Patellofemoral Instability

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Overview
- Demographics
- Anatomy & Biomechanics
- Physical Exam
- Imaging
- Treatment Algorithm
  - 1st Time Dislocation
  - Recurrent Dislocation

Demographics of PF Instability
- Incidence
  - Overall 5.8 per 100,000
  - Ages 10-17
    - 29 per 100,000

- Initial Dislocation
  - Recurrence rate of 15-44%
  - 58% with limitation while doing strenuous activity
  - 55% fail to return to sports

- Recurrent Dislocation
  - Recurrence rate rises to 50%
**Anatomy & Biomechanics**

### Biomechanics
- Patella serves to increase mechanical advantage of Quadriceps
- Full Extension
  - Patella typically not engaged
  - MPFL has maximal role (50%) in preventing lateralization
- 20 degrees of flexion
  - Inferior patella contacts first
  - MPFL is 30% of lateral restraint
  - Pain/crepitus in early flexion suggest inferior pole chondrosis
- 90 degrees of flexion
  - Quadriceps tendon engages trochlea
- Dynamic Factors
  - Hip Abductor, External Rotator
  - VMO

### Anatomy of Stabilization
- Articular Geometry
  - Trochlear Groove
  - Patellar Facets
    - Medial, Lateral, Odd
- Stabilizing Ligaments
  - MPFL
  - Lateral Retinaculum
  - Patellofemoral ligaments
- Dynamic Stabilizers
  - VMO
    - Attachments onto MPFL
The Anatomy of the Medial Patellofemoral Ligament

- Layer II of Medial Knee Structure
- Origin
- Groove between medial epicondyle and adductor tubercle
- Proximal MCL
- Origins combine with VMO
- Insertion
- Ventral bony edge of patella

Factors of patellar instability: an anatomic radiographic study

- Radiographic comparison
- Operative: 143 Knees
- Non-operative: 67 Knees
- Additional
  - 190 Control Xrays
  - 27 Control CTs
- Trochlear Dysplasia (85%)
- Quadriceps/VMO Dysplasia (83%)
- Measured by evaluating for Patellar Tilt
- Patella alta (24%)
- TT-TG >20mm (56%)

Exam

- Limb Alignment
- Hip Abductor Strength
- VMO
- IT Band Tightness
- Patellar mobility
- Q Angle
  - Greatest at full extension
- Medial retinaculum
Imaging

- **Xrays**
  - AP
  - Lateral (30°)
    - Identify Patella Alta/Baja, trochlear dysplasia
  
- **CT**
  - Measure TT-TG Distance
  - Normal <15mm

- **MRI**
  - Evaluate articular cartilage

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Tibial Tubercle – Tibial Groove

- **Values**
  - Mean value of 13mm
  - Values >20 indicate higher likelihood of recurrent dislocation

- **Measurement**
  - Axial CT
  - 30° Axial Xray
    - High variability

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Acute Patellar Dislocation
- MPFL
  - Consistently ruptured
  - Typically at femoral origin

Evaluate for Chondral Injury

61% at Patella
12% at Femur
12% at Both
6% No Injury
9% Combined

Zone of Injury of the Medial Patellofemoral Ligament After Acute Patellar Dislocation

In Children and Adolescents

Non-operative
- Patellar Bracing
- Rehab
  - VMO
    - Enhanced with closed chain exercise
  - Hip Abductor/Extensors
- Immobilization
  - Leads to higher rates of knee stiffness

Operative
- Consider for Loose Bodies
- Simultaneous Medial Sided Repair for Acute Avulsions
Recurrent Dislocation

After 2nd dislocation, 50% rate of redislocation

Operative Treatment Options

- Over 100 Procedures Described
- Lateral Release
- Medial Repair/Plication
- Tibial Tubercle Osteotomy
  - Elmslie
  - Fulkerson
- MPFL Reconstruction
- Trochleoplasty

Lateral Release

- Structures of Lateral Retinaculum
  - Lateral Patellotibial Ligament
  - Vastus Lateralis Insertion
  - Meniscotibial Ligament

- May cause
  - Paradoxical increase in lateral instability
    - Force required to produce a 10mm lateral subluxation was by 16-19% after an isolated lateral release. Christoforakis et al., 2006
    - Increased medial + lateral instability
Lateral Release Outcomes

- Kolowich et al.
  - 100% Persistent Instability
  - 28/28 Patients continued to have recurrent dislocations after an isolated lateral release

- Lattermann et al.
  - Systematic Review of 14 Studies
  - 63.5% Satisfied at 4 Year Follow-up

The Biomechanics of Medial Patellofemoral Ligament Repair Followed by Lateral Retinacular Release

- After repair of MPFL, adding a LRR lowered the ability of the patella to resist lateral displacement by 7-11%

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>Raw Forces Data in Newtons (N) ± Standard Deviation Required to Displace the Patella 1 cm Laterally</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition</td>
<td>0</td>
</tr>
<tr>
<td>Average Force (N)</td>
<td>80.7 ± 31</td>
</tr>
<tr>
<td>MPFL</td>
<td>74.8 ± 31</td>
</tr>
<tr>
<td>MPFL with LRR</td>
<td>84.5 ± 31</td>
</tr>
</tbody>
</table>

Medial Repair

- Nikku et al.
  - Medial Repair vs. Nonoperative
  - 2yr and 7yr Followup
  - No difference in Tegner and Lysholm scores (p=0.7)

- Palmu et al.
  - Medial Repair vs. Nonoperative
  - F/U at 14 years
  - No difference in recurrence rate (70% in both)
MPFL Reconstruction

The Anatomy of the Medial Patellofemoral Ligament

Layer II of Medial Knee Structure

Origin
- Groove between medial epicondyle and adductor tubercle
- Proximal MCL
- Origins combine with VMO

Insertion
- Ventral bony edge of patella
- Upper 2/3 of patella

Current Concepts Review

The Medial Patellofemoral Ligament

MPFL: Load to Failure = 208N
Amis et al. Knee, 2001

MPFL isometry most dependent on femoral origin. Stevens et al. APM 2004
Anatomical Confirmation of the Use of Radiographic Landmarks in Medial Patellofemoral Ligament Reconstruction

4 Fresh Frozen Cadavers
Proposed Radiographic landmark placed
Origin on less than 4 mm from the anatomic origin

Average placement was 2.3mm anterior and 0.6mm distal to anatomic origin.
Tibial Tubercle Transfer

Indications:
Normal TT – TG = 10-15mm
TT – TG > 20

Elmslie-Trillat Fulkerson

- Medial Transfer

The Effects of Medialization and Anteromedialization of the Tibial Tubercle on Patellofemoral Mechanics and Kinematics

- 10 Cadaveric Knees
- Tested 0 – 90°
- Both techniques corrected maltracking
- Medialization corrected shift of force to lateral facet
13 paired fresh frozen cadaver
Load to Failure
* Higher in Flat Osteotomy (1639 N vs 1166 N)
* No difference in stiffness
Mode of Failure
* Flat Osteotomy – Tubercle Fracture
* Oblique Osteotomy – Posterior Tibial Cortex (2 of 13)
Recommended brace and protected WB for oblique osteotomy patients

Anteromedialization
Anteromedialization
Review and Technique
John C. McClure, MD
University of Washington
Seattle, WA
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Pedicle Length Target is 7-10cm
The Role of Trochlear Dysplasia in Patellofemoral Instability

- 96% of patients with PF dislocations had evidence of trochlear dysplasia.
- Can be treated with proximal and distal realignment.
- Trochleoplasty can be associated with persistent pain and articular cartilage damage.
- Zaki et al. N=25, F/U of 54 months, 33% had residual pain, swelling, crepitus.
- Utting et al. N=54, F/U of 8.3 years, 15 with worsened pain, 10 with evidence of DJD.

Current Recommendations

Initial Dislocation
- Non-operative
  - Patellar Bracing
  - Rehabilitation
  - VMO Activation
  - Hip Abductor/Extensor
- Surgical Treatment
  - Intraarticular fragment
  - Consider acute medial repair for MPFL avulsion

Recurrent Dislocation
- No Lateral Release
- MPFL Reconstruction
- TT-TG > 20mm
- Tibial tubercle transfer
- Medialization
  - Lateral or distal facet chondrosis
- Distalization
  - Patella Alta
Thank You