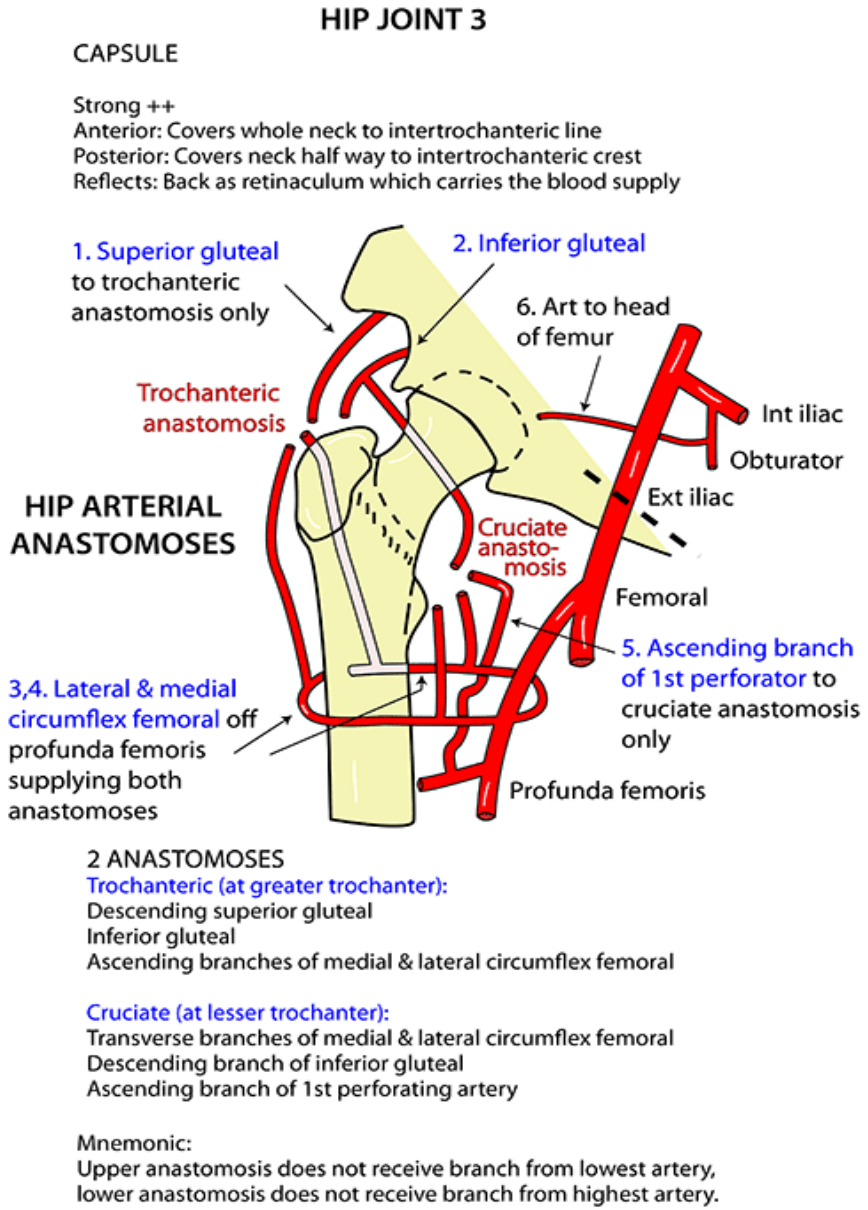
Lower Limb

Ahmad and Emma

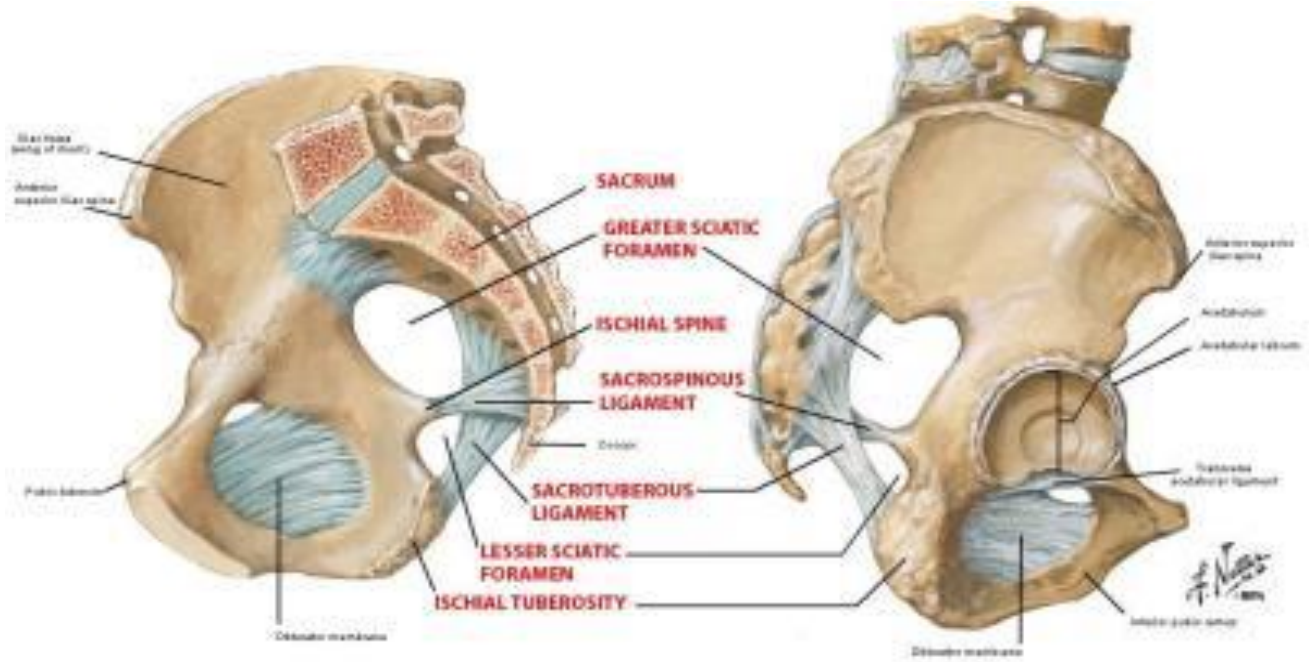
Blood Supply to the Hip

- 4 main arteries and 2 anastomosis
  - Trochanteric (GT) anastomosis: Descending superior gluteal, inferior gluteal, medial and lateral circumflex femoral
  - Cruciate (LT) anastomosis: Ascending branch of 1st perforating, inferior gluteal, medial and lateral circumflex femoral



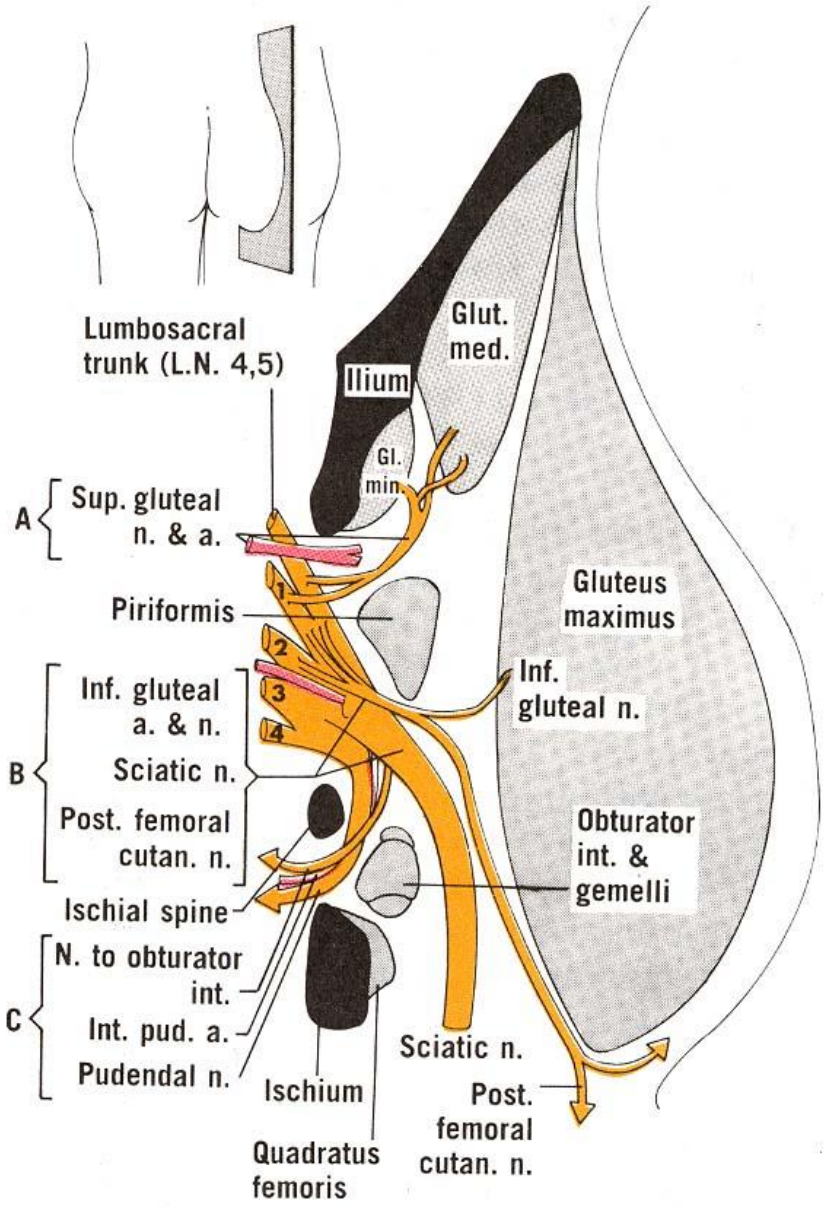
Sciatic Foramen

- Sacrospinous ligament
  - Ischial spine to sacrum
- Sacrotuberous ligament
  - Ischial tuberosity to sacrum



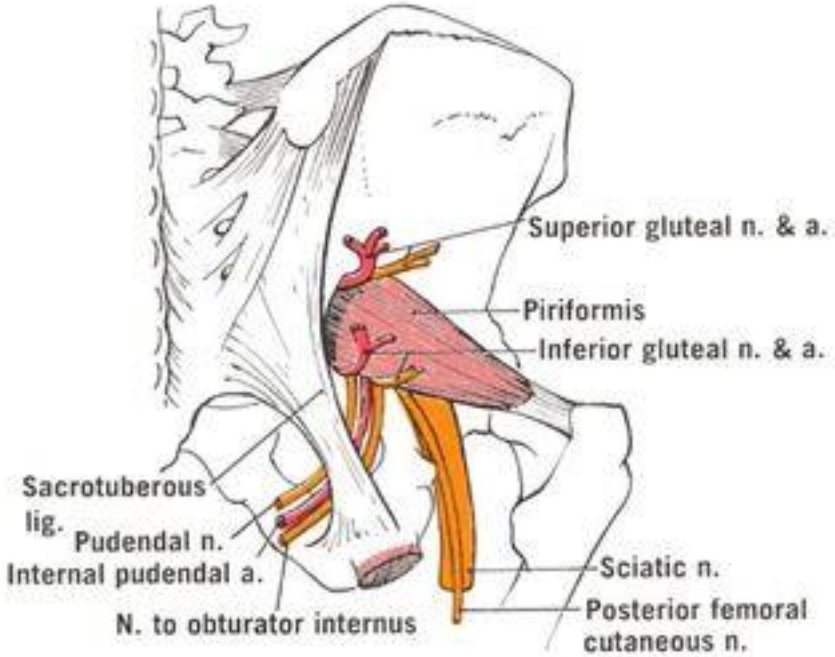
Greater Sciatic Foramen

- Boundaries:
  - Anterior/superior – Posterior border of hip
  - Posterior – Sacrotuberous ligament
  - Inferior – Sacrospinous ligament
- Contents:
  - Piriformis (leaves pelvis through it) and SPINS
  - Above piriformis:
    - Superior gluteal a. and n
  - Below piriformis –
    - Pudendal a. and n.
    - Inferior gluteal a. and n.
    - Nerve to obturator internus and quadratus
    - Sciatic n, and posterior femoral cutaneous nerve



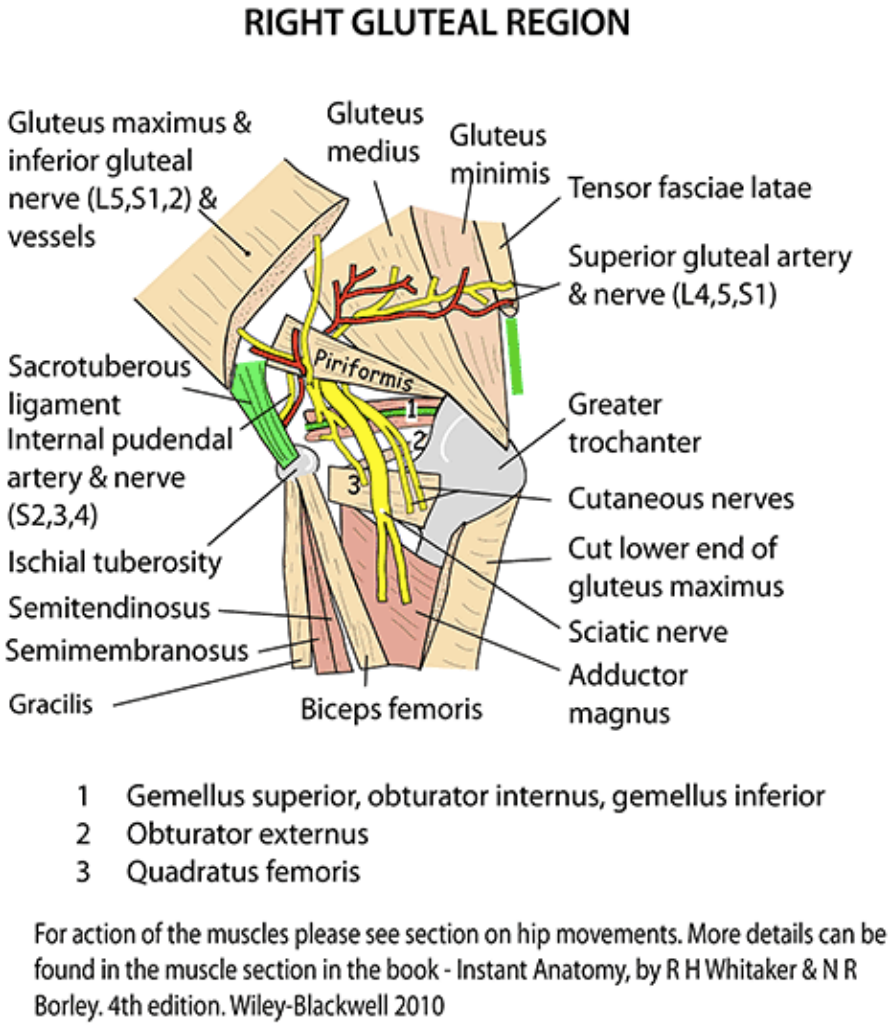
Lesser Sciatic Foramen

- Some structures come out greater sciatic foramen and back into the lesser sciatic foramen to supply perineum
  - Pudendal a. & n
  - Nerve to obturator internus
  - Tendon to obturator internus



Anterior relations to sciatic nerve

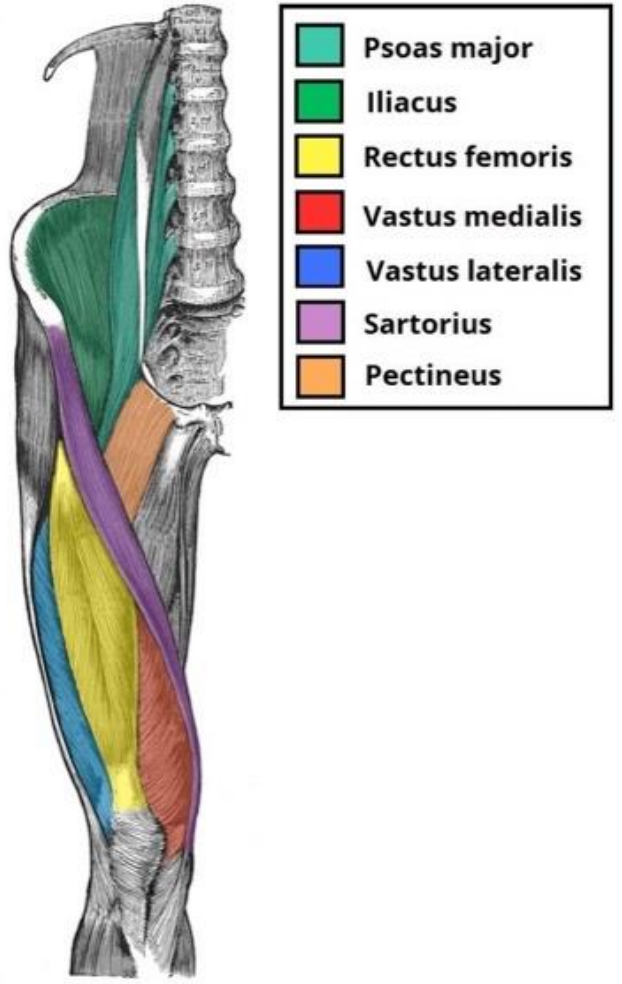
- Referred to as the red carpet
  - Superior gamellus
  - Obturator internus
  - Inferior gamellus
  - Obturator externus
  - Quadratus femoris
  - Note: obturator n. supplies obturator externus and n. to obturator internus supplies the obturator internus



For action of the muscles please see section on hip movements. More details can be found in the muscle section in the book - Instant Anatomy, by R H Whitaker & N R Borley. 4th edition. Wiley-Blackwell 2010

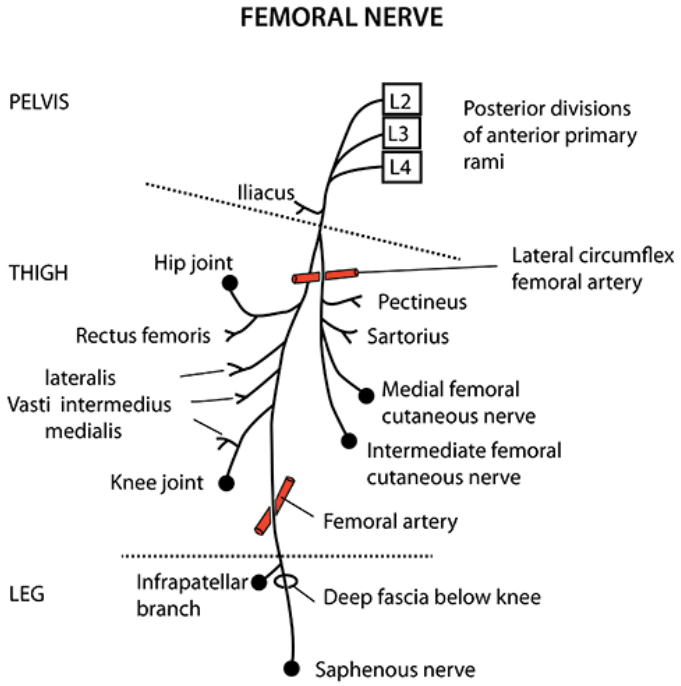
Anterior compartment of thigh

- Quadriceps:
  - VM, VI, VL, rectus femoris (supplied by deep branch of femoral n.) AND Sartorius and pectineus (superficial branch of femoral n.)
  - Iliacus (to GT) and Psoas major (to LT)
  - Tensor fascia lata
  - Supplied by the femoral n. and branches of profunda femoris



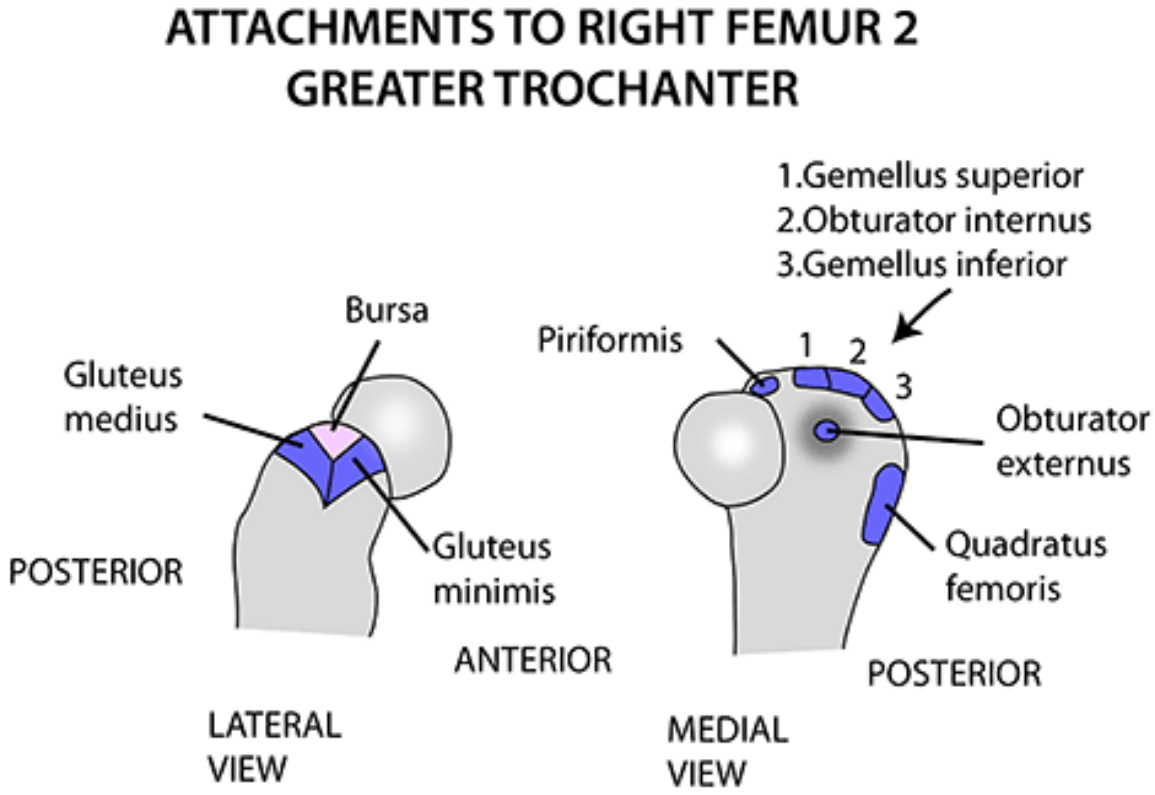
Femoral Nerve

- PDAR L2, 3, 4
- Gives iliacus and the splits at lateral circumflex femoral artery
- Superficial Branches (2 muscular and 2 cutaneous)
  - Sartorius and pectineus
  - Medial & anterior femoral cutaneous n.
- Deep Branches (4 muscles and 1 cutaneous)
  - Rectus femoris, VM, VI, VL
  - Saphenous n.



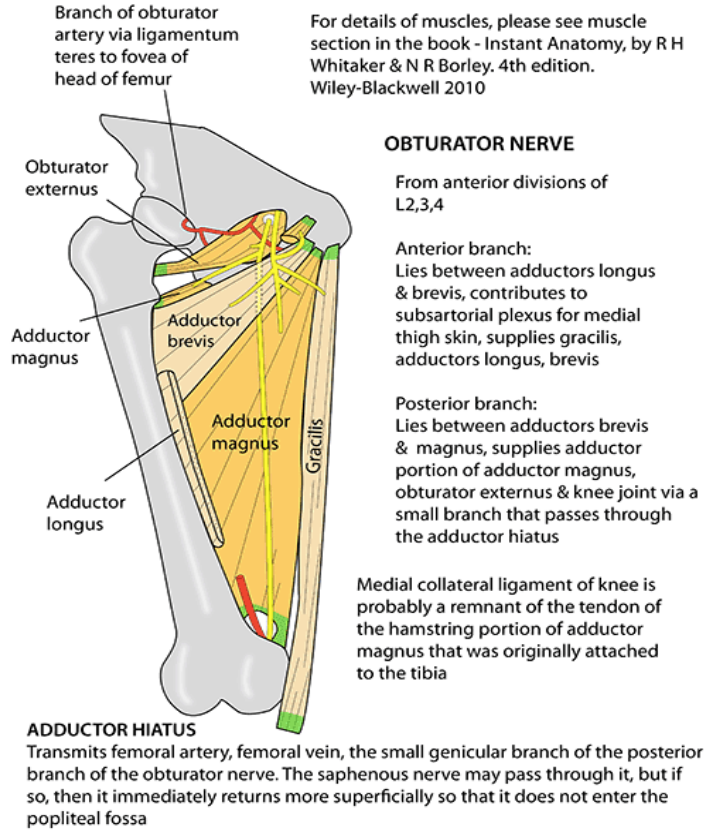
Greater Trochanter Attachments

- Origin: VL
- Insertion:
  - Obturator internus
  - Gemellus superior and inferior
  - Quadratus femoris
  - Quadratus externus
  - Gluteus medius and minimus



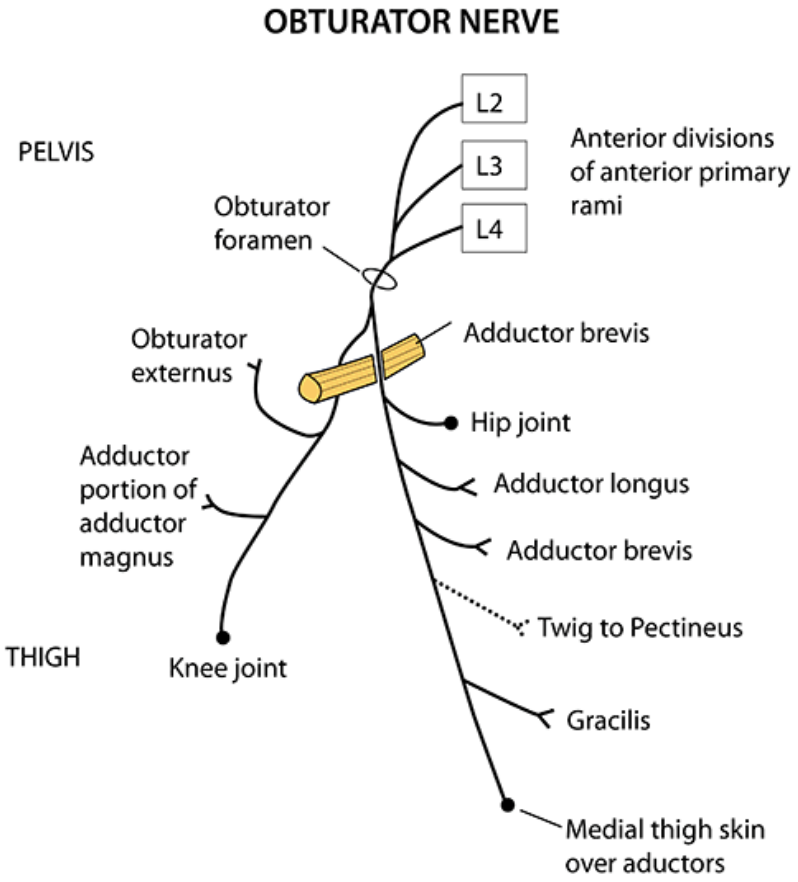
Adductor compartment of thigh

- Muscles:
  - Gracilis (most medial)
  - Adductor longus (Ant)
  - Brevis (under longus)
  - Magnus (note hiatus: some sciatic n. supply)
- No septum
- Supplied by the obturator n. and branches of profunda femoris a.
- Adductor brevis splits obturator n. (L2-4)



Obturator Nerve

- ADAR L2, 3, 4
- Anterior and Posterior divisions
- Divided by Adductor Brevis
- Anterior
  - Obturator externus
  - Adductor magnus
- Posterior to all else
  - Hip joint
  - Adductor longus and brevis
  - Pectineus
  - Gracilis
  - Medial thigh skin over adductors



Questions

1. Structures passing through the lesser sciatic foramen include

1: the pudendal nerve

2: the inferior gluteal vessels

3: the tendon of obturator internus muscle

4: the posterior cutaneous nerve of thigh

2. The femoral nerve

1: supplies skin on the medial side of the leg

2: enters the thigh anterior to the iliopsoas fascia

3: supplies the psoas major muscle

4: supplies the pectineus muscle

3. The obturator nerve

1: arises from the anterior divisions of the posterior rami of L2, L3 and L4

2: lies above the obturator vessels on the lateral wall of the pelvis

3: supplies the gracilis muscle

4: has no sensory branches

4. The cruciate anastomosis is formed from

1: the transverse branch of the medial circumflex a.

2: the descending branch of the inferior gluteal a.

3: the ascending branch of the first perforating a.

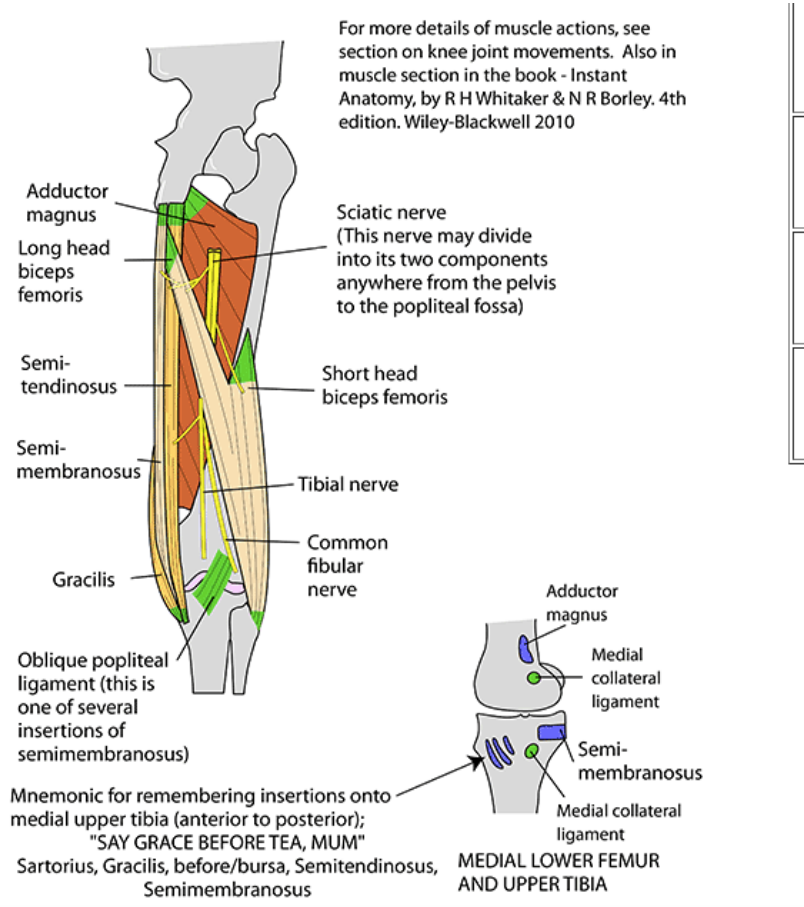
4: the ascending branch of the lateral circumflex a.

Answers

1. TFTF
2. TFFT
3. FTTF
4. TTTF

Posterior compartment of thigh

- Semimembranosus:
  - IT to medial condyle of tibia (flatter and deeper)
- Semitendinosus:
  - IT to pes anserinus
- Biceps femoris:
  - Long – tibial n., from IT head of fibula
  - Short – Common peroneal n., from linea aspera to head fibula
- Nerve supply by sciatic nerve
- Blood supply by profunda femoris and gluteal arteries
- Tips:
  - Muscles medial, femur lateral
  - Orient yourself by plantaris m. runs superolateraly to inferomedially
  - No septa between adductor and posterior compartments

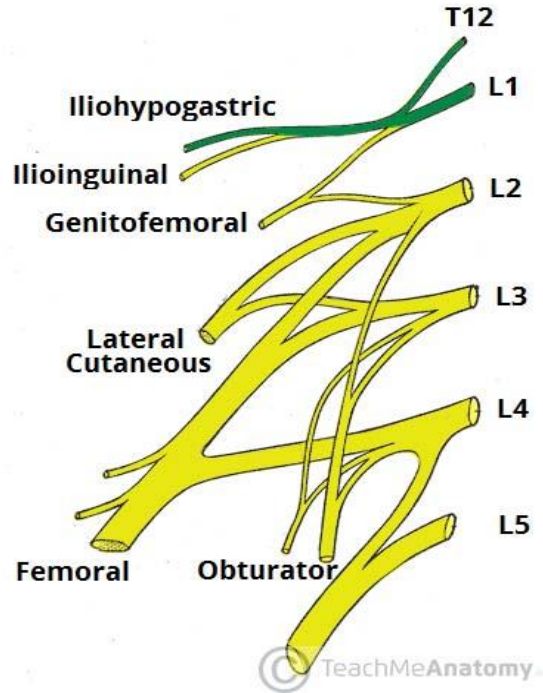


Movements of the Hip

- Abduction:
  - Gluteus medius, gluteus minimus & TFL
  - Superior gluteal n.
- Adduction:
  - Adductors L/B/M
  - obturator n.
- Flexion:
  - Ilipsoas, quadriceps, sartorius
  - Femoral n.
- Extension:
  - Gluteus maximus, hamstrings
  - Sciatic n.
- External rotation:
  - Gluteus maximus, gemelli, quadratus femoris
- Internal rotation:
  - Gluteus medius and minimus

Lumbosacral Plexus

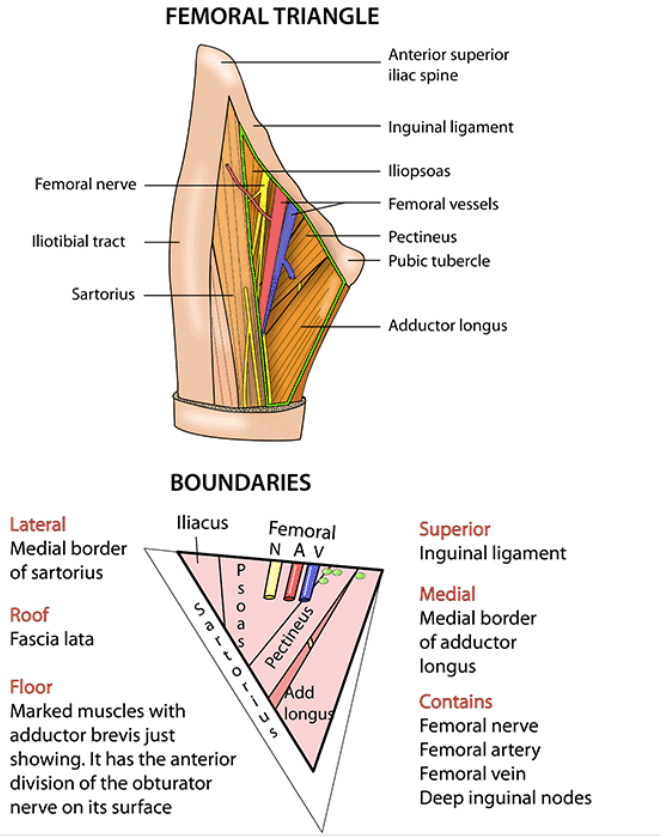
- ANTERIOR
  - Iliohypogastric/Ilioinguinal: T12/L1,
  - Iliohypogastric: M+S, Upper Buttock/Mons/Transverse Abdominis/Int Oblique
  - Ilioinguinal: M+S, Conjoint Tendon/Root of Penis/Ant Scrotum
  - Genitofemoral: L1 (Femoral)/2 (Genital). Femoral sheath pierces skin above femoral triangle
  - Femoral: PDAR L2-4
  - Obturator: ADAR L2-4
- POSTERIOR
  - Superior Gluteal: L4-S1
  - Inferior Gluteal: L5-S2
  - Sciatic: L3-S3
  - Pudendal: S2-4



Tricks for nervous supply

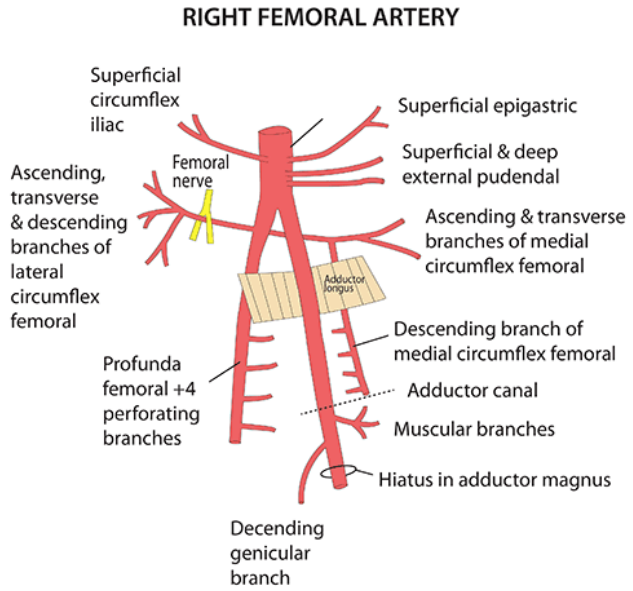
- Superior gluteal:
  - Gluteus minimus/medius/TFL
- Inferior gluteal:
  - Gluteus maximus
- Nerve to Obturator Internus:
  - Obturator Internus, Sup glamellus
- Nerve to Quadratus Femoris:
  - Quad Fem, Inf glamellus, articular hip branches
- Obturator Nerve:
  - Obturator Externus
- *Remember inferior gluteal supplies gluteus MAXimus
- *Remember Obturator externus by obturator n.

Femoral Triangle



- Boundaries: SAIL
  - Lateral: Sartorius (medial border of Sartorius)
  - Medial: Adductor longus (medial border of AL)
  - Superior: Inguinal Ligament
  - Roof: Fascia Lata
  - Floor: Pectineus
- Contents: NAVEL
  - Nerve – Artery – Vein – Empty Space (Canal) – Lacunar Ligament
  - Nerves (Lat to Med): Femoral, Femoral Branch of Genitofemoral
  - Femoral n. is not part of the sheath
  - Femoral branch of genitofemoral n. supplies cutaneous sensation to the femoral triangle. The genital branch DOES NOT have any cutaneous supply
  - Inside sheath: Vein, Artery and Fem branch of genitofemoral

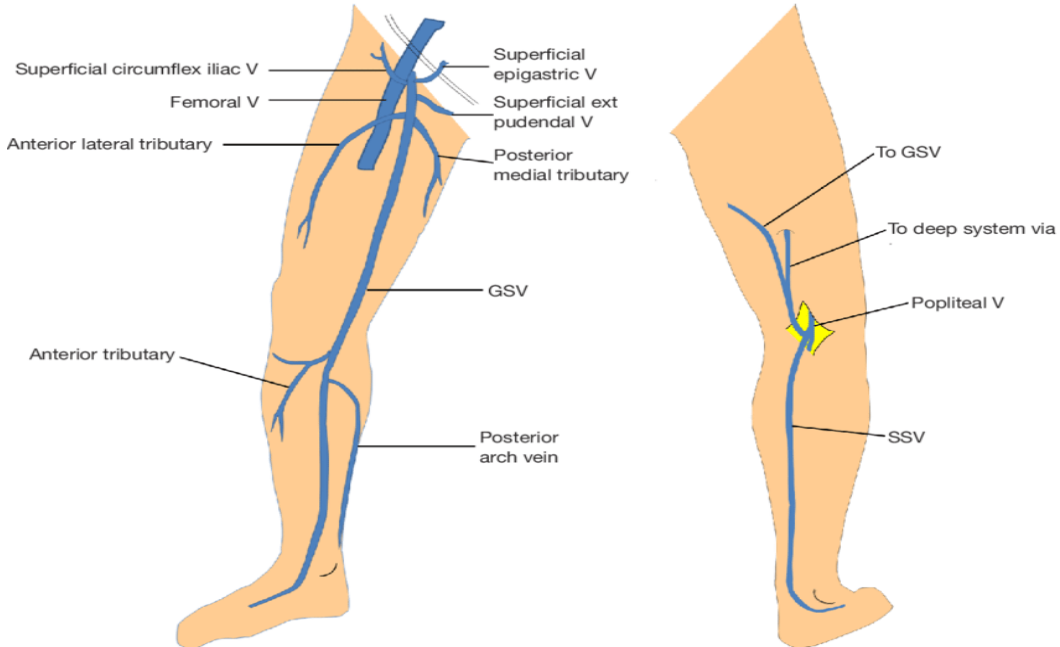
Arterial supply of LL



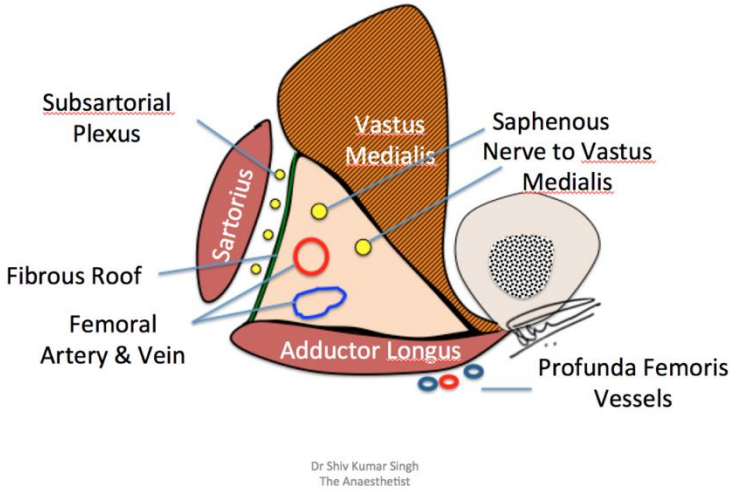
- Femoral Artery
  - Starts at mid-inguinal point
  - Inguinal ligament to branching profunda femoris
  - Superficial femoral artery to adductor hiatus
  - 4 superficial branches –
    - Superficial epigastric
    - Superficial circumflex iliac
    - Superficial external pudendal
    - Deep external pudendal
  - Femoral artery will become popliteal artery, which will further fivide into Anterior tibial and Peroneal (straight down the middle)
  - SFA has NO branches

Veins of lower limb

- Femoral Vein
  - Short saphenous vein joins popliteal to form femoral vein
  - Sural nerve runs with SSV
- Great saphenous vein: Anterior
  - Goes from anterior to medial medial malleolus to 4cm inferiorolateral to pubic tubercle
  - Joins femoral vein
  - Related to saphenous nerve
  - 4 superficial tributaries –
    - Superficial epigastric
    - superficial circumflex iliac
    - superficial external pudendal
    - deep external pudendal
- Lesser saphenous vein: Posterior



Adductor Canal



- AKA Hunters/Subsartorial canal
- It is weakness in adductor magnus
- Boundaries
  - Roof: Sartorius and Subsartorial plexus (MCNT/Ant. Obturator n.) and fascia
  - Medial: Adductor longus/brevis
  - Lateral: Vastus medialis
- Contents:
  - Femoral artery and vein
  - Saphenous nerve (not always)
  - Genicular branch of posterior division of obturator n.

Questions

1. The femoral triangle

1: has a floor formed by the iliacus muscle, the psoas major tendon, the pectineus muscle and the adductor longus muscle

2: is bounded below and medially by the adductor brevis muscle

3: is roofed over by the fascia lata of the thigh

4: contains the obturator nerve

2. The adductor (subsartorial) canal

1: contains the nerve to the vastus medialis muscle

2: contains the saphenous nerve

3: is bounded laterally by the vastus lateralis muscle

4: contains the profunda femoris vessels

3. The great (long) saphenous vein

1: has more valves above the knee than below

2: is intimately related to the saphenous nerve in the leg

3: is connected to the deep veins by perforating vessels whose valves contain muscular sphincters derived form the tunica media

4: is anterior to the medial malleolus

4. The sciatic nerve

1: gives a branch to adductor magnus

2: supplies extensors of the hip

3: supplies flexors of the knee

4: supplies skin on the posterior aspect of the thigh

Answers

1.TFTF

2.TTTT

3.TTFF

4.TTFT

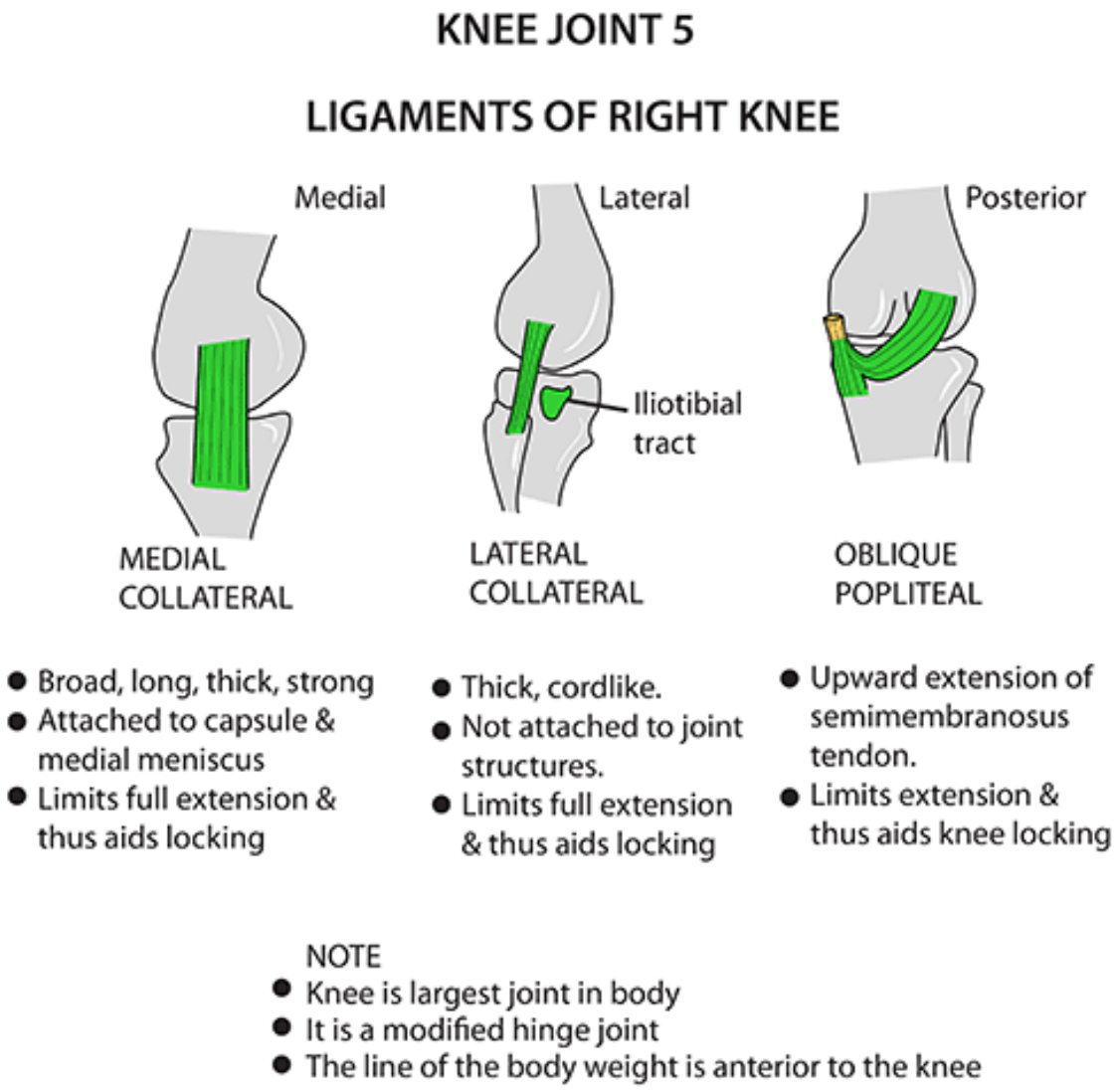
Knee – arteries, nerves and movements

- Movements:
  - Flexion: semimembranosus, semitendinosus, biceps, gracilis, sartorius (gastrocnemius, plantaris, popliteus)
  - Extension: Quadriceps femoris, iliotibial tract (gluteus maximus, tensor fasciae latate) (limited by the tension of the ACL)
  - Internal rotation: semimembranosus, semitendinosus (with knee flexed): gracilis, sartorius
  - External rotation: biceps
- Nerves – knee supplied by
  - Posterior division of obturator
  - Femoral
  - Sciatic
- Blood:
  - Femoral gives: descending branch from profunda
  - Genicular arteries
    - Popliteal branches – superior (medial and lateral)
    - Middle: supplies the cruciate ligaments
    - Inferior

Knee - Ligaments

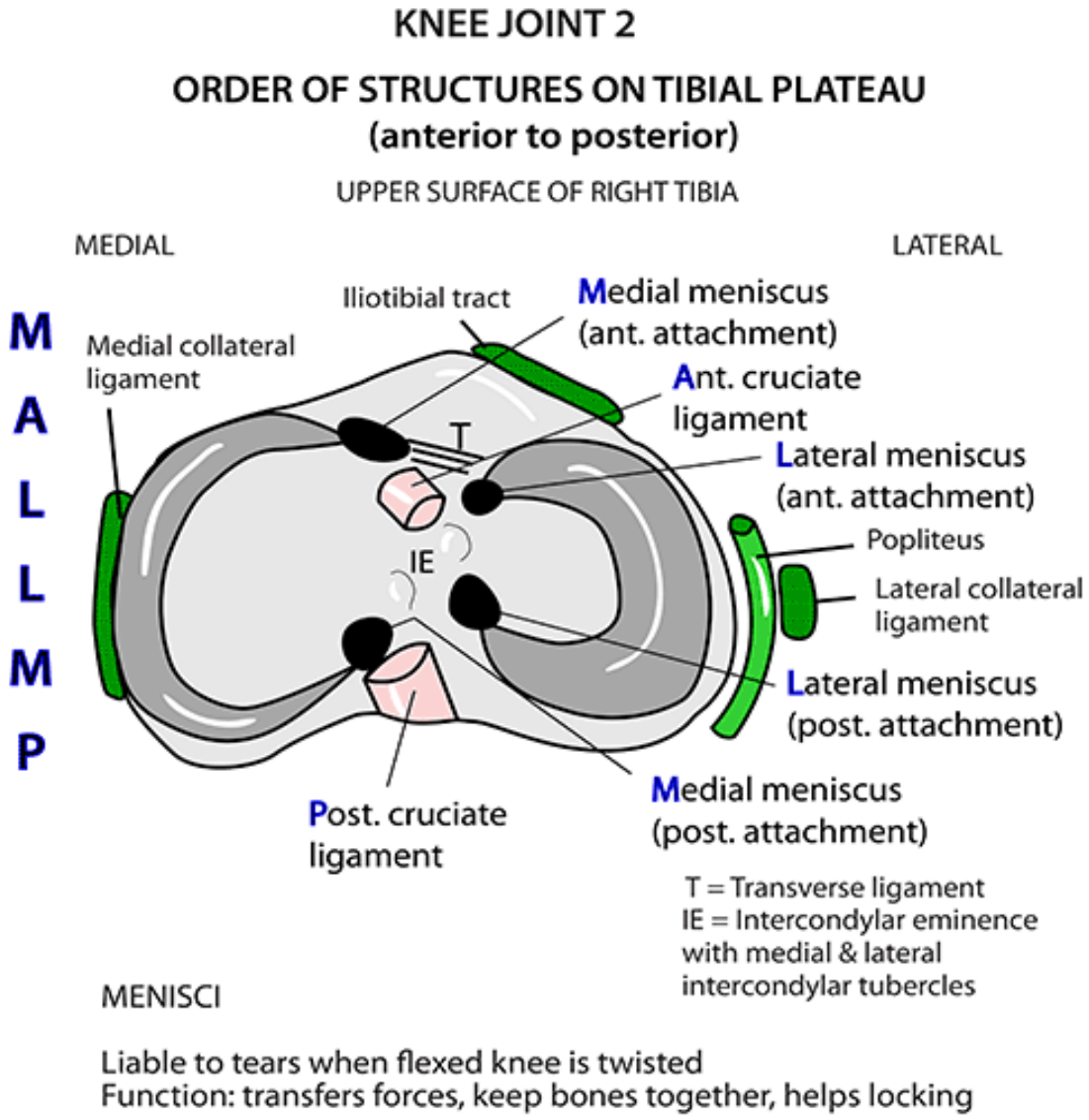
The anterior cruciate ligament of the knee

- Limits extension of the lateral condyle of the femur
- Is the primary resistant of posterior displacement of tibia upon femur
- Is extra synovial
- Arises from the anterior tibial spine



Knee Menisci

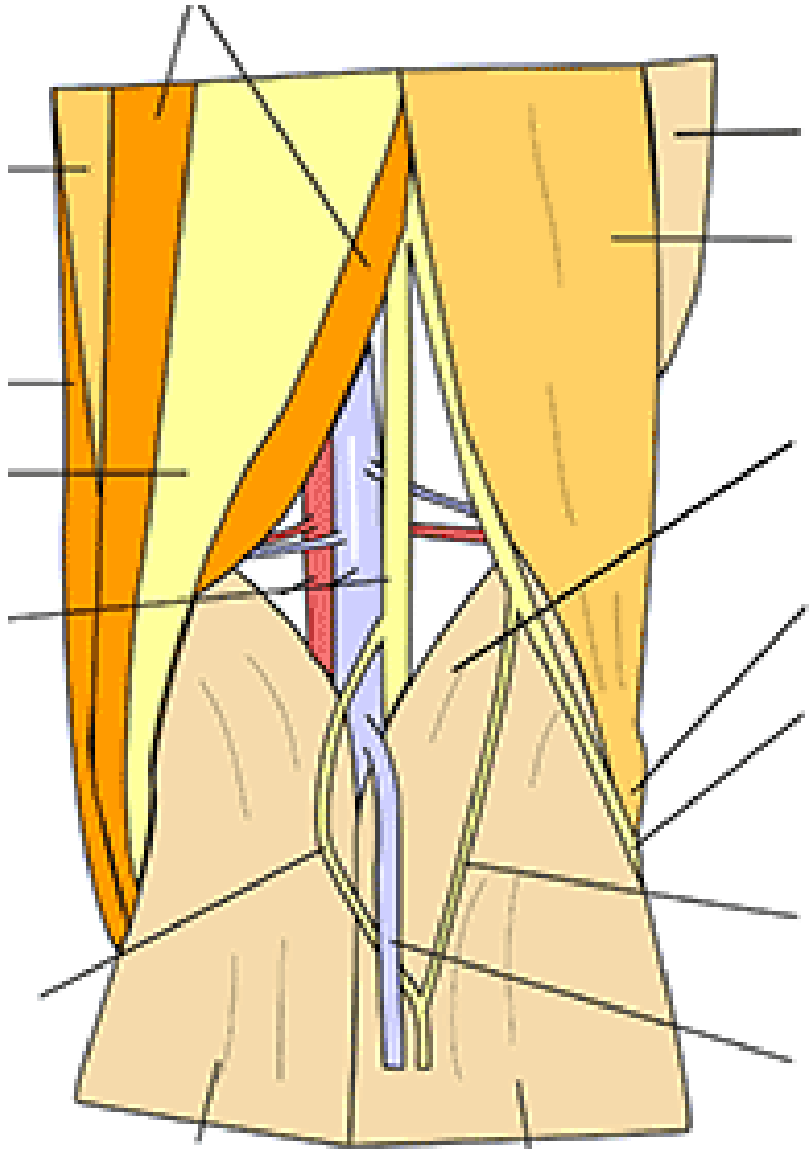
- Lateral meniscus
  - More truly c shaped
  - Horns are closer together
  - Smaller
  - Not attached to lateral collateral ligament
- Medial meniscus
  - Larger
  - More comma shaped than c shaped
  - Open curve whose ends or horn enclose the horns of the lateral meniscus
  - More liable to damage than lateral



1. The semilunar cartilages of the knee
    - Function in load absorption
    - Contribute to stability of the joint
    - Move passively during flexion and extension of the knee
    - Are vascular close to their peripheral attachments

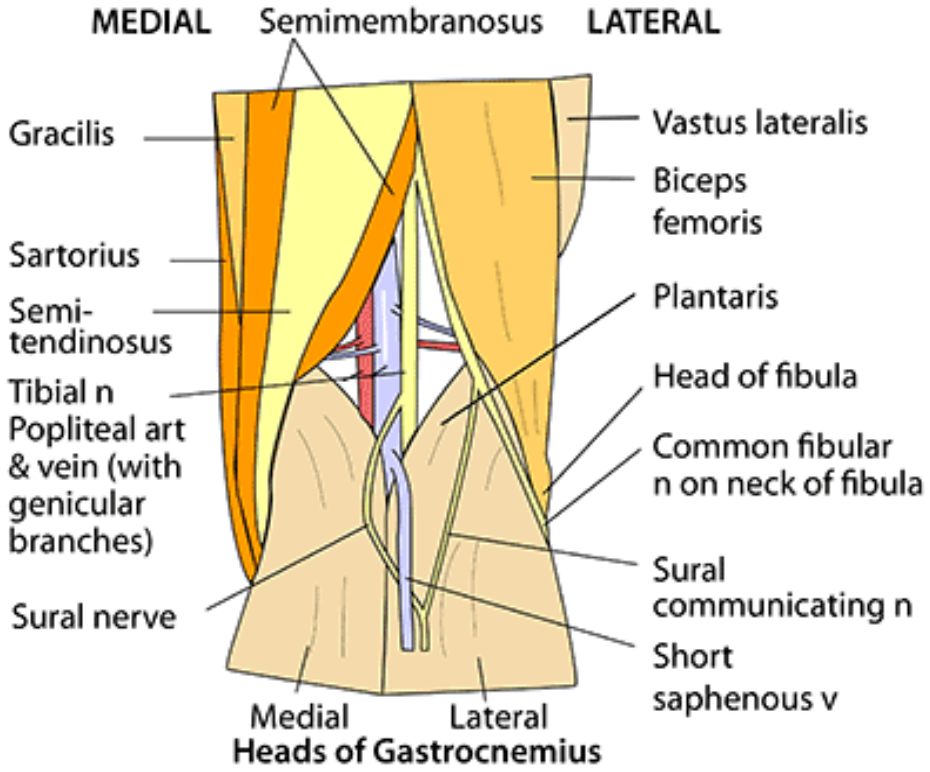
2. The lateral meniscus of the knee
    - Is attached to the fibular collateral ligament
    - Gives part origin to the popliteus muscle
    - Is attached to the anterior cruciate ligament by an extension of the attachment of the anterior horn
    - Is larger than the medial meniscus
    - Is totally devoid of vascular supply

Popliteal Fossa



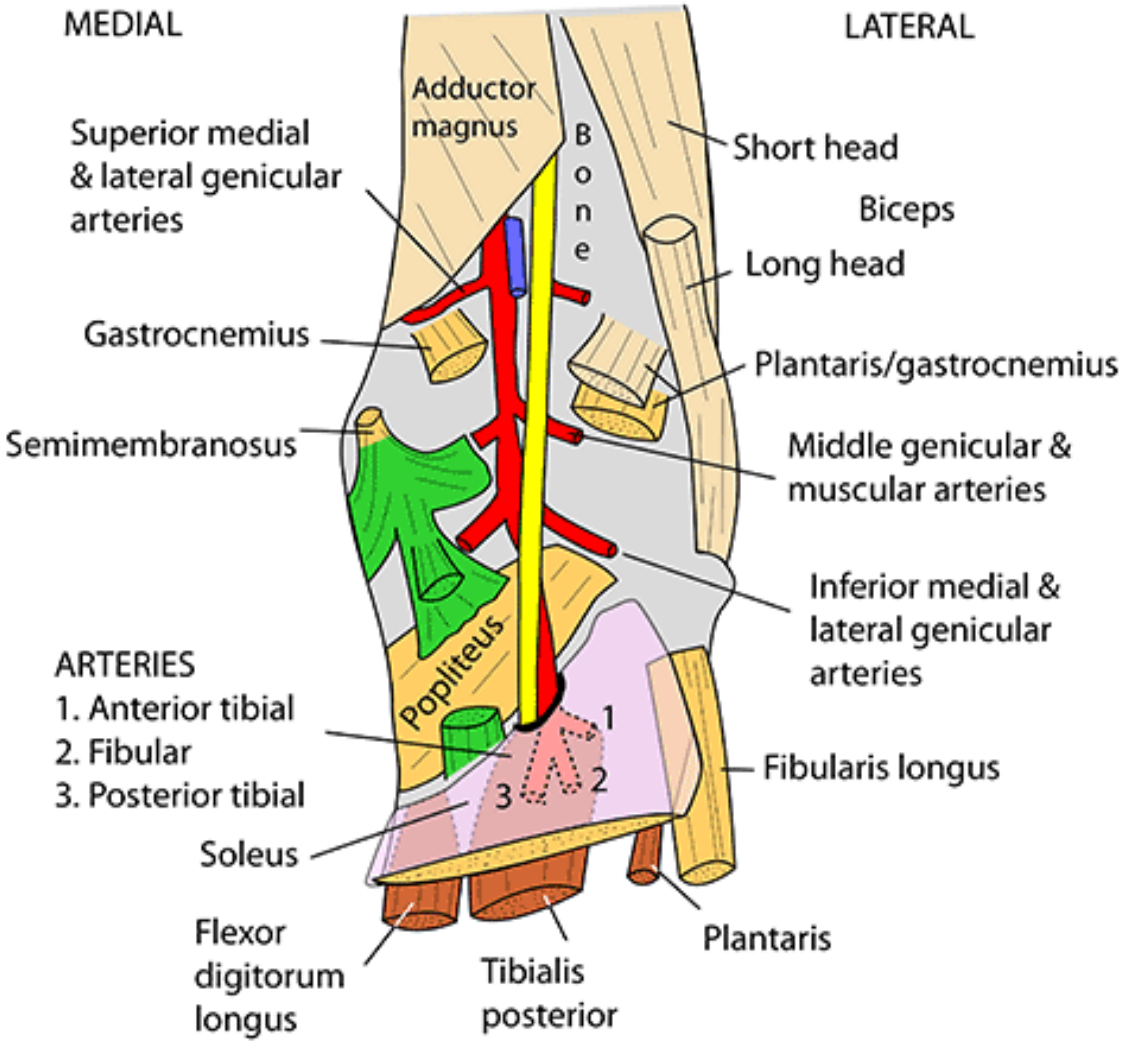
Popliteal Fossa – Superficial

- Popliteal artery is the deepest structure in the fossa
- Anterior to the artery are back of femur capsule of knee joint and popliteus
- Diamond shape
  - Upper medial: semimembranosus and semitendinosus
  - Upper lateral: Biceps femoris
  - Lower medial Medial head of gastronemius
  - Lower lateral: Plantaris and gastrocnemius (lateral head)
  - Floor: popliteus, capsule, femur
  - Roof:
    - Short saphenous and communicating veins
    - Lateral sural cutaneous nerve
    - Sural communicating nerve
    - End of posterior femoral cutenous nerve
    - Fascia lata



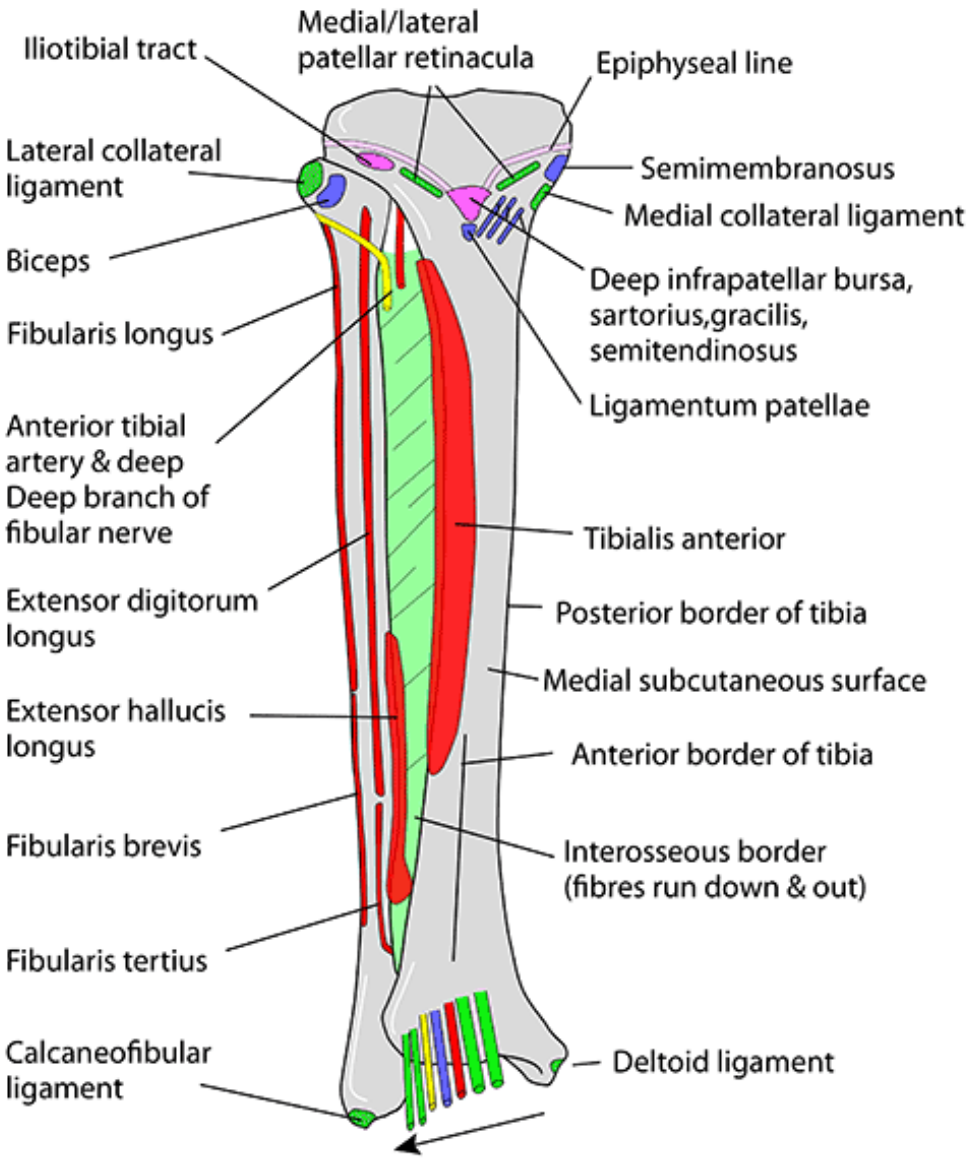
Popliteal Fossa – Deep

- Popliteal artery
  - 8 inches long
  - Starts medial to tibial nerve
  - Ends lateral to tibial nerve
  - Vein always between two
- Contents
  - Popliteal artery
  - Popliteal vein
  - Tibial nerve
  - Common Fibular nerve
  - Fat
  - Lymph nodes



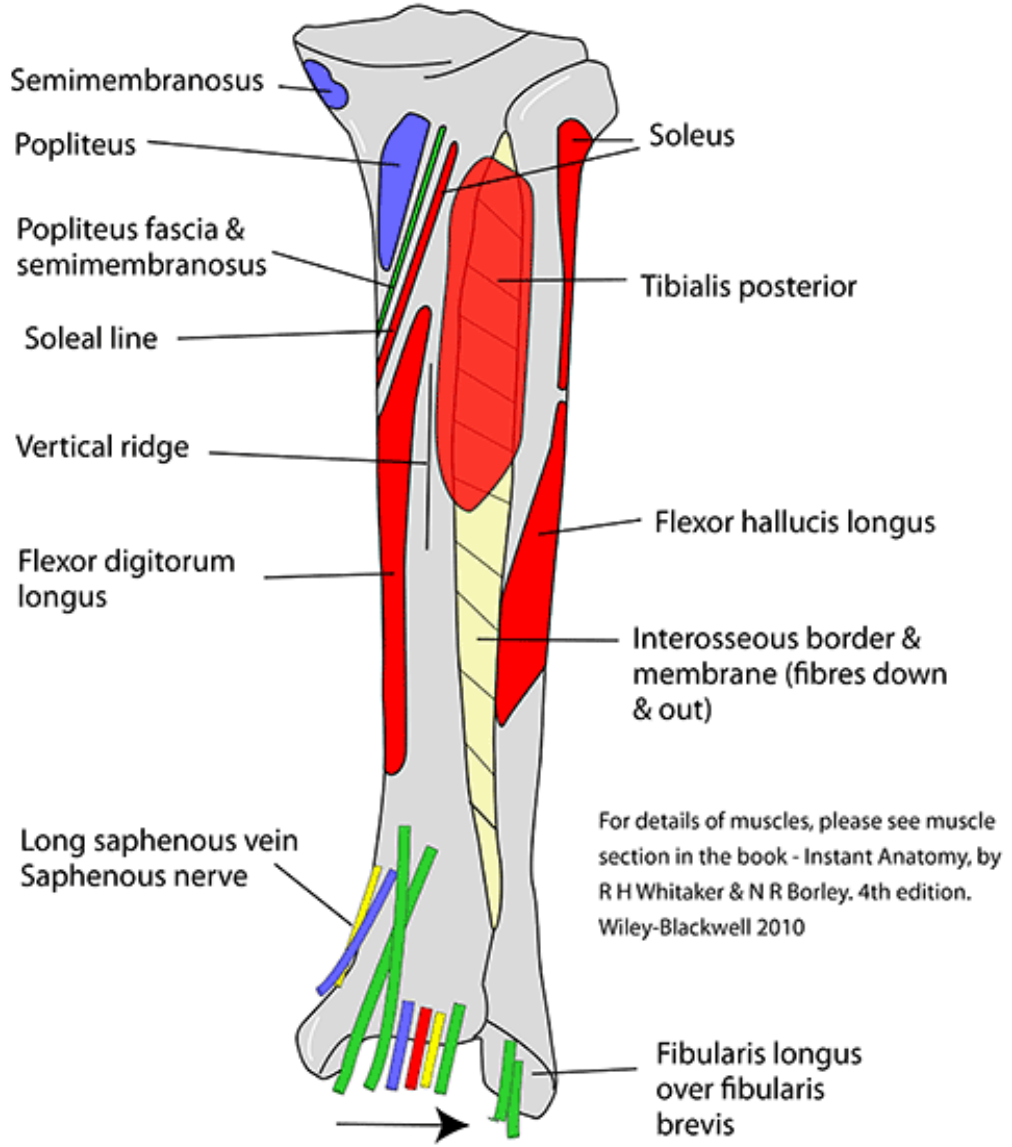
Lower Leg

ANTERIOR LOWER RIGHT LEG



Order of structures across dorsum of foot in direction of arrow: Tibialis anterior, extensor hallucis longus, anterior tibial artery/vein, deep fibular nerve, extensor digitorum longus, fibularis tertius
Mnemonic: Timothy Has A Very Nasty Diseased Foot

POSTERIOR LOWER RIGHT LEG



For details of muscles, please see muscle section in the book - Instant Anatomy, by R H Whitaker & N R Borley. 4th edition. Wiley-Blackwell 2010

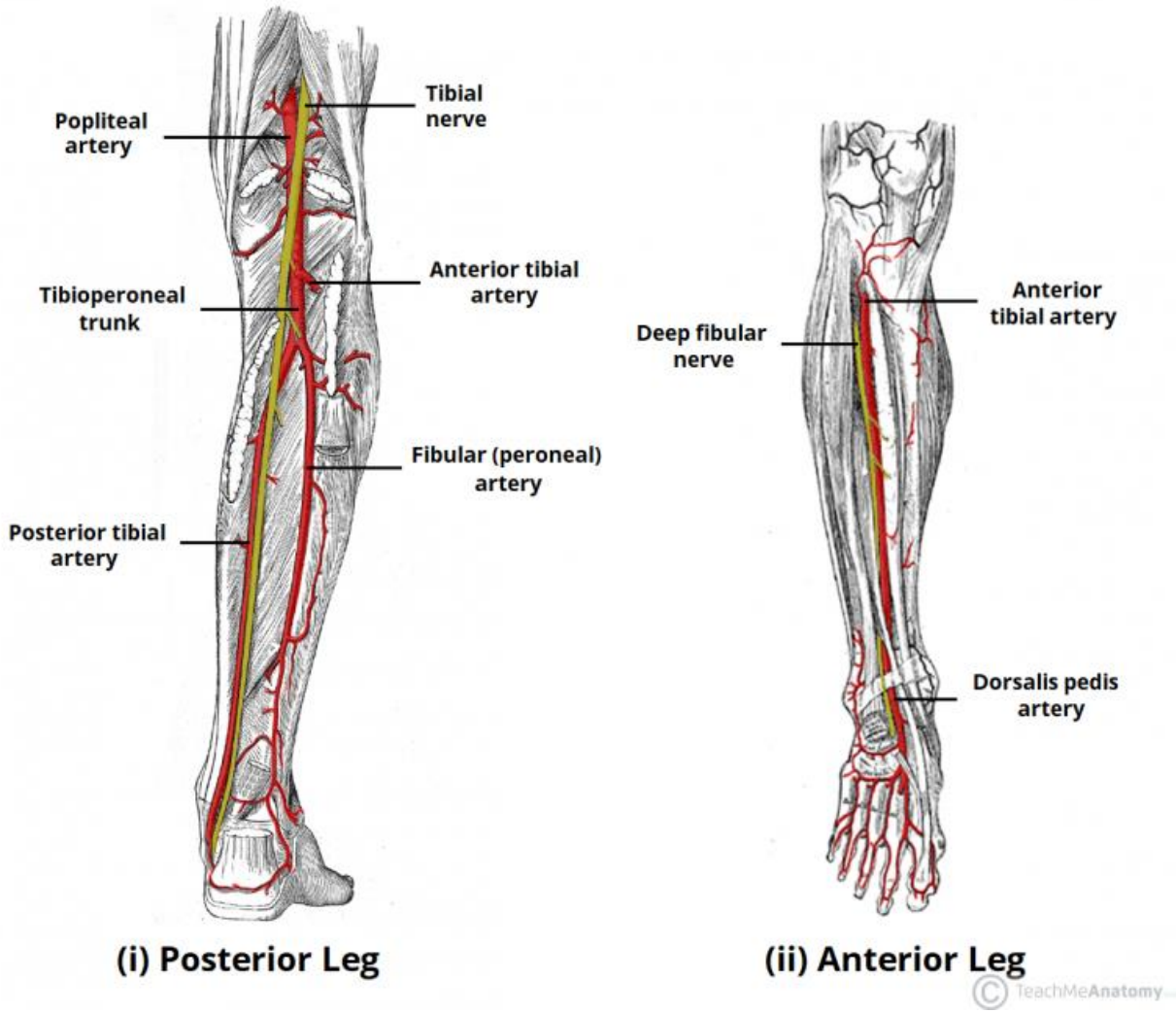
Order of structures behind medial malleolus as indicated by arrow: Tibialis posterior, flexor digitorum longus, posterior tibial vein & artery, tibial nerve, flexor hallucis longus
Mnemonic: Timothy Doth Vex All Nervous Housemaids OR
Tom Dick And A Very Nervous Harry

Nerves of the Lower Limb

- The Common fibular nerve
- The superficial fibular nerve
- The deep fibular nerve

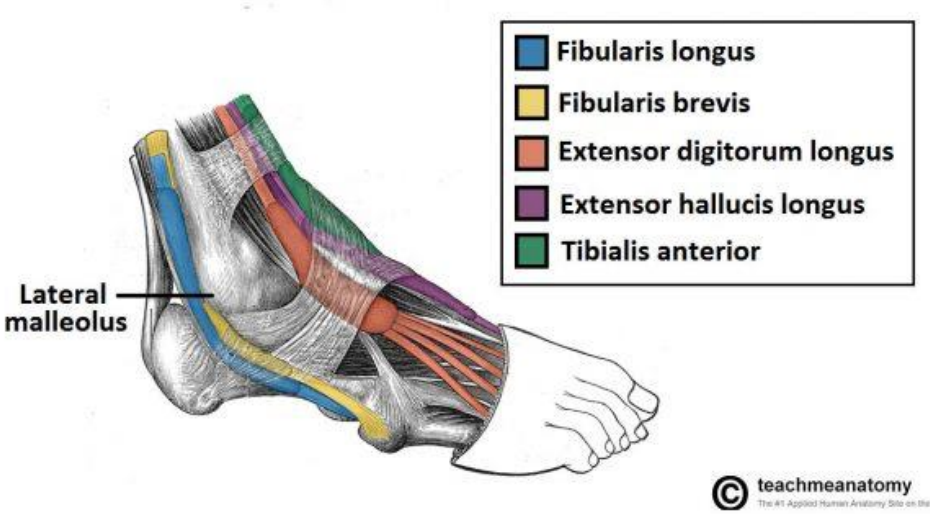
Arterial Supply LL

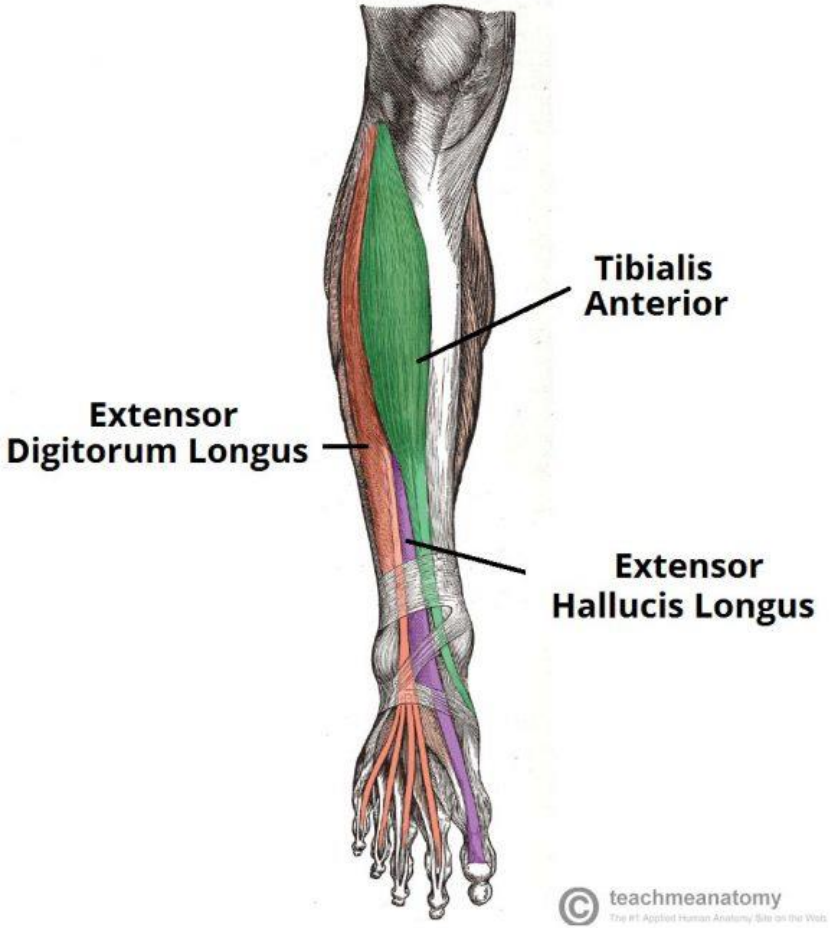
- Posterior tibial artery
- Fibular artery



Muscle anterior compartment of the leg

- Tibialis anterior
- Extensor digitorum longus
- Extensor hallucis longus
- Fibularis tertius



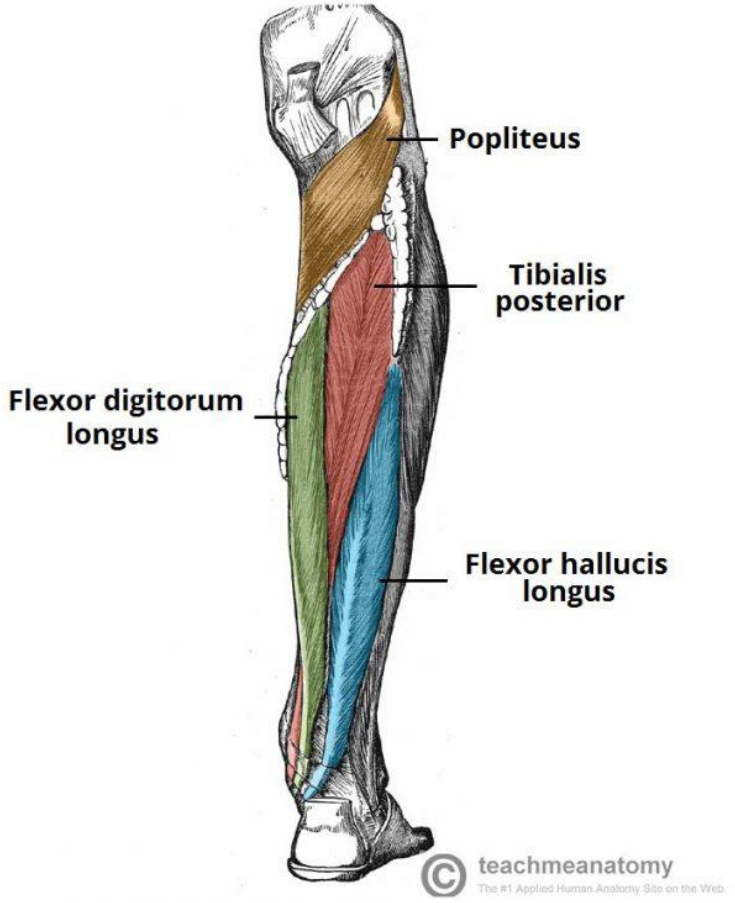


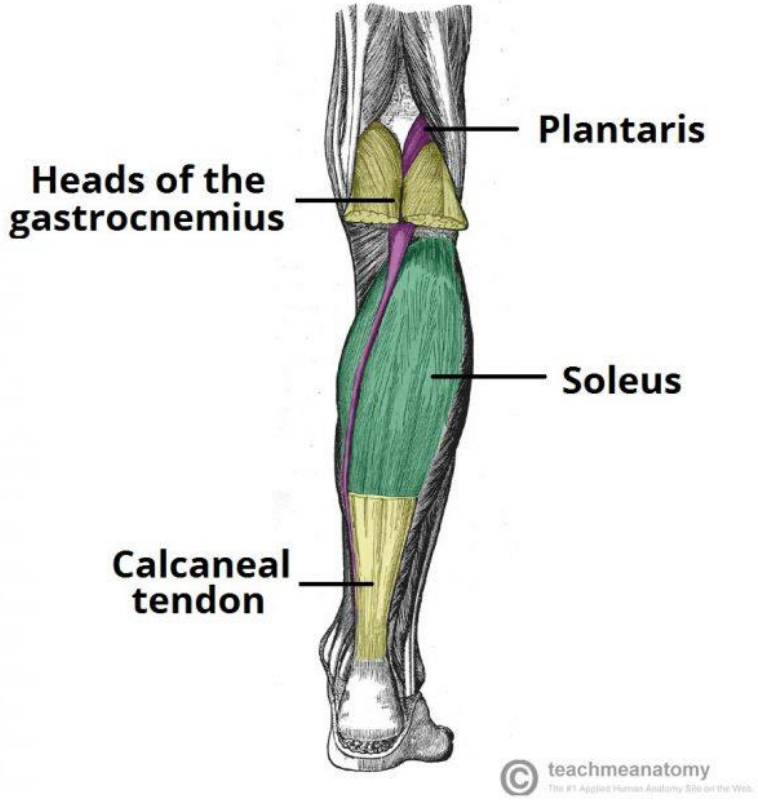
Posterior compartment of the leg

- Superficial muscles
  - Gastrocnemius
  - Plantaris
  - Soleus

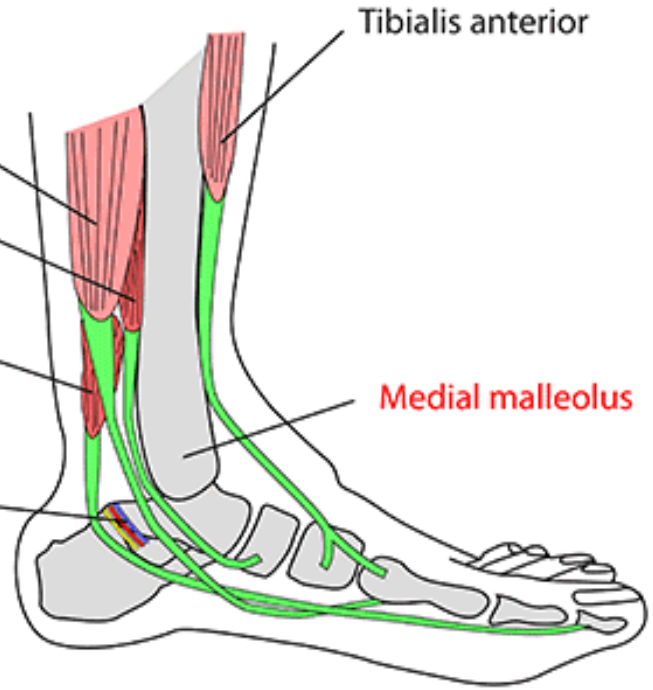
Deep:

- Popliteus
- Tibials posterior
- Felxor digitorum longus
- Felxor hallucis longus





TENDON & NEUROVASCULAR RELATIONSHIPS ON MEDIAL ASPECTS OF ANKLE

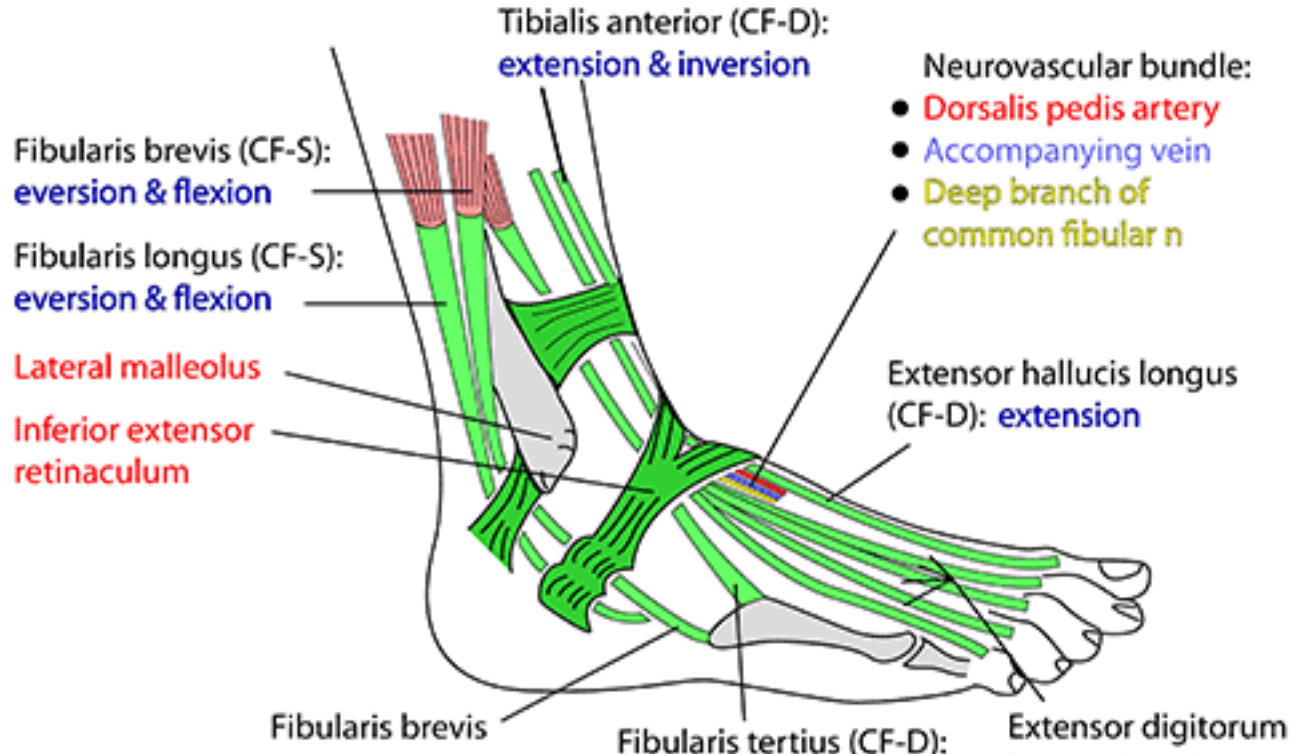


"Timothy Doth Vex All Nervous Housemaids"
or "Tom, Dick And A Very Nervous Harry"

Order of structures behind medial malleolus from anterior to posterior:
Tibialis posterior, flexor digitorum longus, posterior tibial vein & artery, tibial nerve, flexor hallucis longus
Mnemonic: Timothy Doth Vex All Nervous Housemaids

Flexor retinaculum
Tip of medial malleolus to medial calcaneal process and plantar aponeurosis

TENDON & NEUROVASCULAR RELATIONSHIPS ON LATERAL ASPECTS OF RIGHT ANKLE



(CF-S) = Superficial br of common fibular n
(CF-D) = Deep br of common fibular n

Mnemonic for dorsal tendons, vessels & nerves from medial to lateral :

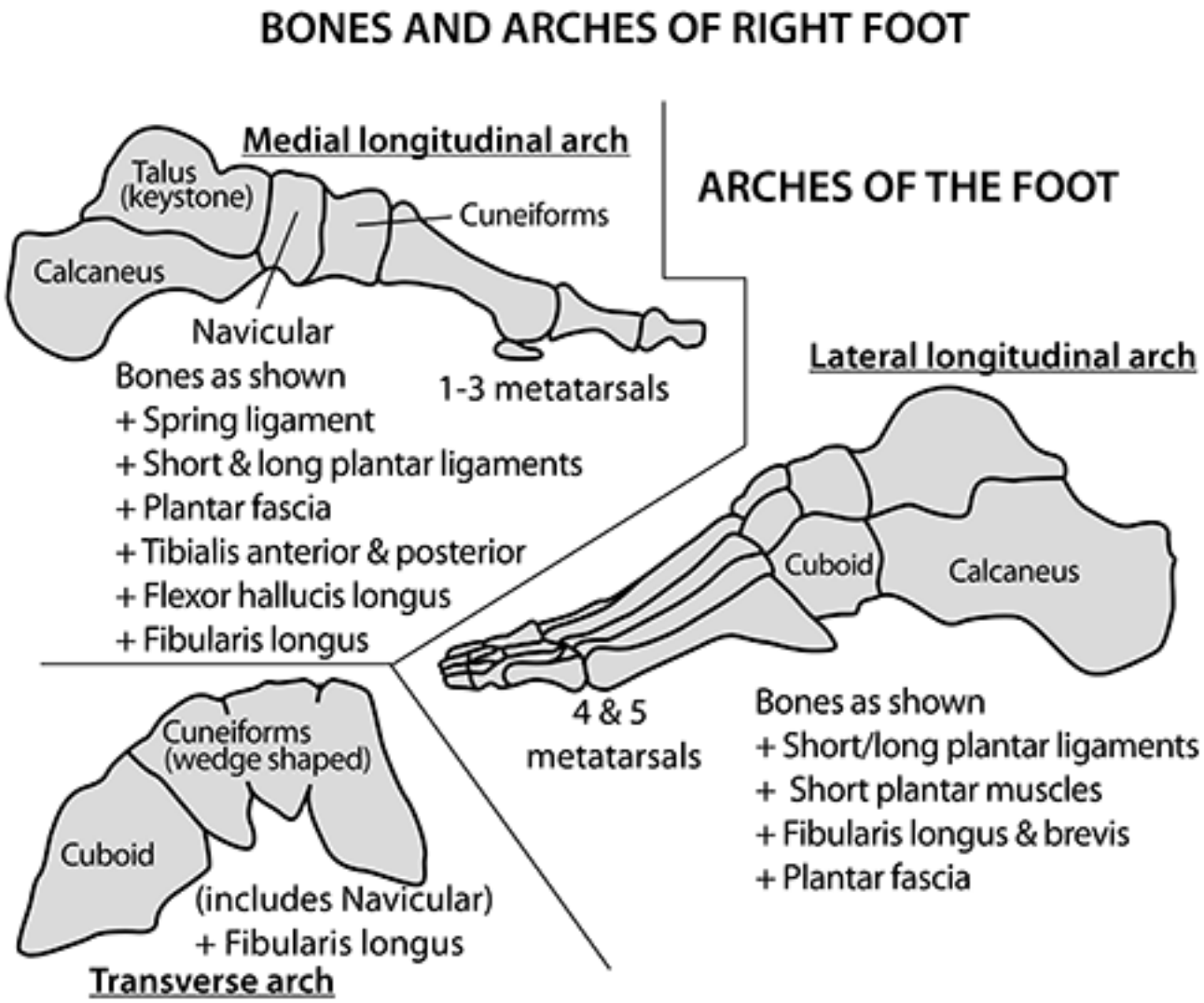
"Timothy Has A Very
Nasty Diseased Foot"

Ankle movements

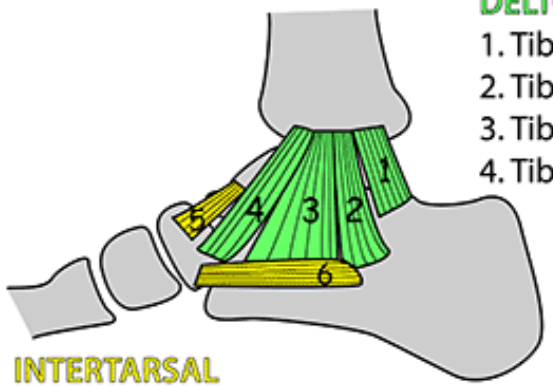
- Hinge joint + axis of rotation
- Inversion
  - Toes adduct
  - Tibialis anterior/posterior +/- flexor hallucis longus
- Eversion
  - Toes abduct
  - Fibularis longus and brevis
  - Tertius

Supporting mechanism of the foot

- Medial longitudinal arch
- Lateral longitudinal arch
- Transverse arch



ANKLE LIGAMENTS



DELTOID/MEDIAL COLLATERAL

1. Tibiotalar (posterior)
2. Tibiosustenacular
3. Tibio-spring ligament
4. Tibionavicular

INTERTARSAL

5. Talonavicular
6. Spring (plantar calcaneo-navicular)
   Thick, strong, non-elastic, from sustenaculum tali to navicular. Upper surface articulates with head of talus.

LIGAMENTS OF MEDIAL SIDE OF RIGHT ANKLE

Joints

- Intertarsal
- Ankle

INFERIOR TIBIOFIBULAR LIGAMENT

1. Anterior tibiofibular
2. Posterior tibiofibular

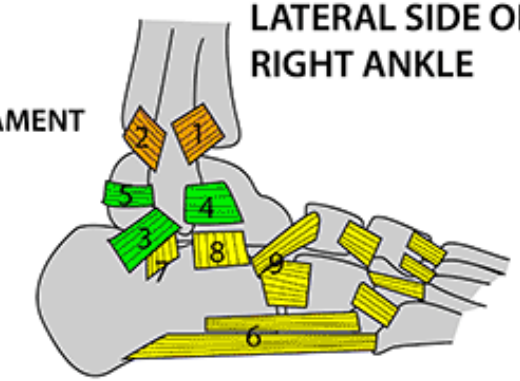
LATERAL COLLATERAL LIGAMENT

3. Calcaneofibular
4. Anterior talofibular
5. Posterior talofibular

TARSAL/METATARSAL LIGAMENTS

6. Short/long plantar
7. Lateral talocalcaneal
8. Cervical
9. Bifurcate

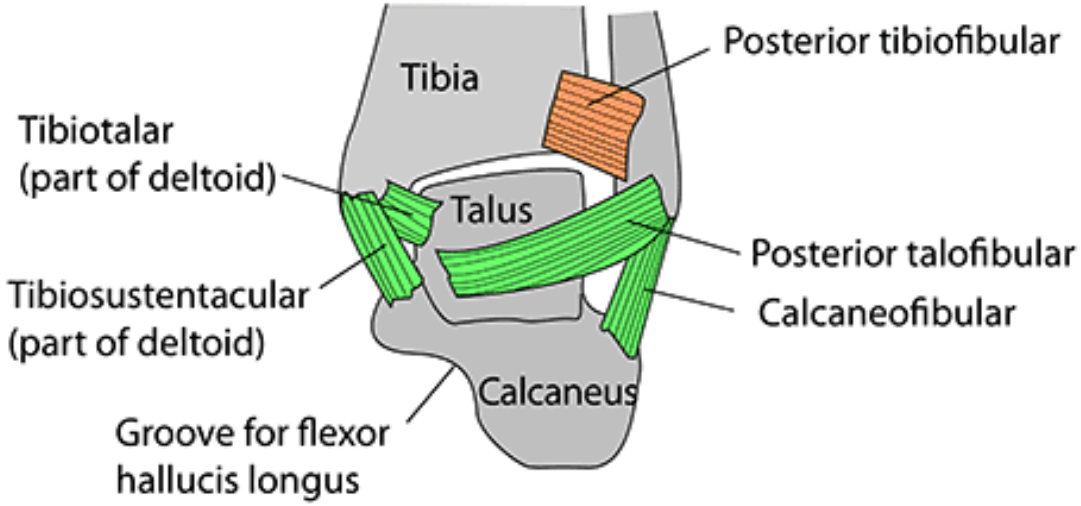
LIGAMENTS OF LATERAL SIDE OF RIGHT ANKLE



Joints

- Inferior tibiofibular
- Ankle
- Intertarsal

POSTERIOR VIEW OF RIGHT ANKLE



Because the fibula sticks out more laterally from the ankle joint than the tibia, the 3 parts of the lateral ligament are less strong and are easily torn in an inversion injury

Joints

- Inferior tibiofibular
- Ankle

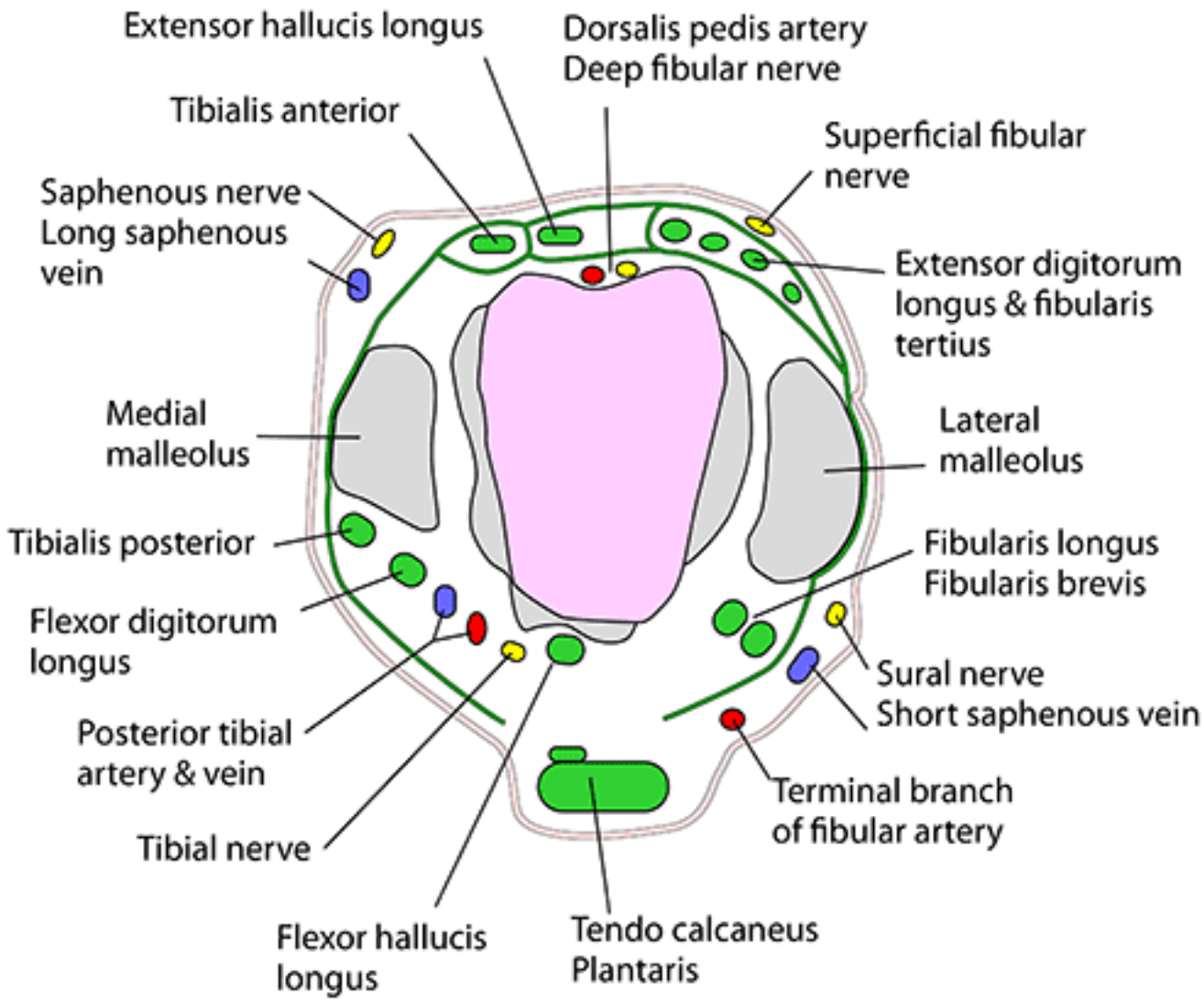
- The talus articulates with all EXCEPT which of the following?
  a. The tibia
  b. The navicular
  c. The posterior tibiofibular ligament
  d. The inferior calcaneonavicular ligament
  e. The long platar ligament

The deltoid ligament is attached to the

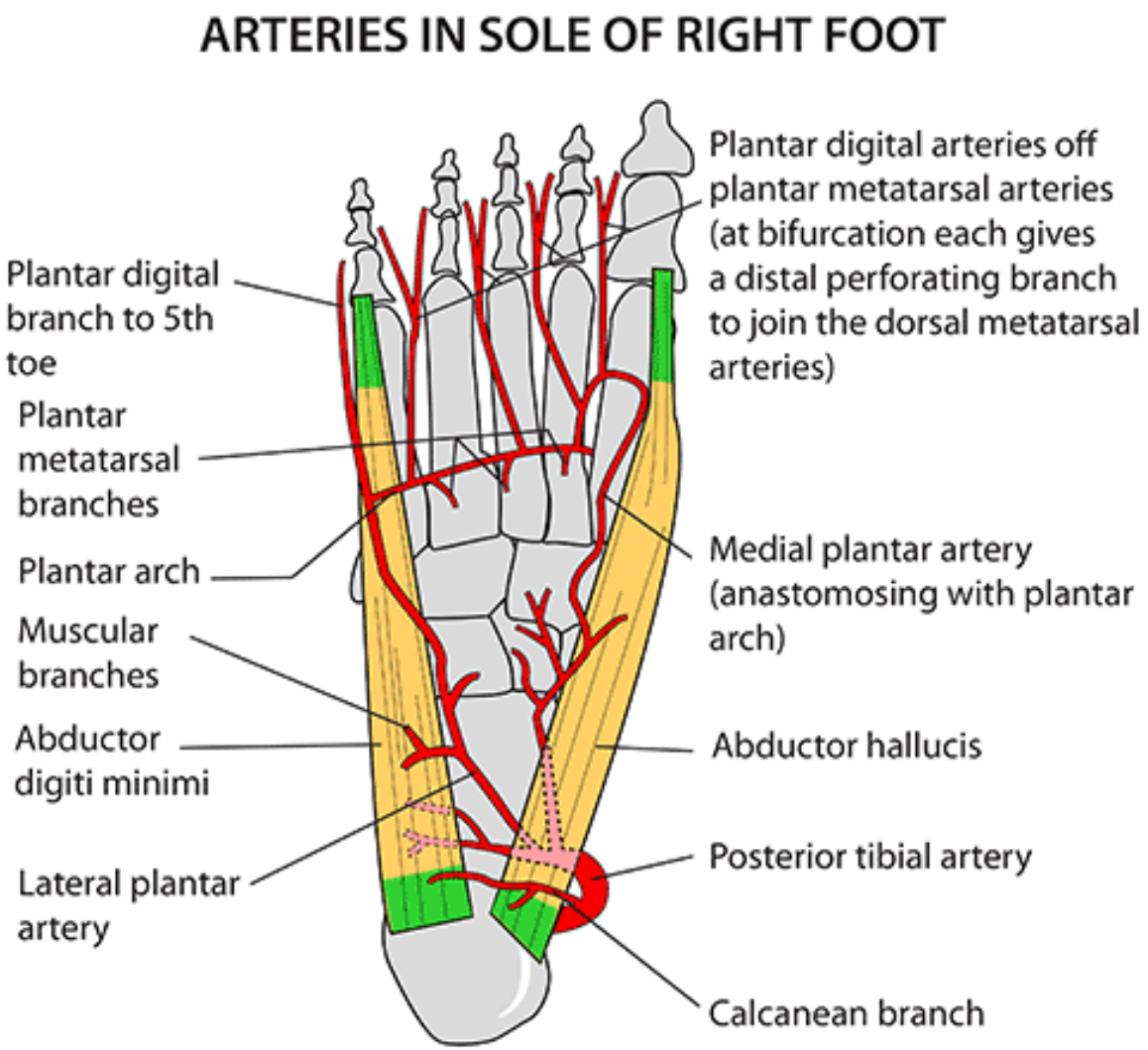
- Medial malleolus
- Sustentaculum tail in continuity with the inferior transverse ligament
- Inferior calcaneo-navicular (spring ligament)
- The tuberisoity of the navicular

1. IN the region of the ankle joint
   - The posterior tibial artery can be palpated behind the medial malleolus
   - The anterior tibial artery can be palpated between the tendons of the extensor hallucis longus and extensor digitorum
   - The flexor retinaculum is attached to the medial malleolus above the calcaneus
   - The dorsalis pedis artery terminates at the distal end of the first intermetatarsal space

AXIAL (CROSS) SECTION THROUGH ANKLE RIGHT ANKLE



- Plantar arch
- Neurovascular plane:
  - Lies between 1st and snd layers
  - Has arteries lying marginal and nerves central

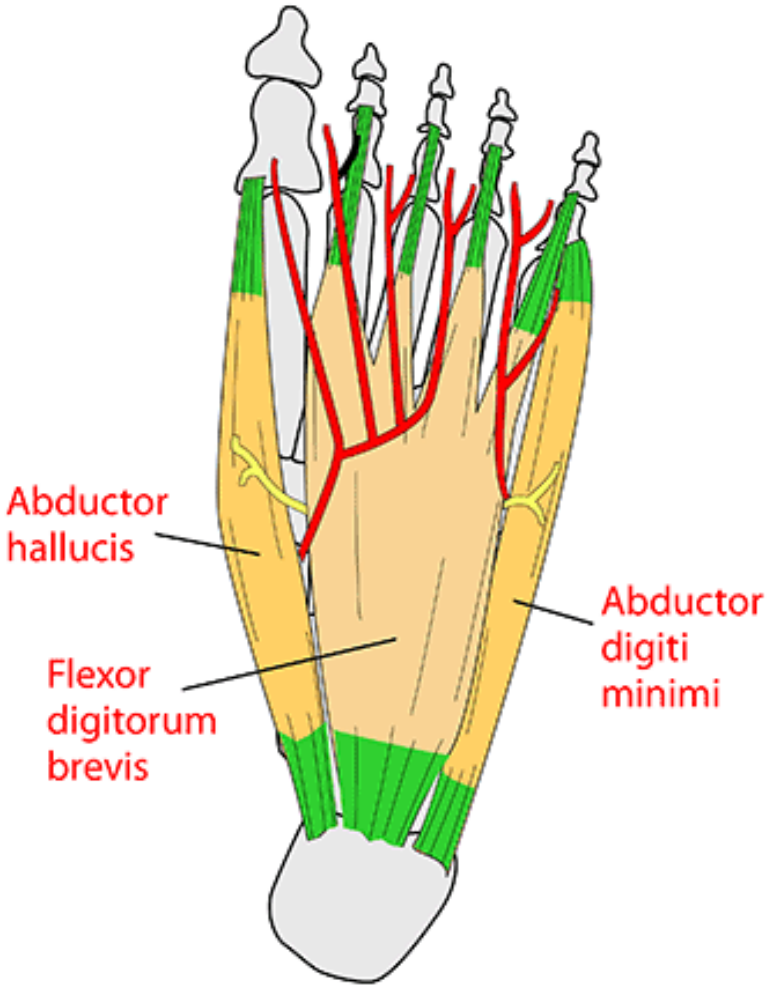


The lateral plantar artery

- Anastomoses with the medial plantar artery to complete the plantar arch
- Crosses the sole obliquely on the lateral side of the lateral plantar nerve
- Lies deep to the flexor accessorius muscle
- Anastomoses wit dorsalis pedis and arcuate arteries

FIRST LAYER OF SOLE OF LEFT FOOT

3 MUSCLES

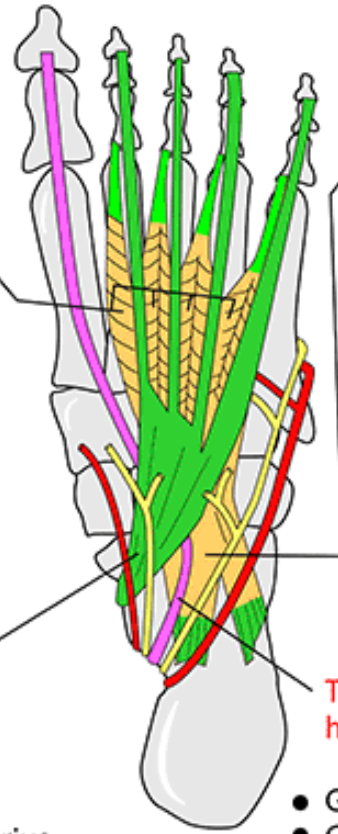


Decussating chiasma of flexor digitorum brevis deep to tendon of flexor digitorum longus

For details of the muscles, please see muscle section in the book - Instant Anatomy, by R H Whitaker & N R Borley. 4th edition. Wiley-Blackwell 2010

SECOND LAYER OF SOLE OF LEFT FOOT

2 MUSCLES
2 TENDONS



Lumbricals

- Lateral 3 are bipennate & are between tendons of flexor digitorum longus (lateral plantar nerve).
- Medial one from medial side of 1st tendon & is unipennate (medial plantar nerve)

Flexor accessorius

- 2 heads.
- Pulls flexor digitorum longus tendons so that they pull straight.
- Assists the long tendons with flexion of lateral 4 toes when ankle is flexed (lateral plantar nerve)

Tendon of flexor digitorum longus

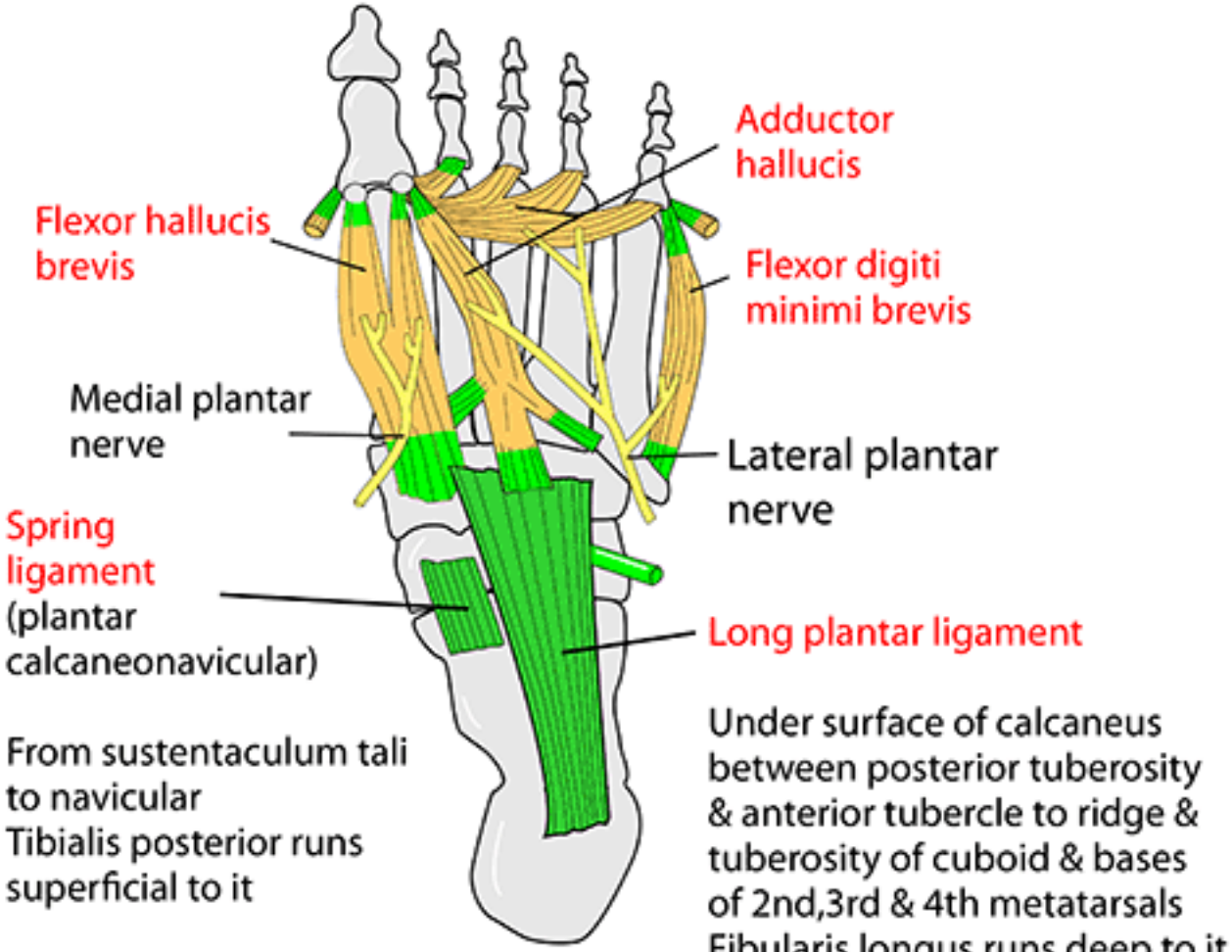
- Crosses superficial to flexor hallucis longus
- Receives flexor accessorius
- Gives off lumbricals
- Receives 2 slips from flexor hallucis longus to 2 medial tendons
- To base of distal phalanges via fibrous flexor sheaths

Tendon of flexor hallucis longus

- Grooves sustentaculum tali
- Crossed by flexor dig longus
- Gives slips to medial 2 tendons of flexor digitorum longus
- Into base of distal phalanx
- Synovial sheath throughout (opened distally here)

THIRD LAYER OF SOLE OF LEFT FOOT

3 MUSCLES
2 LIGAMENTS



From sustentaculum tali to navicular
Tibialis posterior runs superficial to it

Under surface of calcaneus between posterior tuberosity & anterior tubercle to ridge & tuberosity of cuboid & bases of 2nd,3rd & 4th metatarsals
Fibularis longus runs deep to it

FOURTH LAYER OF SOLE OF LEFT FOOT

1 MUSCLE
1 LIGAMENT
3 TENDONS

Tibialis anterior tendon
(Inserts into medial side of base of 1st metatarsal & medial cuneiform)

Fibularis longus tendon
(In synovial sheath Between long & short plantar ligaments Across cuboid & cuneiforms Into lateral base of 1st metatarsal & medial cuneiform)

Plantar interossei -3
(Arise medial sides of 3,4,5 metatarsals Insert medial bases of proximal phalanges with slips to dorsal expansion of 3,4,5. Adduct 3,4,5 toes & assists lumbricals to extend interphalangeal joints & flex metatarsophalangeal joints.
Deep branch of lateral plantar nerve. Unipennate

Short plantar ligament
(plantar calcaneocuboid)
(Anterior calcaneal tubercle to cuboid)

Tibialis posterior tendon

SUMMARY OF LAYERS OF THE SOLE OF FOOT

PLANTAR APONEUROSIS

LAYER 1	3 MUSCLES (AHB, ABDM, FDB)

NEUROVASCULAR PLANE

LAYER 2	2 MUSCLES (LUMBRICALS, ACCESSORIUS) 2 TENDONS (FHL, FDL)
LAYER 3	3 MUSCLES (ADH, FHB, FDMB) 2 LIGAMENTS (SPRING, LONG PLANTAR)
LAYER 4	1 MUSCLE (INTEROSSEI) 1 LIGAMENT (SHORT PLANTAR) 3 TENDONS (FL, TP, TA)

Popliteal fossa

- Plantaris is inferio-lateral for orientation
- Boundaries:
  - Superio-medial: Semi-membranosus (+tendinosus)
  - Superio-lateral: Biceps femoris
  - Inferio-medial: Medial gastrocnemius
  - Inferio-lateral: Plantaris + lateral gastrocnemius
  - Floor: Popliteus, capsule, femur
  - Roof: fascia lata
- Contents:
  - NVA (superifical to deep)
  - Sural is formed by common peroneal and tibial n. to form in midline of gastrocnemius