Evaluating the Knee
The Knee

Two Joints:

- Tibiofemoral
- Patellofemoral
Remember the questions from lecture #2?
OBSERVATION

- Girth
What are the consequences of faulty alignment?
BLOCK METHOD
Q-Angle

Knee Flexed

Knee Extended
Patellar Position

- Patella Alta
- Patella Baja
- Squinting Patellae
- "Frog Eyed" Patella
Where’s the swelling?
Palpation

- Four Aspects
  - Anterior
  - Medial
  - Lateral
  - Posterior

- Start with the Tibial Tuberosity
- ANTERIOR
  - Tibial Tuberosity
    - Patellar Tendon
  - Patella
    - Quadriceps Tendon
    - Quadriceps Muscles
    - Sartorius

Interactive Knee 1.1 © 2000 Primal Pictures Ltd.
Medial

- Tibial Plateau
  - Meniscus
  - MCL
  - Pes Anserine
  - Semimembranosus
  - Gracilis
- Femoral Condyle
- Femoral Epicondyle
Posterior

- Popliteal Fossa
- Hamstrings
- Heads of Gastroc
STRESS
Triplanar Knee Motion

- A simple hinge joint would simply flex and extend

- This is not a simple hinge joint!!
Tibia on a fixed Femur

- **FLEXION**
  - Backward Rolling
  - Internal Rotation
  - Varus
  - Posterior Translation

- **EXTENSION**
  - Forward Rolling
  - External Rotation
  - Valgus
  - Anterior Translation
Femur on a fixed Tibia

- **FLEXION**
  - Backward Rolling
  - External Rotation
  - Varus
  - Anterior Translation

- **EXTENSION**
  - Forward Rolling
  - Internal Rotation
  - Valgus
  - Posterior Translation
Knee Motion

- Bony Geometry
- Soft Tissue Constraints
- Muscle Forces
Bony Factors

- Different size of the medial and lateral femoral condyles
- Different size of the articular surfaces of the femoral condyles and the tibial condyles
- Variation in curvature from anterior to posterior
Medial Condyle is larger than the Lateral Condyle
Larger Femoral Condyles

What’s the consequence of larger femoral condyles?
Motion of the femoral condyles during flexion

Motion of the femoral condyles during extension
Convex-Concave Rule

a. Fixed bony lever

b.
The Menisci
The Menisci

- Tibiofemoral load transmission
- Shock absorption
- Lubrication
- Prevent synovial impingement
- Distribute synovial fluid
- Contribute to joint stability
- Assist in gliding motion
Levangie and Norkin, 2001
Movements of menisci

- **during flexion** - move posteriorly
- **during extension** - move anteriorly

... menisci move posteriorly unequally

... the menisci follow, or stay with the, femoral condyles
Movements of menisci

- **during lateral rotation of the tibia**
  - the menisci follow the femoral condyles, e.g. they remain with the femoral condyles while the tibia rotates

- **during medial rotation** (compare to lateral rotation)

... the menisci follow, or stay with the, femoral condyles
How would you palpate the menisci?
Movement of the Menisci

Lateral meniscus moves more than medial meniscus (Vedi, 1999)

- Anterior horns move more than posterior horns (Vedi, 1999)
The menisci attach to the tibia, but move with the femur.

What are the consequences?
Evaluating the Menisci
McMurray’s

Starkey & Ryan, 1996
Weight bearing with flexion and extension...

- Climbing stairs
- Rising from a chair
Let’s Review…

- Different sizes of femoral condyles means triplanar motion.

- Different sizes of the femoral and tibial condyles means that gliding must accompany rolling.

- The meniscal reaction force is partially responsible for this gliding.
Anterior Cruciate Ligament

- Prevents anterior translation of the tibia with respect to the femur
- Or...
- Stabilize in other directions as well
Posterior Cruciate Ligament

- Prevents posterior translation of the tibia with respect to the femur
- Or…
- Provides stability in other directions as well
The Cruciates & Knee Motion

ACL assists in anterior glide during flexion

PCL assists in posterior glide during extension
Tibial:

• Anterior Translation
• Internal Rotation
• Valgus or Varus
Testing the ACL

- Greatest forces on ligaments = anterior tib forces + internal tibial torque + valgus/varus

- Anterior shear loads at 30 degrees of flexion produced greater strain on the AMB than shear loads at 90 degrees. (Beynnon, 1992)
Anterior Drawer

Starkey & Ryan, 1996
Lachman’s
Alternate Lachman’s
PCL injuries...direct impact
Testing the PCL

- Posterior translation was twice as much at 90 degrees of flexion compared to 30 degrees after sectioning PCL (Grood, 1988)
- Test PCL at 90 degrees (posterior drawer and posterior sag test).
- Internal rotation in this position will decrease laxity (Bergfeld, 2001)
Posterior Drawer

Starkey & Ryan, 1996
Let’s Review…

- Larger medial condyle produces triplanar motion
- Larger femoral condyles require a combination of rolling and gliding
- The menisci and cruciates are largely responsible for these gliding motions
Medial Collateral Ligament

- Restrains valgus loading
- Checks lateral tibial rotation
- Back-up anterior displacement
Lateral Collateral Ligament

- Resists varus stress
- Also limits lateral rotation
Testing the Collaterals

- 57% of valgus load at 5 degrees of flexion
- 78% of valgus load at 25 degrees of flexion

Best position to test the integrity of the collaterals?
Valgus Stress

Starkey & Ryan, 1996
Varus Stress

Starkey & Ryan, 1996
Rotational Instabilities

- Relative motion of the tibia on the femur
- Multiple structures are involved
- Total may be greater than the sum of the parts
Slocum Drawer
Crossover Test
FRD Test

[A and B images of a person performing the FRD Test on a knee]

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External Rotation
Osteochondral Defects

- Fractures of articular cartilage and underlying bone
- Shear and compressive forces
Tib-Fib Translation Test
Why do we have a patella?
Patellar Motions
The Effect of the Quads on the Patella
Patellofemoral Pain

\[ \text{Force} = \frac{\text{Stress}}{\text{Area}} \]
Trochlear Depth – 60° Flexion
Trochlear Depth – Full Extension
Patellar Glides

(A) Medial Patellar Glides

(B) Lateral Patellar Glides
Clarke’s Sign
Apprehension Test
Medial Synovial Plica
Stutter Test
Range of Motion

- PASSIVE
- ACTIVE
- RESISTED
Noble Compression Test
Ober’s Test
A final word of advice...

The knee is part of a kinetic chain.

Don’t look at it in isolation!
It’s not my fault!!

Heh! Heh!

Heh! Heh!