medius</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>47.23</td>
<td>18</td>
</tr>
<tr>
<td>Reverse</td>
<td>62.45</td>
<td>8</td>
</tr>
<tr>
<td>In Abduction</td>
<td>67.63</td>
<td>6</td>
</tr>
<tr>
<td>In Abduction/Extension</td>
<td>76.88</td>
<td>4</td>
</tr>
</tbody>
</table>

Strengthening

- Boren K. et al. IJSPT. 2011
  - Gluteus Maximus

<table>
<thead>
<tr>
<th>Exercise</th>
<th>% MVIC Gluteus Maximus</th>
<th>Rank Gluteus Maximus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front Plank-Hip Ext</td>
<td>106.22</td>
<td>1</td>
</tr>
<tr>
<td>Gluteal Squeeze</td>
<td>80.72</td>
<td>2</td>
</tr>
<tr>
<td>Side Plank Abd (DL Up)</td>
<td>72.87</td>
<td>3</td>
</tr>
<tr>
<td>Side Plank Abd (DL Down)</td>
<td>70.96</td>
<td>4</td>
</tr>
<tr>
<td>Single Limb Squat</td>
<td>70.74</td>
<td>5</td>
</tr>
</tbody>
</table>
Strengthening

- Boren K. et al. IJSPT. 2011

<table>
<thead>
<tr>
<th>Exercise</th>
<th>%MVIC Gluteus Medius</th>
<th>%MVIC Gluteus Maximus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front Plank-Hip Ext</td>
<td>75.13</td>
<td>106.22</td>
</tr>
<tr>
<td>Side Plank Abd (DL Up)</td>
<td>88.82</td>
<td>72.87</td>
</tr>
<tr>
<td>Side Plank Abd (DL Down)</td>
<td>103.11</td>
<td>70.96</td>
</tr>
<tr>
<td>Single Limb Squat</td>
<td>82.26</td>
<td>70.74</td>
</tr>
</tbody>
</table>

- Selkowitz DM et al. JOSPT 2013
  - Activate gluteus medius and superior gluteus maximus while minimizing TFL
  - Fine-wire EMG
  - 11 exercises
  - 20 healthy subjects
  - Calculated Gluteal to TFL Index for each exercise
    - Not simply looking at EMG values
Strengthening

- Selkowitz DM et al. JOSPT 2013

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Gluteal-to-TFL Activation Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clam (resistance)</td>
<td>115</td>
</tr>
<tr>
<td>Sidestep (resistance)</td>
<td>64</td>
</tr>
<tr>
<td>Unilateral Bridge</td>
<td>59</td>
</tr>
<tr>
<td>Quad Hip Ext-Knee Ext</td>
<td>50</td>
</tr>
<tr>
<td>Quad Hip Ext-Knee Flexed</td>
<td>50</td>
</tr>
</tbody>
</table>

Strengthening

- Selkowitz DM. et al. JOSPT 2013

<table>
<thead>
<tr>
<th>Exercise</th>
<th>TFL</th>
<th>Glut Med</th>
<th>Sup Glut Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>SL Hip Abd</td>
<td>32.3± 13.31</td>
<td>43.5± 14.7</td>
<td>23.7± 15.3</td>
</tr>
<tr>
<td>Hip Hike</td>
<td>31.4± 14.4</td>
<td>37.3± 15.1</td>
<td>17.7± 15.2</td>
</tr>
</tbody>
</table>
Strengthening

- Selkowitz DM et al. JOSPT 2013
  - Limitations
    - Healthy subjects
    - CLAM & SIDESTEP used elastic resistance
      - Likely increased EMG amplitudes and GTA Index
    - Did not include gluteus minimus
      - 20% of abductor cross sectional area

Clamshell Exercise

- Willcox EL & Burden AM. JOSPT 2013
  - 17 healthy subjects
  - Surface EMG
  - ↑ Glut in PNeutral
  - ↑ Gmed in 60° flex
  - TFL activation low
Clamshell Exercise

- Bishop BN et al. IJSPT 2018
  - Best Gluteal to TFL Muscle Activation (GTA)

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Glut Max</th>
<th>Glut Med</th>
<th>TFL</th>
<th>GTA Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clam with resistance</td>
<td>42.03 ± 19.31</td>
<td>30.48 ± 16.66</td>
<td>13.54 ± 6.32</td>
<td>99.54</td>
</tr>
<tr>
<td>Clam without resistance</td>
<td>36.32 ± 14.62</td>
<td>25.35 ± 10.39</td>
<td>11.16 ± 5.34</td>
<td>87.89</td>
</tr>
</tbody>
</table>

Strengthening

- Proximal strength
  - Cambridge ED et al Clin Biomech 2012
    - Forefoot resistance: ↑ gluteals vs. TFL
    - Likely due to ER of hips
Posture Matters

- Berry JW et al. JOSPT. 2015
  - Resisted side stepping upright & squat positions
  - EMG of Gmed, Gmax & TFL
  - EMG > in stance limb (p ≤ .001)
  - Glut activity > TFL activity in squat position (p ≤ .001)

Strengthening

- MacAskill MJ et al IJSPT 2014
  - Surface EMG (Gmax & Gmed)
  - Weightbearing
    - Forward Step-Up
    - Lateral Step-Up
  - Non-Weightbearing
    - 10RM
    - Prone Hip Extension
    - Sidelying Hip Abduction
Clinical Pearls

- Do the **Correct** exercises the **Correct** way
    - As angle of hip abduction increases from zero degrees to 30 degrees
      - Glute max activation increases
      - Hamstring activation decreases

Strengthening

- Nascimento LR et al. *JOSPT*. 2018
  - Hip strengthening with/without knee strengthening
  - Systematic Review with Meta Analysis
    - Randomized and/or controlled trials were included
    - 14 trials (673 participants)
    - Hip & Knee strengthening effective & superior to knee strengthening
      - ↓ Pain & Improved Activity
      - **No concurrent change in strength**
Blood Flow Restriction

  - Double-Blind RCT; 69 subjects (standard = 34; BFR = 35)
  - 8 weeks of leg press & leg extension
    - Standard: 70% 1RM; BFR: 30% 1RM
  - BFR 93% greater ↓ pain with ADLS (p=0.02) @ 8 weeks
  - Similar improvement between groups with VAS “worst pain” & Kujala Patellofemoral score
  - **No difference between interventions @ 6mo

Summary

- Gluteal strengthening shown to be critical in lower extremity function
- Consider the quality of tissue, phase of healing and baseline strength
- What muscle should be activated and what muscle activation should be minimized
- Unknown if findings would be similar for patients presenting with pain / pathology
Treatment Summary

- (+) Hip and knee focused exercise
- (+) Foot Orthoses
- (-) Electrophysical agents in isolation
- (-) PF, Knee or lumbar mobilization is isolation
- (?) Taping, bracing, dry needling, STM, BFR


Treatment

- Acute Phase
  - Decrease swelling
    - 20-30ml fluid impacts muscle function
  - Stop inhibition of VMO
    - Avoid fatigue
Treatment

- Sub-Acute Phase
  - Patellar mobilizations
    - creep
  - Stretch lateral structures
    - ITB
  - Strengthening
    - Avoid deep flexion
  - Biofeedback
  - Endurance training

- Chronic Phase
  - PREs
    - Hip and quad
  - Closed chain
  - Motor Control
Summary

- Determine cause of symptoms
- Activity modification
- Utilize specific and individual treatment approach
- Correct faulty biomechanics

Surgical Considerations for Patellofemoral Pain
Surgical Options

- Lateral Release
- Distal Realignment
  - Medialization (Trillat 1964)
  - Anteriorization (Maquet)
  - Anteromedialization (AMZ, Fulkerson 1983)
- MPFL Reconstruction
- Patellofemoral Arthroplasty
- Patellectomy

Lateral Release

- Procedure for pain
  - Indications
    - Anterior knee pain 2° ELPS
    - Evidence of lateral tilt
    - Failure of non-surgical management
  - Contraindications
    - Hypermobile patella
    - Should NOT be done in isolation for recurrent lateral patellar dislocations; studies show deterioration of results over time
  - Rehabilitation
    - Within 2 days post-op
Distal Realignment

- **Indications**
  - Patellar instability due to increased Q angle or tibial tubercle malalignment
  - Patellar tilt and subluxation that cannot be corrected by MPFL alone

- **Advantages**
  - Corrects subluxation & tilt radiographically
  - More aggressive rehab
    - Immediate, full ROM

- **Disadvantages**
  - Does not address MPFL
  - Not performed prior to skeletal maturity

MPFL Reconstruction

- **Indications**
  - Lateral patellar instability due to laxity of proximal medial restraints
  - Procedure for instability

- **Contraindications**
  - Not performed for malalignment, arthrosis or pain
MPFL Reconstruction

  - Systematic Review of Return to Play Guidelines
  - 53 studies met inclusion criteria were reviewed
    - WB restrictions (90.6%)
    - ROM restrictions (84.9%)
    - Timeline for RTP or return to full activity (66.0%)
    - Subjective or objective criteria to determine return to activity (18.9%)

Patellofemoral Pain Case Study
Case Study

- 15 year old female basketball player
- 4 teams
- Recent onset of B anterior knee pain
- Worse with basketball & stairs
- Father reports “worried about how she runs”

Case Study

- Walking Gait Video
Case Study

- Examination
  - Limited muscle length
    - Iliopsoas, quad, gastroc-soleus, hamstrings
  - Limited strength
    - Quad & hamstrings: 4/5 B
    - Gluteus medius & maximus: 3+/5 B

- Running Gait Videos
Case Study

- Running Gait Videos

Case Study

- Drop Jump Task Videos
Case Study

- Drop Jump Task Videos

Case Study

- Treatment
  - LE flexibility
    - Hip flexors critical
  - Gluteal activation exercises
    - Significant compensation
    - HS for glut max
    - TFL for glut med
  - Proprioception / Neuro Re-ed
    - Static → Dynamic
Summary

- PFP is a multifactorial condition requiring an individually tailored multimodal approach
- Immediate pain relief should be a priority to gain patient trust
- Patient empowerment by emphasizing active over passive interventions is important
- Good patient education and activity modification is essential


Thank You