Pediatric Patellofemoral Instability: Current Concepts

Peter D. Fabricant, MD, MPH
Pediatric Orthopaedic Surgery & Sports Medicine, Hospital for Special Surgery
Assistant Professor of Orthopaedic Surgery, Weill-Cornell Medical College
New York, NY, USA

Disclosures

- Board or Committee Memberships:
  - POSNA Evidence Based Practice Committee, e-Editorial Committee
  - PRiSM Executive Committee
  - Research in OsteoChondritis of the Knee (ROCK) Study Group

- Editorial or Governing Boards:
  - Clinical Orthopedics and Related Research (CORR)
  - Journal of ISAKOS (JISAKOS)
Format

- Concepts of patellofemoral instability
- How to approach first time pediatric/adolescent PF dislocator
  - Imaging
  - When to operate
  - When to nonop
- Risk factors for recurrent instability in children and adolescents
- Surgical Considerations

Contributors to PF Stability

- Contributors to patellofemoral stability – Static Bony
  - Coronal Alignment (eg. valgus)
  - Axial Alignment (eg. TT-TG)
  - Rotational Alignment (eg. femoral and tibial torsion)
  - Trochlear Groove Morphology
- Contributors to patellofemoral stability – Static Soft Tissue
  - Patellar tendon length (eg. patella alta)
  - MPFL
  - Lateral Retinaculum
  - Ligamentous Laxity
- Contributors to patellofemoral stability – Dynamic Soft Tissue
  - Quadriceps
  - Hip/Core

http://noyeskneeinstitute.com/unstable-kneecap/
### Patellofemoral Instability – Thought Process

<table>
<thead>
<tr>
<th>Type</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traumatic – First Time</td>
<td>Initial dislocation event due to trauma or noncontact twisting</td>
</tr>
<tr>
<td>Traumatic - Recurrent</td>
<td>Repeated traumatic dislocations, typically less energy required each time</td>
</tr>
<tr>
<td>Syndromic</td>
<td>Genetic predisposition, severe CT disorders</td>
</tr>
<tr>
<td>Fixed Lateral</td>
<td>Irreducible, remains laterally dislocated</td>
</tr>
</tbody>
</table>

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### Patellofemoral Instability – First Time Dislocator

- Recurrent Dislocator → Surgery
Patellofemoral Instability – First Time Dislocator

- History
  - How did it happen?
  - How did it reduce?
  - Swelling / Effusion → Resolution?

- Physical Exam
  - Alignment
  - Effusion
  - Ligamentous laxity
  - Coronal and Rotational Alignment
  - ROM
  - J-Sign
  - Apprehension / Moving Apprehension
  - Patellar Translation
  - Tenderness to Palpation

Patellofemoral Instability - Imaging

- Physis
- Tilt
- Trochlear Geometry
- Patella Height
- Loose Bodies - Osseous
Patellofemoral Instability - Imaging

- Physis
- Tilt
- Trochlear Geometry
- Patella Height
- Loose Bodies – Chondral
- TT-TG (Axial Alignment)
- MPFL Tear Location

Patellofemoral Instability - Imaging

- Standing Limb Alignment
- Mechanical Axis
Patellofemoral Instability - Imaging

- Skeletal Maturity (Bone Age)

PFI Event

- XR
- MRI
- EOS Hip to Ankle
- Left Hand Bone Age

Dejour et al. KSSTA. 1994

Patellofemoral Instability - Imaging
Patellofemoral Instability – Risk Factors for Recurrence

- N=584 patients, treated nonoperatively (surgical cases excluded)
- Recurrence rate 36% at 20 years (Contralateral rate 5.4%)
- Risk Factors:
  - Age <18
  - Trochlear dysplasia
  - Patella Alta
  - Increased TT-TG
  - Female

Christensen et.al. AJSM 2017

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Patellofemoral Instability – Risk Factors for Recurrence

- N=198 peds / adolescent, treated nonoperatively
- 38% Recurrence (overall)
- 69% Recurrence in skeletally immature with trochlear dysplasia

Lewallen et.al. AJSM 2013
Patellofemoral Instability – First Time Dislocator

- Reasons to operate on traumatic patellar dislocator:
  - Recurrent dislocator
  - Loose body
  - Coronal malalignment in skeletally immature
  - Several risk factors (long discussion, unlikely testable)

Patellofemoral Instability – MPFL Recon vs. Repair/Plication

- Historically MPFL repair alone did poorly
  - Recurrence rates as high as 30-65%

- Recent interest in “algorithmic” repair approach
  - Address bony deformity as needed
  - Repair if focal MPFL injury from femur or patella

- MPFL Reconstruction has dropped recurrence to as low as 5-6%

Nikku et.al. Acta Orthop 2005
Camp et.al. AJSM 2010
Arendt et.al. AJSM 2011
Dragoo et.al. OJSAM 2017
Weinberger et.al. KSSTA. 2016
Patellofemoral Instability – MPFL Recon Techniques

Weeks et.al. (Green) SMAR 2012

Patellofemoral Instability – Allograft vs. Autograft
**ACL Tear – Graft Choice**

- **N = 926**
- Multicenter ACL Group (MOON)

### Allograft Versus Autograft: Anterior Cruciate Ligament Reconstruction: Predictors of Failure From a MOON Prospective Longitudinal Cohort

Christopher C. Kaecling, MD,1* Brian Anes, MD,1 Angela Rodriguez, MPH,1 Erik Pflitl, MD,1 Arzino Amendola, MD,1 Jack T. Andrist, MD,1 Warren P. Dunn, MD, MPH,1 Robert G. Marx, MD,1* Eric C. McCarthy, MD,1* Richard D. Parker, MD,1* Reid W. Wright, MD,1* and Kurt P. Spindler, MD,1*

*Sports Health 2011*

**Primary ACL allograft is bad in youth athletes!**

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**Patellofemoral Instability – Allograft vs. Autograft**

<table>
<thead>
<tr>
<th>ACL</th>
<th>MPFL</th>
</tr>
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<tbody>
<tr>
<td>Stout / “Rope”</td>
<td>Thin / “Paper”</td>
</tr>
<tr>
<td>2,160 N</td>
<td>208 N</td>
</tr>
<tr>
<td>Intraarticular</td>
<td>Extraarticular</td>
</tr>
<tr>
<td>All ROM</td>
<td>0-30 Degrees</td>
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</table>
Patellofemoral Instability – Allograft vs. Autograft

- SR / MA of N=31 Studies (1,065 reconstructions)
- No difference in recurrent instability
  - Autograft: 5.7%   Allograft: 6.7%   (p=0.74)
- Double-limb construct had lower failure rate
  - Double: 5.5%   Single: 10.6%   (p=0.03)

- N=25 Pediatric/Adolescent patients, >1 year f/u
- Gracilis Allograft, 2-limb reconstruction
- 8% recurrent instability

Patellofemoral Instability – Allograft vs. Autograft

- Either is reasonable for MPFL reconstruction
- Unlikely a tested topic
### Patellofemoral Instability – My Surgical Armamentarium

<table>
<thead>
<tr>
<th>Location</th>
<th>Soft Tissue</th>
<th>Bony</th>
</tr>
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<tbody>
<tr>
<td>Proximal</td>
<td></td>
<td>Varus-Producing DFO / IMGG</td>
</tr>
<tr>
<td>Middle</td>
<td>MPFL</td>
<td>± Lateral Release</td>
</tr>
<tr>
<td>Distal</td>
<td></td>
<td>TTO</td>
</tr>
</tbody>
</table>

- **MPFL Reconstruction Techniques**
  - Allograft Semitendinosus with Anchors / MQTFL (Immature)
  - Allograft Semitendinosus with Tunnels (Mature)
  - Quad Turndown (Goyal)
Patellofemoral Instability – Treatment Algorithm

Fig. 2
Our preferred evidence-based algorithm for treating patellar dislocation in children and adolescents. TTO = tibial tubercle osteotomy, and AP = anteroposterior.

Patellofemoral Instability – MPFL Femoral Origin

- Avg. MPFL femoral attachment in kids:
  - 5mm distal to physis
  - 8.5mm distal to physis
  - 4-9mm distal to physis

Kepler et.al. AJSM 2011
Farrow et.al. AJSM 2014
Shea et.al. JPO 2014
Shea et.al. AJSM 2017
Patellofemoral Instability – MPFL Femoral Origin

Testing Strategies

- Know the anatomy and biomechanics
- Know the risk factors for recurrence
- Think algorithmically
- Operate on recurrent dislocators and first-timers only when forced to
- MPFL > Plication
Thank You!