

**REHAB SUMMIT**



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CROSS COUNTRY  
EDUCATION

# Athletic Rehab Institute Presents

What's up with Anterior Knee  
Pain?

Rehabilitation of the Extensor  
Realignment

# What's up with Anterior Knee Pain?

- Patella-Femoral Pain Syndrome (PFPS)
- Lateral Patellar compression
- Proximal mal-alignment
- Distal mal-alignment
- Chondromalacia

- One of the most frequently presented complaints in the orthopaedic and sports medicine clinic both in the athletic and non-athletic population.
- Females are typically more affected by PFPS
- Retropatellar and peripatellar pain resulting from physical and biomechanical changes altering the stress and loading of the PF joint. Mal-alignment – Q angle geometry, neuromuscular insufficiency
- Activities that facilitate symptoms: stair climbing, squatting, running, and kneeling
- It is estimated that 7% to 15% of the general population have some sort of anterior knee pain

*References: Taunton, Ryan, Clement, Mckenzie, Llyod-Smith, Zumbo 2002; Herrington, Al-Sherhi 2007*

# What is the Real Cause of PFPS?

- Neuromuscular insufficiency
  - Is it really the VMO or over-all general quadriceps weakness
- Hypo-mobility of the lateral Retinaculum
- Do the hamstrings play a role?
- Increase Q angle
- Faulty LE mechanics – patella posture
- Exercise or training overuse

# Current EBP Treatment Recommendation

- Quadriceps recruitment
- Hamstrings over quadriceps co-contraction
- Strengthening of hip musculature
- Manual therapy
- Taping – bracing for decompression
- Foot orthotics

# Updates on Today's Thinking

- Strengthening the weak hip
- Limits on open kinetic chain exercises
- Greater role for the hamstrings
  - For decompression (knee version)
- More closed kinetic chain exercises
- Use of modalities

# Clinical Applications of Hip Strength

## Research Reports

- Female subjects age 12 – 35. Significant impairments in isometric strength of their hip abductors – 27%, hip extensors – 52%, and hip external rotations – 30%
- Compared to the weaker limbs of the control subjects

*(Robinson & Nee 2007)*

# Clinical Applications of Hip Strength

## Research Reports

- Runners with PFPS. 21 Runners, 5 male, 15 female
  - Isometric hip abduction and external rotation pre & post prolonged run.
  - Subjects displayed weaker hip abductor

*(Dierks, Manal, Hanill, Davis 2008)*

# Therapeutic Value of this Research

- Proximal strengthening of the hip core
- Eccentric emphasis of Abduction and external rotators
- Open kinetic chain
  - Hip abduction – standing and side-lying
  - Side-lying clam
- Closed kinetic chain
  - Wall squats
  - Lateral and front step-up

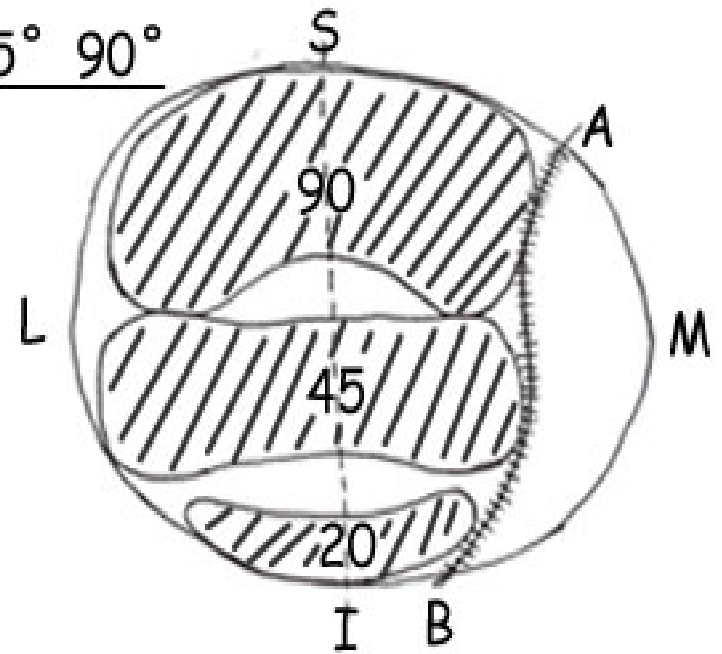
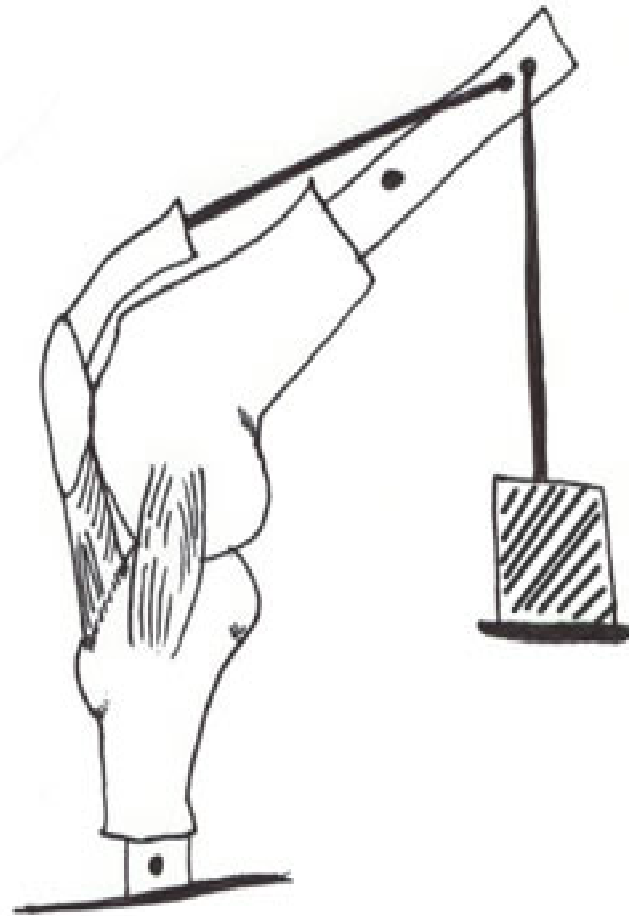
*Reference: Ayothe, Stetts, Keenan, Greenway 2007*

# VMO:VL EMG Ratio Arc Of Motion

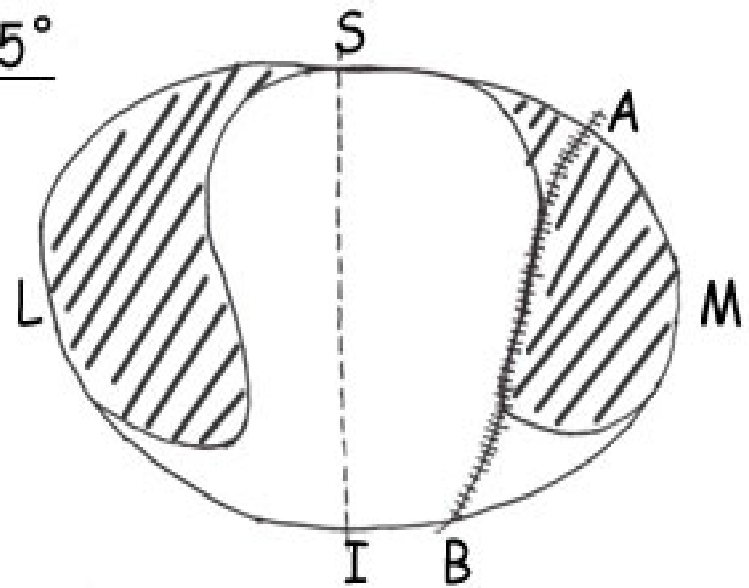
- 60 – 85 degree are greater than 35 – 60 degree
- 60 – 85 degree are greater than 10 – 35 degree
- 35 – 60 degree are greater than 10 – 35 degree

*Reference: Szczepanski, TL, Gross, MT, Duncan PW, Chandler JM: Effect of Contraction Type, Angular Velocity, And Arc of Motion on VMO = VL EMG Ratio. JOSPT 14: 256-262, 1991.*

20° 45° 90°



135°



# Contact areas on the Patella as a function of Knee Flexion

- Inferior Pole -  $20^\circ \rightarrow 0^\circ$
- Central Medial and Central Lateral Poles  
 $45^\circ \rightarrow 20^\circ$
- Superior Medial and Superior Lateral Poles  
 $90^\circ \rightarrow 45^\circ$

## *Reference:*

*Goodfellow J, Hungerford DS, Zindel M : Patellofemoral joint mechanics and pathology. J. Bone Joint Surg 588(3) : 287-290, 1976*

# Knee Version

Version of the knee is determined by measuring the angle between the line joining the posterior tibial condyles and the line joining the posterior femoral condyles on the CT scan of the knee in full Extension.

Static Rotation of the tibia with respect to the femur in extension (Version of the knee)

# Patients with Anterior Knee Pain

- Increase in External Rotation of the tibia  $7^{\circ}$  compared to  $1^{\circ}$  (Asymptomatic)
- External Rotation causes lateral pulled patella - Compression Syndrome
- External Rotation will translate the tubercle 5 to 10 mm laterally , increasing the Q angle.

# Clinical Relevance

- Strengthening the medial hamstrings  
internal tibial rotators, semimembranosus,  
semitendoninosus, satorius
- Hamstrings stretching – Biceps Femoris,  
Iliotibial band, lateral Retinaculum

# Exercise Application

- Functional Hamstrings Lengthening with medial rotation of the femur
- Co-Contraction of the Hamstrings over the Quads with minimal flexion moment angle.

## *Reference:*

*Eckhoff DG, Brown AW, Kilcoyne RF, Stamm ER. Knee version associated with anterior knee pain. Clin orthop 339 : 152-155, 1997.*

# Kinetic Chain Recruitment (PF)

## Closed Kinetic Chain

- Mini squats – double to single - co-contraction
- Balance vectors – tri-plane – emphasize transverse plane
- Leg press – range of motion short-arc to long-arc
- Lateral step-ups/lunges – VMO advanced training
- Wall slides squats – single leg – high level recruitment

# Mobility of the Lower Extremity

- Functional hamstrings lengthening
- Lateral Retinaculum glides
- Heel cord re-lengthening
- SI joint mobility
- Quadriceps lengthening
- Prone figure 4

# Advanced Functional Exercises

- Balance vectors on uneven surfaces
- Lateral step-ups . Step downs (eccentric)
- Lunges
- Wall squats single leg

# Functionality: How Do We Define It?

- Mobility
- Recruitment
- Tri Planar Stabilization

# Post Operative Rehab Phases

- Phase One
  - Mobility and early recruitment
- Phase Two
  - Strengthening – advanced recruitment (OKC/CKC)
- Phase Three
  - Tri-plane stabilization – advanced functional exercises

# Arthroscopic Lateral Retinaculum Release

- Phase One – post-op week 1 to 3
  - Pain control and reduction of swelling
    - Modalities – infrared & E-Stim
  - Weight bearing to tolerance PWB → FWB with leg control
  - Mobility ROM controlled flexion
    - Hamstring heel cord lengthening and patella mobility
  - Sub-max – isometric quadriceps setting
  - Co-contraction – hamstrings over the quadriceps
  - Core stabilization – hip strengthening (OKC)
  - Closed kinetic chain when ready. No squat balance and double leg mini squats

# Arthroscopic Lateral Retinaculum Release

- Phase Two – post-op week 4 to 6
  - Return to normal ROM – increase flexion as tolerated
  - Full weight bearing for functional CKC exercises
    - Mini squats, total gym/leg press, standing terminal extension (STE)
  - OKC strengthening – short-arc 90° - 45°
    - Terminal extension low angle 0° - 15°
    - Hamstring PRE
  - Progressive hip strengthening (Advanced Core Activities)
  - Proprioception training / balance vectors / three planes
  - Stage one lateral step-ups

# Arthroscopic Lateral Retinaculum Release

- Phase Three – post-op week 6 and beyond
  - Advanced strengthening (OKC/CKC)
    - BOSU and plyo-toss with squat
  - Proprioception on uneven surfaces
    - BOSU and plyo-toss with squat
  - Total leg strengthening
    - single leg press to body weight goals
    - Lateral step-ups phase two
  - Functional testing – sports specific activities

*Reference: Manske's Book – chapter 23 & 24*

# FUNCTIONAL LOWER EXTREMITY TESTING

- Balance testing – eyes open and closed
- Balance vector testing
- Leg press test
- Isolated strength assessment (Isotonic vs. Isokinetic)
- Return to Sports – Functional Testing
  - Jump test – Double leg
  - Hop test – Time and distance – Single leg

*Reference: Reid A, Birmingham TB, Stratford PW, Alcock GK, Griffin RJ. Hop Testing Provides a Reliable and Valid Outcome Measure During Rehabilitation After Anterior Cruciate Ligament Reconstruction. Phys Ther (87) 337-349; 2007*

# ATHLETIC REHAB INSTITUTE

## FUNCTIONAL PROGRESSION

Walk Program	20 Minutes	Treadmill-Retro (Backwards)
Jog Program	Goal 10-15 Minutes	Mix of Retro and Forward
Running Program	Straight Running 3-5 miles at 7/8 min/mile on track Goal: increase to sprint (Add any equipment once patient can sprint)	

# Distal Realignment – Post-op Guidelines

- Phase One – post-op weeks 1 to 4
  - ROM – full resting extension
    - Flexion:
      - First week 45°
      - Second week 60°
      - Third week 90°
      - Fourth week 110°
    - Weight bearing 50% PWB to FWB at 6-8 weeks
    - Early recruitment – co-contraction H/Q
      - Submax isometric quads (No SLR)
    - OKC – hip strengthening for the core
    - Hamstrings and heel cord lengthening
    - Modalities – swelling and pain control
    - CKC – touch down standing terminal extension (STE)

# Distal Realignment – post-op guidelines

- Phase Two – post-op 4 to 12 weeks
  - ROM
    - Flexion:
      - Week 5: 115°
      - Week 6: 125°
      - Week 8: 130° to normal
    - Full weight bearing – 6 to 8 weeks
      - CKC activities – double leg mini squats to single leg balance
    - Continue hip strengthening with adductor squeezes / standing SLR / Clam
    - OKC strengthening – short-arc flexion 90°-45°
      - Hamstrings 30°-90°, low angle terminal extension 15°-0°
    - CKC strengthening – leg press / total gym / protective flexion
      - Single leg balance vectors
      - Phase one lateral step-ups
      - Wall squats

# Distal Realignment – post-op guidelines

- Phase three – post-op week 12 and beyond
  - Full ROM
  - Advance CKC strengthening / proprioceptive training
    - Balance vectors on uneven surface, BOSU, plyo-toss with squat, phase two lateral step-ups, normal leg press based on body weight
  - OKC strengthening as needed
  - Return to activity – sports specific training
  - Functional testing – plyometric training

# Proximal Realignment – Post-op Guidelines

- Phase One – post-op weeks 1 to 4
  - ROM – slow with flexion – normal resting extension
    - Week one – 0° → 60°
    - Week three to four – 0° → 90°
    - Week four to six – 0° → 105°
  - Weight bearing
    - NWB first two weeks
    - PWB 3 to 4 weeks < 50%
  - OKC strengthening – leg control – hip strengthening
    - Co-contraction H/Q, short-arc flexion angle for isometrics 90°  
– 40°, clam
  - Modalities for swelling and pain control
  - Hamstrings and heel cord lengthening

# Proximal Realignment – Post-op Guidelines

- Phase two – post-op 4 to 12 weeks
  - Continue ROM to full flexion
  - Full weight bearing with good leg control
  - OKC strengthening with PRE Quadriceps ( $90^{\circ} \rightarrow 45$ ) and hamstrings ( $30^{\circ} \rightarrow 90$ )
  - CKC – functional progression – single leg balance to mini squat with balance when ready, STE, phase one lateral step-ups, leg press/total gym, balance vectors, wall squats

# Proximal Realignment – Post-op Guidelines

- Phase three – post-op 12 weeks and beyond
  - Continue OKC strengthening – mostly short-arc extension  $90^{\circ} \rightarrow 40^{\circ}$
  - Balance/proprioception training on uneven surface, leg press to body weight goals, phase two lateral step-ups, lunges
  - Functional testing and sports/work specific training may include plyometric exercises