ANATOMY OF KNEE JOINT
The patella presents these features:
An Apex (Distal pole) a base (proximal pole).
3 edges: Superior, medial, and lateral.
2 surfaces: Anterior and posterior.
• The Posterior surface lower quarter is rough and non-articular, while its upper 3-fourth is smooth and articular.

• The Small non-articular part near the apex is split into 2 regions: A lower and an upper regions:
  – i) The Lower area gives connection to ligamentum patellae.
  – ii) The Upper area is related to infrapatellar pad of fat.

Making apart this medial strip, entire of articular outermost layer of the patella is subdivided into upper, middle, and lower regions by 2 faint horizontal lines.
Muscle actions on Patella
• The large articular area is mainly split by a vertical ridge into a bigger lateral and a smaller medial area to fit with the articular surfaces of the **Patellar surface of the femur**.

• The vertical ridge itself takes up the **groove on the patellar surface of femoral lower end**.
  
  – i) Larger lateral articular area is located in contact together with the **lateral femoral condyle** in all places of the knee.

  – ii) Small medial articular area is further split by another vertical ridge into a large lateral part and a narrow medial part referred to as **Medial Strip**.

  – The medial strip comes in touch with the under surface of **medial femoral condyle** during total flexion in the knee.
The patella plays an integral part in the normal kinematics of the knee by:

- Acting as a transmitter of quadriceps force across the knee
- Enhancing the leverage (internal moment arm) of the quadriceps muscle

During normal patello-femoral joint motion, the patella glides distally as the knee is flexed and proximally as the knee is extended (C). As the patella glides proximally and distally, it must remain stable within the inter-condylar groove of the femur.
Knee Joint

ARTICULAR SURFACE

THE ARTICULAR SURFACES OF KNEE JOINT ARE AS FOLLOWING.

• THE CONDYLES OF FEMUR.
• THE PATELLA.
• THE CONDYLES OF TIBIA.
Knee Anatomy

- The Knee Joint is the largest & complex joint in the body.
- It consists of 3 Joints:

1) **Medial Condylar Joint**: Between the medial condyle “of the femur” & the medial condyle “of the tibia”

2) **Latral Condylar Joint**: Between the lateral condyle “of the femur” & the lateral condyle “of the tibia”

3) **Patello-femoral Joint**: Between the patella & the patellar surface of the femur.

- The fibula is NOT directly involved in the joint.
FEMORAL CONDYLES

– Lateral Condyle
  • Smaller radius of curvature
  • Smaller in all dimensions
  • Extends more anteriorly
– Medial Condyle
  • Larger radius of curvature
  • Extends more distally
– Intercondylar notch

TIBIAL PLATEAU

– Medial Plateau
  • Greater surface area
  • Concave
  • Circular shape
– Intercondylar Eminence
– Lateral Plateau
  • Smaller surface area
  • Convex
  • Oval shape
LIGAMENTS

• Fibrous (articular) capsule.
• Coronary ligament.
• Ligamentum patellae.
• Anterior cruciate ligament.
• Posterior cruciate ligament.
• Tibial/medial collateral ligament.
• Fibular/lateral collateral ligament.
• Oblique popliteal ligament.
• Arcuate popliteal ligament.
• Medial meniscus.
• Lateral meniscus.
• Transverse ligament.
FIBROUS CAPSULE

• It is very thin capsule.
• It surrounds the sides and posterior aspect of joint.
• Anteriorly: It is deficient.
• Laterally it encloses the popliteus.

It is STRENGTHENED by the followings.
• Anteriorly: medial and lateral patellar retinacula (vastus medialis, vastus lateralis.)
• Laterally: illiotibial tract.
• Medially: tendons of sartorius, semimembranosus.
• Posteriorly: oblique popliteal ligament.
The capsule is strengthened on each side of the patella by expansions of the tendons of *vastus lateralis* and *medialis*, and posteriorly by the expansion of the *semimembranous muscle* and *oblique popliteal ligament*.
(d) Posterior view of the joint capsule, including ligaments
The synovial membrane of the knee joint attaches to the margins of the articular surfaces and to the superior and inferior outer margins of the menisci.

It lines the joint capsule except posteriorly where cruciate ligaments found.

The two cruciate ligaments, which attach in the intercondylar region of the tibia below and the intercondylar fossa of the femur above are outside the articular cavity, but enclosed within the fibrous capsule of the knee joint.

In front, it is absent from patella.

Posteriorly, the synovial membrane reflects off the fibrous membrane of the joint capsule on either side of the posterior cruciate ligament and loops forward around both ligaments thereby excluding them from the articular cavity.

Anteriorly, the synovial membrane is separated from the patellar ligament by an infrapatellar fat pad.
(B) Superior view of superior articular surface of tibia (tibial plateau)
SYNOVIAL MEMBRANE
CORONARY LIGAMENT

- Fibrous Capsule is attached to periphery of Menisci.
- Connects the periphery of the menisci to the tibia
- They are the portion of the capsule that is stressed in rotary movements of the knee
LIGAMENTUM PATELLAE

- It is the central portion of common tendon of insertion of quadriceps femoris
- It is related to superficial and deep infrapatellar bursae and infrapatellar pad of fat.
- Attachments:
  - Superior: APEX OF PATELLA.
  - Inferior: tibial tuberosity.
CRUCIATE LIGAMENTS

- Very thick, strong fibrous bands
- Direct bonds of union between femur & tibia
- Represent collateral ligaments of original femoro tibial joints
- Maintain antero-posterior stability
- Named according to attachment on tibia
- Supplied by vessels and nerves which pierce oblique popliteal ligament
ANTERIOR CRUCIATE LIGAMENT

• The anterior cruciate ligament attaches to the intercondylar area of the tibia and ascends posteriorly to attach to the lateral wall of the intercondylar fossa of the femur.

• The anterior cruciate ligament crosses lateral to the posterior cruciate ligament as they pass through the intercondylar region.
• The anterior cruciate ligament prevents anterior displacement of the tibia relative to the femur
• It is taut during knee extension

POSTERIOR CRUCIATE LIGAMENT

• the posterior cruciate ligament attaches to the posterior aspect of the intercondylar area of the tibia and ascends anteriorly to attach to the medial wall of the intercondylar fossa of the femur.
• posterior cruciate ligament restricts posterior displacement
• it tauts during knee flexion
The lateral collateral ligament (LCL) runs on the outside of your knee. It limits sideways motion.

The anterior cruciate ligament (ACL) connects the femur to the tibia in the center of your knee. It limits rotation and the forward motion of the tibia.

The meniscus is cartilage that absorbs shock in your joint.

Articular Cartilage lines the bones, cushioning your joint.

The medial collateral ligament (MCL) runs down the inside of your knee joint. It connects the femur to the tibia and limits the sideways motion of your knee.

The posterior cruciate ligament (PCL) also connects the femur and tibia. It limits backward motion of the tibia.

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MEDIAL COLLATERAL LIGAMENT (MCL) OR TIBIAL COLLATERAL LIGAMENT

- Is attached superiorly to the medial epicondyle of the femur just below adductor tubercle.
- Inferiorly it divides into superficial and deep
- Superficial part attached to the upper third of the tibia
- The deep portion, short, fuses with the capsule and with the medial meniscus
- A bursa usually separates the two parts
- MCL, tightens in extension
LATERAL/FIBULAR COLLATERAL LIGAMENT (LCL)

- Superiorly attached to lateral condyle of femur just above popliteal groove.
- Inferiorly embraced with tendon of biceps femoris and attached to head of fibula in front of its apex.
- Separated from lateral meniscus by popliteal tendon and fibrous capsule.
- Inferolateral genicular vessels and nerve separate it from capsule.
- Tightest in extension, 0-30 degrees.
- Becomes looser in flexion >30 degrees.
- Primary restraint to varus.
- Secondary restraint to ER and posterior translation.
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- Tightest in extension, 0-30 degrees.
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- Primary restraint to varus.
- Secondary restraint to ER and posterior translation.
- It is an expansion from the semimembranosus tendon close to its insertion to the tibia
- Oblique popliteal ligament passes upwards and laterally
- Fuses with the Fabella if present
- Lends with posterior surface of Capsule above lateral femoral condyle
- Pierced by middle genicular vessels and nerve
- Branch from the posterior division of the obturator nerve, pierces the ligament, supplies cruciates and articular twig to knee (referred pain from pelvic peritoneum to knee)
- Popliteal artery lies on it
- Strengthens the posterior portion of the capsule and prevents extreme lateral rotation
(a) Posterior view, superficial layer
Transverse Ligament

Connects the Anterior margin of the lateral meniscus to the anterior end of the medial meniscus.
ANATOMY OF MENISCI

- Menisci are fibro cartilagenous.
- Crescent shaped attached ends to tibia. Deepen the articular surface of tibia.
- Wedge shaped on cross section
- Outer border thick, convex, fixed and vascular
- Inner border thin, concave, free, avascular and nourished by synovial fluid
- They are intracapsular and intra synovial
ANATOMY OF MENISCI

- It has two ends, two borders and two surfaces
- Flexion and extension takes place at the upper surface of the menisci
- Rotation occurs between the lower surface of the menisci and the tibia
FUNCTION OF MENISCUS

- Shock absorption
- Redistributes forces
- Spread synovial fluid
- Minimal effect on stability
- On rotation menisci move with femur
- Lateral moves 20 - 24 mm
- Medial less mobile 10 - 15 mm
- Lateral meniscus bears more load
MEDIAL MENISCUS

- It is relatively immobile.
- It is c-shaped/semicircular fibrocartilagenous disc.
- Peripheral margin adherent to tibial collateral ligament.
- More liable to injury.

LATERAL MENISCUS

- It is more round/circular in shape.
- The posterior end of the meniscus is attached to femur through 2 meniscofemoral ligaments.
- The tendon of popliteus and fibrous capsule separate it from lcl.
- Mobility of posterior end is controlled by popliteus and 2 meniscofemoral ligaments.
TRANSVERSE LIGAMENT

- IT CONNECTS THE ANTERIOR ENDS OF MEDIAL AND LATERAL MENISCI.

Go to this site: https://musculoskeletalk.key.com/knee-injuries-2/
MENISCOFEMORAL LIGAMENTS

- The ANTERIOR MENISCOFEMORAL LIGAMENTS (Humphrey) is attached to lateral aspect of the medial femoral condyle in front of the PCL.
- The POSTERIOR MENISCOFEMORAL LIGAMENTS (Wrisberg) is attached posterior to the PCL.
- The posterior meniscofemoral ligament is usually present.
- Vary in size.
The arcuate ligament is not a separate ligament but is a condensation of the fibers of the origin of the popliteus.

Its posterior expansion of the Short Lateral Ligament.

It extends backwards from head of the Fibula, arches over the popliteal tendon and is attaches to posterior border of the intercondylar area of the tibia.

Fibers oriented in various directions.

Y-shaped configuration over popliteus.

Medial limb terminates into oblique popliteal ligament.

Lateral limb invariable present, and is less distinct.
Posterior Ligaments

- Oblique Popliteal Ligament
  - Thickening of posterior capsule
  - Expansion of semimembranosus tendon
  - Passes superior and laterally to femoral intercondylar line

- Arcuate Popliteal Ligament
  - Inferior lateral aspect of posterior capsule
  - From fibula head to posterior tibial and lateral femoral condyle
RELATIONS OF KNEE

ANTERIORLY:

- ANTERIOR BURSA, LIGAMENTUM PATELLAE, PATELLAR PLEXUS
RELATIONS OF KNEE

Posteriorly:

- Popliteal vessel, tibial nerve, peroneal nerve, gastrocnemius, plantaris, semitendinosus, semimembranosus, gracilis, popliteus
**Lateral relation** Layers I and II of structures of lateral side of knee.

- **A**, Major constituents of layer I: iliotibial tract and superficial portion of expansion of biceps.
- **B**, Layer I has been incised and peeled back from lateral margin of patella, showing layer II. Layer II includes vastus lateralis and its expansions as well as patellofemoral and patellomeniscal ligaments.
• Superficial medial ligament, and medial half of semimembranosus sheath removed, structures composing posteromedial corner can be seen. Note the distinct insertions of semimembranosus tendon (1 and 2) as opposed to extensions of semimembranosus tendon sheath (3, 4, and 5). Fibers of extension 5 are variable and appear to have little effect on superficial medial ligament.

• Inset is included for orientation and shows sites of attachment of superficial medial (SML) and deep medial (DML) ligaments and insertions of semimembranosus tendon. B, Point where layers II and III merge. C, Oblique popliteal ligament.
As many as 13 bursae have been described around knee joint.

- Four are anterior
- Four are lateral
- Five are medial.
ANTERIOR BURSAE

These are four in numbers.
• Subcutaneous prepatellar bursa.
• Subcutaneous infrapatellar bursa.
• Deep infra patellar bursa.
• Suprapatellar bursa.
LATERAL BURSAE

There are four lateral bursae.
• A bursa deep to lateral head of gastrocnemius.
• A bursa b/w fibular collateral ligament and the biceps femoris.
• A bursa b/w fibular collateral ligament and tendon of popliteus.
• A bursa b/w tendon of popliteus and lateral condyle of the tibia.

MEDIAL BURSAE

THE three MEDIAL BURSAE ARE AS FOLLOWS.
• A bursa deep to the medial head of gastrocnemius.
• The anserine bursa. (Complicated)
• A bursa deep to the tibial collateral ligament.
• A bursa deep to semimembranosus.
Popliteofibular ligament

- Average length 42 mm
- Descends from popliteus muscle (at musculotendinous junction) to posterosuperior fibular head
- Composed of anterior and posterior fascicle
- Functions as pulley to the popliteus
Knee movements

- Quadricep muscles (at rest)
- Patella (knee cap)
- Patellar tendon
- Tibia (shin bone)
- Hamstring muscles (at rest)
- Hamstring muscles (contract)
BLOOD SUPPLY

KNEE JOINT IS SUPPLIED BY ANASTOMOSES AROUND IT.

• 5 GENICULAR BRANCHES OF POPLITEAL ARTERY.
• DESCENDING GENICULAR BRANCH OF FEMORAL ARTERY.
• DESCENDING BRANCH OF LATERAL CIRCUMFLEX FEMORAL ARTERY.
• 2 BRANCHES OF ANTERIOR TIBIAL ARTERY.
• CIRCUMFLEX FIBULAR BRANCH OF TIBIAL ARTERY.
NERVE SUPPLY OF KNEE JOINT

- Number: ten nerves.
  1) **Femoral nerve**: gives twigs from the nerves to the three vasti.
  2) **Tibial nerve**: gives:
     1) Superior medial genicular.
     2) Inferior medial genicular.
     3) Middle genicular nerve.
  3) **Common peroneal nerve**: gives:
     1) Superior lateral genicular.
     2) Inferior lateral genicular.
     3) Recurrent genicular nerve.
  4) **Obturator nerve**: gives the genicular branch from its posterior division.
TIBIAL NERVE

- Initially lateral to the popliteal artery
- Crosses at midpoint to end medial to the artery at soleus arch
Knee movements

- Quadricep muscles (at rest)
- Patella (knee cap)
- Patellar tendon
- Tibia (shin bone)
- Quadricep muscles (contract)
- Hamstring muscles (at rest)
- Hamstring muscles (contract)
Screw home mechanism
locking and unlocking of the knee

• Knee achieves terminal extension via the “screw home mechanism
• The tibia externally rotates in relation to the femur.
• When the knee needs to flex, the popliteus contracts which causes internal rotation of the tibia and in essence unlocking the knee and allowing it to bend
• The locking of the knee, occurs at the end of knee extension. It reduces die work performed by the quadriceps muscles during standing.
• **During flexion**: The femoral condyles roll posteriorly and glide, so that their centres of rotation move posteriorly on the tibia.

• The femoral glide pushes the posterior horns of the medial and lateral menisci posteriorly.

• **During extension**: The femoral condyles roll anteriorly, and glide anteriorly on the surface of the tibia. The femoral glide pushes the anterior horns of the medial and lateral menisci anteriorly.
• Screw home mechanism of the knee **during standing**:
• Extension, ACL acts to resist hyperextension and becomes taught.
• Full extension, PCL, also becomes taught, resisting the anterior movement of the femur on the tibia.
• Anterior movement of the femur on the tibia is additionally blocked by the anterior horn of the medial meniscus. (which has reached its maximally anterior position).
• Further quadriceps contraction produces a medial rotation of the femur on the tibia, (this occurs because the medial femoral condyle is "longer" than the lateral femoral condyle).
• This femoral rotation into full extension is the "screw home". Eventually, femoral movement ceases when the ACL and the Collateral Ligaments of the knee have become taught, resulting in a position of slight hyperextension known as the "locked out knee".
• "Unlocking" of the knee. During knee flexion, it is first necessary to "untwist" and reduce tension within the major ligaments of the knee, in order to prevent their repeated excessive stretching. Contraction of the popliteus muscle, laterally rotates the femur on the tibia, and pulls the lateral meniscus posteriorly, out of the way of the rotating lateral femoral condyle. Once the femur has laterally rotated, the knee is said to be "unlocked" and flexion can proceed.
• https://www.youtube.com/watch?v=fvTMzr3d3s
• https://www.youtube.com/watch?v=CCAZnu489jM
• https://www.youtube.com/watch?v=X7xbuAN2XDk
• https://www.kenhub.com/