ANATOMY OF THE FOOT

Dr. Gary Mumaugh

Mnemonic for Learning Tarsal Bones:

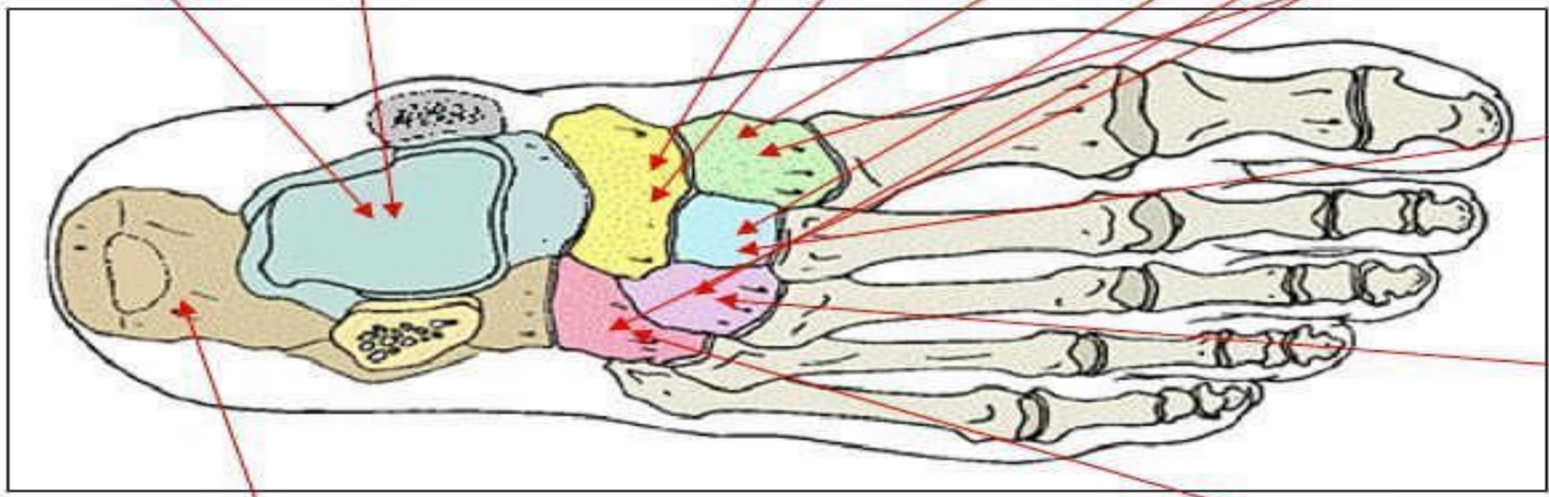
Tiger Cubs *Need* *M I L C*

Talus

Navicular

A boat
It sails on the Cs

Medial cuneiform (1)

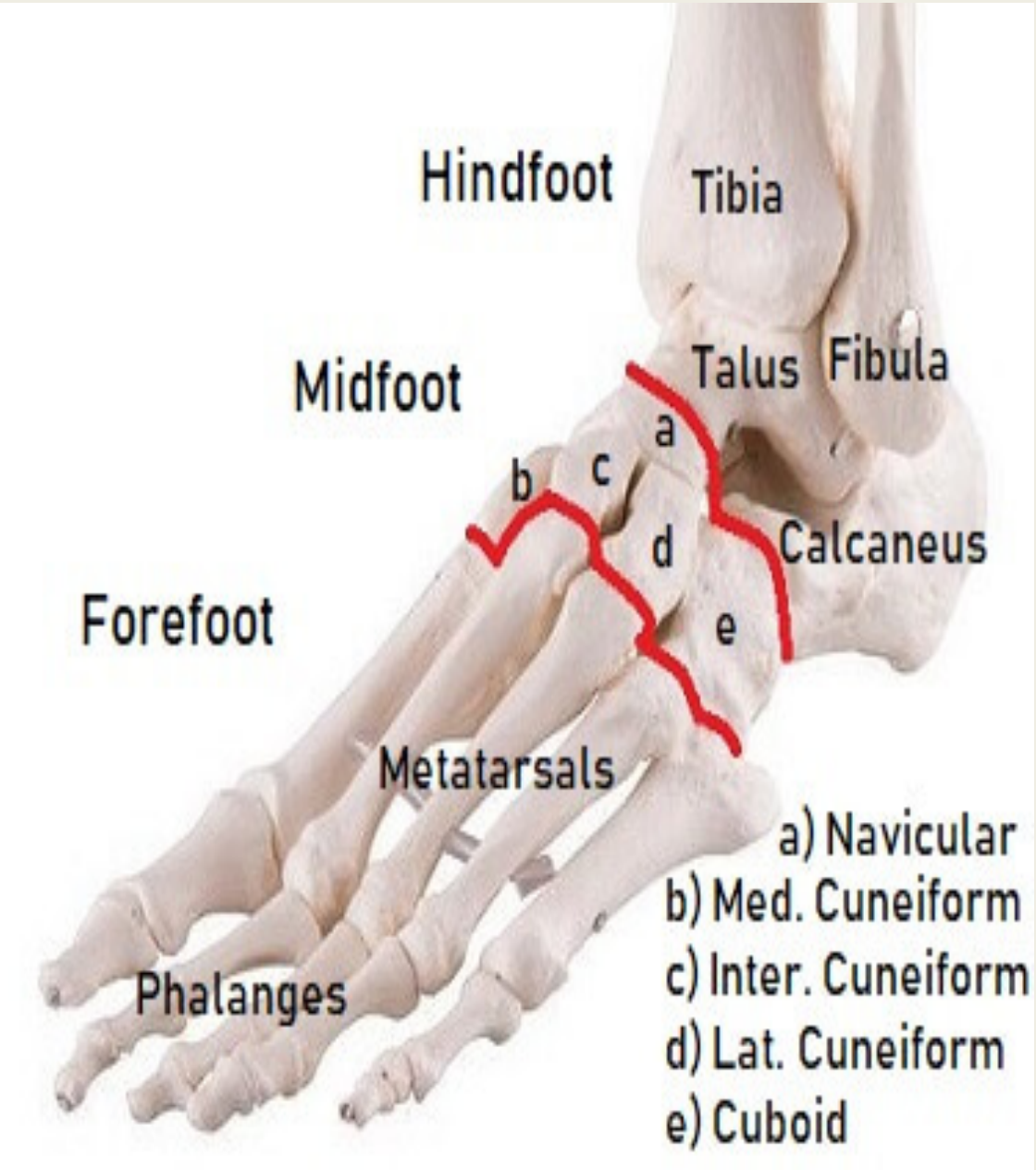


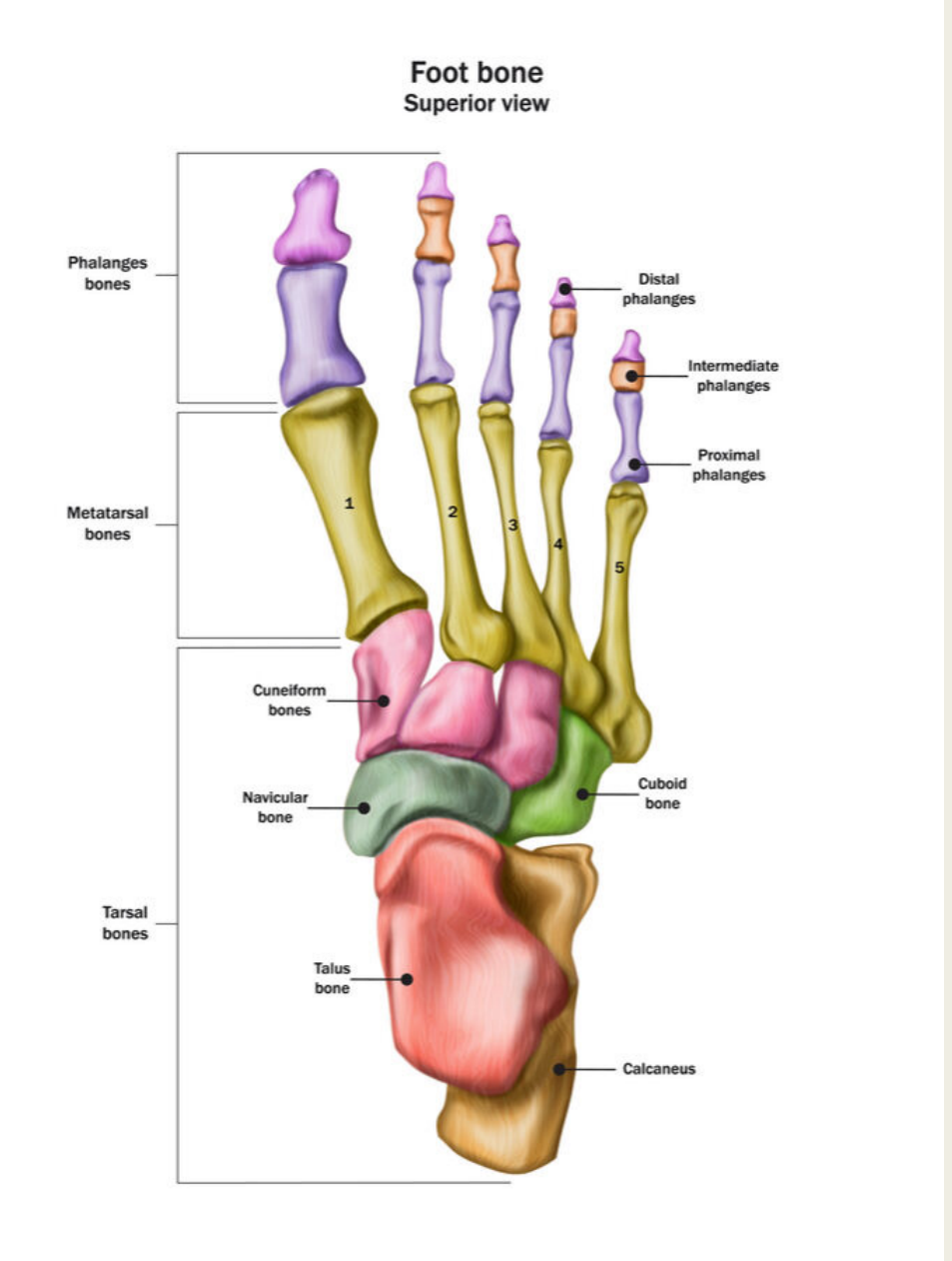
Intermediate cuneiform (2)

Lateral cuneiform (3)

Calcaneus

Cuboid

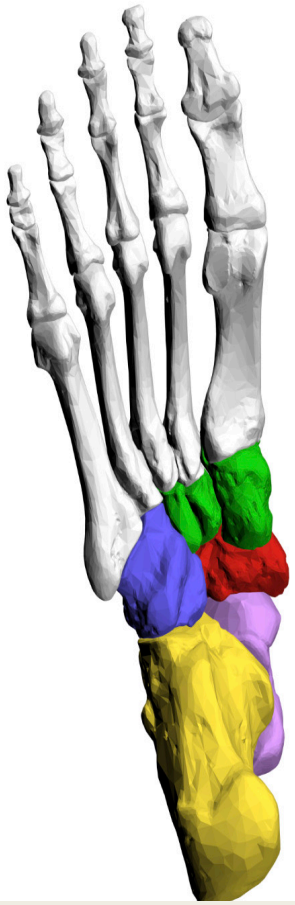

Hindfoot
Tibia
Midfoot
Talus
Fibula
a
b
c
d
e
Calcaneus
Forefoot
Metatarsals
Phalanges
a) Navicular
b) Med. Cuneiform
c) Inter. Cuneiform
d) Lat. Cuneiform
e) Cuboid

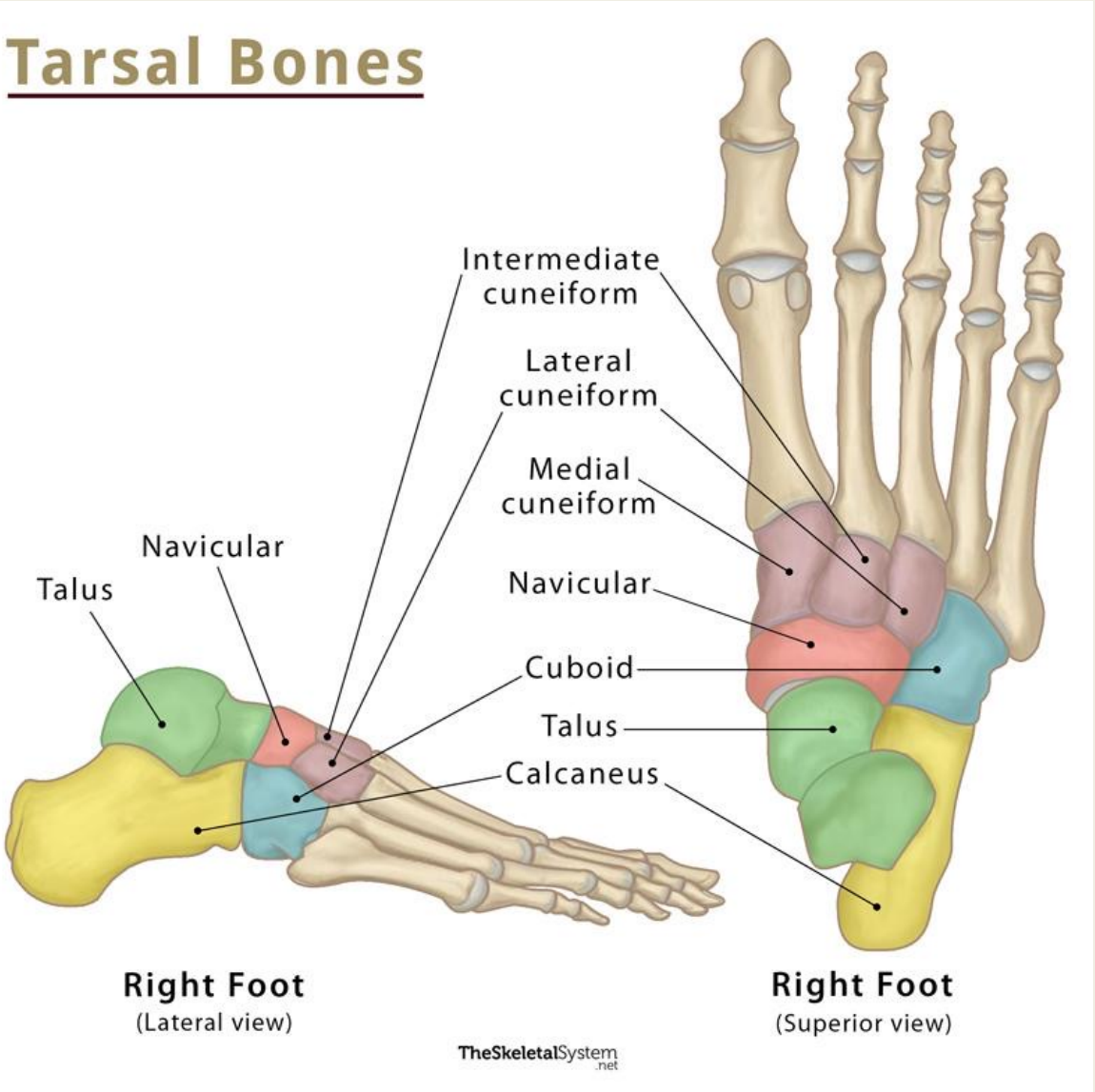

Foot bone
Superior view
Phalanges bones
Distal phalanges
Intermediate phalanges
Proximal phalanges
Metatarsal bones
1
2
3
4
5
Cuneiform bones
Navicular bone
Cuboid bone
Tarsal bones
Talus bone
Calcaneus

Tarsal Bones

Inferior view

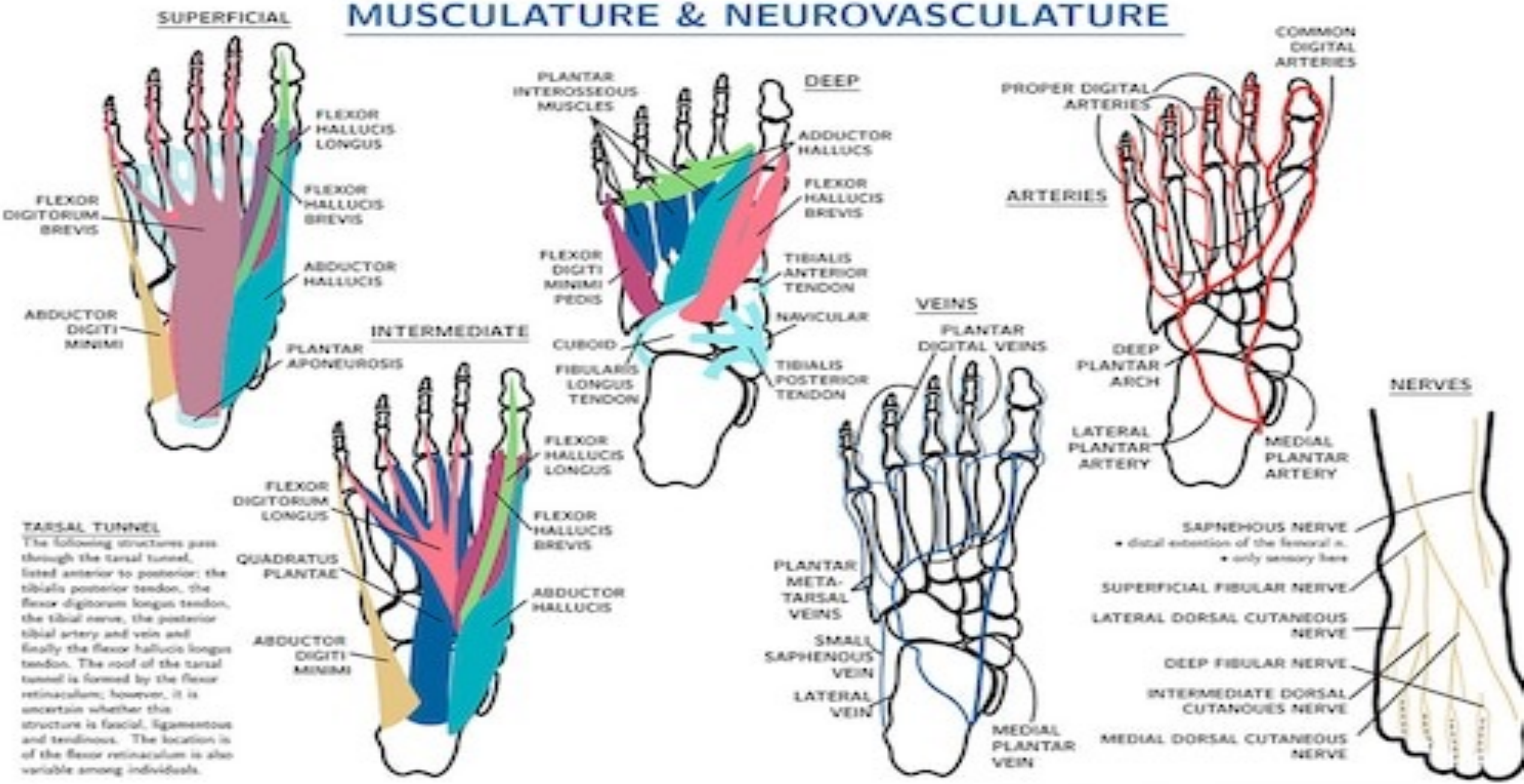
- Calcaneus
- Talus bone
- Cuboid bone
- Navicular bone
- Cuneiform bones





PLANTAR ASPECT OF FOOT

MUSCULATURE & NEUROVASCULATURE



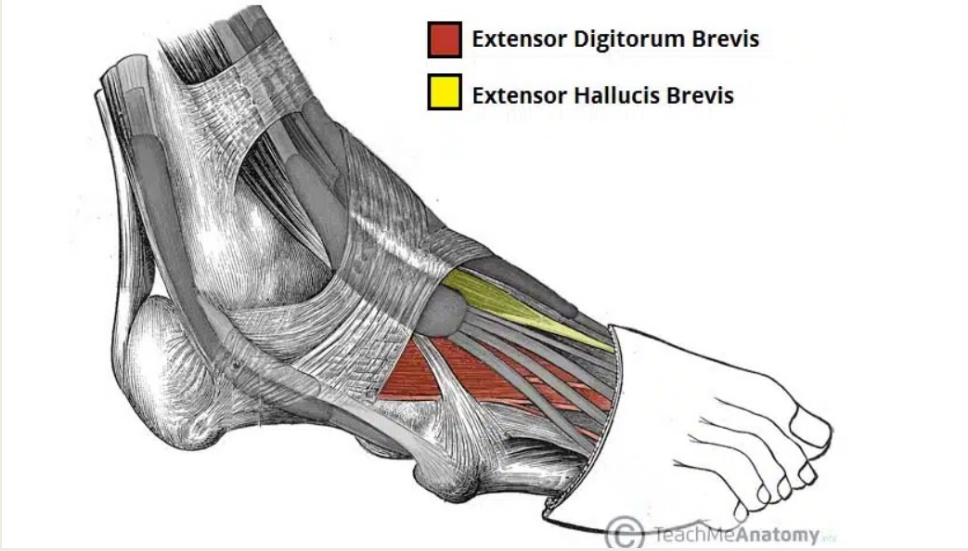
TARSAL TUNNEL

The following structures pass through the tarsal tunnel, listed anterior to posterior: the tibialis posterior tendon, the flexor digitorum longus tendon, the tibial nerve, the posterior tibial artery and vein and finally the flexor hallucis longus tendon. The roof of the tarsal tunnel is formed by the flexor retinaculum; however, it is uncertain whether this structure is fascial, ligamentous and tendinous. The location is of the flexor retinaculum is also variable among individuals.

- The muscles acting on the foot can be divided into two distinct groups; extrinsic and intrinsic muscles.
- Extrinsic muscles arise from the anterior, posterior, and lateral compartments of the leg.
- They are mainly responsible for actions such as eversion, inversion, plantarflexion and dorsiflexion of the foot.
- Intrinsic muscles are located within the foot and are responsible for the fine motor actions of the foot, for example movement of individual digits.
- We shall examine the anatomy of the intrinsic muscles of the foot. They can be divided into those situated on the dorsum of the foot, and those in the sole of the foot.

Dorsal Aspect

- There are **two** intrinsic muscles located within the dorsum of the foot – the extensor digitorum brevis and extensor hallucis brevis.
- They assist the extrinsic muscles of the foot in extending the toes and are both innervated by the **deep fibular nerve**.

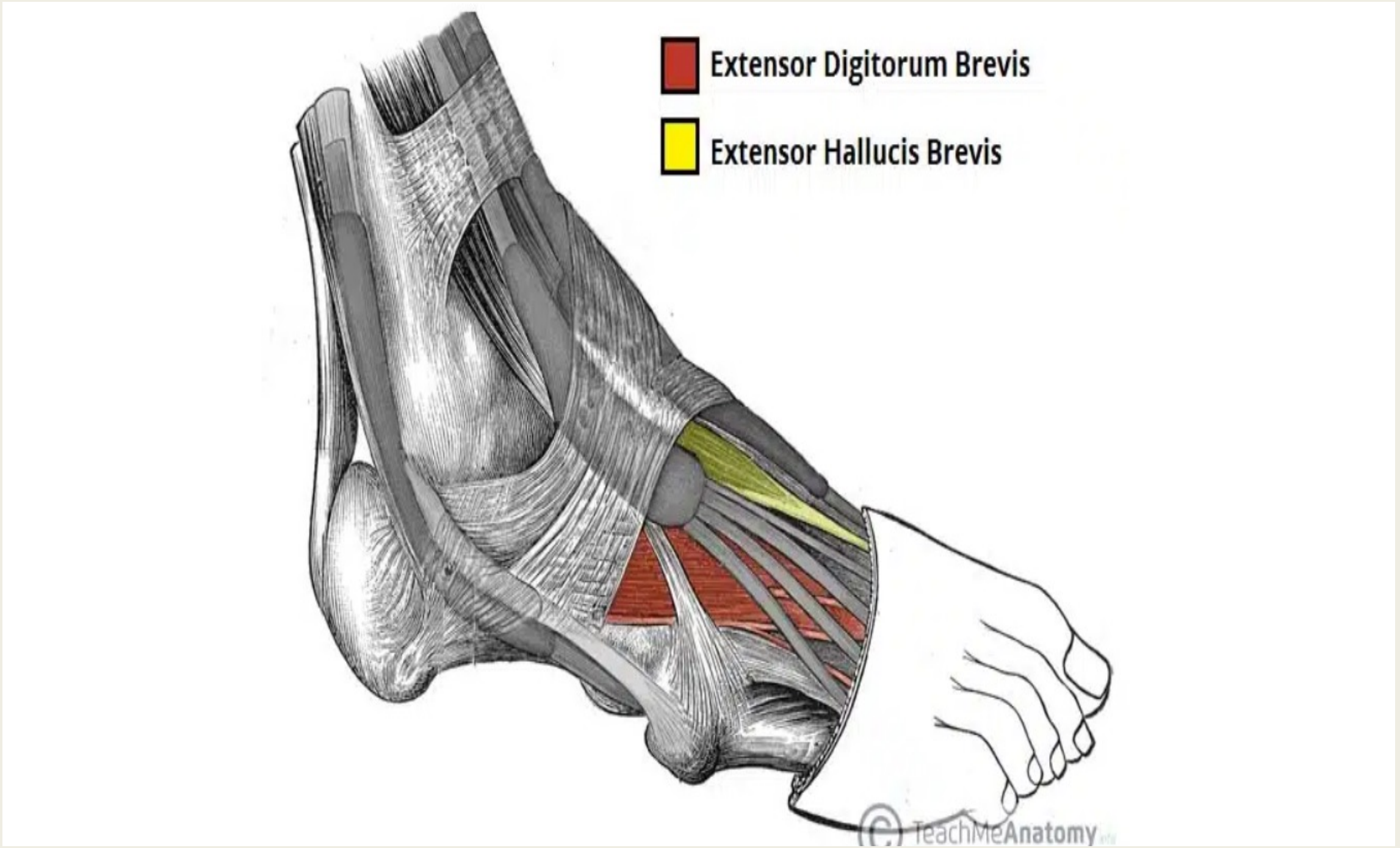


Extensor Digitorum Brevis

- The extensor digitorum brevis is a small, thin muscle which lies underneath the long extensor tendons of the foot.
- **Attachments**: Originates from the calcaneus and inferior extensor retinaculum. It attaches onto the long extensor tendons of the medial four toes.
- **Actions**: Extension of the lateral four toes.
- Innervation: Deep fibular nerve

Extensor Hallucis Brevis

- The extensor hallucis brevis is often considered to be the medial part of the extensor digitorum brevis muscle, rather than a separate structure.
- **Attachments**: Originates from the calcaneus and inferior extensor retinaculum. It attaches to the base of the proximal phalanx of the great toe.
- **Actions**: Extension of the great toe.
- **Innervation**: Deep fibular nerve.


Extensor Digitorum Brevis
Extensor Hallucis Brevis
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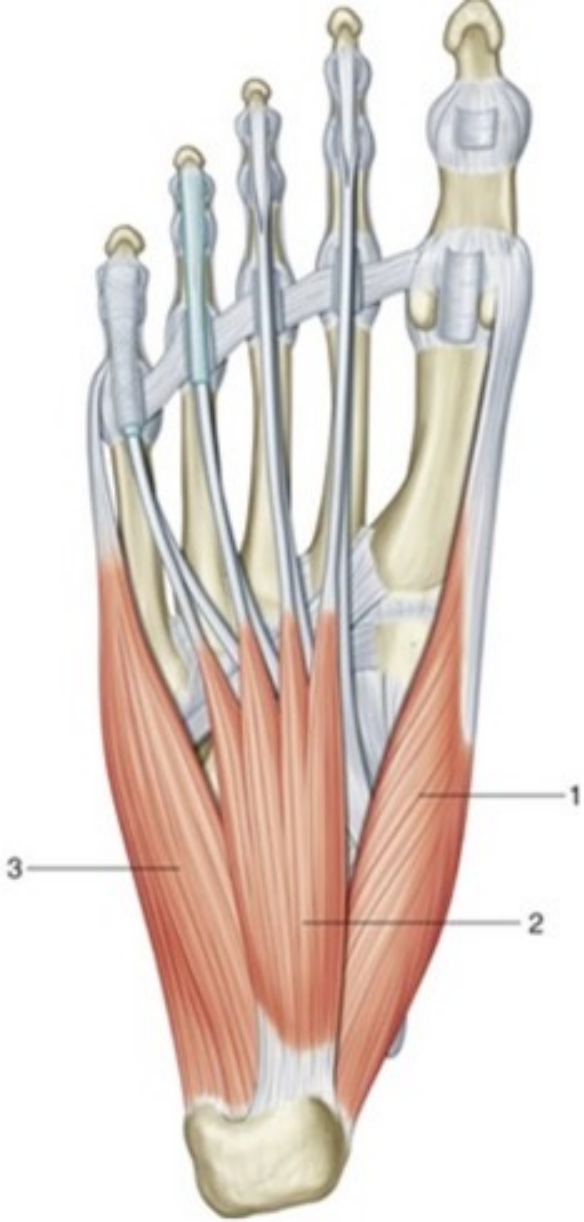
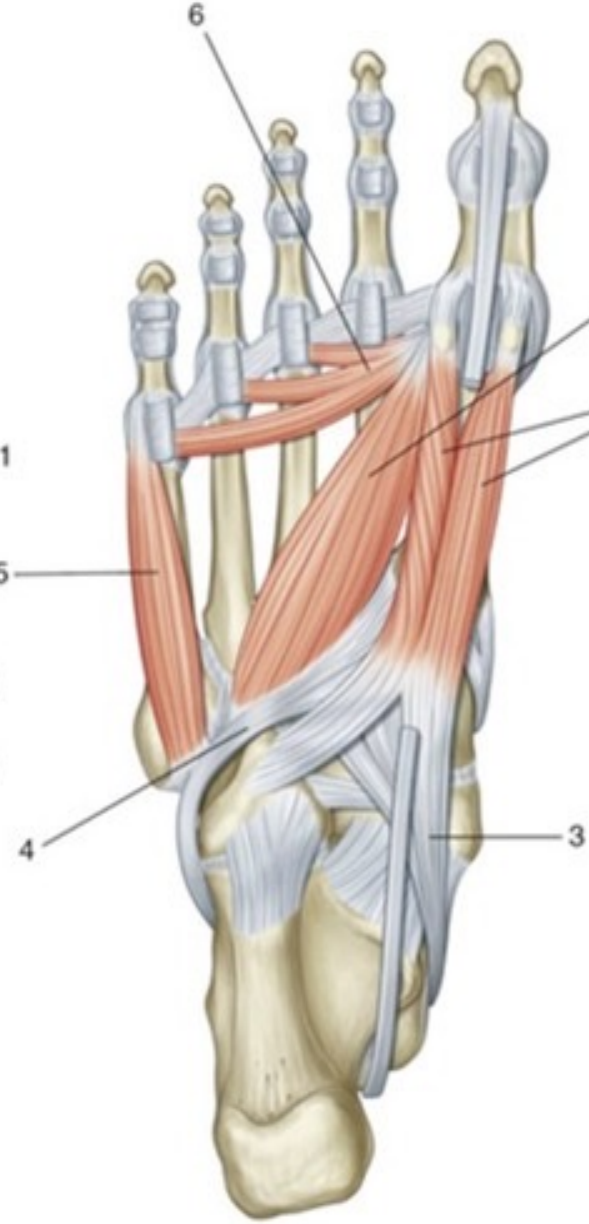
Plantar Aspect

- There are ten **intrinsic muscles** located in the plantar aspect (sole) of the foot.
- They act collectively to stabilize the arches of the foot and individually to control movement of the digits. They are innervated by the medial or lateral plantar nerves – which are branches of the **tibial nerve**.
- The muscles of the plantar aspect are arranged in **four** layers (superficial to deep).

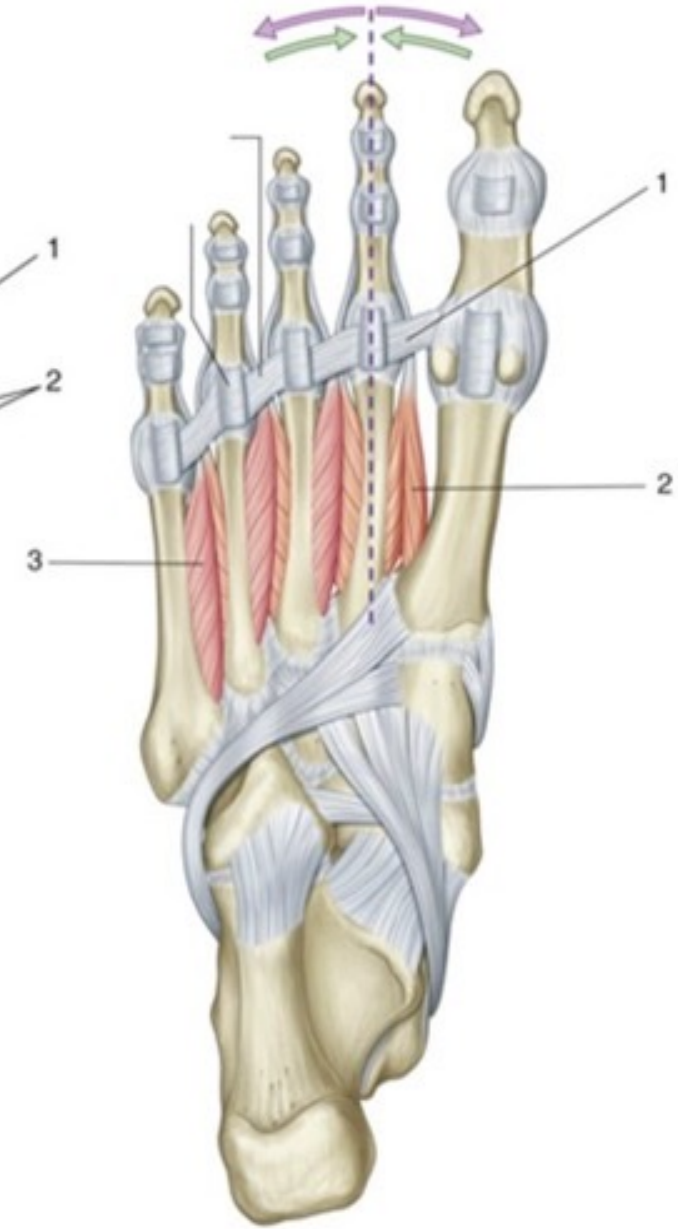


First Layer of muscle
on sole of the foot
(most superficial)

Second layer of muscle
on sole of the foot

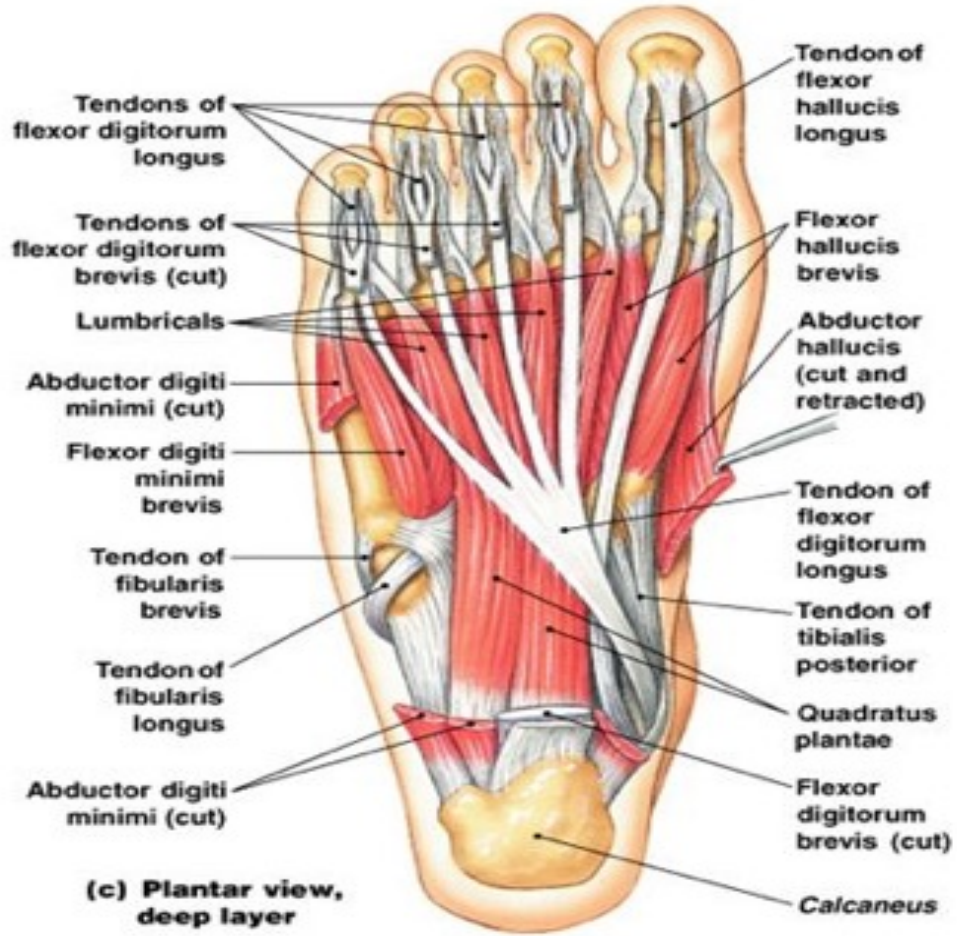


Third layer of muscle
on sole of the foot



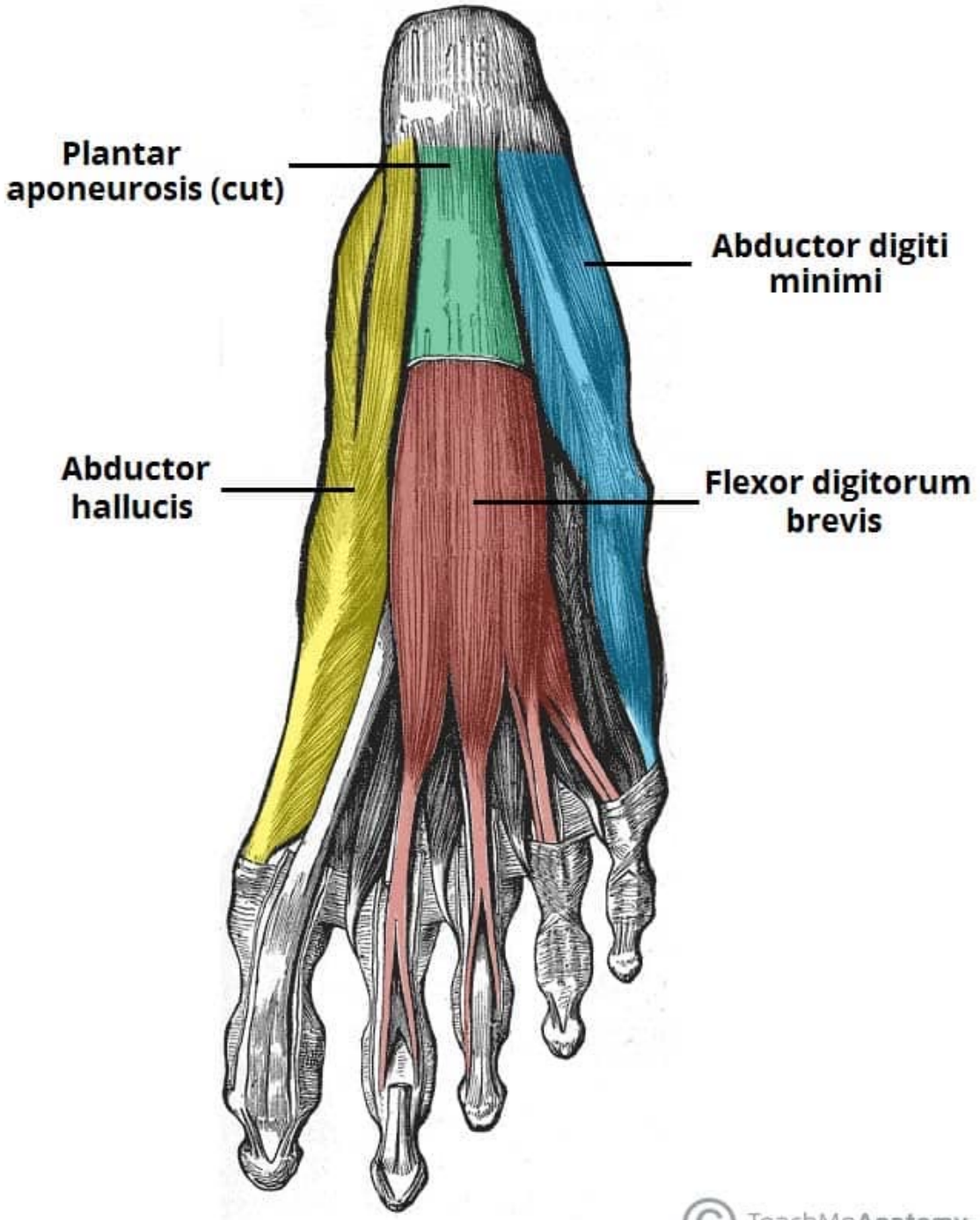
Fourth layer of muscle
on sole of the foot
(most deep)

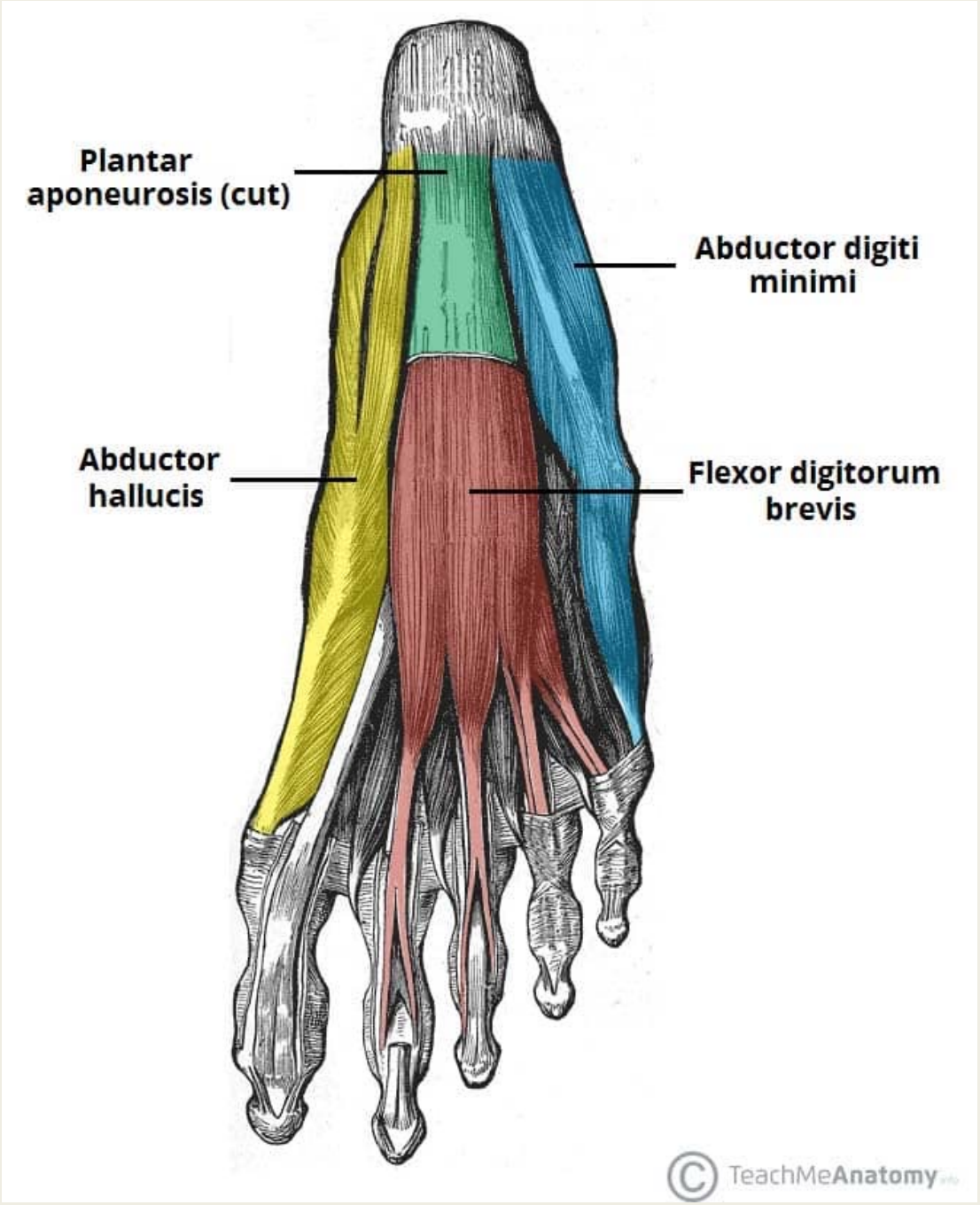
The Intrinsic Muscles of the Foot

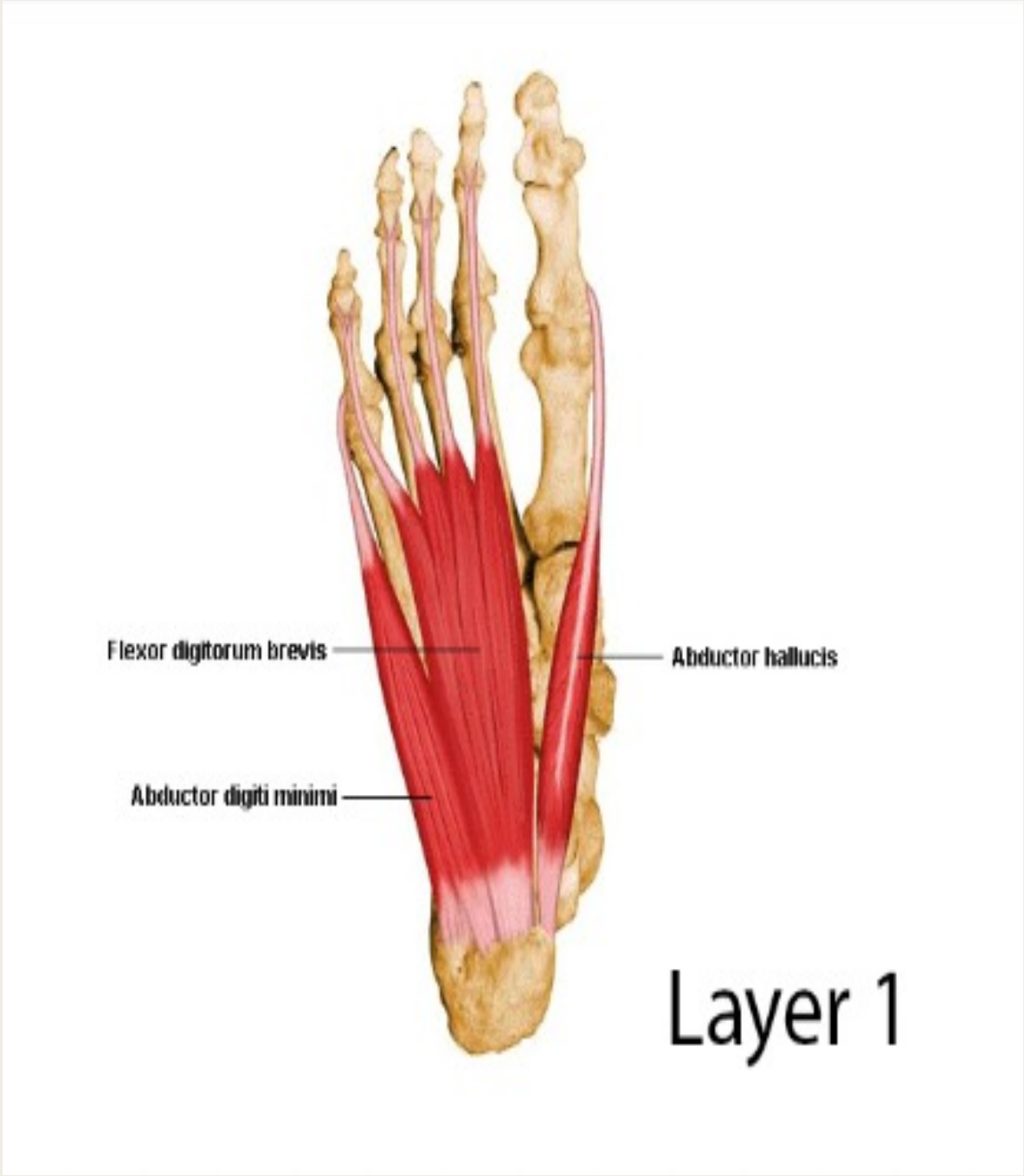


First Layer

- The first layer contains three muscles.
- It is the most superficial and is located immediately underneath the plantar fascia.
- **Abductor Hallucis**
- **Flexor Digitorum Brevis**
- **Abductor Digiti Minimi**




Plantar aponeurosis (cut)
Abductor digiti minimi
Abductor hallucis
Flexor digitorum brevis
TeachMeAnatomy


Flexor digitorum brevis
Abductor hallucis
Abductor digiti minimi
Layer 1

Abductor Hallucis

- The abductor hallucis muscle is located on the medial side of the sole, where it contributes to a small soft tissue bulge.
- **Attachments**: Originates from the medial tubercle of the calcaneus, the flexor retinaculum and the plantar aponeurosis.
- It attaches to the medial base of the proximal phalanx of the great toe.
- **Actions**: Abduction and flexion of the great toe.
- **Innervation**: Medial plantar nerve

Flexor Digitorum Brevis

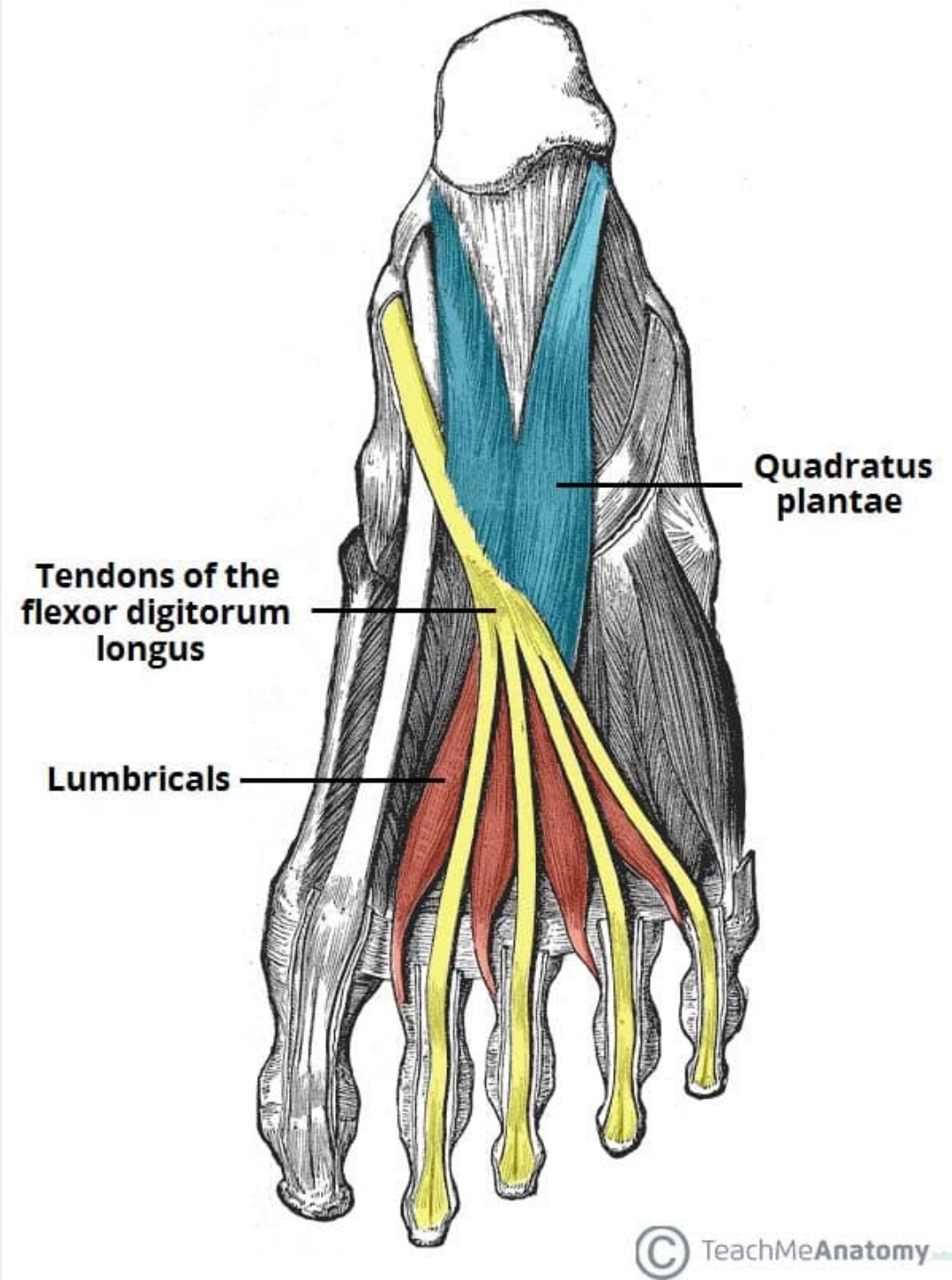
- The flexor digitorum brevis muscle is located laterally to the abductor hallucis. It sits in the center of the sole, sandwiched between the plantar aponeurosis and the tendons of flexor digitorum longus.
- **Attachments**: Originates from the medial tubercle of the calcaneus and the plantar aponeurosis.
- It attaches to the middle phalanges of the lateral four digits.
- **Actions**: Flexion of the lateral four toes at the proximal interphalangeal joints.
- **Innervation**: Medial plantar nerve.

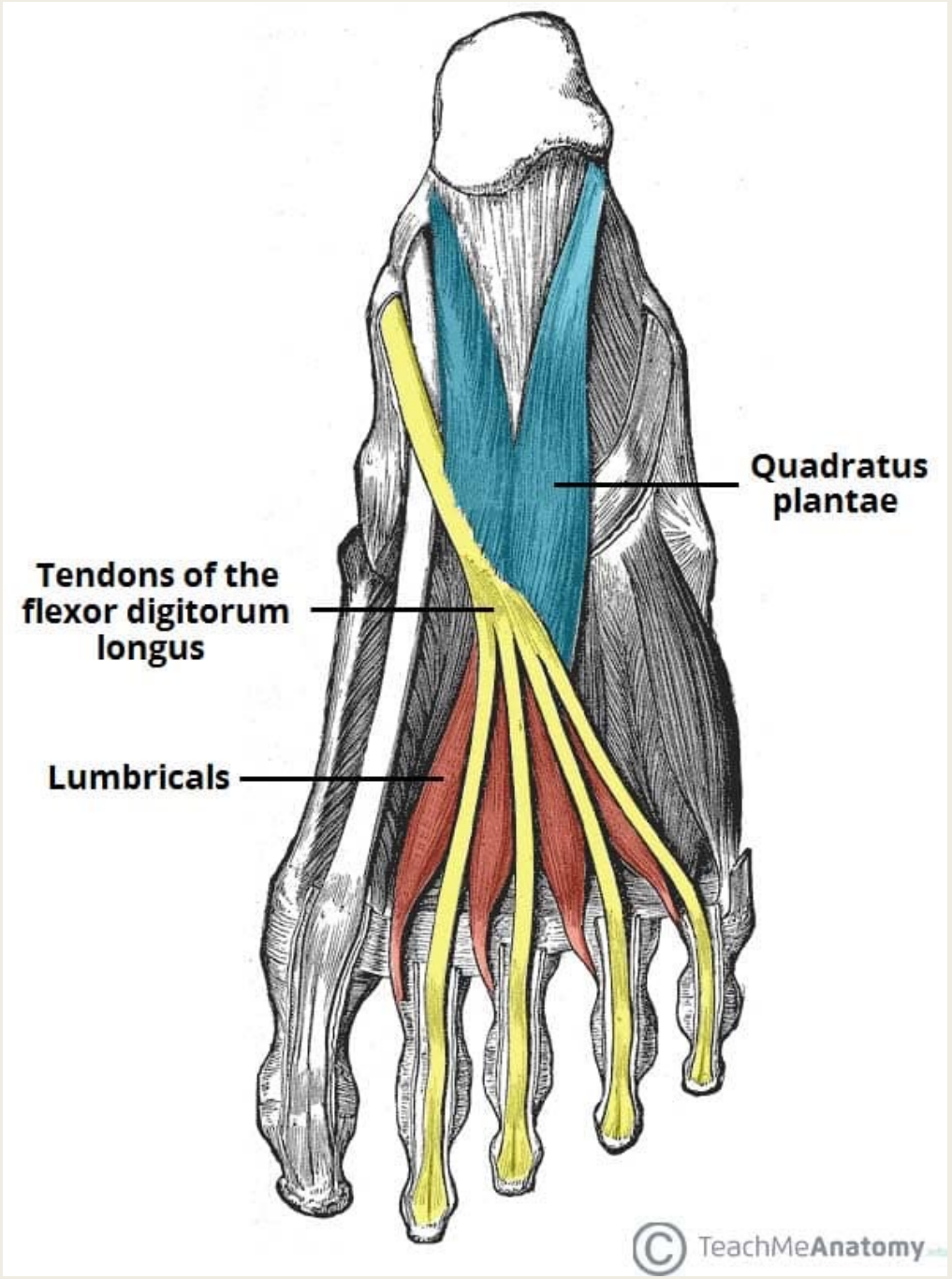
Abductor Digiti Minimi

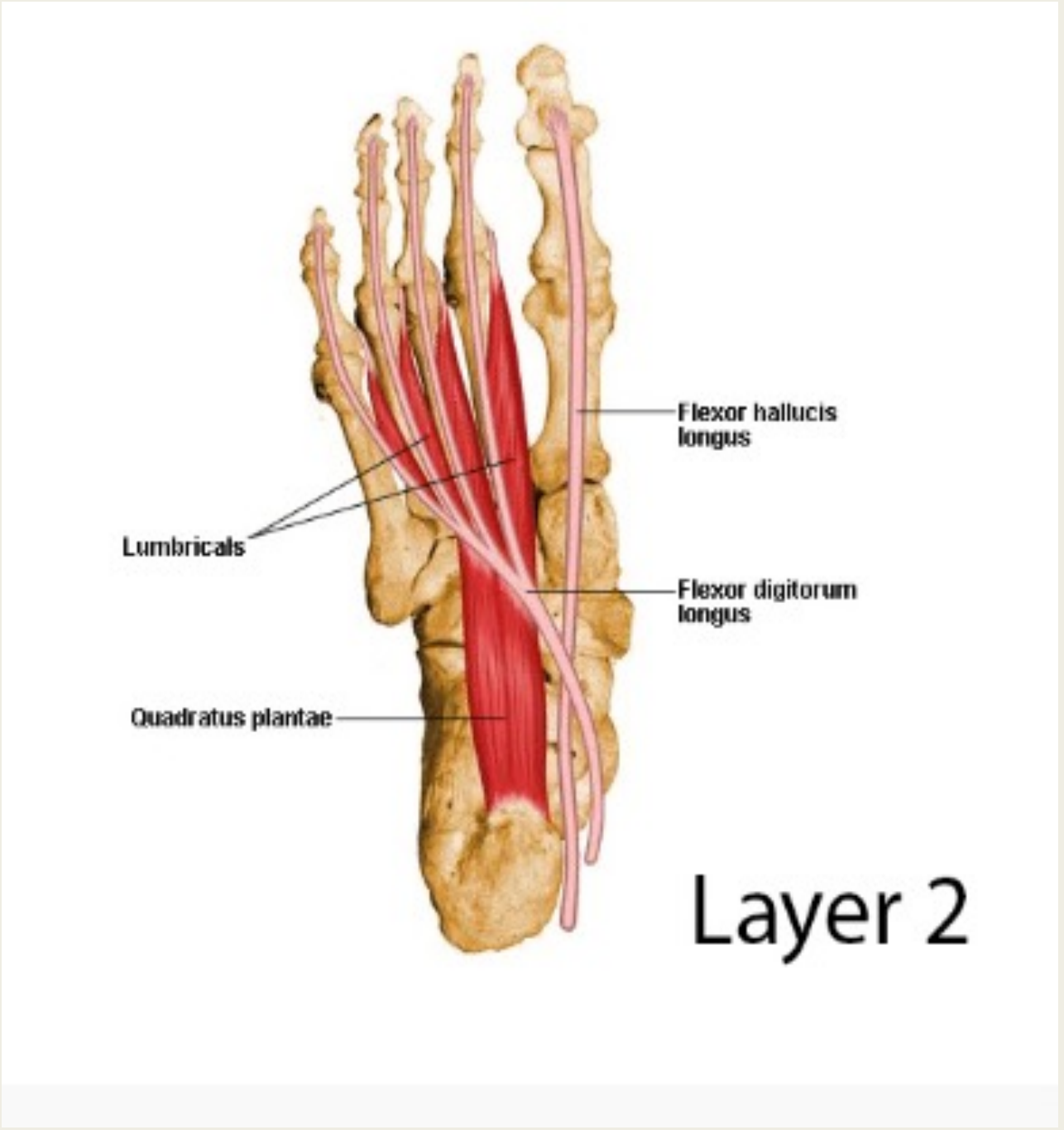
- The abductor digiti minimi muscle is located on the lateral side of the foot.
  - It is homologous with the abductor digiti minimi of the hand.
- **Attachments**: Originates from the medial and lateral tubercles of the calcaneus and the plantar aponeurosis. It attaches to the lateral base of the proximal phalanx of the 5th digit.
- **Actions**: Abduction and flexion of the little toe.
- **Innervation**: Lateral plantar nerve.

Second Layer

- The second plantar layer contains two muscles – the quadratus plantae and the lumbricals.
- The tendons of the flexor digitorum longus (an extrinsic muscle) also travel through this layer.
- **Quadratus Plantae**
- **Lumbricals**

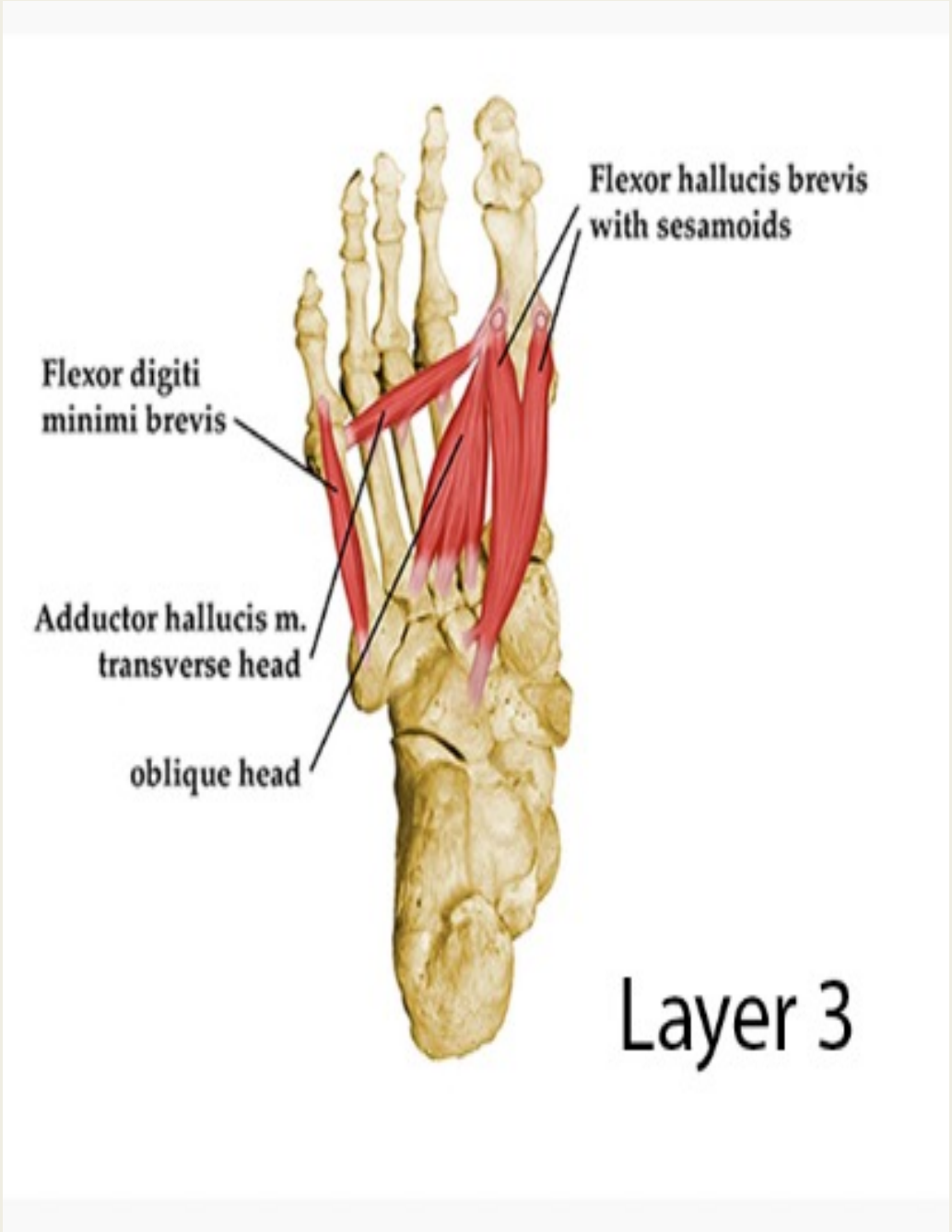



Quadratus plantae
Tendons of the flexor digitorum longus
Lumbricals
© TeachMeAnatomy


Flexor hallucis longus
Lumbricals
Flexor digitorum longus
Quadratus plantae
Layer 2

Third Layer

- The third layer contains three muscles.
- The flexor hallucis brevis and adductor hallucis are associated with movements of the great toe.
- The remaining muscle, the flexor digiti minimi brevis, moves the little toe.
- **Flexor Hallucis Brevis**
- **Adductor Hallucis**
- **Flexor Digiti Minimi Brevis**



Flexor Hallucis Brevis

- The flexor hallucis brevis muscle is located on the medial side of the foot. It has two heads of origin.
- **Attachments**:
  - Lateral head – originates from the plantar surfaces of the cuboid and lateral cuneiforms
  - Medial head – originates from the tendon of the posterior tibialis tendon.
  - The fibrers converge into a single muscle belly, which attaches to the base of the proximal phalanx of the great toe.
- **Actions**: Flexion of the great toe at the metatarsophalangeal joint.
- **Innervation**: Medial plantar nerve.

Adductor Hallucis

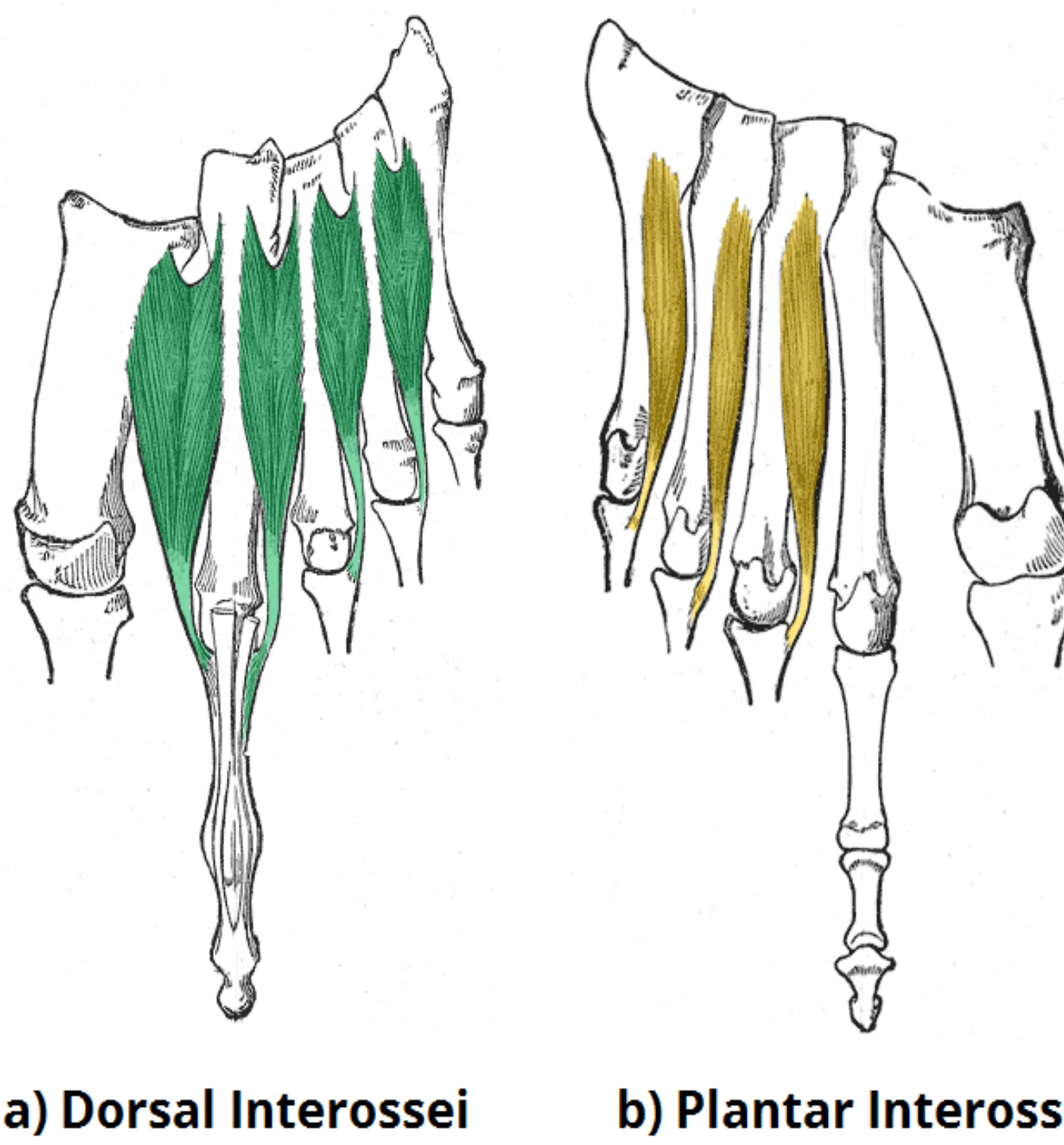
- The adductor hallucis muscle is located laterally to the flexor hallucis brevis. It consists of an oblique and transverse head.
- **Attachments**:
  - Oblique head – originates from the bases of the 2nd, 3rd, and 4th metatarsals.
  - Transverse head – originates from the plantar ligaments of the metatarsophalangeal joints.
  - Both heads attach to the lateral aspect of the base of the proximal phalanx of the great toe.
- **Actions**: Adduction of the great toe. Supports the transverse arch of the foot.
- **Innervation**: Deep branch of lateral plantar nerve.

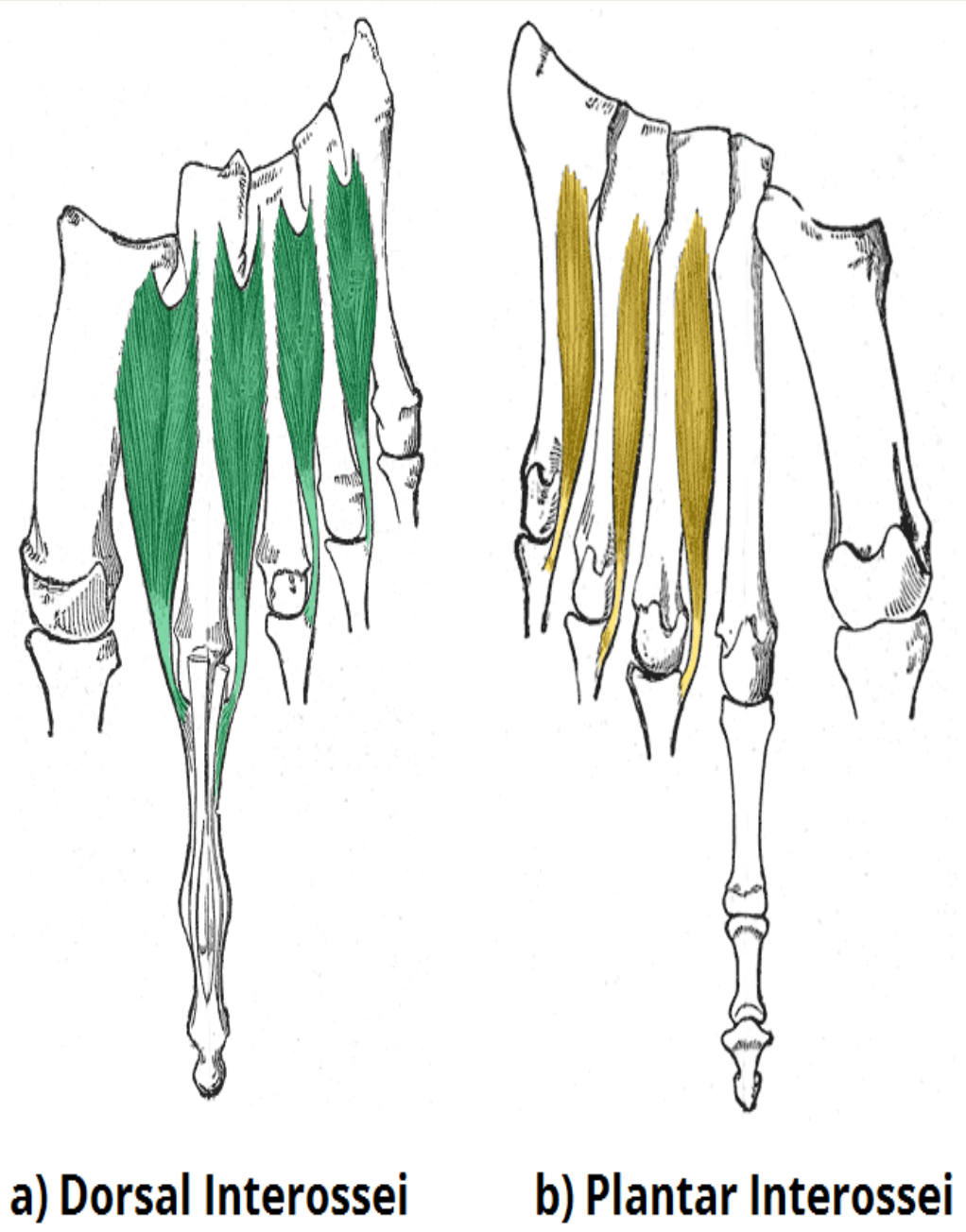
Flexor Digiti Minimi Brevis

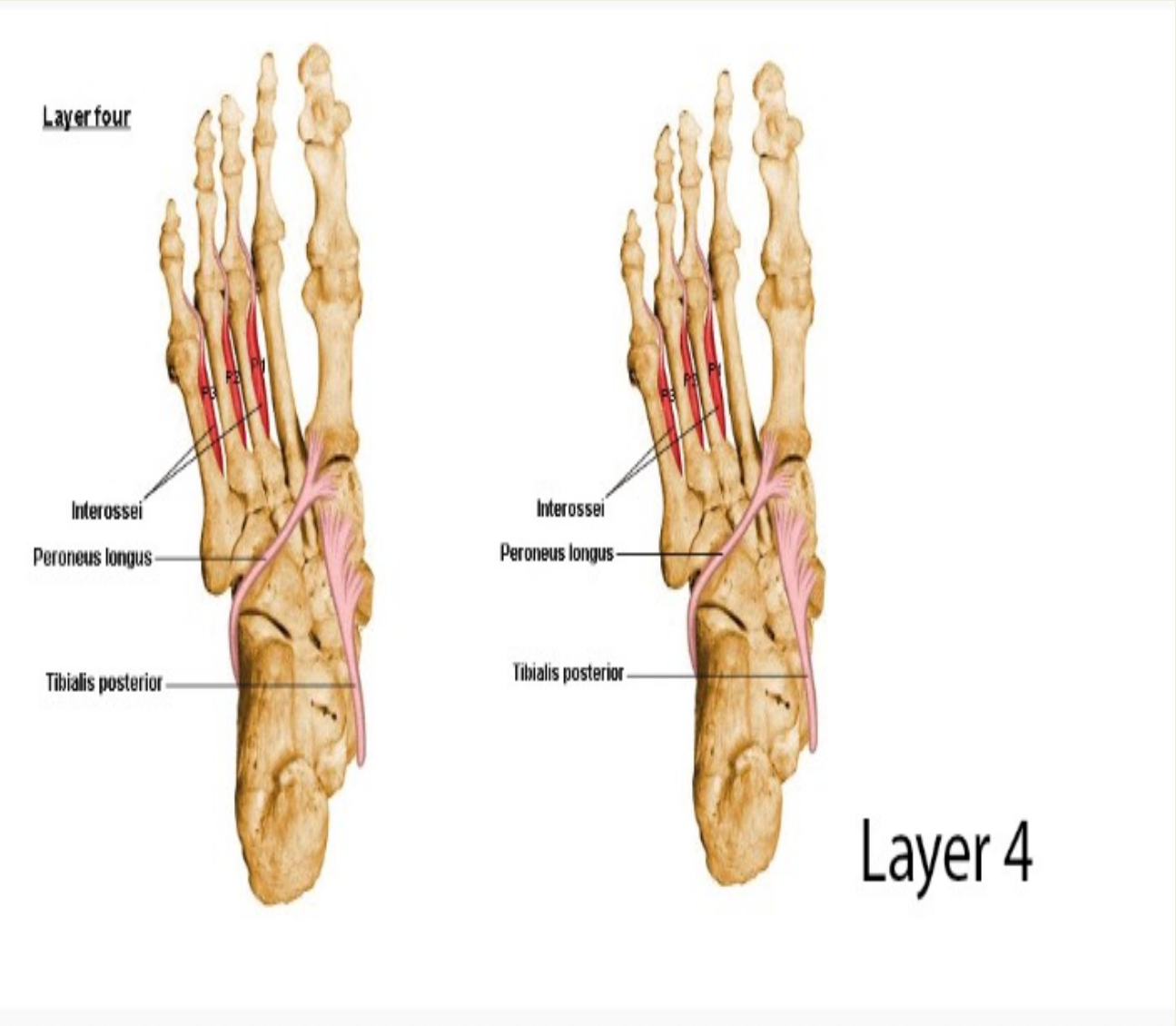
- The flexor digiti minimi brevis muscle is located on the lateral side of the foot, underneath the metatarsal of the little toe. It resembles the interossei in structure.
- **Attachments**: Originates from the base of the fifth metatarsal and attaches to the base of the proximal phalanx of the fifth digit.
- **Actions**: Flexion of the little toe at the metatarsophalangeal joint.
- **Innervation**: Superficial branch of lateral plantar nerve.

Fourth Layer

- The plantar and dorsal interossei comprise the fourth and final plantar muscle layer.
- **Plantar Interossei**
- **Dorsal Interossei**

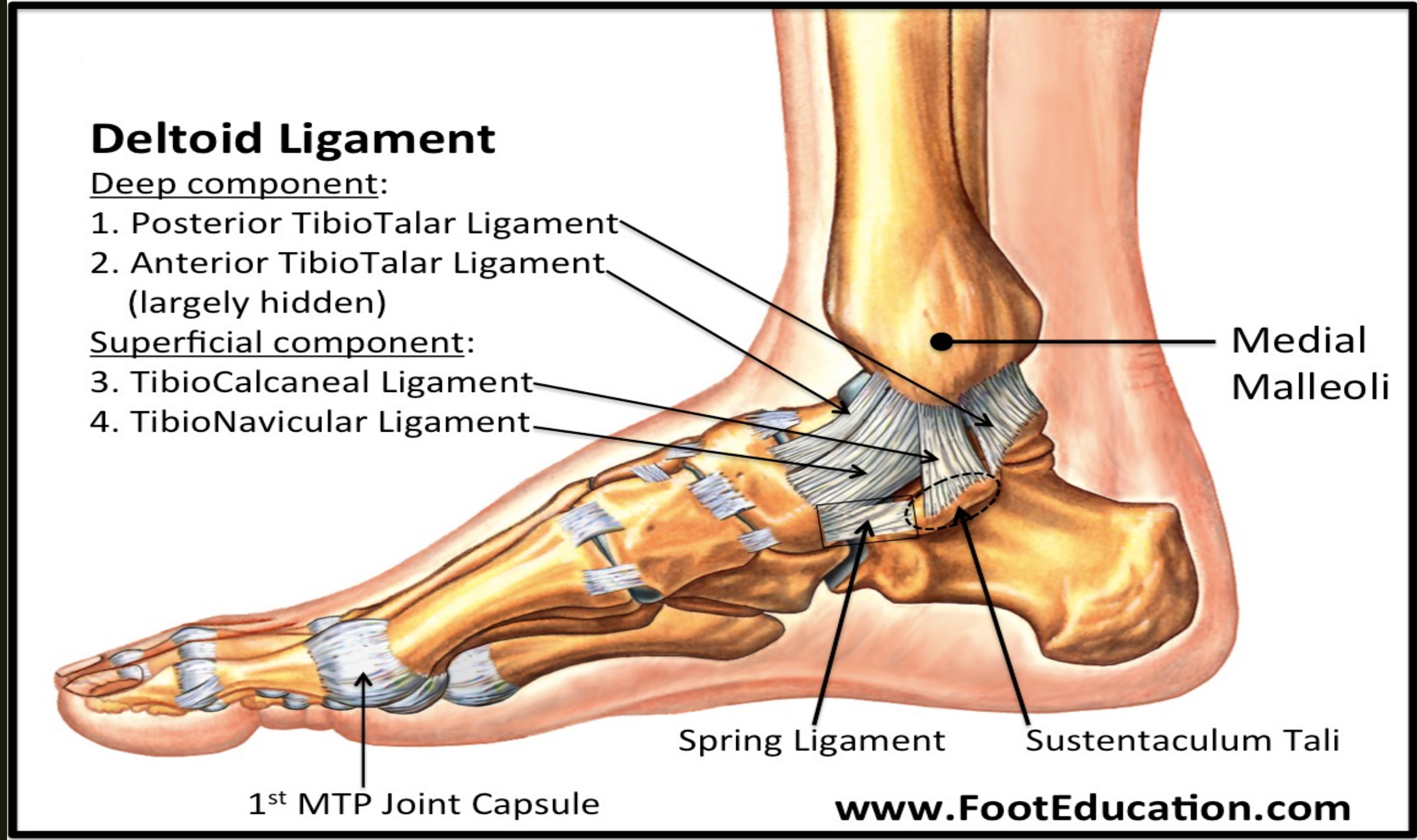


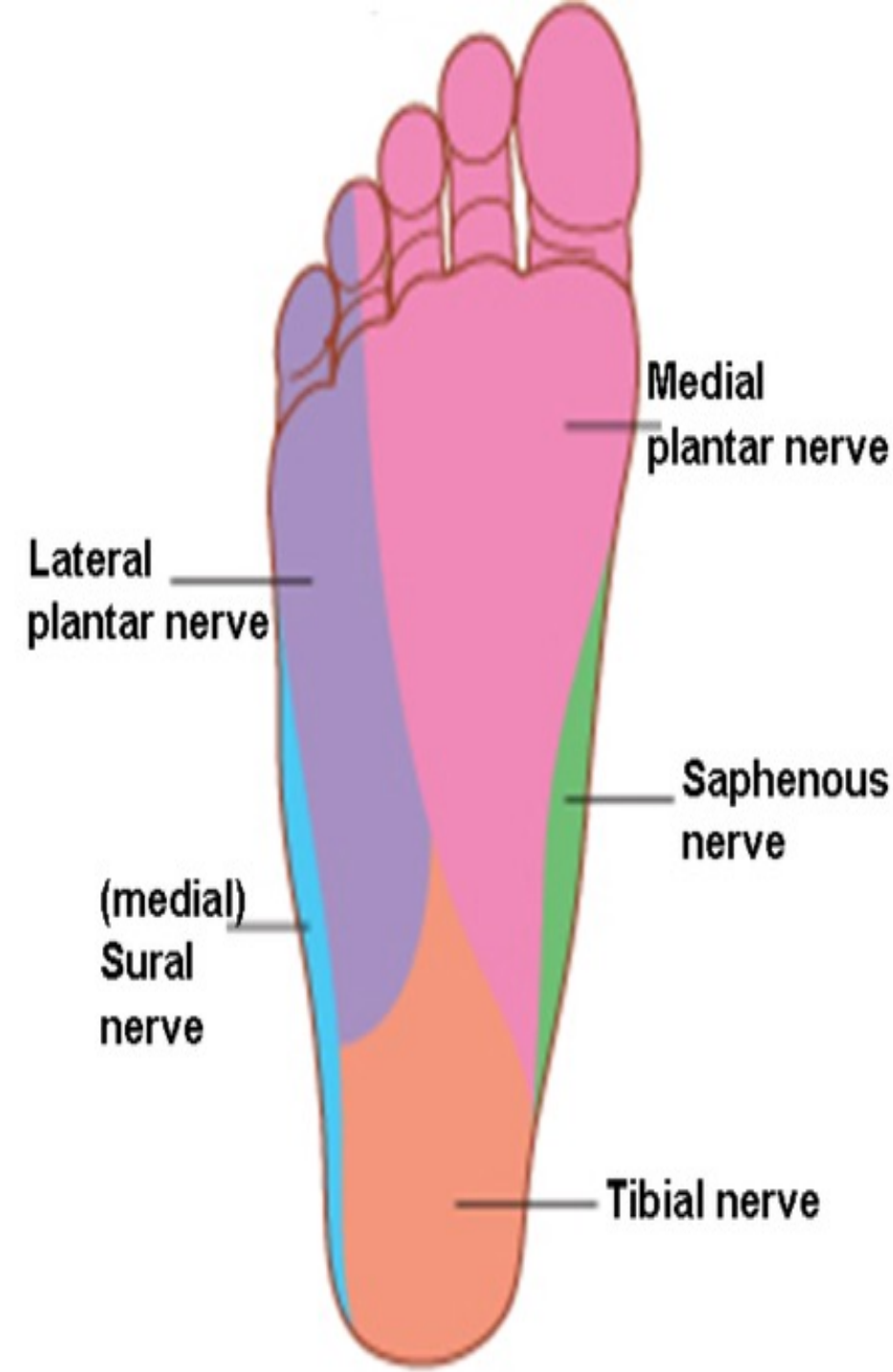

a) Dorsal Interossei
b) Plantar Interossei

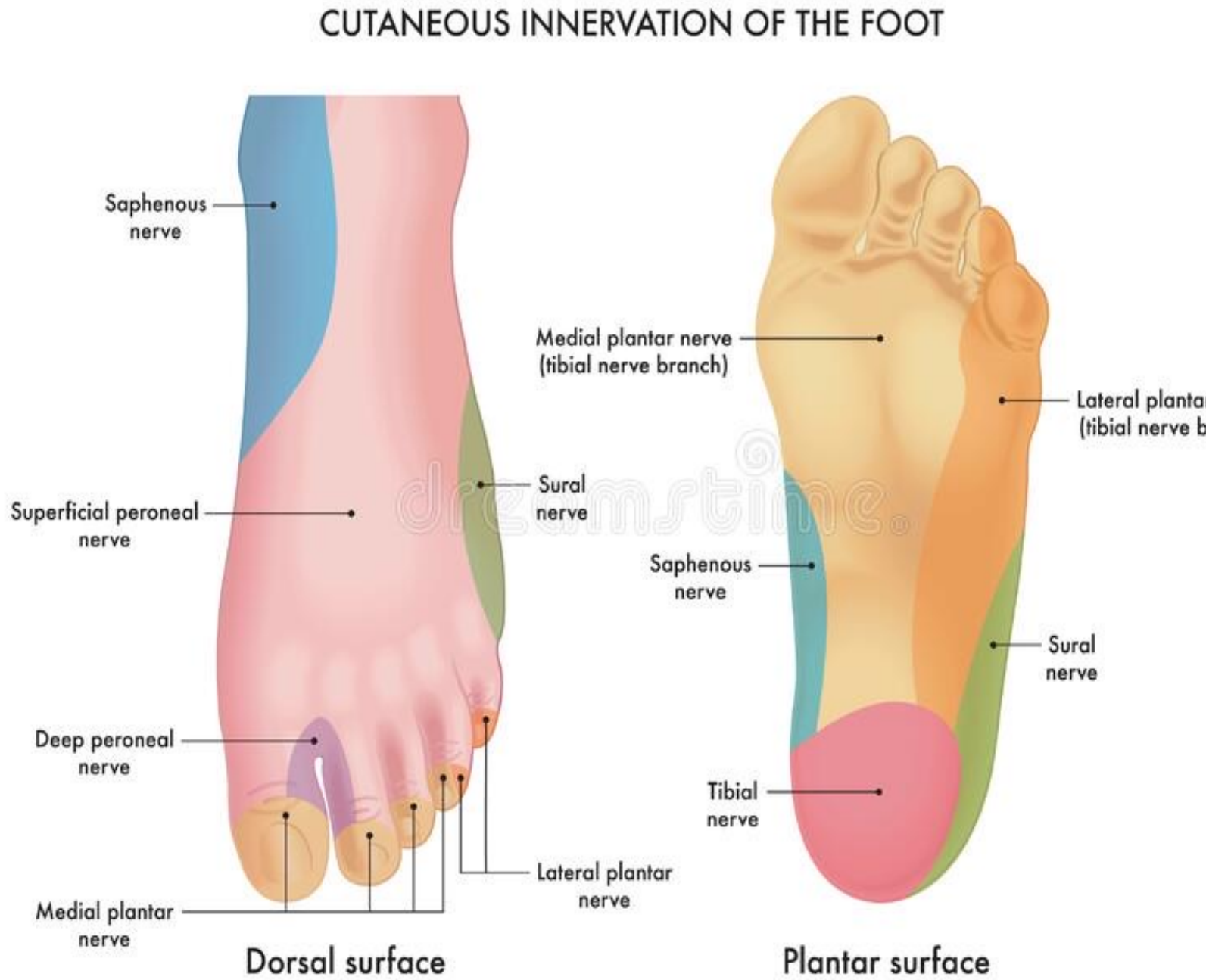

Layer four
Interossei
Peroneus longus
Tibialis posterior
Interossei
Peroneus longus
Tibialis posterior
Layer 4

Clinical Relevance: Medial Plantar Nerve Entrapment

- The **medial plantar nerve** can become compressed and irritated as it passes deep to the **abductor hallucis** muscle.
- This can cause aching, numbness and paresthesia on the medial side of the sole of the foot.
- The muscle can become compressed during repetitive **eversion** of the foot, which may occur in some sports such as gymnastics.


Deltoid Ligament
Deep component:
1. Posterior TibioTalar Ligament
2. Anterior TibioTalar Ligament
(largely hidden)
Superficial component:
3. TibioCalcaneal Ligament
4. TibioNavicular Ligament
Medial Malleoli
Spring Ligament
Sustentaculum Tali
1st MTP Joint Capsule
www.FootEducation.com

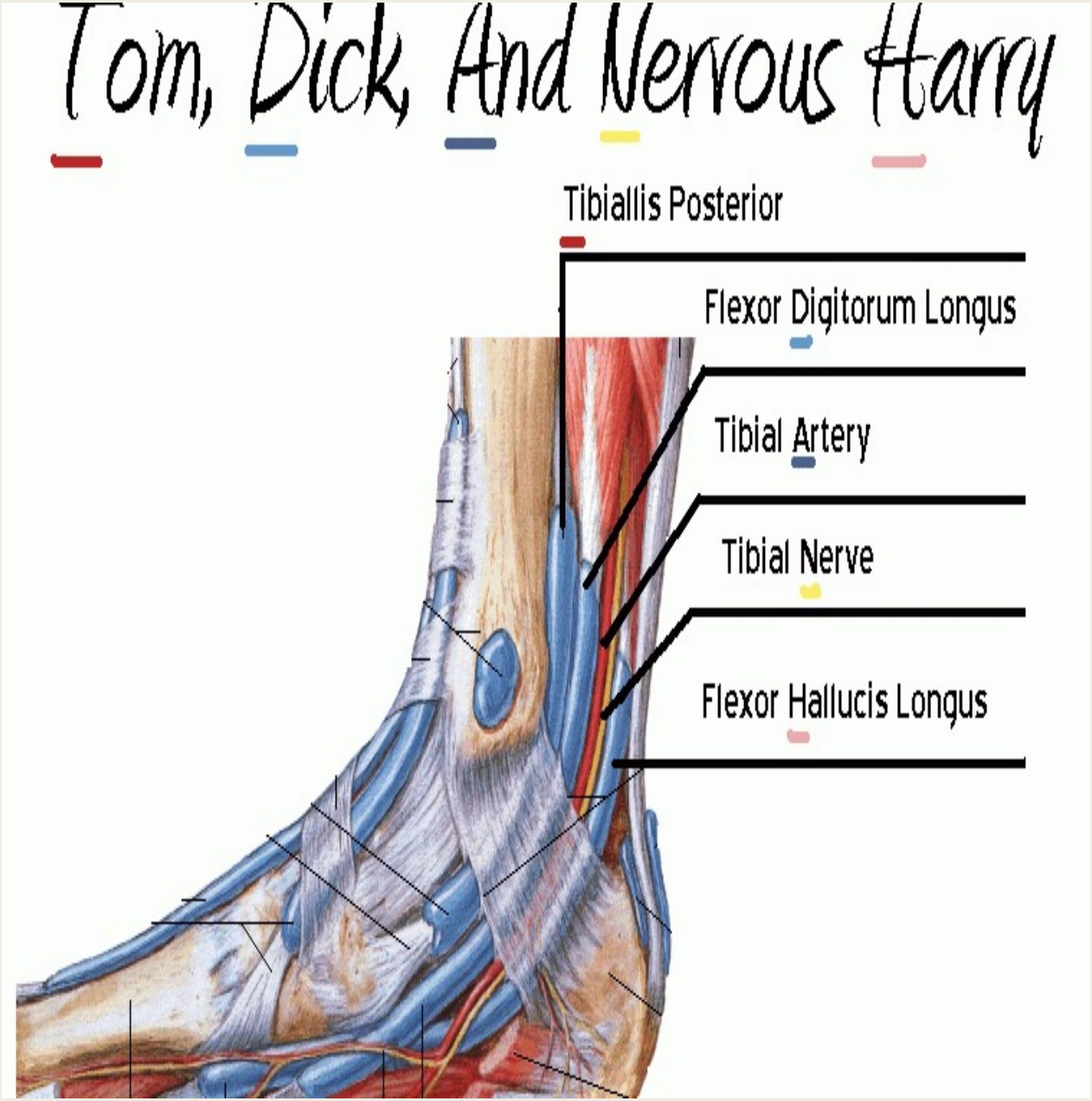

Medial
plantar nerve
Lateral
plantar nerve
Saphenous
nerve
(medial)
Sural
nerve
Tibial nerve


CUTANEOUS INNERVATION OF THE FOOT
Saphenous
nerve
Superficial peroneal
nerve
Deep peroneal
nerve
Medial plantar
nerve
Sural
nerve
Lateral plantar
nerve
Dorsal surface
Medial plantar nerve
(tibial nerve branch)
Saphenous
nerve
Tibial
nerve
Lateral plantar
(tibial nerve b
Sural
nerve
Plantar surface

Extrinsic Muscles

- In terms of anterior leg muscles that insert onto the foot, there is a helpful mnemonic to remember the order and names of them.
- Tom, Dick And Nervous Harry stands for **t**ibialis posterior, flexor **d**igitorum longus, tibial **a**rtery, tibial **n**erve, and flexor **h**allucis longus.
- These five tendons and nerves all run down in order from closest to the medial malleolus to furthest, underneath the medial malleolus on their way to their attachment point.

- **Tom, Dick And Nervous Harry**
- **T**ibialis Posterior
- Flexor **D**igitorum Longus
- Posterior Tibial **A**rtery
- Tibial **N**erve
- Flexor **H**allucis Longus



- The posterior leg muscles that insert on the foot are: **gastrocnemius**, **plantaris**, **soleus**, **tibialis posterior**, **flexor digitorum longus**, and **flexor hallucis longus**.
- Collectively, the posterior leg muscles work to plantarflex and invert the foot. They are innervated by the tibial nerve.
- The lateral leg muscles that insert on the foot are the **fibularis longus** and **fibularis brevis**.
- These two muscles perform eversion of the foot and are innervated by the superficial fibular nerve.

Joints of the Foot

- Subtalar Joint
- Transverse Tarsal Joint
- Metatarsal Joint
- Interphalangeal Joint

Subtalar Joint

- This is named because of the location of the meeting point of the talus and the calcaneus.
- The talus connects with the calcaneus just beneath it. Hence the term “Subtalar”.
- This joint is important because it allows for inversion and eversion of the foot.

Transverse Tarsal joint

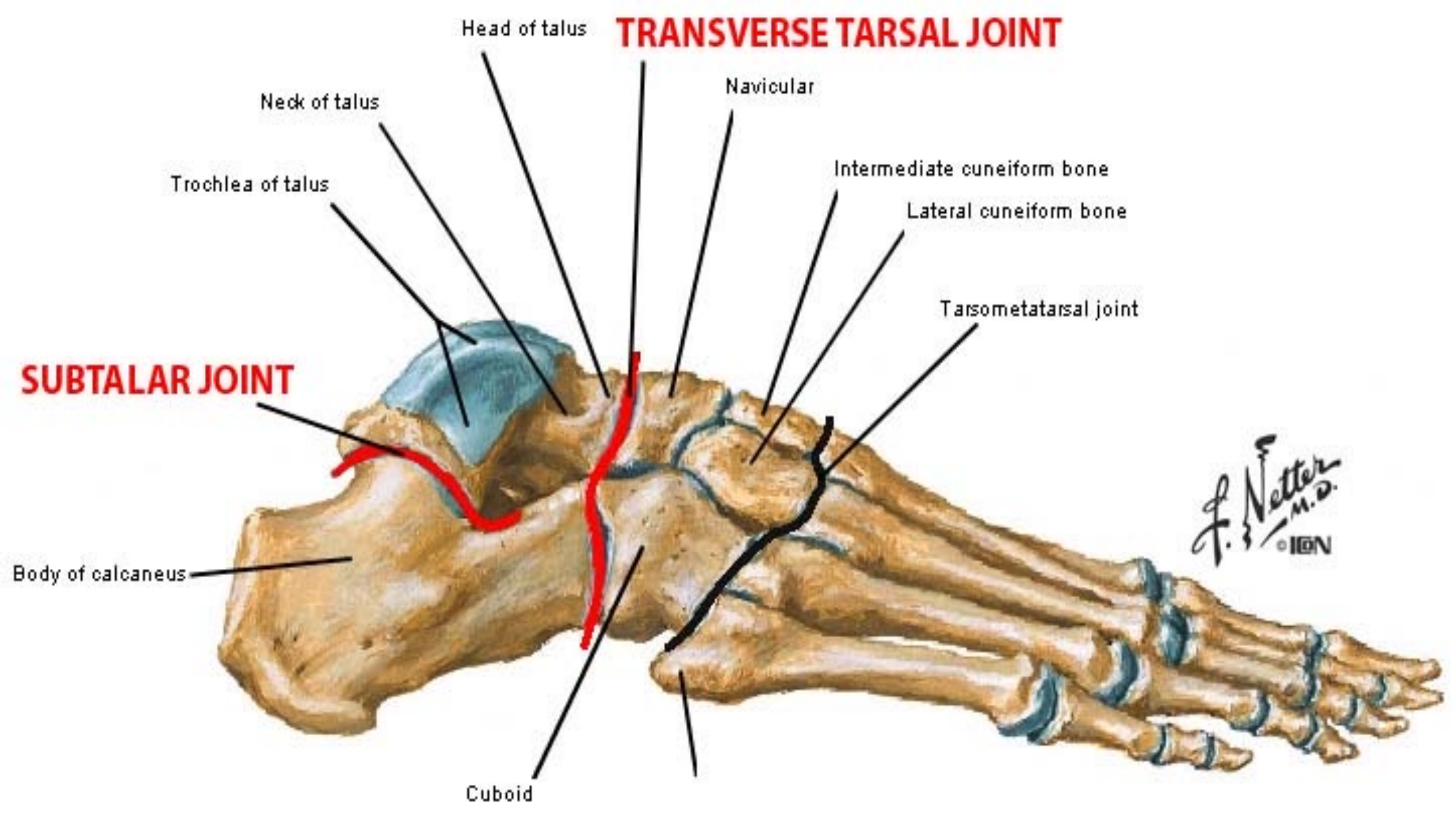
- The transverse tarsal joint is a complex joint seeing as it consists of both the Calcaneocuboid joint and the talonavicular joint.
- This joint creates most of the ability of supination and pronation of the foot.

Metatarsal Phalangeal Joint

- Also known as the metatarsophalangeal joint.
- There are five metatarsal-phalangeal joints and they are all where the metatarsal of the foot connects with their matching proximal phalanges.

Interphalangeal Joint

- Includes all of the joints that connect the phalanges (toes) together.
- All Phalanges except for the hallux have two interphalangeal joints; the proximal interphalangeal joint, and the distal phalangeal joint.
- The hallux only contains one joint, and that's the interphalangeal joint.


Head of talus
TRANSVERSE TARSAL JOINT
Navicular
Neck of talus
Intermediate cuneiform bone
Trochlea of talus
Lateral cuneiform bone
Tarsometatarsal joint
SUBTALAR JOINT
Body of calcaneus
Cuboid
F. Netter M.D.
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