A 12 year old boy sustains an injury to his knee while playing football. Exam reveals diffuse tenderness, a 2+ effusion, and restricted range of motion. He has 2+ laxity with valgus stress. Which of the following imaging studies will best aid in diagnosis:

1. Bone scan
2. MRI
3. CT
4. Bone age Xrays
5. AP and lateral Xrays with and without stress

Skeletally immature: physes and bone fail before ligaments! Stress view Xrays often diagnostic

Intrarticular Effusions rare with isolated MCL

If large effusion, think ACL, patella dislocation, or fracture

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**Children and knee injuries**

- Almost 1/3 of injuries from all causes due to sports
- ↑ participation of kids in sports
- Knee is the most injured joint in children

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**Why are Children Different?**

- Growth
- Healing potential is greater
- Physeal plates weaker than tendons or ligaments
- Alignment
- Children can be flexible
History

The patient or parent will tell you what’s wrong
• Pain
• Swelling
• Instability
• Limp
• Abnormal function

Evaluation - History

• Mechanism:
  – twisting injury?
  – Associated with sports?
• Traumatic vs. atraumatic (overuse)
• Sudden onset vs. insidious
• Swelling initially/now? How much?
• Length of symptoms
• Aggravators/Relievers
• PT, bracing, NSAIDS tried?

History

• Pain vs. instability complaint?
• Pain: Diffuse, poorly localized vs. localized activity related: stairs, sitting, running, squats (degree of flexion with pain)
• Instability: due to quad weakness or inhibition, an unstable knee (ligament), or patellar subluxation?
• Locking/loose body symptoms?

RED FLAGS- Don’t Miss these…

• Night pain
• Fever
• Weight Loss
• Limp
  – THINK ABOUT INFECTION OR TUMOR!!
• Always check the hip and back
Swelling
- Suggests intra-articular pathology
- Consider timing of swelling after injury:
  - Immediate - minutes
  - In 24 hours
  - Insidious - days

Immediate - Hemarthrosis
- ACL (almost 50%)
- Fracture (Patella, tibial plateau, supracondylar Femur, Physeal)
- Patellar dislocation
- Tendon Rupture (Quadiceps, Patellar)
- Osteochondritis Dissecans
- SOME Meniscal lesions

“Locked Joint”
- Unable to fully extend the knee
- Potential Causes: Ligament injury, Osteochondritis Dissecans or Meniscal injury
- Requires urgent Orthopaedic referral

Anterior Knee Pain- Children
- Osgood-Schlatter’s Disease
- Sinding-Larsen Johannsson
- Patellar Tendonitis
- Patellar Instability
- Patellofemoral Pain
Osgood-Schlatter’s Disease

- Repetitive forces on quads and patellar tendon cause microavulsion fractures in tibial tuberosity

Osgood-Schlatter’s Disease

History - Common in 11-15 year olds; jumping athletes
- Pain over tibial tubercle after activities
- Pain and weakness on extension

Osgood-Schlatter’s Disease

Treatment
- Conservative
- RICE, NSAIDS
- Physiotherapy
- Hamstring stretching → ↓ stress on anterior knee during extension
- Quadriceps strengthening → painful inhibition of quads leads to atrophy
- Rarely surgery to remove ossicle

Osgood-Schlatter

- Most improve in 1-2 years with activity modification
- Goal is to eliminate pain, not for cosmesis
- May operate prior to skeletal maturity
Sinding-Larsen-Johansson
- Common in 10-12 year old boys
- Jumping activities/repetitive stress
- Ant knee pain distal pole of patella
- Xrays: fragmentation of distal pole of patella or small calcifications prox patellar tendon
- Differentiate from Sleeve avulsion!!!

Sinding-Larsen-Johansson
- Treatment similar to Osgood Schlatter’s
- Surgery Rare: Goal is to eliminate pain
- Excise calcification
- Debride avascular tissue

Periosteal Sleeve Avulsion of Patella
- Younger athletes 9-12 years old
- Fracture is often isolated acute event
- Mech: forceful quad contraction due hyperflexion or sudden deceleration

Periosteal Sleeve Avulsion of Patella
- Unable to actively extend knee
- Palpable gap and swelling distal pole of patella
- Xrays: may see rim of bone separated from rest of patella, patella alta
- REQUIRES SURGICAL REPAIR!!!
Patellofemoral Instability

Literature Review: Natural History

- Avg. age 14-15 yrs. (10-27)
  - rare after age 30
  - Female: Male 3:1
- Recurrence Rate 15-44%
- Associated Risk Factors
  - Ligamentous Laxity
  - Patellar Malalignment
    - ALTA
    - Increased Q-Angle

Evaluation - History

- **Mechanism:**
  - femoral internal rotation on a fixed externally rotated tibia
  - often a twisting injury
  - 38% during athletics (ER + valgus)
  
  *Baum, 1973*

- Acute hemarthrosis

Evaluation - Radiographs

- **Insall Ratio**: 1.4

**MUST RULE OUT OSTEOCHONDRAL/CHONDRAL FRACTURE**
**Evaluation - Other Studies**

- Torn medial patellofemoral ligament
- Osteochondral fracture

**Management - Non-operative**

**Acute management**
- Often relocate spontaneously
- Aspirate hemarthrosis (optional)
- Cryocuff / crutches

**MUST RULE OUT OSTEOCHONDRAL/CHONDRAL FRACTURE!!! Present 40-55% of time**

**Management - Non-operative**

- Aspirate hemarthrosis?
- Rehabilitation -
  - VMO strengthening
  - Hamstring stretching
- Patellar stabilization braces
- McConnell Taping
- ? Return to Play: 3 months

**Management - Operative**

**“Acute” Surgery: Not the Standard of Care**

CONTROVERSIAL - Young athlete with dislocation by indirect mechanism. Recent reports cite <10% incidence of redislocation if acute repair of MPFL +/- VMO (Ahmad, Handy, Sallay)

- YES - “First time dislocator” with presence of displaced osteochondral fracture
**Management - Recurrent Instability**

**Proximal (Soft-Tissue Only):**
- Medial Retinaculum Repair
- Isolated Lateral Retinacular Release
- Lateral Release +/- Medial Reefing

**Proximal/Distal (Osseous):**
- Lateral release +/- Medial Reefing
- Distal Tibial Tubercle realignment

SOFT TISSUE PROCEDURES ONLY IN SKELETALLY IMMATURE PATIENTS. HIGH FAILURE RATE

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**Anteromedialization-Fulkerson**

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**Patellofemoral Pain**
**Case Example**

- CC: HPI: Bil. knee pain, L>R
- 17 yo female
- h/o bil. ant. knee pain
- Multiple “dislocations” (???)
  - Sx increased x 1-2 yrs.
  - Pain with ADL’s, stairs, squat, kneeling
- Failed PT, NSAIDS

**Physical Examination**

- Normal body habitus / + lig. laxity
- Mild (2 deg.) valgus bil.
- Moderately pronated feet
- Squat 90 deg-pain
- 5% quad atrophy
- Very mild swelling
- + tenderness M/L facets, lat trochlea

**Non-operative tx**

- Patellar taping/bracing
- Patellar mobilization
- Quadriceps strengthening
- Stretching exercises
  - HS, quads, IT band
- Foot orthotics/heel lifts
- NSAIDS
- Surgery rare for PF pain in young people

**Meniscal Pathology**

- Patellofemoral Pain
- Patellofemoral Pain
- Patellofemoral Pain
Meniscal Injury

• **Mechanisms:**
  • Rotation of the femur against a fixed tibia during flexion and extension (twisting injury)
  • History of twisting, squatting, or cutting

• **Clinical signs:**
  • Joint line pain, giving way, clicking, and effusions. Locking of the joint in fixed flexion may occur after displacement of a meniscal fragment or pseudolock due to hamstring muscle spasms

Meniscal Injury - MRI

Normal Meniscus

Posterior Horn Tear

Partial Menisectomy

• If meniscal tear disrupts mechanics of knee and patient is not a good candidate for meniscal repair
• Debridement (remove as little as possible)
Discoid Meniscus

- **Description:**
  - Meniscal tissue covers entire tibial plateau (coin shaped) with variable peripheral attachments
  - Most commonly lateral meniscus
- **Clinical signs:**
  - Often asymptomatic
  - When symptomatic, may present with popping, clicking, catching symptoms, tenderness lateral joint line

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A 20 year-old soccer player attempts to avoid an oncoming defender by making a rapid cut and change of direction. As she pivots to change direction, she hears a loud pop in her knee. She tries to continue playing but has a moderate amount of discomfort in her knee, and her knee “gives out” on her the next time she tries to make a rapid change in direction. Her knee swells a great deal in the next few hours. The most likely diagnosis is

1. Meniscus Tear
2. Anterior Cruciate Ligament Tear
3. Patellar Tendon Rupture
4. Chondromalacia patella/patella maltracking

ACL Injury

- Mechanisms: Contact vs. Non-contact
- #1: Forced valgus in external rotation: causes disruption of the MCL and medial supporting structures (clipping injury)
- #2: hyperextension, associated with a meniscus tear (volleyball, gymnastics, basketball)
- A sudden deceleration to change direction can also produce an anterior drawer force on the proximal tibia from forceful quadriceps contraction (football players, basketball)

ACL Injury on MRI

[Normal ACL vs Torn ACL images]
**Graft Options**

**Autograft**
- Patellar tendon
- Hamstrings
- Quad tendon

**Allograft**
- Patellar tendon
- Achilles tendon
- Hamstrings

_GROWTH PLATES MUST BE CONSIDERED!!!_

**Graft Options-Skeletally Immature Patients**

_GROWTH PLATES MUST BE CONSIDERED!!!_
- Hardware or Bone plugs crossing growth plates likely to cause growth arrest and angular deformity
- One option: non-transphyseal or partial transphyseal reconstruction (over the top technique on femoral side)
- Recent reports show success with transphyseal tunnels and soft tissue graft (hamstrings), fixation away from physes.

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**Intra-articular Reconstruction**

Hamstrings with Endobutton Technique

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**ACL Hamstring Graft In Position**
Tibial Eminence Fractures

- Avulsion of ACL instead of intrasubstance tear
- More common in skeletally immature patients
- Even if repaired may have residual instability due to intrasubstance ACL injury

Tibial Eminence Fractures - TX

Physeal Injury

- Injury to distal femoral physis more common than proximal tibial physis

History/Mechanism

- Direct force to knee usually varus or valgus (clipping)
- Pain out of proportion!!!
Physeal Injury

P/E
- Large effusion
- Tender joint line or physis
- Rule out ligamentous laxity
- Compare vs nml knee

Diagnostic Tests
- X-ray including stress views
- Exam under anesthesia

Complications
- Neurovascular injury
- Compartment syndrome
- Growth disturbance
- Associated ligament injury

Treatment
- Closed reduction and casting 4-6 weeks
- Occasional Closed/Open reduction and pinning
- Follow for growth disturbance
- Epiphysiodesis to prevent angular deformity or leg length discrepancy

Osteochondritis Dissecans
- Avascular necrosis of osteochondral fragment
- Usually lateral aspect of medial femoral condyle
**Osteochondritis Dissecans**

Hx - Vague knee pain; may have locking symptoms, may have acute large effusion. Wilson’s sign

Dx - X-rays
- MRI (Stage lesion)
- Arthroscopy

**Treatment**
- Management determined by age of patient and stage of lesion
- Young children more likely to heal stable lesions than older children
- Older children may require pinning/stabilization of fragment or osteochondral graft replacement

**OSTEOCHONDRAL DEFECT**
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