THE LOWER LIMB

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SURFACE MARKINGS

1. BONES & JOINTS

• Superior anterior iliac spine

• Greater tuberosity [trochander] of humerus

A hand's breadth below the iliac crest, easily palpable with the hip adducted, so thet the hip abductors [gluteus minimus, gluteus medius & tensor fasciae latae] are relaxed.

• Ischial tuberosity

The body weight is put on it when the subjects sits. Is covered by the gluteus minimus which slips away when sitting.

Patella

Is freely mobile from side to side

- Condyles of femur
- Condyles of tibia
- Adductor tubercle of femur

Is the first bony prominence met when the hand runs down the medial side of thigh.

- Knee joint line
- Tibial tuberosity

A bony prominence 6cm below the knee where the patellar ligament of rectus femoris inserts.

• Head of fibula

Is easily palpable below the lateral epicondyle of tibia

• Shaft of tibia

Its anterior surface is subcutaneous

- Medial malleolus
- Fibula

Is subcutaneous on its distal 7-10cm.

• Lateral malleolus

Lies inferiorly than the medial malleolus

• Head of talus

Is the block of bone felt in front of malleoli

• Tuberosity of the navicular

A bony prominence 3cm in front of medial malleolus [insertion point of tibialis anterior]

• Base of 5th metacarpal

At the lateral border of the foot, the insertion point of peroneus brevis

- Calcaneus
 - Peroneum tubercle, 2.5 cm below lateral malleolus
 - Sustentaculum tali, 2.5 cm below medial malleolus

2.BURSAE

Some bony prominences of the lower limb have an overlying bursa [risk of inflammation leading to considerable distension].

• Over ischial tuberosity

Is caused by too much sitting [weaver's bottom]

• In front of patella

Prolonged forward kneeling [housemaid's knee], causing prepatellar bursitis

• Infrapatellar bursitis

Inflammation of the bursa over the ligamentum patellae, caused be more erect kneeling

- Bursitis over Achiles tendon, navicular tuberosity or over the phalanges
- Is caused by tight shoes

• Bunion

A thickened bursa on the inner aspect of the 1st metatarsal head, usually associated with hallux valgus deformity.

3. LIMB MEASUREMENTS

• REAL SHORTENING OF LIMB

Actual loss of bone length.

The legs are put into exactly the same position and the **distance between anterior superior iliac spine and medial malleolus** is measured bilaterally.

• APPARENT SHORTENING

May be due to fixed deformity of the limb.

The limbs are positioned parallel [as erect] and the **distance between the umbilicus and medial malleolus is measured**.

Apparent shortening is usually more than the real; if it is less, this can only be explained by an ankylosed hip in the abducted position.

• WHERE IS THE SHORTENING LOCATED?

1. HIP

- a. **Nelaton's line**: line joining superior anterior iliac spine and ischial tuberosity. It should lie above the greater trochanter
- b. Distance between superior anterior iliac spine and greater trochanter
- c. **Bryant's triangle**: the distance between a perpendicular from the superior anterior iliac spine and the greater trochanter [a 90° triangle]

2. FEMUR

Distance from superior anterior iliac spine to the knee joint.

Distance from greater trochanter to the knee joint.

3. TIBIA

Distance of a line joining the knee joint to the medial malleolus

4. MUSCLES & TENDONS

• QUADRICEPS FEMORIS

The prominent anterior bulk mass of the thigh inserting into the patella [more on the medial than lateral side]

• SARTORIUS

The hip is put flexed and externally rotated. Extends from the superior anterior iliac spine to the medial border of the upper tibia, forming the **lateral border of femoral triangle**.

• GLUTEUS MAXIMUS

The bulk of buttock. More prominent with the hip extended.

• GLUTEUS MINIMUS & MEDIUS [HIP ADDUCTORS]

They tighten and become prominent in resistent adduction and abduction of the hip

• TENDONS AROUND THE KNEE

Laterally: 1. Biceps femoris tendon, inserting into the head of fibula

- 2. Iliotibial tract [tensor fasciae latae]: 2.5cm in front of lateral tibial condyle
- 3. Vastus lateralis tendon
- Medially: 1. Semitendinous [laterally]
 - 2. Semimembranosus
 - 3. Gracilis [medially]
 - 4. Sartorius
- ACHILLES TENDON

Fusion of the tendons of the **gastrocnemius and soleus** muscle, inserting into the **calcaneus**.

• ANKLE TENDONS

IN FRONT OF MEDIAL MALLEOLUS

- **Tibialis anterior tendon** [inserts into the navicular and base of 1st metatarsal], medially
- Extensor hallucis longus tendon [middle]
- Extensor digitorum longus tendon [laterally]

TENDONS BELOW THE LATERAL MALLEOLUS

- Peroneus *longus*
- Peroneus brevis

TENDONS BEHIND THE MEDIAL MALLEOLUS

From medial to lateral, under the **flexor retinaculum**, pass:

- 1. Tibialis posterior
- 2. Flexor digitorum longus posterior tibial artery and venae commitantes tibial nerve
- 3. Flexor hallucis longus
- 4. Achilles tendon

5. VESSELS

• FEMORAL ARTERY

Passes below the inguinal ligament at the **mid-inguinal point** [half the distance between superior anterior iliac spine and pubic symphysis]; it then lies [SFA] in a **line towards the adductor tubercle** with the hip somewhat flexed and externally rotated.

• **FEMORAL NERVE**: a finger's breadth laterally

• FEMORAL VEIN

Immediately posteromedially to the artery

• POPLITEAL ARTERY

Inside the popliteal fossa, with the knee flexed and the fingers pressing firmly towards the back of femur.

• DORSALIS PEDIS [absent in 14%]

On the **dorsum of the foot**, between the tendons of extensor hallucis longus and extensor digitorum.

• POSTERIOR TIBIAL ARTERY [absent in 5%]

A finger's breadth posteroinferiorly to the medial malleolus

• LONG SAPHENOUS VEIN

Always present in front of medial malleolus. Anterior to it lies the saphenous nerve.

The **saphenofemoral junction** in the groin lies 2.5cm below the inguinal ligament and 2.5 cm medial to femoral pulse [**one finger lateral to the pubic tubercle**]

• SHORT SAPHENOUS VEIN

Behind the **lateral malleolus**, ascending **halfway between the edge of fibula and the Achilles tendon**. Posterolaterally to it lies the **sural nerve**.

6. NERVES

• FEMORAL NERVE

Emerges below the inguinal ligament, a finger's breadth lateral to the femoral pulse. Its course is only 5 cm, branching immediately into terminal branches for the quadriceps femoris.

• SCIATIC NERVE

Commences at the **midpoint between superior anterior iliac spine and ischial tuberosity**. Curves outwards and downwards, passing at the **midpoint between the greater trochanter and ischial tuberosity**. Continues vertically downwards, lying on the **midline of the posterior thigh surface**. Above the true popliteal fossa it divides into the **tibial nerve** [medially] and the **common peroneal nerve** [lateral]

• COMMON PERONEAL NERVE.

It winds round the neck of fibula, lying superficially. Injury there will be followed by foot drop. It splits into superficial and deep peroneal nerve.

BONES

1. OS INNOMINATUM [INNOMINATE BONE]

Fusion of ilium, ischium and pubic bone.

2. THE FEMUR

Is **the longest bone** of the body [**45cm**, the same length as vas deferens, spinal cord, thoracic duct, distance from incisor teeth to cardia]

• HEAD

Comprises 2/3rds of a sphere, facing upward, medially and forwards. Is covered with cartilage, except the **central fovea** where the **ligamentum teres** is attached. Blood supply to the head is derived from:

- a. vessels traveling up from the diaphysis
- b. vessels from the hip synovial capsule
- c. vessels from ligamentum teres

• NECK

5cm long, forming a 125° angle to the shaft.

- Greater trochanter [laterally], the insertion point of gluteus minimus ans medius.
- Intertrochanteric line [anteriorly]
- Lesser trochanter [medially], insertion of iliopsoas
- Trochanteric crest [posteriorly]

FRACTURES OF THE NECK OF FEMUR

- **Subcapital** [beneath the head]
- Cervical [at the midpoint]
- Basal

• Pertrochanteric

Neck fractures interrupt the blood supply from the diaphysis; if the retinacula is also torn, the result will be **avascular necrosis** of the head. This is more common in fractures closer to the head while it almost never happens with pertrochanteric fractures.

• SHAFT

Cylindric at its middle, flattens posteriorly at its extremities

- Linea aspera [a strong posterior crest]
 - Superiorly
 - gluteal tuberosity [laterally]
 - spiral line
 - Inferiorly
 - lateral supracondylar ridge
 - medial supracondylar ridge, leading to
- Adductor tubercle
- Popliteal surface between the two supracondylar ridges



• The bones of the upper lower limb [anterior view]

- Two condyles [lateral & medial]
 - intercondylar notch [posteriorly]
 - articular surface for the patella [anteriorly]

FRACTURES OF THE SHAFT

Are accompanied by considerable shortening due the action of the strong surrounding muscles.

• Proximal fractures

The proximal segment is flexed by iliopsoas and abducted by gluteus minimus-medius, while the distal segment is pulled medially by the adductor muscles. Reduction should be performed initially by powerful traction followed by proper manipulation.

• Distal fractures [rare]

The distal part is tilted backwards by the action of gastrocnemius. The popliteal artery may thus be torn.

3. THE PATELLA

A sesamoid bone within the tendinous expansion of quadriceps femoris, which continues distally as the ligamentum patellae. On its posterior surface [which has 2 facets] the patella is covered by cartilage, articulating with the patellar surface of the two femoral condyles. Lateral dislocation of the patella is restricteed because of:

- a. medial insertion of vastus medialis tendon into the patella
- b. prominent articular surface of lateral condyle

The patella may **fracture by violent quadriceps contraction**, in which case the tear might extend proximally [into the tendon expansion] or distally [into the ligamentum patellae]; the upper fragment could then be pulled proximally and operative repair is necessary.

The patella can be excised without leaving any knee joint deficienies.

4. TIBLA

- HEAD
 - Medial & lateral condyles
 - Intercondylar area
 - a. Intercondylar eminence
 - b. Medial intercondylar tubercle
 - c. Lateral intercondylar tubercle
- TIBIAL TUBEROSITY

A hand's breadth below the patella, into which the **patellar ligament** is attached. Is subcutaneous and bears in front of it only the **infrapatellar bursa**

• Shaft

Triangular. The anterior border and the anteromedial surface are subcutaneous through its whole length.

Its posterior surface bears the **soleal line** for the attachment of soleus muscle. Just above this line inserts the popliteus muscle.

• LOWER END

Is quadrilateral bearing the:

- a. Fibular notch, partaking in the lower tibiofibular joint
- b. Medial malleolus, with a groove for tibialis posterior tendon just posterior to it



• The bones of lower part of leg [anterior view]

c. Articular surface for the upper ankle joint

5. FIBULA

FUNCTIONS

- a. Origin of muscles
- b. Partaking in the ankle joint
- c. Pulley function for the peroneus longus and brevis tendons

HEAD

• Styloid process, for the insertion of biceps

NECK

• The common peroneal nerve winds round it

SHAFT

• Quadrilateral

LOWER END

- Lateral malleolus
- Medial rough surface for the lower tibio-fibular joint
- Articular facet for articulation with talus
- Posterior groove for peroneus longus and brevis tendons

6. THE BONES OF THE FOOT

- 1. Calcaneous
- 2. Talus
 - Superior articular surface
 - Lateral tubercle
 - Sustentaculum tali
- 3. Navicular [articulating with 2nd and 3rd cuneiform bones and talus]
- 4. **Cuboid** [articulating with 4th & 5th metatarsals and calcaneous]
- 5. 1st cuneiform bone [medially]
- 6. 2nd cuneiform
- 7. **3rd cuneiform** [laterally]
- 8. 5 metatarsal bones

The 5th has a **tuberosity** for the insertion of peroneus longus

Below the heads of the metatarsals [especially the 1st which has its epiphyseal line at its head and not the base as the others] **sesamoid bones** develop

9. Phalanges



• The bones of the foot

MUSCLES OF THE LOWER LIMB

• GLUTEAL REGION & POSTERIOR THIGH

Superficial Intermediate Deep gluteus maximus

gluteus medius

gluteus minimus

piriformis

obturator internus

gemellis

quadratus femoris

adductor magnus

adductor magnus

semimembranosus

semitendinosus

biceps femoris [long head]

biceps femoris [short head]

gastrocnemius

plantaris

• ANTERIOR ASPECT OF THIGH

Superficial [laterally to medially]

Sartorius Tensor fascia latae Quadriceps femoris rectus femoris vastus medialis vastus lateralis

Adductors

Deeper layer

Iliopsoas [iliacus & psoas major] Pectineus Adductor longus Adductor brevis Gracilis Adductor magnus Vastus intermedius [quadriceps]

• ANTEROMEDIAL ASPECT OF THIGH

Rectus femoris Sartorius Iliacus Vastus intermedius Vastus lateralis Pectineus



• The gluteal muscles [posterior view. On left superficial, right deeper layer



• Anterior thigh muscles [A superficial, B deep]

Adductor longus Gracilis Adductor brevis Adductor magnus

• MEDIAL ASPECT OF THIGH

Superficial layer

Sartorius Adductor longus Vastus medialis

Deeper layer

Gluteus maximus Gracilis Adductor magnus Semimembranosus Semitendinosus

• LATERAL ASPECT OF THIGH

Gluteus maximus Tensor fasciae latae Biceps femoris [short & long head] Iliotibial tract Vastus lateralis Rectus femoris

• ANTERIOR TIBIAL COMPARTMENT

Tibialis anterior Extensor hallucis longys Extensor digitorum longus Peroneus tertius *anterior tibial vessels deep peroneal nerve*

• PERONEAL COMPARTMENT

Peroneus longus Peroneus brevis superficial peroneal nerve

• POSTERIOR COMPARTMENT

Deep

Flexor digitorum longus Tibialis posterior Flexor hallucis longus *posterior tibial vessels tibial nerve peroneal vessels*

Superficial

Gastrocnemius Plantaris Soleus



• Posterior muscles of the thigh [A superficial, B deep layer]



• Muscles of the leg [A anterior, B anterolateral]

JOINTS AND MUSCLES

1. THE HIP

Is **the largest** joint of the body, **ball & socket type**, with 3 degrees of movement [flexion / extension, adduction, rotaion, circumduction].

• THE JOINT

The head of femur and the acetabular fossa of os innominatum [deepened by the accetabular labrum, a fibrocadtilage lip] form the bony parts of the joint. The accetabulum has a lunate, C-shaped articular surface and an oval non-articular surface.

The **lower accetabular notch** is closed off by the **transverse accetabular ligament** from which arises the **ligamentum teres**, a synovial tube fixed to the **femur fovea** [tip of the head]; it is open inferiorly at the **accetabular foramen** which is continuous with the synovial membrane covering the fat pad in the non-articular part of the accetabular fossa. Above the membrane is the transverse accetabular ligament. The ligamentum teres conveys a branch of the **accetabular artery** [an obturator artery branch], supplying the head of femur.

• SYNOVIAL CAPSULE

Is attached, anteriorly, to the **margins of the accetabulum [labrum]** and the **transverse ligament**, distally, to the **trochanteric line** and the **bases of the two trochanters**, and posteriorly to the **neck of femur**, 12mm proximal to the trochanteric crest.

Capsular fibres are reflected proximally to the femoral neck as **retinacula**, providing a pathway for blood supply from the femur diaphysis to the head of femur.

The capsule is **weak anteriorly**, at the site covered by the **psoas bursa**, but is guarded by the **psoas tendon**.

• LIGAMENTS

- 1. **Iliofemoral ligament of Bigelow** [inverted, Y-shaped, the strongest]. Arises from the anterior inferior iliac spine and is attached to the trochanteric line
- 2. **Pubofemoral ligament** [weak]. From the iliopubic junction to the medial site of capsule.
- 3. Ischiofemoral, from the ischium to the greater trochanter, lying posteriorly.
- 4. Transverse accetabular ligament

• MUSCLES ACTING ON THE HIP

- Relations of muscles to hip joint Anteriorly:
 - 1. pectineus
 - 2. Iliopsoas

femoral artery, vein and nerve

Laterally:

Above the iliofemoral ligament

1. rectus femoris



• The hip joint

2. gluteus minimus

3. gluteus medius

Below the ligament

- 1. tensor fasciae latae
- 2. sartorius

Posteriorly:

- 1. obturator internus
- 2. gemelli
- 3. quadratus femoris
- 4. gluteus maximus
 - sciatic nerve

Superiorly:

1. rectus femoris

Inferiorly:

- 1. obturator externus
- FLEXORS
 - 1. Iliopsoas, lying on the ilipsoas groove of iliopubic bone. Is a fusion of:
 - a. iliacus [from iliac crest to lesser trochanter]
 - b. psoas major [from transverse processes of L1-L5 to lesser trochanter]
 - c. psoas minor
 - 2. Rectus femoris [from anterior inferior iliac spine to the patella and tibial tuberosity]
 - 3. Sartorius [from anterior superior iliac spine to the medial tibial condyle]
 - 4. **Petineus** [from iliopubic crest to the spiral line of posterior surface of femur, below the two trochanters]
- EXTENSORS
 - 1. Gluteus maximus. From the posterior superior iliac spine, ilium, ischium and coccyx
 - to the gluteal tuberosity on the posterior aspect of femur. Acts also as a lateral rotator.
 - 2. The hamstrings. They all originate from the ischial tuberosity.
 - a. biceps femoris [inserts to the head of fibula]
 - b. semitendinosus [inserts to the medial tibial epicondyle]
 - c. semimembranosus [inserts to the medial tibial epicondyle]
- ADDUCTORS

They originate from the **pubic bone or the pubic ramus of ischium** and all of them have a linear attachment to the **linea aspera**. They are assisted by pectineus and gracilis.

- 1. Adductor longus
- 2. Adductor brevis
- 3. Adductor longus. Is the deepest with the most extensive origin and insertion, reaching distally to the adductor tubercle. The superficial femoral artery passes through a tunnel in its aponeurosis, the adductor canal or adductor hiatus.
- 4. Pectineus. From the iliopubic crest to the spiral line. It also flexes the thigh.
- 5. **Gracilis**. From the pubic tubercle to the lateral tibial condyle. It flexes and rotates the leg medially.
- ABDUCTORS

They are mostky dorsal muscles, in the gluteal region, originating from the ilium and inserting into the **greater trochanter**.



• Hip ligaments

Gluteus medius. From posterior surface of ilium to the greater trochanter. It also acts as extensor.

- 1. Gluteus minimus. From the mid-posterior surface of ilium to the greater trochanter.
- 2. Piriformis. From anterior sacral surface to the greater trochanter.
- 3. **Tensor fasciae latae**. From anterior inferior iliac spine, forming the **iliotibial tract**, to the lateral head of fibula.

Superior to piriformis emerge the **superior gluteal artery and nerve**. Inferior to it appear the **internal pudental artery**, the **pudental nerve**, the **sciatic nerve** and the **inferior gluteal artery**.

• LATERAL ROTATORS [EXTERNAL]

Largely dorsal muscles, in the **deep gluteal region**, comprising the **rotator group**. They originate from **sacrum or ilium** and insert into or adjacent to the **greater trochanter**. They are all innervated by twigs of the **sacral plexus**, apart from obturator externus.

1. Piriformis

- 2. Superior gemellis
- 3. Obturator internus
- 4. Inferior gemellis
- 5. Obturator externus [obturator nerve]
- 6. Quadratus femoris
- MEDIAL [INTERNAL] ROTATORS

These are muscles that cross the hip joint, like

- 1. Iliopsoas
- 2. Posterior belly of adductor magnus
- 3. Sartorius
- 4. Anterior fibres of gluteus minimus & medius
- 5. Semitendinosus
- 6. Semimembranosus

• BLOOD SUPPLY

1. **OBTURATOR ARTERY** [branch of the internal iliac].

It passes through the **obturator foramen**, giving off an **anterior branch** to supply the thigh adductors and a **posterior branch** to supply the hamstrings, which gives off the **accetabular artery** for the head of femur. These two branches anastomose freely.

2. PROFUNDA FEMORIS ARTERY.

Disappears behind and into the **adductor longus**. It gives off the **lateral circumflex**, the **medial circumflex** and the **perforating branch**.

The **femoral artery** lies between **two motor nerve teritorries**, that of the **obturator nerve medially** and that of the **femoral nerve** [branching in a number of twigs as it exits the groin] laterally. No motor nerve crosses the anterior aspect of the artery and is crossed only by the superficial inferior epigastric vein [long saphenous tributary].

• SURGICAL APPROACH TO THE HIP

• LATERAL APPROACH

The fibres of the tensor fasciae latae are split, followed by splitting the gluteus minimus and medius fibres. The gluteal muscles insertions to the greater trochanter can then be detached.

• ANTERIOR APPROACH



• Hip vasculature

The rectus femoris origin is divided between the sartorius and tensor fasciae latae, exposing the anterior aspect of the joint. If more room is needed, the glutei minimus and medius could be detached from the ilium bone.

• POSTERIOR APPROACH.

An angled incision from the posterior superior iliac spine to the trochanter, which then goes vertically downwards. Gluteus maximus is split along its fibres and its tendinous insertion is incised. Gluteus minimus and medius are detached from their insertion into greater trochanter.

• CLINICAL FEATURES

• HILTON'S LAW.

The nerves crossing a joint supply the muscles acting on the joint and the joint itself [femoral, sciatic, obturator; however, these nerves also supply the knee joint]

• TRENDELENBURG'S TEST

The hip stability on standing position depends on the strength of muscles and the integrity of the head-neck of femur. When standing, the powerful contraction of the abductor muscles [to maintain hip fixation] causes the opposite side of pelvis to rise slightly. If there is any defect, [i.e. paralysis due to osteomyelitis, congenital dislocation, non-united fracture etc] the opposite side of pelvis tilts downwards. The test is then considered positive. The patient walks with a dipping gait.

• hip dislocation

The hip dislocation is usually backwards [**posterior**] caused by force with the hip flexed. If the hip was abducted, there is usually a concomitant fracture of the posterior accetabular lip. If the hip was adducted, dislocation can occur without accetabular fracture. If the femoral head is violently thrust through the accetabulum, the dislocation is **central**. **Anterior dislocation** is rare.

2. THE KNEE JOINT

A hinge joint, formed by the **femoral condyles** articulating with the **patellar articular surface** and the **tibial condyles**.

• INTERIOR STRUCTURES

1. MENISCI [LATERAL & MEDIAL]

They are **semilunar cartilages covering the outer part of tibial condyles**, attached to the tibial intercondylar area and the joint capsule. Their lip is covered by the **coronary ligament**. They only slightly deepen the articulation and can be removed without affecting the function of the joint.

2. CRUCIATE LIGAMENTS

- **anterior**, from the anterior tibial intercondylar area to the intercondylar notch of femur, **resisting hyperextension**.
- **posterior**, from the posterior tibial intercondylar area to the intercondylar notch of femur, **resisting hyperflexion**.

3. INFRAPATELLAR FOLD

Connects the intercondylar notch to the synovial fold below the patella [alar fold]



• The knee: anterior aspect

• JOINT CAPSULE [SYNOVIUM]

Is attached to the **margins of the articular surfaces**. The joint cavity communicates with the **suprapatellar bursa** [between femur and quadriceps], the posteromedially **lying bursa beneath the gastrocnemius**, the **semimebranous bursa** and the **popliteal bursa** [posterolaterally]. The **popliteus tendon** constricts the capsule on its posterolateral aspect.

• LIGAMENTS

1. MEDIAL [TIBIAL COLLATERAL LIGAMENT]

A band-like ligament, with 3 tendons raving above it [sartorius, gracilis, semitendinosus] and 1 posteriorly [semimembranosus]

2. LATERAL [FIBULAR] COLLATERAL LIGAMENT

A cord like ligament inserted to the head of fibula, separated from the capsule by the popliteus tendon. Anterior to it lies the **iliotibial tract** [protecting thus this exposed part of the joint] while posteriorly lies the **lateral head of gastrocnemius**.

- 3. ANTERIOR LIGAMENTS
 - Patellar ligament
 - Medial patellar retinacula
 - Lateral patellar retinacula
 - Infrapatellar fat pad
 - Prepatellar bursa

• MOVEMENT

Flexion / extension and just a slight rotation when flexed.

In full extension the knee is rigid, as the large medial tibial condyle rides forward, **screwing thus the joint**. The first step in flexion is **unscrewing** it [or **internal rotation**], brough up by the action of **popliteus muscle** [originates from the side of the lateral femoral condyle, posteromedially to the joint, and inserts into the back of the upper end of tibia]

• MUSCLES ACTING ON THE JOINT

- EXTENSORS
 - a. **Quadriceps femoris,** inserting into the tibial tuberosity via the patellar ligament. Is innervated by the **femoral nerve**.
 - 1. Rectus femoris, originating from anterior inferior iliac spine
 - 2. Vastus medialis, originating from the proximal part of femur
 - 3. Vastus lateralis, originating from the proximal posterior part of femur
 - 4. Vastus intermedius, originating from the anterior part of proximal femur
- FLEXORS
 - a. Hamstrings, innervated by the tibial nerve [sciatic]

1. **Biceps femoris**, from the ischial tuberosity and proximal dfemur to the head of fibula.

- 2. Semitendinous, from the ischial tuberosity to the medial tibial condyle
- 3. Semimembranosus, from the ischial tuberosity to the posterior tibial condyle
- b. **Gracilis**, from the pubic ramus to the medial aspect of the neck of tibia. Is innervated by the **obturator nerve**



• The knee: posterior view

- c. **Sartorius**, from anterior superior iliac spine to the medial aspect of the neck of tibia. Is innervated by the **femoral nerve**.
- d. **Gastrocnemius**. From the posterior aspect of femoral condyles to the calcaneous. Innervated by the **tibial nerve**.
- INTERNAL [MEDIAL] ROTATORS
 - a. Popliteus [tibial nerve]

• CLINICAL FEATURES

Joint stability depends on the strength of muscles and in a second degree to the ligaments [surgical repair of ligaments will be a failure if the muscles are not strong to support it.

THE 3-CS [collaterals, cruciates, cartilages]

- Collateral ligaments
 - The medial [tibial] can be torn by violent abduction
 - The lateral [fibular] is torn by violent adduction

The extended knee is rocked away from the affected side.

• Cruciates

Can be torn by **abduction / adduction** together with the collaterals.

- The anterior is torn by hyperextension or anterior dislocation
- The **posterior** is torn by **posterior dislocation**
- Cartilages [menisci]

Can tear **only when the knee is able to rotate, i.e. when flexed**. The knee **"locks"** [cannot be fully extended], because the displaced cartilage segment lodges between the condyles.

- **Medial**. Common injury in football players. The flexed knee is abducted and externally rotated. The cartilage is sucked in and then is split by the femoral and tibial condyles.
- Lateral. Is less common injury and may follow severe adduction and internal rotation.

3. TIBIOFIBULAR JOINTS

1. PROXIMAL [SUPERIOR] JOINT

Horizontal and oblique articular surfaces and a quite taught joint capsule.

FUNCTIONS:

- a. Dissipation of torsional stress applied at the ankle
- b. Dissipation of lateral tibial movements
- c. Tensile weight bearing

2. INTEROSSEOUS MEMBRANE

Connects the two inner aspects of tibia and fibula. It is pierced at the level of **tibial tuberosity** by the **anterior tibial artery** and at the level of the **distal end of the tibial shaft** by the **perforating branches of the peroneal artery**.

3. INFERIOR [DISTAL] JOINT

A fibrous joint just above the ankle.



• The knee: cartilages & ligaments

4. THE ANKLE

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• THE JOINT

A hinge joint between the head of tibia and malleoli with the articular surface of talus. The joint capsule is weak anteriorly and posteriorly and is reinforced by:

- 1. Lateral collateral ligament [anterior and posterior talo-fibular ligament]
- 2. Medial collateral ligament [deltoid, tibio-talar ligament]
- 3. Tibio-fibular ligament [anterior and posterior]

• MOVEMENTS

Flexion [plantar] Extension [dorsiflexion] Inversion /eversion [medial / lateral]

• MUSCLES ACTING ON THE ANKLE

• DORSIFLEXORS

- 1. Tibialis anterior
 - From the anterolateral surface of tibia to the base of 1^{st} metatarsal
 - Dorsiflexion and inversion of foot
 - Innervated by the **deep peroneal nerve**
- 2. Extensor digitorum longus
 - From the medial surface of fibula and lateral tibial condyle to the 2nd and 3rd phalanges of 2nd 5th toes.
 - Extension of metatarsophalangeal joints
 - Deep peroneal nerve

3. Extensor hallucis longus

- From the anteromedial aspect of fibula to the 2nd phalanx of great toe
- Extension of great toe
- Deep peroneal nerve
- 4. Peroneus tertius
 - Anterior aspect of distal fibula to the base of 5^{th} metatarsal
 - Dorsiflexion and foot eversion
 - Deep peroneal nerve
- PLANTAR FLEXORS
 - 1. Gastrocnemius
 - From posterior surface of femoral condyles to calcaneus
 - Tibial nerve
 - 2. Soleus
 - From the soleal line of tibia, interosseous membrane and fibula to the calcaneus.
 - Innervated by the **tibial nerve**
 - 3. Plantaris
 - From the lateral supracondylar ridge to calcaneus.
 - Tibial nerve



• Posterior calf muscles acting on ankle

- From the posterior lateral surface of tibia to the **navicular tuberosity**
- Plantar flexion and foot inversion
- Tibial nerve

5. Flexor digitorum longus

- From posterior surface of medial tibia to the distal phalanges of 2nd 5th toe
- Flexes distal phalanges
- 6. Flexor hallucis longus
 - From posterior aspect of fibula to the pjhalanges of great toe
 - Flexes the hallux
 - Tibial nerve
- 7. Peroneus longus
 - From the proximal fibula to the 5th metatarsal and cuneiform
 - Plantar flexion and foot eversion
 - Superficial peroneal nerve
- 8. Peroneus brevis
 - From distal fibula to the base of the 5th metatarsal
 - Plantar flexion and **foot eversion**
 - Superficial peroneal nerve
- INVERSION [MEDIAL ROTATION] MUSCLES
 - 1. Tibialis anterior
 - 2. Tibialis posterior
 - 3. Extensor hallucis longus
 - 4. Flexor hallucis longus
- Eversion muscles
 - 1. Peroneus lomgus
 - 2. Peroneus brevis
 - **3.** Peroneus tertius
- CLINICAL FEATURES
- SPRAIN: The lateral fibular collateral ligament is torn after forcible adduction / abduction.
- **FRACTURE**: Most common after leg abduction and external rotation of foot. **Pott's fracture:**
 - Pott's fracture:
 - 1st degree: spiral fracture of lateral malleolus
 - 2nd degree: avulsion of medial [tibial] collateral ligaments
 - 3rd degree: the tibia is carried forward and is sheared off against the talus

5. JOINTS OF THE FOOT

- 1. Talo-calcaneal
- 2. Mid-tarsal [between calcaneus- cuboid and navicular-talus

They allow inversion and eversion of foot [rotatory movement]

3. Rest of tarsal joints: allow only a slight gliding movement



• Muscles of the dorsum of the foot

4. Tarsometatarsal joints

- 5. Metatarso-phalangeal joints
- 6. Phalangeal joints

6. THE FOOT

• THE ARCHES

The arches play a significant role in standing and walking and are maintained by:

- 1. The shape of the joints which are interlocking
- 2. The ligaments
- 3. Muscle action

• MEDIAL ARCH

Is higher than the lateral arch and is formed by:

- Calcaneus
- Talus
- Navicular
- Medial 3 metatarsals
- The 3 cuneiforms
- LATERAL ARCH
 - Calcaneus
 - Cuboid
 - The 2 lateral metatarsals

• MOVEMENT

The **heel and the heads of the metatarsals** are the **principal weight bearing points** when standing [the lateral side of the foot and the phalanges contribute to a lesser degree]. The foot plays a double role.

a. provide support for the body weight

b. **provides a springboard during walking and running**. The arches of the foot sink in standing but unlock and become a mobile lever as the foot is raised

SEQUENCE OF STEPPING

- heel is raised
- the metatarsophalangeal joints are flexed [to provide a push off]
- plantar flexion of ankle
- dorsiflexion of the foot to clear the toes
- the heel of the other foot makes contact with the ground
- the hips are swung forwards

• LIGAMENTS

They are much stronger in the palmar aspect of foot.

1. Interosseous ligaments

They cover each joint of the small bones of the foot.

- a. Dorsal interosseous ligaments
- b. Plantar interosseous ligaments



• Major ligaments & tendons of ankle and foot

2. Spring ligament [calcaneo-navicular]

Passes from the sustentaculum tali of calcaneus to the navicular tuberosity. Supports the head of talus and the inferior aspect of mid-tarsal joint.

3. Short plantar ligaments [calcaneo-cuboid]

Supports the inferior aspect of mid-tarsal [transverse tarsal]joint.

4. Long plantar ligament

passes from the calcaneus [plantar surface] to the bases of the 2nd to 4th metatarsals. It is pierced by the tendon of peroneus longus which is inserted into the base of the 1st metatarsal

5. Tibialis posterior and peroneus longus tendons.

They pass on the medial and lateral aspects of the foot sole, forming a **stirrup** between them to support the foot arch.

There are two tendons posterior to the medial malleolus [tibialis posterior and extensor digitorum longus] each one in a separate sheath and another two tendons [peroneus longus & brevis] posterior to the lateral malleolus, but this time in a common synovial sheath

6. Plantar fascia

Is the condensed deep somatic fascia. Arises from the calcaneus and at the heads of the metatarsals forms the **plate of the plantar ligament** [synovial sheath for tendons] and the **superficial** and **deep transverse metatarsal ligaments** which link the heads of the metatarsals.

• MUSCLES OF THE FOOT

- 1st layer
 - 1. Abductor hallucis
 - 2. 2. Flexor digitorum brevis
 - 3. Abductor digiti minimi
- 2nd layer

1. Flexor hallucis longus

Its tendon enters an **osteofibrous tunnel.** In front of it pass the **posterior tibial artery** and the **tibial nerve**, which bifurcates to the **medial** [innervating the $3 \frac{1}{2}$ medial toes] and lateral plantar nerve [innervating the $1 \frac{1}{2}$ lateral toes].

2. Flexor digitorum longus.

Crosses the long flexor hallucis tendon at the navicular tuberosity

3. Quadratus plantae

Acts as a guide wire, modifying the oblique pull of the flexor tendons

- 4. Lumbricals
- 3rd layer
 - 1. Flexor digiti minimi
 - 2. Adductor hallucis [oblique and transverse heads]
 - 3. Flexor hallucis brevis
- 4th layer

1. Three plantar interossei

They adduct the 3 lateral toes

2. Four dorsal interossei

They abduct the tose

3. Tendon of peroneus longus muscle



• Plantar muscles: A superficial, B deeper layer

• BLOOD SUPPLY

The **posterior tibial artery** crosses the ankle sandwiched by the **flexor digitorum longus** and **flexor hallucis longus**. It bifurcates in front of the **osseofibrous tunnel** of the latter into **medial and lateral plantar arteries** which give off branches to the calcaneous. The **tibial nerve** accompanies the artery and bifurcates at the same level to the **medial and lateral plantar nerves**. The medial plantar artery contributes to the formation of the **superficial plantar [pedal] arch** while the lateral in the formation of the **deep plantar arch**. The **plantar metatarsal** and **digital arteries** arise from the arches.

The **anterior tibial artery** also gives **two branches [tarsal]** which contribute to the formation of the two pedal arches.



• The foot vasculature

AREAS OF SURGICAL INTEREST

1. THE FEMORAL TRIANGLE

• **BOUNDARIES**

Superiorly:

• inguinal ligament

Medially

• medial border of adductor longus

Laterally

• medial border of sartorius

Apex

- point where the **medial borders of sartorius and adductor longus cross** Anteriorly [roof]
- Anterioriy [roo
 - **superficial fascia** [the **long saphenous veins**, its **tributaries** and the **superficial inguinal nodes** are contained in the superficial fascial compartment]
 - deep fascia [fascia latta]

Floor [posteriorly]

- iliacus muscle and its fascia [adheres to the inguinal ligament]
- psoas fascia and psoas tendon [separate the femoral artery grom the hip joint]
- pectineus muscle and pectinate fascia
- **adductor longus muscle** [is partially continuous with pectineus; the gap between them is covered by the adductor brevis and the anterior branch of obturator nerve passes there]
- CONTENTS
- 1. Femoral artery and its branches
- 2. Femoral vein and its tributaries
- 3. Femoral nerve
- 4. Deep inguinal nodes

• FASCIA LATA

Is the **deep thigh fascia** which enseaths the whole lower limb. It is attached to the lower limb root, formed by the inguinal ligament, public ischium, sacrum, coccyx and iliac crest.

It is **dense laterally** [where it receives the **tensor fascia latae muscle**] forming the **iliotibial tract** and **posteriorly**, where part of gluteus maximus is inserted into it.

• FEMORAL SHEATH, CANAL & FEMORAL RING

The common femoral artery emerges midway between the anterior superior iliac spine and the pubic symphysis, accompanied by the femoral vein, both of them enclosed in a fascial tube, the femoral sheath. The sheath is derived from the fascia covering the iliacus [posteriorly], the



• The femoral sheath [transverse cut]



• Boundaries of femoral triangle

pectinate fascia [medially] and the extraperitoneal fatty areolar tissue [transversalis fascia] which progects inferiorly in a funnel shape [anterolaterally].

The femoral nerve is outside the femoral sheath, passing below the iliacus fascia. At the lateral edge of the femoral sheath it gives off the lateral cutaneous nerve of the thigh.

The femoral sheath has **3 compartments**, the **arterial**, the **venous** and a medial called the **femoral canal**. The latter has a 12mm diameter, and only the tip of the small finger can feel it. It contains a plug of fat and a constant lymph node, called **Rosenmuller's or Cloquet's node**.

- Boundaries of femoral canal
 - Anteriorly:
 - inguinal ligament
 - Posteriorly:
 - **pectineal ligament** [Astley Cooper ligament], a thickened fascia derived from the periosteum of superior pubic ramus
 - Laterally:
 - femoral vein
 - Medially:
 - the reflected [pectineal] part of inguinal ligament, called the lacunar or Gimbernati's ligament.

Inferiorly, the femoral sheath opens to receive the long saphenous vein [**saphenous opening**] while the superior opening of the femoral canal [along the sharp edge of the lacunar ligament] is called the **femoral ring**.

In the female pelvis, due to its greater width, the canal is somewhat larger, and this is the reason why femoral hernias are more common in women. **Femoral hernias** are never congenital. As the sac enlarges it may protrude through the saphenous opening along the pathway of the superficial epigastric and circumflex iliac venous tributaries, projecting above the inguinal ligament. It may then be difficult to differentiate it from an inguinal hernia; however, the **neck of the hernia is always below the inguinal ligament**.

In case of strangulation [common], the femoral ring can be opened either **by incising the lacunar ligament** [risk of damaging an aberrant obturator artery anastomosing with the pubic ramus of inferior epigastric artery] or **incising the inguinal ligament** directly above [risk of damaging the superficial epigastric artery and vein]

2. INGUINAL LYMPH NODES

- SUPERFICIAL
- 1. Horizontal chain [proximal superficial nodes], parallel to the inguinal ligament Drain the skin and tissues above the superficial somatic fascia of:
 - lower trunk and back [below umbilicus]
 - buttock
 - perineum
 - scrotum & penis [or vulva and lower vagina]
 - uterus, along the round ligament



• Femoral hernia



• The inguinal lymph nodes

2. Longitudinal chain [distal superficial nodes]

They are **along the long saphenous vein**, receiving the bulk of superficial limb lymphatics [apart from some lymphatics that course along the short saaphenous vein and empty in the popliteal fossa]

• DEEP INGUINAL NODES

They lie medial to the femoral vein.

They receive the deep lymphatics of the lower limb. A dozen of **efferent lymph channels** arise from the deep nodes, half of them passing through the **femoral canal** and the other half **along the femoral vessels**, inside or outside the sheath, to drain to the **external iliac nodes**.

• DIFFERENTIAL DIAGNOSIS OF FEMORAL LUMP

- skin, soft tissues \rightarrow sebaceouss cyst, lipoma, sarcoma
- artery \rightarrow aneurysm
- vein \rightarrow saphenous varix
- nerves \rightarrow neuroma
- femoral canal \rightarrow hernia
- psoas sheath \rightarrow psoas abscess
- lymph nodes [the commonest]

• BLOCK NODE DISSECTION OF THE GROIN

The superficial and deep fasciae of the femoral triangle are removed, as well as the saphenous vein and its tributaries and all the fatty tissue, leaving the femoral vessels and rge femoral nerve naked. The inguinal ligament is also lifted or detached and the extraperitoneal external iliac nodes are removed as well.

3. THE ADDUCTOR CANAL [HUNTER'S, SUBSARTORIAL]

At the **apex of the femoral triangle** there are 4 vessels [superficial femoral and profunda femoris arteries and veins] and 2 nerves [nerve to vastus medialis laterally and saphenous nerve anteromedially]

From this point starts the **adductor canal** which transfers the **superficial femoral artery & vein and the saphenous nerve**, which travel on the **medial side of vastus medialis**. The **profunda vessels pass behind the adductor longus**, while the superficial vessels in front of it, covered by the insertion of adductor magnus into the femur. They then appear through the **adductor hiatus [fibrous arch]** to enter the **proximal popliteal fossa**. The anterior aspect of the canal is covered by the sartorius.

The adductor canal is the commonest site of atherosclerotic occlusive disease.

- Boundaries
 - Posteriorly:
 - adductor longus [upper half]
 - adductor magnus [distal half]
 - Anteromedially
 - sartorius:



• The femoral triangle and the adductor canal

- Anterolaterally:
 - vastus medialis

4. THE POPLITEAL FOSSA

A direct continuation of the adductor canal, having a rhomboid [diamond] shape, which, truthfully, is a packed compartment

- **BOUNDARIES**
- Superomedially
 - Semitendinosus
 - Semimembranosus
- Superolaterally:
 - biceps tendon
- Inferiorly:
 - the two heads of gastrocnemius [arising beneath the hamstrings]
- FLOOR
 - popliteal surface of femur
 - posterior aspect of knee joint
 - posterior surface of tibia
 - plantaris and popliteus muscles
- ROOF
 - skin & superficial fascia
 - short saphenous vein [between the two heads of gastrocnemius]
 - sural nerve [between the two heads of gastrocnemius]
 - deep fascia [pierced by the short saphenous at a variable level
- CONTENT
- 1. **Popliteal vein** [medially and anteriorly]
- 2. Tibial nerve [middle, crossing over the popliteal artery more distally]
- 3. Common peroneal nerve [laterally]

The tibial nerve gives off only one branch from its **medial side [safest side for posterior dissection]** from its lateral side emerges the **sural nerve** [which passes above the gastrocnemius] while the trunk of the tibial nerve passes behind the soleus muscle. The common peroneal nerve gives off the **sural communicating branch** and the **lateral cutaneous nerve** before bifurcating into deep and superficial peroneal nerve.

4. Popliteal artery.

Is the deepest structure. It gives off the superior and inferior [medial and lateral] geniculate arteries. At the level above the soleus bufurcates into the anterior tibial artery and the tibioperoneal trunk. [exposure of the tibioperoneal trunk needs detachment of the soleus from its tibial origin].

- 5. Fat
- 6. Politeal lymph nodes



• The popliteal fossa

VESSELS OF THE LOWER LIMB

ARTERIES

• FEMORAL ARTERY

Is the direct continuation of the **external iliac artery** as the latter passes **below the inguinal ligament**, and is called **the common femoral artery**. It gives off three small branches, the **superficial circumflex iliac**, the **superficial inferior epigastric** and the **superficial external pudental**. The latter anastomoses with the obturator artery, a communication site between external and internal iliac systems.

The common femoral artery lies in the **mid-inguinal point** [half distance between superior anterior iliac spine and public bone] and traverses the **femoral canal** [10cm distance] lying rather superficially. It bifurcates within the femoral triagle to the **profunda femoris** which courses **behind the adductor longus** and the **superficial femoral artery** which is its main continuation.

The latter, accompanied by the **saphenous nerve**, enters the **adductor canal** and appears through the **adductor hiatus** [common site of atherosclerotic lesions] running behind the distal end of femur to become the **popliteal artery**. It gives **no branches** in its proximal 2 thirds, while just beyond the hiatus ir gives off the **descending geniculate artery**, communicating with the same branch of the profunda and the popliteal geniculate arteries.

The **surface marking** of the common femoral and superficial femoral artery are the **2/3rds of a line joining the mid-inguinal point to the adductor tubercle** with the hip somewhat flexed and externally rotated.

• POPLITEAL ARTERY

Emerges from the **adductor hiatus**, a hand's breadth above the adductor tubercle, as continuation of the **superficial femoral artery**.

It crosses the popliteal fossa and terminates at the distal border border of popliteus muscle [proximal to soleus] where it bifurcates to the **anterior tibial artery** [comes off at an almost 90° angle] and the **tibioperoneal trunk**. The latter, after 3-5cm distance] bifurcates to the **posterior tibial** and **peroneal artery**.

Above the knee it gives off the **superior medial and superior lateral geniculate arteries**, while in its below knee course it gives off the **inferior [medial and lateral] geniculate arteries**. These form a rich anastomotic network around the knee, communicating the descending geniculate artery [SFA & profunda] and the ascending [recurrent] tibial geniculate [anterior tibial artery]. The popliteal artery can be **surgically approached**:

- **posteriorly** [an S-type incision behind the knee, with the upper limb laterally and the lower medially] where the structures to be encountered are: **short saphenus vein** [superficially], **sural nerve** [superficially and laterally], **politeal vein** [intermediate and slightly laterally], **tibial nerve** [medially and posteriorly] and **popliteal artery** [deep, midline]
- medially, either above or below the knee

Aneurysms of the popliteal artery were common in past, due to repeated injury because of horseriding and using high boots.





• ANTERIOR TIBIAL ARTERY

Arises from the popliteal with an almost **vertical angle** and passes forward between the tibia and fibula, piercing the **mesosteous [interosseous] membrane** below the **neck of fibula** [on the lateral aspect of the neck lies the **common peroneal nerve**]. It gives off **the anterior tibial recurrent artery** which gives the **ascending tibial geniculate artery**.

Descends in the **anterior compartment** of the leg, lying on the mesosteous membrane, accompanied by the **deep peroneal nerve** and overlapped by the **tibialis anterior and extensor hallucis longus muscles**. The extensor digiti longus muscles lies lateral to the artery.

Above the ankle it becomes superficial and is crossed by the tendon of **flexor digitorum longus**, continuing in the foot as the **dorsalis pedis artery** [absent in 14% of people]. The latter disappears between the two heads of the dorsal interosseous muscles, giving off the **arcuate artery**, which is the major contributor to the **superficial plantar arch**. Its distal end communicates with the lateral plantar artery [posterior tibial artery branch] to form **the deep plantar arch**.

• TIBIOPERONEAL TRUNK

Direct continuation of the popliteal after the origin of the anterior tibial. At the level of **soleus muscle** it bifurcates to the **posterior tibial** and **peroneal artery**.



• The arteries of the lower limb

• POSTERIOR TIBIAL ARTERY

It descends in the **deep posterior compartment** of the leg, lying on the tibialis posterior muscle, sandwiched by the **flexor digitorum longus and flexor hallucis longus**, overlapped by the soleus muscle. It is accompanied by the **tibial nerve**.

In the lower third of the leg it becomes more superficial and passes **behind the medial malleolus**, between the tendons of the two long flexors. It bifurcates into the **two plantar arteries** of which the **medial** contributes in the **superficial plantar arch** while the **lateral** is the major contributor to the **deep plantar / pedal arch**.

• PERONEAL ARTERY

Descends on the **posteromedial aspect of fibula** in the deep posterior compartment. Is sandwiched by the **tibialis posterior and flexor hallucis longus**. It does not cross the ankle but gives off **two perforating branches** which communicate with the posterior and anterior tibial respectively.

The easiest surgical approch is through **fibulectomy**.

VEINS

• DEEP VEINS

Accompany the corresponding named arteries.

• SUPERFICIAL VEINS

1. SHORT SAPHENOUS.

Is the main vein into which drains the **lateral dorsal venous plexus of the foot**. It passes behind the **lateral malleolus** and ascends in the **mid-distance between achiles tendon and edge of fibula**, closely related to the **sural nerve**. At the mid calf it crosses the lateral gastrocnemius and ascends **between the two heads** to enter the **popliteal fossa** [passing underneath the fascia] and empty into the popliteal vein. The saphenopoliteal junction varies considerably in most cases and may be in a quite high or low position.

A tributary communicates with the Long saphenous vein.

2. LONG [GREAT] SAPHENOUS

Starts at the **medial aspect of the dorsal venous plexus of the foot**. It ascends **passing in front of the medial malleolus** [a constant position] and running one finger's breadth medial to the **border of tibia**. It crosses the knee passing over **the posterior part of medial tibial epicondyle**. Below the knee it receives an arch vein that courses over the medial head of gastrocnemius called the **arch of Leonardo**, through which the calf **perforators** communicate with the superficial veins. At the lower third of the medial aspect of the leg there are usually 2 perforators [**Cockett's system**]; another perforator is usually located 10cm below and another one 10cm above the knee [**Dott's perforators**]. In the leg is closely related to the saphenous nerve [above the knee the latter accompanies the superficial femoral vein]

It ascends on the medial aspect of the thigh, reaches the saphenous opening in the femoral canal and empties into the femoral vein. Just before this **saphenofemoral junction** it receives **4 tributaries** which should be identified and properly ligated in varicose vein surgery:

- a. Lateral accessory tributary
- b. Superficial inferior epigastric vein
- c. Superficial circumflex iliac vein
- d. Superficial external pudental vein



• The superficial veins of the lower limb

NERVES OF THE LOWER LIMB

SEGMENTAL CUTANEOUS INNERVATION OF LOWER LIMB

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- L2 \rightarrow anterolateral aspect of proximal thigh
- L3 \rightarrow anteromedial aspect of distal thigh and knee
- L4 \rightarrow anteromedial surface of leg and heel
- L5 \rightarrow anterolateral aspect of leg
- \rightarrow medial aspect of foot
- S1 \rightarrow lateral side of foot
- S2 \rightarrow posterior surface of leg
- \rightarrow poaterior surface of thigh
- $S3 \rightarrow buttocks$
- S4 \rightarrow perianal region

THE LUMBAR PLEXUS AND ITS NERVES

• THE LUMBAR PLEXUS

Is formed by **fusion of the anterior primary rami of the L1-L5 roots**. The **trunks traverse the psoas major** and appear on its lateral border. The **obturator nerve** appears on its medial aspect, the **femoral** on its lateral, while the **genitofemoral nerve** pierces the psoas and emerges anterior to it. On the anterior psoas surface run also the **ilio-inginal** and **iliohypogastric nerves [L1 & T12]** while the **subcostal nerve [T12]** crosses it a more proximal level

• LATERAL CUTANEOUS NERVE OF THE THIGH [L2]

Supplies the **lateral aspect of the thigh**. Is formed by the L2 root and emerges superolaterally to the femoral nerve. It passes **deep below the inguinal ligament**. If it pierces the ligament, then a condition characterised by pain and anaesthesia over the outer lateral thigh may appear, called **meralgia paraesthetica**.

• THE FEMORAL NERVE [L2-L4]

• MOTOR INNERVATION

The anterior compartment of the thigh muscles.

- Sartorius
- Quadriceps
- Pectineus
- CUTANEOUS INNERVATION
 - Medial cutaneous thigh nerve [anteromedial aspect of thigh]
 - Intermedial cutaneous thigh nerve [anterior thigh aspect]
 - Saphenous nerve [medial aspect of leg, ankle and foot to the great toe]



• The femoral and obturator nerves

• OBTURATOR NERVE [L2-L4]

Emerges **medially to the psoas** and runs forwards and downwards, **behind the iliac vessels**. It exits the pelvis through the **obturator foramen**, piercing the **obturator membrane**, accompanied by the **obturator vessels**. Enters the **thigh below the obturator internus** and gives off its branches to supply:

- muscles \rightarrow adductor muscles and gracilis
- $skin \rightarrow an$ area over the medial aspect of thigh
- joint \rightarrow hip and knee joints

Spasm of the adductor muscles in spastic paraplegia can be relieved by **obturator neurectomy**, by extraperitoneal approach of the nerve through a transverse or curved incision.

• OBTURATOR FORAMEN HERNIA

the pressure exerted by the hernia sac on the nerve is associated with referred pain in its distribution area, i.e. medial thigh, hip. The diagnosis of such a hernia is usually confirmed only surgically, after laparotomy for intestinal obstruction.

THE SACRAL PLEXUS AND ITS NERVES

• SACRAL PLEXUS

Is formed by fusion of the anterior primary rami of **roots L4, L5, S1 - S4.** The sacral nerves emerge from the **anterior sacral foramina** and unite **in front of the piriformis**, forming a major trunk, **the sciatic nerve**. From this emerge the **superior and inferior gluteal nerves** on the lateral aspect of the trunk. Medially to the sciatic pass the **pudental nerve** [S1-S4] and the **posterior cutaneous thigh nerve** [S1-S3].

Nerves from the sacral plexus supply the pelvic muscles, the hip and the skin of the buttock and posterior aspect of the thigh.

• POSTERIOR CUTANEOUS NERVE OF THE THIGH

Innervates the posterior aspect of thigh and buttocks.

• PUDENTAL NERVE [S2-S4]

Provides the **principal innervation of perineum**. It exits the pelvis through **the great sciatic foramen**, **below the piriformis** and **medially to the sciatic nerve**. It **reenters the pelvis through the lesser sciatic foramen**. Traverses the lateral wall of the ischiorectal fossa, passing through the **Alcock's canal**, accompanied by the **pudental vessels**, on the medial aspect of obturator internus. There it gives off the **inferior rectal nerve before** dividing into the **perineal nerve** and the **dorsal nerve of penis** [or clitoris]

It innervates the external anal sphincter, the anterior perineum muscles, the perianal skin and the external genitalia skin.

It can be blocked by injection of local anaesthetic, through a long needle, in front of the ischial spine. If that is done bilaterally, there is loss of anal reflex, the pelvic floor muscles are relaxed and the sensation from the external genitalia is lost [useful in deliveries and episiotomy].

• SCIATIC NERVE [L4, L5, S1-S3]



• The sciatic nerve

Is the largest nerve of the body. Commences at the **midpoint between superior posterior iliac spine and ischial tuberosity**. Exits the pelvis from the **greater sciatic foramen**, below the piriformis, at the **midpoint between the greater trochanter and ischial tuberosity**, covered by gluteus maximus. Continues vertically downwards, on the posterior aspect of adductor magnus, lying deep to the hamstrings and being crossed by the head of biceps femoris.

Terminates usually on the mid- lower thigh, dividing into **common peroneal nerve** [laterally] and **tibial nerve** [medially]. Is accompanied by a branch from the inferior gluteal artery, which bleeds sharply on its division.

It supplies the **hamstrings** and **part of the adductor magnus**. The muscle branches arise from its medial site; only the twig to the short head of biceps travels laterally. The lateral site of the nerve is, therefore, safer for surgical dissection.

DAMAGE TO THE NERVE WILL CAUSE:

- paralysis of the hamstrings
- loss of all movements below the knee [foot drop]
- loss of all sensation below the knee, apart from an area along the medial side of the leg and foot, which are supplied by the saphenous nerve

• TIBIAL NERVE [L4, L5, S1-S3]

Is the largest terminal branch of the sciatic nerve. Traverses the **popliteal fossa** lying **medially and slightly superficial to the popliteal vessels**, before **crossing the artery** to pass on its lateral side.

It supplies the **gastrocnemius, popliteus and soleus** and gives off the **sural nerve**, a cutaneous nerve supplying the lateral site of the leg and foot and the great toe.

It descends **deep behind the soleus** [in the deep posterior compartment], accompanied by the posterior tibial vessels. At the ankle, it passes **behind the medial malleolus** and divides into **medial** [\approx median] and **lateral** [\approx ulnar] **plantar nerves**, which supply the intrinsic foot muscles and the sole of the foot.

• COMMON PERONEAL NERVE

Enters the **popliteal fossa** beneath the **biceps tendon** and **winds around the neck of fibula** to enter the lateral leg compartment. Into the peroneus longus it divides into **the deep peroneal nerve** [running in the anterior compartment with the anterior tibial vessels] and the **superficial peroneal nerve**, running in the lateral compartment.

- The superficial peroneal nerve innervates the muscles of the lateral compartment of the leg [peroneus longus & brevis] and the skin of the distal two thirds of the leg and the dorsum of the foot.
- The deep peroneal nerve supplies the muscles of the anterior compartment of the leg [tibialis anterior, extensor digitorum longus, extensor hallucis longus, peroneus tertius] and a small skin area in the web between 1st and 2nd toes.
- Damage to the nerve is associated with foot drop. If the injury affects the common nerve, the foot will be also inverted, due to paralysis of peroneus muscles, supplied by the superficial peroneal nerve.



• The common peroneal & tibial nerves

