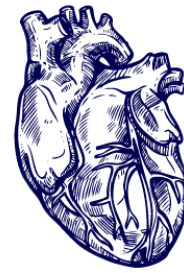


Primary Cast Episode 15 - Lower Limb Anatomy Part 2

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Primary Cast

1. The Knee

Please demonstrate the bony features on this xray of a knee:

You must be able to identify main features on an xray of the knee

These include:

- Features of the femur - medial and lateral condyles & epicondyles, the adductor tubercle
- Features on the tibia - medial and lateral condyles that form the tibial plateau. The intercondylar eminence in the middle of the plateau which is formed by the medial and lateral intercondylar tubercles. Further distally on the tibia is the tibial tuberosity
- Features of the fibula - the head and the tibiofibular joint which is where it articulates with the tibia
- Also the patella

What factors stabilise the knee joint?

- Muscular and ligamentous factors. Little to no bony contribution
- In the knee, it's primarily the strength and actions of surrounding muscles and their tendons. Most important = quadriceps femoris especially the vastus lateralis and medialis
- Ligaments connecting the femur and tibia - the main ones being the anterior and posterior cruciates and medial and lateral collaterals.

Describe the movement of the knee joint and the muscles involved

- Extension - quadriceps femoris
- Flexion - semitendinosus, semimembranosus, biceps femoris
- Medial rotation when flexed - semitendinosus, semimembranosus. When non weight bearing and knee extended - popliteus
- Lateral rotation when flexed - biceps femoris

Describe the process of the locking and unlocking of the knee as the joint is extended and flexed.

- When going from flexion to extension, the lateral condyle completes its extension just short of full extension, the lateral condyle then rotates forward around a taut ACL and the medial condyle glides backwards as full extension approaches. The result is approximately 10 degrees of hyperextension.
- In this position the knee is passively 'locked'
- The knee unlocks through contraction of the popliteus, rotating the femur laterally on the tibial plateau to allow flexion

2. Ligaments

Describe the anatomical features and attachments of the cruciate ligaments

(if you cross your legs while standing, your legs form the arrangements of the cruciates for whichever leg is in front)

- Anterior and posterior cruciates (posterior is shorter and stronger)
- Intracapsular but extrasynovial
- Cross each other in the form of an X, with the anterior lying in front
- Anterior Cruciate: arises from the anterior intercondylar eminence, passes superiorly and posterolaterally to insert on the medial aspect of the lateral femoral condyle.
- Posterior Cruciate: arises from the posterior intercondylar area of the tibia, passes superiorly and anteromedially to insert on the lateral aspect of the medial femoral condyle.

What are the actions of the cruciates?

- Most important factor in stabilising the knee
- Anterior cruciate prevents posterior movement of the femur on the tibia - limiting hyperextension of the knee
- Posterior cruciate limits anterior movement of the femur on the tibia and prevents hyperflexion of the knee

Please identify the other ligaments of the knee joint and their attachments

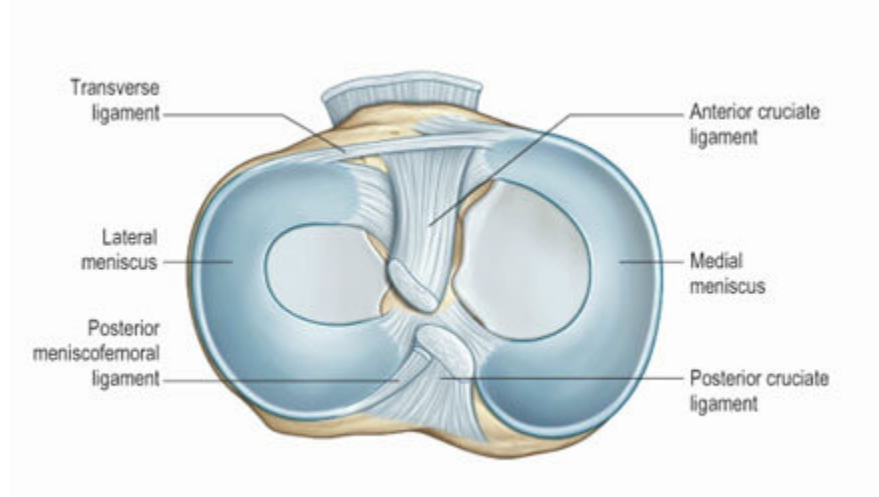
- Patellar ligament - apex of patella to the tibial tuberosity
- Fibular (or lateral) collateral ligament - from the lateral epicondyle of the femur to the lateral surface of the fibular head
- Tibial (medial) collateral ligament - medial epicondyle of the femur to the lateral and superior aspect of the tibia. Has a deep component that attached to the medial meniscus
- posterior oblique
- arcuate ligament

What are the actions of the collateral ligaments?

They are taut in extension and relax in flexion. Assist with knee stability in extension.

3. Menisci and capsule

What are the attachments of the menisci?



- Attached to the intercondylar area of the tibia, C shaped fibrocartilage
- Thickens towards the joint margins
- External parts attached to the capsule
- 2 ligaments - coronary ligaments from the articular margins of the femur and tibia
- Medial meniscus: anterior horn attached to the intercondylar area of the tibia in front of the ACL and the posterior horn in front of the PCL. Firmly attached to the deep medial collateral ligament. Less mobile than the lateral meniscus.
- Lateral meniscus: both horns attached to the intercondylar area of the tibia immediately in front of and behind the intercondylar spine.

Describe the capsular attachments of the knee

- Attached to the margins of the articular surfaces
- Femoral attachments -to the proximal margin of the condyles posteriorly.
- Anteriorly there is a deficit allowing for the suprapatellar bursa, capsule blends with the patella retinacula and ligament
- Laterally - passage of popliteus tendon, attached to the head of the fibula
- Medially - deep component of the MCL and meniscus
- There is a weak attachment to both menisci

Describe the articulations between the tibia and the fibula

Tibiofibular joint superiorly and the tibiofibular syndesmosis inferior.

TF joint - synovial joint between the fibular head and the tibial condyle

TF syndesmosis - a compound fibrous joint which is part of the interosseous membrane and the anterior/posterior tibiofibular ligaments

4. Popliteal Fossa

What are the boundaries and contents of the popliteal fossa? (note - they can show you the dissection image from the book)

- Superior border: biceps femoris laterally and the semimembranosus medially
- Inferior border: medial and lateral heads of gastroc as well as the plantaris muscle laterally
- Contents (from medial to lateral) popliteal artery, popliteal vein (from the small saphenous), tibial nerve which branches to the common fibular nerve - note, that can help you decide if it is the left or right side because the common fibular nerve always goes towards the fibula which is lateral

5. Nerves

Outline the course of the common fibular nerve and its branches

- Originates from the sciatic nerve as it bifurcates in the apex of the popliteal fossa
- Passes over the posterior part of the head of the fibula and then winds around the fibula neck
- Divides into the superior and deep fibular nerve and also gives a branch to the knee joint
- The common fibular nerve supplies the skin of the posterior leg
- The superficial branch does the motor supply to the lateral compartment and the sensory supply to the distal $\frac{1}{3}$ of the anterior leg and foot
- The deep branch provides the motor supply to the anterior muscles of the leg and the dorsum of the foot, as well as the sensory supply to the first webspace (*a favourite question for the MCQ*)

What functional deficit results from injury to the common fibular nerve and why?

- Foot drop - loss of innervation of extensor muscle function (tibialis anterior, extensor digitorum longus, fibularis tertius, extensor hallucis longus)
- High stepping gait
- Inability to evert foot - due to loss of innervation to fibularis longus and brevis
- Sensory loss to 1st webspace, dorsum of foot

Outline the course of the tibial nerve

- Formed at the apex of the popliteal fossa by the bifurcation of the sciatic nerve
- Runs vertically in the popliteal fossa with the popliteal artery, passing between the heads of gastroc and deep to the tendinous arch of the soleus
- Runs inferiorly in the tib post with the posterior tibial vessels
- Divides into medial and lateral plantar nerves under the flexor retinaculum
- Has only one cutaneous branch that is the sural nerve

What functional deficit results from a tibial nerve injury at the knee and why?

- Motor loss: Unable to stand on tiptoes due to the loss of plantar flexors - soleus , tibialis posterior, flexor digitorum longus and flexor hallucis longus. Also loss of ability to flex the toes. Inversion weakened but still possible due to tibialis anterior
- Sensory loss: Loss of sensation over the sole of the foot from loss of the medial calcaneal, medial and lateral plantar nerves.

6. Vascular Supply**How does the popliteal artery supply the leg and foot?**

- Popliteal artery divides into posterior and anterior tibia; arteries at the lower border of the popliteus.
- The fibular artery (which supplies posterior and lateral compartments) branches of the posterior tibial artery. The bit before they divide is sometimes called the tibioperoneal trunk.
- Posterior tibial artery runs in the posterior compartment and is then palpable posterior to the medial malleolus. It then divides into the medial and lateral plantar arteries to the sole of the foot.
- The anterior tibial artery runs in the anterior compartment and then crossed =anteriorly over the ankle to become the dorsalis pedis

Commencing with its origin in the foot, describe the course and relations of the long saphenous vein

- Commences at the medial side of the dorsal venous arch
- Courses upward in front of the medial malleolus
- Crosses behind the medial border of the tibia and passes behind the knee
- Travels up the medial aspect of the thigh to pass through the cribriform fascia where it joins the femoral vein
- Perforating veins connect the long saphenous to the deep system in the foot, the mid calf and the thigh

7. Anterior Compartment of the leg**Identify the muscles of the anterior compartment of the leg and describe their attachments**

- Tibialis anterior
 - Originates from the lateral condyle and the superior lateral surface of the tibia and the interosseous membrane.
 - Attaches to the medial cuneiform and base of the first metatarsal.
 - Dorsiflexes and everts the foot
- Extensor digitorum longus
 - Originates from the lateral condyle of the tibia and the superior-medial fibula and interosseous membrane

- Attaches to the middle and distal phalanges of the lateral 4 digits
- Dorsiflexes ankle and extends the lateral 4 digits
- Extensor hallucis longus
 - Arises from the middle anterior fibula and the interosseous membrane
 - Attaches to the dorsum of the base of the distal phalanx of the great toe
 - Dorsiflexes the ankle and extends the toe
- Fibularis tertius
 - Originates from the inferior $\frac{1}{3}$ of the anterior fibula and the interosseous membrane
 - Attaches at the base of the 5th metatarsal
 - Dorsiflexes and everts the foot

What nerves supply the muscles of the anterior compartment?

- The deep fibular nerve
- Tibialis anterior is supplied by L4/L5 whereas the others are L5/S1

8. Lateral compartment

Identify and describe the fibularis muscles

Fibularis Longus, Brevis and Tertius (which is actually in the anterior compartment & already covered)

Fibularis Longus

- Originates from the head and upper shaft of the fibula
- Passes deep to the superior fibular retinaculum, behind the lateral malleolus then deep to the inferior retinaculum
- It then passes inferior to the fibular trochlear of the calcaneus, through a groove on the cuboid and crosses the sole of the foot to insert on the base of the first metatarsal and the medial cuneiform

Fibularis Brevis

- Originates on the distal shaft of the fibula.
- Passes behind the lateral malleolus and superior to the fibular trochlea of the calcaneus.
- Inserts on the base of the 5th metatarsal

What nerve supplies these muscles?

Fibularis longus and brevis are supplied by the superficial fibular nerve
Fibularis tertius is supplied by the deep fibular nerve

What are the actions of the fibular muscles?

- Evert the foot
- Stabilise the foot in the 'toe-off' phase of walking and running
- Weak plantar flexion by fibularis longus and brevis as they run posterior to the axis of the ankle joint

- Fibularis tertius has a weak dorsiflexor action (more in line with the other anterior compartment muscles)

What joints are involved with inversion and eversion of the foot ?

- Subtalar or the talocalcaneal joint
- Transverse tarsal joint - which includes the calcaneocuboid and the talonavicular joints

9. Posterior compartment of the leg

What are the muscles in the posterior compartment of the leg

Superficial

- Gastrocnemius
- Soleus
- Plantaris

Deep

- Popliteus
- Flexor digitorum longus
- Tibialis posterior
- Flexor hallucis longus

What are the attachments of the superficial muscles?

- Gastrocnemius
 - the lateral head Originates from the lateral femoral condyle, medial head from the surface of the femur above the medial femoral condyle
 - Inserts onto the calcaneal tendon with fibres from soleus
- Soleus
 - Arises from the posterior aspect of the superior part of the fibula, soleal line and the medial border of the tibia, with a tendinous arch between these attachments
 - Inserts onto the calcaneal tendon
- Plantaris
 - Originates at the inferior end of the lateral supracondylar line of the femur

Describe the actions of the muscles of the deep compartment

Popliteus

- Pulls the lateral meniscus posteriorly during knee flexion
- Assists the posterior cruciate ligament in preventing anterior displacement of the femur on the tibial plateau when standing with the knee flexed
- Also unlocks the knee via laterally rotating the femur

FHL

- Flexes all the joints of the great toe
- Supports the medial longitudinal arch of the foot

FDL

- Flexes the lateral 4 digits
- Supports the longitudinal arches of the foot

Tib post

- Plantar flexion and inversion

Which muscles form the Achilles tendon?

Gastroc and soleus with sometimes input from plantaris

Where does the achilles tendon insert?

The supero-posterior aspect of the calcaneus

What is the nerve supply to these muscles?

Tibial nerve, which is a branch of the sciatic nerve

What is the blood supply to these muscles?

Gastroc is supplied by the sural artery (a branch of the popliteal)

Soleus is supplied by the posterior tibial and the peroneal arteries

10. Ankle

What structures make up the ankle joint?

Distal ends of the tibia and fibula plus the talus

What movements occur through this joint?

Plantarflexion and dorsiflexion

In what position of the foot is the ankle most unstable and why?

Plantarflexion, because in that position the trochlear (the superior part of the talus which is most narrow at the posterior end) sits the most loosely in the mortise between the malleoli

What are the ligaments that stabilise the ankle?

Lateral ligaments - from the lateral malleolus

- Anterior talofibular ligament - the weakest, injured in inversion injuries
- Posterior talofibular - strong
- Calcaneofibular ligament

Medial ligament (also called the deltoid) - fans out from the medial malleolus to attach to:

- Talus - anterior and posterior tibiotalar
- Calcaneus - tibiocalcaneal ligament
- Navicular - tibionavicular ligament

What structures run posterior to the medial malleolus

From medial to lateral - Tom, Dick and Very Nervous Harry

- Tibialis posterior
- Flexor **D**igitorum longus
- Posterior tibial **A**rtery
- Posterior tibial **V**ein
- Tibial **N**erve
- Flexor **H**allucis longus

11. The foot

Identify the bones of the foot

Talus, calcaneus, cuboid, navicular, cuneiforms (medial, intermediate, lateral), metatarsals and phalanges

Describe the sensory innervation of the foot

- Saphenous nerve supplies the medial dorsum to the base of the big toe
- Superficial fibular nerve supplies the rest of the dorsum
- Deep fibular nerve does the 1st webspace
- Sural nerve does the lateral edge of the foot
- Medial and lateral plantar nerves supply the medial and lateral plantar surface
- Medial calcaneal nerve does the heel

Where would you infiltrate to block these nerves?

Posterior tibial nerve - between the achilles tendon and the medial malleolus

Sural nerve - between the achilles tendon and the lateral malleolus

Identify the structures lying deep to the extensor retinaculum

From medial to lateral (Timothy Has A Very Nasty Dirty Toe)

- Tibialis Anterior
- Extensor **H**allucis Longus
- Ant. Tibial **A**rtery
- Ant. Tibial **V**ein
- Deep fibular **N**erve
- Extensor **D**igitorum longus
- Fibularis **T**ertius

Describe the venous drainage of the foot

- *Superficial and deep veins*
- *Deep veins* are paired with arteries and are internal to the deep fascia
- *Superficial veins* are not accompanied by arteries and are in the subcutaneous space
- Perforating veins provide one way shunting of blood from superficial to deep

- The dorsal venous arch of the metatarsals drains into the dorsal venous arch of the foot.
- Plantar venous network either becomes the medial marginal vein which becomes the great saphenous vein, or the lateral marginal vein which becomes the small saphenous vein