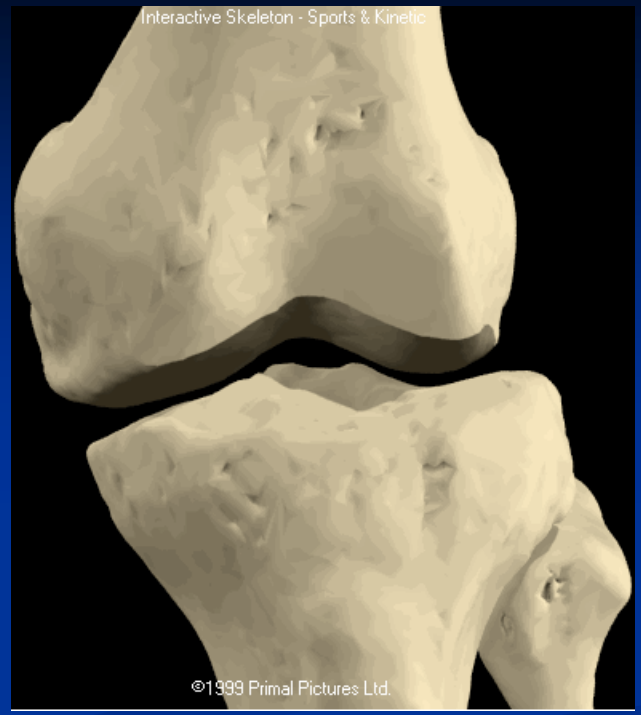
Evaluating the Knee

The Knee

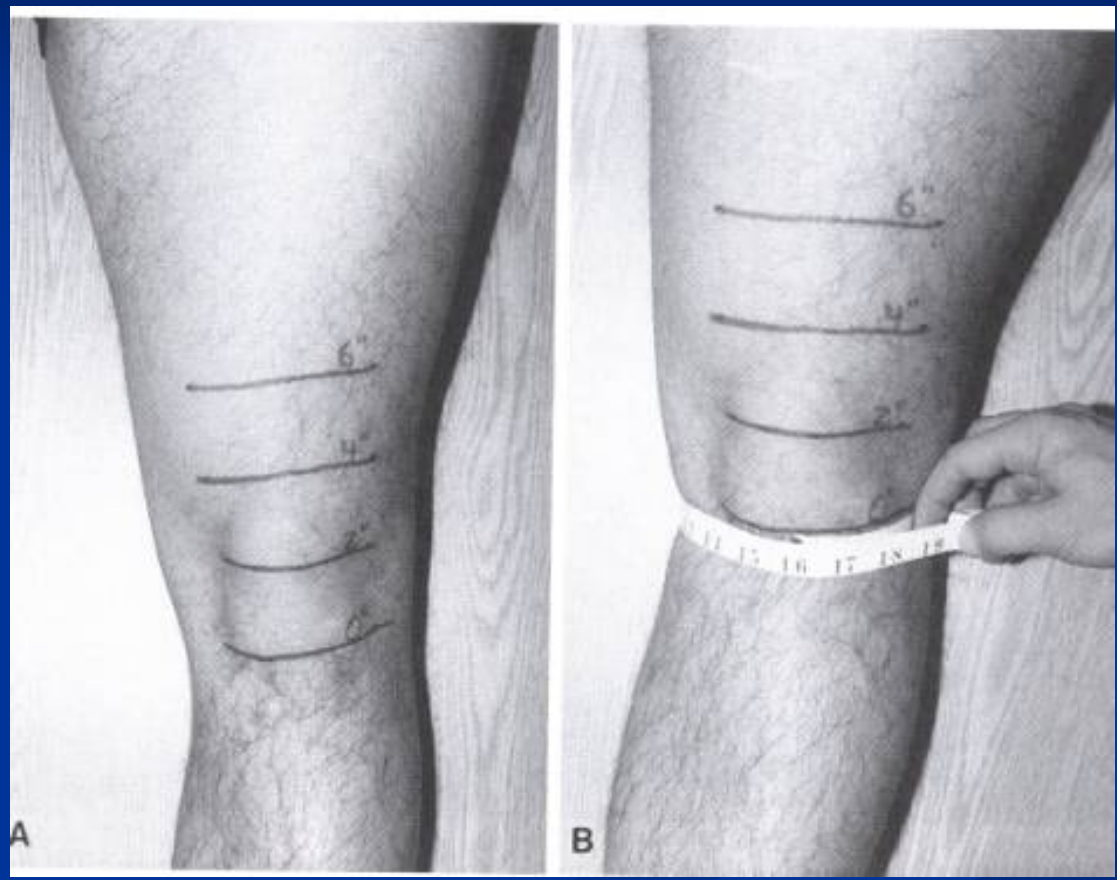
- Two Joints:
  - Tibiofemoral
  - Patellofemoral



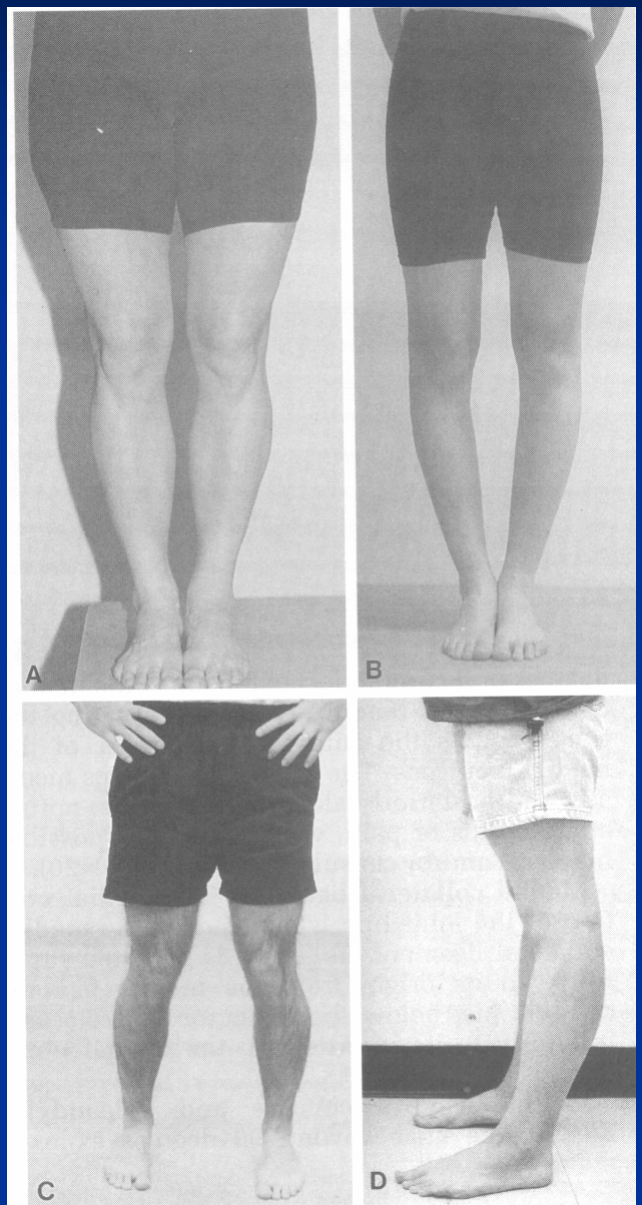
HISTORY

OBSERVATION

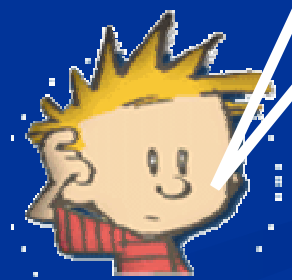
- Girth



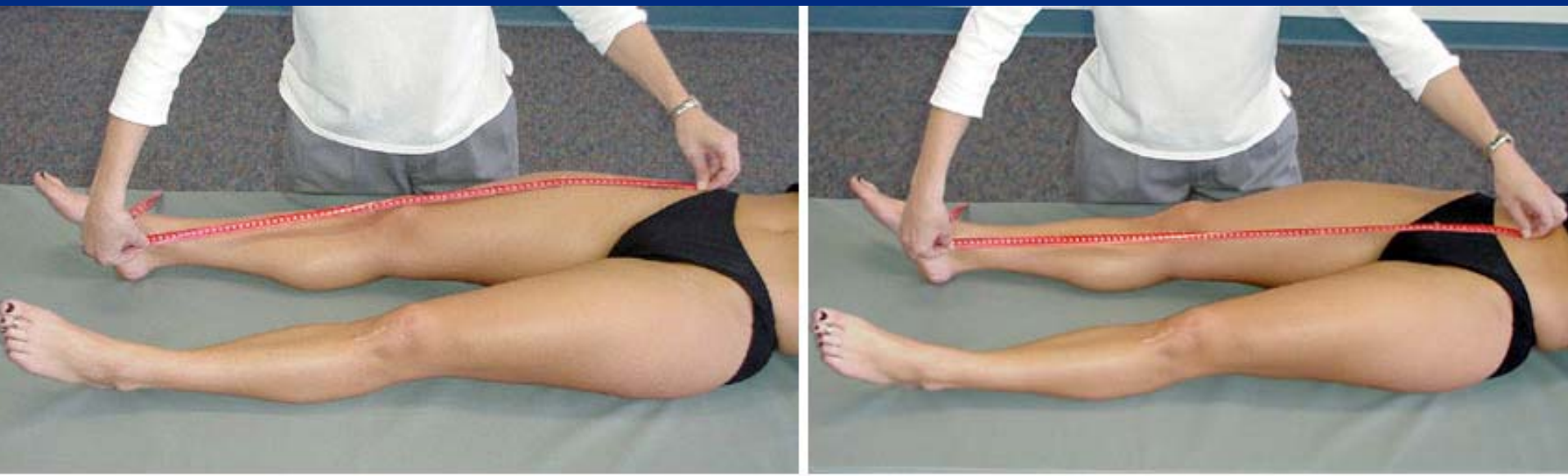
TibioFemoral Alignment



What are the consequences of faulty alignment?



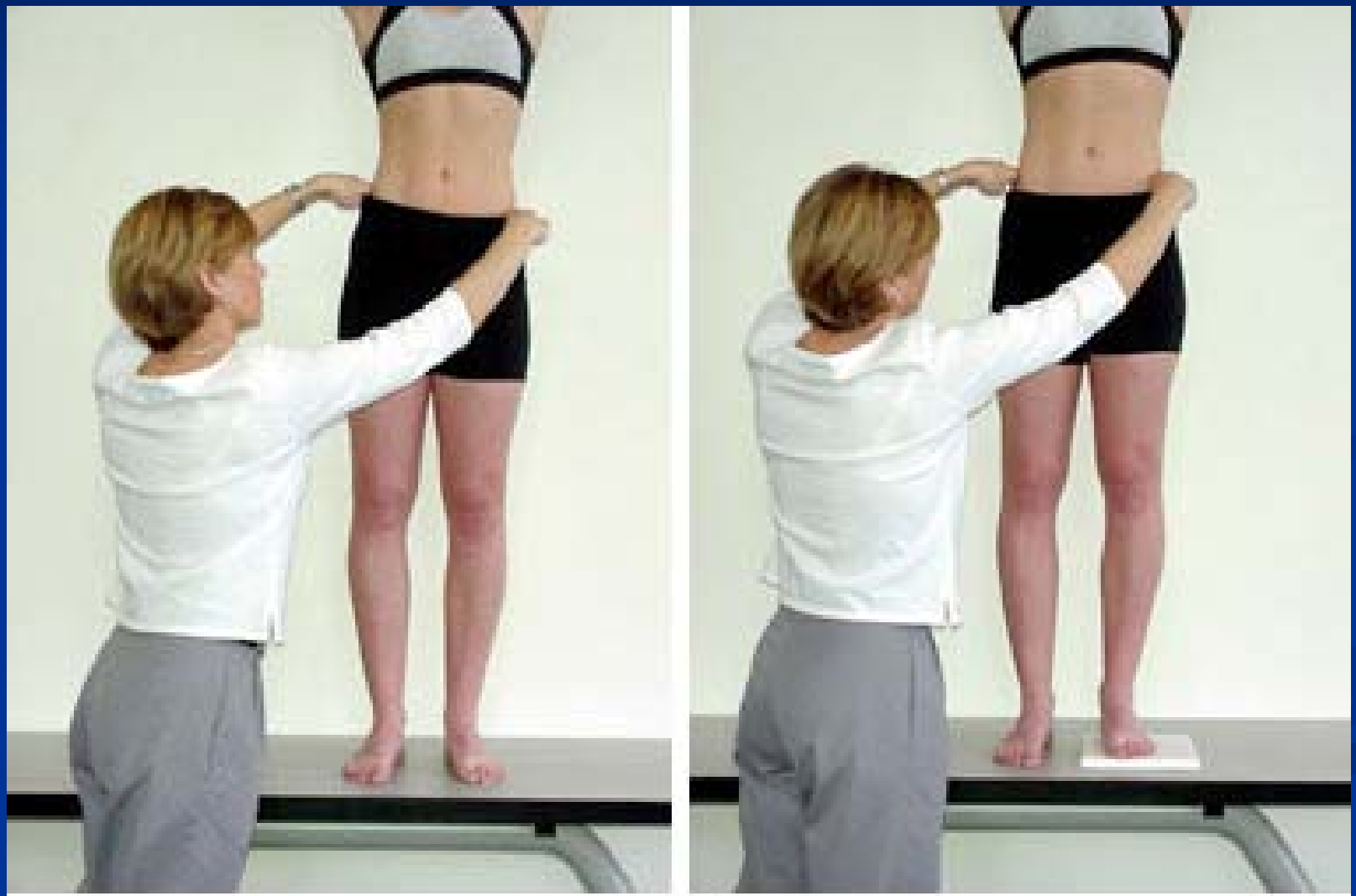
Leg Length



TRUE

APPARENT

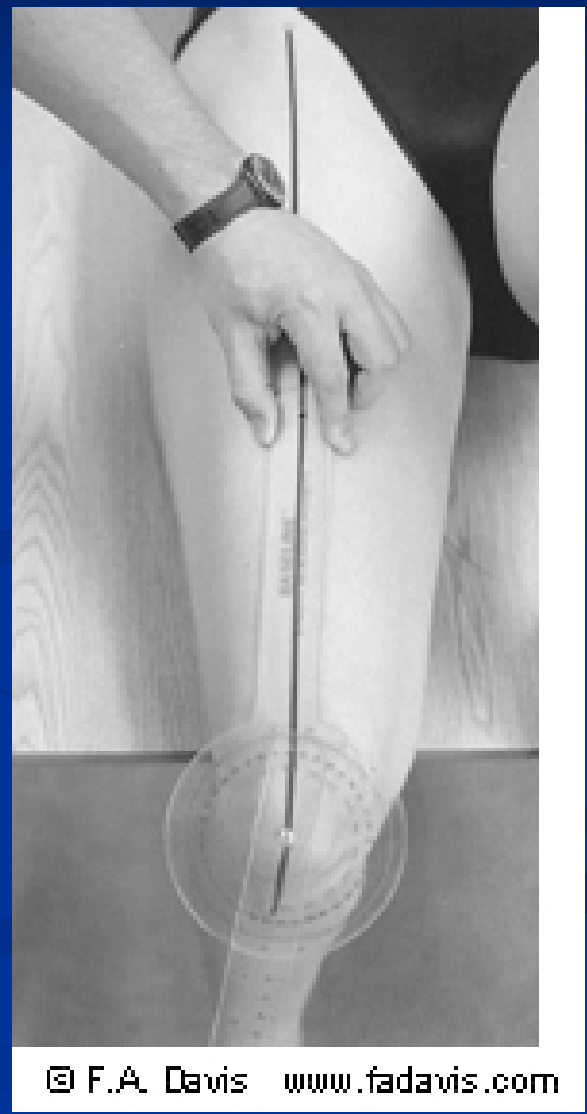
BLOCK METHOD



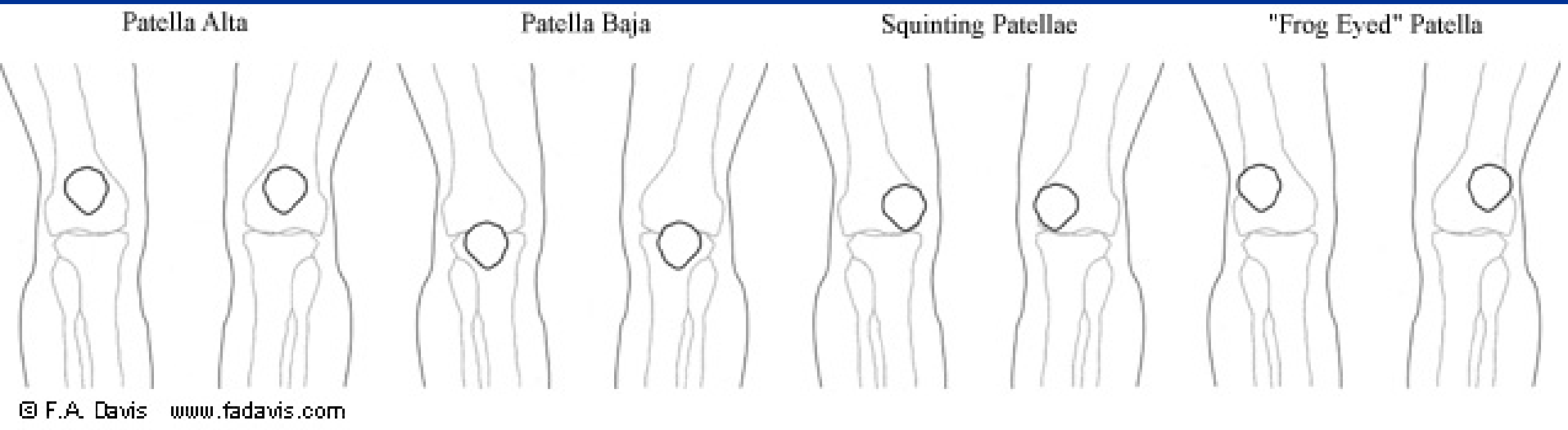
Q-Angle

Knee Flexed

Knee Extended



Patellar Position



Where's the swelling?

Palpation

- Four Aspects
  - Anterior
  - Medial
  - Lateral
  - Posterior
- Start with the Tibial Tuberosity

Interactive Knee 1.1 © 2000 Primal Pictures Ltd.

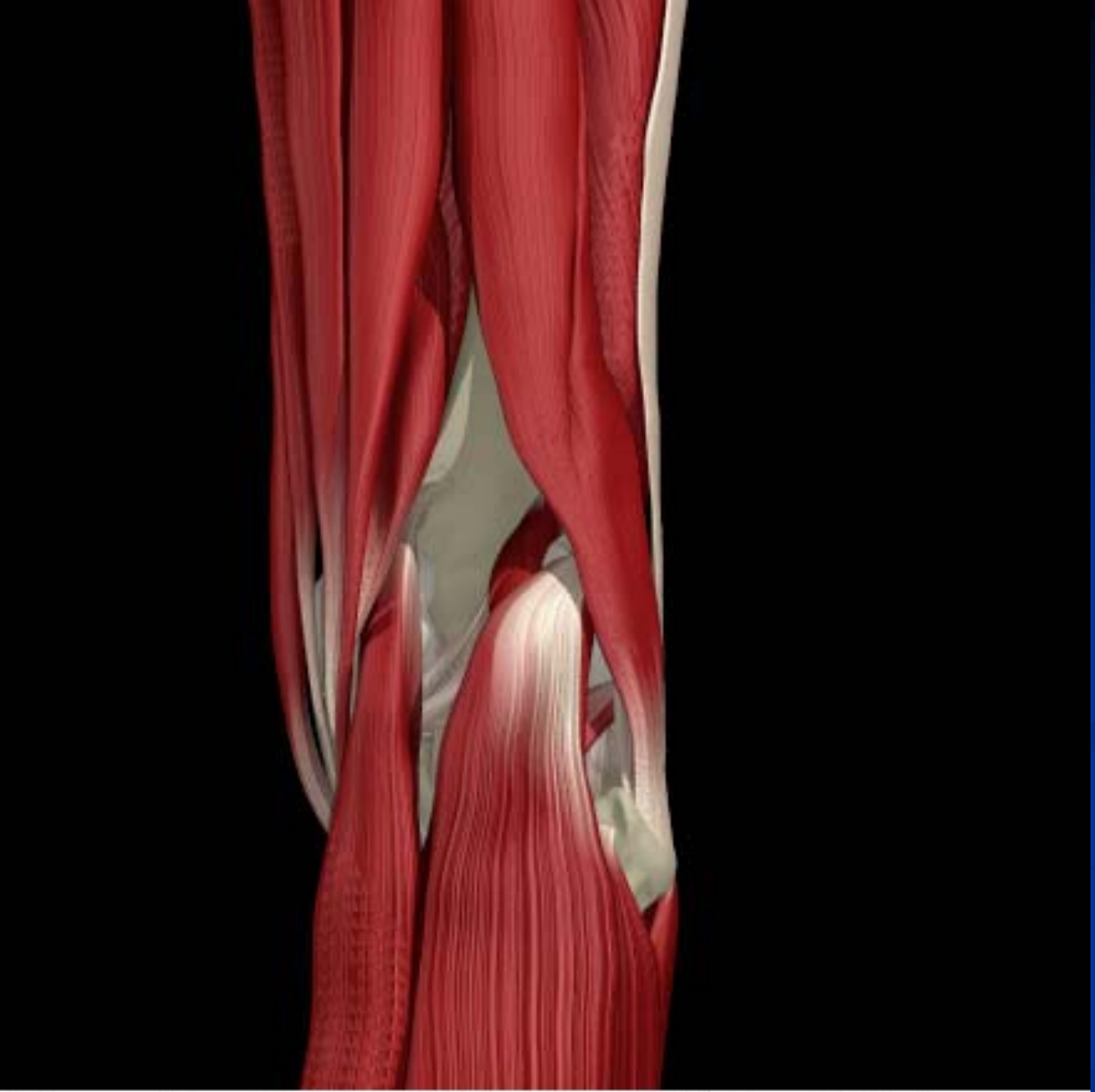
- ANTERIOR
  - Tibial Tuberosity
    - Patellar Tendon
  - Patella
    - Quadriceps Tendon
    - Quadriceps Muscles
    - Sartorius

Interactive Knee 1.1 © 2000 Primal Pictures Ltd.

- Medial
  - Tibial Plateau
    - Meniscus
    - MCL
    - Pes Anserine
    - Semimem
    - Gracilis
  - Femoral Condyle
  - Femoral Epicondyle

Interactive Knee 1.1 © 2000 Primal Pictures Ltd.

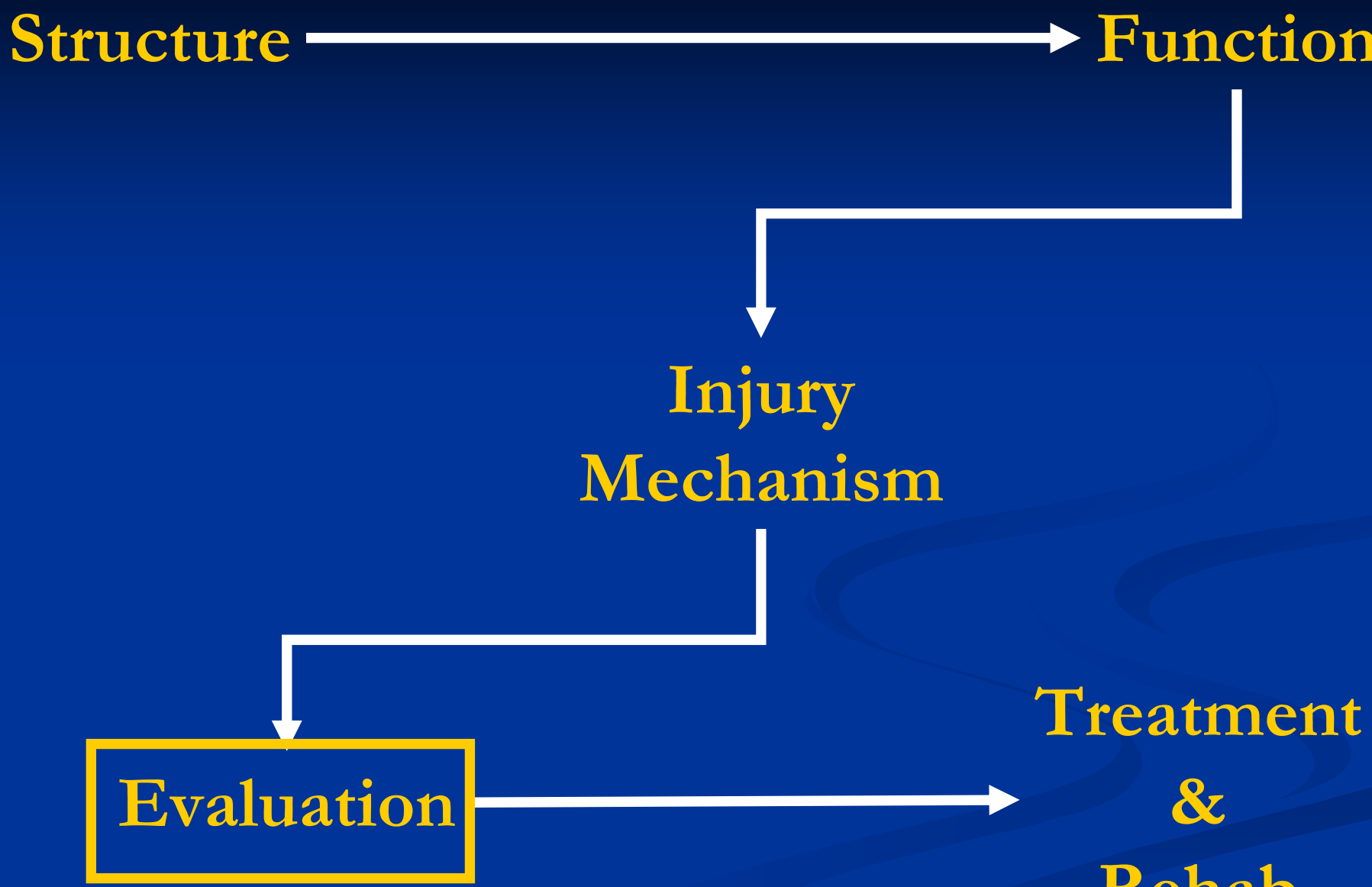
- Lateral
  - Tibial Plateau
    - Meniscus
  - Fibular Head
    - LCL
    - Popliteus
    - Biceps Fem
    - ITB
  - Femoral Condyle
  - Femoral Epicondyle



Interactive Knee 1.1 © 2000 Primal Pictures Ltd.

- Posterior
  - Popliteal Fossa
  - Hamstrings
  - Heads of Gastroc

STRESS


Structure
Function
Injury
Mechanism
Evaluation
Treatment
&
Rehab

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

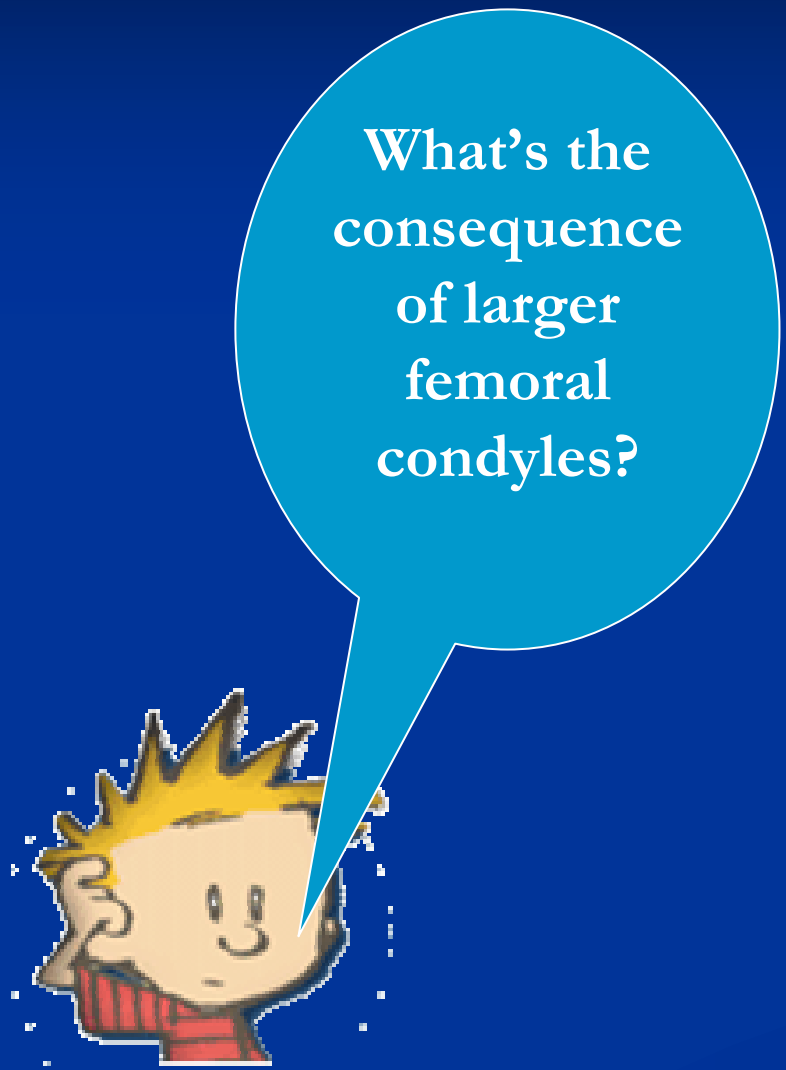
- Bony Geometry
- Soft Tissue Constraints
- Muscle Forces

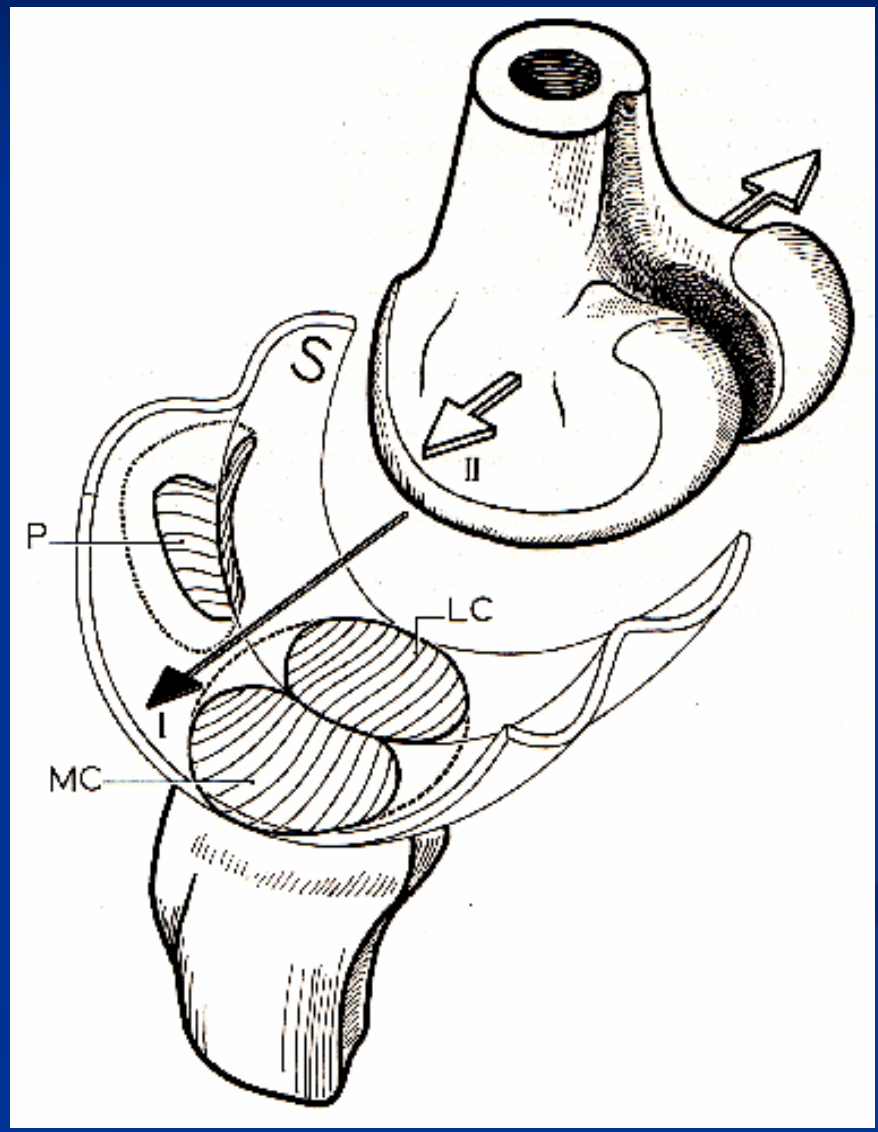
Bony Factors

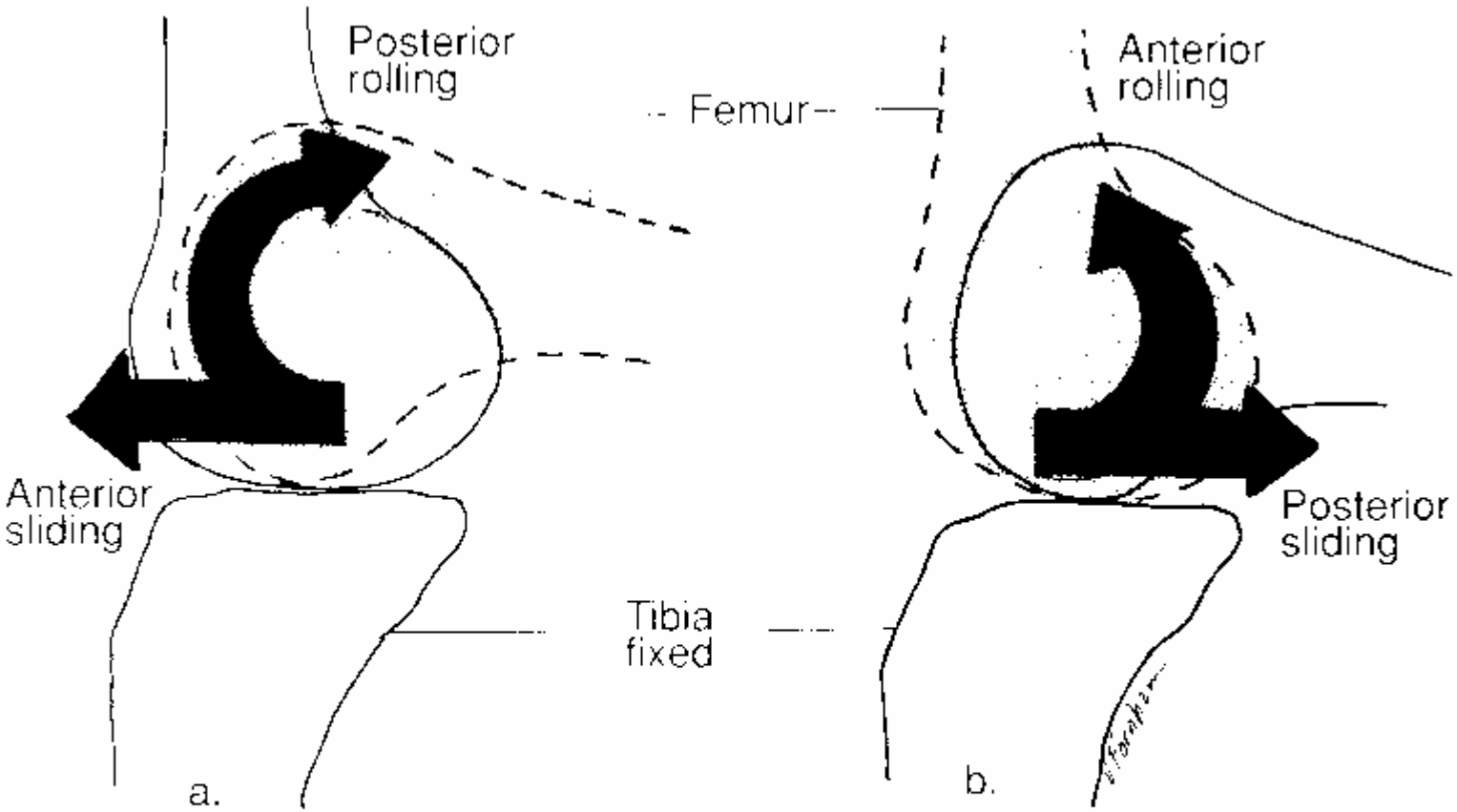
- Different size of the medial and lateral femoral condyles
- Different size of the articular surfaces of the femoral condyles and the tibial condyles
- Variation in curvature from anterior to posterior

Medial Condyle is larger than the Lateral Condyle

Larger Femoral Condyles



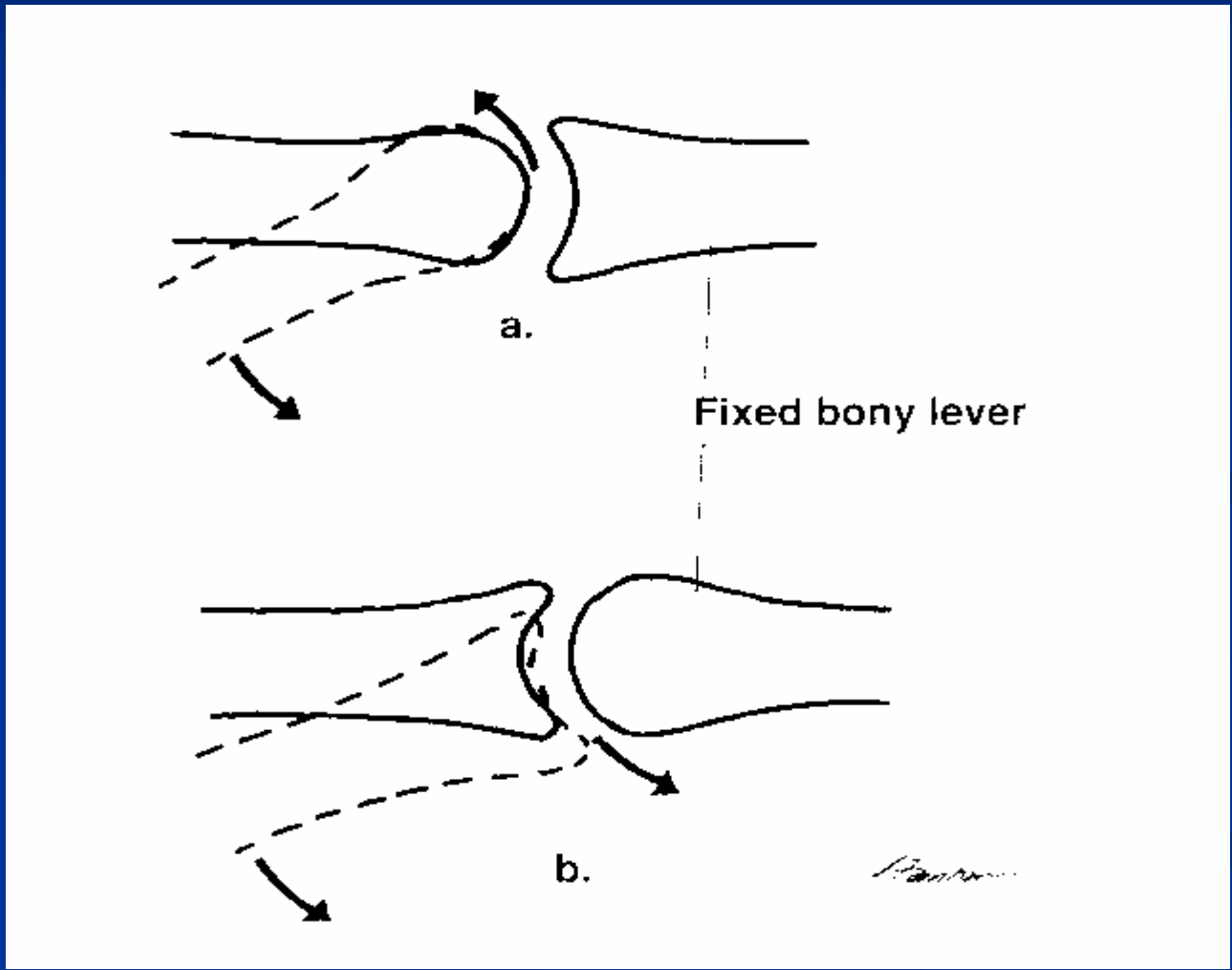




Motion of the femoral condyles during flexion

Motion of the femoral condyles during extension

Convex-Concave Rule

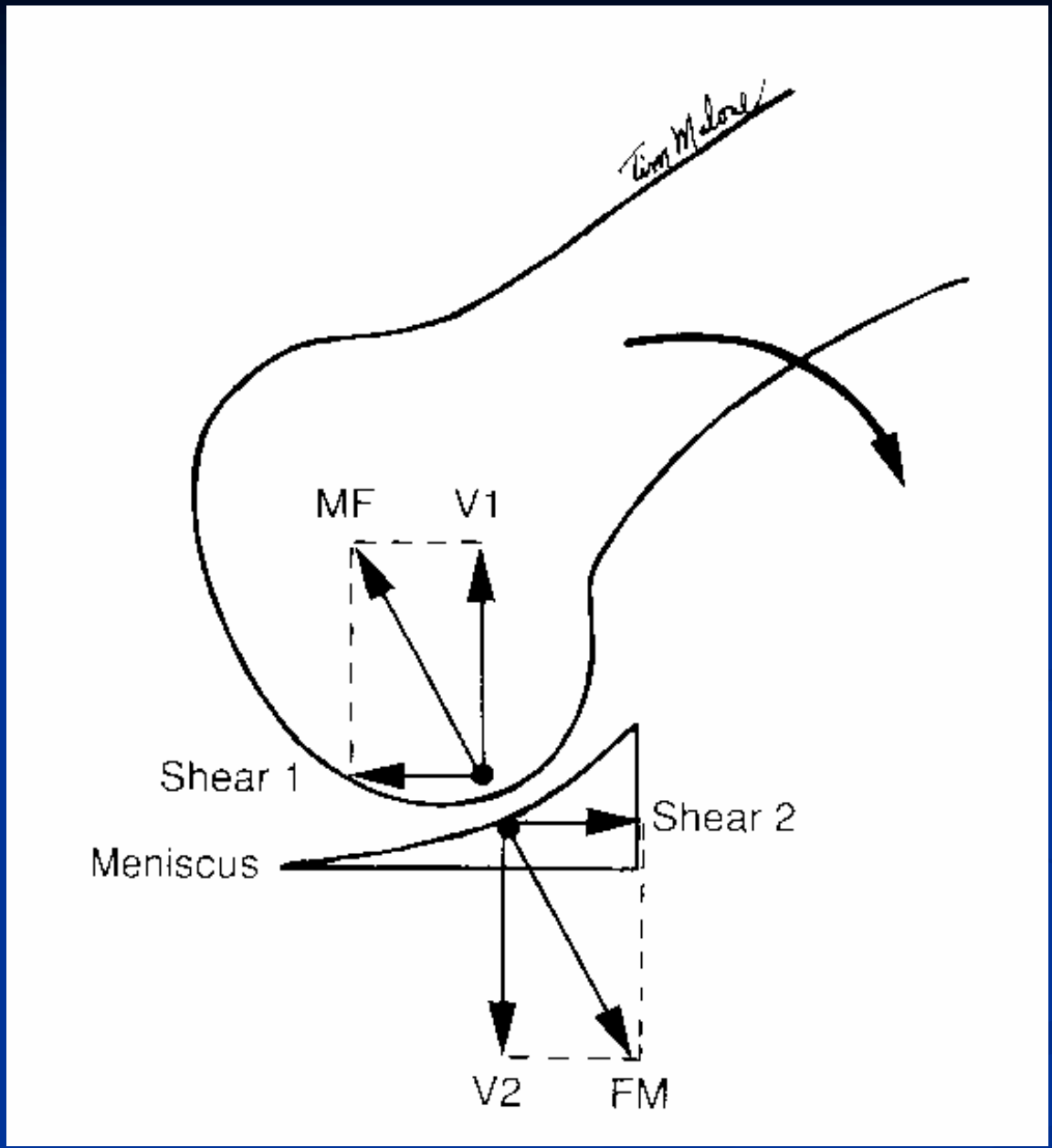


The Menisci

Interactive Skeleton - Sports & Kinetic

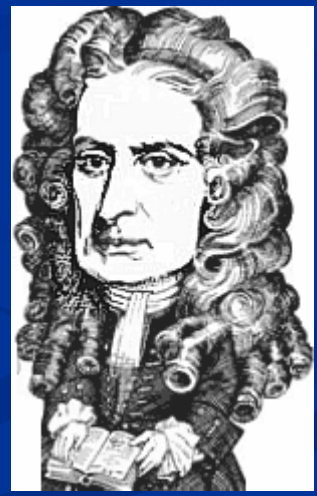
The Menisci

- Tibiofemoral load transmission
- Shock absorption
- Lubrication
- Prevent synovial impingement
- Distribute synovial fluid
- Contribute to joint stability
- Assist in gliding motion



Levangie and Norkin, 2001

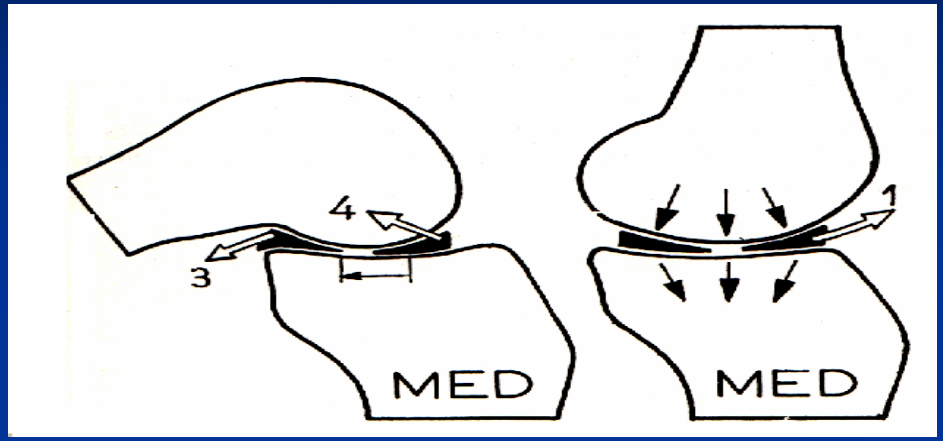
My Third Law

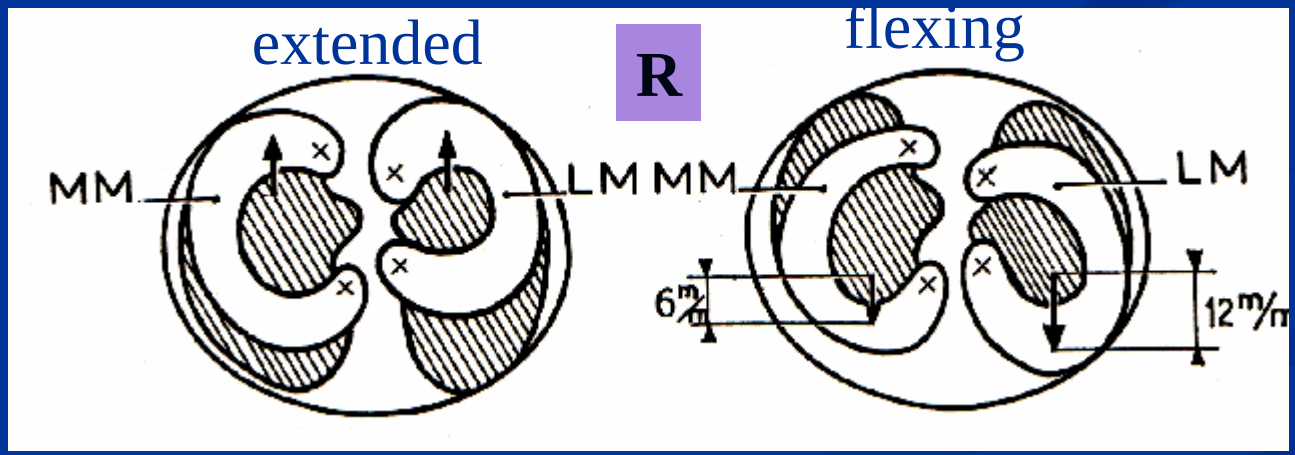


Movements of menisci

- during flexion - move posteriorly

- during extension - move anteriorly



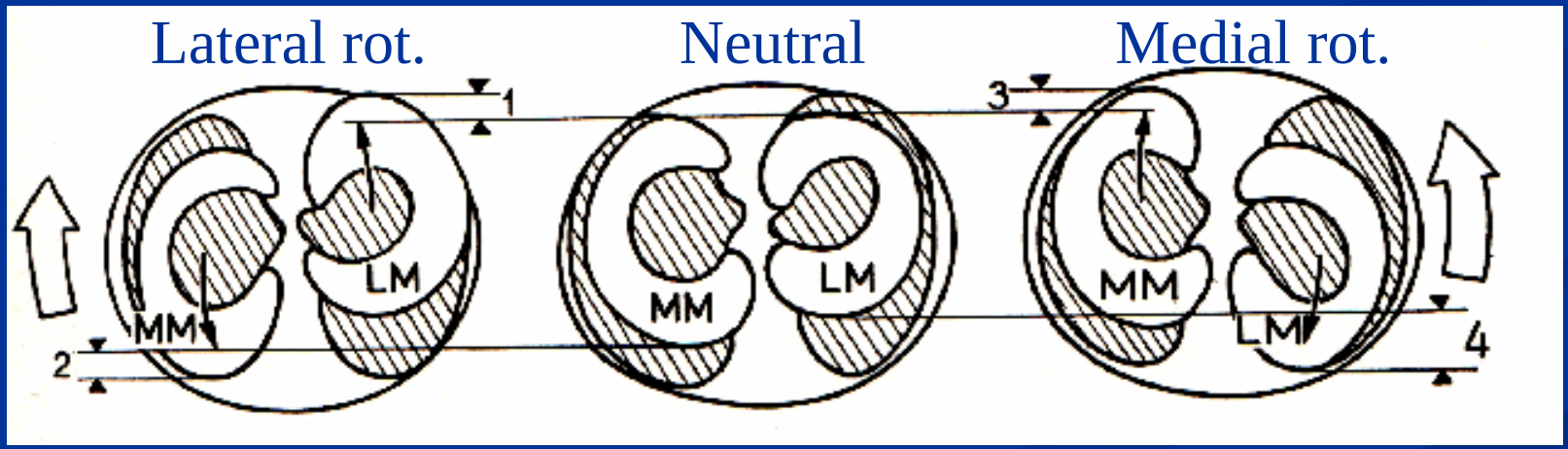


… menisci move posteriorly unequally

… the menisci follow, or stay with the, femoral condyles

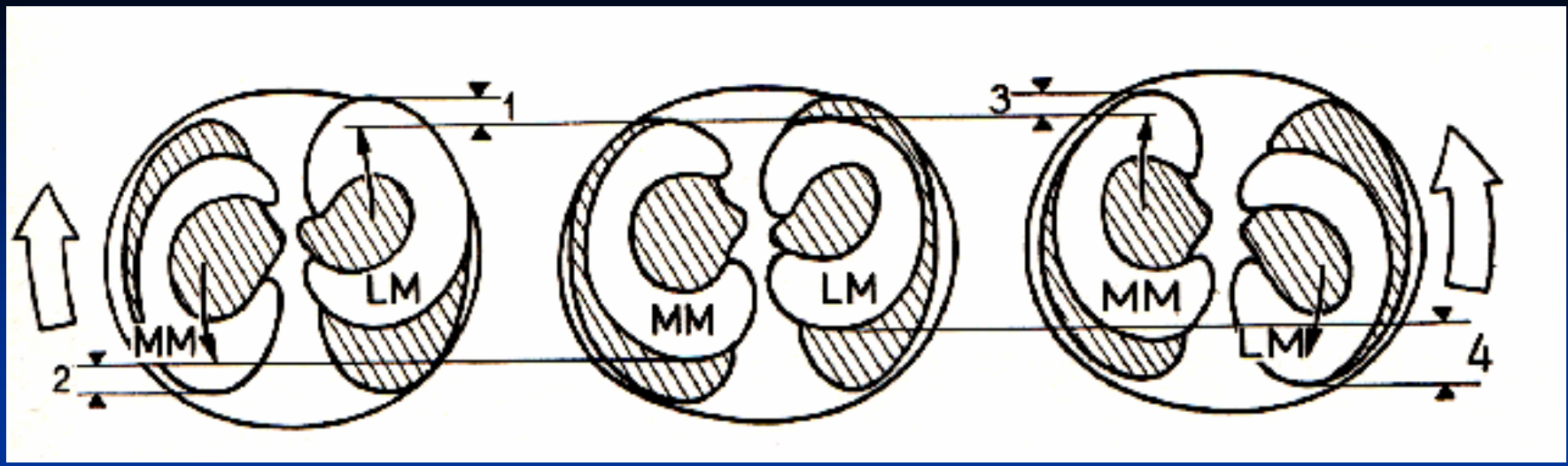
Movements of menisci

- 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)



R

… the menisci follow, or stay with the, femoral condyles



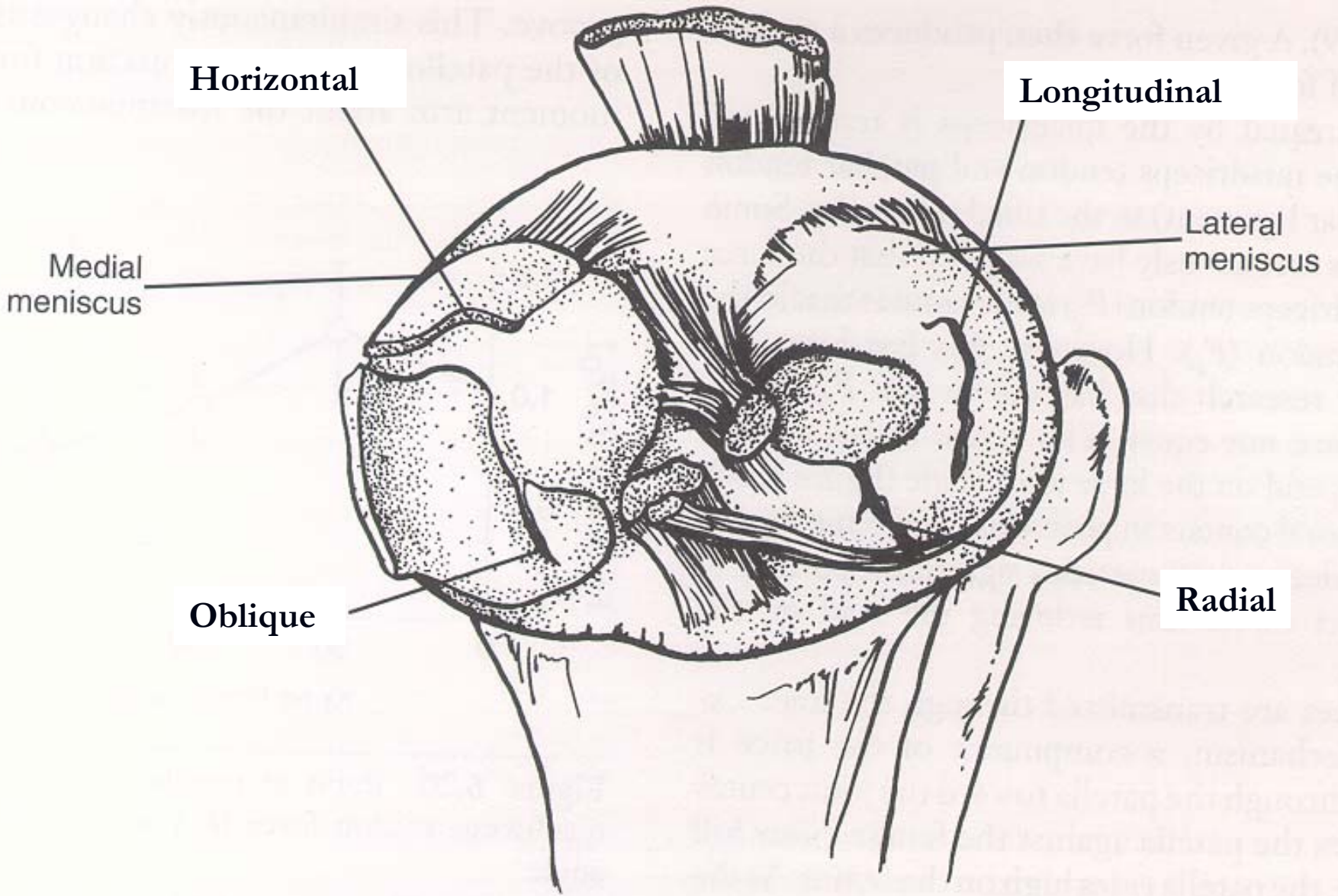
How would you palpate the menisci?

Movement of the Menisci

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

- Anterior horns move more than posterior horns (Vedi, 1999)

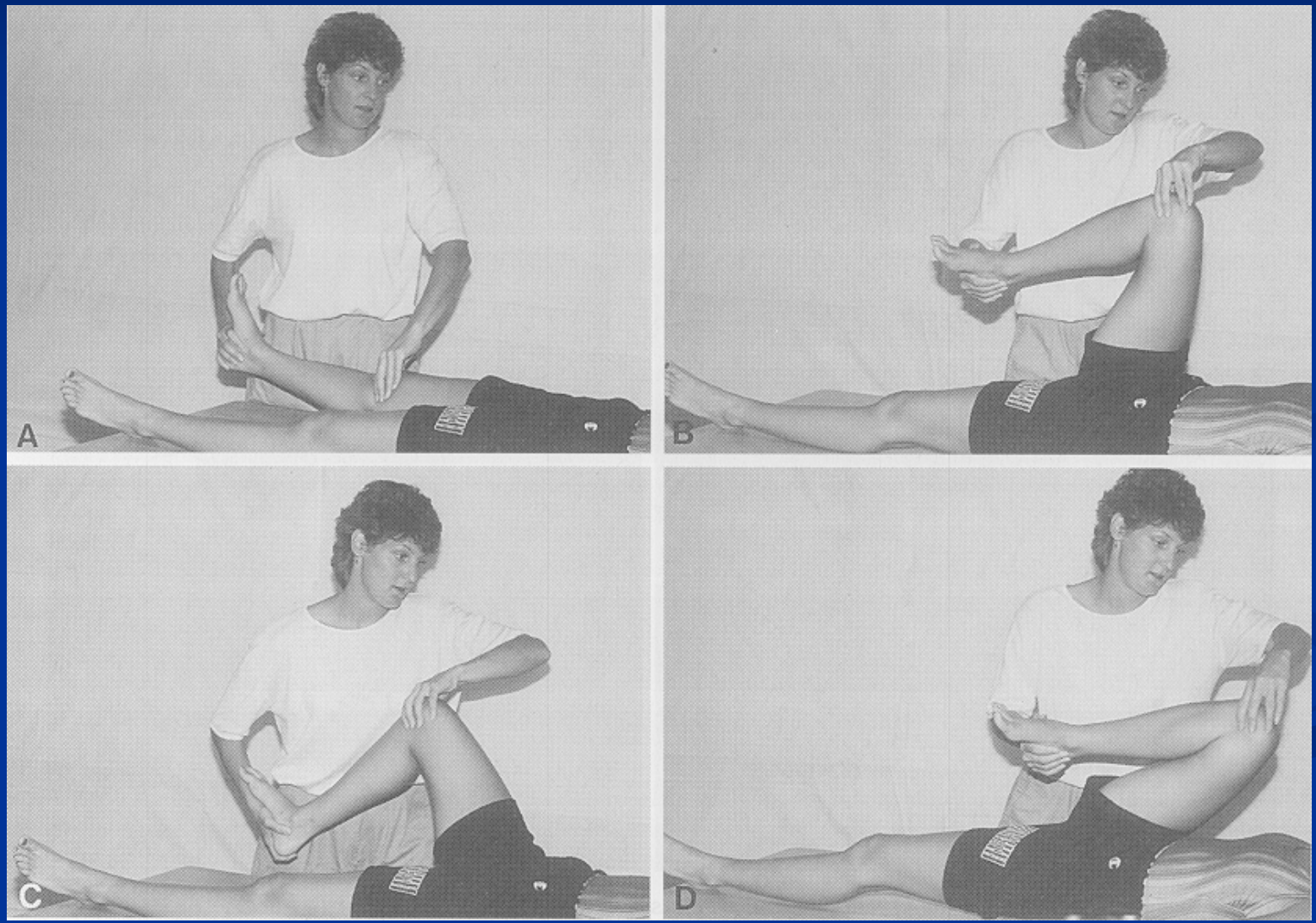
The menisci attach to the tibia, but move with the femur.



Whiting and Zernicke, 1998

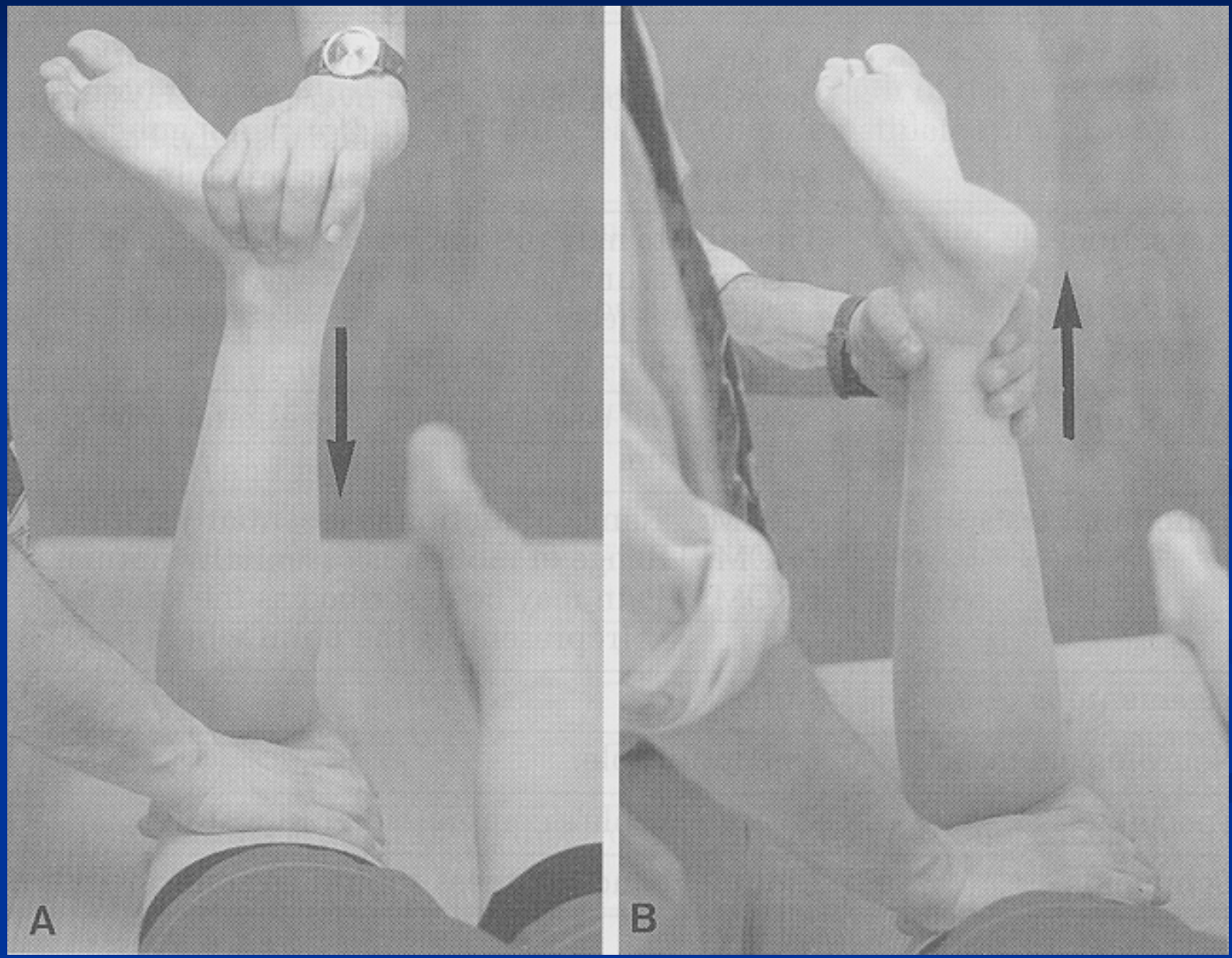
Evaluating the Menisci

McMurray's



Starkey & Ryan, 1996

Apley'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.

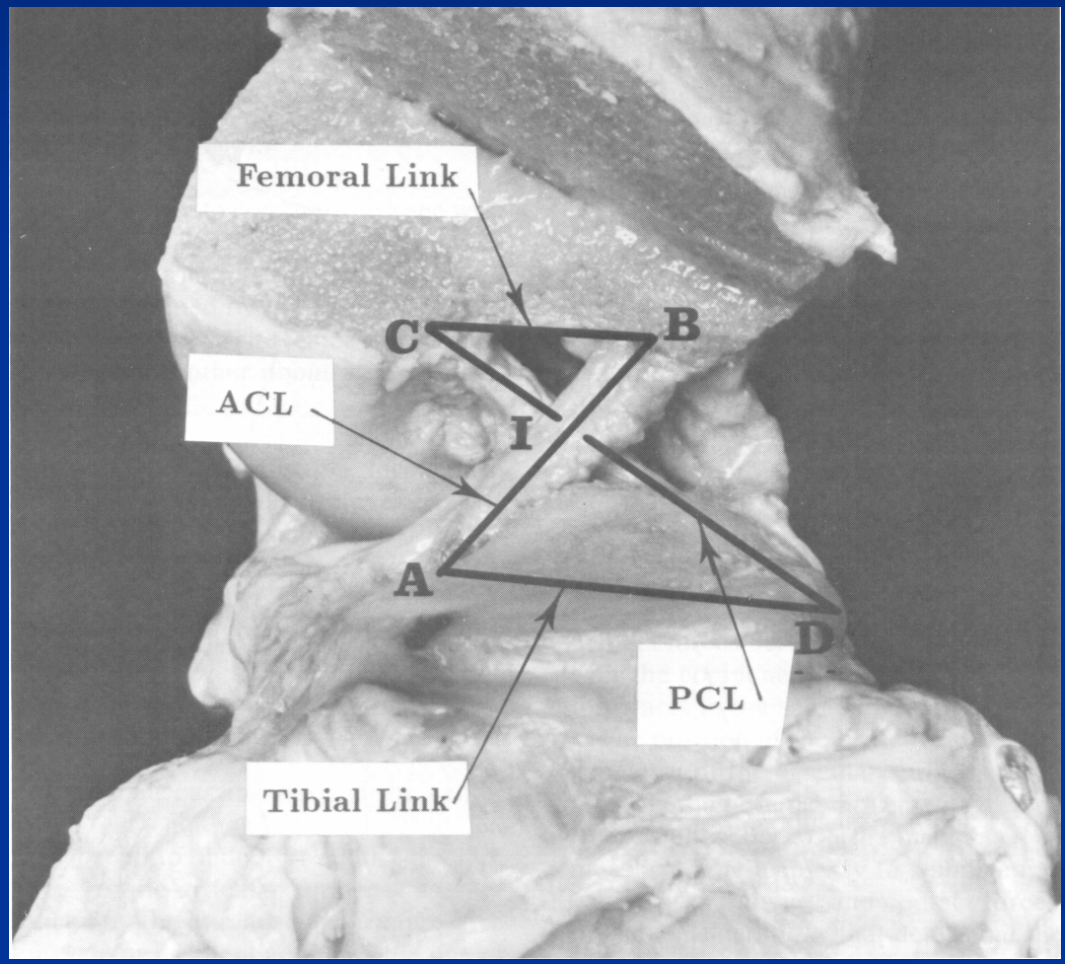
Anterior Cruciate Ligament

- Prevents anterior translation of the tibia with respect to the femur
- Or…
- Stabilize in other directions as well

Posterior Cruciate Ligament

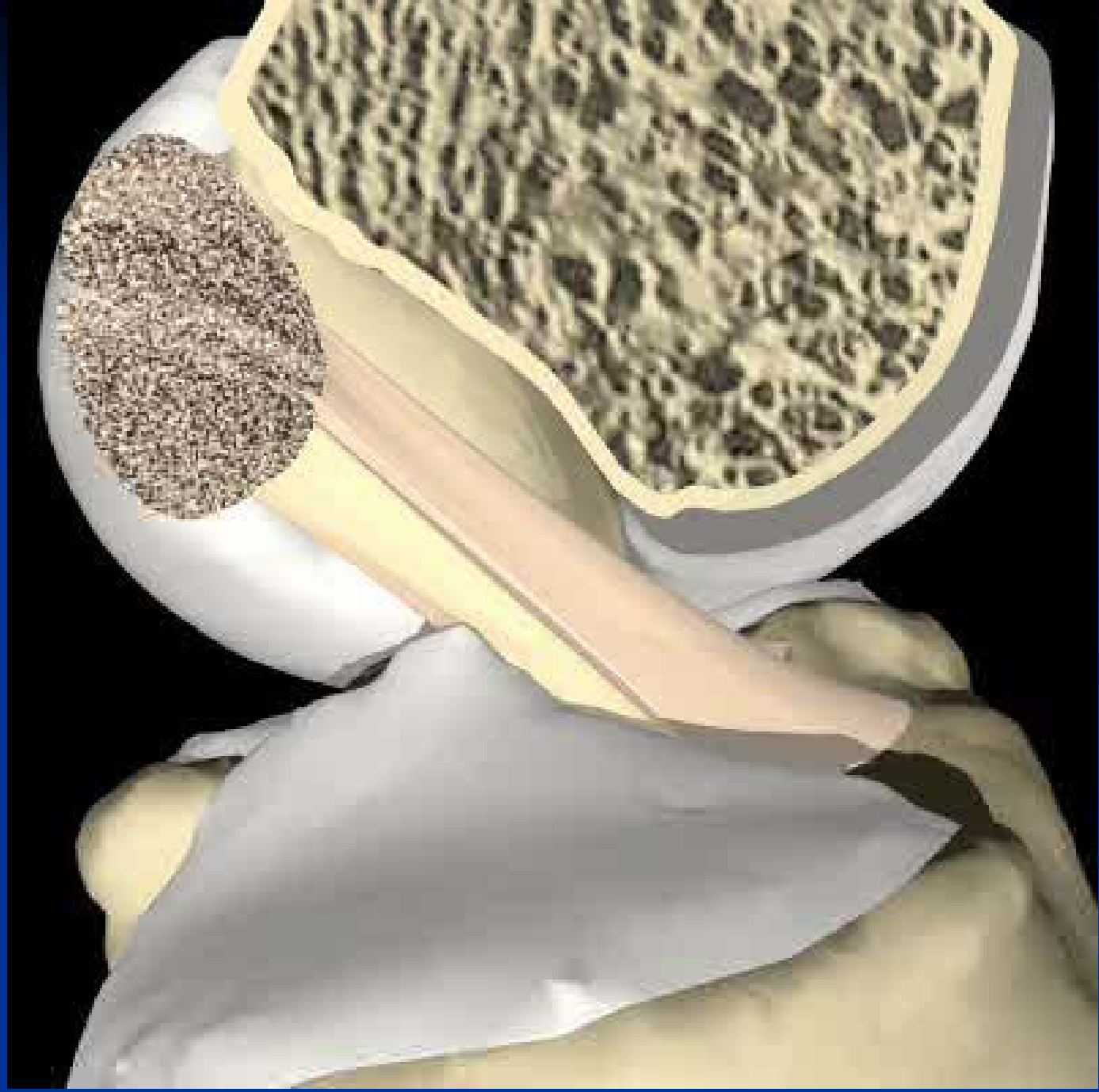
- Prevents posterior translation of the tibia with respect to the femur
- Or…
- Provides stability in other directions as well

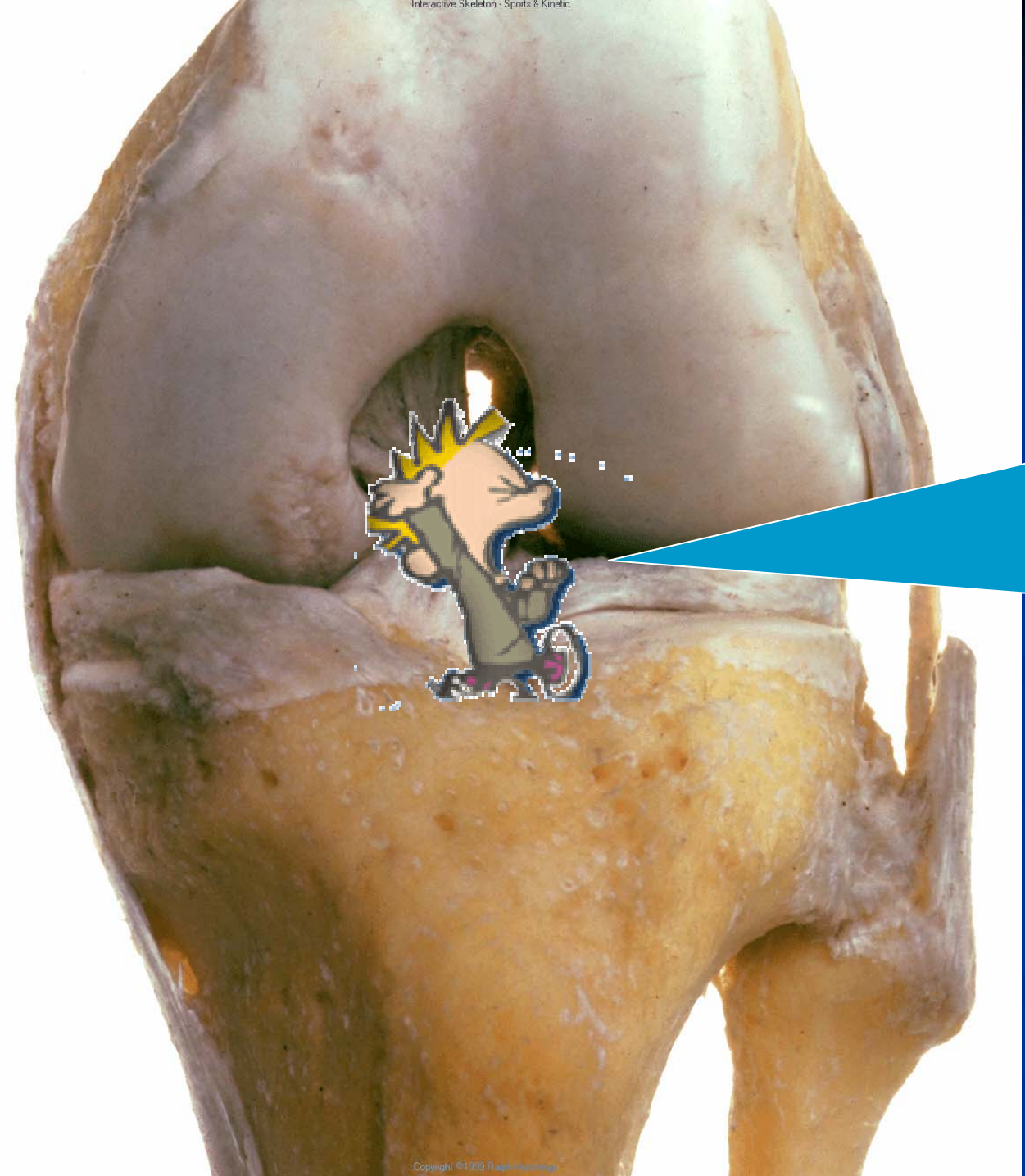
The Cruciates & Knee Motion



ACL assists in anterior glide during flexion

PCL assists in posterior glide during extension





Tibial:

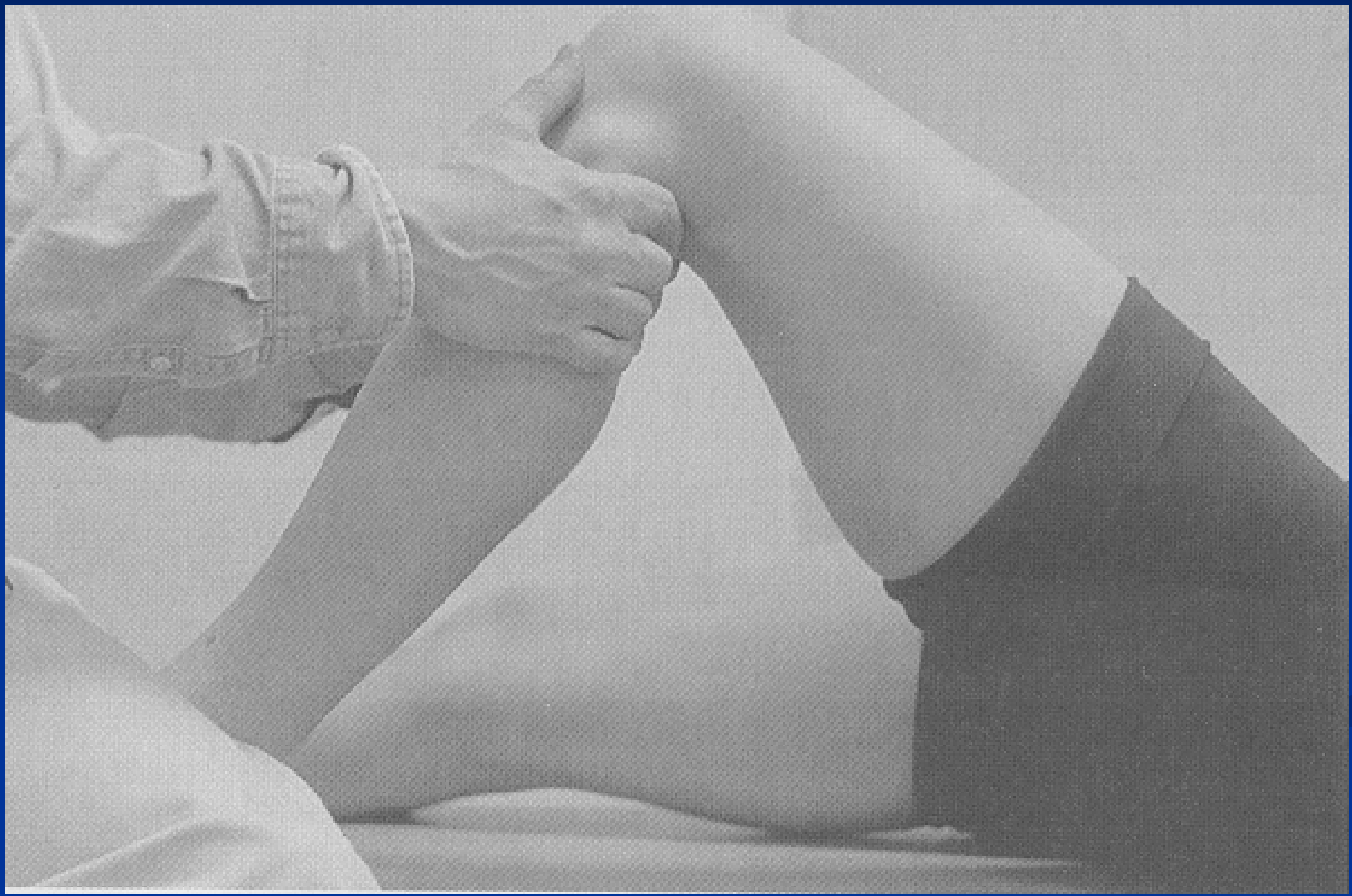
- Anterior Translation
- Internal Rotation
- Valgus or Varus

Testing the ACL

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

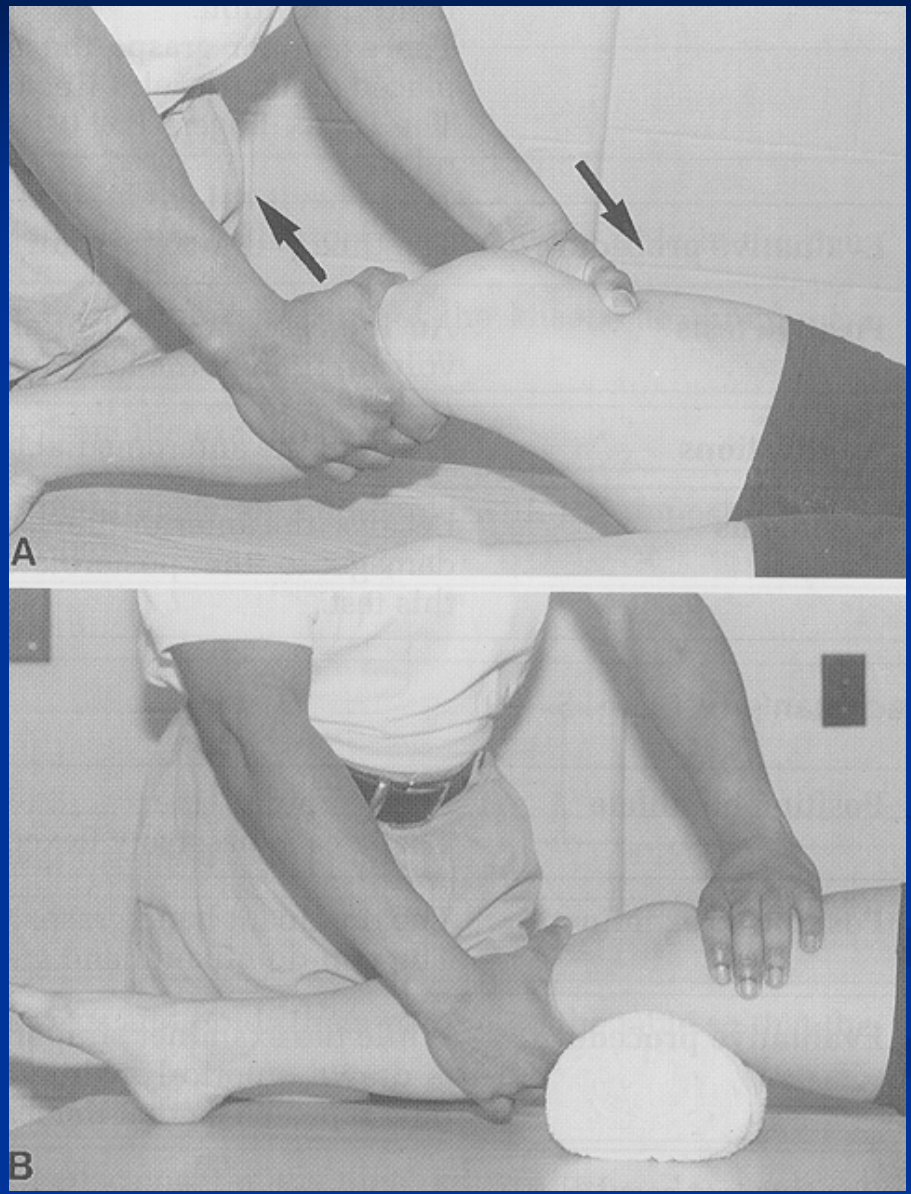
- Anterior shear loads at 30 degrees of flexion produced greater strain on the AMB than shear loads at 90 degrees. (Beynnon, 1992)

Anterior Drawer



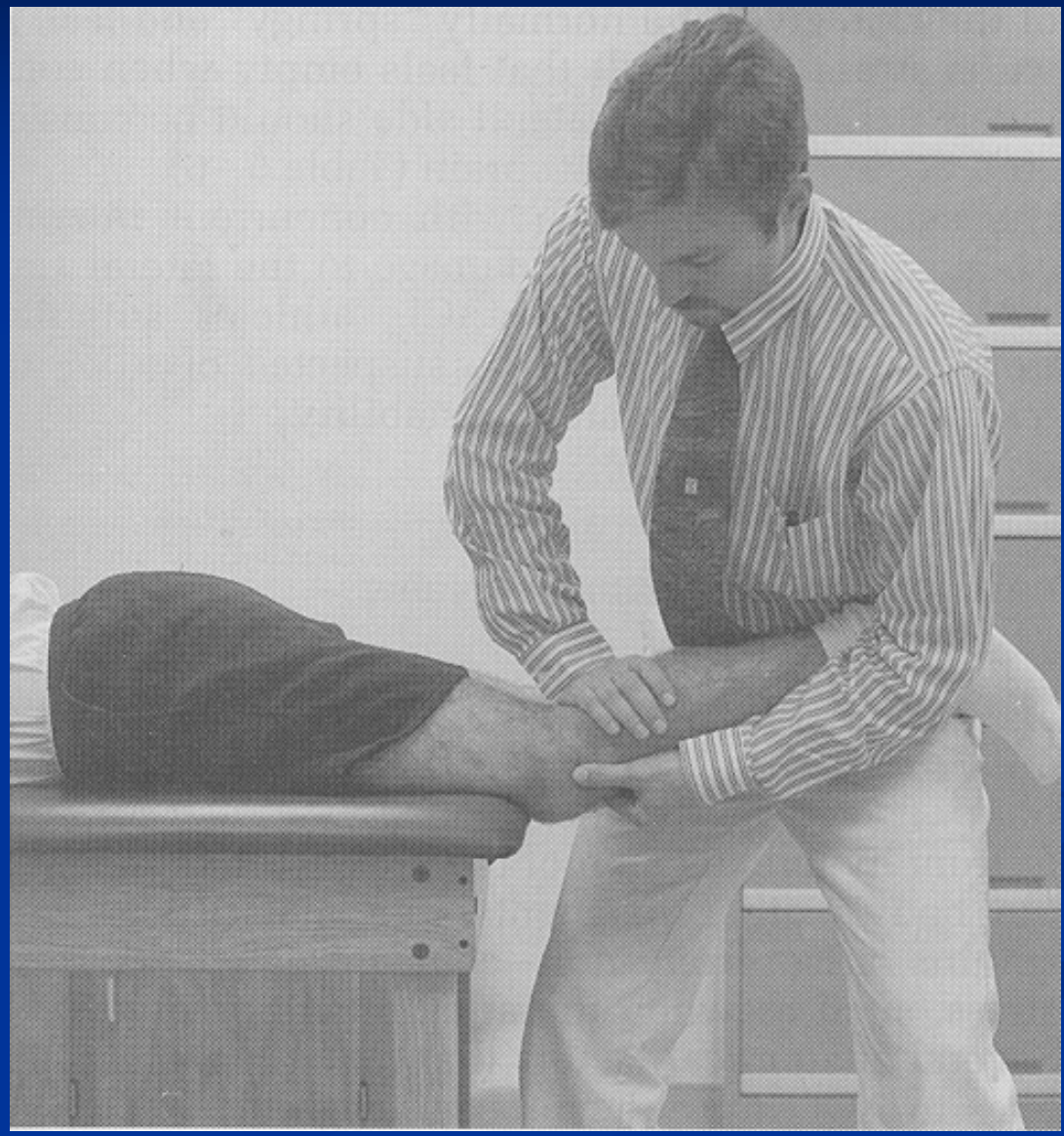
Starkey & Ryan, 1996

Lachman's



Starkey & Ryan, 1996

Alternate Lachman's



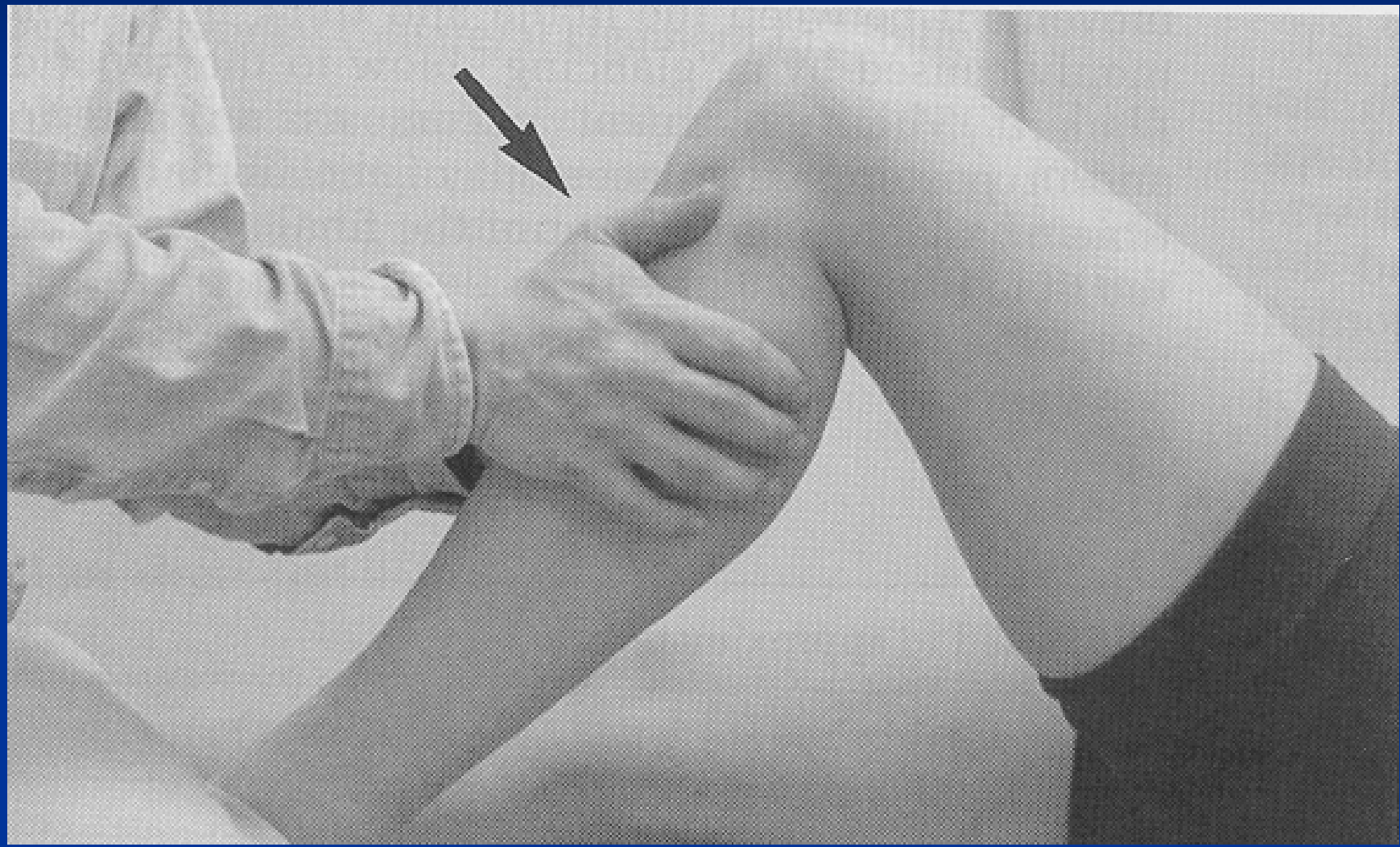
Starkey & Ryan, 1996

PCL injuries…direct impact

Testing the PCL

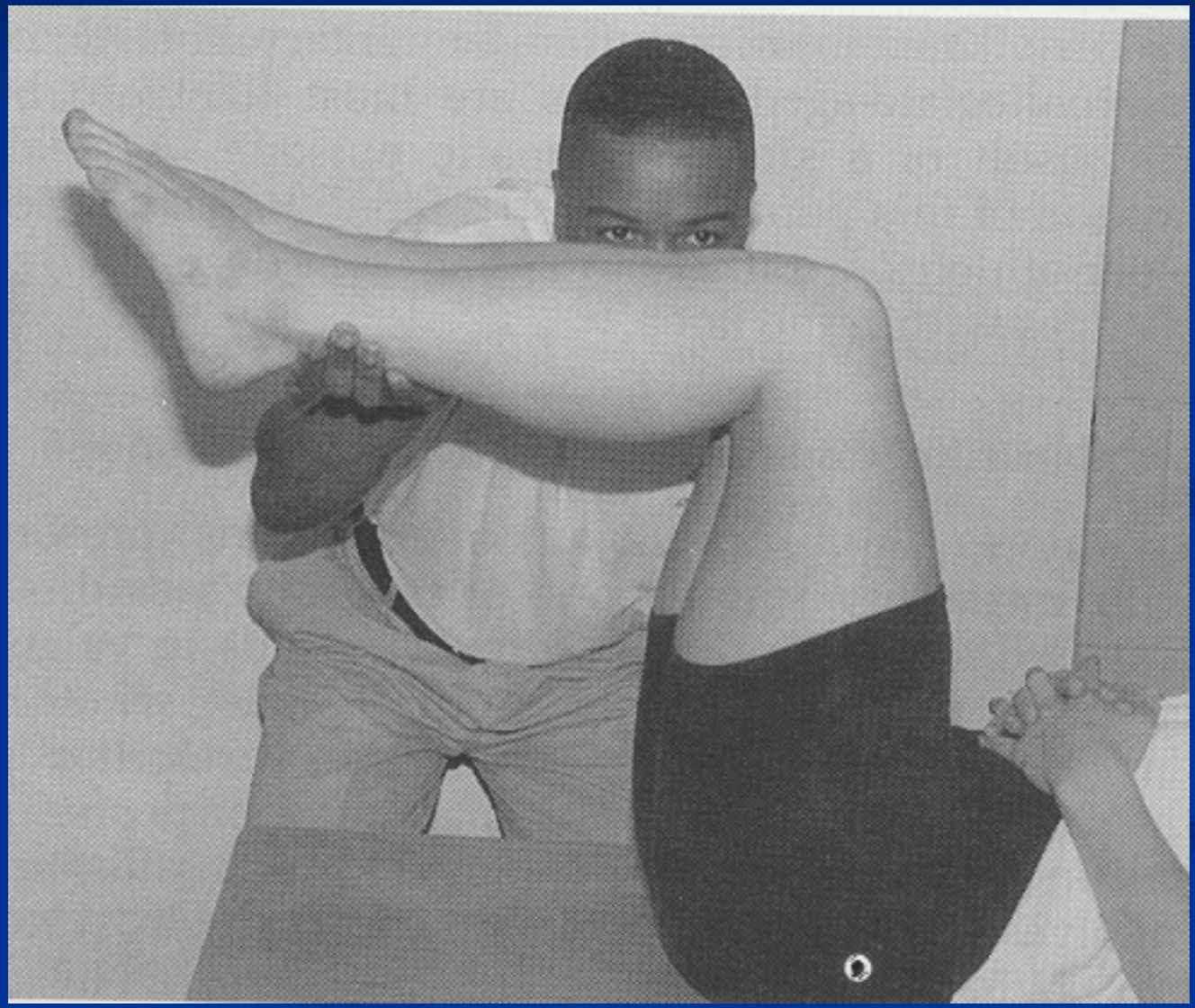
- Posterior translation was twice as much at 90 degrees of flexion compared to 30 degrees after sectioning PCL (Grood, 1988)
- Test PCL at 90 degrees (posterior drawer and posterior sag test).
- Internal rotation in this position will decrease laxity (Bergfeld, 2001)

Posterior Drawer



Starkey & Ryan, 1996

Godfrey's



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

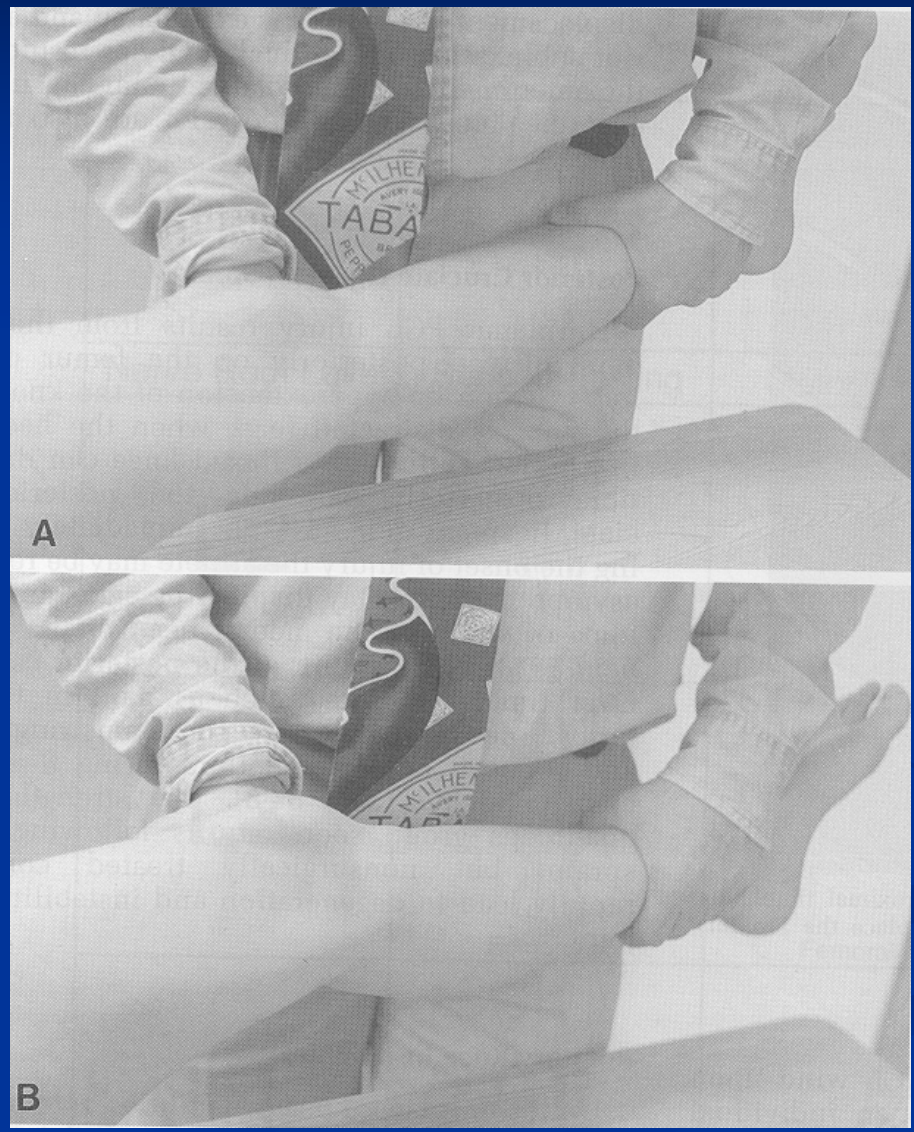
Lateral Collateral Ligament

- Resists varus stress
- Also limits lateral rotation

Testing the Collaterals

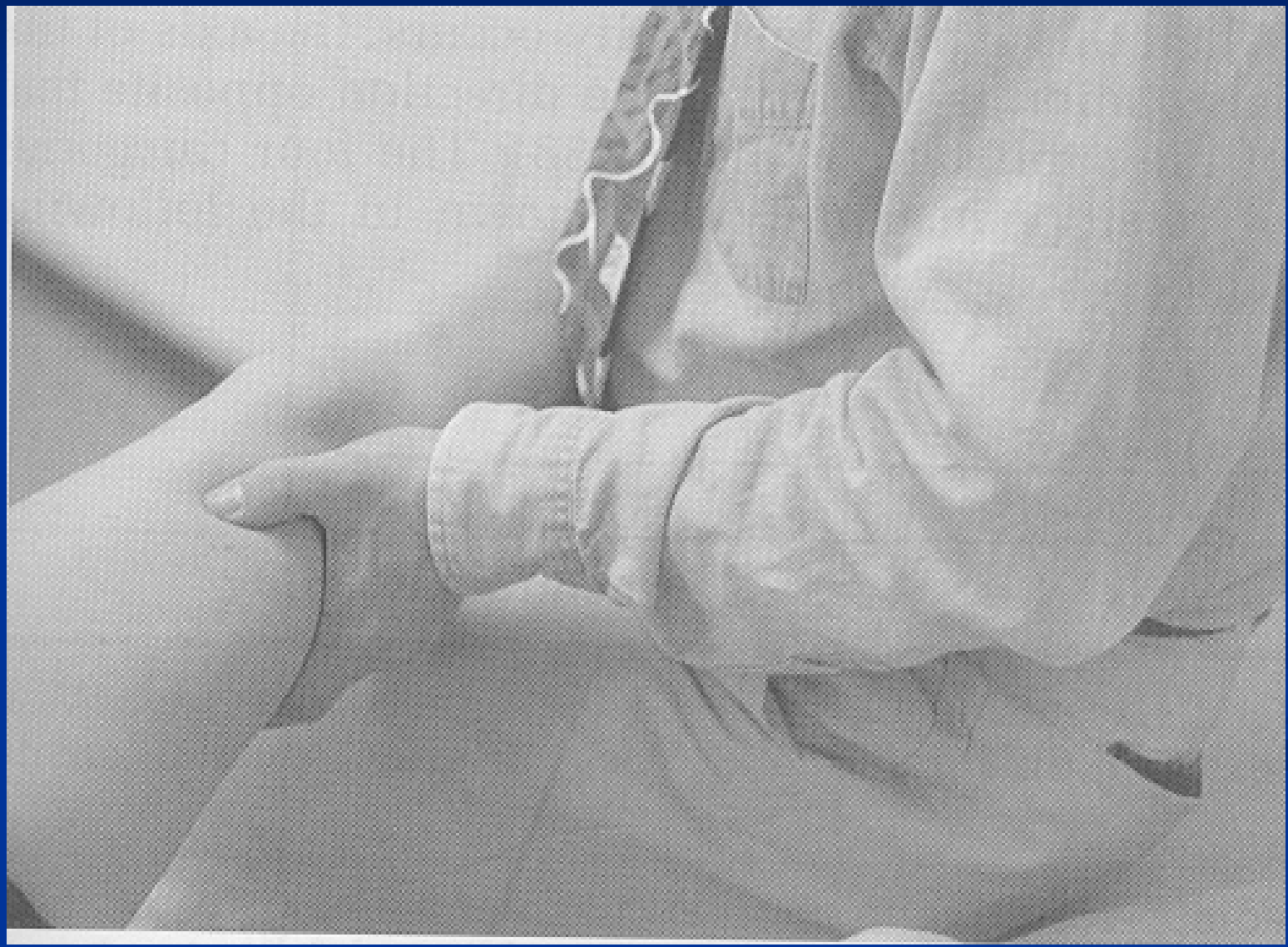
- 57% of valgus load at 5 degrees of flexion
- 78% of valgus load at 25 degrees of flexion

Valgus Stress



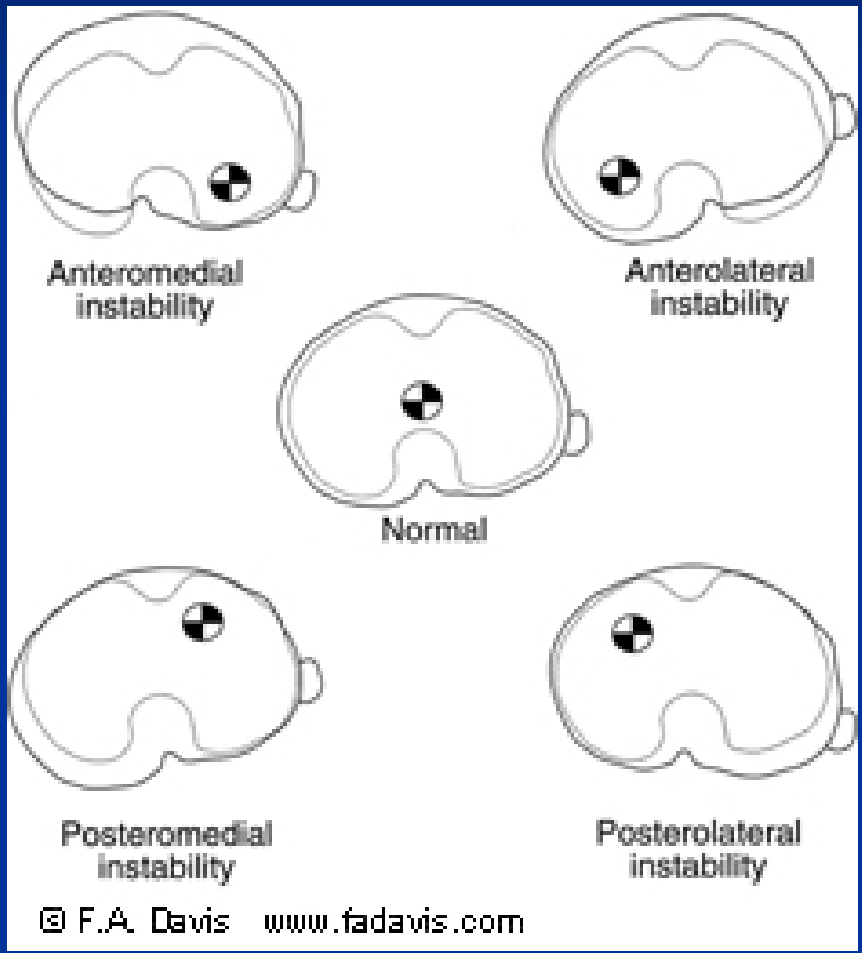
Starkey & Ryan, 1996

Varus Stress



Starkey & Ryan, 1996

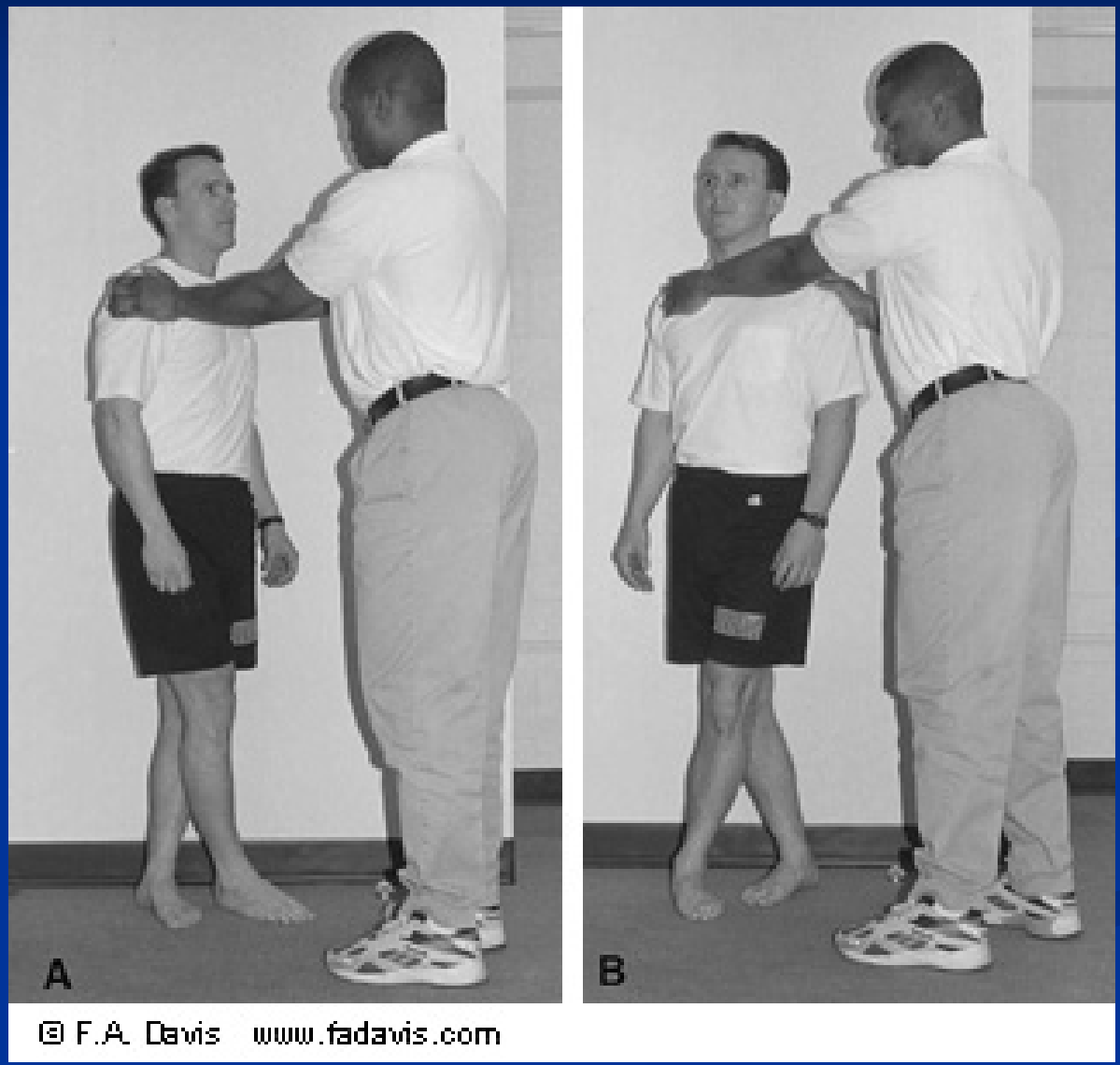
Rotational Instabilities



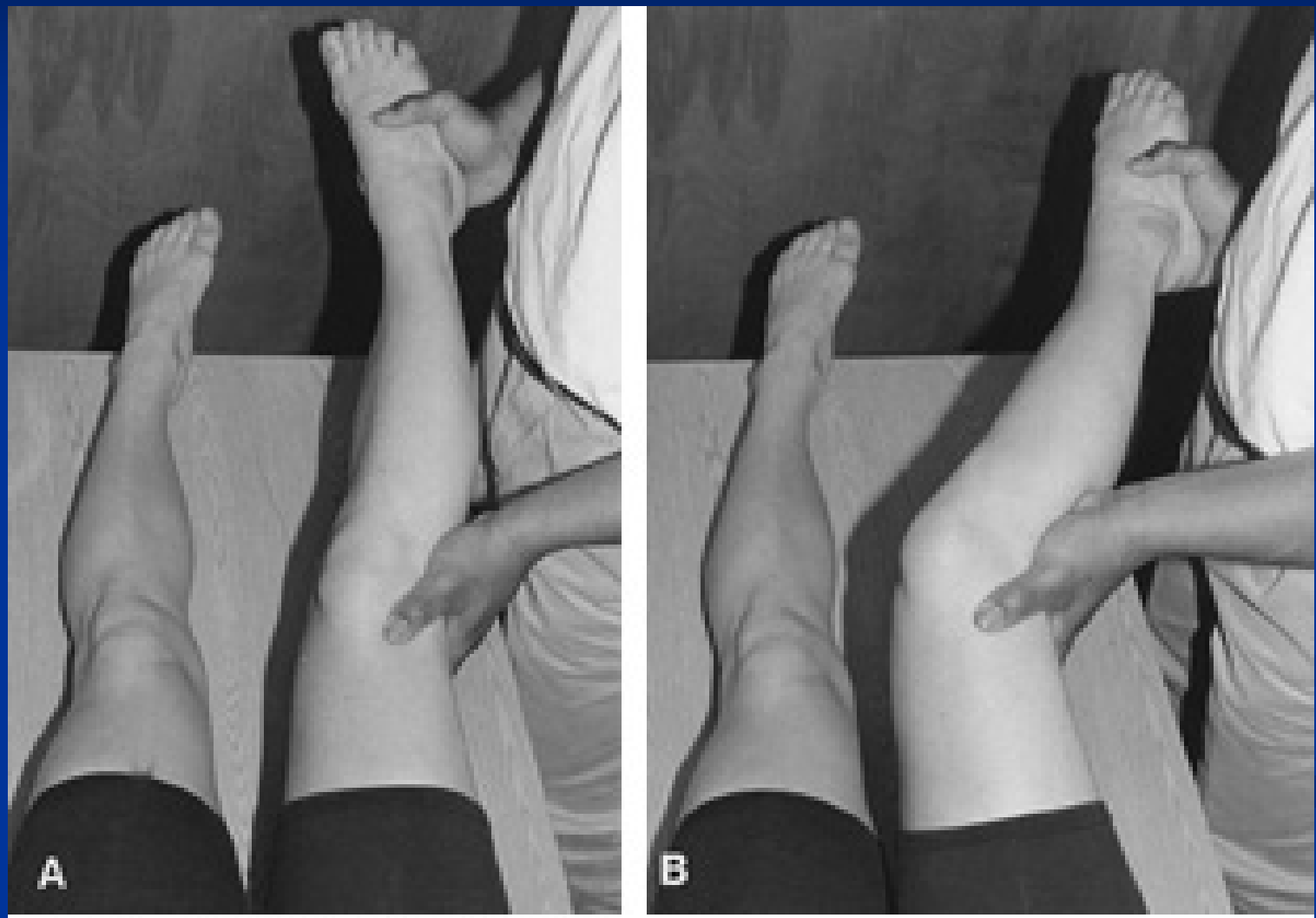
- Relative motion of the tibia on the femur
- Multiple structures are involved
- Total may be greater than the sum of the parts

Slocum Drawer

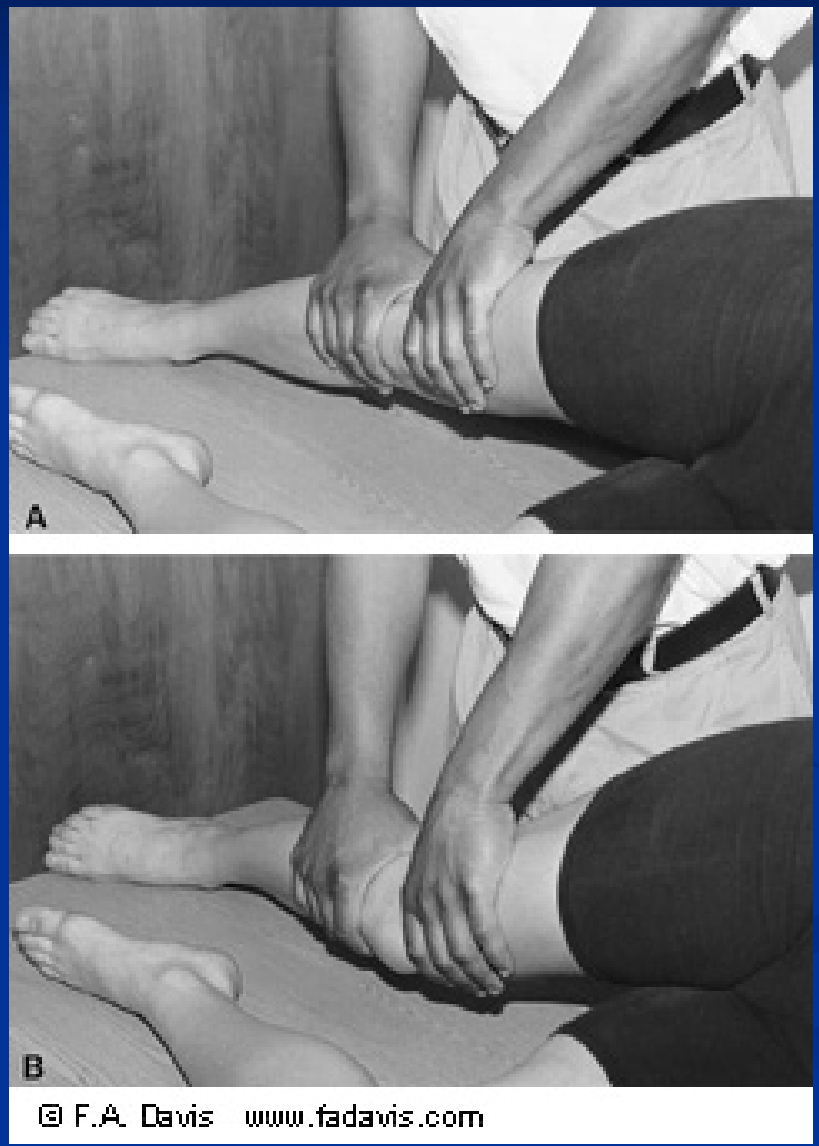
Crossover Test



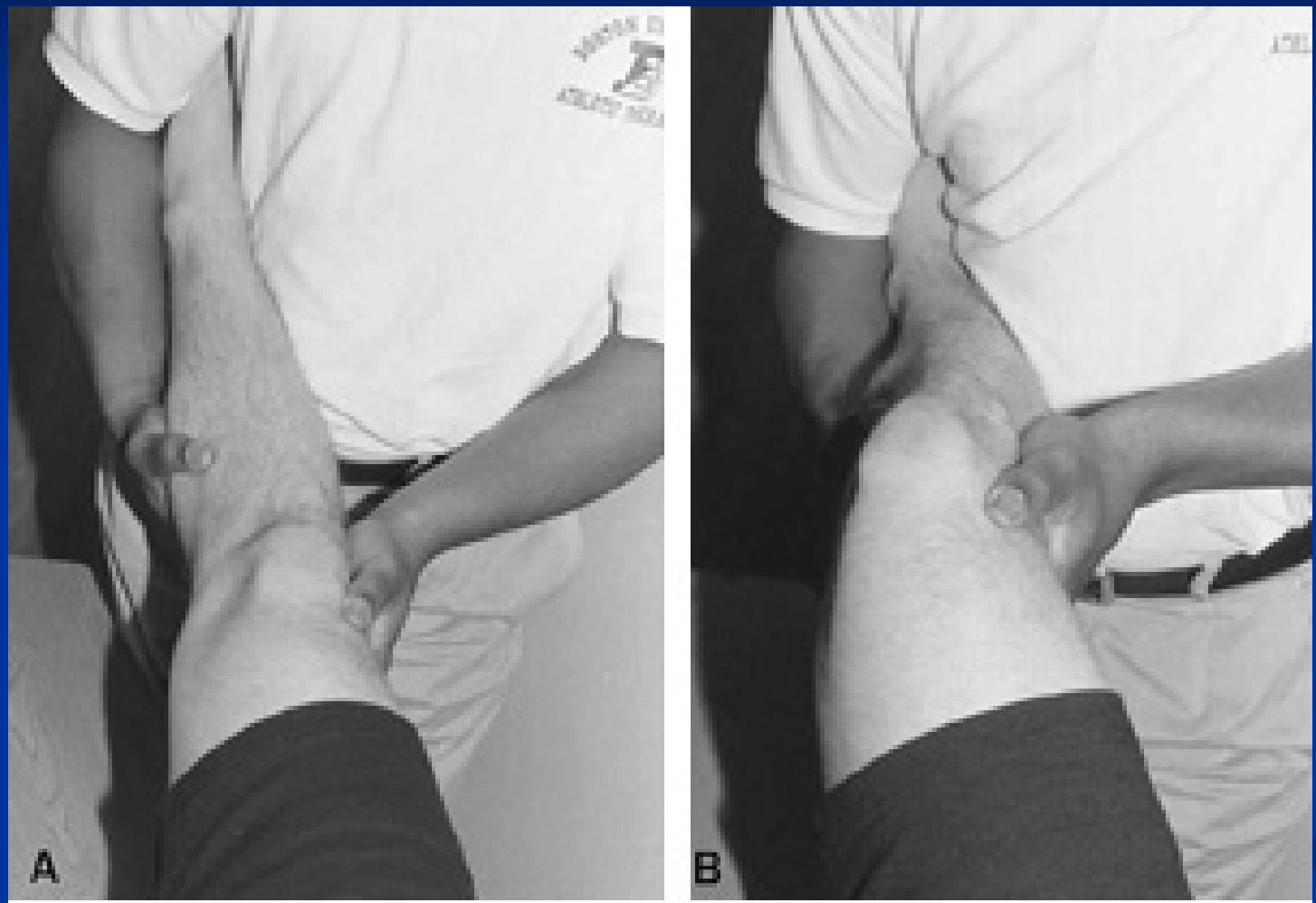
Pivot Shift



ALRI

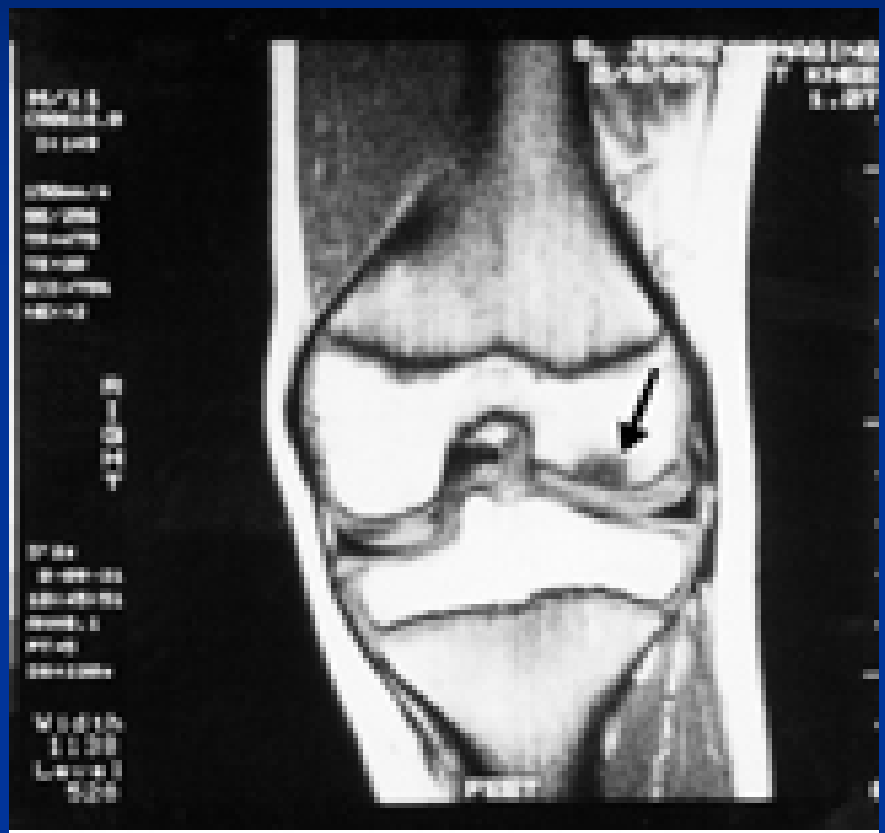


FRD Test



External Rotation

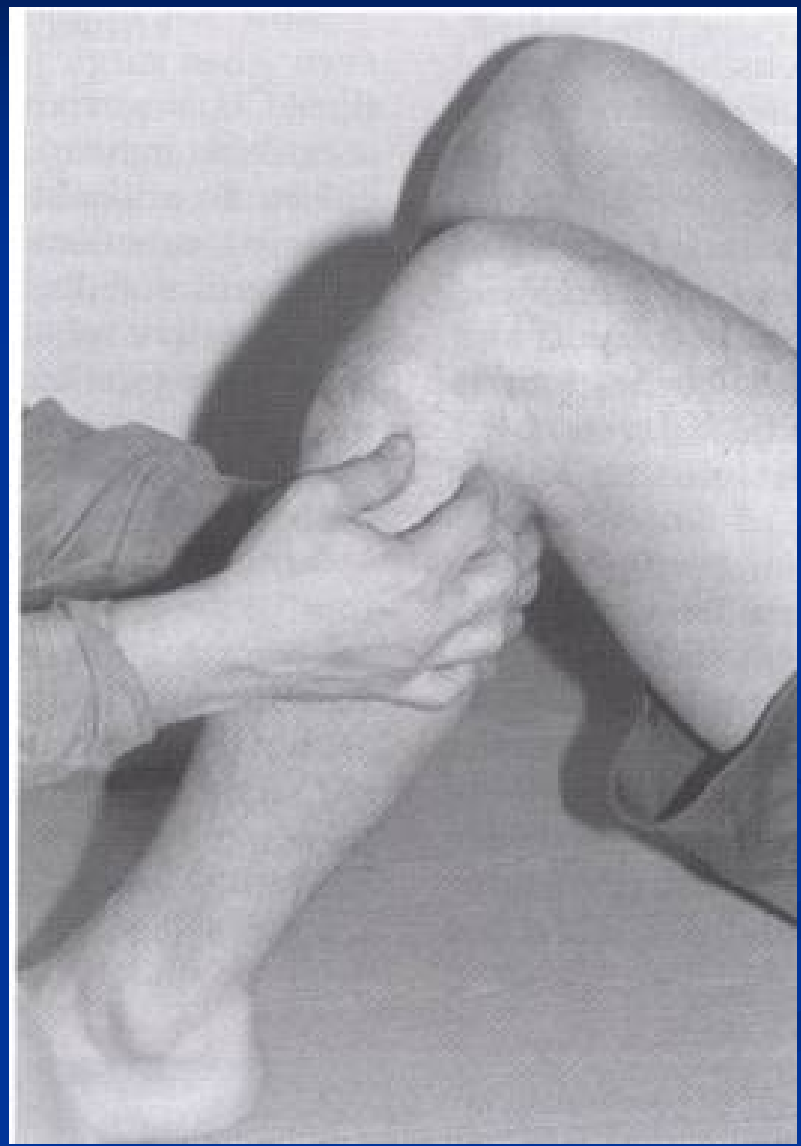
Osteochondral Defects



- Fractures of articular cartilage and underlying bone
- Shear and compressive forces

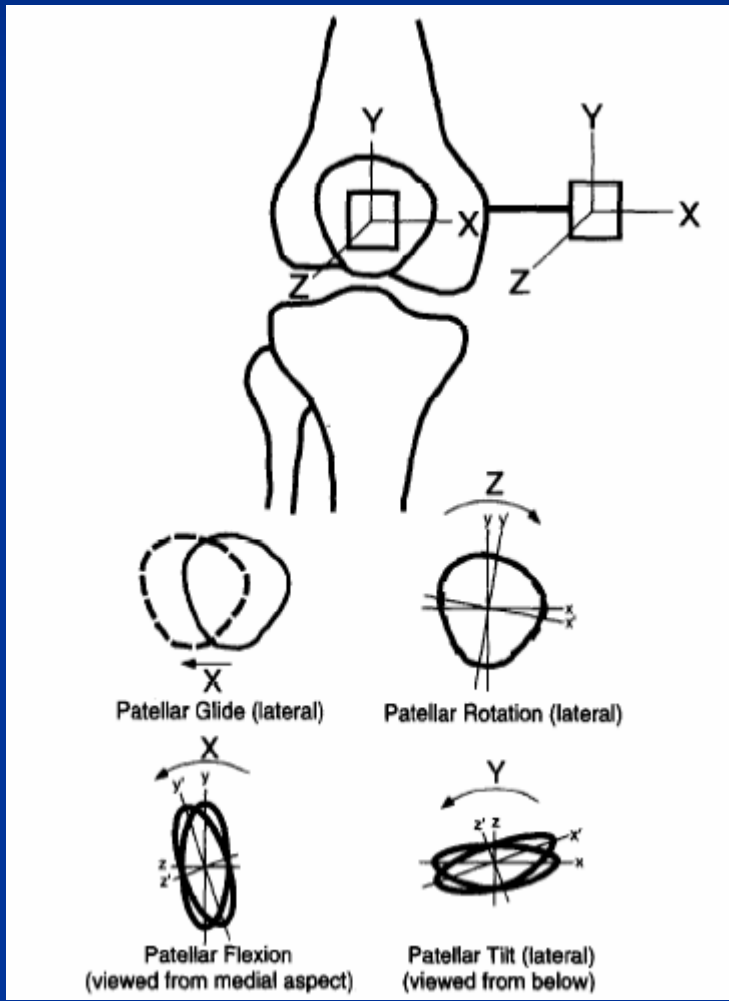
Wilson's Test for OCD

Tib-Fib Translation Test

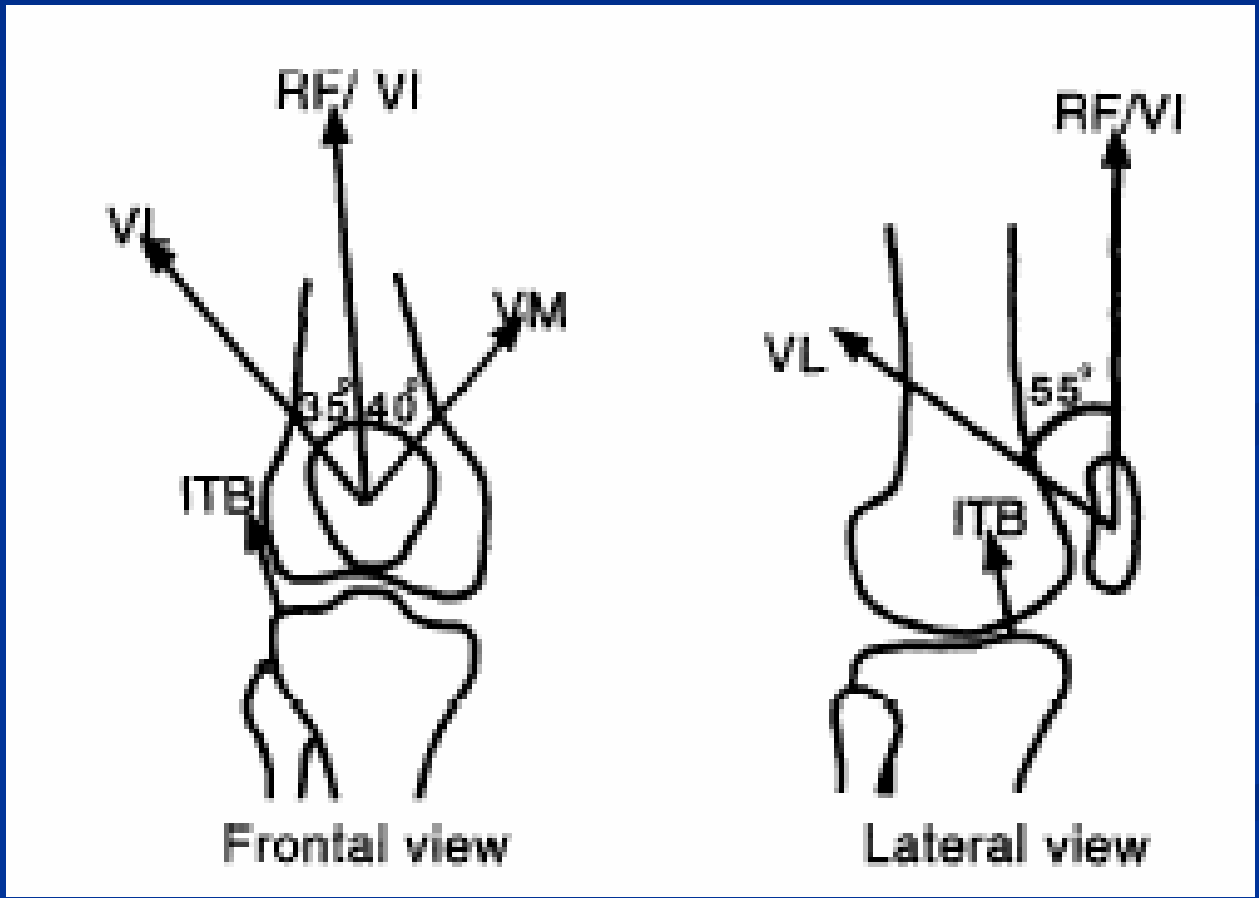


Why do we have a patella?

Patellar Motions



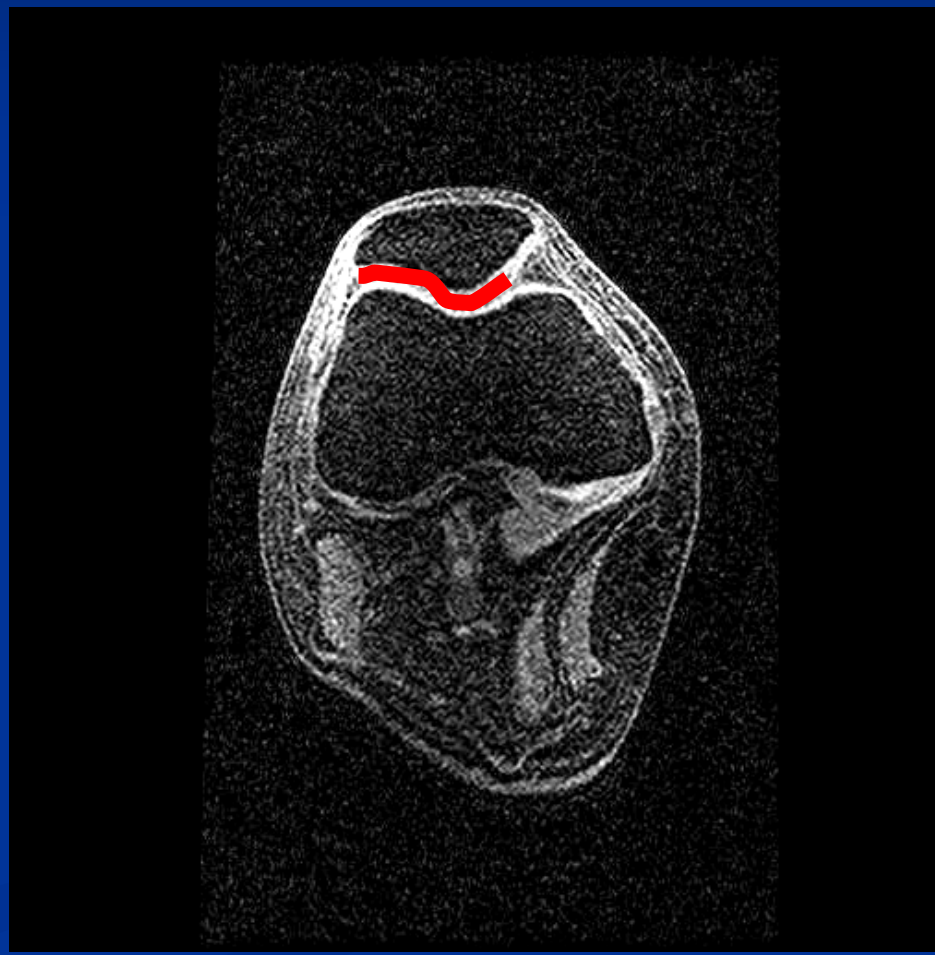
The Effect of the Quads on the Patella



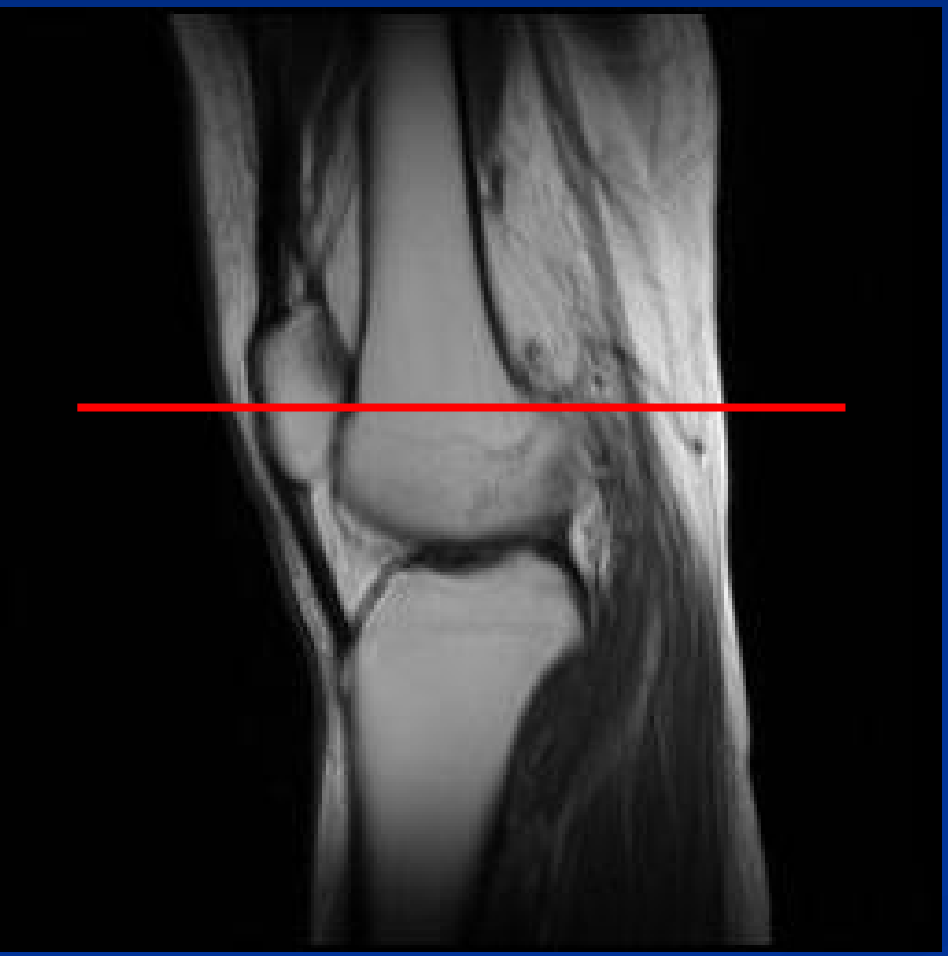
Patellofemoral Pain

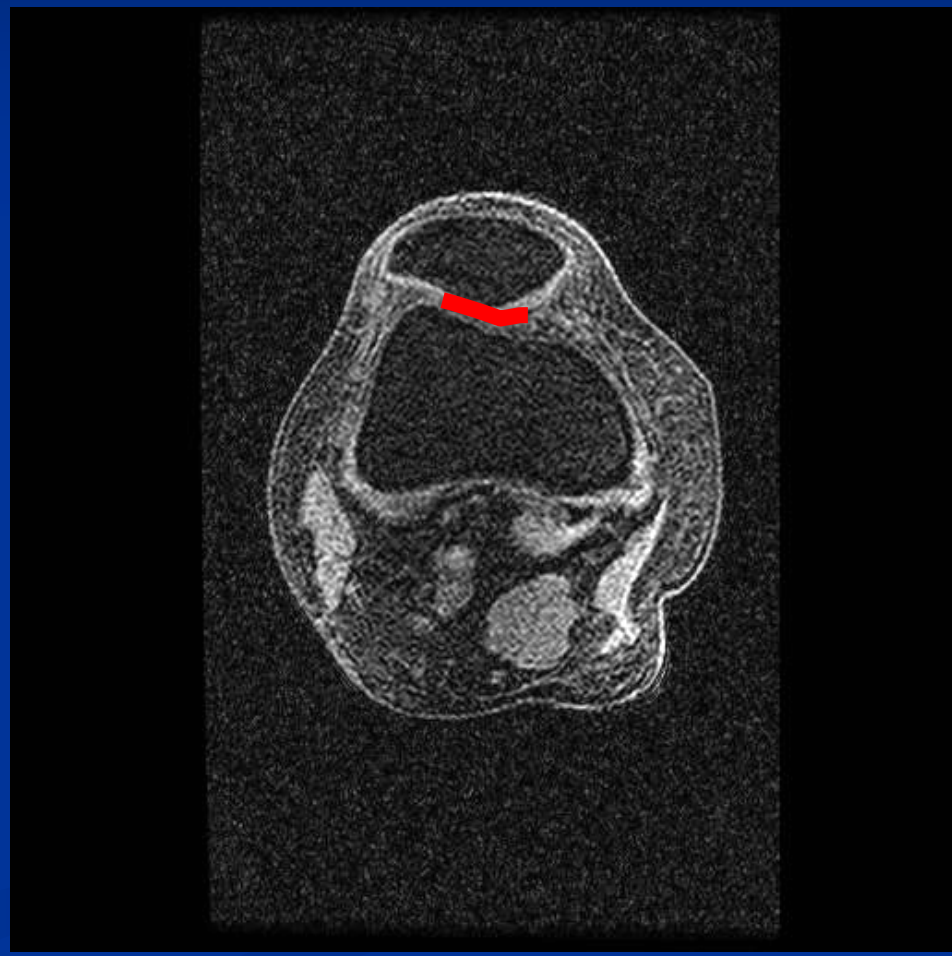
$$\text{Stress} = \frac{\text{Force}}{\text{Area}}$$

Trochlear Depth – 60° Flexion

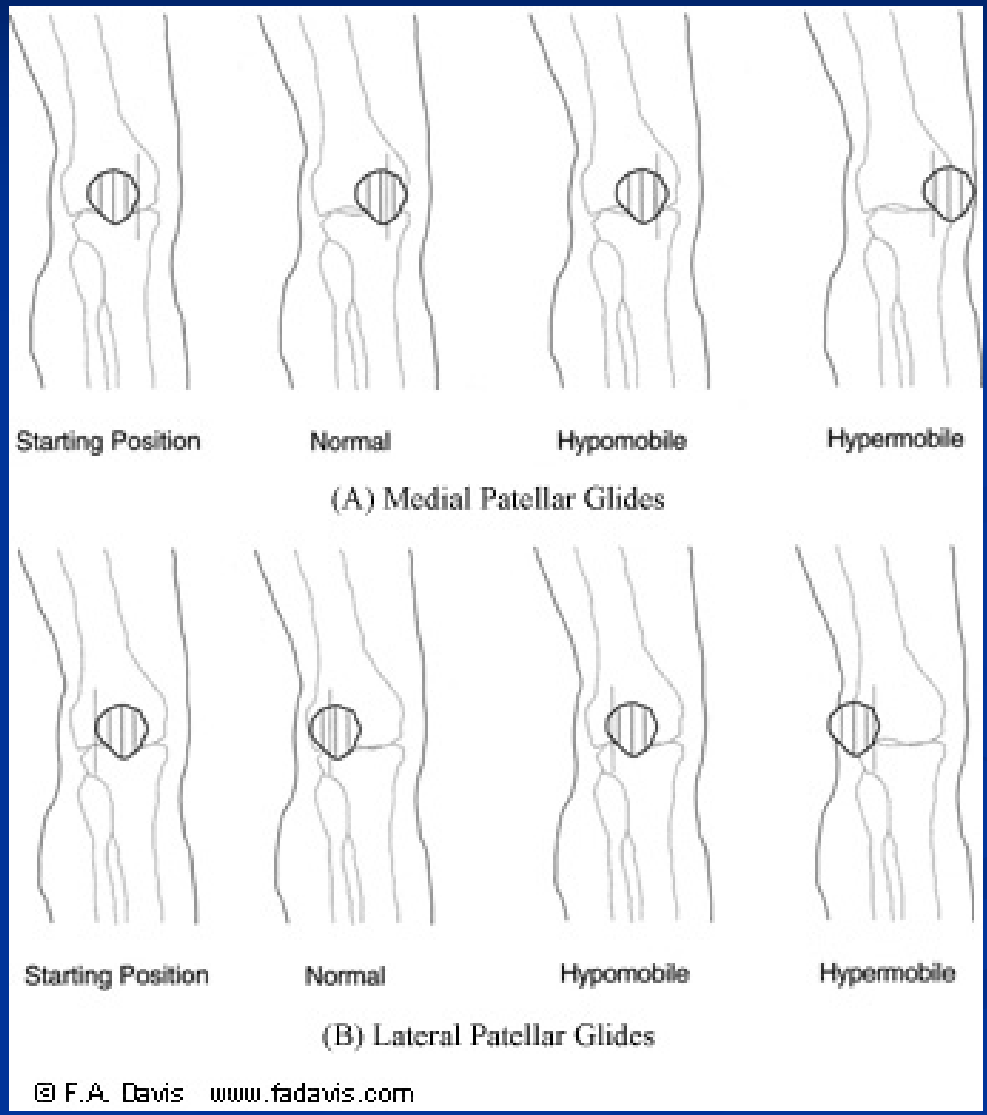


Trochlear Depth – Full Extension





Patellar Glides



Patellar Tilt

Clarke's Sign

Apprehension Test

Medial Synovial Plica

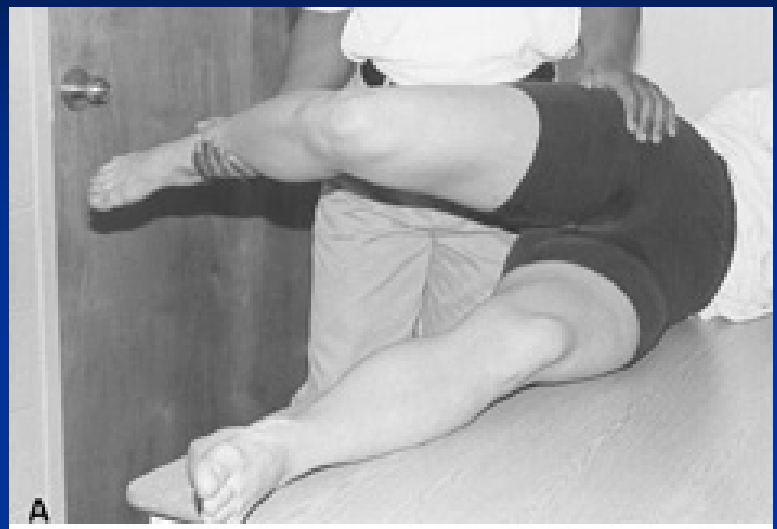
Stutter Test

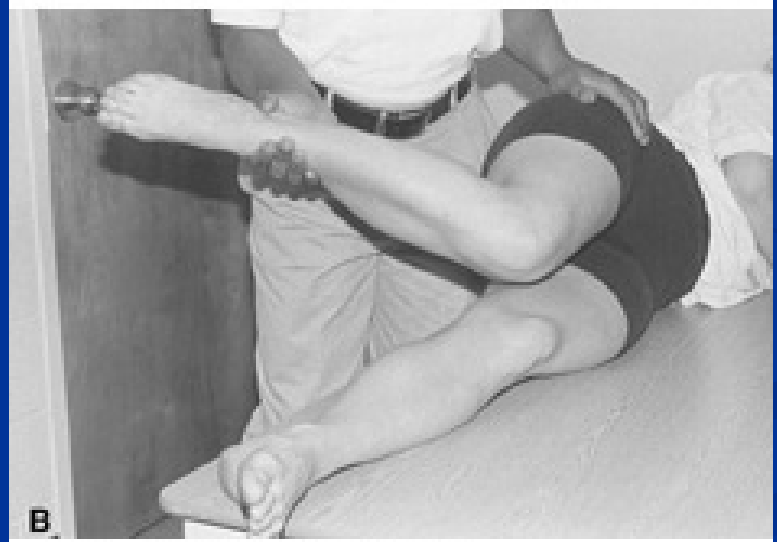
Range of Motion

- PASSIVE
- ACTIVE
- RESISTED

Noble Compression Test

Ober's Test

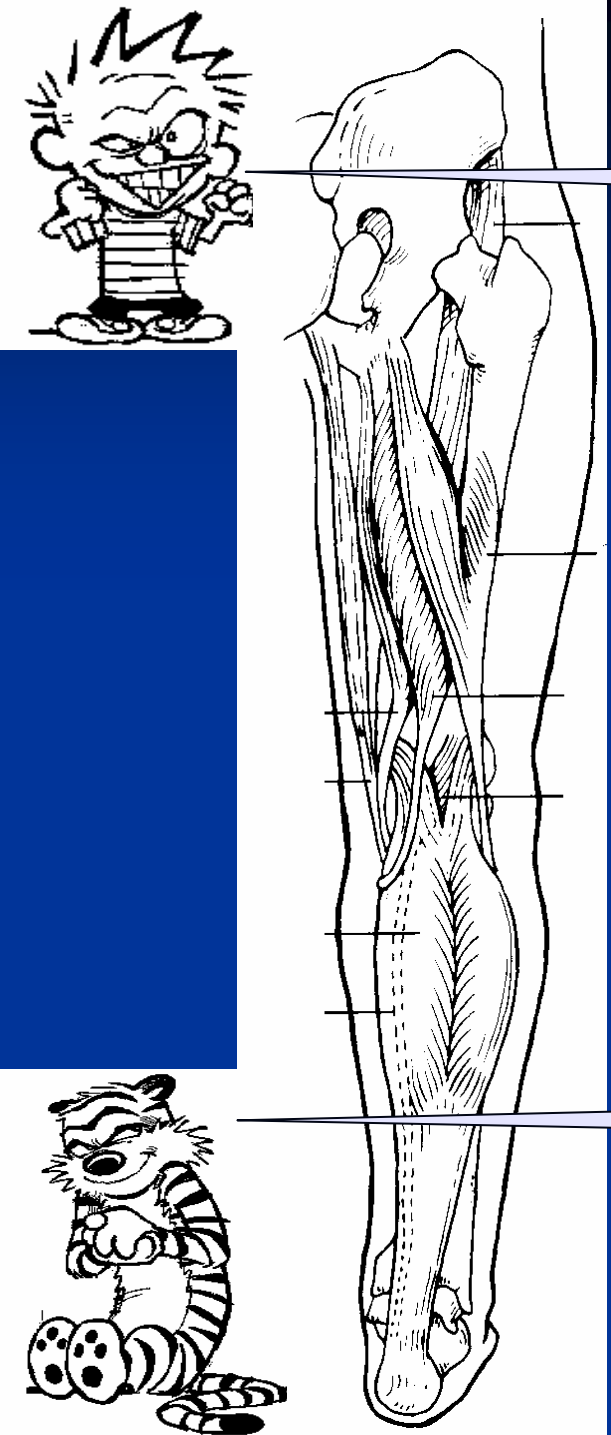




A final word of advice…

The knee is part of a kinetic chain.

Don't look at it in isolation!



Heh!
Heh!

It’s not my fault!!

Heh!
Heh!