Anterior Knee Pain (AKP) Outline

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- Anterior Knee Pain DDx
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- Clinical Assessment
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  - 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 (OSS, 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 (Predominantly Flexion-Extension)

- 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: \( \frac{1}{2} \times \text{body wt.} \)
    - 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
  - Laterally displaced Tibial Tuberosity
  - Foot Hyperpronation

Predisposing factors for Patellar Malalignment and Patellar Instability

- 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 increases 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, Alleviating/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.
  - Not easily modified with conservative rehab.
  - Femoral Anteversion, Knee Position (Varum, Valgum, Recurvatum), Foot/Ankle WB position
  - "Miserable Malalignment Posture" (Moinzadeh, 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.
    - Angle line thought to represent the line of action of quadriceps force.
    - “Normal” varies from 10-22 degrees
    - PFPS has been demonstrated to be associated with a larger Q-angle (Lankhorst NE. 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 sinking, trunk rotation, loss of hip control.
    - Excessive contralateral hip drop
    - Hip adduction and IR
    - Knee abduction
    - Tibial ER, hyperpronation
    - Seated: “J Sign”: lateral tracking of patella.

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
  - Posterior knee pain, foot pain

- **Neurovascular Exam**
  - Numbness/Tingling
  - Reflexes/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 Tilt/Patellar subluxation
  - Distroarthrits
  - 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)
  - Distrochondral 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 it’s 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**
- **Immovilize 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/Inflexibility)
  – 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
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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
  – This is due to reflex inhibition of quadriceps muscle secondary to pain, effusion, or deconditioning (Houghton, Ped Rheumatology, 2007)

• 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/vtt
  – Muscular Etiologies (Juhn, Am Fam Phys, 1999)
    – Quadricep Weakness, VMO dysplasia: Valgus moment with one leg iskant
    – Tight ITB: Positive Ober’s
    – Tight Hamstrings: Inability to fully extend at knee
    – Weakness of hip muscles (adductors, abductors, external rotators): Positive Trendelenberg
    – 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 patellar tendon, usually at attachment to inferior pole of 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.

Osteochondroses: Osgood Schlatter, 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 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 affect 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
• Fat Pad Impingement

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. (Kodali 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
  — Plain 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 hyper sensitive 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.
References


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