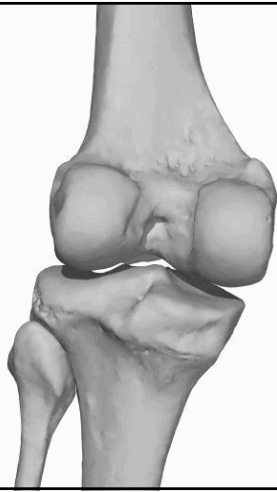

Anatomy & Examination of the Knee Joint



Housekeeping

QuickTime™ and a
Animation decompressor
are needed to see this picture.

Anatomy of the Knee



Outline

- anatomy of the knee joint
- examination of the knee joint
- concentrating mainly on the structures intrinsic to the knee as well as the patellofemoral joint:
 - cruciate ligaments
 - collateral ligaments
 - menisci
 - patellofemoral joint

References

- **POD2PBM manual**
 - (Altchek, 1993) - excellent
 - (Blake, Burns & Colson, 1981) - dated in sections
 - (Tiberio, 1987) - background to historical understanding of foot/knee biomech
 - Cavanagh & Sims (in Jahss), 1991 - good background overall
- **Web**
 - MedNet knee pages - excellent reference for KJ examination - link from lecture notes

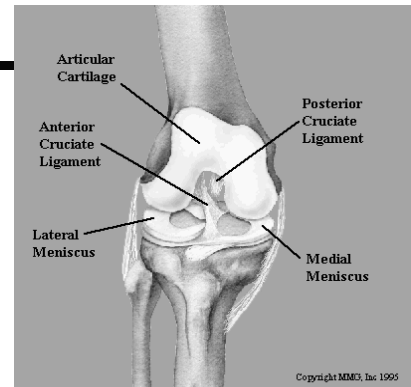
Cruciate Ligaments

- **Anterior Cruciate Ligament (ACL)**
 - runs posteriorly and superiorly from the front of the tibial plateau to its femoral attachment at the posterolateral aspect of the intercondylar notch
 - prevents forward movement of the tibia in relation to the femur and helps control rotational movement
 - is essential for pivotal movements

Cruciate Ligaments cont.

- **Posterior Cruciate Ligament (PCL)**
 - runs anterosuperiorly from the posterior part of the tibial plateau to its femoral attachment at the medial aspect of the intercondylar notch
 - prevents the femur from sliding forwards off the tibial plateau

Cruciate Ligaments



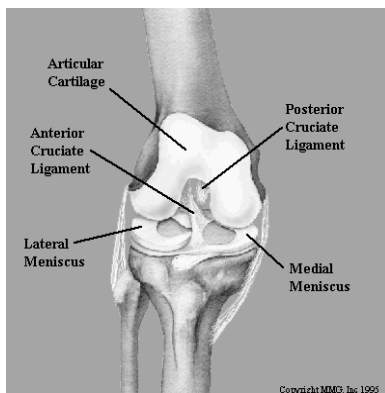
Collateral Ligaments

- **Medial Collateral Ligament (MCL)**
 - provides medial stability
 - originates from the medial epicondyle of the femur approx. 3 cm above the joint line and passes downward as a thickened band to attach to the anteromedial aspect of the tibia, also has an attachment to the medial meniscus
 - injured with a valgus stress
 - Eg. Football, running/jumping sports
 - Unable to continue playing
 - Knee swells up rapidly (1-2hrs), v. painful

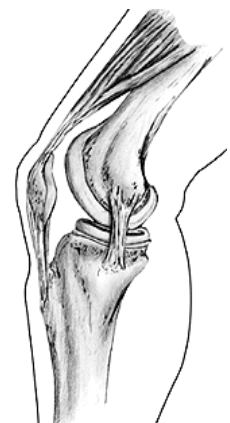
Collateral Ligaments cont.

- **Lateral Collateral Ligament (LCL)**
 - provides lateral stability
 - 'cord like', 'ropey'
 - Easy to palpate sitting cross-legged
 - arises from the lateral epicondyle of the lateral border of the femur and passes downwards to attach to the head of the fibula
 - injured during a varus stress
 - Very rarely injured

Collateral Ligaments



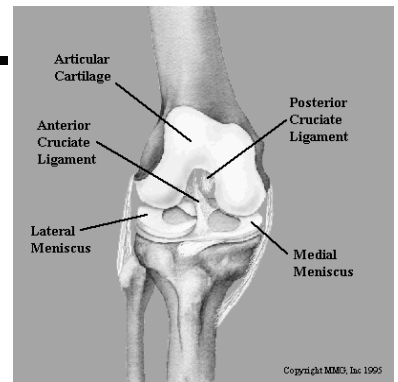
Collateral Ligaments



Menisci

- medial and lateral
- intra-articular
- attach to the tibial plateaus
- **absorb** some of the force placed through the knee
- protects articular cartilage
- helps stabilise the knee
- contributes to lubrication & nutrition of KJ (esp. avascular cartilage)

Menisci



Patellofemoral joint

- quadriceps insert superiorly
- inferiorly the patella tendon inserts into the tibial tuberosity
- **medial** and lateral patella retinaculum stabilise
- often injured via poor biomechanics whereby the patella tracks poorly in the patellofemoral joint (?)



Patellofemoral joint



Patellofemoral joint



Patellofemoral joint



Patellofemoral joint cont.

- ...lateral tracking can lead to chondromalacia patellae (softening of patellar cartilage), not always symptomatic, subluxation, dislocation...
- decreased VMO strength
- patella position
 - Tilt (med/lat movement)
 - Rotation (inf/sup patella poles not vertical)
 - Displacement (sup/inf movement)
- an increase in the Q-angle (>15 degrees)?
 - excessive subtalar joint pronation, causing more of a valgus positioning of the knee?

Examination of the Knee

& how does the foot affect the knee?

Observation

- Need to adequately expose both knees
- Must have proper examination table
- Stance:
 - eg. g.varum/valgum/recurvatum,
 - Baker's cyst
 - Posterior protrusion of the synovial membrane, seen as popliteal swelling prone and in stance
 - Spontaneous, sometimes associated with RA

Cruciate Ligaments

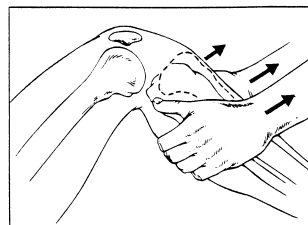
- anterior drawer sign
- posterior drawer sign
- Lachman test
- pivot shift test
- posterior sag test

Anterior & Posterior Drawer Sign

- knee at 90 degrees flexion
- patient's foot kept stable
- hamstrings need to be relaxed
- tibia drawn anteriorly to test ACL
- pushed posteriorly for PCL
- assess extent of movement and quality of end point
 - Reproduce any pain?



Anterior & Posterior Drawer Sign



- Increasingly firm pull
- Pain/ROM/QOM
- Compare L to R
- Greater than or equal to 0.5cm displacement
 - Ruptured ACL

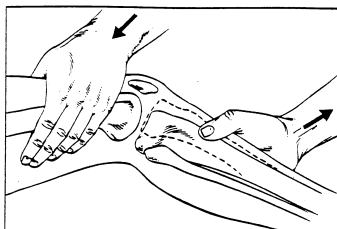
Lachman Test

- follows ACL and PCL test
 - More sensitive than, pt. Less able to contract hamstrings
- flex knee to 30°, grasp proximal tibia and support distal femur
 - Size of pt./practitioner - assistant/pillows?
- tibia then pulled anteriorly
- note difference in translation and the presence or absence of a firm end point
- when uninjured the ligament should have a crisp end point as it stops forward progression of the tibia

Lachman Test...

- complete rupture of the ligament results in a notable (>4mm) increase in translation & an absence of a firm end point
- if there is an increase in translation and an end point, then a partial rupture of the ACL or an injury to the PCL should be considered

Lachman Test...

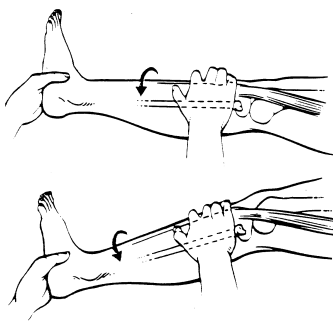


Pivot Shift Test (norm vs. reverse)

- helps detect ACL injuries and anterolateral rotatory instability
- Place patient on their side
- Whilst internally rotating tibia
 - With the 'reverse' pivot shift test the tibia is externally rotated (tests posterolateral knee)
- ... with knee in full extension
- valgus force applied to knee
- in ACL deficient knee the condyles will be subluxed
- then patient's knee is flexed, looking for a 'clunk' of reduction, rendering the test positive

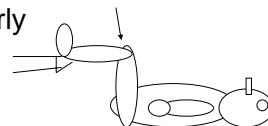
Pivot Shift Test (Reverse)

1. EXT. rot. Tib
2. Knee fully ext.
3. Valg. Force on KJ
4. Flex KJ -- 'clunk'? -- gradings...



Posterior Sag

- PCL rupture test
- thigh muscles need to be relaxed
- patient supine
- flex knees to 90 degrees, hold heel
- when a PCL tear is present the tibia should sag posteriorly

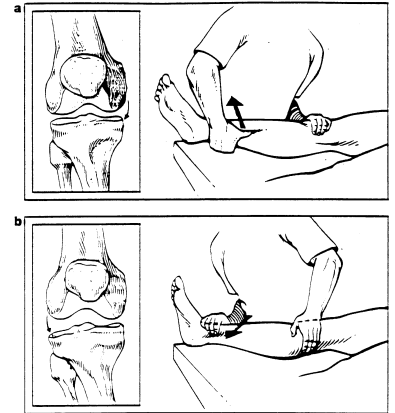


Collateral Ligaments

- knee fully extended and at 30 degrees of flexion to relax posterior knee capsule
 - Extended +ve = MCL & cruciate damage
 - Flexed +ve = MCL damage only
- apply a varus (LCL) and a valgus (MCL) force
- do not allow the femur to rotate
- assess for pain, extent of movement and feel for an end point
- M. spasm can mask a low-grade tear
- Best if tested shortly after injury

Collateral Ligaments

Variation...
Foot & ankle
between chest
wall and arm



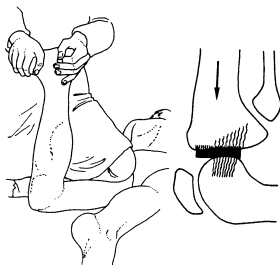
Menisci

- Apley Compression Test
- McMurray's Test
- Meniscal injury
 - Rotational force
 - Accompanied by a 'pop' sometimes
 - Often able to continue activity (unlike most other ligamentous injuries)
 - Swelling development in area
 - Sometimes unable to fully 'lock' the knee in extension - due to bits of torn meniscus

Apley Compression Test

- prone
- knee flexed to 90 degrees
- push down on foot
 - Int/ext rotate the tib
 - Like a 'pepper grinder'
- places pressure on to the posterior half of the menisci
- pain if a tear(s) are present

Apley Compression Test



McMurray's Test

- **WARNING!** Never on acutely painful knee
- tests for tears in the anterior half of the meniscus (tests posterior as well)
- Patient supine
- hip and knee flexed
- at various stages of moving the hip and knee from flexion to extension, internal and external rotation of the tibia on the femur is performed
- can add varus and valgus stress

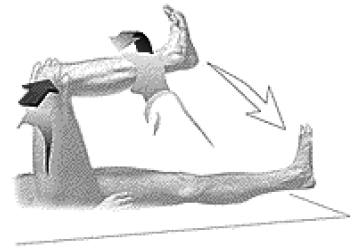
McMurray's Test cont.

- pain and a palpable 'clunk' is a positive McMurray's test
- if no 'clunk' but pain is present, the meniscus may be damaged or have patellofemoral joint pathology

McMurray's Test cont.

Med. meniscus
Hip/knee flexed
Valgus stress on KJ
Ext. rot. Tib.
... while extending limb

Lat. Meniscus
As above, but with
Int. tib. Rot.
Varus stress on knee



Patellofemoral joint syndrome

- Also called: anterior knee pain syndrome, overutilization syndrome
- Gradual onset of pain around the patella
- Incidence: high in:
 - Young athletic individuals
 - Obese adolescent females
- Observation
 - standing (biomechanics)- patellar position?
 - lying supine
 - Swelling - inf/sup, med/lat to patella?

PFJ

- Palpation
 - tenderness → where?
 - Warmth?
 - tight lateral retinaculum
 - move medially, laterally, inferiorly and superiorly and check for pain and crepitus
 - active movement with quad. contraction
 - apprehension test
 - Isn't particularly good test
 - Lots of false positives

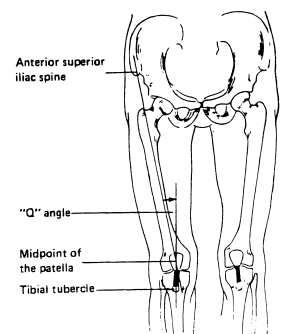
Patellofemoral joint cont.

- Patella position
 - displacement
 - tilt
 - rotation
 - McConnell, *Aust. J. Physio.*, 1986
 - McConnell taping
 - Tape patella medially
 - Effectiveness?
 - Psychological/proprioceptive effect?
 - Shelton & Thigpen, *JOSPT*, 1991

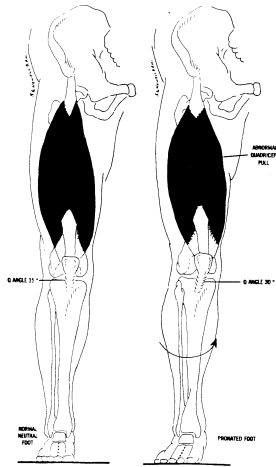
Q-angle

Line 1: ASIS - patella bisection
Line 2: patella bisection - tib. Tuberosity bisection

- Biomechanics
 - alignment (Q-angle ideally, 15°)
 - pelvic instability, anterior and lateral
 - excessive subtalar joint pronation?
 - Reliability?
 - Validity?



Q-angle



Patellofemoral joint cont.

- Muscle function
 - VMO strength and timing
- Functional tests
 - squats, stairs etc.

How does the foot affect the knee?



Historical answer:

- ...foot orthoses decelerate and limit the magnitude of rearfoot pronation which, in turn, decelerates and limits the magnitude of internal tibial and internal femoral rotation...
- Evidence?
 - Unclear - it would seem that the above exists, but there is relatively little motion

...what are some of the problems?

- Overemphasis on Q-angle and relationship to patellar tracking
- 'Screw home' or locking mechanism of the KJ doesn't exist (La Fortune, 1990)
- Increased joint reaction force?
- Increased valgus force on the knee?
 - (when STJ pron and knee flexed)
 - See Sims & Cavanagh in manual

Further research?

- External markers are not indicative of bony motion in measuring knee rotation (except flex/ext) (Reinschmidt, 1996)
- Jt. Compressive forces (eg. In PFJ)
 - There may not be a corresponding large change in the rotational movements of the tibia

...But

- Positive clinical effect
 - 102 patients
 - Chondromalacia patellae
 - PF pain/syndrome
 - Effectiveness of orthoses
 - 76% improvement in symptomology
- (Saxena, Amol and Haddad, 1998)

Summary

- Need to be aware of different knee testing procedures for different structures
 - Cruciate ligaments
 - Menisci
 - Collateral ligaments
 - PFJ including Q-angle
- How does the foot affect the knee?
 - Historical understanding
 - What further research needs to be done