ACL Injury: 
Evaluation and Imaging

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OBJECTIVES

• Epidemiology of ACL injuries
• Anatomy
• Diagnosis of ACL Injuries
• Imaging for ACL injuries
• Treatment Options
Facts & Epidemiology

• Substantial Physical & Psychological morbidity for athletes.
• Lost Playing Time
• Lost Productivity
• Possible Future Osteoarthritis (>50% at 10 yr.)
• 70% of injuries are Non-Contact
Facts & Epidemiology

- Females 4-6 x greater risk than males (Title IX)
- >50K Female Athletes (HS & College) tear their ACL/yr. in the USA
- $17K/ACL Recon & Rehab
- Unusual in children <14 y/o
Anatomy
Ligamentous
Anatomy
Attachments
Anatomy

• Vascular Supply

  • Middle Geniculate Artery (Primary Source)

  • Perisynovial sheath and terminal elements of the tibia and femur.
Anatomy

• Nerve Supply

• Posterior articular nerve (sub-synovial)
Function

- Prevent excessive anterior translation of the tibia on the femur
- Control normal kinematics
- Prevent Hyperextension
- Prevent excessive internal rotation of the tibia on the femur
Pathology

• Nontraumatic ACL Insufficiency
  • Physiologic joint laxity (bilat-exam)
  • Congenital absence of the ACL (rare)
    • Absence of tibial eminence
    • Absence of intercondylar notch
  • Developmental absence
    • Associated with
      • Proximal focal femoral deficiency
      • Congenital knee dislocation
      • Leg length discrepancy
Pathology

• Traumatic ACL Insufficiency
  • Location of Injury
    • Tibial or femoral avulsion fracture
    • Mids substance
  • Time of Injury
    • Acute <3 weeks
    • Subacute 3 – 12 weeks
    • Chronic > 12 weeks
Pathology

• Traumatic ACL Insufficiency
  • Age of Patient
    • Chronologic
    • Physiologic
      • Tanner Stege
      • Bone Age
  • Natural History
    • Adult: ACL instability – degenerative disease
    • Children: Not well understood. Especially partial tears.
History

Acute (MOI)
Noncontact
(>50%)
Twisting/cutting maneuver
  • Rapid change of direction
Contact
History

• History
  • Acute
    • “POP”
  • Unable to return to play
  • Effusion (hemarthrosis)
History

Chronic

- Instability/giving way/“fist” sign
- Locking/catching (meniscal)
- Recurrent effusions
Physical Examination

• Acute, sub-acute, chronic
• Bilateral extremity exam
• Hip exam
Physical Examination

• **INSPECTION:**
  • Skin changes: Ecchymosis or erythema
  • Effusion
Physical Exam

- Meniscal exam
- Leg lengths
- Pulses
- Growth plate pain
- Valgus/varus stress (physis vs. collateral ligament)
- Patella Femoral Joint
ACL Specific Exams

- Lachman Test
- Anterior drawer
- Pivot shift test
- Instrumented arthrometers (KT-1000)
Physical Exam
Lachman Test
Physical Exam
Anterior Drawer

Anterior Drawer Test
Pivot Shift Maneuver

1. Tibia in valgus anterolateral rotation
2. Iliotibial band reduces flexion

Pivot shift test for anterolateral knee instability:

- Patient supine and relaxed. Examiner sits on top of bed, keeping knees fully extended and green knee with other hand, placing thumbs on each head on iliac crest. Examiner applies strong external rotation to tibia and gently at both knee and ankle while lifting proximal tibia. Keep patietnt to 30°, about 20° examiner pushes medially with proximal hand and pulls with ulnar hand to produce a valgus stress on knee.

As internal rotation, valgus force, and forward displacement of lateral malleoli continue, maintained knee suddenly caves. Anterior translation of tibia anterolateral instability present, quadriceps visible, quadriceps, and popliteal fat pad are seen at about 20°–40°. Review for persistent anterolateral fat pad impact. Especially if lateral capsular ligament ruptured, especially if lateral capsular ligament is torn.
Physical Exam Video
Dr. Eric Janssen

- Lachman
- Anterior drawer
- Pivot shift test

- [http://www.youtube.com/watch?v=vEQw-G1Vr18](http://www.youtube.com/watch?v=vEQw-G1Vr18)
- 3:14
Instrumented Arthrometers (KT-1000)
Physical Exam
Knee Aspiration

• Hemarthrosis
  • Blood in the joint
    • ACL Tear
    • Meniscal Tear
    • Occult Fx (Fatty Droplets)
Imaging Studies

- X-rays
- MRI
- CT Scan
- Ultra sound
X-Rays

4 views. Ap, Lat, Notch, P-F

• Avulsions of bone (tibia, femur) Segond fx
• Physeal maturity
• Physeal injury (stress views)
• Osteochondritis dissecans
• Hypoplasia of tibial eminence or femoral notch
X-Rays
AP & Lateral
X-Rays
Notch & Patella Views
Notch Ratio View
Notch Ratio

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<tr>
<th>Type</th>
<th>#1 U-shaped</th>
<th>#2</th>
<th>#3</th>
<th>#4</th>
<th>#5 Wave-shaped</th>
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<tbody>
<tr>
<td>Normal</td>
<td>3/17 (18%)</td>
<td>2/17 (12%)</td>
<td>3/17 (18%)</td>
<td>1/17 (6%)</td>
<td>1/17 (6%)</td>
</tr>
<tr>
<td>Unilateral</td>
<td>1/17 (6%)</td>
<td>1/14 (7%)</td>
<td>5/17 (29%)</td>
<td>6/14 (43%)</td>
<td>6/17 (35%)</td>
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<tr>
<td>Bilateral</td>
<td>1/14 (7%)</td>
<td>1/8 (12%)</td>
<td>6/14 (43%)</td>
<td>3/8 (37%)</td>
<td>2/14 (14%)</td>
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<tr>
<td>&quot;narrowed&quot;</td>
<td>5/48 (10%)</td>
<td>1/8 (12%)</td>
<td>19/18 (40%)</td>
<td>3/8 (37%)</td>
<td>9/48 (19%)</td>
</tr>
<tr>
<td>Total</td>
<td>9/48 (19%)</td>
<td>6/48 (12%)</td>
<td>21/18 (40%)</td>
<td>11/18 (60%)</td>
<td>9/48 (19%)</td>
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X-Rays
Segond Fracture

Paul F. Segond
Paris, France
1851-1912

High (>75%) Association with ACL tears
X-Rays
Segond Fracture

Figure 4. Segond fracture. (From Prog Méd 16: 1879.)
X-Rays
Tibial Eminence Fractures
X-Rays
Hypoplastic Tibial Eminence or Femoral Notch
X-Rays
Physeal Injury
Magnetic Resonance Imaging (MRI)

- Coronal, SAGITTAL, axial views
- Area of ACL injury
- Chondral injury
- Meniscal injury
- Physeal maturity
Magnetic Resonance Imaging (MRI)
Treatment

“Igor, quick! Run over to the cemetery, dig up a corpse, and bring me an anterior cruciate ligament.”
Treatment

• Objectives
  • Return to as near normal function as possible
  • Eliminate/decrease episodes of instability and further injury
Treatment

• Non-Operative
  • Rehab
  • Bracing
  • Avoidance of High Risk Activities
Treatment

• Operative
  • Unable to “repair”
  • Must “Reconstruct” ACL
Summary

• Epidemiology of ACL injuries

• Anatomy

• Diagnosis of ACL Injuries
  • HISTORY
  • Physical Exam

• Imaging for ACL injuries
  • X-rays
  • MRI

• Treatment Options
  • Non-Operative
  • Operative
Questions?
Thank You