ANATOMY OF KNEE JOINT

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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) Lateral Condylar Joint : Between the lateral condyle “of the femur” & the lateral condyle “of the tibia”.
  3) Patellofemoral Joint : Between the patella & the patellar surface of the femur.

- The fibula is NOT directly involved in the joint.
ARTICULAR SURFACE

THE ARTICULAR SURFACES OF KNEE JOINT ARE AS FOLLOWING.

• THE CONDYLES OF FEMUR.
• THE PATELLA.
• THE CONDYLES OF TIBIA.
FEMORAL CONDYLE

A – Lateral Condyle
  • Smaller radius of curvature
  • Smaller in all dimensions
  • Extends more anteriorly

B – Medial Condyle
  • Larger radius of curvature
  • Extends more distally

C – Intercondylar notch
TROCHLEAR GROOVE AND INTERCONDYLAR NOTCH

• Anteriorly, the condyles are separated by Patello femoral Groove.
• Posteriorly, the condyles are separated by the intercondylar notch.
TIBIAL PLATEAU

- D – Medial Plateau
  - Greater surface area
  - Concave
  - Circular shape
- E – Intercondylar Eminence
- F – Lateral Plateau
  - Smaller surface area
  - Convex
  - Oval shape
• 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.
• In front, it is absent from patella.
• 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 membrane of the knee joint.
• 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**.

• **alar fold**

• the **infrapatellar synovial fold**.

• pouches in two locations

• **subpopliteal recess**

• **suprapatellar bursa** (small articularis genus muscle)
BURSAE

• AS MANY AS 13 BURSAE HAVE BEEN DESCRIBED AROUND KNEE JOINT.
• THE FOUR ARE ANTERIOR
• FOUR ARE LATERAL
• FIVE ARE MEDIAL.
ANTERIOR BURSAE

THESE ARE FOUR IN NUMBERS.

• SUBCUTANEOUS PREPATELLAR BURSA.
• SUBCUTANEOUS INFRA PATELLAR 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 FOUR 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.

• OCCASIONALLY A FIFTH BURSA PRESENT B/W TENDONS OF SEMIMEMBRANOUS AND SEMITENDINOSUS.
BURSAE

Interactive Knee 1.1 © 2000 Primal Pictures Ltd.
INJECTION AND ARTHROCENTESIS
### STEPS

#### INJECTION

1. Ask patient about allergies.
2. Place patient in seated position with knee flexed and hanging.
3. Prep skin (iodine/soap) over the anterior knee.
4. Prepare syringe with local/steroid mixture on 21/22 gauge needle.
5. Palpate the “soft spot” between the border of the patellar tendon, the tibial plateau, and the femoral condyle.
6. May locally anesthetize the skin over the “soft spot.”
7. Horizontally insert the needle into the “soft spot,” aiming approximately 30° to the midline toward the intercondylar notch. If the needle hits the condyle, redirect it more centrally into the notch.
8. Gently aspirate to confirm that you are not in a vessel.
9. Inject solution into knee. The fluid should flow easily.
10. Withdraw needle and dress the injection site.

#### ASPIRATION/ARTHROCENTESIS

1. Ask patient about allergies.
2. Place patient supine with the knee fully extended.
3. Palpate the borders of the patella and femoral condyle.
4. Prep skin (iodine/antiseptic soap) over this area.
5. Insert needle, usually 21 or 18 gauge (for thick fluid), horizontally into suprapatellar pouch at level of superior pole of the patella.
6. Aspirate fluid into syringe (may use multiple syringes if needed).
7. Gently compress knee to “milk” fluid to the pouch for aspiration.
8. Withdraw needle and dress the injection site.
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(ARTICULAR) CAPSULE

• THIN CAPSULE WITH TIBIAL AND FEMORAL ATTACHMENT
• ANTERIORLY DEFICIENT
• POPLITEUS MUSCLE AND TENDON
FIBROUS CAPSULE STRENGTHENING

IT IS STRENGTHENED BY THE FOLLOWINGS.

• ANTERIORLY: MEDIAL AND LATERAL PATELLAR RETINACULA (VASTUS MEDIALIS, VASTUS LATERALIS.)

• LATERALLY: ILLIOTIBIAL TRACT.

• MEDIANLY: TENDONS OF SARTORIUS, SEMIMEMBRANOSUS.

• POSTERIORLY: OBLIQUE POIPLITEAL LIGAMENT.
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
FIBROUS CAPSULE OPENINGS

• TWO CONSTANT GAPS
• LEADING INTO SUPRA PATELLAR BURSA
• EXIT OF POPLITEAL TENDON
• SOMETIMES THERE ARE GAPS THAT COMMUNICATE WITH BURSA DEEP TO MEDIAL HEAD OF GASTROCNEMIUS AND DEEP TO SEMIMEMBRANOSUS
LIGAMENTUM PATELLAE

- IT IS THE CENTRAL PORTION OF COMMON TENDON OF INSERTION OF QUADRICEPS FEMORIS. (remaining portions of the tendon form MEDIAL & LATERAL PATELLAR RETINACULA)
- IT IS RELATED TO SUPERFICIAL AND DEEP INFRAPATELLAR BURSAE AND INFRAPATELLAR PAD OF FAT.
- ATTACHMENTS:
  - ABOVE: APEX OF PATELLA.
  - BELOW: 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 a facet on the anterior part of the intercondylar area of the tibia and ascends posteriorly to attach to a facet at the back of 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
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, as far down as the tibial tuberosity.
- The deep portion, which is short, fuses with the capsule and with the medial meniscus.
- A bursa usually separates the two parts.
- MCL, tightens in extension.
- A valgus stress will put a strain on the ligament.
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.
Oblique Poqipileal Ligament

- 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
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
Menisci & Stress Distribution

Meniscus
- femur
- patella
- tibia
- menisci intact
- meniscectomy

Stress distribution comparison:
- Menisci intact: Even stress distribution
- Meniscectomy: Increased stress concentration
WEDGE EFFECT OF MENISCI
• The major orientation of collagen fibers in the meniscus is circumferential; radial fibers and perforating fibers also are present.

• The circumferential tension in the menisci counteracts this outward or radial force.

• These hoop forces are transmitted to the tibia through the strong anterior and posterior attachments of the menisci.

• Hoop tension is lost when a single radial cut or tear extends to the capsular margin; in terms of load bearing, a single radial cut through the meniscus may be equivalent to meniscectomy.
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
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.
FUNCTION OF MENISCI

- 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
TRANSVERSE LIGAMENT

• IT CONNECTS THE ANTERIOR ENDS OF MEDIAL AND LATERAL MENISCII.
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.
SHORT LATERAL LIGAMENT

- Extends from Lateral epicondyle of femur
- To Medial border of the Apex of Fibula
- It is a cord-like thickening of capsule deep to LCL.
- Deep in interval between iliotibial band and biceps femoris
- Surrounded by biceps femoris
ARCUATE LIGAMENT

- 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
ARCUATE LIGAMENT

- 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
Fabella

- Fabella lies at point on the poster lateral side of knee
- Where multidirectional collagenous tensile stress meet
- 8% - 10% osseous
- 90% - 92% cartilagenous

Fabbricani & Oransky, 1992
Poster Lateral Corner

- Posterior horn of lateral meniscus
- Arcuate complex
- Popliteus
- Lateral head of gastrocnemius
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
POPLITEAL FOSSA

• Borders
  – Superomedial: semimembranosus
  – Superolateral: biceps femoris
  – Inferomedial: medial gastroc head
  – Inferolateral: lateral gastroc head

• Contents
  – Popliteal artery and vein
  – Tibial and common peroneal nerves
RELATIONS OF KNEE

MEDIALLY:

• SARTORIUS, GRACILIS, SEMITENDINOSUS, SAPHENOUS VEIN, SAPHENOUS NERVE, SEMIMEMBRANOSUS.

LATERALLY:

• BICEPS FEMORIS, TENDON OF POPLITEUS
BLOOD SUPPLY OF KNEE

Diagram showing the blood supply to the knee joint, including:
- Descending branch of lateral circumflex femoral artery
- Femoral artery
- Adductor magnus
- Adductor hiatus
- Descending genicular artery
- Saphenous branch
- Superior lateral genicular artery
- Adductor magnus
- Superior medial genicular artery
- Inferior lateral genicular artery
- Popliteal artery
- Circumflex fibular artery
- Recurrent branch of anterior tibial
- Interosseous membrane
- Inferior medial genicular artery
- Posterior tibial artery
- Anterior tibial artery
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.
LYMPHATIC DRAINAGE OF KNEE

- Drainage is to Popliteal Lymph Nodes
- Usually 6 small L.Nodes
- Termination of Short Saphenous Vein
- Popliteal Artery and posterior of knee (direct vessels from knee joint)
- Accompanying Genicular Arteries (most vessels)
VENOUS DRAINAGE

- Popliteal
NERVE SUPPLY

FOLLOWING NERVES SUPPLY THE KNEE JOINT.

- FEMORAL NERVE THROUGH ITS BRANCHES TO VASTI (ESP VASTUS MEDIALIS)
- SCIATIC NERVE THROUGH GENICULAR BRANCHES OF TIBIAL AND COMMON PERONEAL N.
- OBTURATOR NERVE THROUGH ITS POSTERIOR DIVISION.
- INFRAPATELLAR BRANCH OF SAPHENOUS
TIBIAL NERVE

- Initially lateral to the popliteal artery
- Crosses at midpoint to end medial to the artery at soleus arch
Common Peroneal Nerve

- Lateral aspect of the popliteal space
- Medial and posterior to the biceps femoris tendon
INFRAPATELLAR BRANCH OF SAPHENOUS
MUSCLES

• Anterior – Quadriceps

• Posterior – Hamstrings

• Medially – Pes anserine group

• Laterally – Illiotibial band
Anterior Musculature

- Rectus femoris
- Vastus lateralis
- Vastus intermedius
- Vastus medialis
Rectus Femoris

- O: AIIS
- I: Tibial tuberosity via infrapatellar tendon
- N: Femoral
- A: Knee extension, hip flexion
Vasti Muscles

- **O:**
  VL – Greater trochanter, upper ½ of linea aspera;
  VI – Anterolateral upper 2/3 of femur, lower ½ of linea aspera
  VM – Distal intertrochanteric line, medial linea aspera

- **I:** Tibial tuberosity via infrapatellar tendon

- **N:** Femoral

- **A:** Knee extension
Posterior Musculature

- Biceps femoris
- Semimembranosus
- Semitendinosus
- Popliteus
- (Gastrocnemius)
Biceps Femoris

- **O:** Long – ischial tuberosity; Short – lateral linea aspera, upper 2/3 of supracondylar line
- **I:** Fibular head, lateral tibial plateau
- **N:** Long – tibial Short – common peroneal
- **A:** Knee flexion, Hip extension (long H.), Knee external rotation
Semimembranosus

- O: Ischial tuberosity
- I: Posteromedial of medial tibial plateau
- N: Tibial
- A: Knee flexion, Hip extension, Knee internal rotation
Semitendinosus

- **O:** Ischial tuberosity
- **I:** Medial tibial flare (pes anserine)
- **N:** Tibial
- **A:** Knee flexion, Hip extension, Knee internal rotation
Popliteus

• O: Lateral femoral condyle
• I: Posteromedial tibia
• N: Tibial
• A: Knee internal rotation,
  Knee flexion
Pes Anserine Muscles

• Sartorius (most anterior)
• Gracilis (middle)
• Semitendinosus (most posterior)
Sartorius

- O: ASIS
- I: Anteromedial tibial flare (pes anserine)
- N: Femoral
- A: Hip flexion, Hip abduction, Hip external rotation, Knee flexion
Gracilis

• O: Symphysis pubis, inferior ramus of pubic bone
• I: Anteromedial tibial flare (pes anserine)
• N: Obturator
• A: Hip adduction,
  Hip flexion,
  Knee flexion
Iliotibial Band/TFL

- **O:** Anterior superior iliac crest
- **I:** Anterolateral tibia at Gerdy’s tubercle
- **N:** Superior gluteal
- **A:** Hip flexion, Hip abduction, Hip internal rotation
• A division of the vastus medialis muscle into two populations of fibers has been hypothesized:
  1. one population is thought to be long and relatively inline with the quadriceps ligament: the vastus medialis longus (VML)
  2. the other is thought to be shorter and more obliquely oriented with respect to the quadriceps ligament: the vastus medialis obliquus (VMO).
At the present time, there is insufficient evidence to conclusively confirm or deny this hypothesis. For clinical and rehabilitation purposes, the vastus medialis is often referred to simply as the VMO in reference to its potentially important role in correct patellar tracking and prevention of patellofemoral joint syndrome.
WEAK VASTUS MEDIALIS

- Lower most fibres of vastus medialis
- Partly arise adductor magnus
- Straightens the pull on the quads tendon and patella
- Controls patella tracking during flexion extension of the knee
- Fibres atrophy quickly after knee injury
- 10-15 ml of effusion inhibit VMO
- VMO rehabilitation strength and timing of contraction
Medial Structures

• Medial ligament

• Pes anserinus consists of:
  – Sartorius
  – Gracilis
  – Semitendinosus

• Tibial inter-tendinous bursa between them
Posterior Medial Structures

- Semimembranosus into the groove on posterior aspect of medial tibial condyle and its extensions
- Upwards and lateral is oblique popliteal ligament
- Downwards and lateral forms fascia covering popliteus
- Downwards and medially fuses with medial ligament
Lateral Structures

Iliotibial Tract Friction Syndrome

- Tensor fasciae latae m.
- Iliotibial tract
- Vastus lateralis m.
- Lateral femoral epicondyle

As knee flexes and extends, iliotibial tract glides back and forth over lateral femoral epicondyle, causing friction

Area of diffuse pain and tenderness

Netter
Lateral Knee

- Lateral ligament
- Iliotibial tract
- Arcuate complex
  - Fabellofibular ligament
  - Deep portion of capsule
  - Meniscotibial ligaments
Lateral Structures

- **Layer 1**
  - IT band
  - biceps tendon

- **Layer 2**
  - Lateral retinaculum
  - patellofemoral ligaments

- **Layer 3**
  - Joint capsule
  - LCL
  - arcuate ligament
  - fabellofibular ligament
  - popliteofibular ligament
Lateral Structures

- **Layer 1**
  - IT band
  - biceps tendon

- **Layer 2**
  - Lateral retinaculum
  - patellofemoral ligaments

- **Layer 3**
  - Joint capsule
  - LCL
  - arcuate ligament
  - fabellofibular ligament
  - popliteofibular ligament
Popliteus

- Origin inferior, popliteal surface of tibia, above the soleal line, fascia of semimembranosus
- Deep to arcuate popliteal ligament
- Enters capsule
- Crosses lateral surface of lateral meniscus
- Attached by popliteal-meniscal fibres which bound hiatus
- Enters hiatus
- Crosses femoral condyle
- Deep to lateral collateral ligament
- Inserts into anterior part of groove
- Superior popliteal recess communicates joint
FIGURE 45-2 Popliteus muscle with its tripartite origin. Main tendon attached to lateral condyle of femur (A). Attachment to posterior horn of lateral meniscus (B). Attachment to fibular head (C).
Popliteus Complex

• Dynamic
  – Popliteus muscle

• Static
  – Popliteofibular ligament
  – Popliteotibial fascicle
  – Popliteomeniscal fascicle
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
Posterolateral Corner

- FCL
- Popliteus tendon
- Popliteofibular ligament
Posterolateral Corner

- Static Stabilizers (highly variable)
  - LCL
  - Fabellofibular ligament
  - Short lateral ligament
  - Popliteofibular ligament
  - Arcuate ligament
  - Posterolateral capsule
  - Posterior horn lateral meniscus
  - Lateral coronary ligament
Posterolateral Corner

- Dynamic Stabilizers
  - IT band
  - Lateral gastrocnemius
  - Biceps femoris
  - Popliteus
Fabellofibular vs Short Lateral Ligament

- **Fabellofibular ligament**
  - Present when fabella present (8-16%)
  - Courses from fabella to fibular head

- **Short lateral ligament**
  - Present when fabella absent
  - Courses from lateral femur to fibular head
  - Represents a homologue of the fabellofibular ligament
Iliotibial Band

- Coalescence at greater trochanter of tensor fascia lata, gluteus medius and gluteus maximus
- The iliotibial tract is a thickening of the deep fascia of the thigh, tensor fascia lata (inserted into the tract)
- The superficial three quarters of the gluteus maximus end in a thick tendinous lamina which is inserted into the iliotibial tract
- IT band continues distally to form the:
  - IT tract
    - Inserts distally on Gerdy’s tubercle and on distal femur through intermuscular septum
    - The tract is attached to Gerdy’s tubercle on the anterolateral aspect of the lateral tibial condyle
  - Iliopatellar band
    - Inserts on lateral patella resisting medial directed forces
Iliotibial Tract

• The iliotibial band acts as an extensor of the knee when the knee is flexed from 0° to 30° and as a flexor when the knee is flexed more than 40°, due to the change in the transverse axis which occurs at 30–40° flexion.

• The pelvic tilt is a mechanism for tightening the iliotibial band. The pull of the band stabilises the knee in extension, as well as helping to resist extension and adduction of the hip of the weight-bearing leg.
IT Band Biomechanics

• Functions
  – Stabilizes against varus opening
  – Knee extensor in extension
  – Knee flexor in flexion
  – External rotator of tibia in >40 flexion
Medial Patellofemoral Ligament

- Runs transversely in Layer 2
- Originates from adductor tubercle, femoral epicondyle, and superficial MCL
- Proximal fiber inserts on undersurface of VMO and vastus intermedius
- Distal fibers insert on superomedial patella
- Width averages 1.3 cm
MPFL Biomechanics

- Soft tissue restraint of extensor mechanism
- Patella subluxes most easily at 20° knee flexion
- MPFL resists patellar lateral subluxation greatest in extension
- Primary stabilizer followed by patellomeniscal, patellotibial, and medial retinaculum
Screw Home Mechanism

- 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
• Screw home mechanism — locking and unlocking of the knee

• The screw home mechanism, or locking of the knee, occurs at the end of knee extension. It reduces the work performed by the quadriceps muscles during standing. During knee flexion and extension, the femoral condyles multiply and horizontally glide on the surface of the tibial plateau.
• 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.
Screw-Home Mechanism

Tibia internally rotates and moves distally away from femur when knee flexes

Tibia externally rotates when knee extends and screws up into the femur

[Nordin & Frankel, 1989]
Flat surface of femoral condyles is in contact with tibia and stabilizes joint.

Medial rotation of femur on tibia tightens ligaments.

Line of center of gravity is anterior to knee joint and maintains extension.
PATELLOFEMORAL CONTACT POINTS

A

Articular surface of patella
Articular surface of femur
Lateral
Medial

B

At 80° flexion
At 135° flexion

"Odd facet"
Patellofemoral Biomechanics

• Joint Reactive Force
  – In flexion, patella compressed onto femur creating joint reactive force
  – Stair climbing – 3.5 X BW
  – Deep bends – 7-8 X BW
Q ANGLE

• Brattström first described the \textit{Q angle as an angle} formed by the line of pull of the quadriceps mechanism and that of the patellar tendon as they intersect at the center of the patella.
Q ANGLE

• Clinically, this angle is represented by the intersection of a line drawn from the anterior superior iliac spine to the center of the patella with a second line drawn from the center of the tibial tuberosity to the center of the patella.

• Measurement to be accurate, the patella must be centered on the trochlea by flexing the knee 30 degrees.
Q ANGLE IN MALES AND FEMALES

• In males, the Q angle normally should be 8 to 10 degrees; in females, the normal angle is 15 degrees (+/-) 5 degrees
• An increase in Q-angle can mean a higher risk of kneecap problems including patellar subluxation and patellar dislocation.
MCMURRAY TEST FOR MENISCAL INJURY
APLEY GRIND TEST FOR MENISCAL INJURY
COLLATERAL LIGAMENTS

Varus and valgus tests
Patient supine on table, relaxed, leg over edge of table, flexed about 30°. With one hand fixing thigh, examiner places other hand just above ankle and applies valgus stress. Degree of mobility compared with that of uninjured side, which is tested first. For varus stress test, direction of pressure reversed.
Valgus stress
Lateral force to knee at 30°, then 0°
Laxity at 30°—MCL injury; 0°—MCL and cruciate ligament injury

Varus stress
Medial force to knee at 30°, then 0°
Laxity at 30°—LCL injury; 0°—LCL and cruciate ligament injury

FIGURE 45-45  A and B, Abduction and adduction stress testing
ANTERIOR CRUCIATE LIGAMENT

Anterior drawer test
Patient supine on table, hip flexed 45°, knee 90°. Examiner sits on patient's foot to stabilize it, places hands on each side of upper calf and firmly pulls tibia forward. Movement of 5 mm or more is positive test. Result also compared with that for normal limb, which is tested first.

Flex knee 90°, anterior force on tibia
Laxity/anterior translation: ACL injury

Flex knee 20-30°, anterior force on tibia
Laxity indicates ACL injury. Most sensitive exam for ACL rupture. Grade 1: 0-5mm, 2: 6-10mm, 3: >10mm; A: good, B: no endpoint.

Flexion in knee test
Pivot shift test for anterolateral knee instability

Patient supine and relaxed. Examiner lifts her foot to flex hip 45° keeping knee fully extended, grasps knee with other hand, placing thumb head of fibula. Examiner applies strong internal rotation to tibia and fibula at both knee and while lifting proximal fibula. Knee permitted flex about 20°; examiner then pushes medial proximal hand and pulls with distal hand to a valgus force at knee.

Supine, extend knee, IR, valgus force on proximal tibia, then flex knee

Clunk with knee flexion indicates ACL injury. (If ACL is deficient, the tibia starts subluxated.)
POSTERIOR CRUCIATE LIGAMENT

Posterior drawer test

Procedure same as for anterior drawer test, except that pressure on tibia is backward instead of forward.

Posterior sag sign

Leg drops backward.

Flex knee 90°, posterior force on tibia  
Posterior translation: PCL injury

Supine, hip 45°, knee 90°, view laterally  
Posterior translation of tibia (by gravity) on femur indicates PCL injury
Reverse pivot shift

Supine, flex knee 45°, ER, valgus force on proximal tibia, then extend knee

Clunk with knee extension indicates PCL injury. (If PCL is deficient, the tibia is subluxated posteriorly, then reduces w/extension, causing the clunk.)
PLC

**Figure 45-61** A-C, Prone external rotation-recurvatum test. Increased external rotation at 30 degrees that decreases at 90 degrees indicates isolated injury to posterolateral corner; increased external rotation at both 30 and 90 degrees indicates injury to both posterior cruciate ligament and posterolateral corner.

**Figure 45-59** A and B, External rotation-recurvatum test (see ER recurvatum, supine, legs straight, raise legs by toes)
SURGICAL APPROACHES

**Anatomical relationships of superficial structures on medial aspect of knee.**

- Rectus femoris muscle
- Vastus medialis muscle
- Patella
- Patellar tendon
- Sartorius muscle
- Saphenous vein
- Infrapatellar branch of saphenous nerve
- Saphenous nerve
- Gastrocnemius muscle

**Figure 1-42**
ANTERIOR APPROACH
(VON LANGENBECK TECHNIQUE)
SUBVASTUS (SOUTHERN) ANTERO MEDIAL APPROACH
TECHNIQUE: (ERKES, AS DESCRIBED BY HOFMANN, PLASТЕR, AND MURDOCK)

**FIGURE 1-44** Subvastus anteromedial approach. A, Superficial fascia is incised medial to patella. B, Superficial fascia is bluntly elevated from perimuscular fascia of vastus medialis down to its insertion on medial patellar retinaculum. C, Tendinous insertion elevated by blunt dissection. Line indicates arthrotomy. D, Patella is everted, and knee is flexed. SEE TECHNIQUE 1-32.
ANTEROLATERAL APPROACH TECHNIQUE: (KOCHER)
POSTEROLATERAL APPROACH TECHNIQUE: HENDERSON
OTHER APPROACHES

- POSTEROMEDIAL APPROACH (TECHNIQUE: HENDERSON)
- MEDIAL APPROACH (TECHNIQUE: CAVE, HOPPENFELD AND DEBOER)
- TRANSVERSE APPROACH TO THE MENISCUS
- LATERAL APPROACH TO THE KNEE (TECHNIQUE: BRUSER, BROWN ET AL, HOPPENFELD AND DEBOER)
- EXTENSILE APPROACH TO THE KNEE (TECHNIQUE: FERNANDEZ)
- DIRECT POSTERIOR APPROACH (TECHNIQUE: BRACKETT AND OSGOOD; PUTTI; ABBOTT AND CARPENTER)
- DIRECT POSTEROMEDIAL APPROACH TO THE KNEE FOR TIBIAL PLATEAU FRACTURE (TECHNIQUE: GALLA AND LOBENHOFFER AS DESCRIBED BY FAKLER ET AL.)
- DIRECT POSTEROLATERAL APPROACH (TECHNIQUE: MINKOFF, JAFFE, AND MENENDEZ)
THANK YOU