Anterior Knee Pain (AKP) Outline

- Terminology
- Anterior Knee Pain DDx
- Anatomy Review and Patellofemoral Biomechanics
- Clinical Assessment
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- Diagnostics
  - Review of Common AKP Diagnoses
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    - Patellofemoral Pain Syndrome (PFPS)
    - Patellar Tendinitis
    - Osgood Schlatter, Sinding-Larsen-Johansson
    - Synovial Impingement Syndromes
    - Bursitis

Terminology

- Anterior Knee Pain (AKP)
  - Nonspecific term which encompasses many diagnoses.
  - Pain can be generated from variety of anatomic structures.
  - May include Patellofemoral Pain within differential.
- Chondromalacia Patella
  - Found infrequently in the skeletally immature.
  - It is a diagnosis of degenerative change, usually it is reserved as a surgical finding.
- Patellofemoral Pain Syndrome (PFPS)
  - Indicating pain from the patellofemoral articulation itself.
  - Pain typically peripatellar, retropatellar in nature.
  - Cause is not clearly understood and may have multiple origins.
Anterior Knee Pain Differential Diagnosis

- More Common Causes
  - Patellofemoral Pain
  - Patellar Tendonitis
  - Osteochondroses (OSD, SLJ)
  - Patellofemoral Instability
  - Synovial Impingement
  - Fat Pad Irritation
  - Osteoarthritis
  - Synovial Plica
  - Bursitis: Pre-, Infra-, Pes
  - ITBS
  - Quadriceps Tendinopathy

- Additional Causes...
  - Tumor
  - Trauma
  - Patellar Stress Fracture
  - Insufficiency Fractures
  - Osteochondritis Dissecans
  - Hip Pathology
    - SCFE, Stress Fracture
    - Idiopathic AKP
    - Psychiatric Disorders
      - Stress, Depression
    - Meniscal Tears
    - Referred Spine Pain (L4)

Anatomy Review

- Hinge Joint (Primarily Passive/Extends)
- Patella: Largest Sesamoid Bone
  - Biomechanical lever arm
  - Increases extensor mech. efficiency 1.5x
  - Centralizes divergent forces
  - Bony shield to tibiofemoral joint
- Thickest articular cartilage (up to 6.5mm)
Anterior Knee Pain

**Patellofemoral Biomechanics**

- During flexion, patella moves medial and engages in trochlear groove
  - Increasing area of contact with increasing flexion.
  - Increasing contact pressures with increasing flexion.
  - Maximum contact pressures at 90 degrees.

- Loaded Knee Flexion
  - Subjects the patellofemoral joint to large forces:
    - Level Walking: ½ x body wt.
    - Upstairs: 3-4x body wt.
    - Squat: 7-8x body wt.

**Predisposing factors for Patellar Malalignment and Patellar Instability**

- **Bony Abnormalities**
  - Helping to keep the patella centered in the trochlear groove is the v-shaped anatomy of patella (facets) and configuration of femoral condyles (trochlear groove)
  - Dysplasia of Trochlear Groove – various degrees, med or lat.
  - Asymmetry of patellar facets - affects patellar congruity

- **Lower Extremity Malalignment**
  - Patella Alta
  - Femoral Anteversion
  - Knee Valgus
  - Lateral displaced Tibial Tuberosity
  - Foot Hyperpronation

- **Muscle and Soft Tissue Imbalances**
  - Imbalance between VMO and VL
  - VMO weakness
  - Timing deficit with delayed onset of VMO strength
  - Abnormal Soft Tissue Length
    - Tightness in Quadriceps
    - Directly increase contact pressures PF joint
    - Tightness in Hamstrings, Calf
    - Constant flexion moment to PF joint
    - Tightness in Iliotibial Band (ITB)
    - Affects normal PF excursion
    - Contribute to lateral patellar tilt, excessive pressure lateral patella
Clinical Assessment: AKP History

- Presenting Symptom
  - Pain, Instability or Combination of Both
- Onset/Duration
  - Acute or Chronic, Overuse or Overload
  - Acute exacerbation of a chronic problem
- Pain
  - Location, Character, Aggravating factors, QHS
  - Inflammatory symptoms (morning stiffness, swelling)
- Instability
  - True Instability vs. "Quadriceps Inhibitory Reflex" (Due to Pain)
  - # of true episodes, under what circumstances/MOI
- Associated Problems
  - LBP, Hip pain, Prior surgeries/treatment, PMedHx

Clinical Assessment: Physical Examination

- During the exam, physician should try to reproduce the patient’s knee pain through palpation, as well as, biomechanical evaluation.
- Observation
  - Alignment (Static and Dynamic)
- Palpation
- Special Orthopaedic Testing
  - Hip/Lumbar Spine
- Neurovascular Exam

Physical Exam: Observation

- Findings are often subtle for PFPS.
- Clinical studies have NOT been able to consistently demonstrate biomechanical or alignment differences between patients with PFPS and healthy individuals


- Static Alignment
  - Identifiable when patient is NOT moving.
  - Femoral Anteversion, Knee Position (Varum, Valgum, Recurvatum), Foot/Ankle WB position
  - “Miserable Malalignment Posture” (Andrishe, Orthop Clin N Am, 2008)
Physical Exam: Observation

- **Static Alignment cont’d**
  - Common Clinical Measurement is Q-angle
  - Q-angle
    - Line connecting ASIS to center of patella and line connecting center of patella to middle of anterior tibial tuberosity.
    - “Normal” varies from 10-22 degrees
    - PFPS has been demonstrated to be associated with a larger Q-angle (Lemmers N. BJSM. 2013)

- **Dynamic alignment**
  - May exist during movement as a result of poor muscular control
  - Can have patient step slowly up/down from 6” stool or single leg squats
  - Presence of any abnormal movements of patella as it engages into trochlea, any body shifting, trunk rotation, loss of hip control.
  - Excessive contralateral hip drop
  - Hip adduction and IR
  - Knee abduction
  - Tibial ER, hyperpronation

Physical Exam: Palpation

- **Seated exam**
  - Surface anatomy is best appreciated with knee flexed to 90 degrees
  - Retropatellar crepitus

- **Supine exam**
  - Leg length discrepancy: >1cm adverse effect of LE with running.

- **Correlate point of maximal tenderness with underlying anatomical structures.**

- **Swelling**
  - Intraarticular effusion versus Prepatellar/Infrapatellar bursitis
  - As little as 20 ml fluid can inhibit VMO function
**Physical Exam:** Review of a FEW Orthopaedic Tests

- **Patellar Tilt Test**
  - Supine, Knee extended, Quad relaxed: Compare height of medial patellar border to lateral patellar border. If medial border is more anterior, then there is a lateral tilt.

- **Medial/Lateral Patellar Glide**
  - Noting degree of movement relative to width of patella, > 75% translation is hypermobile.

- **Patellar Compression/Grind**
  - Direct compression into trochlea, contraction of Quadriceps

- **Patellar Apprehension Test**
  - Apply lateral pressure to patella at 30 degrees flexion. Test is positive if patient feels instability or pain.

**Physical Exam:** For completeness: Addtl. Orthopaedic Tests

- **Ober**’s
  - Flex knee 90 degrees and abduct, add hip extension and release
  - Positive test has tightness through ITB, tight/ pain anterior hip is hip flexors.

- **Valgus/Varus stress at 0, 30 degrees**
  - MCL/CL sprain/tear

- **Anterior/Posterior Drawer**
  - ACL/PCL sprain/tear

- **Lachman, Pivot Shift, Bounce Home**
  - ACL

- **McMurray, Apley Compression**
  - Menisci

**Hip/Lumbar Spine Exam; Neurovascular Exam**

- **Hip Exam**
  - Referred pain to the knee including OA, SCFE, LCP
  - Assess gait pattern as well.

- **Lumbar Spine Exam**
  - Referred pain from spine (L4 radiculopathy) to anterior knee.
  - History of LBP/Intervention
  - Posterolax knee pain, foot pain

- **Neurovascular Exam**
  - Numbness/Tingling
  - Reflex/Pulses
AKP Diagnostics

• Radiology is an adjunct to H&P
• Plain Radiographs: WB AP, Notch View, Lateral View (15 degrees flexion), Merchant View (30-45 degrees flexion)
  – Rule out other sources for AKP: Loose bodies, Occult Fx, Tumor
  – Anatomical variants, Bipartite Patella
  – Patella height
  – Lateral Tib/Patellar subluxation
  – Osteoarthrits
  – Trochlear Dysplasia

AKP Diagnostics

• Computed Tomography (CT)
  – Further evaluation of Trochlear Dysplasia (pre-surgical)
    – Tibial Tubercle-Trochlear Groove Distance (TT:TG)
• Magnetic Resonance Imaging (MRI)
  – MPFL/Retinaculum Tear (Patellar Dislocation)
  – Osteochondral Injury; Loose body
  – Patellar tendon; Extensor mechanism
  – Stress fracture/Insufficiency fractures
  – Ligamentous tear; Meniscal tear
  – Tumors
• Bone Scan
  – Limited use: Stress fracture

Review of Common AKP Diagnoses

• Patellofemoral Instability
  – Dislocation, Subluxation
• Patellofemoral Pain
• Patellar Tendinitis
• Osgood Schlatter, Sinding-Larsen-Johansson
• Synovial Impingement
• Bursitis
Patellofemoral Instability

- Dislocation
  - Complete, usually lateral displacement of patella from femoral trochlea that persists until reduced, usually by extending knee +/- medial pressure.

- Subluxation
  - Transient partial displacement of patella from femoral trochlea; may occur acutely, as in a dislocation, or may be transient. There is spontaneous reduction of displacement.

- Highest risk of acute patellar dislocations in 2nd decade

- Recurrence Rates 15-44% after initial dislocation

- Mechanism of Injury – Acute injuries
  - Valgus +/- Twisting with strong quadriceps contraction
  - 61% Sports Related; 9% Dance Related

Patellar Dislocation/Subluxation

- Predisposing Risk Factors
  - Variations of alignment and anatomy about PF, lower extremity
  - VMO weak; VL hypertrophy, ITB tight, patella alta, trochlear dysplasia, increased Q angle, pes planus, “miserable malalignment”, Positive J sign
  - (More easily seen in acute case on uninjured knee)
  - Genetic predisposition, connective tissue d/o, Ligamentous laxity
  - Increase risk of subsequent dislocation: Female sex, family history of patellar instability, history of patellar subluxation or dislocation

Patellar Dislocation/Subluxation

- Patient History
  - May or may not have previous sx of instability or PF pain.
  - May report lying on ground with knee flexed, feeling something “out of place”, felt a popping sensation
  - Either reduces on its own or with pushing medially
  - Try and obtain number of episodes/frequency/MOI
  - Swelling within first two hours for acute dislocation.
  - With subluxation, may occur with force or with everyday activities.
  - With subluxation, may have a feeling a slipping with cutting, twisting or pivoting; may have recurrent swelling.
Patellar Dislocation/Subluxation

- **Physical Exam**
  - Depends on whether patella is still dislocated or has been reduced.
  - Pre-reduction: Patella will be located over lateral femoral condyle with prominence of uncovered medial femoral condyle.
  - Post-reduction: May have large hemarthrosis with patellar hypermobility. Marked apprehension with patellar mobilization. May have associated medial ligamentous instability.
  - Hypermobile patellae, +Patellar grind/compression/tilt/apprehension. Pain medial patellar retinaculum/MPFL

- **Imaging**
  - Plain XR
  - Rule out osteochondral fracture/occult fracture
  - Unusual to still find patella dislocated (positioning will often reduce)
  - MRI
    - Assess loss of medial support structures (MPFL); Assess osteochondral fracture/occult fracture; loose bodies; Other associated injuries (MCL, meniscus)
  - CT
    - Presurgical/Patellofemoral alignment; bony anatomy

Patellar Dislocation Treatment

- Reduction, PRICE, Crutches if painful WB - PWB
- Immobilize initially for comfort; 2-3 weeks (Extension)
- Transition to patellar supportive bracing
  - J, True-Pull, Breg, Playmaker
- Physical Therapy/Rehabilitation
  - Quad strength, ROM, Proprioception, CORE strength
  - Patellofemoral Rehabilitation (hip, abdomen, back)
  - Taping/Kinesiotaping
- Operative Indications (Debated - 1st time dislocation)
  - Osteochondral fracture/Lose body
  - Disruption of VMO insertion; Medial retinaculum/MPFL tear
  - Recurrent dislocation/Failure of nonoperative management
Recurrent dislocations/subluxation treatment

- Despite disability with recurrent patellar dislocations, persistence with nonsurgical treatment is warranted when
  - Dislocations are isolated or infrequent
  - Habitual or obligatory
  - Most importantly: When the existing patellar mechanics are able to accommodate the rehabilitation process.
  (Andrish, Orthop Clin N Am, 2008)

- Surgical Intervention
  - Over 100 procedures described, lack of high quality studies.
  - No gold standard, Needs to be individualized to each patient and pathoanatomic findings which allow/provoke episodes.

Patellofemoral Pain Syndrome (PFPS)

- PFPS definition and importance:
  - Average recreational runner has 37-56% incidence being injured during a year’s training.
  - Knee MOST common site.
  - PFPS constitutes nearly 25% of injuries to the knee.
  - Constellation of symptoms arising from patellofemoral compartment.
  - Pain typically retropatellar, peripatellar in nature
  - Complex and multifactorial, many times etiology is unclear
  - Many theories include overuse, overload, biomechanical, muscular
  - PFPS is the “single most common condition seen by most sports medicine practitioners” (Bruckner and Khan, Clinical Sports Medicine, 2nd Ed.)

Patellofemoral Pain Syndrome

- Predisposing Risk Factors/History
  - Same as for patellar instability
  - Biomechanics, Muscular Dysfunction (Weakness/Flexibility)
  - Adolescents with rapid growth may have soft tissue contractures (e.g. hamstring, hip flexors) which increase stress to PF joint
  - Overuse and Overload
  - Repeated weight bearing, impact (Running)
    - Especially hills, uneven ground, steps/stairs
  - Weight training/Training Errors leading to soft tissue microinjury: Continued strenuous activity without time for healing and repair leads to overload and microfailure.
  - Prolonged sitting (“Theater Sign”), Sitting in tight space with knee flexed
Patellofemoral Pain Syndrome

- **Patient History**
  - Onset of Pain (with activity, sitting) Was there an injury?
  - True instability usually does not occur in PFPS but patients report “giving way” sensation.
  - This is due to reflex inhibition of quadriceps muscle secondary to pain, effusion, or deconditioning (Houghton, Ped Rheumatology. 2007)
  - Direct trauma to a flexed knee may disrupt articular cartilage so there may be a history of an inciting event leading to start of PF irritation.
  - May have “snapping and popping” (retropatellar crepitus)
  - No close association between crepitus and pain
  - Johnson (1998) noted that 94% of healthy women and 45% of healthy men exhibited patellofemoral crepitus

- **Physical Exam**
  - Usually subtle, not usually an effusion unless a component of instability exists.
  - As discussed predisposed risk factors (Same as for instability)
  - Hypermobile patella, positive compression/grind/apprehension/vitil
  - Muscular Etiologies (Juhn, Am Fam Phys, 1999)
    - Quadriceps Weakness, VMO dysplasia: Valgus moment with one leg squat
    - Tight ITB: Positive Ober’s
    - Tight Hamstrings: Inability to fully extend at knee
    - Weakness of hip muscles (adductors, abductors, external rotators): Positive Trendelenburg
    - Tight calf muscles

- **Imaging**
  - Plain XR: May be normal, Lateral patellar tilt on merchant view, May have predisposing instability findings: Trochlear dysplasia, Patella Alta
  - MRI: No role initially unless diagnosis in question, helpful with persistent pain despite conservative intervention. (R/O OCD e.g.)

- **Treatment**
  - Patient Education
  - Rest and Activity Modification
  - Physical Therapy
  - NSAIDs
  - Knee Braces, Arch Supports/Custom Orthotics
  - McConnell Taping, Kinesiotaping
  - Surgery
**Patellar Tendinitis: “Jumper’s Knee”**

- Inflammation of the patellar tendon, usually at the attachment to the inferior pole of the patella

**History**
- Excessive jumping or bounding activity
- High patellofemoral stress activity
- Pain initially after activity, then noted during exercise and finally, as it progresses, at rest/everyday WB

**Physical Exam**
- TTP inferior pole patella, tendon attachment
- Decline squat test, puts extra stress, can elicit pain
- Look for predisposing alignment issues, weakness etc.

**Imaging**
- XR may show ossicles/enthesiophytes at tendon insertion
- MSK US, MRI can identify chronic changes to tendon
  - Thickened tendon with increased signal

**Treatment**
- Rest, Activity Modification
- Infrapatellar strapping may provide some symptom relief
- Physical Therapy
- NSAIDs, Icing
- Platelet Rich Plasma (PRP) / Prolotherapy injections
- Surgery: Patellar tendon debridement.

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**Osteochondroses: OsgoodSchlatter, Sinding-Larsen-Johansson**

**Osteochondroses: disorders that affect the immature and growing skeleton**
- Abnormal growth, injury, overuse of the developing growth plate and surrounding ossification centers.
- Exact etiology unknown: genetic, repetitive trauma, vascular abnormalities, mechanical factors and hormonal imbalances.
- Symptoms will resolve once growth plates fuse.
- DIFFERENTIATE FROM Osteochondritis Dissecans (OCD)
  - OCD is an inflammatory condition of bone and overlying cartilage (chondral) that can affect immature and mature skeletons.
- These lesion may or may not also have effusions, locking/catching.
- May or may not resolve with nonoperative treatment
- OCD of knee most common: medial femoral condyle.
Osgood-Schlatter Disease

- Repetitive traction of patellar tendon on tibial tubercle ossification center or apophysis
- May cause substantial inflammation and pain
  - Up to 30% bilateral involvement
  - Nearly 50% involved in regular athletic activities
- History
  - Symptomatic patient age usually between 10-14 yo
  - Pain exacerbated by jumping activities, direct pressure/kneeling
- Physical
  - TTP, swelling, tibial tuberosity, possible deformity-prominence
  - Diagnosis usually made clinically (H&P)

Sinding-Larsen-Johansson Disease

- Similar to Osgood-Schlatter except pain is at inferior pole of patella.
- History
  - Affected patients between 10-13 yo
  - Often involved in athletics
  - Aggravated by jumping activities, kneeling
- Physical
  - TTP inferior pole of patella
  - Diagnosis usually made clinically (H&P)

Osgood-Schlatter Dz., Sinding-Larsen-Johansson Dz.

- Imaging
  - Plain X-R: May show anterior soft tissue swelling, fragmentation of apophysis.
  - MRI usually not needed unless diagnosis in question, not responsive to conservative measures. R/O other etiology.
- Treatment
  - Usually a self-limited process
    - Increased susceptibility to epiphyseal fracture has been described (Kodali, et al. 2011)
  - PRICE, activity modifications
  - Physical Therapy
  - NSAIDs
  - Infrapatellar bracing, taping
  - Surgery for refractory cases
Synovial Impingement Syndromes

- Synovium and Fat Pad are “exquisitely sensitive” with severe localized pain (Dye et al. 1998)
  - Due to nociceptive nerve fibers containing substance P identified throughout IFP and surrounding synovial tissue.
  - Substance P shown to effect pain mediation by increasing sensitivity to nociceptive signals
  - Promote inflammation via vasodilation, extravasation of plasma proteins and adhesion of leukocytes (Dragoo et al. 2012)
  - This deep innervation supports view that IFP and its synovial lining act as sources for anterior knee pain.

Pathologic Plica

Pathologic Plica; Synovial Plica Syndrome

- A plica is an extension of the protective synovial capsule of the knee that can become irritated, enlarged or inflamed. It can ALSO be a normal finding.

  - PATHOLOGIC plica can be an elusive diagnosis.
    - Medial plica most commonly pathologic.
    - Can be difficult to feel on exam, find on imaging (MRI)
    - May be a diagnosis determined after diagnostic arthroscopy.

Pathologic Plica; Synovial Plica Syndrome

- History and Physical
  - Focal pain that impairs function in combination with a thickened, hypertrophic plica.
  - May have history of overuse (running)
  - At times, can have a history of a direct hit to the knee. May have a “window” period free of sx. Then develop pain symptomatic with activities like running. (Jhala et al. 2011)
  - Sometimes can be felt as a ropey cord, thickened band.
  - Might have a snapping or popping sensation.
  - Aggravated with knee flexion, relieved with extension.
  - Flexion test: Allow knee to flex with gravity from an extended position and then ask patient to stop flexion moment.
  - This produces an eccentric quadriceps contraction which may elicit pain.
Pathologic Plica; Synovial Plica Syndrome

- **Treatment**
  - Conservative nonsurgical management can be initial treatment and is more effective when symptoms are of a shorter duration.
  - Reverse inflammation before it becomes fibrotic/chronic.
  - Aimed at decreasing inflammation of synovial capsule.
  - Activity modification, reducing aggravating activities.
  - Physical therapy, Modalities
  - NSAIDs/Steroid injection
  - Simple external patellar support
  - Surgical Intervention: Removal of plica

Fat Pad Impingement – “Hoffa Syndrome”

- **Infrapatellar Fat Pad (IFP) is an intracapsular, extrasynovial structure filling the anterior knee compartment.**
  - **Significant Pain Generator**

- **History**
  - Burning or aching infrapatellar anterior knee pain

- **Physical**
  - May have swelling infrapatellar as well.
  - Pain with Hoffa maneuver: compression to fat pad on either side of patellar tendon while bringing knee into extension.

- **Imaging**
  - Pain XR – not helpful.
  - MRI can detect subtle areas of high signal within fat pad
  - edema, fibrosis, calcifications, infrapatellar bursitis

- **Treatment**
  - Often successfully treated nonsurgically.
    - Rest, activity modification
    - Passive taping to offload or shorten an inflamed IFP
    - Physical Therapy, Modalities – TENS, US, Cryotherapy
    - Injection (Local anesthestic with steroid)
    - Surgery for refractory cases
      - Arthroscopic resection; Variety of operative approaches
Bursitis

- Inflammation of any of various bursae around knee: typically prepatellar, pes anserine
- Prepatellar most common — Housemaid’s Knee
- History/Physical
  - Overuse, direct pressure, Direct blow/hit
  - Can have bleeding into bursa with trauma
  - Swelling, pain over anatomic bursa(e)
  - May be hypersensitive to touch/light trauma

Prepatellar Bursitis

- Imaging
  - Rule out associated fx if trauma.
  - Rule out other diagnosis if refractory to txmt.

- Treatment
  - Acute
    - PRICE, Knee padding (if occupational)
    - Aspiration if swelling is large, affecting gait/knee ROM
    - NSAIDs
  - Chronic or Recurrent
    - As above plus:
    - Physical therapy with modalities - US
    - Aspiration with corticosteroid injection

In Conclusion

- Anterior knee pain can be challenging to diagnose.
- Etiology of anterior knee pain is multifactorial.
- Successful treatment relies on individualized workup.
- Always encourage follow up if pain persists.
  - Especially if you have not done other imaging, children/adolescents.
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