Patellofemoral Joint Disorders and Treatment Options

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DISCLOSURES

- I do not have anything to disclose

Overview

- Anatomy and Basic Biomechanics
- Classification of Patellofemoral Disorders
- Treatment Options
Patellofemoral Basics and Anatomy

- Thickest articular cartilage in the body
  - Up to 5-7mm at central ridge
- Joint reaction forces
  - 0.5 x BW walking/biking
  - 3.3 x BW ascend stairs
  - 5 x BW descend stairs
  - 7.8 x BW squatting
  - 20 x BW deep squatting

Contact Areas

Huberti JBJS 1984

Facet orientation

- Wiberg classification
  - I 24%
  - II 57%
  - III 19%
  - IV 1%
- Believed to be determined by loading during development

Wiberg 1941 and Baumgart 1944
Soft Tissue Stabilizers
Active and Passive

- Medial
  - Medial Retinaculum and MPFL
    - MPFL runs from upper medial 2/3's of patella to adductor tubercle
  - Vastus Medialis obliquus
    - Pulls at angle 55 to 70 degrees
    - Contribution at 30 deg

Medial Patellofemoral Ligament

- Main constraint in EARLY flexion
  - Checkrein to lateral translation
- Taut and elongated in full extension
- Decreasing contribution after 30 degrees
- Shortens and lax with increasing flexion

MPFL on MRI
Lateral Stabilizers

- **Lateral retinaculum**
  - Superficial oblique fibers attach to ITB
  - Deep transverse fibers connect to ITB, tibia, & lateral epicondyle
    - IT band moves posteriorly in flexion which contributes to tilt and subluxation

- **Vastus lateralis**
  - Tight with obligatory dislocators

Bony stabilizers

- **Geometry of the patella and trochlea**
- **Lateral trochlea primary passive restraint to lateral translation**
- **Important with increasing flexion angles when MPFL becomes lax**

**HISTORY and PHYSICAL**
History

- Typically anterior knee pain
  - May be confused with meniscal pathology
- Explore any trauma

History

- Overuse Injuries
- Inciting activities
  - Squats, stairs, skiing, biking uphill
  - Movie theater sign

History

- Instability
  - Episode of frank subluxation or dislocation
  - Objective vs. subjective instability
- Mechanical symptoms
  - Grinding
  - Catching
Physical Exam

- Observation, including
gait
- Standing alignment
- Hip excess anteversion
- Tibial Torsion
- Foot position

Physical Exam

- Palpation
  - Tends to be anterior to
course of MCL
  - Medial synovial plica???
- ROM and strength
testing
- Flexibility
  - hamstrings/quads/ITB

Physical Exam

- Patellar mobility
  - Assess quadrants
- Special maneuvers
  - Apprehension
  - Compression/Grind
  - Tilt lateral tilt
  - Lateral translation/J sign
- Complete ligament
  exam
J Sign
- Lateral translation with extension
- Moves medial with flexion
- Lateral instability

Q-angle
- Angle of pull of the quadriceps
- Men 15
- Women 18
- Inadequate measure of tubercle malalignment
  - Post et al 2002

Limb Alignment
- Miserable Malalignment
- Femoral anteversion
  - Increases in anteversion rotates knee internally relative to pull of quads
- External tibial torsion
  - Tibercle moved laterally increasing angle
- Valgus knee alignment
  - Physiologic or Pathologic
- Hyper-pronation
Patellofemoral Malalignment

- Multifactorial
- May present with pain or mechanical issues
- Overall limb alignment
- Trochlear geometry
- Patellar tilt
- Quadriceps function
- J-sign

IMAGING

- Radiologic evaluation
  - Plain X-rays
    - AP, Lateral, Axial view
  - Radiographic measurements
    - Sulcus angle
    - Tilt angle
    - Congruence angle
  - CT scan
    - Very good axial imaging
    - Shows osseous changes
    - Tracking CT – varying degrees of flexion
  - MRI
    - Articular cartilage
    - Ligament injuries
**Merchant View**

- Normal 137 degrees
- Elevated in trochlear hypoplasia
  - Aglietti et al 1983

**Sulcus Angle**

- Normal 137 degrees
- Elevated in trochlear hypoplasia
  - Aglietti et al 1983

**Lateral Tilt Angle**

- Angle should open laterally
- Parallel or medial increases chance of subluxation
**Patellar tilt**

- Normal: -6 to -10 degrees
- Patella apex should be medial to bisected trochlea

**Congruence Angle**

- Normal: -6 to -10 degrees
- Patella apex should be medial to bisected trochlea

**Trochlear Dysplasia**

Cross over sign

Trochlear prominence

Trochlear Hypoplasia

TT-TG Distance

- Measures lateralization of tibial tubercle
  - Déjour 1994
- Normal 10-12 mm
- Instability >15 mm
  - Schoettle et al 2006
- >20 mm necessary for distal realignment
  - International Patellofemoral Study Group 2006
MRI Calculation of TT-TG

- Initial calculations on CT scan  [Dejour et al. 1994]
- Excellent inter-rater reliability both CT and MR  [Camp et al. AJSM 2013]

Pediatric TT-TG distance

- 10-12 mm adults
- May be less in pediatric pts
- Plotted on growth curve  [Dickens et al. JBJS 2014]

Check for Patella Alta

- Insall-Salvati
- Blackburne-Peel
Treatment Options

Conservative Treatment
- Rest, Ice, NSAIDs
  - Rarely involve significant inflammation
- Physical Therapy
  - Maintain of treatment – several months
- Patella Tracking Braces
- McConnell Taping
- Orthoses for hyperpronation or pes planus

Therapeutic Exercises
- Maintain Motion !!!
- Quadriceps, Lateral retinacular, ITB stretching
- Quadriceps strengthening – VMO
  - Painfree arc
  - Terminal extension to maximize quad demand
- I prefer resistance exercises no greater than 45 degrees flexion
- Avoid isokinetic – increases articular pressure
- Remember contact stresses !!!
Surgical Treatment

- Spectrum of pathology
- First identify the pathoanatomy (Fulkerson and Post)
  - Patellofemoral pain with malalignment
  - Patellofemoral pain without malalignment
  - Patellofemoral instability +/- malalignment
    - Soft-tissue disorders without malalignment
  - Patella dislocations
  - Lateral patella tilt
  - Articular degeneration with/without malalignment

Surgical Treatment

- Arthroscopic or Open Lateral Release
- Distal Realignment
  - Tibial tubercle transfer
  - AMZ, distalization
- Proximal Realignment
  - Soft tissue reconstruction
- Cartilage Restoration
- Arthroplasty
- Combined procedures

Lateral Patellar Tilt

- Lateral patellar pain with tight retinaculum and tilt
- Inability to elevate above horizon
- Release only if minimal degenerative changes
**Lateral Retinacular Release**
- Only indication is lateral tilt
- Arthroscopic (can be done open in conjunction with other procedures)
- Ablation device with coagulation function
- Patella must evert above horizontal
- Iatrogenic Medial Instability
  - Hughston et al JSM 1988
- Check alignment & tracking pre/post release
  - LRR alone will not correct tracking or alignment

**Distal Realignment**
- Can be used to correct actual anatomic alignment
- TT-TG > 20 mm
  - Corrects lateralization of tubercle
- Variety of osteotomies have been described
  - Medial, anterior, distal, combo
- Consider condition and desired direction of transfer
- Avoid posterior transfers

**Distal Realignment**
- **Hauser Procedure (1938)**
  - Medial tibial tubercle transfer
  - Resultant posterior displacement of tubercle
  - Increased rates of DJD
- **Roux-Elmslie-Trillat**
  - Medial transfer w/o posterior displacement
  - Included medial tightening & lateral release
  - Much better than Hauser
  - Avoid if significant degenerative changes
Distal realignment

- Maquet Transfer
  - Not actually for malalignment
  - Pure anterior transfer
  - Need large bone graft
  - Used for degenerative changes
  - Decreases joint reaction force
  - Soft tissue complications
    - Mainly with very large elevations
    - Probably OK if 1-1.5 cm elevation

Distal Realignment

- Fulkerson Osteotomy (AMZ)
  - Anteromedial transfer
  - Combination of chondral changes and malalignment
  - Oblique cut
  - Large surface area for healing
  - Ideal for distal and lateral patella lesions
  - Less successful for proximal and medial changes

Fulkerson

**Fulkerson Post-Op Rehab**

- Protected weight-bearing
  - I prefer WBAT with brace
  - Reports of delayed stress fracture with early weight-bearing
- Brace locked initially
  - Open based on quad control
- Early ROM and patella mobilization
- Maintain lateral flexibility
- Return to sports 6 months
  - Radiographic evidence of union

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**Dynamic Instability without Static Malalignment**

- Usually indicative of soft tissue injury
- History of dislocation
- Conservative treatment first
  - Don’t forget to treat hyper-pronation
- Examine arthroscopically
- Proximal realignment procedure
Proximal Realignment

- May combine with previous mentioned procedures
  - Lateral release only indicated – avoid if hypoplastic trochlea
  - Distal realignment only if combined problem

Historically
- Insall: Made medial arthrotomy, advanced medial soft tissues over anterior patella and sutured to lateral border

Today
- Mainly arthroscopic or mini-open plication
- MPFL reconstruction
Proximal Realignment

- For all procedures
  - Avoid pulling patella medially
  - MPFL should act as check-reign to prevent subluxation
  - If medial pull is necessary then do distal realignment

Soft Tissue Advancement

- Need residual MPFL function
- Mini-open
  - Several cm incision over superomedial corner of patella
  - Check integrity of MPFL
  - Advance VMO and MPFL as needed to patella
- Arthroscopic Technique
  - Imbrication of medial tissue
  - Difficult to examine MPFL integrity
  - Tension harder to assess

Arthroscopic Imbrication
Medial Patellofemoral Ligament Reconstruction

- Medial structures not amenable to tightening or hypoplastic trochlea
- I prefer gracilis allograft
- Avoid proximal femoral insertion
- Set proper tension to avoid increasing medial contact stresses

Re-create anatomic MPFL, not isometry
- Favorable anisometry (Thaunat et al. Knee 2007)

Post OP MPFL Rehab

- 0-2 weeks
  - TOWS
  - Brace locked for weight-bearing
  - Quad sets, heel slides, SLR in full extension

- 2-6 weeks
  - WBAT progression
  - Brace to 90 degrees
  - ROM 90°, flexion by 6 weeks

- 6-12 weeks
  - Full painless ROM
  - Progress quad strengthening

- 3+ months
  - Functional, agility and advanced strengthening
  - Return to sports 3-4 months
Treatment option for Trochlear Dysplasia

- Dysplasia with normal TT-TG
  - MPFL reconstruction
  Steiner AJSM 2006
- Dysplasia elevated TT-TG
  - MPFL reconstruction + bony procedure
  Fulkerson JAAGS 2011
- Trochleoplasty as last option
  - Severe dysplasia refractory to other options

Hypoplastic Trochlea

MPFL reconstruction

Patella Alta

Consider distalization
**Patellofemoral Chondral Lesions**

- Medial Facet - Dislocations
- Lateral Facet -
- Conservative Options
  - Avoid aggressive PT
  - Stop offending activities
  - Stay within comfort range

**MRI to Assess Articular Cartilage**

**Patellofemoral lesions**

- Arthroscopy
  - debridement/chondroplasty
- Anterior Displacing Osteotomies
  - Fulkerson
    - Steeper angle for less medialization
  - Maquet
    - avoid huge grafts
**Patellofemoral Chondral Lesions**

- Unpredictable results for larger lesions
  - Noyes et al. Arthroscopy 2013
- Microfracture/Chondral grafts/ACI
  - Less successful than condylar lesions
- Osteochondral autologous transfers do not reproduce cartilage thickness
- ACI and other grafts survivorship decrease with time
  - Nawaz et al JBU 2014
- Probably need osteochondral allograft for larger lesions in younger patients???

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**Articular Degeneration**

- Patella chondral changes correlate poorly with pain
- Thickness of cartilage ???
- Underlying bony changes are better indicator
  - Edema, cystic changes
- Assess location of chondral damage
- Check alignment carefully

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**Patellofemoral Arthrosis**

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Post-Traumatic OA

- Patellectomy
  - Decreases pain
  - Quad function impaired
    - Variable but up to 50% loss
    - Mainly of historical interest
- Patellofemoral arthroplasty
  - Older, lower demand patients
  - Not as well proven as TKA
  - Correct alignment
- TKA
  - Gold standard if coexistent medial/lateral arthrosis

Surgery for PFJ OA
Patellofemoral Procedures
Post Operative Rehabilitation

- Specific to the underlying problem and the surgical treatment
- Emphasis on achieving motion
  - Limited with cartilage procedure
- Typically protected weight-bearing
- Return to sports 3-12 + months
  - MPFL reconstruction – 3 months
  - Fulkerson osteotomy – 6 months
  - Cartilage Restoration - 12+ months

Summary

- Wide spectrum of problems
- Identify the pathology
- Conservative treatment mainstay
- Surgery specific to pathoanatomy

Questions???
Case 1

- 14 y.o female
- High school basketball
- Bilateral anterior knee pain
  - R>L
- No improvement with 3 months PT
**Lateral Release**

**Arthroscopic Medial Imbrication**

**3 Months Post-op**
- Full motion Right knee
- No pain
- Same surgical procedure for Left knee
Case 2

- 21 y.o old male
- Second time dislocation jumping off back of pick up truck
  - First dislocation as teenager
- Required manual reduction in ED
- Works on family farm
**ISSUES and OPTIONS??**

- 2nd dislocation
- Shallow trochlea
- Torn MPFL
- Lateralized tibial tubercle

**SURGERY**

- Proximal Realignment
  - MPFL reconstruction
- Distal Realignment
  - AMZ transfer

**Case 3**

- 24 y.o male history of multiple lateral dislocations
- Previous soft tissue procedures in past as teenager
- 8 weeks PT with no improvement
  - Persistent lateral instability
  - Requiring brace/crutches for ambulation
Combined Problem

TT-TG 12mm
SURGERY

- Proximal Realignment – MPFL reconstruction
- Cartilage Restoration – Juvenile Particulate Cartilage Cell Implantation

THANK YOU