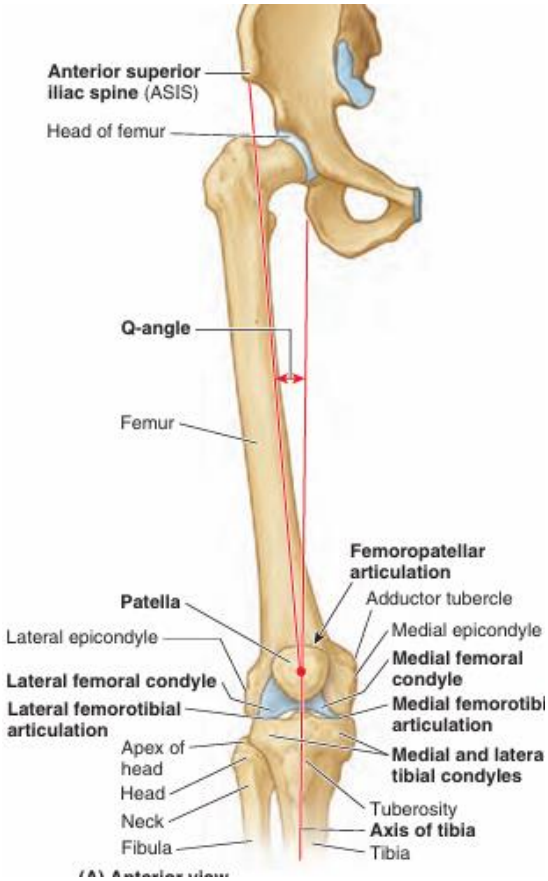
Type of joint

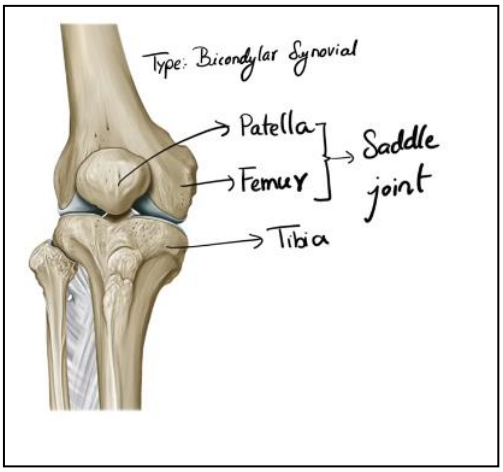
- The knee joint is the largest and most superficial joint.
- Weight bearing joint - wearing tearing leads to ostheoarthritis
- Modified hinge joint – mainly flexion and extension but allow some gliding and rolling
  Axis if flexion and extension is different
  Couple rotation
- **Sadlle joint – articulation between patella and femur**

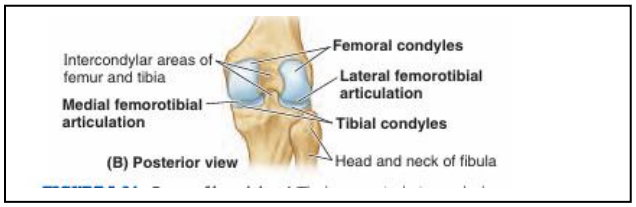
Knee Joint Articulations (3 total):

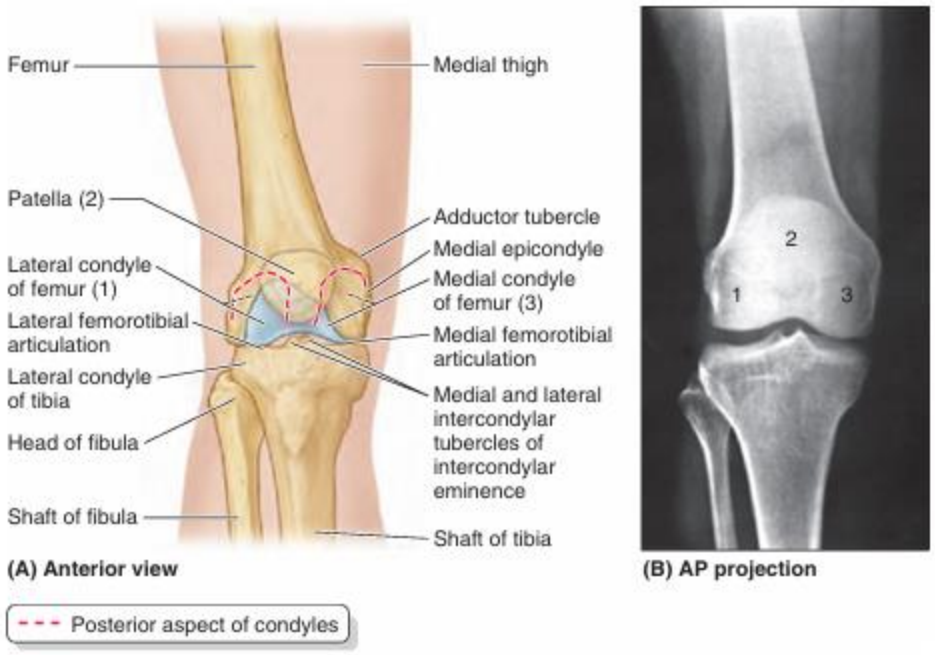
1. Two femorotibial (lateral & medial) between femoral and tibial condyles.
2. One intermediate femoropatellar between patella and femur.

(Note: Fibula is not involved).









Stability & Mechanical Weakness:

Mechanically weak due **to incongruent** articular surfaces ("two balls on a warped tabletop").
Femur condyles are too larger while tibial condyles are too small and shallow

Femur patellar articulation is also not stable because shallow articular surfaces and outward angulation between long axes of femur and tibia

- Stability depends on:

  - Surrounding muscles/tendons (most important, especially *quadriceps femoris* / *vastus medialis* and *lateralis*).
  - Ligaments connecting femur and tibia. – medial and lateral collateral ligament – side to side stability
  - Cruciate ligaments: anteroposterior stability
  - Iliotibial tract: stabilize partially flexed knee

Most Stable Position: Erect, extended position.
Articular surfaces are most congruent, primary ligaments (collateral & cruciate) are taut, and surrounding tendons provide a splinting effect.

Ligaments

Capsule

1. External fibrous capsule ：Fibrous layer is thin and incomplete in areas, with a few thickened parts forming intrinsic ligaments.
2. Internal synovial membrane.

• **Attachments of Fibrous Layer:**

• Superiorly: To femur, just proximal to the articular margins of the condyles.(1-2 CM proximal)

• Posteriorly: Encloses condyles and intercondylar fossa; has a gap for the popliteus tendon.

• Inferiorly: To the margin of the tibial plateau (except where popliteus crosses).

• Anteriorly: **Replaced by the quadriceps tendon, patella, and patellar ligament (no separate fibrous layer here).**

• **Synovial Membrane:**

• Lines all internal surfaces not covered by articular cartilage.

• Attaches to the periphery of articular cartilage (femoral/tibial condyles), posterior patella, and edges of menisci.

• **Folds & Subdivisions:**

• Median infrapatellar synovial fold (covers cruciate ligaments and infrapatellar fat pad, almost subdividing the cavity into right and left femorotibial cavities).

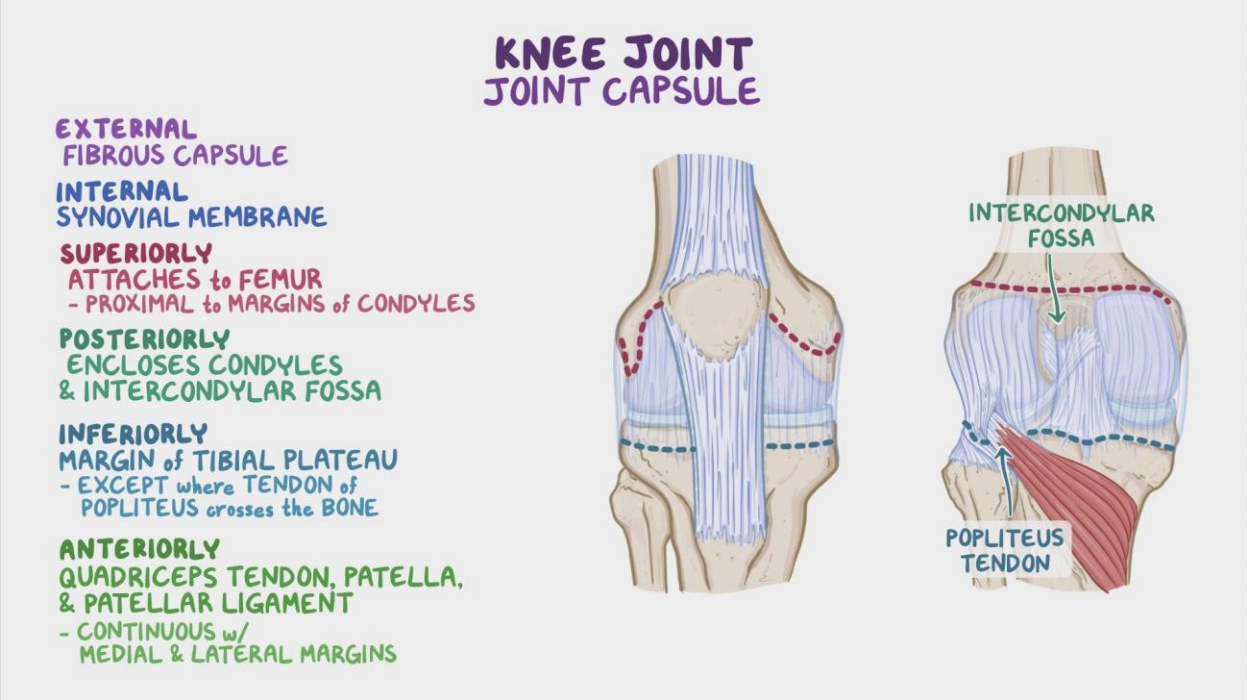
• Lateral and medial alar folds (cover fat pads on each side of the patellar ligament).

• **Suprapatellar Bursa:**

• Extension of the joint cavity deep to the vastus intermedius, extending ~5 cm or more superior to the patella.

Continuous with the joint capsule's synovial membrane.

• Articular muscle of the knee (muscle slips deep to vastus intermedius) attaches to the synovial membrane to retract the bursa during extension.



EXTRACAPSULA LIGAMENTS

1. **Patellar Ligament: 7.5 cm long x 2.5 cm broad**

• Distal part of the quadriceps femoris tendon, passing from patella to tibial tuberosity.

• Acts as the anterior ligament of the knee.

Associated with infrapatellar pad of fat

• Flanked by medial and lateral patellar retinacula (aponeurotic expansions of vastus medialis/lateralis and deep fascia) which maintain patellar alignment against lateral displacement (Q-angle).

2. **Collateral Ligaments:**

• Taut during full extension (standing stability); slacken during flexion to permit/limit rotation.

• **Fibular Collateral Ligament (FCL / Lateral Collateral Ligament):**

Degenerated tendon of peroneus longus muscle

Strong, cord-like; extends from lateral epicondyle of femur to lateral surface of fibular head.

Separated from lateral meniscus by popliteus tendon.

• **Tibial Collateral Ligament (TCL / Medial Collateral Ligament):**

It is a degenerated tendon of insertion of adductor magnus (ischial head)

Strong, flat, intrinsic band from medial femoral epicondyle and adductor tubercle to medial tibial condyle/surface.

Deep fibers attach firmly to the medial meniscus

It resist the forces that push the knee medially

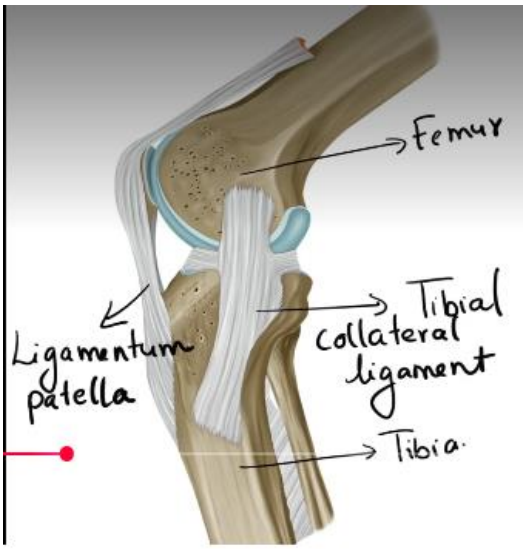
It produces valgus deformity

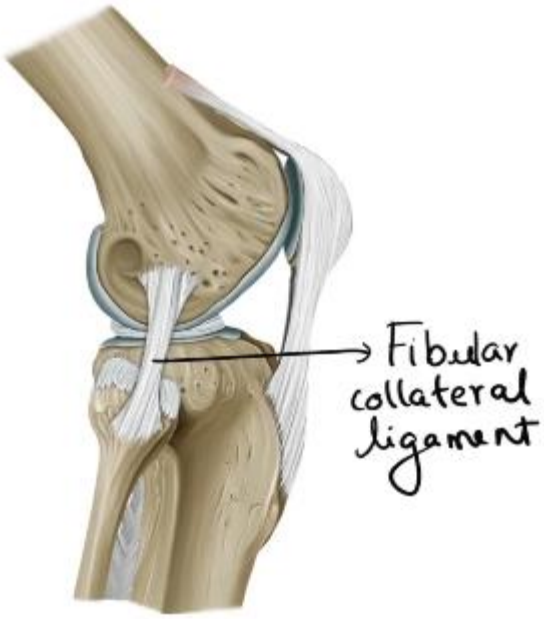
(weaker than FCL, frequently injured/torn with the medial meniscus in contact sports).

3. **Posterior Reinforcing Ligaments:**

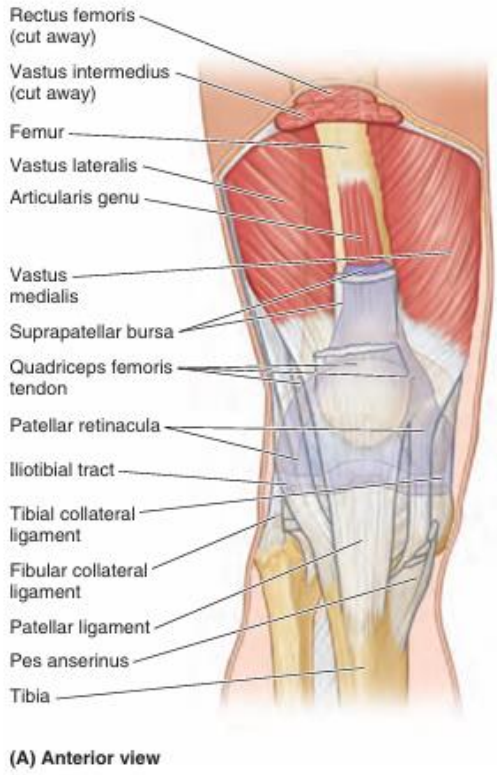
• **Oblique Popliteal Ligament:** Recurrent expansion of semimembranosus tendon reinforcing posterior capsule across intercondylar fossa (from posterior medial tibial condyle to superolateral femoral condyle).

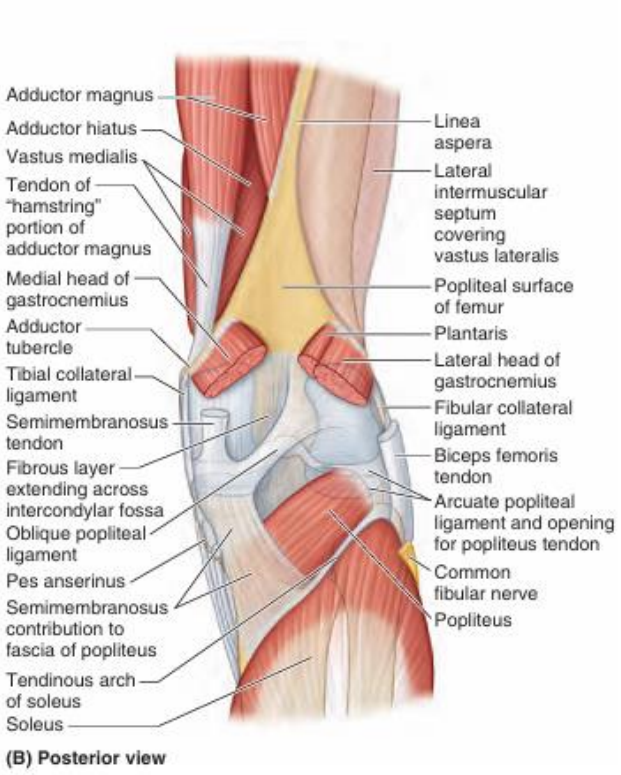
• **Arcuate Popliteal Ligament:** Strengthens posterolaterally; arises from posterior fibular head, passes over popliteus tendon, and spreads over posterior knee. Contributes to posterolateral stability.





Tibial collateral ligament





INTRAARTICULAR LIGAMENTS

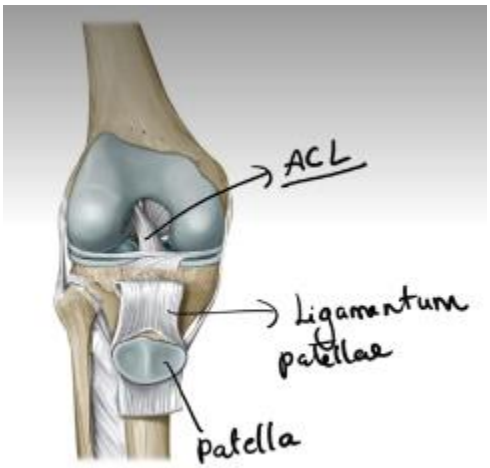
• Includes cruciate ligaments, menisci, and part of the popliteus tendon (located inside the joint capsule but outside the synovial cavity).

• Cruciate Ligaments:

• Cross each other obliquely like an "X" in the center of the joint; wind around each other during medial rotation (limited to ~10°) and unwind during lateral rotation (~60° flexion at 90°).

- Attach tibia with femur
- Maintain anetrioposterior stability
- Name is according to their attachment with tibia
- Act as the pivot for rotatory movements; at least part of one ligament is tense in every position, maintaining articular contact.
- Intracapsular but extrasynovial

• **Anterior Cruciate Ligament (ACL):** Weaker, poor blood supply. Arises from anterior intercondylar tibia, runs upward , backward and laterally attaches to lateral femoral condyle.



It gets taut during extension and lax during flexion

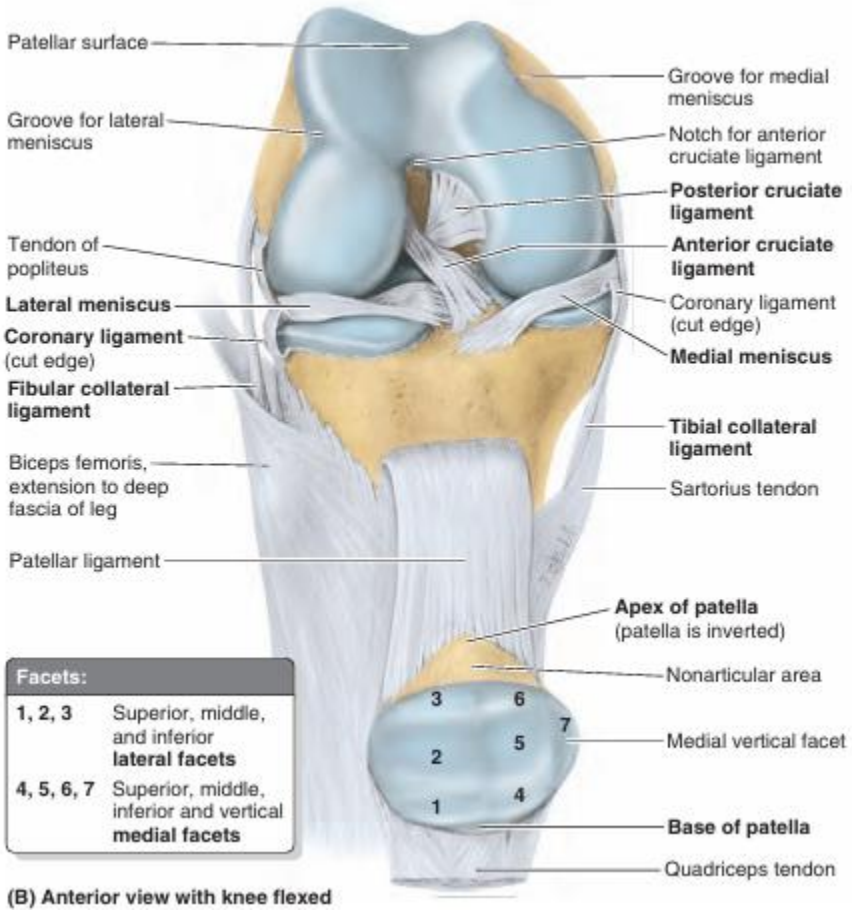
Limits posterior rolling of femoral condyles (converts to spin), prevents posterior femoral displacement and hyperextension (prevents anterior "drawer" pull when flexed).

- **Posterior Cruciate Ligament (PCL):** Stronger.

Arises from posterior intercondylar tibia, forward upward and medially and attaches to medial femoral condyle.

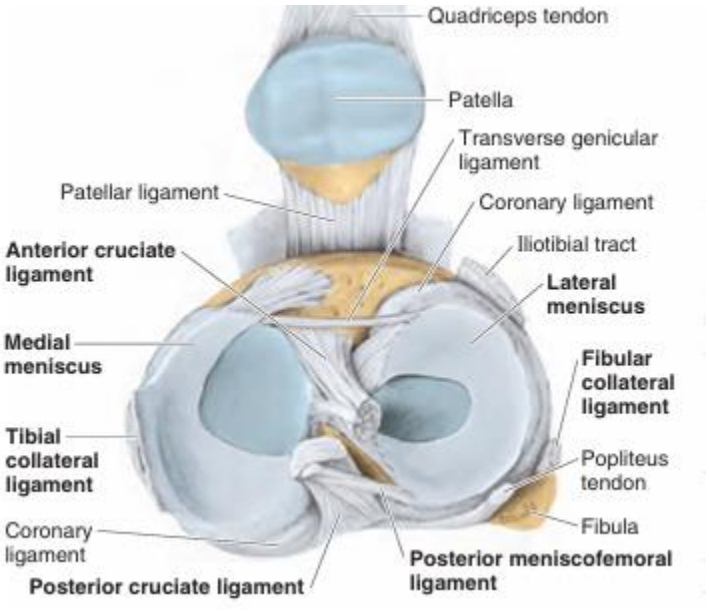
Limits anterior femoral rolling, prevents anterior femoral / posterior tibial displacement, prevents hyperflexion; main stabilizer for the femur on a weight-bearing flexed knee (e.g., walking downhill).

ACL is injured more than PCL as latter is more thicker and stronger



(B) Anterior view with knee flexed

• **Menisci:**



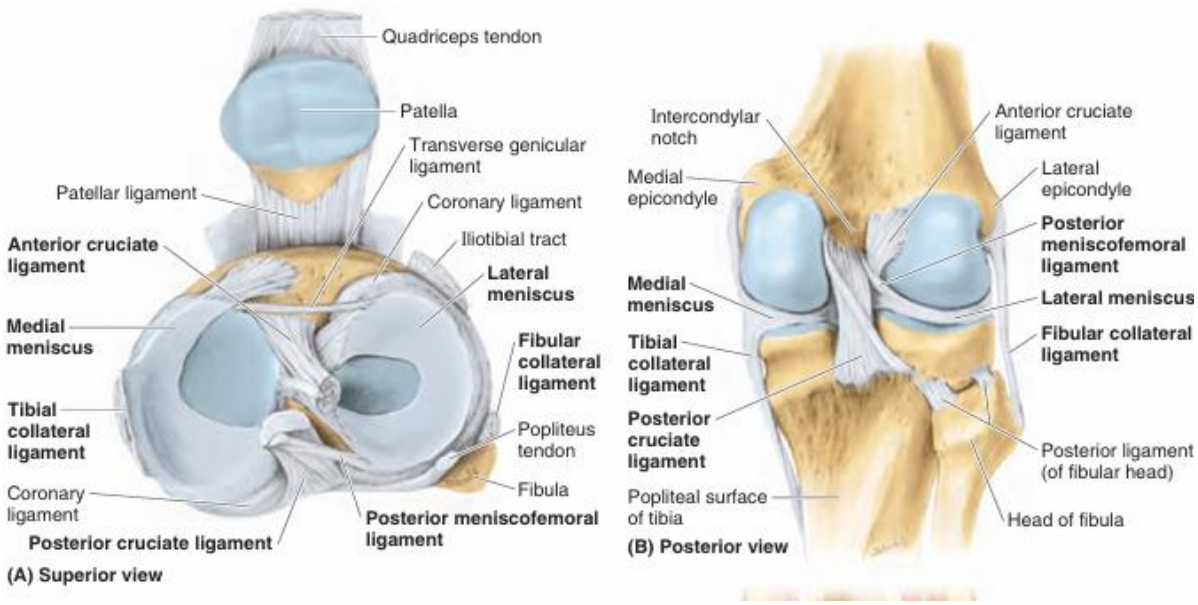
• Crescentic semilunar fibrocartilage plates on the tibia; thicker at outer margins, tapering inward. Deepen the articular surface and absorb shock. Attached to the intercondylar area and joint capsule (via coronary ligaments); joined anteriorly by the transverse ligament of the knee.

• **Medial Meniscus:** C-shaped, broader posteriorly. Firmly adheres to the deep surface of the tibial collateral ligament (TCL), making it less mobile than the lateral meniscus.

• **Lateral Meniscus:** Nearly circular, smaller, more mobile. Associated with the popliteus tendon and joined to the PCL and medial femoral condyle via the posterior meniscofemoral ligament.

Popliteal tendon prevent the injury to laterl meniscus and that is why injuries are more common in medial meniscus

Twisting during knee flexion such as kicking of ball leads to meniscal tears



Divide knee joint into 2 compartments

Upper : flexion and extension

Lower: rotation

Peripheral : thick , vascularized by capillary loops from fibrous capsule and synovial membrane so they heal after surgery

Central: thin and are less vascular so less heal so usually resected if injured

Their external margins attach to the joint capsule of the knee.

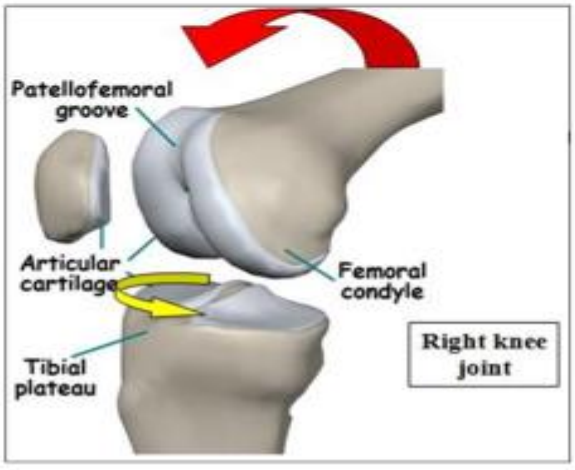
The coronary ligaments are portions of the joint capsule. They coonects the margins of the menisci and most of the periphery of the tibial condyles

A slender fi brous band, the transverse ligament of the knee, joins the anterior edges of the menisci, crossing the anterior intercondylar area (Fig. 5.9A) and tether ing the menisci to each other during knee movements.

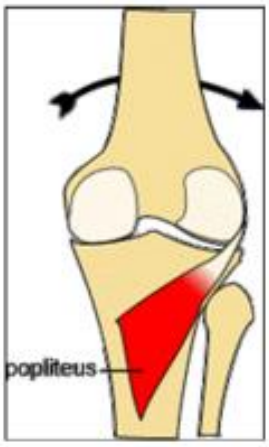
Movement of knee joint

Movement	Degrees Possible	Muscles Producing Movement		Factors Limiting (Checking) Movement	Comments
		Primary	Secondary		
Extension	Normal knees extend to 0° (straight alignment of axes of tibia and femur)[a]	Quadriceps femoris	Weakly: tensor fasciae latae	Anterior edge of lateral meniscus contacts shallow groove between tibial and patellar surfaces of femoral condyles; anterior cruciate ligament contacts groove in intercondylar fossa	Ability of quadriceps to produce extension is most effective when hip joint is extended; flexion diminishes its efficiency
Flexion	120° (hip extended); 140° (hip flexed); 160° passively	Hamstrings (semitendinosus, semimembranosus, long head of biceps); short head of biceps	Gracilis, sartorius, gastrocnemius, popliteus	Calf of leg contacts thigh; length of hamstrings is also a factor—more knee flexion is possible when hip joint is flexed; cannot fully flex knee when hip is extended	Normally, role of gastrocnemius is minimal, but in presence of a supracondylar fracture, it rotates (flexes) distal fragment of femur
Medial rotation	10° with knee flexed; 5° with knee extended	Semitendinosus and semimembranosus when knee is flexed; popliteus when non-bearing knee is extended	Gracilis, sartorius	Collateral ligaments, loose during flexion without rotation, become taut at limits of rotation	When extended knee is bearing weight, action of popliteus laterally rotates femur; when not bearing weight, popliteus medially rotates patella
Lateral rotation	30°	Biceps femoris when knee is flexed		Collateral ligaments become taut; anterior cruciate ligament becomes wound around posterior cruciate ligament	At end of rotation, with no opposition, tensor fasciae latae can assist in maintaining position

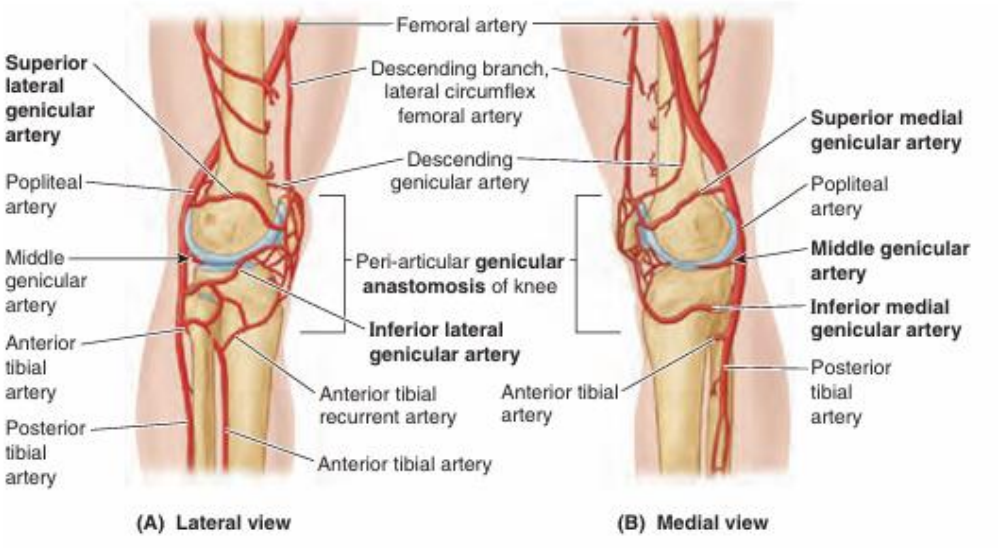
Locking of knee joint: The articular surface of lateral femoral condyle is shorter than that of the medial femoral condyle. As the knee is extended the smaller lateral condyle moves through its arc and is completely used before the medial condyle, which continues to move further posteriorly. During this part of movement, conjunct medial rotation of the femur occurs (foot on the ground). Thus at the end of extension, the medial rotation ensures that all of the articular surface of medial condyle is used , all the ligaments of the joint are taut and the joint is in close packed position called 'locking of knee joint'.



Unlocking of knee joint: In the beginning of flexion of knee joint, there is either lateral rotation of femur (foot on the ground) or medial rotation of tibia (foot off the ground) to unlock the knee joint from its tight packed position. This is done by **popliteus muscle** which is therefore also known as **key muscle of the knee joint**.



BLOOD SUPPLY



The arteries supplying the knee joint are the 10 vessels that form the peri-articular genicular anastomoses around the knee:

1. genicular branches of the femoral
2. Descending branch of lateral circumflex femoral

3. anterior and posterior recurrent branches of the anterior tibial
4. genicular branches of the popliteal artery
5. circumflex fibular arteries

INNERVATION OF KNEE JOINT

Refl ecting Hilton's law, the nerves supplying the muscles crossing (acting on) the knee joint also supply the joint

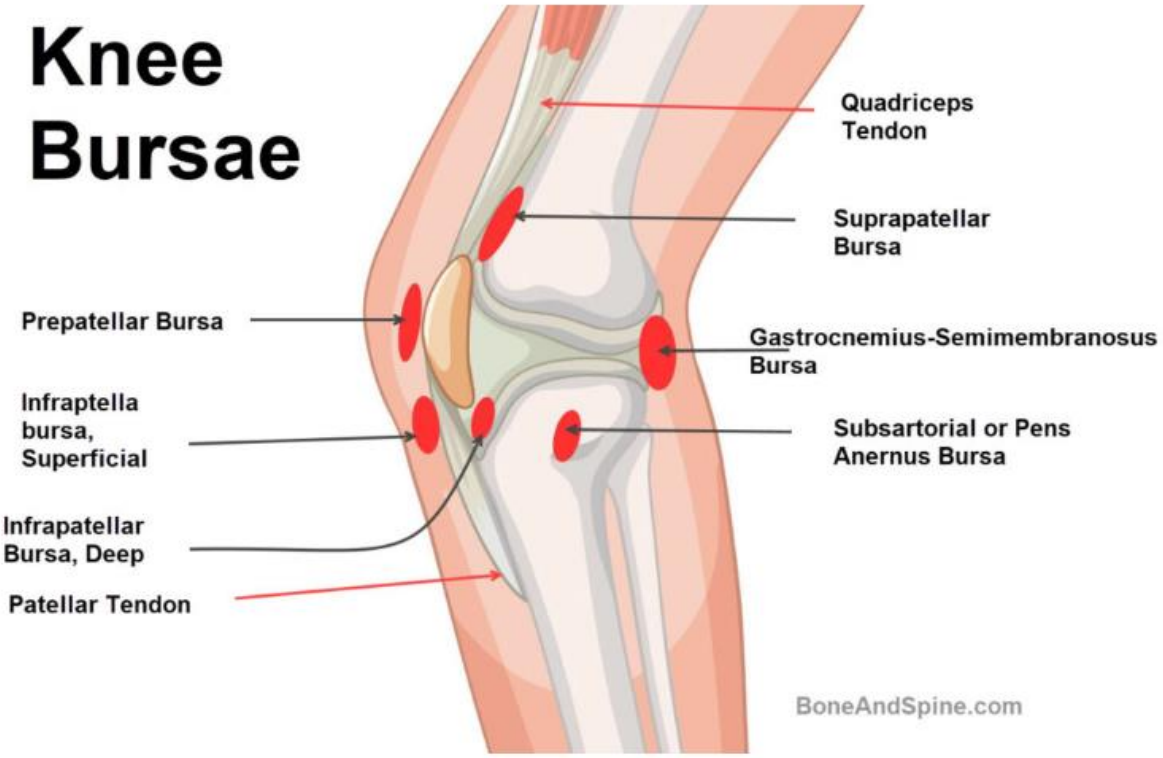
1. femoral (the branches to the vasti) - anetrior
2. Tibial nerve - posterior
3. common fibular nerves- lateral
4. the obturator and saphenous (cutaneous) nerves supply articular branches to its medial aspect.

BURSA

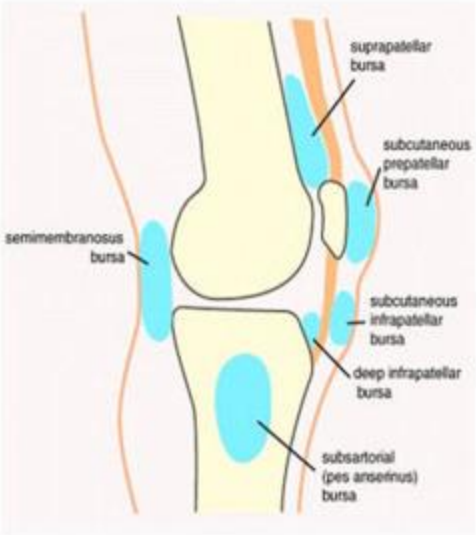
Knee bursae are broadly classified according to location and tissue relationships:

- **Subcutaneous bursae**: These are located between skin and bone or skin and tendon. These are prominent in the anterior knee (e.g., prepatellar, superficial infrapatellar).
- **Subtendinous or Submuscular Bursae**: These are interposed between tendons, ligaments, or muscle bellies and bone. These are present where tendons glide over bony prominences. Examples are the deep infrapatellar bursa, the pes anserine bursa, and the semimembranosus bursa.
- **Deep communicating bursae**: Some bursae communicate with the knee joint cavity. The suprapatellar bursa (suprapatellar pouch) communicates with the synovial cavity in most adults. Posteromedial gastrocnemius–semimembranosus bursa can communicate with the joint through a valvelike mechanism, giving rise to Baker's cysts.

Knee Bursae


Quadriceps Tendon
Suprapatellar Bursa
Prepatellar Bursa
Gastrocnemius-Semimembranosus Bursa
Infraptella bursa, Superficial
Subsartorial or Pens Anernus Bursa
Infrapatellar Bursa, Deep
Patellar Tendon
BoneAndSpine.com

- **Suprapatellar bursa:** lies deep to the quadriceps femoris and communicates with the knee joint cavity.
- **Subcutaneous prepatellar bursa:** lies between skin and the lower part patella and upper half of ligamentum patellae.
- **Subcutaneous infrapateller bursa**: between the skin and lower half of ligamentum patellae and tibial tuberosity.
- **Deep infrapatellar bursa**: deep to the ligamentum patellae.



Housmaid's knee: inflammation of subcutaneous prepateller bursa.
Clergyman's knee: inflammation of subcutaneous infrapateller bursa.