The Knee and Related Structures
• One of most complex joints in the body

• Hinge joint w/ a rotational component

• Naturally unstable

• Stability - ligaments, joint capsule and muscles surrounding the joint

• One of most commonly injured joints in the body
Bones

- Femur
- Tibia
- Fibula
- Patella — sesmoid bone
Muscles

EXTENSION

• **VASTUS Muscles (quads)**
  ◦ Vastus Lateralis
  ◦ Vastus Intermedius
  ◦ Vastus Medialis
  ◦ Rectus Femoris
FLEXION

- Semimembranosus
- Semitendinosus
- Biceps Femoris
- Gastrocnemius (very small amount)

- main job is plantarflexion
ABDUCTORS (attach on lateral knee)
- Tensor fascia latae
- Iliotibial band
- Used is adduction/flexion
- Lateral stabilizers of knee
- Gastrocnemius
- Popliteus
ADDUCTORS (attach on medial side of knee)
- Gracilis
- Adductor magnus
- Adductor longus
- Adductor brevis
Other medial structure

- Pes Anserine-common insertion of 3 muscles
  - Sartorius
  - Gracilis
  - Semitendinosinosis
The Ligaments

INSIDE

- Anterior cruciate ligament (ACL)
  - Prevents anterior translation of the tibia
    - Doesn’t allow tibia to go forward
    - Runs from superior anterior tibia to inferior posterior femur
  - one of most common knee injuries
    - women in bball and soccer
    - stopping and twisting motion
Posterior cruciate ligament (PCL)
- Prevents posterior translation of the tibia
  - Runs from superior posterior tibia to inferior anterior femur
  - Can injure by falling down onto knee
Meniscus

- Shock absorber
- Stabilizer
- Holds femoral condyles in place
- Lat., med., ant., & post. Sides
- Connected to superior tibia
- Medial
  - C shaped
  - More mobile
- Lateral
  - O shaped
Meniscus – additional info

Anatomy

- Thick on outer edge
- Poor blood/nerve supply
- Only outer 1/3 has blood supply

Function

- Deepen facet
- Cushion stress
- Stabilize knee
- Reduce friction
- Distribute weight - Screw home mechanism
ANTERIOR patellar tendon

- technically a ligament because goes bone to bone
- connects patella to ant. Tibia
- common site of tendonitis

- jumpers knee
- cho-pad
- a brace worn around bottom of knee around patellar tendon
Patellar retinaculum

- Ligaments and capsule securing patella in place
LATERAL

- Lateral collateral ligament (LCL)
  - Prevents varus stress (stress to the outside of the knee)
  - Injured by blow to the medial knee

MEDIAL

- Medial collateral knee (MCL)
  - Prevents valgus stress (stress to the inside of the knee)
  - Injured by blow to the lateral knee
  - Attaches to medial meniscus
Femur

Bursa under lateral head of gastrocnemius
Joint capsule
Articular cartilage

Meniscus

Tibia

Quadriceps femoris

Quadriceps femoris tendon

Suprapatellar bursa (pouch)

Prepatellar bursa
Patella

Synovial membrane
Joint cavity

Infrapatellar fat pad

Superficial infrapatellar bursa
Patellar ligament
Deep infrapatellar bursa
Bursa

Several located in knee
- Prepatellar
- Suprapatellar
- Infrapatellar
- Anserine
- Popliteal
- IT band
- Lateral
Prevention of Knee Injuries

物理 conditioning and rehabilitation

- Total body conditioning is required
  - Strength, flexibility, cardiovascular and muscular endurance, agility, speed and balance
- Muscles around joint must be conditioned (flexibility and strength) to maximize stability
- Must avoid abnormal muscle action through flexibility
- In an effort to prevent injury, extensibility of hamstrings, erector spinae, groin, quadriceps and gastrocnemius is important
ACL Prevention Programs

- Focus on strength, neuromuscular control, balance
- Series of different programs which address balance board training, landing strategies, plyometric training, and single leg performance
- Can be implemented in rehabilitation and preventative training programs

Shoe Type

- Change in football footwear has drastically reduced the incidence of knee injuries
- Shoes w/more and shorter cleats does not allow foot to become fixed, while still allowing for control w/ running and cutting
Functional and Prophylactic Knee Braces

- Used to prevent and reduce severity of knee injuries
- Provide degree of support to unstable knee
- Can be custom molded and designed to control rotational forces and tibial translation
Assessing the Knee Joint

- Determining the mechanism of injury is critical

History- Current Injury
- Past history
- Mechanism- what position was your body in?
- Did the knee collapse?
- Did you hear or feel anything?
- Could you move your knee immediately after injury or was it locked?
- Did swelling occur?
- Where was the pain?
History - Recurrent or Chronic Injury

- What is your major complaint?
- When did you first notice the condition?
- Is there recurrent swelling?
- Does the knee lock or catch?
- Is there severe pain?
- Is there grinding or grating?
- Does it ever feel like giving way?
- What does it feel like when ascending and descending stairs?
- What past treatment have you undergone?
Observation

- Walking, half-squatting, going up and down stairs
- Swelling, ecchymosis
- Assessment of muscle symmetry/atrophy
- What is the athlete’s level of function?
  - Does the athlete limp?
  - Full weight bearing?
  - Does athlete exhibit normal knee mechanics during function?
Palpation

- Athlete should be supine or sitting at edge of table with knee flexed to 90 degrees
- Should assess bony structures checking for bony deformity and/or pain

Soft tissue

- Lateral ligaments
- Joint line
- Assess for pain and tenderness
- Menisci
Special Tests for Knee Instability

- Use endpoint feel to determine stability

Classification of Joint Instability

- Knee laxity includes both straight and rotary instability
- Translation (tibial translation) refers to the glide of tibial plateau relative to the femoral condyles
- As the damage to stabilization structures increases, laxity and translation also increase
Valgus and Varus Stress Tests

- Used to assess the integrity of the MCL and LCL respectively
- Testing at 0 degrees incorporates capsular testing while testing at 30 degrees of flexion isolates the ligaments
Anterior Drawer

- With the knee flexed to approximately 80° verification of complete relaxation of the hamstrings is achieved by hamstring palpation.
- With the foot stabilized and in neutral rotation, a firm, but gentle, grip on the proximal tibia is achieved.
• An anterior force is then applied to the proximal tibia with a gentle to-and-fro motion to assess for increased translation compared to the normal contralateral knee.

• [http://www.sportsdoc.umn.edu/Clinical_Folder/Knee_Folder/Knee_Exam/anterior%20drawer.htm](http://www.sportsdoc.umn.edu/Clinical_Folder/Knee_Folder/Knee_Exam/anterior%20drawer.htm)
Lachman Drawer Test

- Will not force knee into painful flexion immediately after injury
- Reduces hamstring involvement
- At 30 degrees of flexion an attempt is made to translate the tibia anteriorly on the femur
- A positive test indicates damage to the ACL
• Apley’s Compression Test
  ◦ Hard downward pressure is applied w/ rotation
  ◦ Pain indicates a meniscal injury

• Apley’s Distraction
  ◦ Pull up on lower leg, w/rotation
  ◦ Pain indicates ligament injury
Recognition and Management of Specific Injuries

Medial Collateral Ligament Sprain

- **Cause of Injury**
  - Result of severe blow or outward twist – valgus force

- **Signs of Injury - Grade I**
  - Little fiber tearing or stretching
  - Stable valgus test
  - Little or no joint effusion
  - Some joint stiffness and pt tenderness on lateral aspect
  - Relatively normal ROM
Signs of Injury (Grade II)
- Complete tear of deep capsular ligament and partial tear of superficial layer of MCL
- No gross instability; slight laxity
- Slight swelling
- Moderate to severe joint tightness w/ decreased ROM
- Pain along medial aspect of knee

Signs of Injury (Grade III)
- Complete tear of supporting ligaments
- Complete loss of medial stability
- Minimum to moderate swelling
- Immediate pain followed by ache
- Loss of motion due to effusion and hamstring guarding
- Positive valgus stress test
Care

- RICE for at least 24 hours
- Crutches if necessary
- Knee immobilizer may be applied
- Move from isometrics and STLR exercises to bicycle riding and isokinetics
- Return to play when all areas have returned to normal
  - Continued bracing may be required
Care

- Conservative non-operative approach for isolated grade 2 and 3 injuries
- Limited immobilization (w/ a brace); progressive weight bearing for 2 weeks
- Follow with 2-3 week period of protection with functional hinge brace
- When normal range, strength, power, flexibility, endurance and coordination are regained athlete can return
  - Some additional bracing and taping may be required
Lateral Collateral Ligament Sprain

- **Cause of Injury**
  - Result of a varus force, generally with the tibia internally rotated
  - Direct blow is rare

- **Signs of Injury**
  - Pain and tenderness over LCL
  - Swelling and effusion around the LCL
  - Joint laxity with varus testing

- **Care**
  - Following management of MCL injuries depending on severity
Anterior Cruciate Ligament Sprain

Cause of Injury

- MOI - tibia externally rotated and valgus force at the knee (occasionally the result of hyperextension from direct blow)
- May be linked to inability to decelerate valgus and rotational stresses - landing strategies
- Male versus female
- Research is quite extensive in regards to impact of femoral notch, ACL size and laxity, malalignments (Q-angle) faulty biomechanics
- Extrinsic factors may include, conditioning, skill acquisition, playing style, equipment, preparation time
- Also involves damage to other structures including meniscus, capsule, MCL
Signs of Injury
- Experience pop w/ severe pain and disability
- Rapid swelling at the joint line
- Positive anterior drawer and Lachman’s
- Other ACL tests may also be positive

Care
- RICE; use of crutches
- Arthroscopy may be necessary to determine extent of injury
- Could lead to major instability in incidence of high performance
- W/out surgery joint degeneration may result
- Age and activity may factor into surgical option
- Surgery may involve joint reconstruction w/ grafts (tendon), transplantation of external structures
  - Will require brief hospital stay and 3-5 weeks of a brace
  - Also requires 4-6 months of rehab
Posterior Cruciate Ligament Sprain

- **Cause of Injury**
  -Most at risk during 90 degrees of flexion
  -Fall on bent knee is most common mechanism
  -Can also be damaged as a result of a rotational force

- **Signs of Injury**
  -Feel a pop in the back of the knee
  -Tenderness and relatively little swelling in the popliteal fossa
  -Laxity w/ posterior sag test

- **Care**
  -RICE
  -Non-operative rehab of grade I and II injuries should focus on quad strength
  -Surgical versus non-operative
    -Surgery will require 6 weeks of immobilization in extension w/ full weight bearing on crutches
    -ROM after 6 weeks and PRE at 4 months
Meniscus Injuries

Cause of Injury
- Medial meniscus is more commonly injured due to ligamentous attachments and decreased mobility
  - Also more prone to disruption through torsional and valgus forces
- Most common MOI is rotary force w/ knee flexed or extended while weight bearing

Signs of Injury
- Diagnosis is difficult
- Effusion developing over 48-72 hour period
- Joint line pain and loss of motion
- Intermittent locking and giving way
- Pain w/ squatting
• Care

  • Immediate care = PRICE
  
  • If the knee is not locked, but indications of a tear are present further diagnostic testing may be required
    • Treatment should follow that of MCL injury
  
  • If locking occurs, anesthesia may be necessary to unlock the joint w/ possible arthroscopic surgery follow-up
  
  • W/ surgery all efforts are made to preserve the meniscus -- with full healing being dependent on location
• Types of tears
Normal meniscus  Torn meniscus
Joint Contusions

- **Cause of Injury**
  - Blow to the muscles crossing the joint (vastus medialis)

- **Signs of Injury**
  - Present as knee sprain, severe pain, loss of movement and signs of acute inflammation
  - Swelling, discoloration

- **Care**
  - RICE initially, and continue if swelling persists
  - Gradual progression to normal activity following return of ROM and padding for protection
  - If swelling does not resolve within a week a chronic condition (synovitis or bursitis) may exist requiring more rest
Bursitis

- **Cause of Injury**
  - Acute, chronic or recurrent swelling
  - Prepatellar = continued kneeling
  - Infrapatellar = overuse of patellar tendon

- **Signs of Injury**
  - Prepatellar bursitis may be localized swelling above knee that is ballotable
  - Presents with cardinal signs of inflammation
  - Swelling in popliteal fossa may indicate a Baker’s cyst

- **Care**
  - Eliminate cause, RICE and NSAID’s
  - Aspiration and steroid injection if chronic
• Bursitis

Knee aspiration

http://www.operationalmedicine.org/Videos/TapKnee.mpg
Loose Bodies w/in the Knee

Cause
- Result of repeated trauma
- Possibly stem from osteochondritis dissecans, meniscal fragments, synovial tissue or cruciate ligaments

Signs of Injury
- May become lodged, causing locking or popping
- Pain and sensation of instability

Care
- If not surgically removed it can lead to conditions causing joint degeneration
Iliotibial Band Friction Syndrome (Runner’s Knee)

- **Cause of Injury**
  - Repetitive/overuse conditions attributed to mal-alignment and structural asymmetries
  - Can be the result of running on crowned roads

- **Signs of Injury**
  - Irritation at band’s insertion
  - Tenderness, warmth, swelling, and redness over lateral femoral condyle
  - Pain with activity

- **Care**
  - Correction of malalignments
  - Ice before and after activity, proper warm-up and stretching;
    NSAID’s
  - Avoidance of aggravating activities
Patellar Fracture

Cause of Injury
- Direct or indirect trauma (severe pull of tendon)
- Forcible contraction, falling, jumping or running

Signs of Injury
- Hemorrhaging and joint effusion with generalized swelling
- Indirect fractures may cause capsular tearing, separation of bone fragments and possible quadriceps tendon tearing
- Little bone separation with direct injury

Management
- X-ray necessary for confirmation of findings
- RICE and splinting if fracture suspected
- Refer and immobilize for 2-3 months
Acute Patella Subluxation or Dislocation

Cause of Injury
- Deceleration w/ simultaneous cutting in opposite direction (valgus force at knee)
- Quad pulls the patella out of alignment
- Some athletes may be predisposed to injury
- Repetitive subluxation will impose stress to medial restraints
- More commonly seen in female athletes

Signs of Injury
- W/ subluxation, pain and swelling, restricted ROM, palpable tenderness over adductor tubercle
- Dislocations result in total loss of function
- First time dislocation = assume fx
Care

- Immobilize and refer to physician for reduction
- Ice around the joint
- Following reduction, immobilization for at least 4 weeks w/ use of crutches
- After immobilization period, horseshoe pad w/ elastic wrap should be used to support patella
- Muscle rehab focusing on muscle around the knee, thigh and hip are key (STLR’s are optimal for the knee)
Chondromalacia patella

Cause
- Softening and deterioration of the articular cartilage
- Possible abnormal patellar tracking due to genu valgum, external tibial torsion, foot pronation, femoral anteversion, patella alta, shallow femoral groove, increased Q angle, laxity of quad tendon

Signs of Injury
- Pain w/ walking, running, stairs and squatting
- Possible recurrent swelling, grating sensation w/ flexion and extension

Care
- Conservative measures
  - RICE, NSAID’s, isometrics for strengthening
  - Avoid aggravating activities
- Surgical possibilities
Patellar Tendinitis (Jumper’s or Kicker’s Knee)

- **Cause of Injury**
  - Jumping or kicking - placing tremendous stress and strain on patellar or quadriceps tendon
  - Sudden or repetitive extension may lead to inflammatory process

- **Signs of Injury**
  - Pain and tenderness at inferior pole of patella and on posterior aspect of patella with activity

- **Care**
  - Avoid aggravating activities
  - Ice, rest, NSAID’s
  - Exercise
  - Patellar tendon bracing
  - Transverse friction massage
Osgood-Schlatter Disease and Larsen-Johansson Disease

Cause of Condition
- An apophysitis occurring at the tibial tubercle
  - Result of repeated pulling by tendon
  - Begins cartilagenous and develops a bony callus, enlarging the tubercle
- Resolves w/ aging

Signs of Condition
- Both elicit swelling, hemorrhaging and gradual degeneration of the apophysis due to impaired circulation
- Pain with activity and tenderness over anterior proximal tibial tubercle
Care

- Conservative
  - Reduce stressful activity until union occurs (6-12 months)
  - Padding may be necessary for protection
  - Possible casting, ice before and after activity
  - Isomeritics