



The Knee

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The Knee: Introduction

- **3 bones:** femur, tibia and patella
- **2 separate joints:** tibiofemoral and patellofemoral.

Function:

- i. Primarily a hinge joint, with gliding and a small amount of rotation
- ii. Provides load transfer through the lower limb.



Knee Joint: Introduction

- Because of the incongruity of the tibial and femoral articular surfaces, Integrity of the joint is highly dependent on muscles and ligaments
- **Joint components:**
 - ***Cartilage:*** menisci - bear weight in standing position (Greek, meniskos = moon crescent)
 - ***Ligaments:***
 - Intracapsular: anterior and posterior cruciate
 - Extracapsular: medial & lateral collateral
- **Injuries:** Arthritis, dislocations, sprains, fractures, tears of ligaments and cartilages.
- **Abnormalities:** Genu varus and Genu valgus (Genu = knee)

Deformities Nomenclature

Bow legs



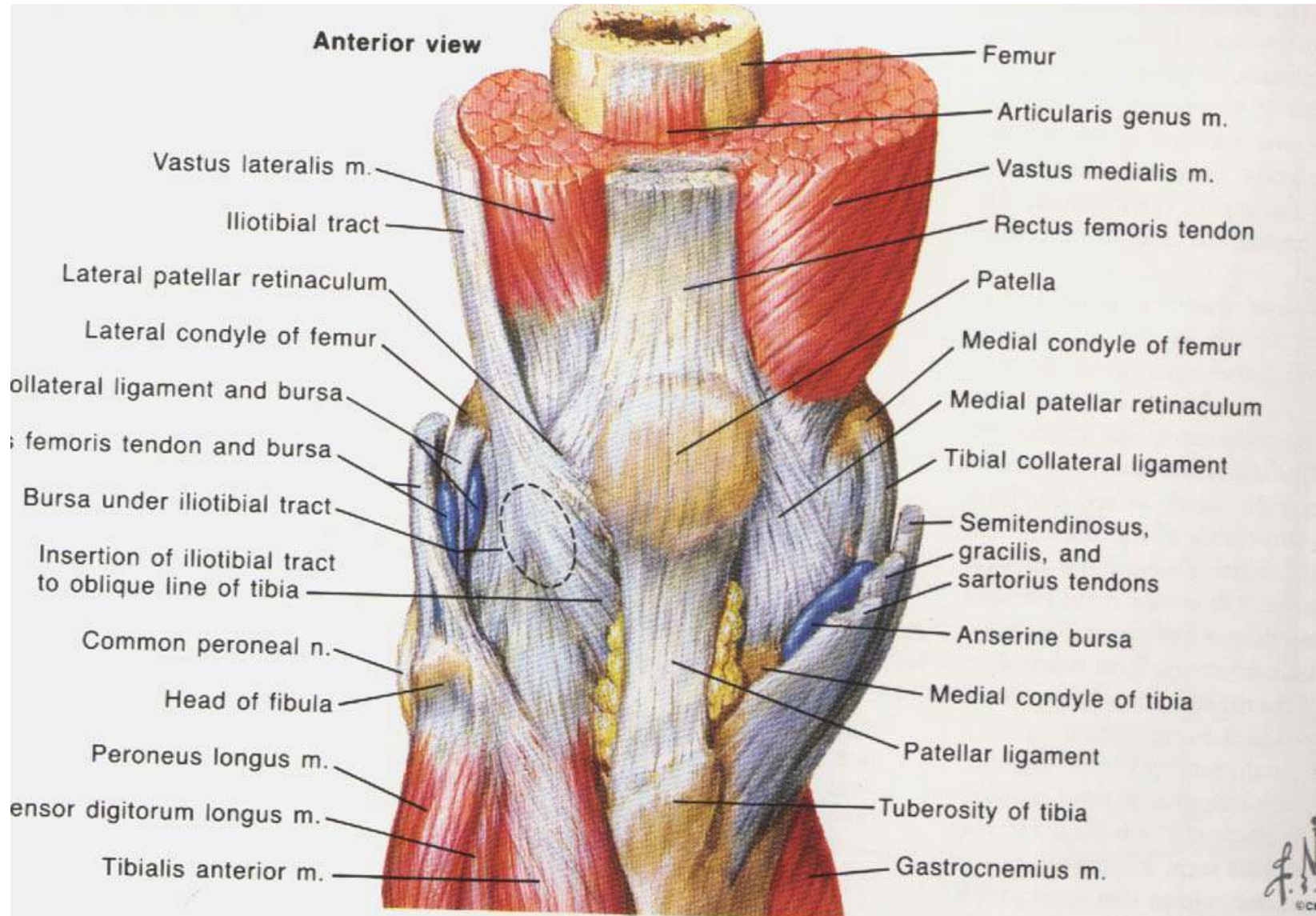
Genu Varus

Knock knees

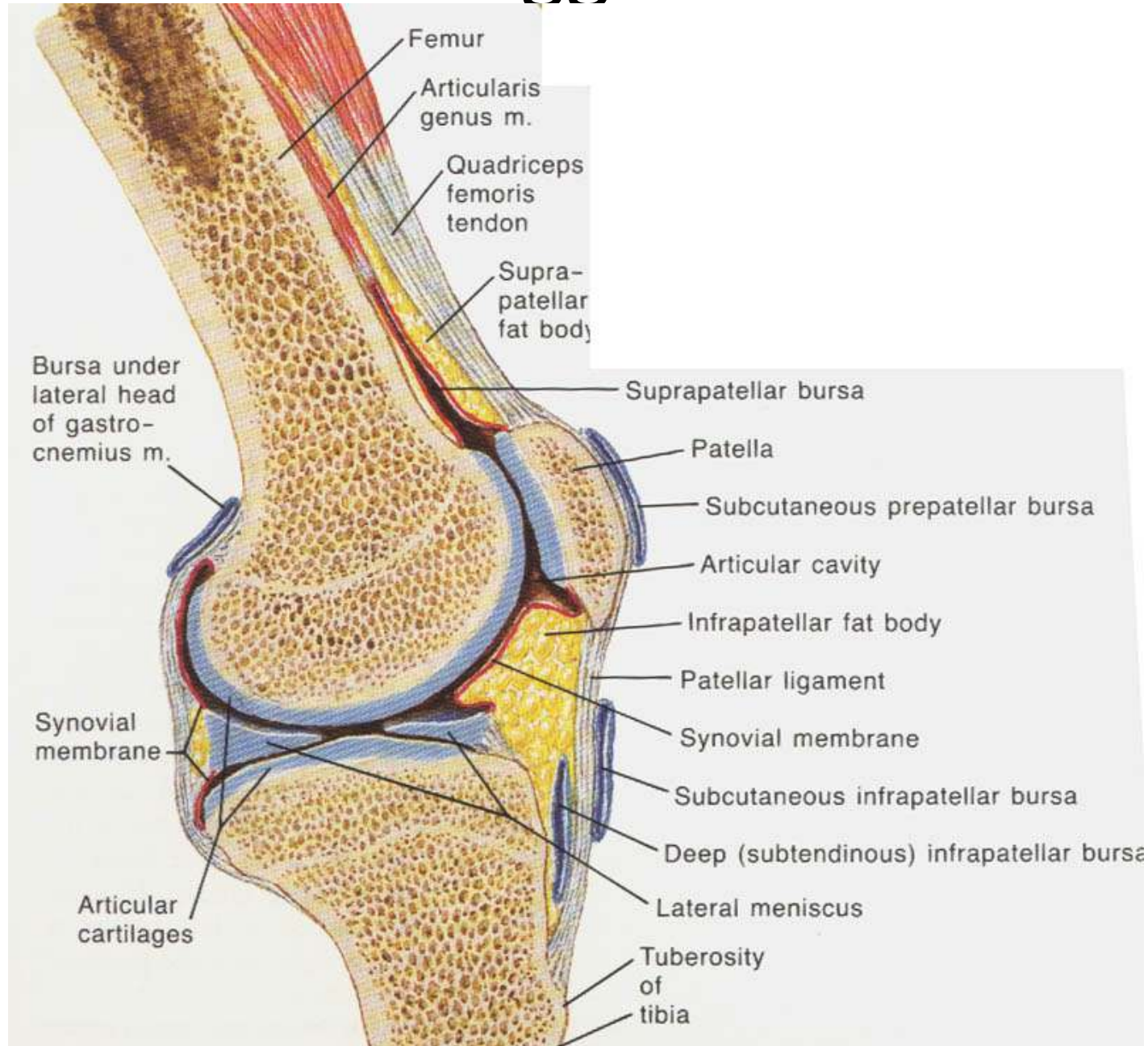


Genu Valgus

Synopsis of the knee



Knee: Saggital Section



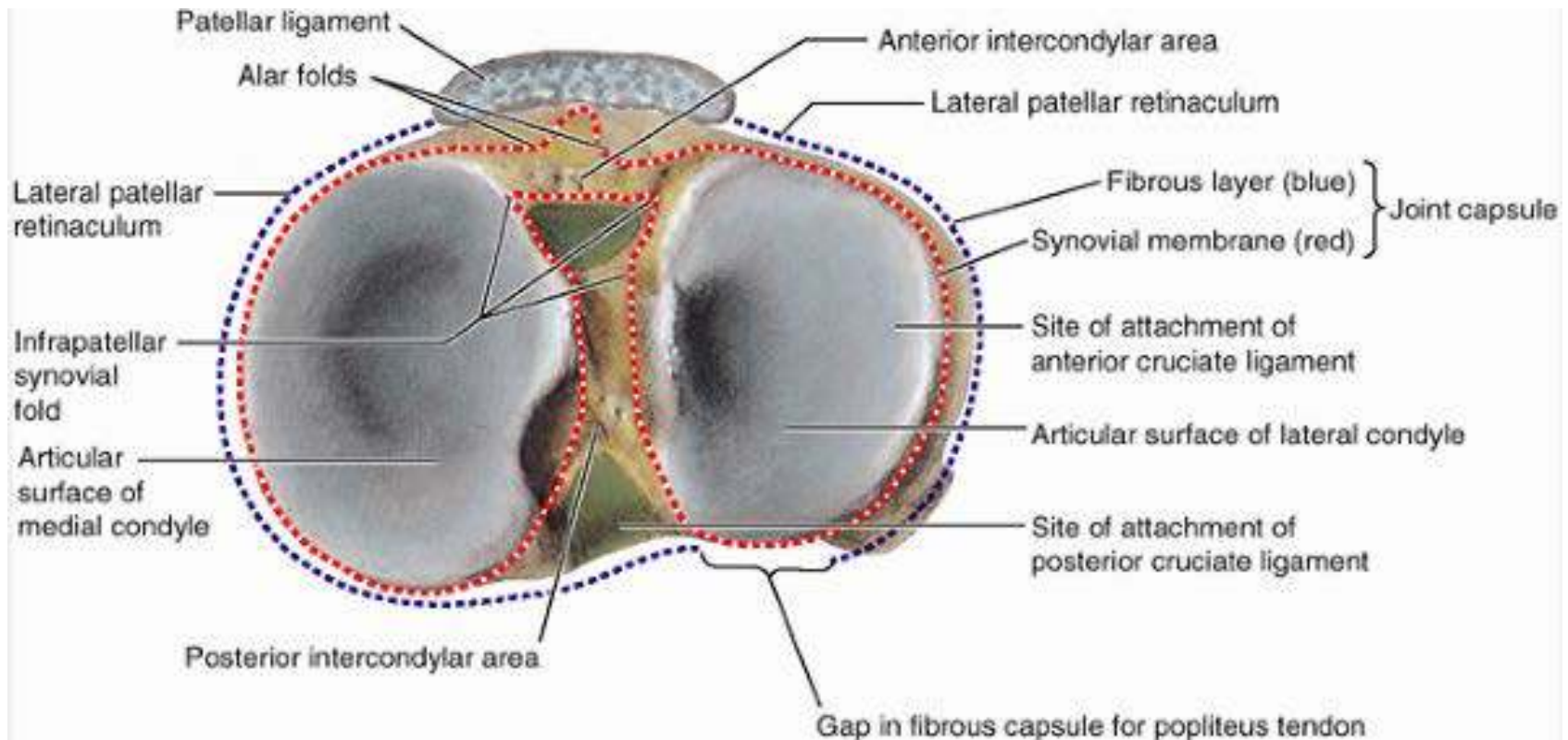
The capsule

2 parts:

- i. External fibrous layer
 - ii. Internal Synovial membrane
- The fibrous layer attaches to the articular margins of femur and tibia
 - Anteriorly, it is replaced by the patella and the quadriceps tendons
 - Posteriorly, it has an opening for the popliteus tendon to emerge from the knee

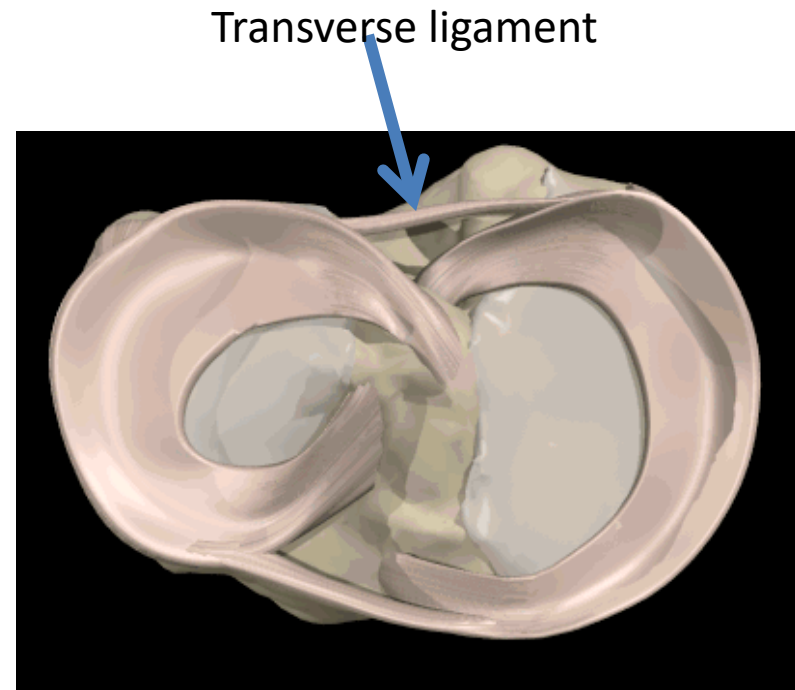
The synovial membrane

- Lines all surfaces bounding the articular cavity (the space containing synovial fluid) not covered by articular cartilage
- Does not cover the cruciate ligaments and the Infrapatella fat pads.
- The synovial thus have a midline fold, called the infrapatella fold; which almost divides the knee into a lateral and a medial cavity



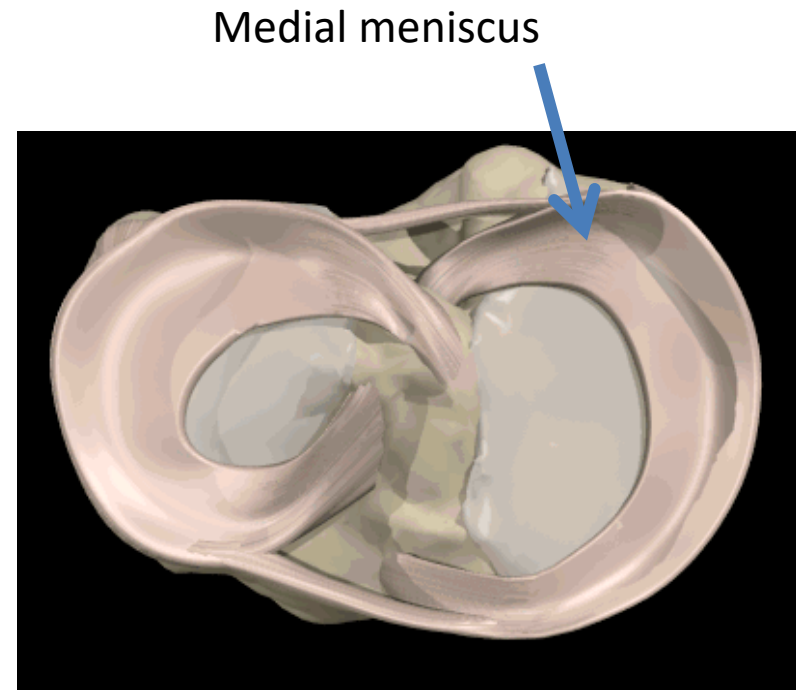
The Menisci

- There are two Menisci
 - i. Medial
 - ii. Lateral
- Join anteriorly by the transverse ligament of the knee
- Both are crescentic in shape
- Both are thicker in their periphery and thins out centrally
- Both possess anterior and posterior horns by which they are attached to the intercondylar region of the tibia



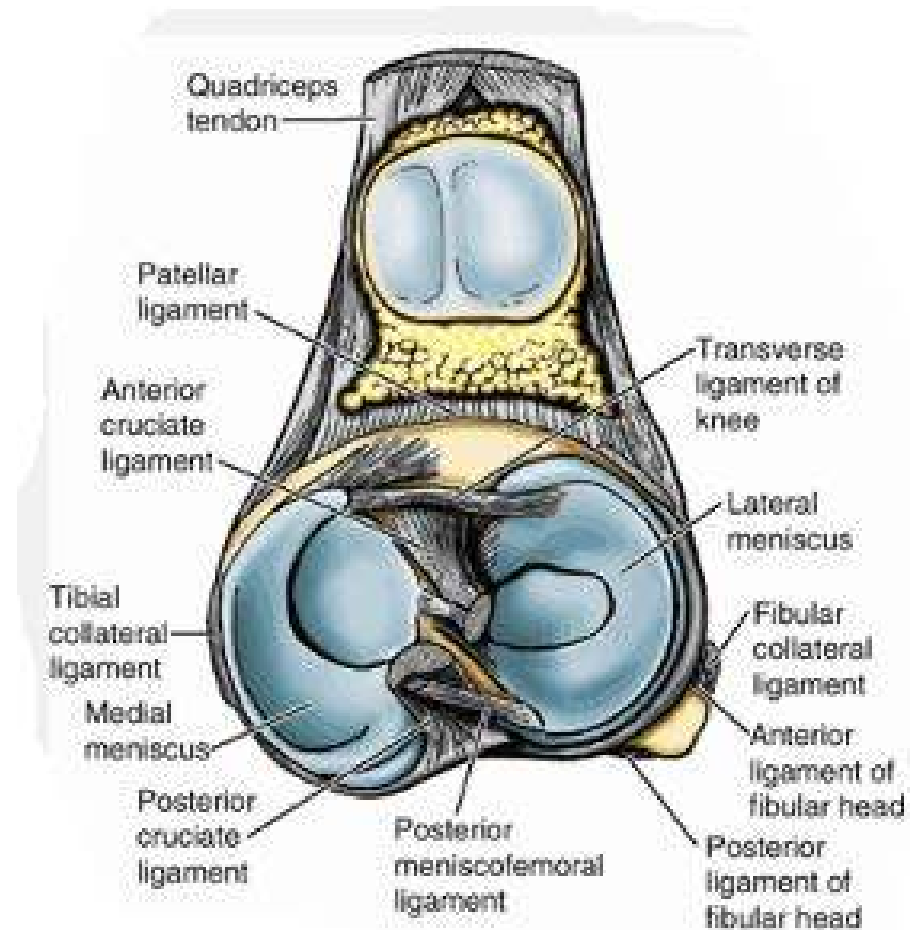
The medial meniscus

- C-shaped.
- Broader and wider than the lateral
- Attached at its rim to the capsule
- Less mobile than the lateral meniscus



The Lateral meniscus

- Almost circular in shape
- Medial part of the popliteus tendon attaches to the posterior limb of the lateral meniscus
- More mobile than the medial meniscus
- A strong tendinous slip, the **posterior meniscofemoral ligament**, joins the lateral meniscus to the posterior cruciate ligament and the medial femoral condyle

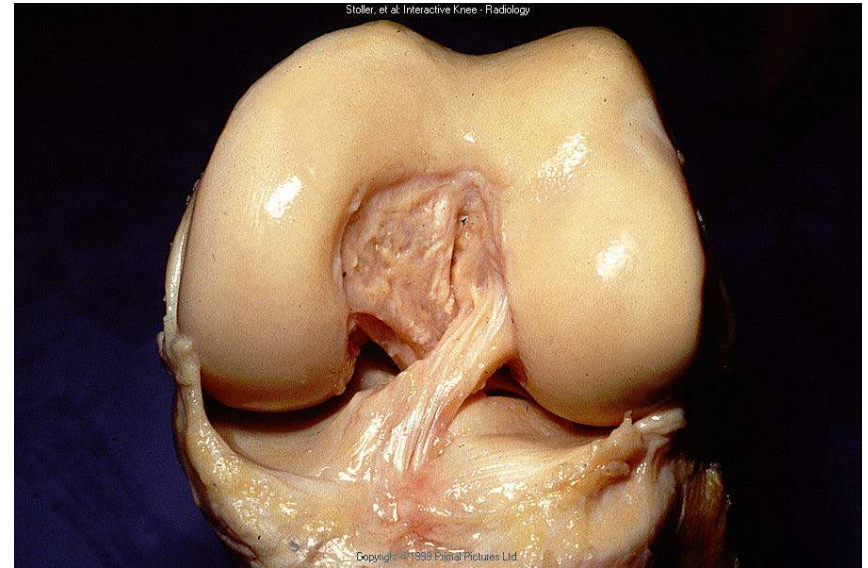


Cruciate Ligaments

- Two in number
- Stabilize the knee joint by preventing the displacement of the tibia forward or backward on the femur:
 - **Anterior** cruciate ligament prevents **anterior** displacement
 - **Posterior** cruciate ligament prevents **posterior** displacement.
- Both criss-cross within the joint (hence the name: cruciate)
- Both are outside the synovial membrane
- Because of their oblique orientation, in every position one cruciate ligament, or parts of one or both ligaments, is tense
- the cruciate ligaments wind around each other during medial rotation of femur on tibia
- Unwinds during lateral rotation. Hence, range of lateral rotation is greater than medial rotation

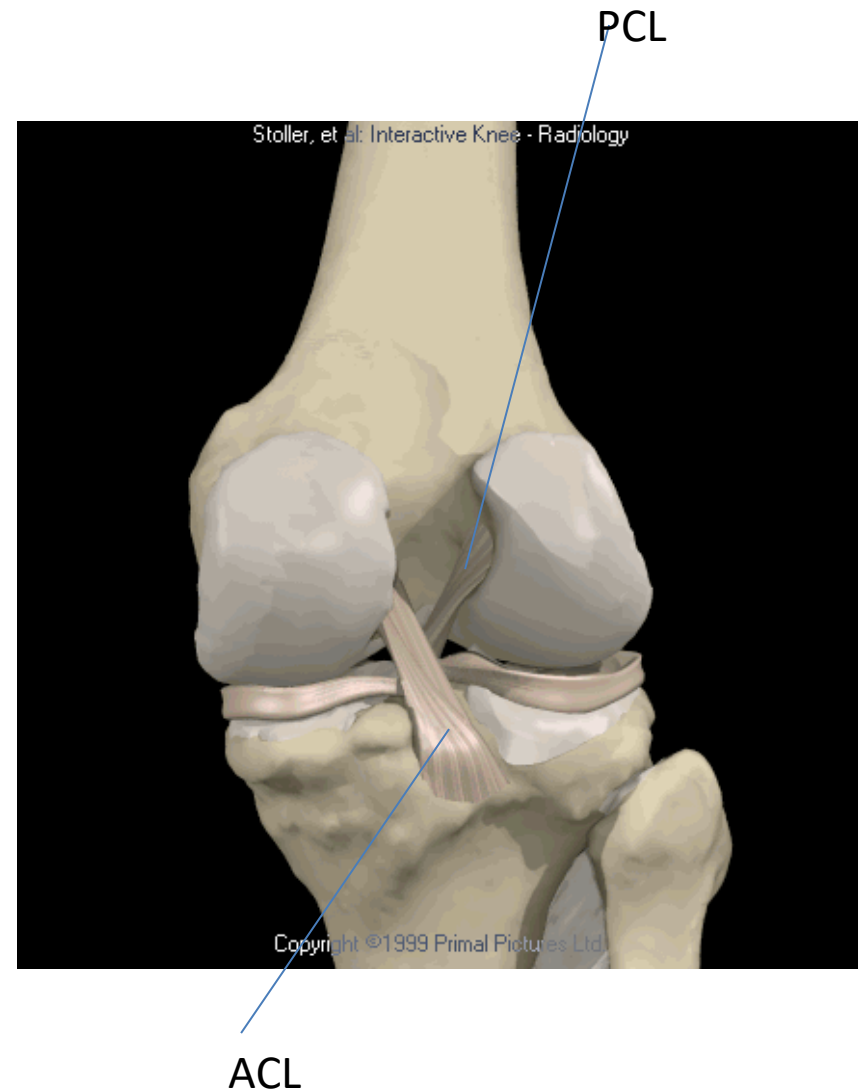
Anterior Cruciate Ligament (ACL)

- Arises from the anterior aspect of the intercondylar region of the tibia
- Extends superiorly, posteriorly, and laterally to attach to the posterior part of the medial side of the lateral condyle of the femur
- Weaker than PCL



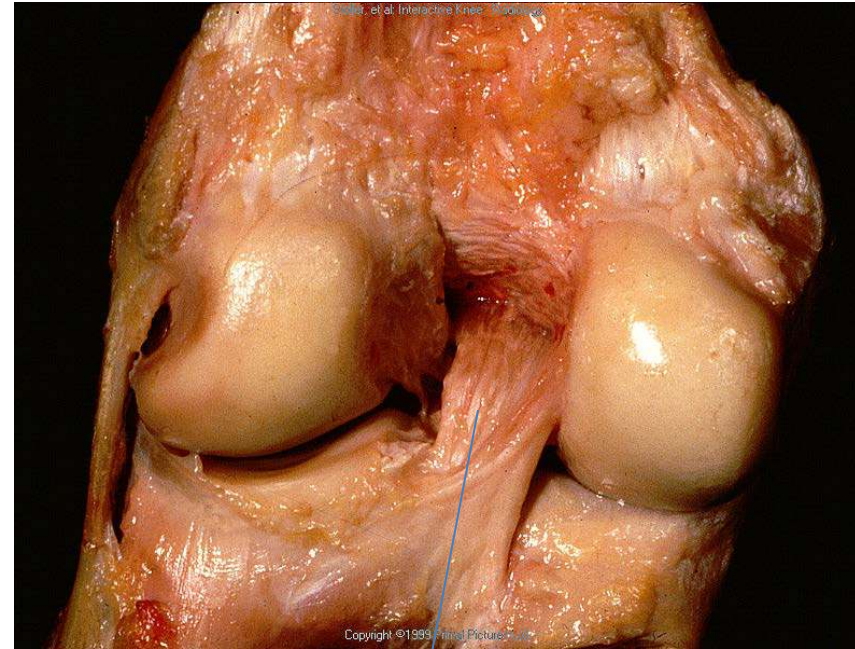
Anterior Cruciate Ligament

- Primary restraint to anterior translation of the tibia and contributes the most at 30° flexion.
- Prevents hyperextension of the knee
- Also resists internal (medial) tibial rotation
- Resists adduction and abduction at full extension
- 'guides' the screw home rotation of the knee joint as it approaches terminal extension



Posterior Cruciate Ligament (PCL)

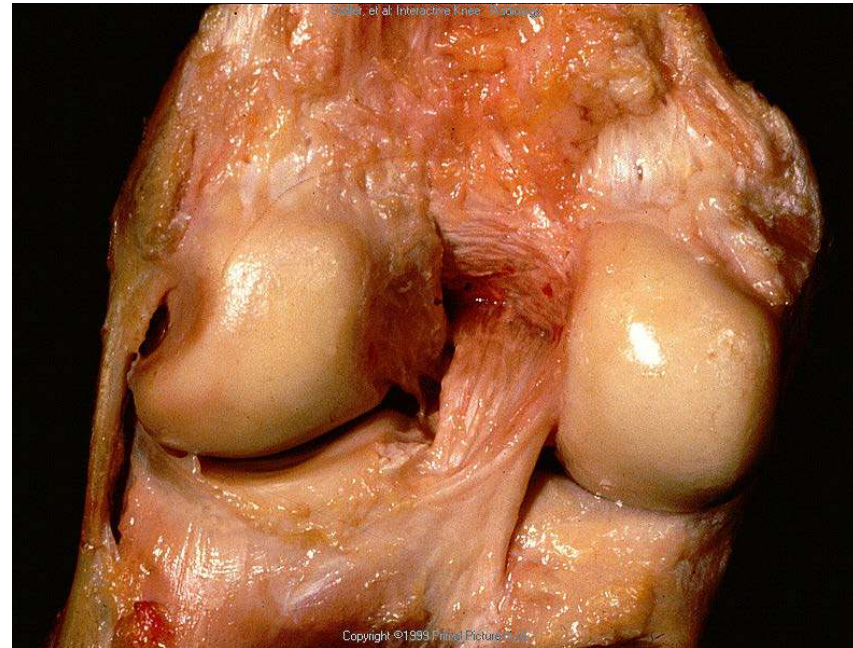
- Arises from the posterior aspect of the intercondylar region of the tibia
- Passes superiorly and anteriorly on the medial side of the ACL to attach to the anterior part of the lateral surface of the medial condyle of the femur



PCL

Posterior Cruciate Ligament

- Primarily restraints the posterior translation of tibia
- Secondary restraints external tibial rotation at 90° flexion
- In the weight-bearing flexed knee, the PCL is the main stabilizing factor for the femur (e.g., when walking downhill)



Collateral Ligaments

- What is the difference between the two collateral ligaments in the knee joint?
- The lateral is stronger and does not attach to the meniscus, while the medial is weaker and does attach to the meniscus

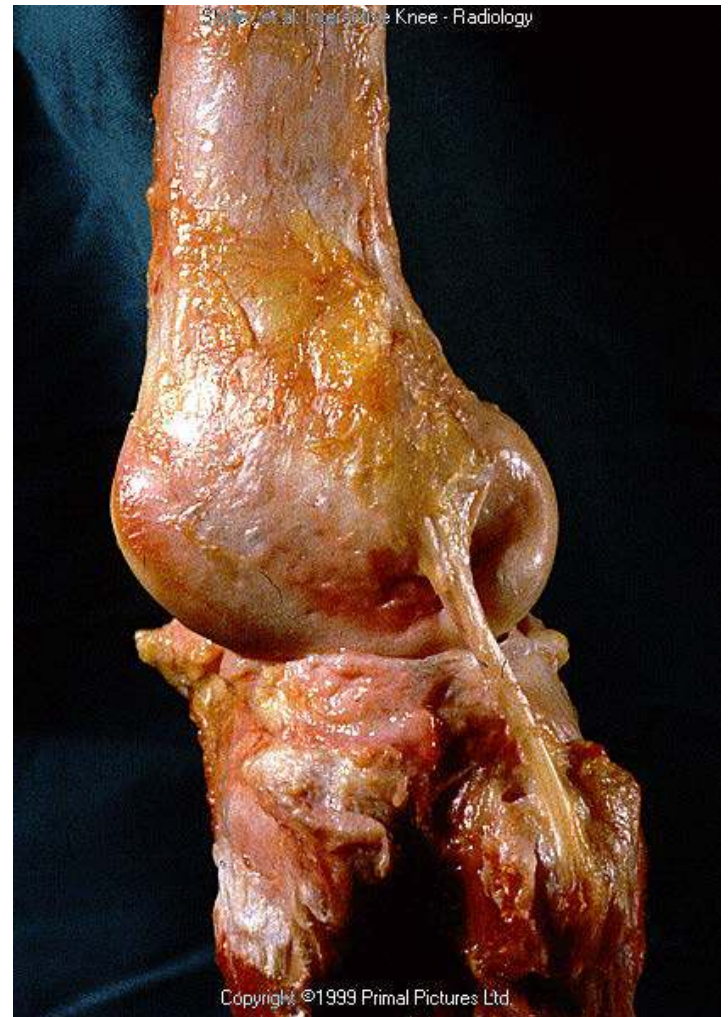
Medial Collateral Ligament

- The medial collateral ligament is the primary restraint to abduction and internal tibial rotation.
- Provides anterior knee stability, which is enhanced by external tibial rotation.
- With anterior cruciate disruption the medial collateral ligament provides most of the anterior stability of the knee.



Lateral Collateral Ligament

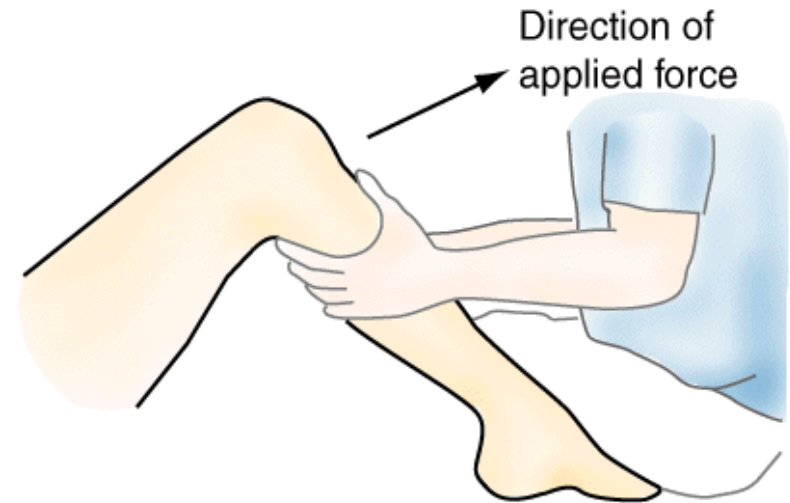
- Primary restraint to adduction of the knee
- Secondary restraint to anterior and posterior drawer, when the drawer displacements are large. Combined with the other lateral structures the lateral collateral ligament is a significant restraint to external rotation of the tibia.



The Drawer's sign

- The anterior and posterior drawer's signs tests for the translation of the tibia on the femur.
- They test the integrity of the cruciate and collateral ligaments

Stoller, et al: Interactive Knee - Radiology



The anterior drawer test is conducted at 90° flexion.

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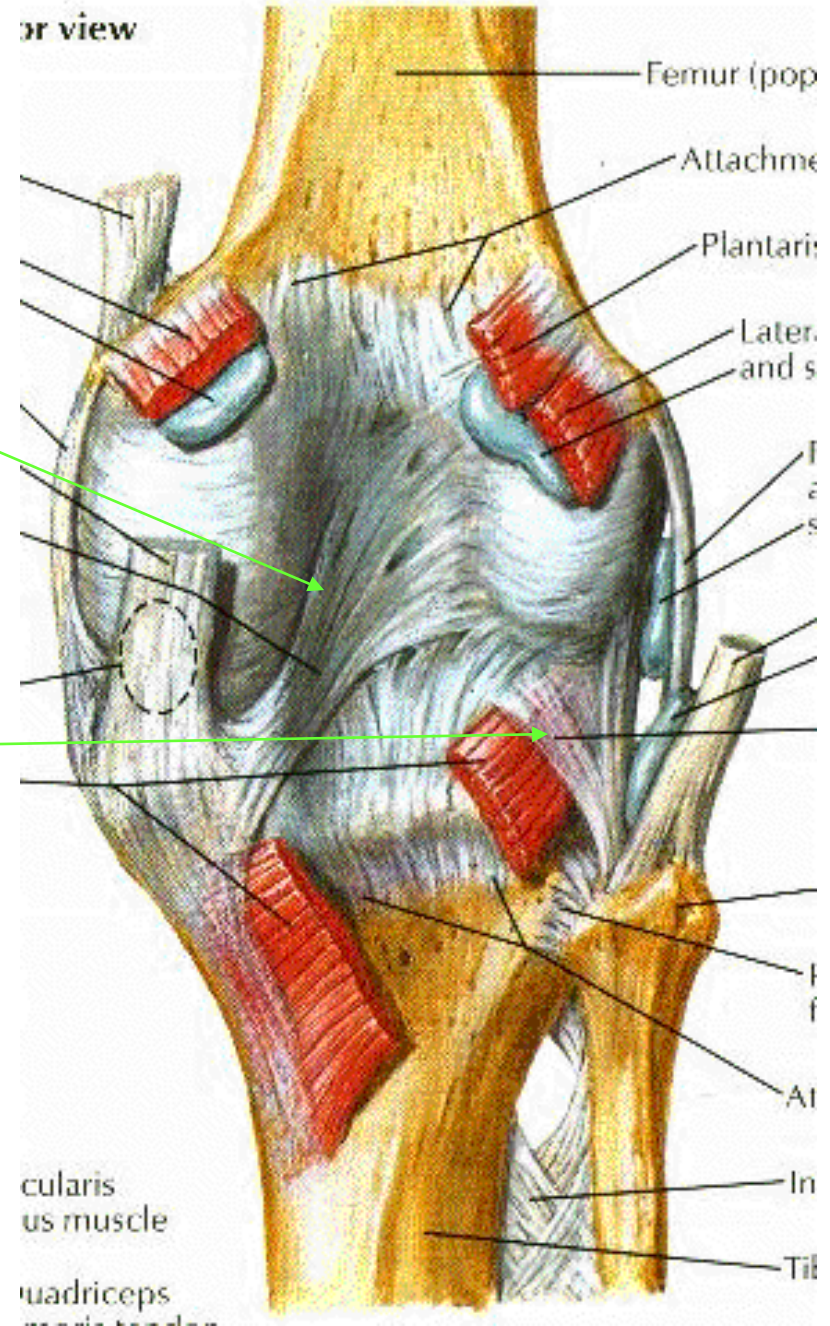
Summary of the functions of the knee ligaments

Restraining Functions of the Four Main Ligaments of the Knee

| <i>Ligament</i> | <i>Primary Restraint</i> | <i>Secondary Restraint</i> |
|-----------------------------|--|--|
| Anterior Cruciate Ligament | Anterior tibial displacement | Internal tibial rotation |
| Posterior Cruciate Ligament | Posterior tibial displacement | External tibial rotation |
| Medial Collateral Ligament | Abduction and internal tibial rotation | Anterior tibial displacement |
| Lateral Collateral Ligament | Adduction | Anterior and posterior tibial displacement |

Other ligaments

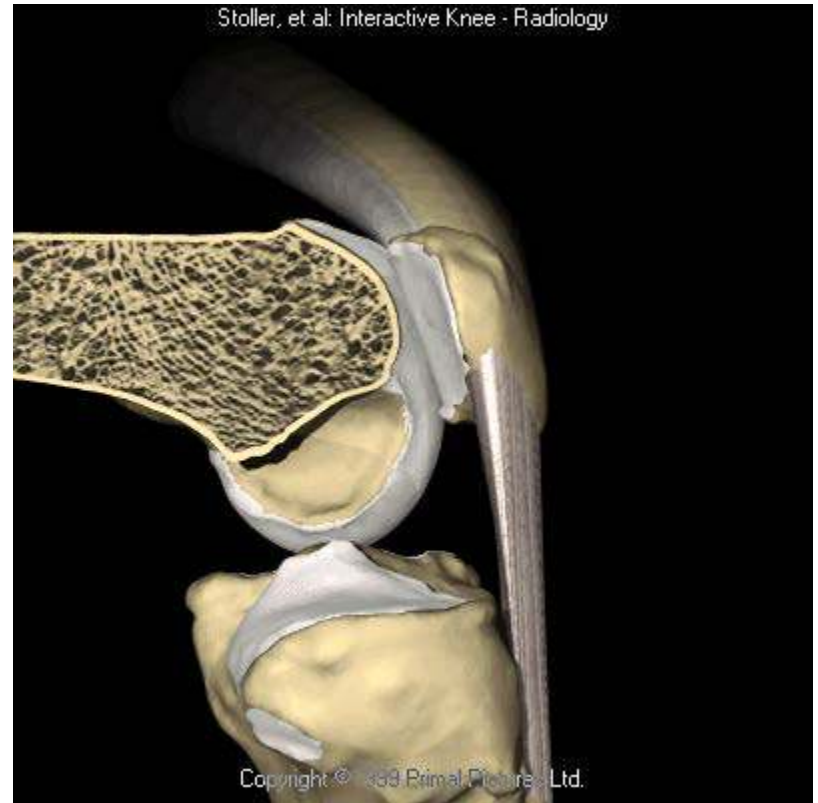
- Oblique Popliteal
 - expansion of semimembranous tendon
 - resists hyperextension
- Arcuate Popliteal
 - covers popliteal tendon
 - strengthens posterior capsule



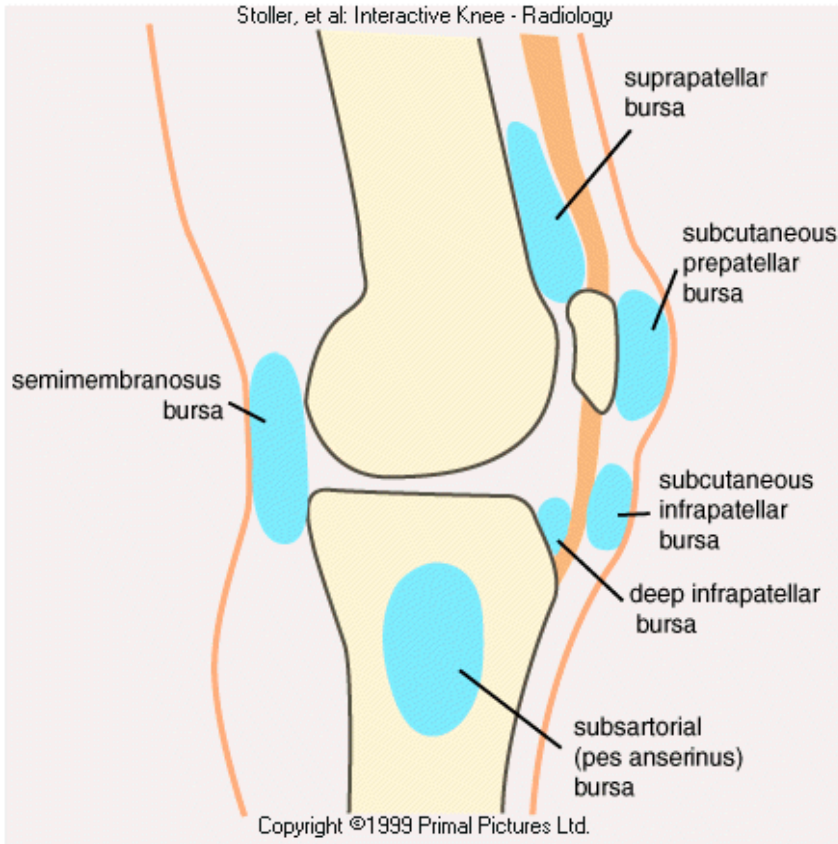
The Patella

- Largest sesamoid bone in the body
- Imbedded in quadriceps & patella tendon
- Serves similar to a pulley for improving angle of pull of quadriceps (results in greater mechanical advantage in knee extension)

Patella tendon

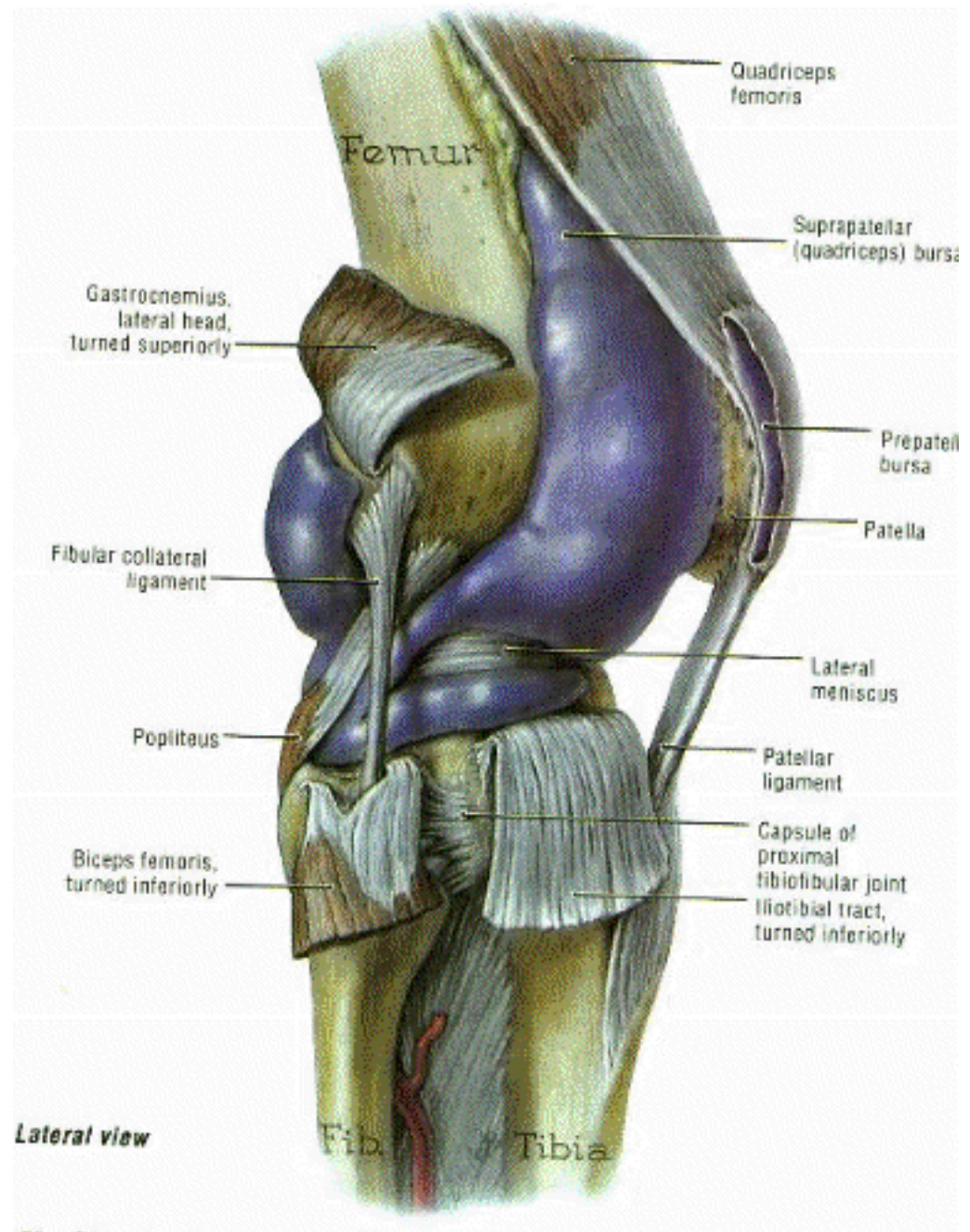


Bursae around the knee joint



- Suprapatellar bursa
 - deep to quads
 - communicates with joint cavity
- Infrapatellar bursa
- Popliteus
- Anserine
- Gastrocnemius
- Semimembranosus bursae

Knee Joint Bursae



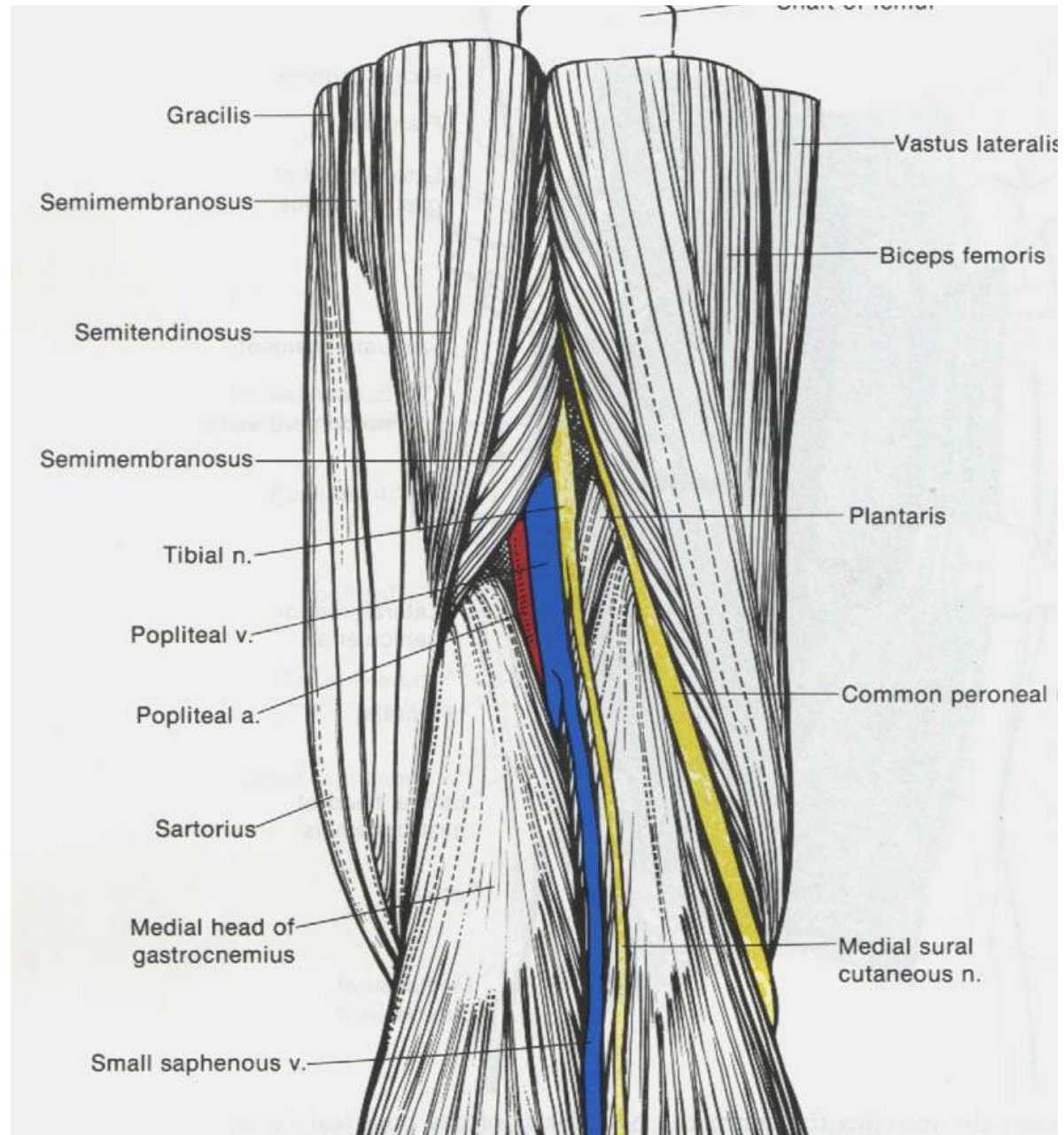
Housemaid's knee



Prepatellar bursitis

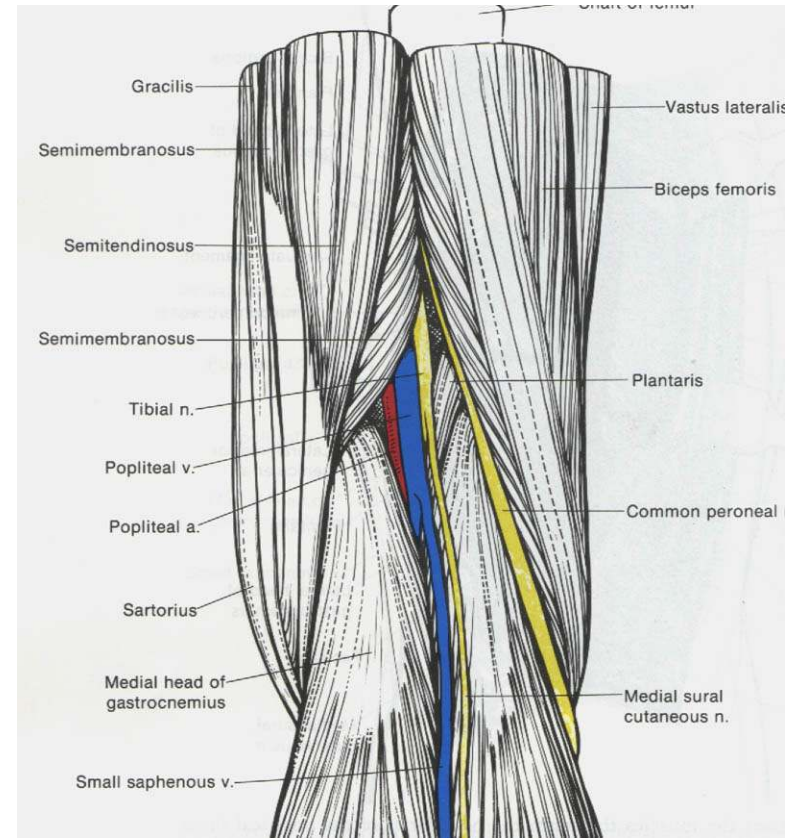
Popliteal Fossa

- Diamond shaped
- Borders
 - Semimembranosus
 - long head biceps
 - medial/lateral gastroc
- Contents
 - popliteal artery
 - popliteal vein & small saphenous vein
 - Tibial and common fibula nerves



Popliteal Fossa

- The popliteal artery lies against the back of the knee joint.
- The popliteal vein is posterior to the artery (more superficial).
- The common fibular nerve descends toward the fibular neck
- The tibial nerve bisects the fossa and lies posterior to popliteal vein.
- So, we have artery, vein, nerve and going anterior (deep) to posterior (superficial).



Knee Movements



Flexion



Extension



External rotation



Internal rotation

The Knee Joint: Normal Range of Movement

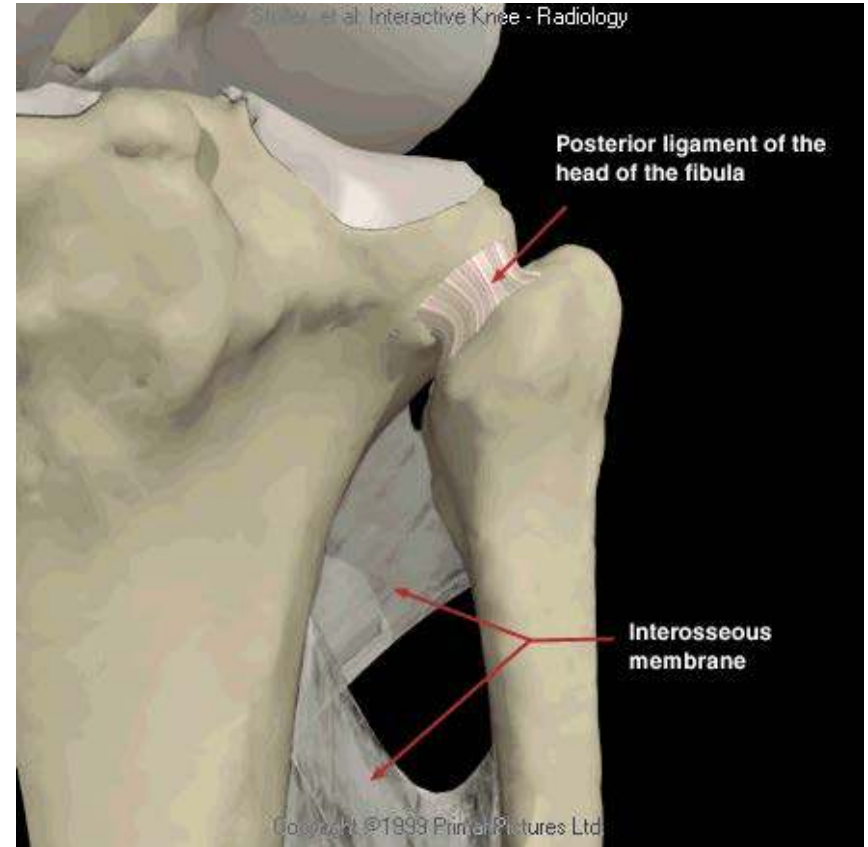
- Extends to 0°
 - Hyperextension normal
- Flexes to 140°
- With knee flexed 30° or $>$
 - ROM= internal (medial) rotation 30°
 - ROM= external (lateral) rotation 45° occurs

Screw Home Mechanism

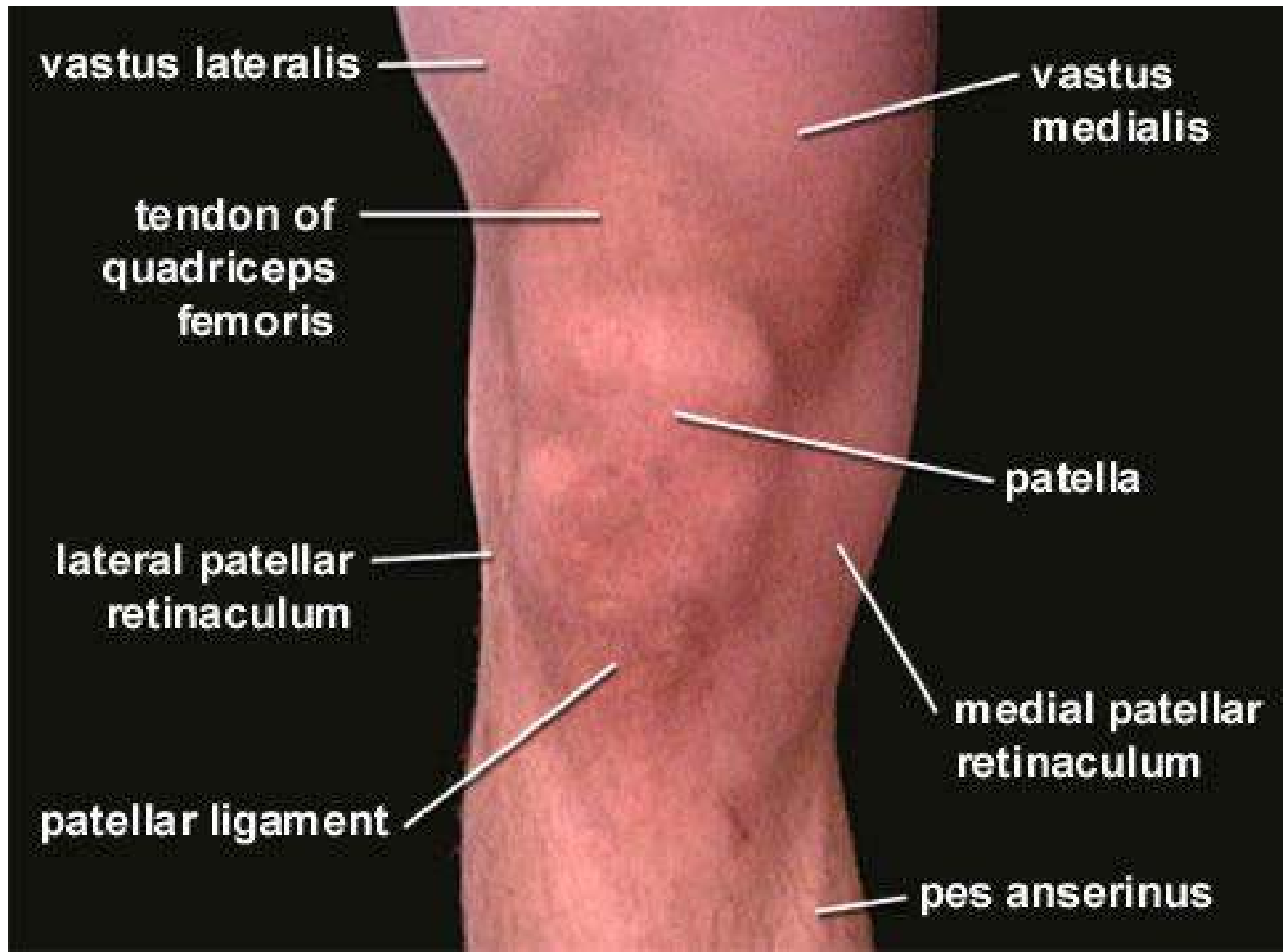
- This is the locking mechanism as the knee nears its final extension degrees
- Automatic rotation of the tibia externally (approx. 10 degrees) during the last 20 degrees of knee extension
- It is dependent on the different sizes of the femoral condyles:
 - Medial has larger surface area
- The tibia glides anteriorly on the femur. As knee extends, the lateral femoral condyle reaches the end of its ability to move due to tightening of the ligaments. The medial condyle continues to glide, resulting in external rotation of the tibia utilizing the *lateral meniscus as the pivot point*.
- ACL & PCL guides the rotation

TIBIOFIBULAR JOINT

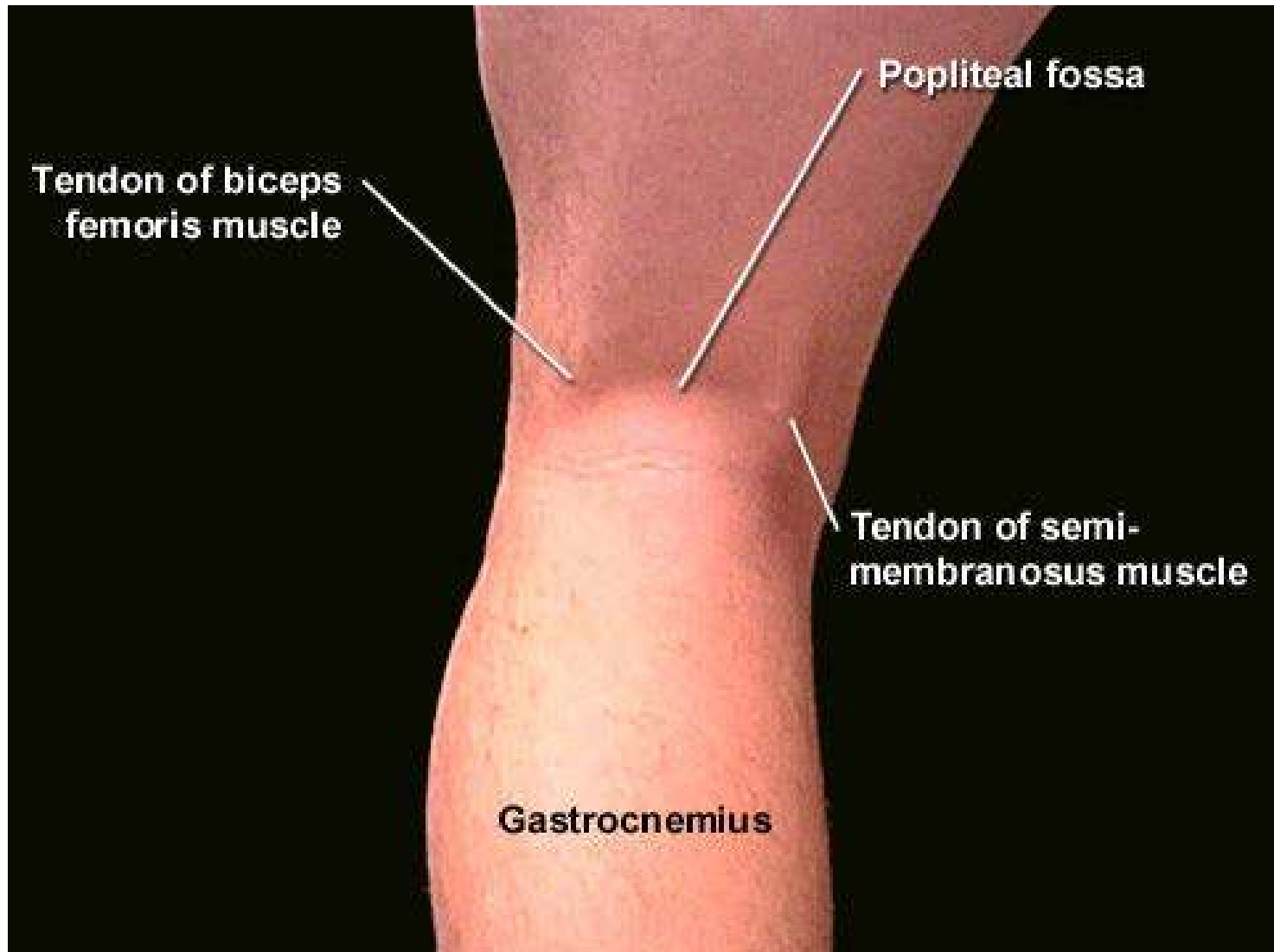
- The fibula is attached to the tibia proximally with ligaments, and along its length by the interosseous membrane.
- Fixed joint . No free movement.
But ...
- Head of the fibula moves slightly with ankle motion



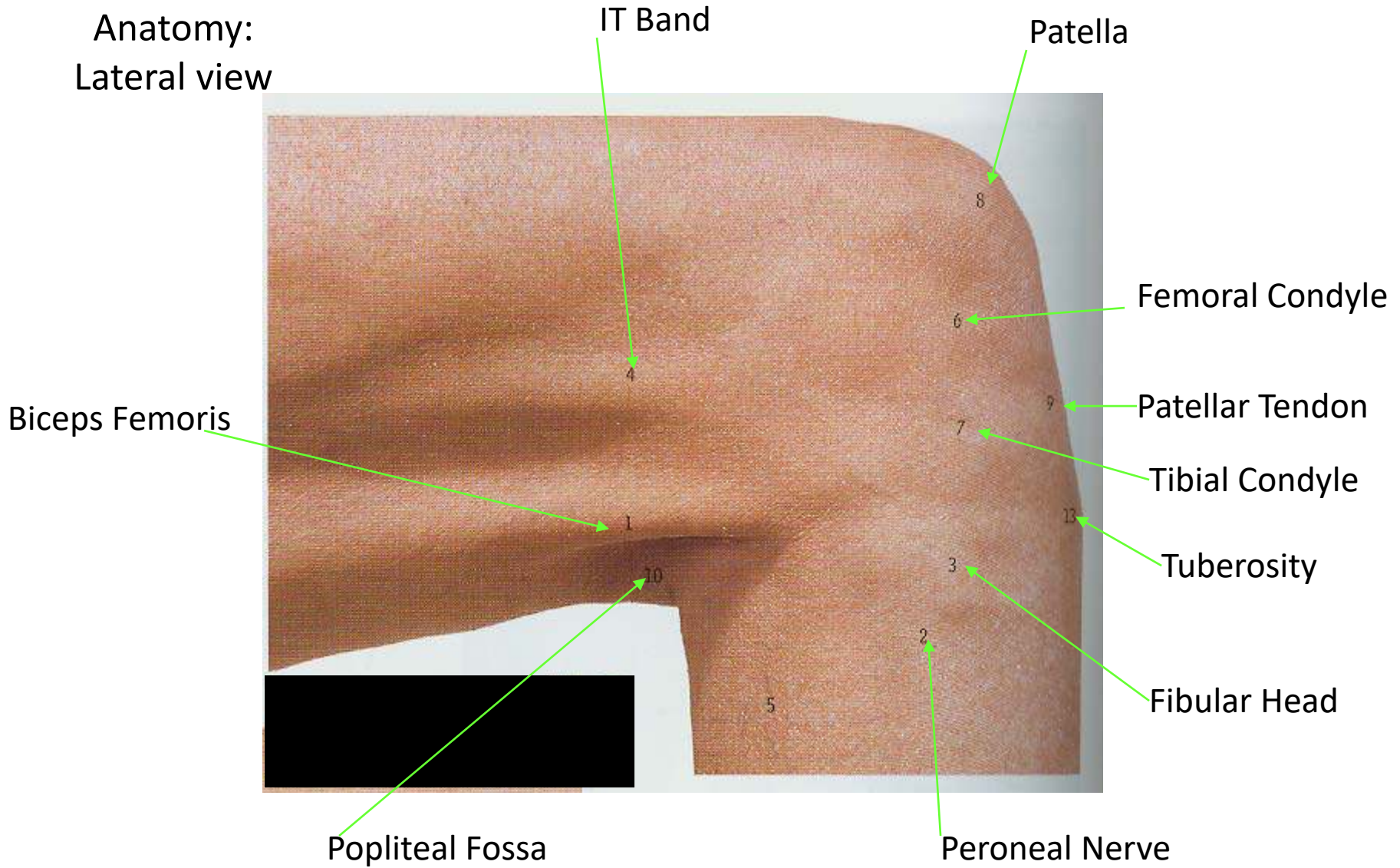
Surface Anatomy of the knee



Posterior Surface Anatomy of the knee




Surface
Anatomy:
Lateral view



Geniculate Anastomosis

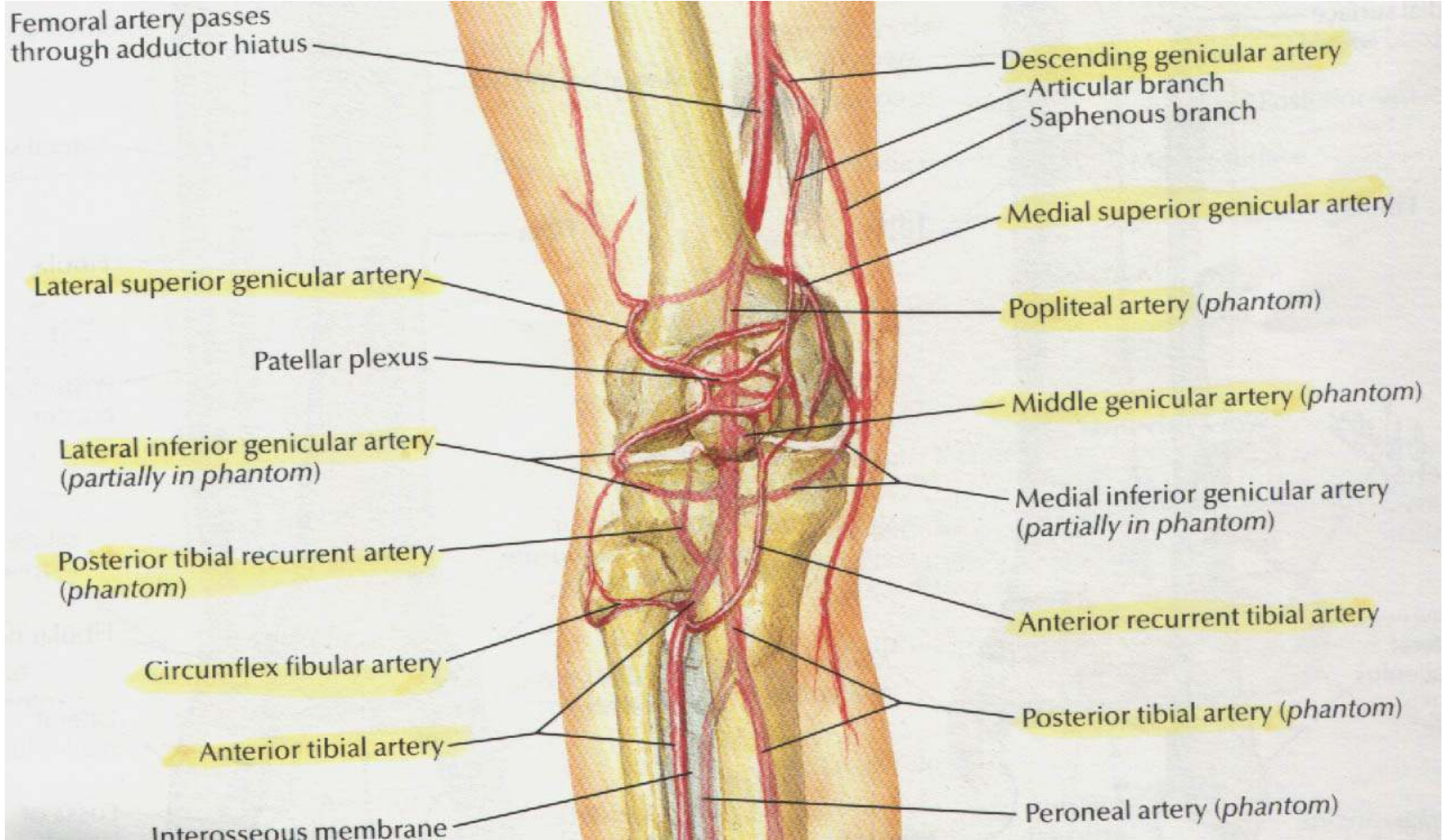
The genicular arteries are the

- i. Superior lateral genicular arteries
- ii. Superior medial genicular arteries
- iii. Middle genicular arteries
- iv. Inferior lateral genicular arteries
- v. Inferior medial genicular arteries
- vi. Descending genicular branch of the femoral artery, superomedially.
- vii. Descending branch of the lateral femoral circumflex artery, superolaterally.
- viii. Anterior tibial recurrent branch of the anterior tibial artery, inferolaterally
- ix. Posterior tibial recurrent branch of the posterior tibial artery inferomedially



Branches of
Popliteal Artery

Genicular anastomosis



Any Question?

