Anatomy Theory of the Hip/Lower Limb

Nerve Innervation and Functions of Muscles

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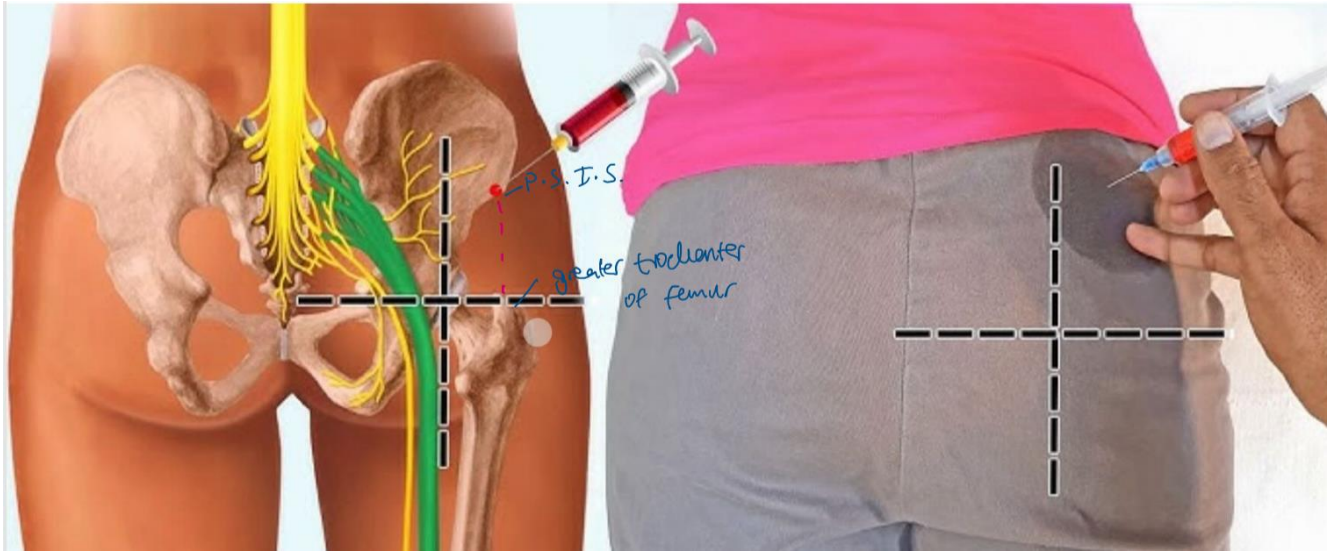
Abbreviations in presentations

A. Artery (A.A. Arteries), V. Vein (V.V. Venous plexus), N. Nerve, VAN collective term for vein, artery and nerve

Innervation of the Hip

- Lumbar plexus & Sacral plexus

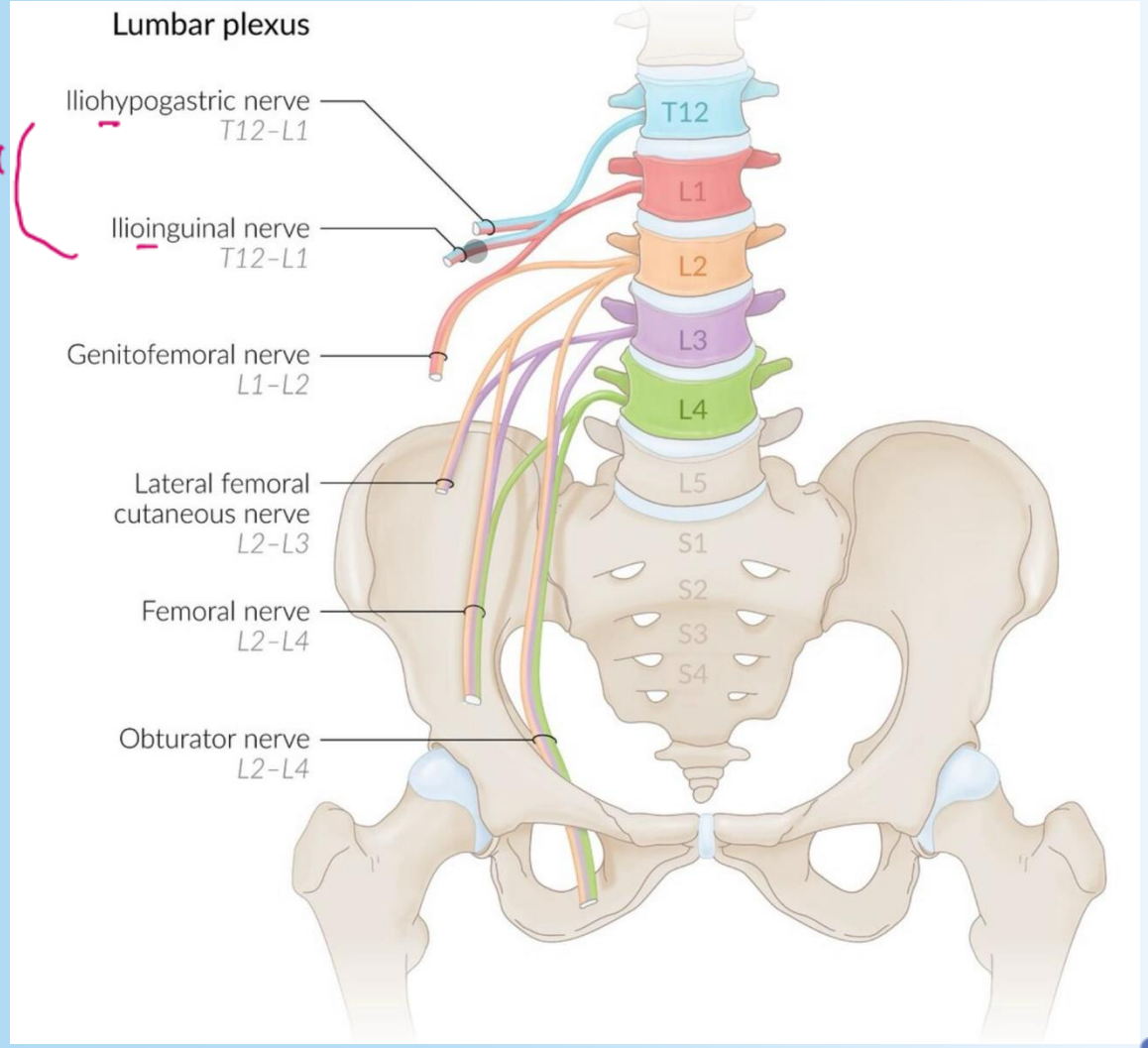


Nervous supply of hip region - Lumbar Plexus

Mnemonic. (See diagram for reference)

- I (Iliohypogastric + ilioinguinal)
- Get
- Leftovers
- On
- Friday
- Luckily (lumbosacral trunk. Sometimes included)

alphabetical order



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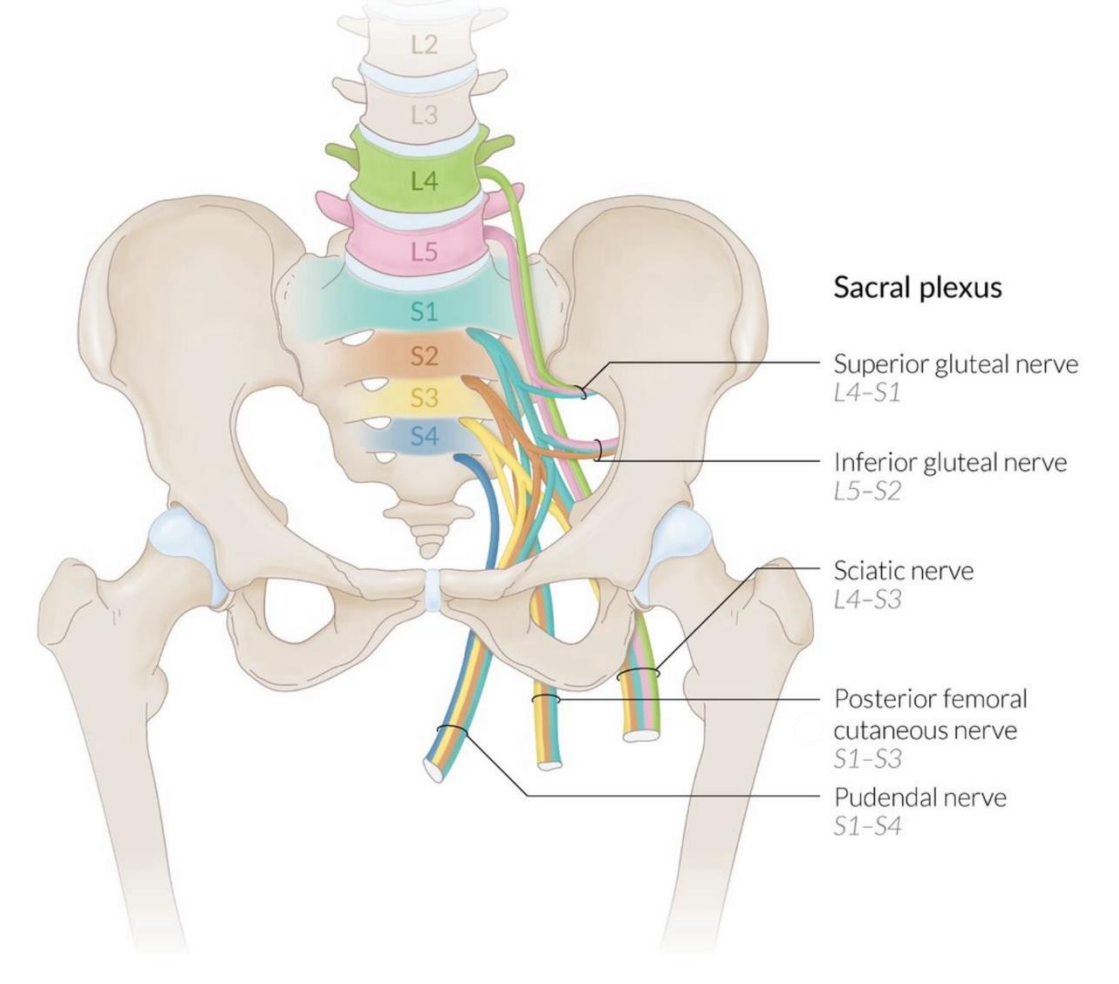
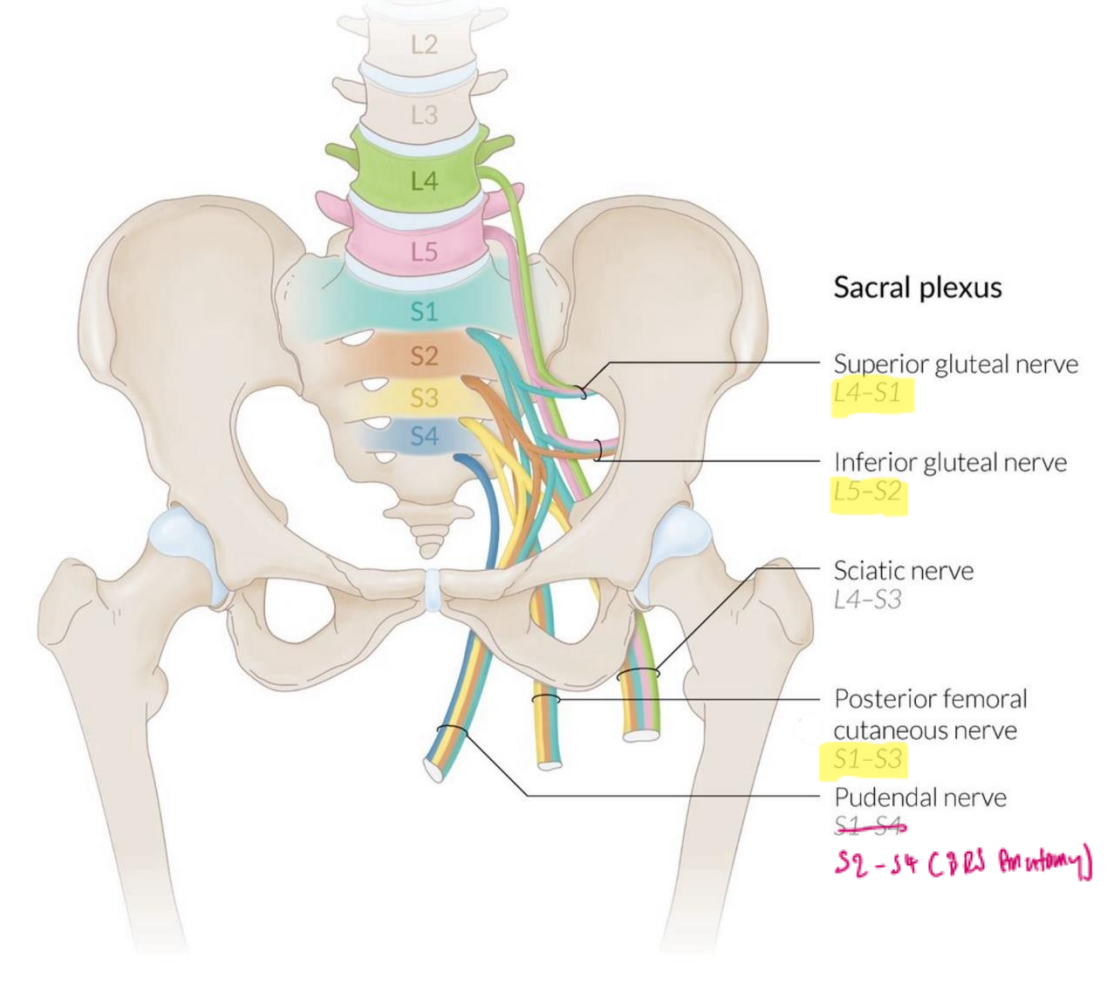
Sacral Plexus Nerves (Memory Tip 1)



To recall nerves and order of the sacral plexus use **SIPPS**

- Superior gluteal N.
- Inferior gluteal N.
- Posterior cutaneous N. of the thigh
- Pundendal N.
- Sciatic N. (Splits into tibial N. and common peroneal N. just before popliteal fossa)

Sacral Plexus Nerve Roots (Memory Tip 2)



- Most of the spinal nerves have 3 spinal nerve roots (except for the sciatic N. (L4-S3) and the nerve to quadratus femoris (L5-S1)

For instance:

- Superior gluteal N. (L4-S1)
- Inferior gluteal N. (L5-S2)
- Nerve to the obturator internus (L5-S2)
- Pudendal N. (S2-S4)

Muscles of the Gluteal Region - Innervation

Superficial Muscles (sup. M. innervated by superior gluteal N. except the gluteus maxiumus):

- **Gluteus** maximus – (Inferior **gluteal** nerve)
- **Gluteus** medius – (Superior **gluteal** nerve)
- **Gluteus** minimus – (Superior **gluteal** nerve)
- Tensor fasciae latae – (Superior gluteal nerve)

Deep Muscles (Lateral Rotators):

- **Piriformis** – (Nerve to **piriformis**)
- **Obturator internus** – (Nerve to **obturator internus**)
- Superior gemellus – (Nerve to obturator internus)
- Inferior gemellus – (Nerve to quadratus femoris)
- **Quadratus femoris** – (Nerve to **quadratus femoris**)

Movement of the hip joint vs movement of knee joint (reciprocal relationship)

Movement	Hip Joint Muscles	Knee Joint Muscles
Flexion	- Iliopsoas- Tensor fasciae latae- Rectus femoris- Adductors- Sartorius- Pectineus- Gracilis	- Hamstrings- Gracilis- Sartorius- Gastrocnemius- Popliteus
Extension	- Hamstrings- Gluteus maximus- Adductor magnus	Quadriceps femoris

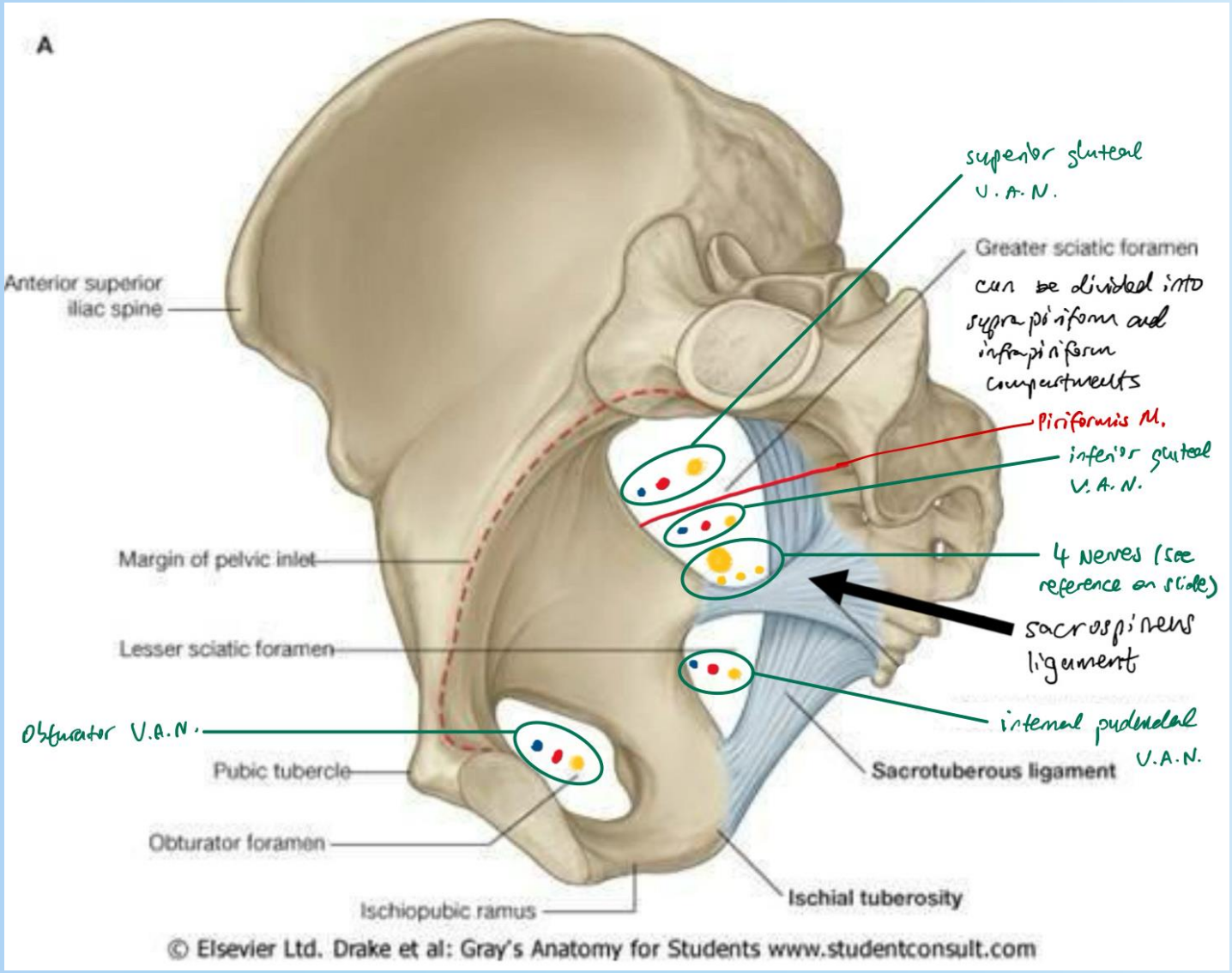
- To remember the interplay between flexion and extension of the lower limb, imagine a footballer preparing to kick a ball.
- **Preparation phase**: The player first **extends the hip** (moving the thigh backward) and **flexes the knee** (bending it) to prepare for the kick.
- **Execution phase**: To complete the kick, the player then **flexes the hip** (moving the thigh forward) and **extends the knee** (straightening the leg) to strike the ball.

Contents of the Greater and Lesser Sciatic Foramina

The greater sciatic foramen is divided into suprapiriform and infrapiriform compartments by the piriformis muscle. The remaining compartments are the lesser sciatic foramen and the obturator foramen.

Mnemonic: "4 VANS & 4 Nerves"

To memorize the structures in each foramen, imagine 4 VANS (Veins, Arteries, Nerves) passing through the suprapiriform, infrapiriform, lesser sciatic, and obturator foramina.



Lastly, recall the 2nd half of the mnemonic, 4 Nerves.

So in addition to the 4 VAN structures, 4 nerves pass through the infrapiriform compartment:

- Sciatic nerve
- Posterior femoral cutaneous nerve
- Nerve to obturator internus
- Nerve to quadratus femoris

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Lower Limb

Anterior
Medial
Posterior compartments of thigh

Adductor Canal

Overview of M. Innervation of Anterior, Medial and Posterior Compartment of the thigh

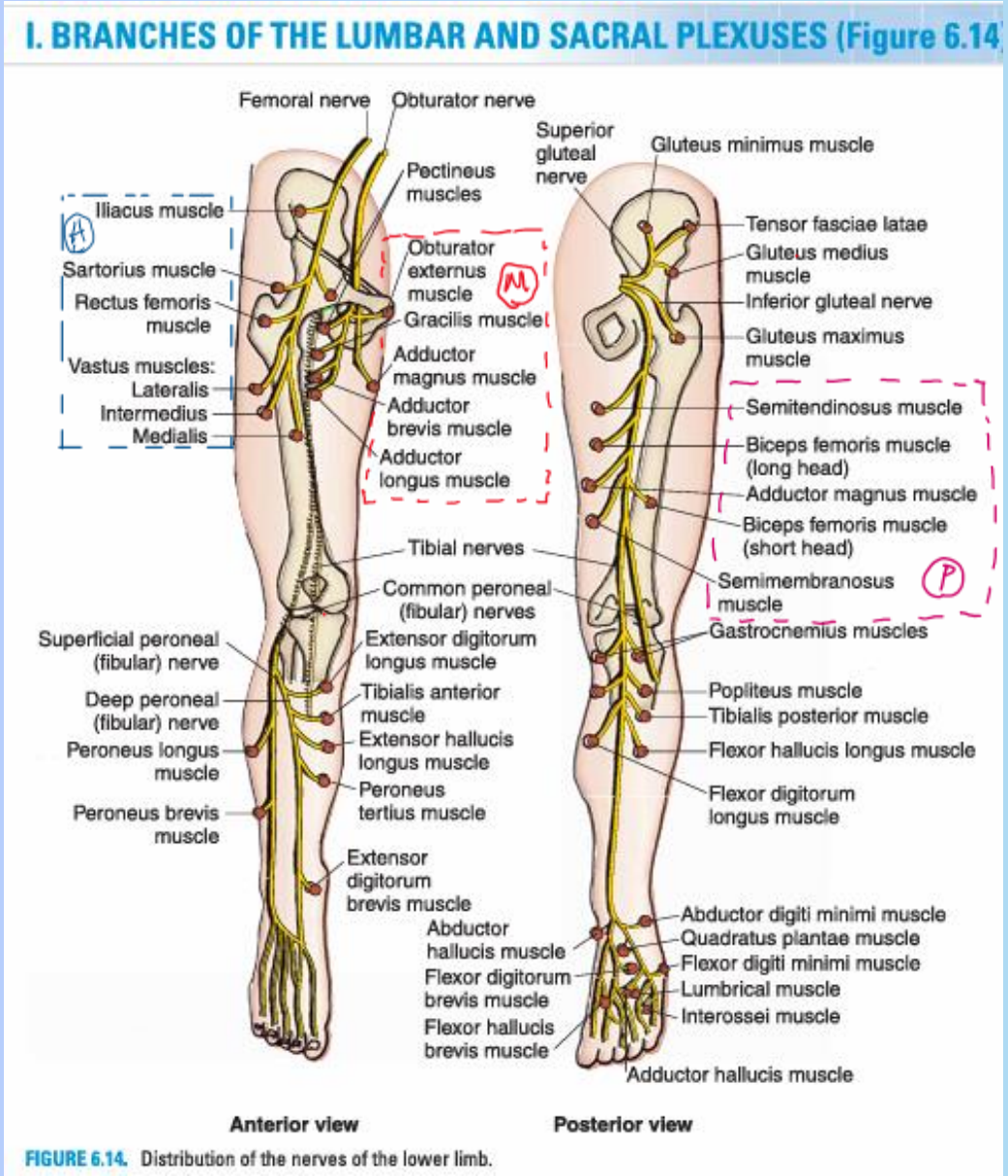

FIGURE 6.14. Distribution of the nerves of the lower limb.

Mnemonic

In order to remember the innervation of thigh compartments you can use the following mnemonic; **MAP OF Sciatic**.

- **M**edial compartment - Obturator nerve
- **A**nterior compartment - **F**emoral nerve
- **P**osterior compartment - **S**ciatic nerve

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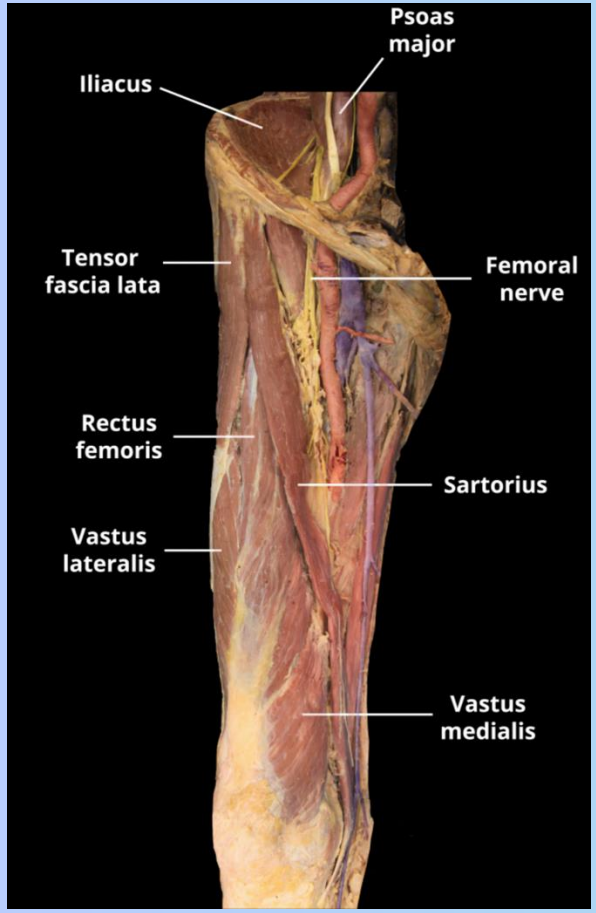
Anterior M. compartment of the thigh



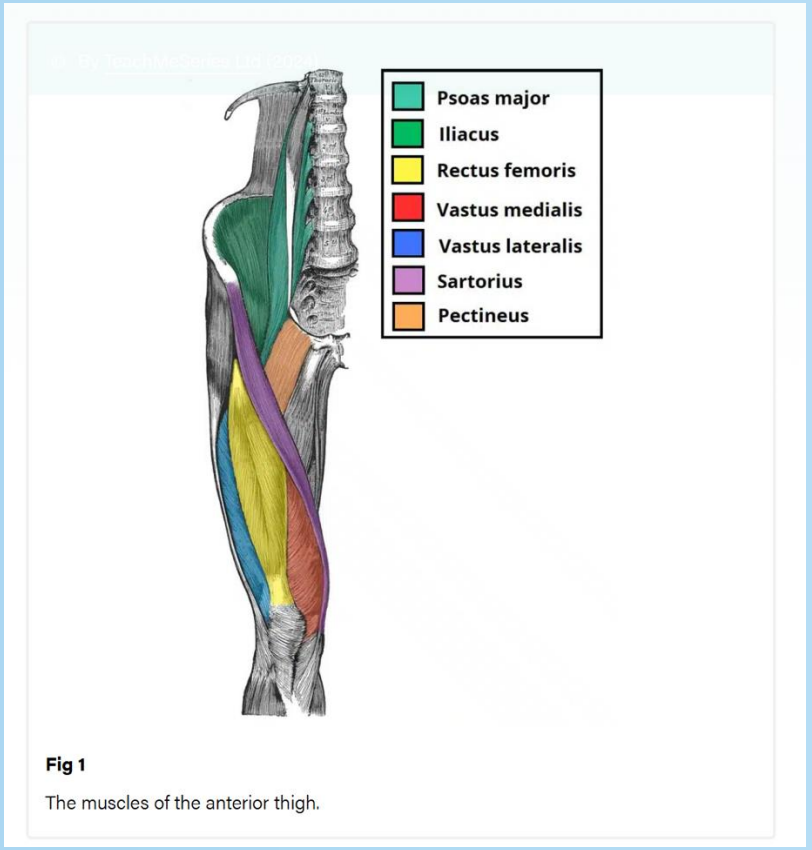
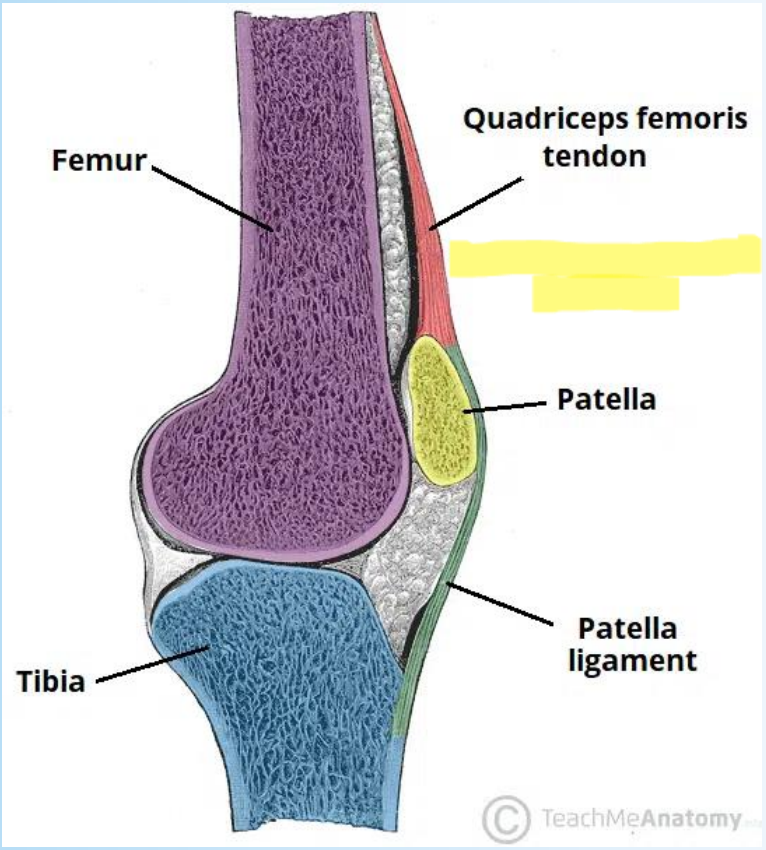


Fig 1

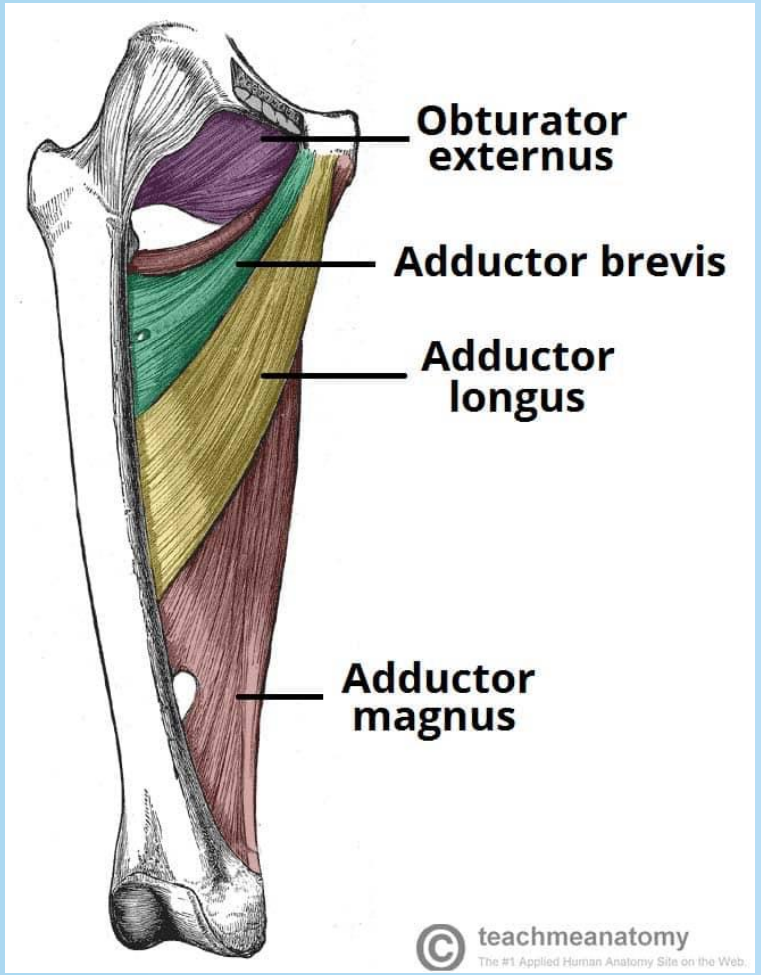
The muscles of the anterior thigh.

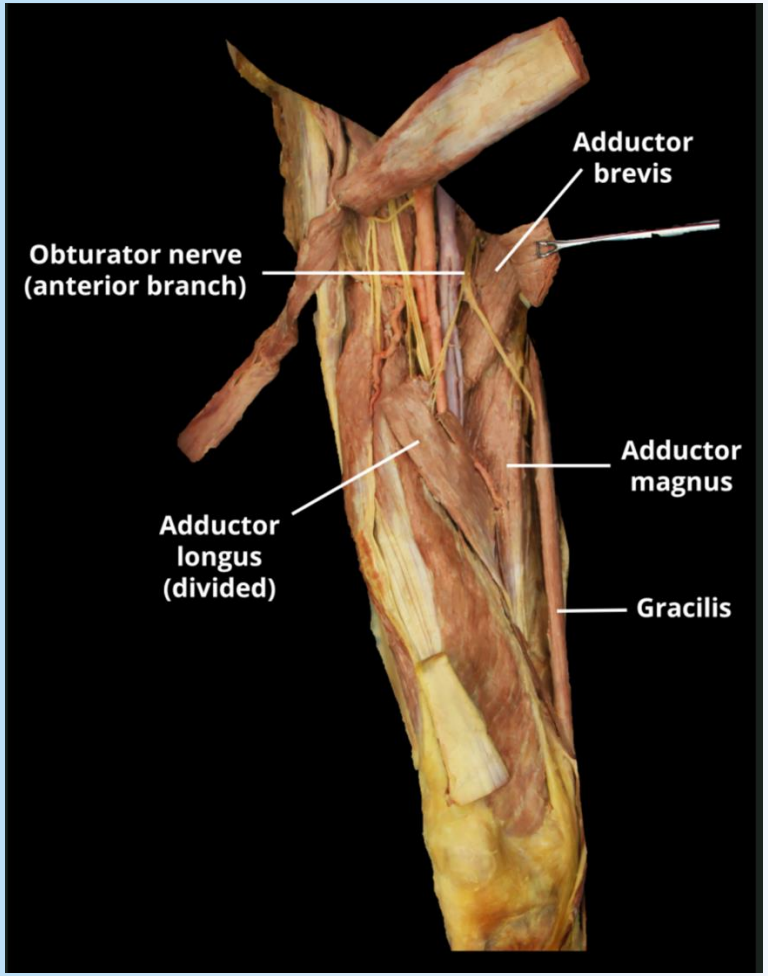


- Sartorius, quadriceps femoris (rectus femoris, vastus medlalis, vastus intermedius, vastus lateralis)
- Anterior compartment innervated by the **femoral N.** (Lumbar plexus)
- Anterior compartment primarily focuses on **hip flexion and knee extension**

Medial Compartment of Thigh (a.k.a Hip adductors)

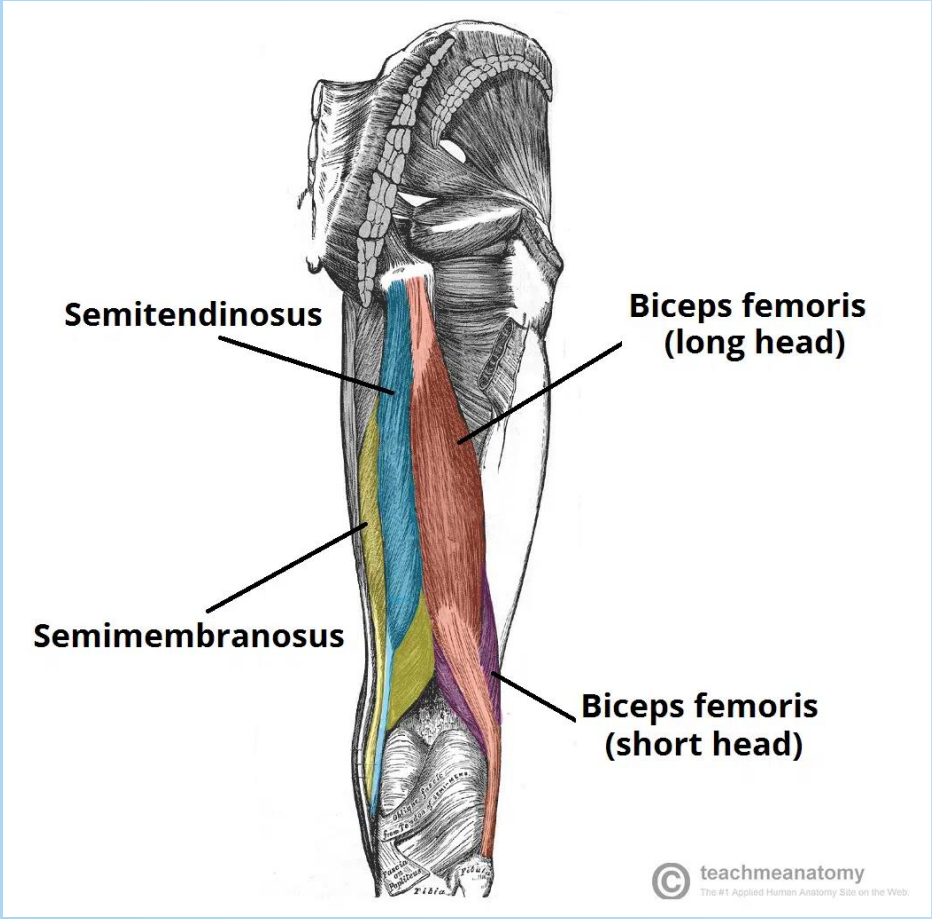
- Adductor longus, adductor brevis, adductor magnus (obturator and tibial nerves), gracilis, obturator externus, pectineus (femoral and obturator nerves).
- The medial compartment is innervated by the obturator N. (Unless otherwise stated)
- The adductors are responsible for **hip adduction** and **flexion** (AMag, AL, AB and AMin)
- Obturator externus – external rotation of hip/adduction
- Gracilis – hip adduction/flexion
- Pectineus hip flexion/adduction/external rotation

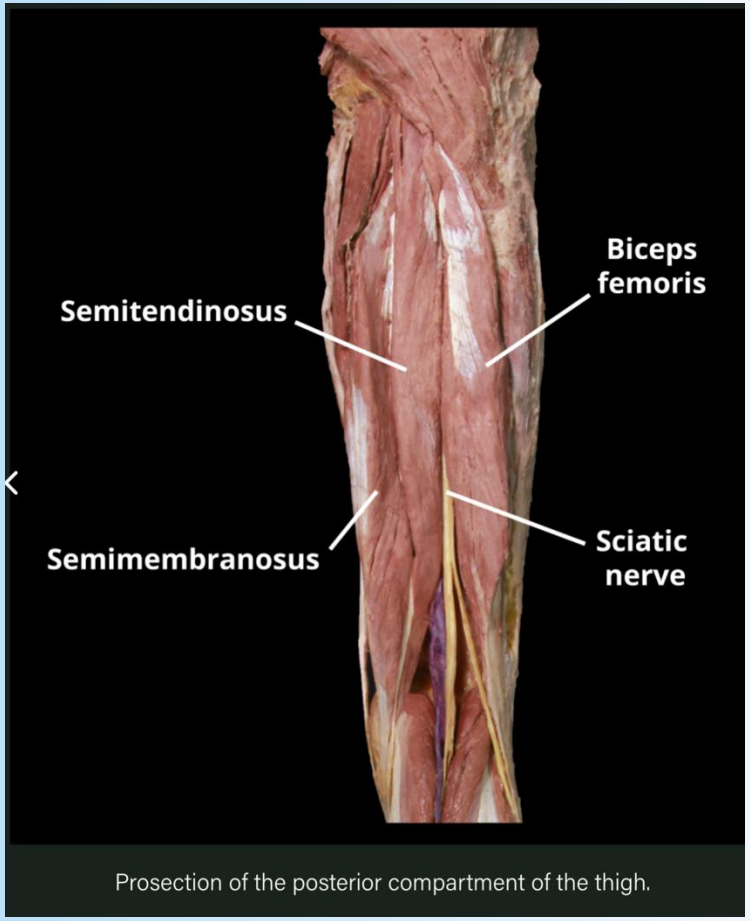




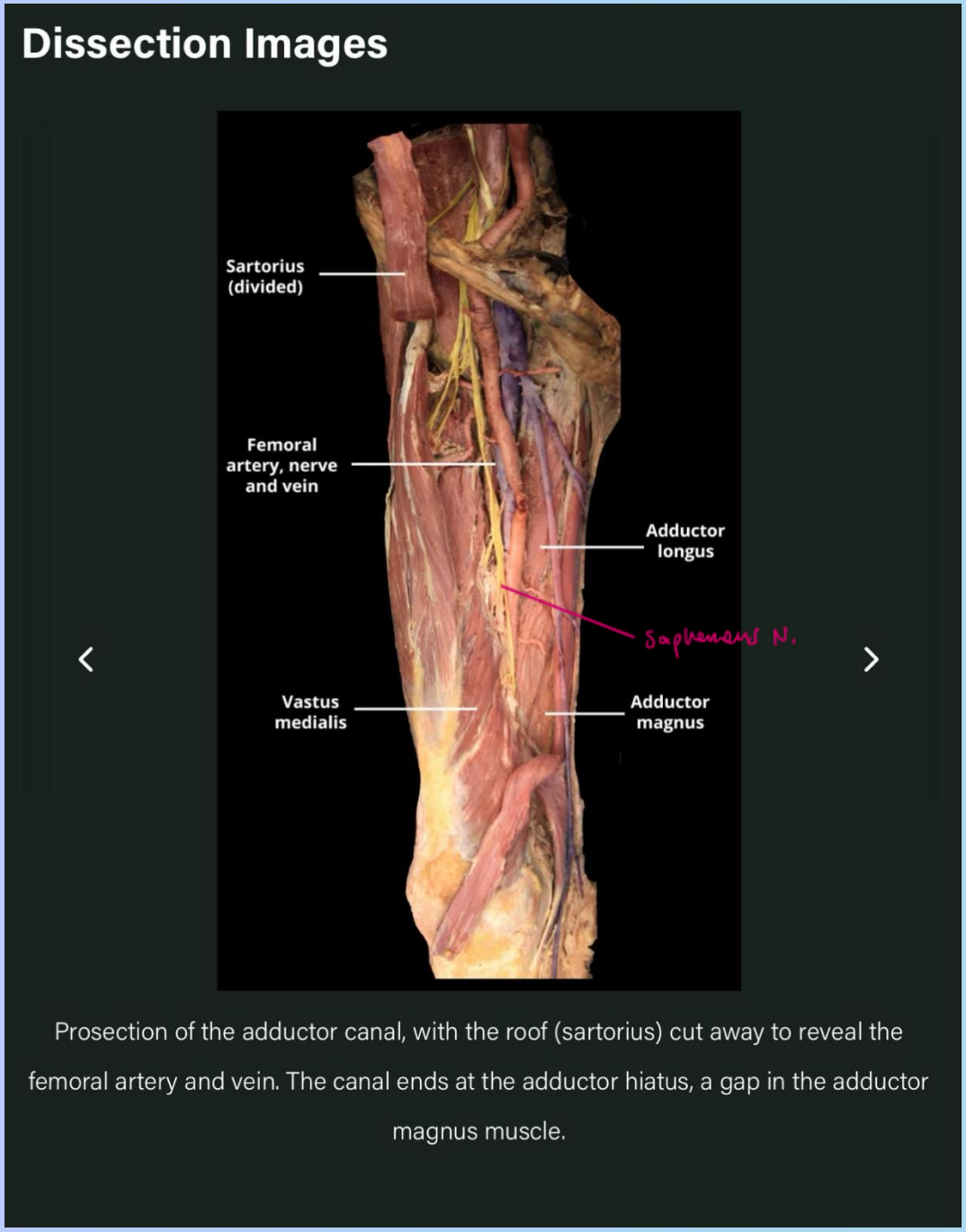
Posterior Compartment of Thigh

- The posterior compartment of the thigh houses the **hamstring muscles**, which are primarily responsible for **hip extension** and **knee flexion**.
- Semitendinosus,Semimembranosus
- Biceps femoris (long head – obturator N.), Biceps femoris (short head innervated by Common fibular part of the Sciatic N.)
- Adductor magnus (tibial part of the sciatic nerve **and** obturator nerve).
- The posterior compartment is innervated by the the tibial part of the sciatic N.
- Mnemonic: **SS** And **BB**





Adductor Canal

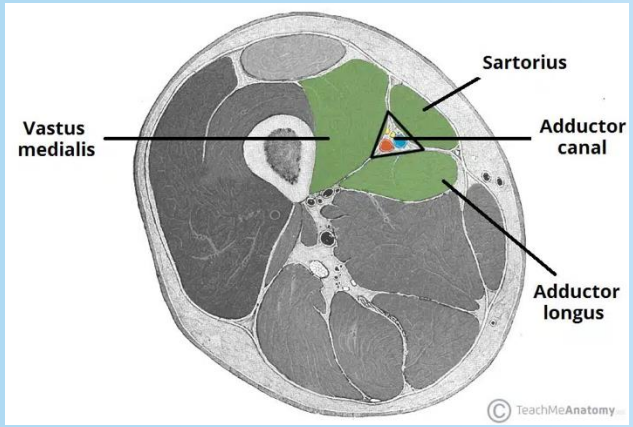


It is approximately 15cm long, extending from the apex of the femoral triangle to the adductor hiatus of the adductor magnus. The canal serves as a **passageway** from structures moving between the anterior thigh and posterior leg.

The adductor canal is bordered by muscular structures:
Anteromedial – Sartorius.
Lateral – Vastus medialis.
Posterior – Adductor longus and adductor magnus.

Contents: femoral artery, the femoral vein, the nerve to vastus medialis (femoral N.) and the saphenous nerve. (The great saphenous V. Does not pass throught the adductor canal!)

Memory aid: Femoral VAN and the Saphenous N.

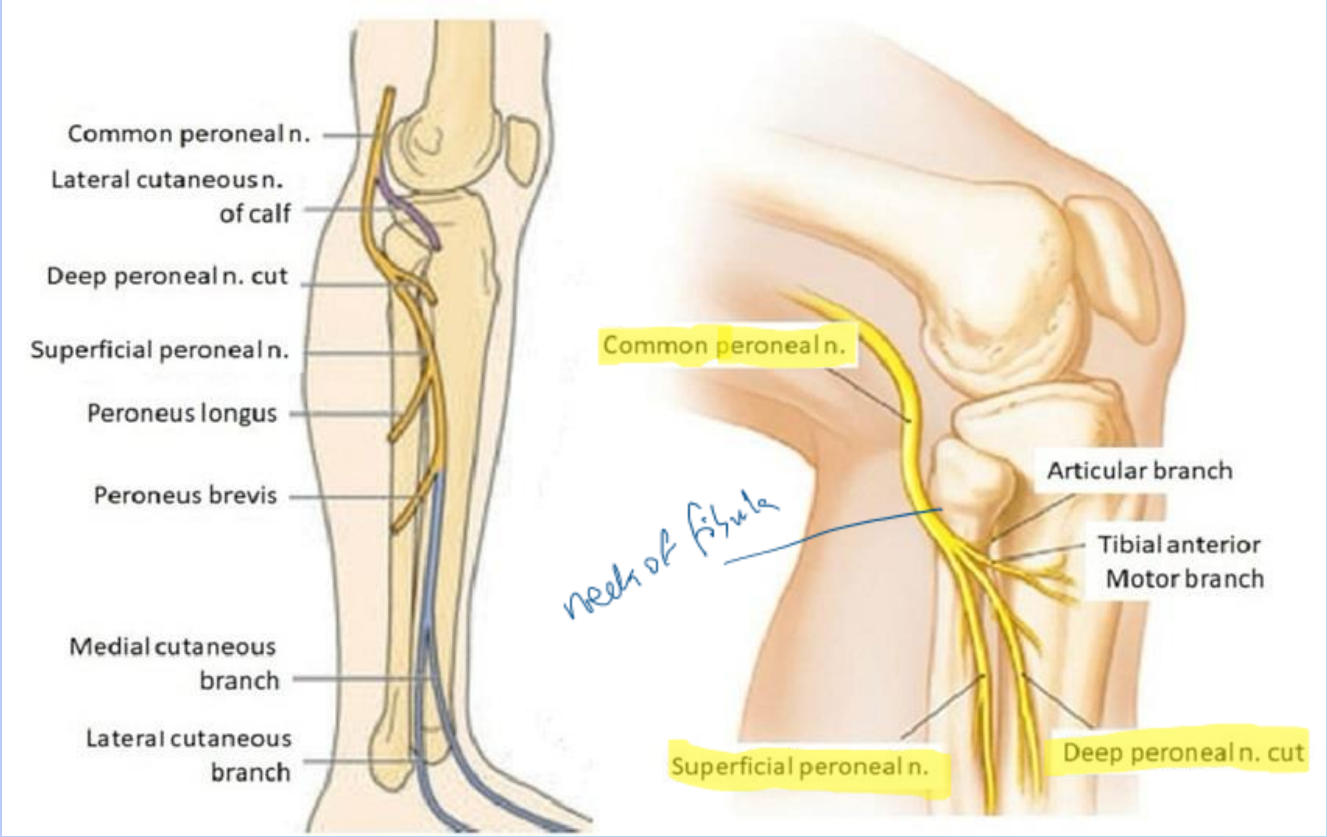


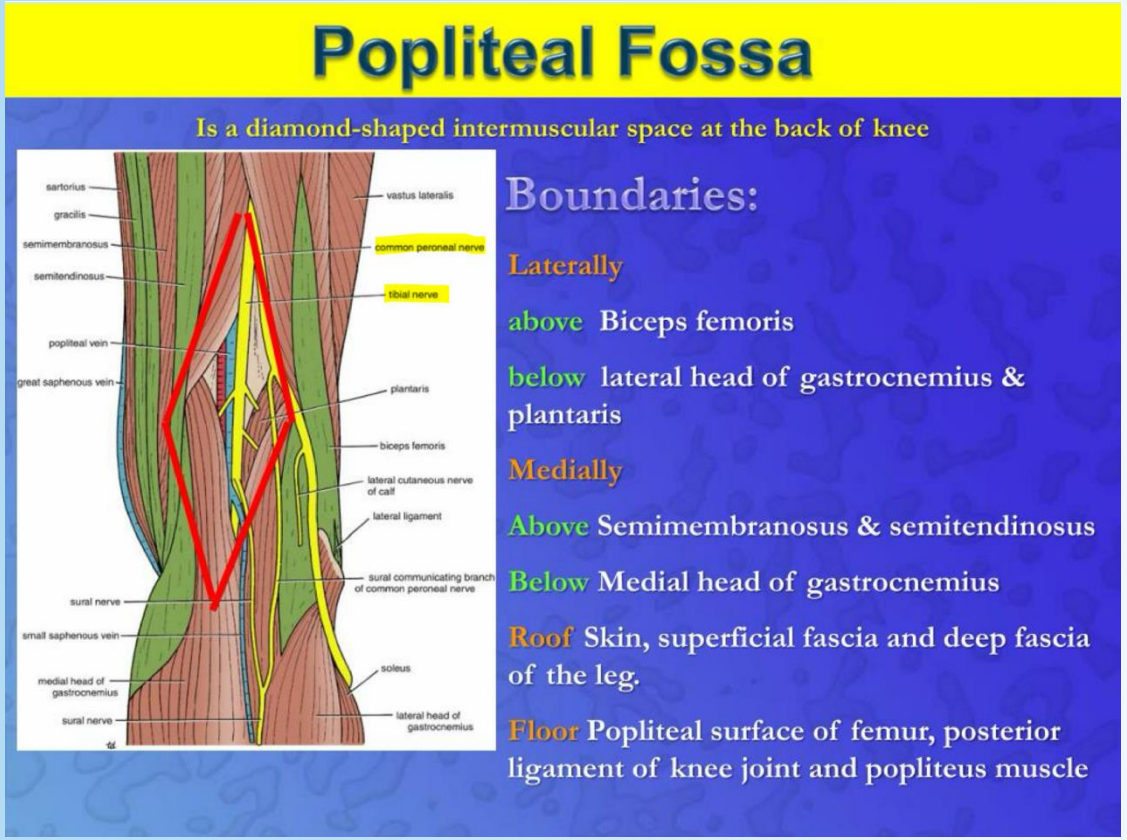
- What structure forms the lateral border of the adductor canal?

- The adductor canal ends at the adductor hiatus, a space within the _____ muscle.

Knee Innervation

Path of the common peroneal (fibular) N.





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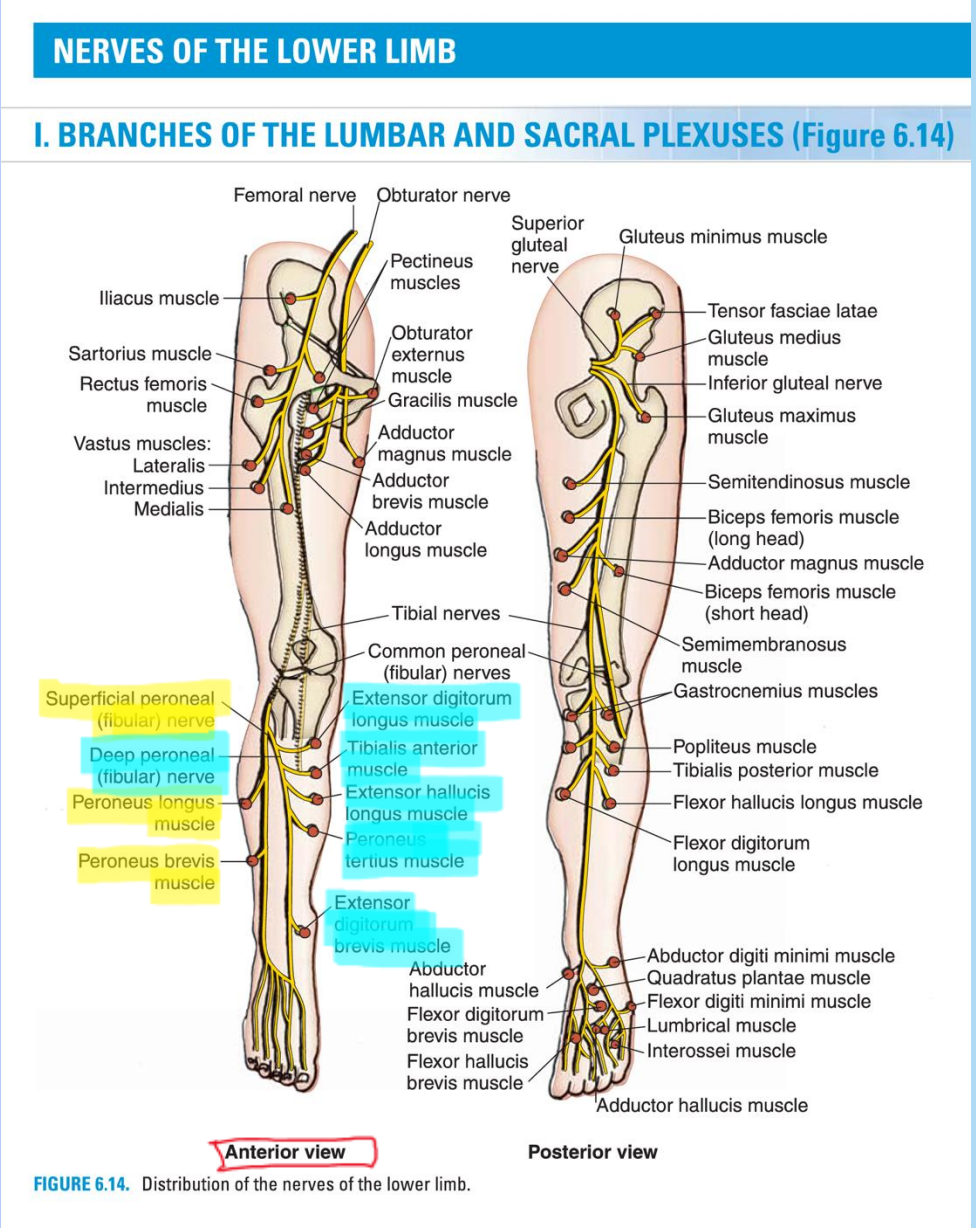
Anterior and Lateral Compartment Innervation of the Anatomical Leg



Lateral compartment of leg

- **FF** innervated by the **superficial fibular (peroneal) N.**

- Fibularis (peroneus) longus M.
- Fibularis (peroneus) brevis M.

Anterior compartment of leg

- **FEET** Muscles are innervated by the **deep fibular (peroneal) N.**

- Fibularis tertius M.
- Extensor hallicis longus M.
- Extensor digitorum longus M.
- Tibialis anterior M.

**The extensor digitorum brevis is innerv. By the deep peroneal N. , but is in ant. foot compartment. (Hence not added to list)

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Posterior (superficial and deep) Compartment of leg all innervated by the tibial N. (Easy! :)

Posterior compartment of the leg (flexor compartment)

Characteristics of the posterior leg compartment

Group	Muscle		Origin	Insertion	Innervation	Function	Testing
Superficial flexor group	Triceps surae	Gastrocnemius	• Lateral head: lateral femoral condyle • Medial head: medial femoral condyle	• Tendons of gastrocnemius and soleus fuse to form the calcaneal tendon (**Achilles tendon**) that is inserted into the posterior aspect of the calcaneus bone.	• Tibial nerve	• Ankle: plantarflexion • Knee: flexion	• Plantar flexion of the ankle against resistance with the knee extended
		Soleus	• Head of fibula, **soleal line** (a prominent, oblique ridge on the posterior surface of the proximal tibia), and middle third of the medial border of the tibia			• Ankle: plantarflexion	• Plantar flexion of the ankle against resistance with the knee flexed
	Plantaris		• Lateral supracondylar line of the femur	• Calcaneus bone		• Ankle: plantarflexion (weak)	• Cannot be tested in isolation
Deep flexor group	Tibialis posterior		• Posterior surfaces of the upper parts of the fibula and tibia and the adjacent interosseous membrane	• Navicular bone, intermediate cuneiform bone, and the bases of the 2^{nd}–4^{th} metatarsals		• Foot: Inversion (main foot inverter)	• Inversion of the plantarflexed foot against resistance
	Flexor digitorum longus (FDL)		• Posterior surface of the tibia	• Splits into 4 tendons that insert into the base of the distal phalanges of the lateral 4 toes		• Lateral 4 toes: flexion of the distal phalanges	• Flexion of the lateral 4 toes against resistance
	Flexor hallucis longus (FHL)		• Distal two thirds of the posterior aspect of the fibula and the adjacent interosseous membrane	• Plantar aspect of the base of the distal phalanx of the hallux		• Hallux: flexion	• Flexion of the hallux against resistance
	Popliteus		• Tendinous origin from knee joint capsule and lateral femoral condyle	• Posterior surface of the proximal tibia (superior to soleal line)		• Internally rotates the tibia on the femur (unlocking the fully extended knee)	• Cannot be tested in isolation

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Posterior Nervous Supply of Lower Limb

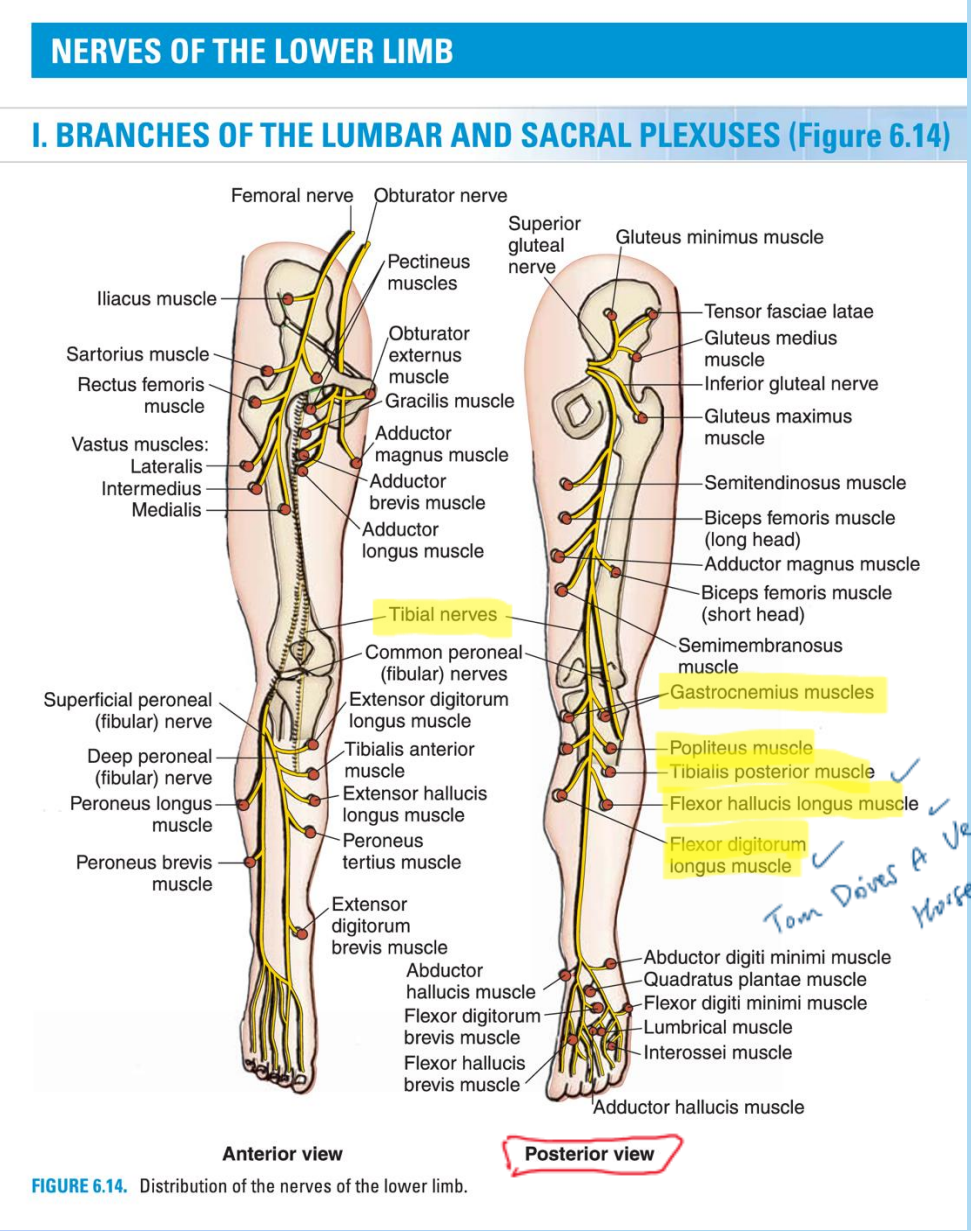
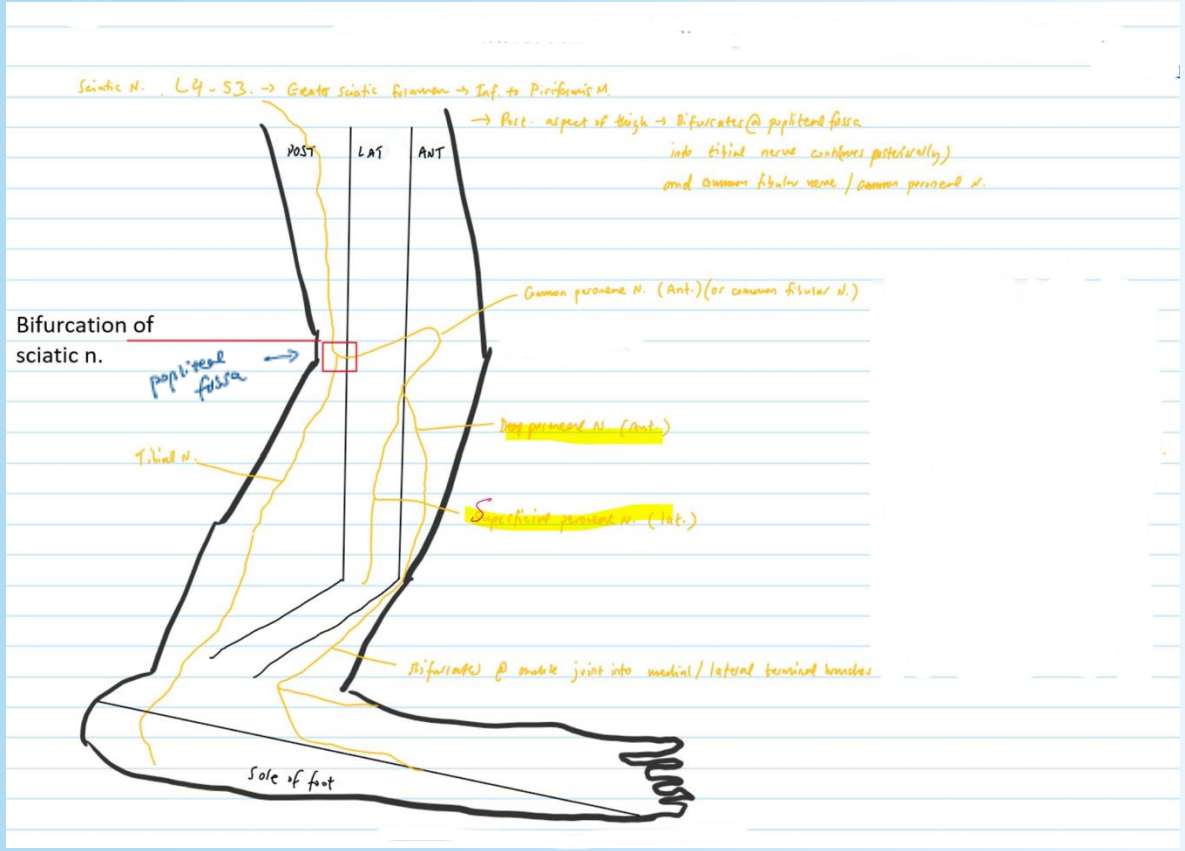


FIGURE 6.14. Distribution of the nerves of the lower limb.



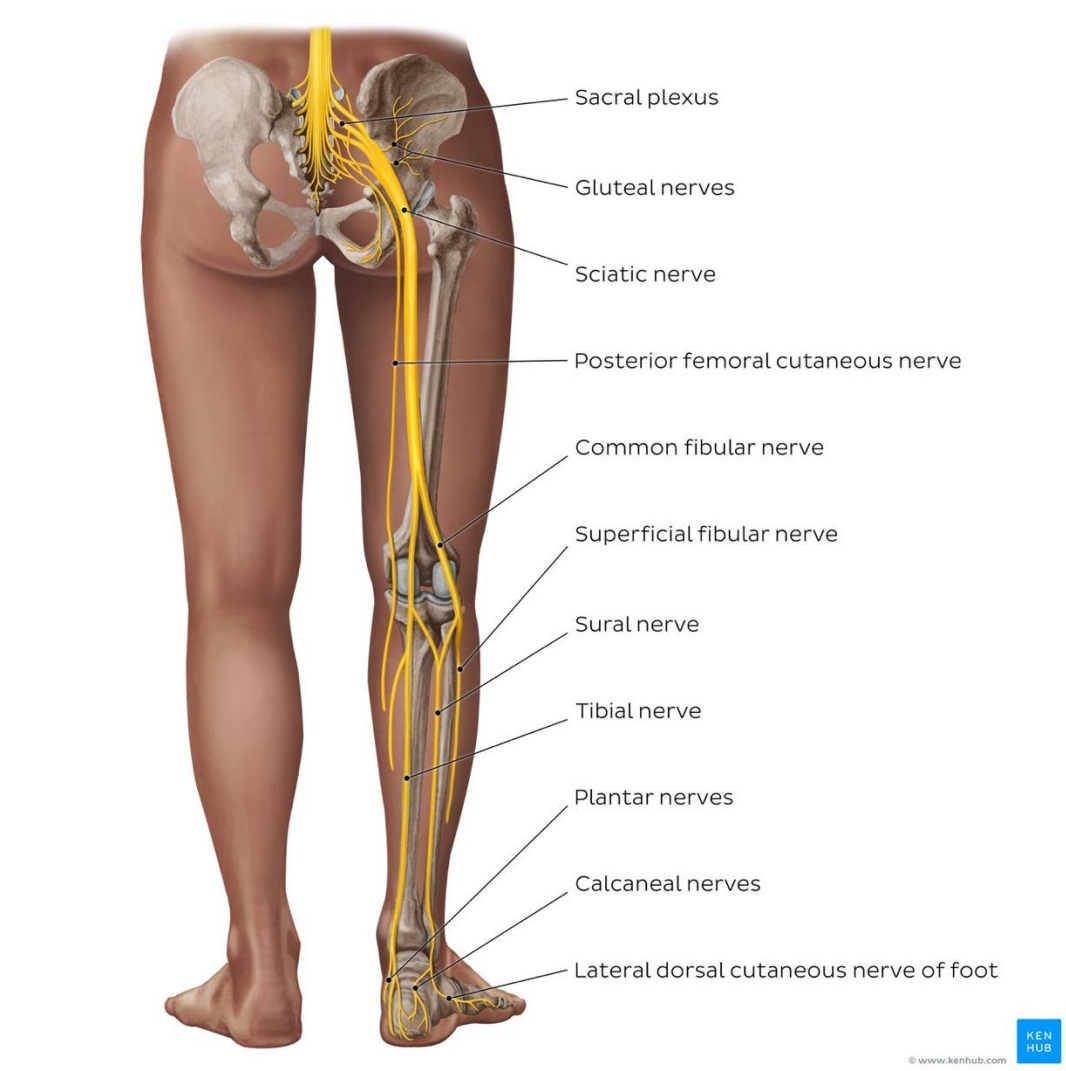
High yield: Path of the **Sciatic N.**

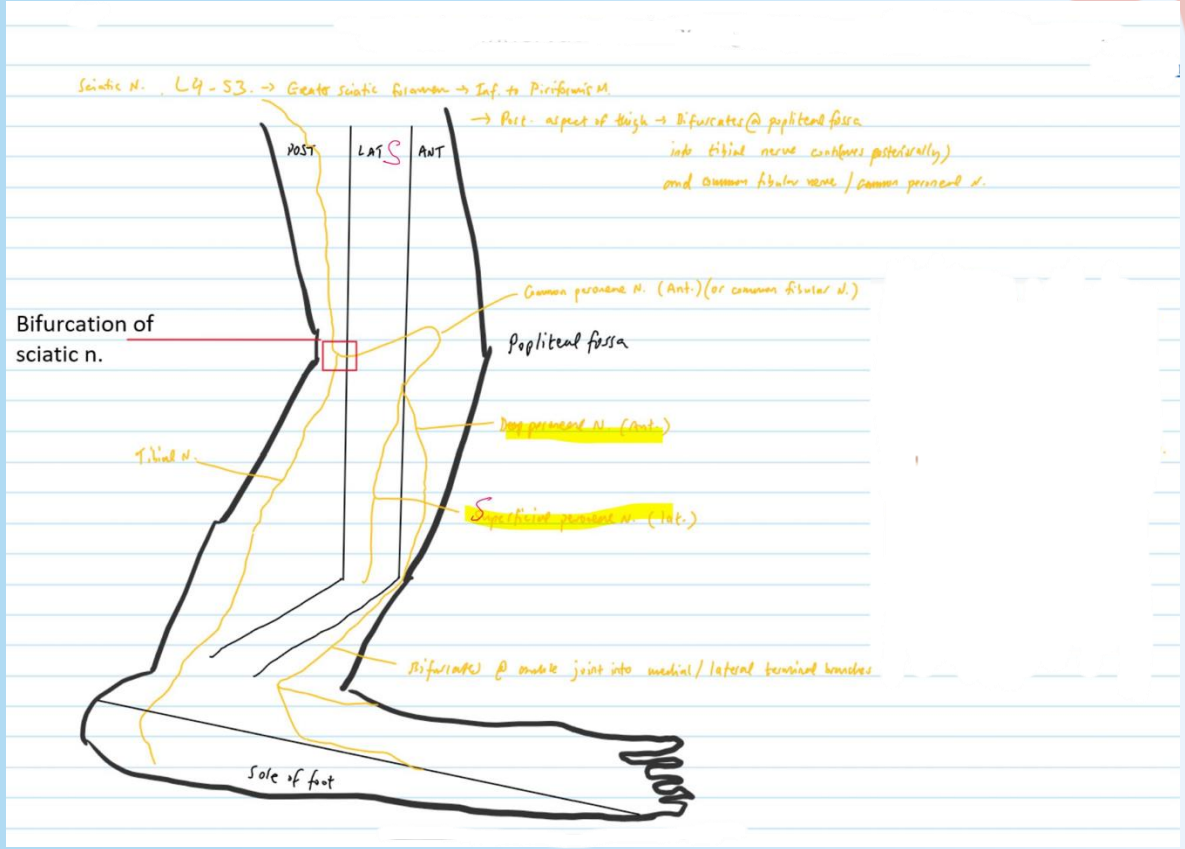
L4-S3 —> via **Greater sciatic foramen** (inf. to piriformis M.) —> posterior aspect of thigh where it **bifurcates** just superior to the popliteal fossa into the **Common peroneal** (**fibular**) **N.** and the **Tibial N**.

Tom Drives A Very Nervous Horse (all pass under flexor retinaculum of foot)

Tibialis posterior M, Flexor Digitorum M. Posterior Tibial Artery/Vein, Tibial N and Flexor Hallicus Longus Tendon. All muscles of this group are innervated by the tibial N.

Posterior Nervous Supply of Lower Limb





High yield: Path of the **Sciatic N.**
L4-S3 —> via **Greater sciatic foramen** (inf. to piriformis M.) —> posterior aspect of thigh where it **bifurcates** just superior to the popliteal fossa into the **Common peroneal** (**fibular**) **N.** and the **Tibial N**.

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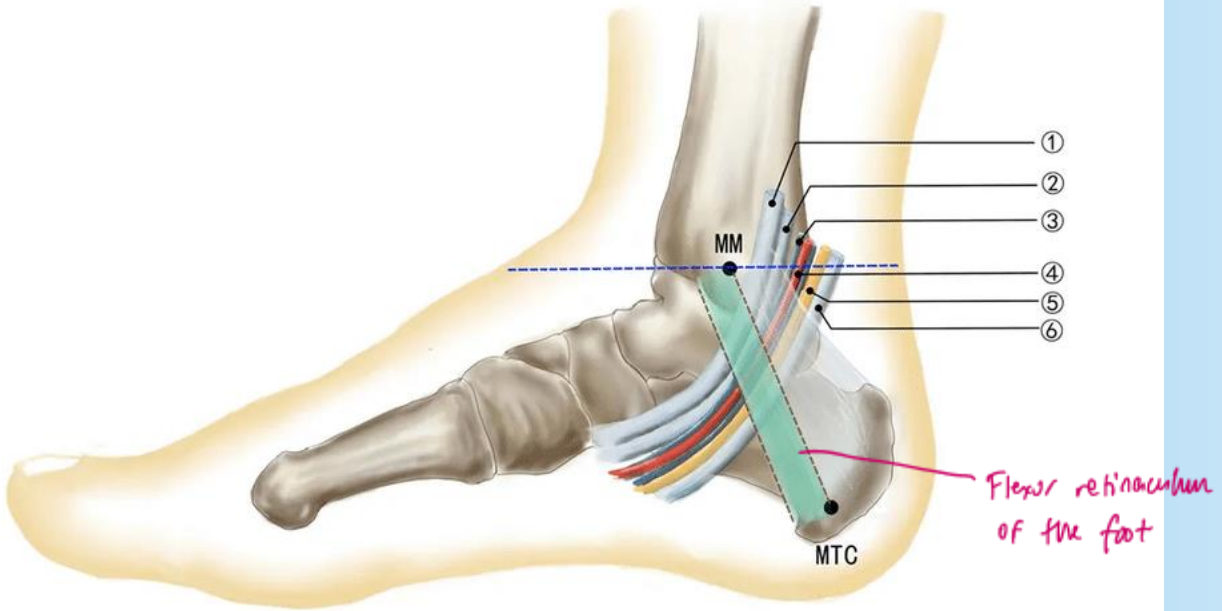
Contents of the Tarsal Tunnel



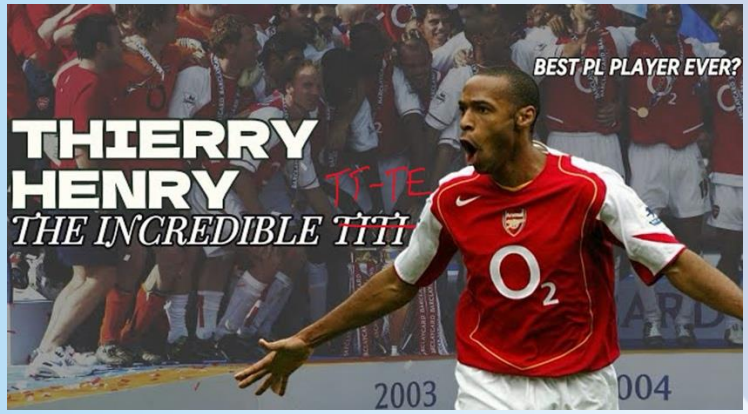
1) Tibialis posterior, 2) Flexor digitorum longus, 3) Tibial vein,
4) Tibial artery, 5) Tibial nerve, 6) Flexor hallucis longus

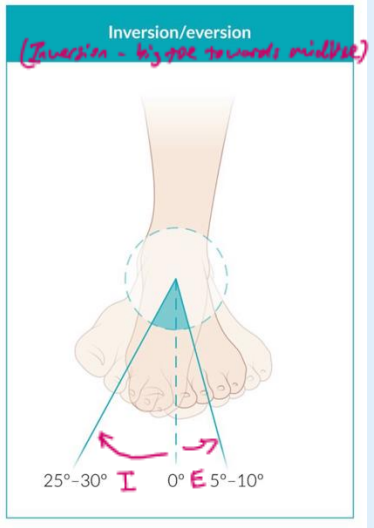
Muscles - Foot Invertors vs Foot Evertors

- **Chief invertors** of the foot are TT-TE

- TT = tibialis anterior/tibialis posterior
- TE = ticeps surae and extensor hallicus longus

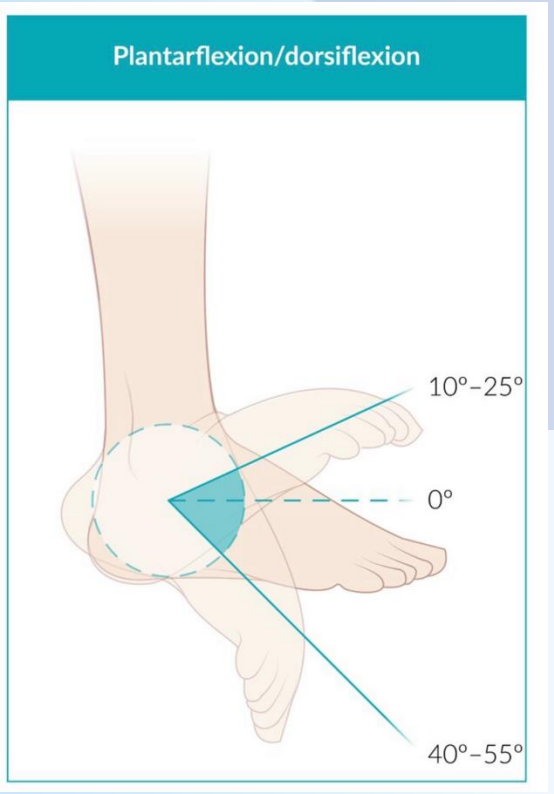
- **Chief evertors** of the foot are: fibularis (peroneus) longus, brevis, and tertius and the extensor digitorum longus
- Memory aid: all the fibularis muscles and the extensor digitorum **longus**





Dorsiflexion and Plantar Flexion

- The foot and ankle dorsiflexors include the tibialis anterior, the extensor hallucis longus (EHL), and the extensor digitorum longus (EDL).
- The plantar flexors (think planting foot in ground) are the flexor hallucis longus and brevis (great toe), the flexor digitorum longus (the lateral four toes at the DIP joints), and the flexor digitorum brevis (the lateral four toes at the PIP joints).

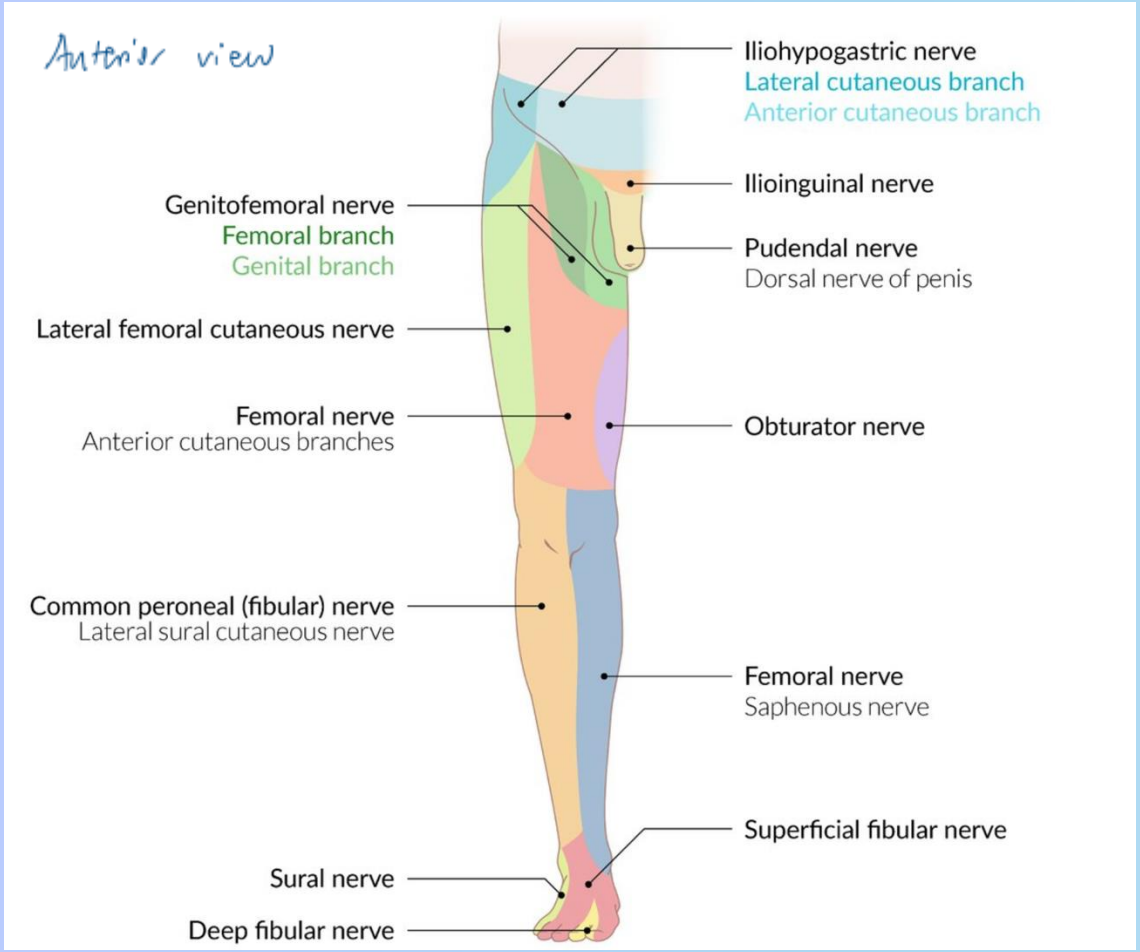


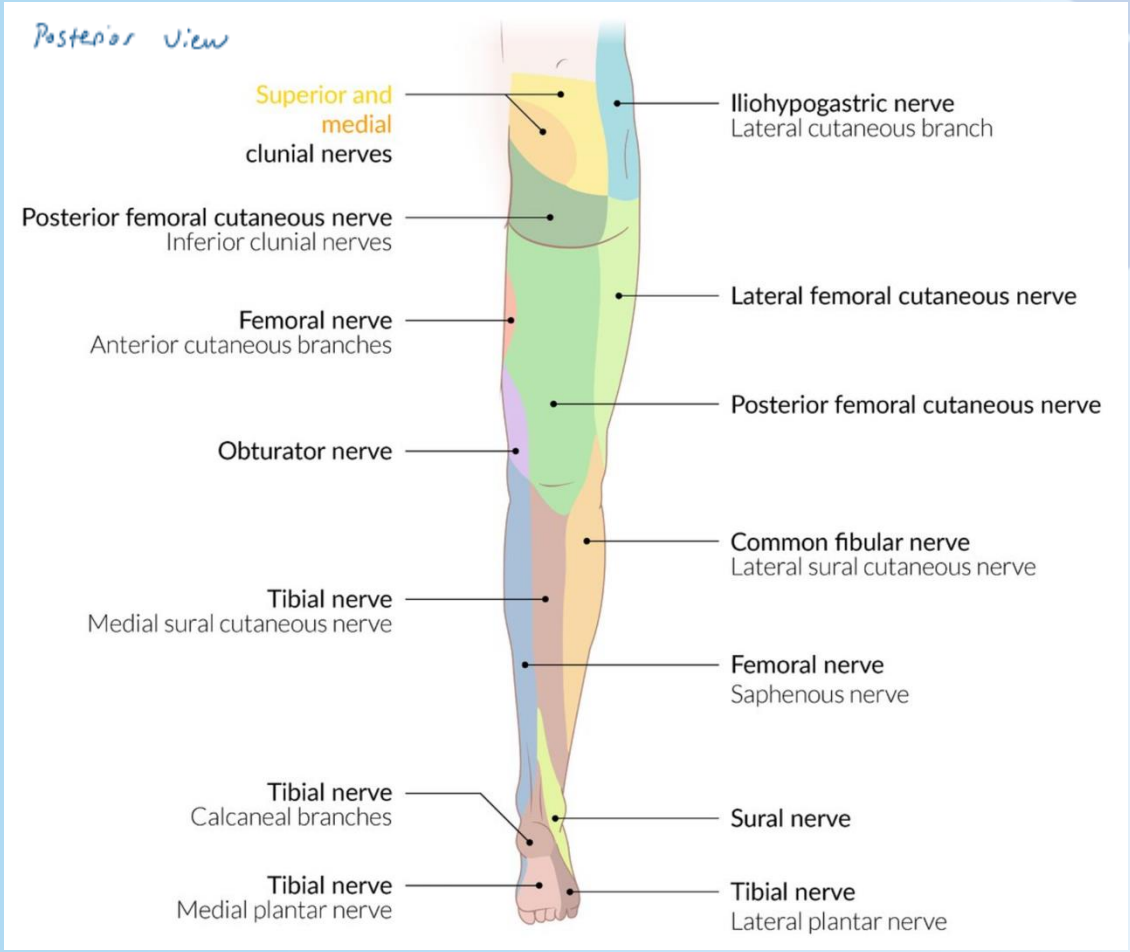
TIPPED = tibial nerve versus peroneal nerve

TIP = **T**ibial nerve **I**nverts and **P**lantarflexes the foot → cannot walk on TIPtoes when injured

PED = **P**eroneal nerve **E**verts and **D**orsiflexes the foot → foot drop when injured

Cutaneous innervation of Lower Limb





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