Knee Evaluation
Quick Facts

- **Tibiofemoral Joint (TFJ)**
- **Normal ROM**
  - Flexion 135-140 degrees
  - Extension 0 degrees
- **Closed Pack Position**
  - Full extension with ER
- **Loose Packed Position**
  - 25 degrees of flexion
Quick Facts

- Patellofemoral Joint (PFJ)
- Variations in PFJ loading during OKC and CKC activities
- PFJ loading increases:
  - with increased flexion in CKC
  - with increased extension in OKC

- PFJ Loading
- Walking
  - 0.3 x body weight
- Ascending Stairs
  - 2.5 x body weight
- Descending Stairs
  - 3.5 x body weight
- Squatting
  - 7 x body weight
History

- **Mechanism of Injury**
  - Table 12-1 in Magee
- **Past Medical History**
- **Functional Limitations**
- **Clicking / Popping**
  - At onset / since onset
- **Pain**
  - Location, description, intensity
- **Activities which increase or decrease pain**
- **Instability during ADL / Functional Activity**
- **Joint Locking?**
- **Effusion**
  - Now or At Onset
- **Gait, Footwear, Training Patterns, ADL**
  - Particularly important in overuse conditions
Common Mechanisms of Injury

- **Hyperflexion:**
  - ACL, PCL

- **Hyperextension:**
  - ACL, PCL, posterior joint capsule

- **Anterior Tibial Translation:**
  - ACL, ITB, LCL, MCL, Med & lateral joint capsule

- **Posterior Tibial Translation:**
  - PCL, popliteus, medial and lateral joint capsule

- **Tibial ER:**
  - Post lateral joint capsule, MCL, PCL, LCL, ACL

- **Tibial IR:**
  - Jt. Capsule (ant. Lateral, post medial, post. Lateral), ACL, LCL

- **Varus force:**
  - LCL, lat. Jt. Capsule, ITB, biceps femoris

- **Valgus force:**
  - MCL, med. Jt. Capsule, pes anserine muscles, medial meniscus
Visual Inspection

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Visual Inspection

- Deformity
  - Osgood-Schlatter Disease
- Swelling
  - Intracapsular swelling
    - Diffuse
    - Knee flexed 15-25 degrees
  - Extracapsular Swelling
    - Localized
  - Baker’s Cyst
- Atrophy/Hypertrophy
  - VMO
  - Quadriceps
- Patellar Position
- Genu Valgus
- Genu Varum
- Genu Recurvatum
- Lateral Tibial Torsion
- Medial Tibial Torsion
- “Miserable Malalignment”
Swelling Assessment

- Brush Test
- Sweep Test
- Ballotable Patella
Baker’s Cyst

- Due to chronic trauma to the knee, internal derangement, recurrent effusion
- Typically large, soft, painless mass
- Found between the gastrocnemius and semimembranosis (popliteal fossa)
Patellar Position

- Patella Baja
- Patella Alta
  - Camel Sign
    - Second “hump” is infrapatellar fat pad or infrapatellar bursa
- Patellar Tilt
  - “Grasshopper Eyes”
    - Tilt outward
  - “Squinting”
    - Tilt inward
- Lateral Glide
- Lateral Rotation
Infrapatellar fat pad

- From the lower pole of the patella to the tibia posterior to the patellar tendon
- Shock absorber and nutrition source for the tendon
Miserable Malalignment

- Increased Femoral Anteversion
- Excessive Lateral Joint Compression
- Excessive Q-Angle
- Patellar Subluxation
- Lateral Tibial Torsion
- STJ pronation

Figure 1. Standing leg alignment of a young woman with severe “miserable malalignment syndrome” demonstrates increased femoral anteversion that produces the following posture characteristics: increased internal rotation of the hip, high Q angle, tibia vara, external tibial torsion, and pronated flat feet.
Palpation

- Pain
- Point Tenderness
- Swelling
- Deformity
- Temperature
- Patellar Position
Range of Motion

- Tibiofemoral Joint
  - Flexion
  - Extension
  - Internal Rotation
  - External Rotation

- Patellofemoral Joint
  - Assess motion & tracking of patella

- Hip & Ankle (as needed)
Manual Muscle Testing

- Quadriceps
- Hamstrings
- Sartorius
- Gracilis
- Gastrocnemius
- Hip Musculature
  - As needed
Special Tests
Anatomy of the ACL

- 3 strands
- Anterior medial tibia to posterior lateral femur
- Prevent anterior tibial displacement on femur
- Secondarily, prevents hyperextension, varus & valgus stresses
Biomechanics of the ACL

- Most injuries occur in Closed Kinetic Chain
- Least stress on ACL between 30-60 degrees of flexion
- Anteromedial bundle tight in flexion & extension
- Posterior lateral bundle tight only in extension
Lachman’s Test

- Best acute ACL test
- Best on field test
- (+) test is a "mushy" or "empty" end-feel
- False (-) if tibia is IR or femur is not properly stabilized
Anterior Drawer Test

- (+) Test is increased anterior tibial translation over 6 mm
- (+) test indicates:
  - ACL (anteromedial bundle)
  - posterior lateral capsule
  - posterior medial capsule
  - MCL (deep fibers)
  - ITB
  - Arcuate complex
- False (-) if only ACL is torn
- False (-) if there is swelling or hamstring spasm
- False (+) if there is a posterior sag sign present
Slocum’s Test

- Tests for multi-planar instability
- ALRI - Anterior lateral rotary instability
  - (+) test indicates:
    - ACL, posterior lateral capsule, arcuate complex, LCL & PCL
- AMRI - Anterior medial rotary instability
  - (+) test indicates:
    - MCL (superficial), posterior oblique, posterior medial capsule, ACL
Lateral Pivot Shift Maneuver

- Tests for ACL and posterolateral rotary instability
  - Posterolateral capsule
  - Arcuate complex
- (+) test is the tibia reduces on the femur at 30 to 40 degrees of flexion, subluxation of the tibia on extension
KT 1000 Testing

- Clinical Uses
- Bilateral Comparison (>5 degrees)
- Adjunct to Overall Assessment
- Patient Position
- Effect of Effusion
- Validity
  - Tyler et al 1999
- Reliability
ACL Tears

- Most common mechanisms
  - Contact:
    - CKC with foot ER w/ valgus stress
    - Hyperextension
    - direct hit on the posterior tibia
  - Non-Contact:
    - Most common
    - Due to sudden deceleration
    - Sudden landing, cutting, or pivoting
- Patient will c/o “buckling” or “giving away”, typically will hear and/or feel a “pop”
ACL Tears

- Muscular weakness
- Shoes/athletic surface
- Hyperpronator
- Anteverted hips
- Menstrual cycle
- Joint laxity
- Small intercondylar notch
- Genu recurvatum
- Small ACL

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ACL Injury in Women

- Increased Joint Laxity
- LE Anatomical Alignment
- Intercondylar Notch Size
- Hormonal Variations
- ACL Size
- Skill & Experience
- Neuromuscular Control
- LE Strength & Endurance
Diagnostic Imaging

Why perform a radiographic knee series after ACL Injury?
Why perform an MRI after ACL injury?
PCL Biomechanics

- Functions:
  - Primary stabilizer of the knee against posterior movement of the tibia on the femur
  - Prevents flexion, extension, and hyperextension

- Taut at 30 degrees of flexion
  - posterior lateral fibers loose in early flexion
Posterior Cruciate Ligament

- Two bundles
  - Anterolateral, taut in flexion
  - Posteromedial, taut in extension
- Orientation prevents posterior motion of tibia
- PCL larger & stronger than ACL
  - CSA 120-150% larger
  - CSA AL 2x PM
- Consider associated role of posterolateral complex when discussing PCL
  - LCL
  - Popliteus Complex
  - Arcuate Ligament
  - Posterior Lateral Capsule
PCL Injuries

- Very rare in athletics, usually due to MVA
  - Due to hyperextension, hyperflexion, or the tibia being forced posteriorly on the femur
  - Only 33% related to sports

- Isolated PCL Injuries unusual
  - Assess other ligaments

- Avulsion Injuries

- Mid-Substance Tears
Posterior Drawer Test

- Tests for posterior instability
- Make sure that there is no anterior translation prior to performing test
- (+) Test indicates:
  - PCL
  - Arcuate Complex
  - Possibly ACL ????

Rubenstein, et al 1994 found posterior drawer test 90% sensitive for PCL injury (versus 58% for Quadriceps Active Test & 26% for Reverse Pivot Shift Test). Clinical exam on whole was 96% effective in detecting PCL dysfunction.
Posterior Drawer Test

Figure 2. When performing a posterior drawer test on a patient who has a suspected PCL injury, the test is negative (a) if when the examiner pushes the tibia it lies 1 cm anterior to the femoral condyle when the knee is flexed 90°. A grade 1 injury (b) is present if the tibia translates posteriorly, but remains anterior to the femoral condyle; a grade 2 injury (c) is present if the tibia translates posteriorly to lie flush with the femoral condyle; and a grade 3 injury (d) is present if the tibia translates to a position posterior to the femoral condyle.
Positive Posterior Drawer
Posterior Sag Test

- Tests for posterior tibial translation
- Tibia “drops back” or sags back on the femur
- Medial tibial plateau typically extends 1 cm anteriorly
- (+) test is when “step” is lost
- (+) Test indicates:
  - PCL
  - Arcuate complex
  - ACL???
Godfrey’s Test

- Tests for posterior cruciate ligament damage
- (+) test is a posterior displacement of the tibial tuberosity
Grading PCL Injuries

- Studies from
  - Gollehon, et al., 1987
  - Noyes, et al., 1988

- Do isolated PCL injuries need to be repaired?

- Combined Injuries?

- Evaluation findings?

- Loss of function & instability most prevalent in what position?
Diagnostic Testing

- Radiographs
- MRI
  - 96-100% accurate in detecting PCL injury
Diagnostic Testing

Normal MRI

Torn PCL
(1) Irregular and thickened posterior cruciate ligament
(2) Anterior cruciate ligament
MCL Biomechanics

- Primary role is to prevent against a valgus force and external rotation of the tibia
- Throughout Full Range of Motion:
  - Both fibers are taut in full extension
  - Anterior fibers are taut in flexion
  - Posterior fibers are taut in mid range
Valgus Stress Test

- Assesses medial instability
- Must be tested in 0° and 30°
- (+) Test in 0°
  - MCL (superficial and deep)
  - Posterior oblique ligament
  - Posterior medial capsule
  - ACL/PCL
- (+) Test in 30°
  - MCL (superficial)
  - Posterior oblique ligament
  - PCL
  - Posterior medial capsule

Grading Sprains

McClure et al 1989 found poor intertester reliability on valgus stress test at 0 and 30 degrees using 3 PT to evaluate 50 patients
MCL Sprains

- Typically due to valgus forces in CKC
  - Foot typically in neutral or externally rotated
- Most frequently injured ligament in the knee
- Usually no joint effusion unless deep portion affected since primarily located outside the joint capsule
LCL Biomechanics

- Primary role is to protect from varus forces and external rotation of the tibia, assists in 2° restraint for anterior and posterior tibial translation.

- Throughout Range of motion:
  - Is taut during extension
  - Loose during flexion
    - Especially after 30° of flexion
Varus Stress Test

- Assesses lateral instability
- Must be tested in 0° and 20/30° flexion
- (+) Test in 0°
  - LCL
  - Posterior Lateral Capsule
  - Arcuate Complex
  - PCL/ACL
- (+) Test in 30°
  - LCL
  - Posterior lateral capsule
  - Arcuate complex
- Grading Sprains
LCL Sprains

- Typically due to varus forces, especially in CKC position with leg adducted and tibia internally rotated
- Usually occur during contact sports
- Typically has limited joint effusion since it is located outside of the joint capsule
Rotatory Instabilities

- With LCL Injury
  - Consider status of ACL / PCL / Meniscus
  - Consider Rotatory Instabilities as well

- Tibial Rotation Cruciates VS Collaterals
  - When the Tibia Externally Rotates
    - the collaterals become taut
    - cruciates relax
  - When the Tibia Internally Rotates
    - the collaterals become lax
    - cruciates become taut
External Rotation Recurvatum Test

- Tests for posterolateral rotary instability
- (+) test is increased hyperextension and external tibial rotation
- (+) test indicates:
  - PCL
  - LCL
  - Posterolateral capsule
  - Arcuate complex
Dial Test

- Tests for posterolateral rotary instability
- Loomer, 1991 found Dial Test more effective than Hughston Test for detecting posteriorlateral injury
- Stabilize femur & ER foot with knee flexed to 30 degrees & 90 degrees
- (+) test is increased external tibial rotation greater than 10 degrees
- (+) test indicates:
  - PCL
  - LCL
  - Posterolateral capsule
Hughston Posteromedial Drawer Test

- Tests for posteromedial rotatary instability
- + test is posterior tibial displacement, especially off the medial tibial condyle
- + test indicates:
  - PCL
  - Posteromedial capsule
  - MCL
  - Posterior oblique ligament
Hughston Posterolateral Drawer Test

- Tests for posterolateral rotatary instability
- (+) test is posterior tibial displacement, especially off the lateral tibial condyle
- (+) test indicates:
  - PCL
  - Posterolateral capsule
  - LCL
  - Arcuate complex
Meniscal Functions

- Deepens the articulation and fills the gaps that normally occur during the knee’s articulation

- **Primary Functions**
  - Load distribution
  - Joint Stability
  - Shock Absorption

- **Secondary Functions**
  - Joint Lubrication
  - Articular Cartilage Nutrition
  - Proprioceptive Feedback
Mechanism of Injury

- **Trauma**
  - Compression
  - Rotational Force
  - Valgus Force
  - Usually Combination of Forces

- **Degenerative Changes**
  - Greater than 30 years old
  - No PMHX required
  - Often due to MOI that “seemed harmless” at time

Noyes, 2002 states 60% of meniscal injuries associated with ACL injury
Clinical Presentation

- History
- Pain
- Catching
- Buckling / Giving Way
- Joint Stiffness
- Antalgic Gait
- Joint Line Pain
  - Shelbourne et al 195
  - Medial joint line pain is 34.5% predictor of meniscal injury
  - Lateral joint line pain is 49.1% predictor of meniscal injury

- Effusion
- Clicking during ROM
- Increased Pain in full flexion
- Pain with Squatting
  - “Duck Walk”
- Pain with Valgus / Varus Stress Testing
- Rule Out ACL, PCL, MCL, LCL
Apley’s Distraction Test

- Tests for meniscal or ligamentous lesions
- (+) test is pain that is eliminated (meniscal injury), or pain that is increased (ligamentous)
Apley’s Compression Test

- Tests for meniscal lesions
  (+) test is increased pain during compression which may increase with rotation in either direction
O’Donohue’s Test

- Tests for meniscal tear or capsular irritation
- (+) test is increased pain, clicking, or popping in the joint line in either one or both flexion or extension during internal or external rotation
McMurray’s Test

- Tests for meniscal injuries
  - Tibia IR
    - Indicates lateral meniscus injury
  - Tibia ER
    - Indicates medial meniscus injury
- (+) test is popping, clicking or locking of knee;
- pain or reproduction of symptoms

Bounce Home Test

- Tests for meniscal tears
- (+) test is when extension is not complete or increased pain
  - Abnormal springy block at extension
Diagnostic Tools

- Aspiration
- Radiologic Exam
- MRI
  - 90% accurate in diagnosing meniscal injury (Bernstein 2000)
Meniscal Injuries
Meniscal Tears

- Radial Tear
- Bucket Handle
- Parrot Beak
- Longitudinal Tear

Degenerative Meniscus Tear
Bucket Handle Tears

- Long longitudinal tear
- Typically due to a CKC rotation
- Torn cartilage may fold and cause locking of the knee
Arthroscopic View

Medial Meniscus Tear

Mild Arthritis

Medial Meniscus after
Red Zone Tear

- Peripheral meniscal tear in the zone of blood supply
- Outer 20% is vascular secondary to capsule & synovium
- White Zone is avascular “inner 2/3 of meniscus”
Unhappy Triad

- MCL, ACL, Medial Meniscus
  - O’Donahue
- MCL, ACL, and Lateral Meniscus
  - Shelbourne & Nitz 1991
- Typically due to a valgus force with the foot planted
PFJ Biomechanics

- During extension, patella glides cranially
- During flexion, patella glides caudally
- Patellar compression
  - OKC greatest at end range (final 30 degrees)
  - increases in CKC after 30 degrees of flexion
Patellofemoral Pain Syndrome

- General term to describe anterior knee pain
- Caused by a variety of factors:
- Signs & Symptoms:
  - Poorly localized P!
  - Theater sign
  - Little to no swelling
  - Pt. Tenderness under lateral patella
  - Insidious onset
Potential Causes of PFPS

- Weak Quads
- Poor VMO Timing
- Muscle Imbalance
- VMO Atrophy
- Tight Lateral Retinaculum
- Lax Medial Retinaculum
- Patella Alta / Baja

- Shallow Femoral Groove
- Increased Q-Angle
- Genu Valgus
- STJ Pronation
- Tight ITB / Quads
- Tight Hamstrings
- Trauma
Special Tests & Procedures

- Timing Test
- Medial Glide
- Patellar Apprehension
- Q Angle Measurement
- Ober Test
- Thomas Test
- Hip Flexor Contracture Test
- SLR Test
- 90/90 SLR Test
- Patellar Grind Test
- Plica Test(s)
- Release Sign
- Knee Extension MMT
Apprehension Test

- Tests for patellar subluxation or dislocation
- (+) test is verbal or facial apprehension from the athlete, OR an attempt to contract the quadriceps to avoid dislocation
Grind Test (Clarke’s Test)

- Tests for patellofemoral pain
- (+) test is the athlete experiences increased pain, or cannot hold the contraction
Hughston’s Plica Test

- Tests for medial plica’s
- (+) test is pain and/or popping of the plical band under the clinician’s fingers on the medial aspect of the knee
Plica Syndrome

- An anomaly or fold in the synovial membrane
  - Usually found along the anterior, superior medial border of the patella
- Only becomes symptomatic if inflamed or taut
- Signs & Symptoms:
  - Snapping, Clicking, or “jumping” of the patella during flexion
  - Along medial border of the patella
  - Swelling
  - Possible locking sensation
Radiographic Views:

AP & Lateral Views
Radiographic Views:

Lateral View
Radiographic Views:

“Skyline” View
Patellar Tendinitis

- Typically occurs from overuse due to repetitive jumping
- Overloading of the extensor mechanism
  - causes microtearing and inflammation of the tendon
- **S&S:**
  - P!, inflammation, mild swelling, pt. Tenderness, crepitus
- Prolonged, chronic cases cause degeneration of the tendon
Osgood Schlatter’s Disease

- Apophysis of the tibial tubercle
- Found in young athletes
  - Males more common
- S&S:
  - Anterior knee pain
  - Swelling
  - Tibial tuberosity pt. Tenderness
  - Increased tibial tuberosity prominence
  - C/o P! w/ k’ extensions, squatting, kneeling & jumping
Sinding-Larsen-Johansson’s Disease

- Apophysitis of the inferior pole of the patella (Similar to OSD)
- Commonly found in children ages 8 – 13 involved in running and jumping
- S&S:
  - Pain
  - Swelling
  - Point tenderness due to excessive strain on the inferior pole of the patella