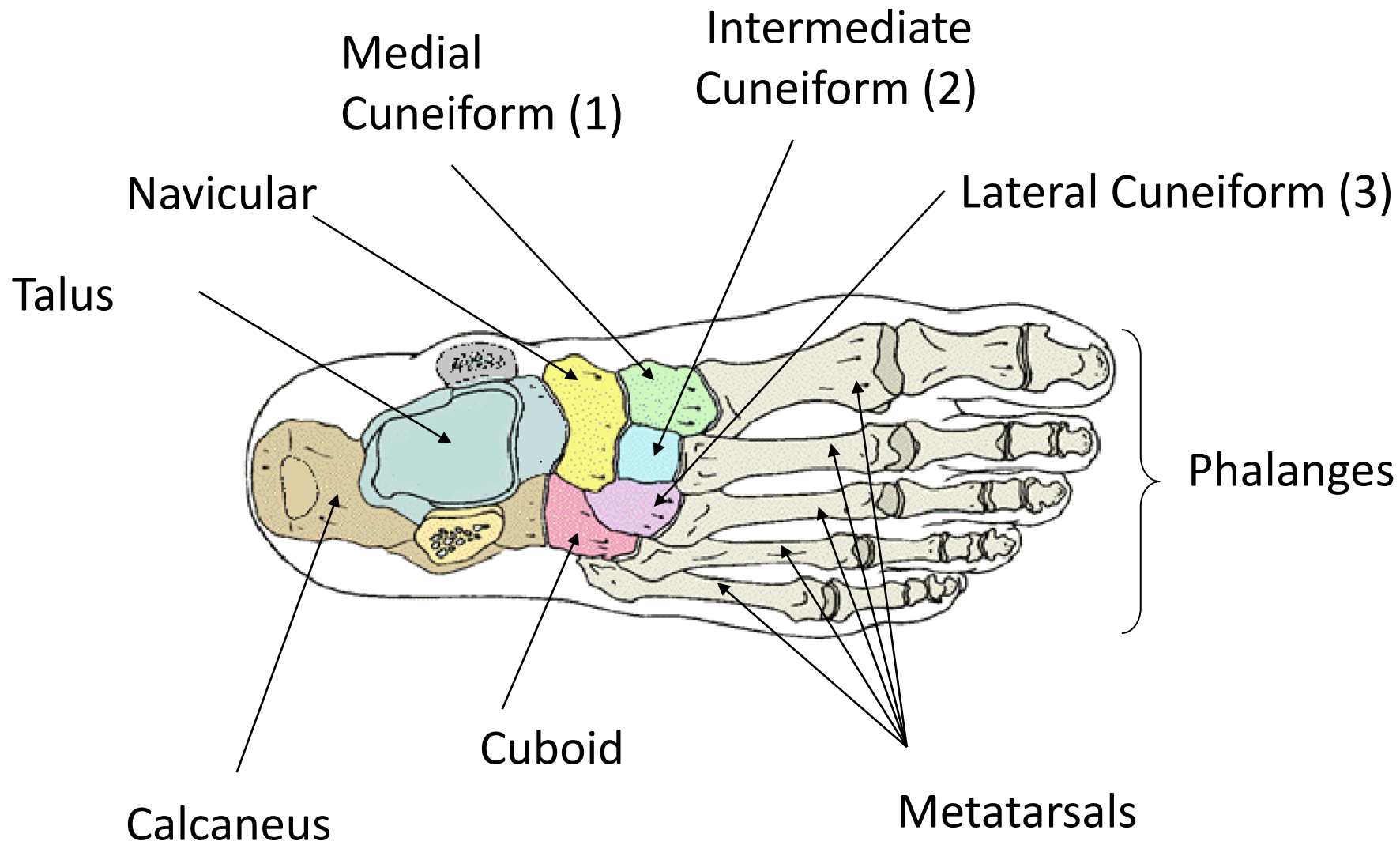


Anatomy of the foot

Prof. Oluwadiya KS
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Bones of the foot

Division of the Foot

- **The hindfoot:** talus and calcaneus.
- **The midfoot:** navicular, cuboid, and cuneiforms.
- **The forefoot:** metatarsals and phalanges



Mnemonic for Learning Tarsal Bones:

Tiger **C**ubs **N**eed **M** **I** **L** **C**

Talus

Navicular

A boat
It sails on the Cs

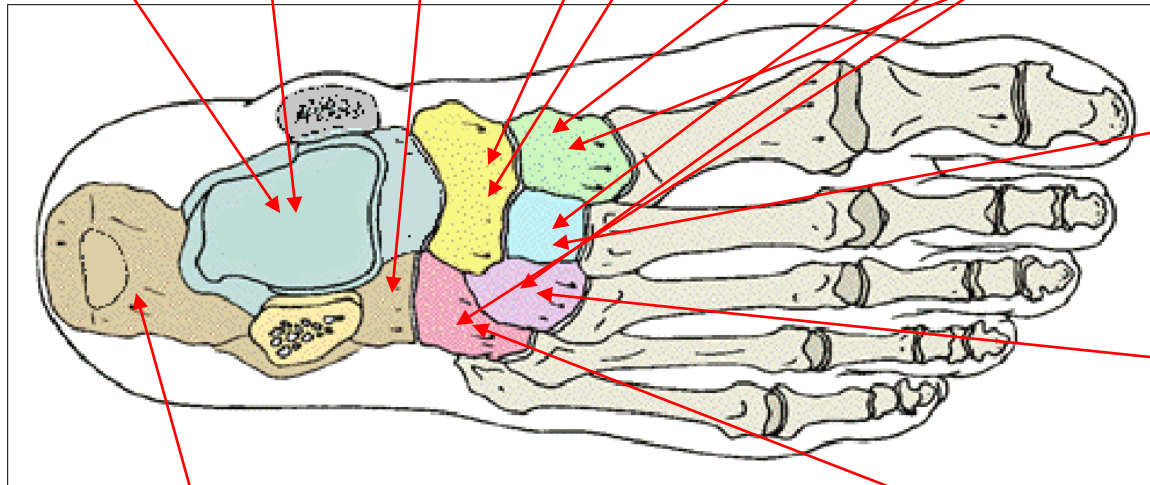
Medial
cuneiform (1)

Intermediate
cuneiform (2)

Lateral
cuneiform (3)

Calcaneus

Cuboid



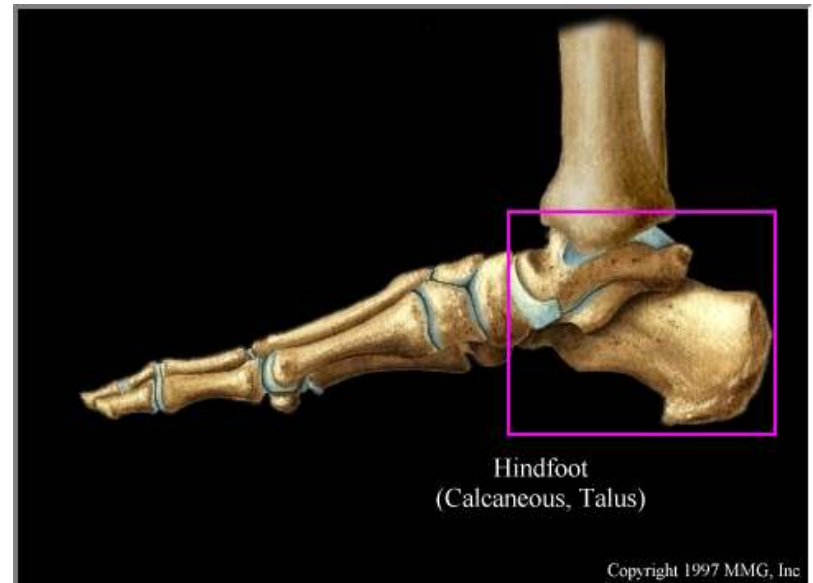
Hindfoot

Bones

- i. Talus
- ii. Calcaneus

Joints:

- i. Subtalar joint
- ii. Talocalcaneonavicular joint

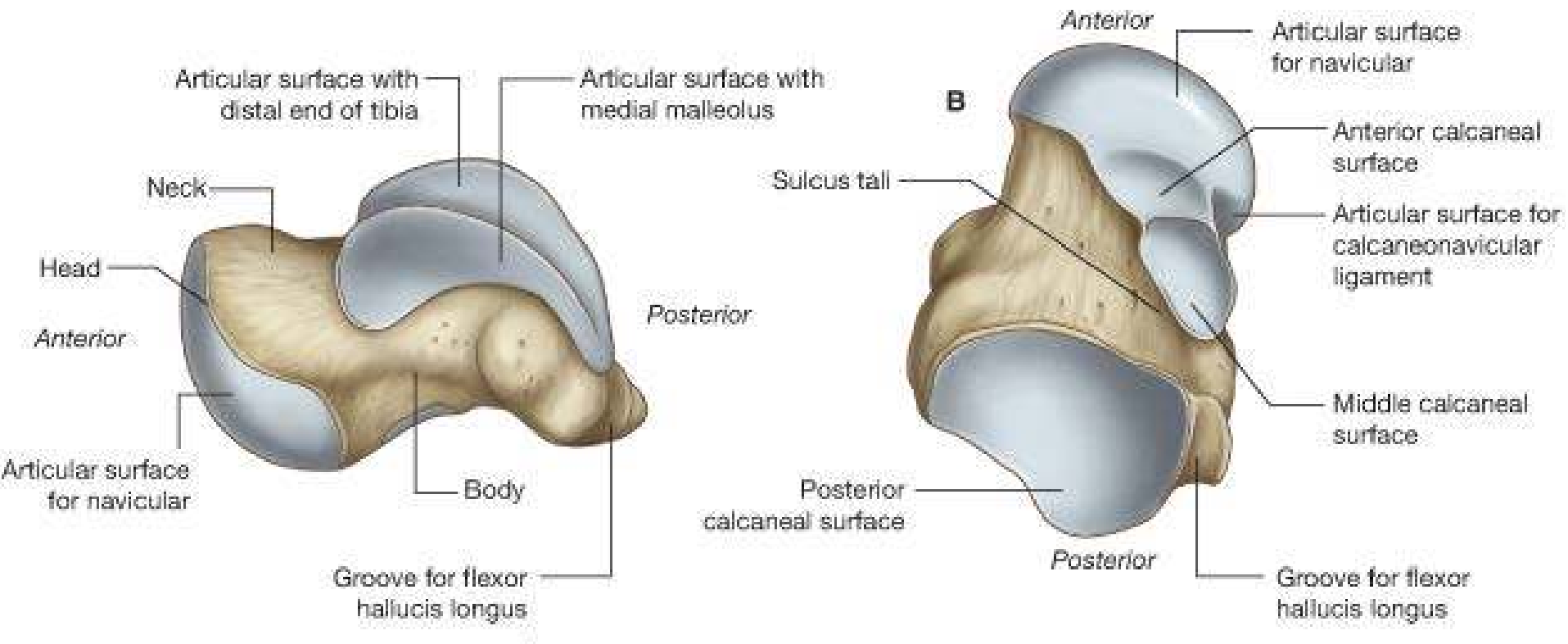


Hindfoot: Talus

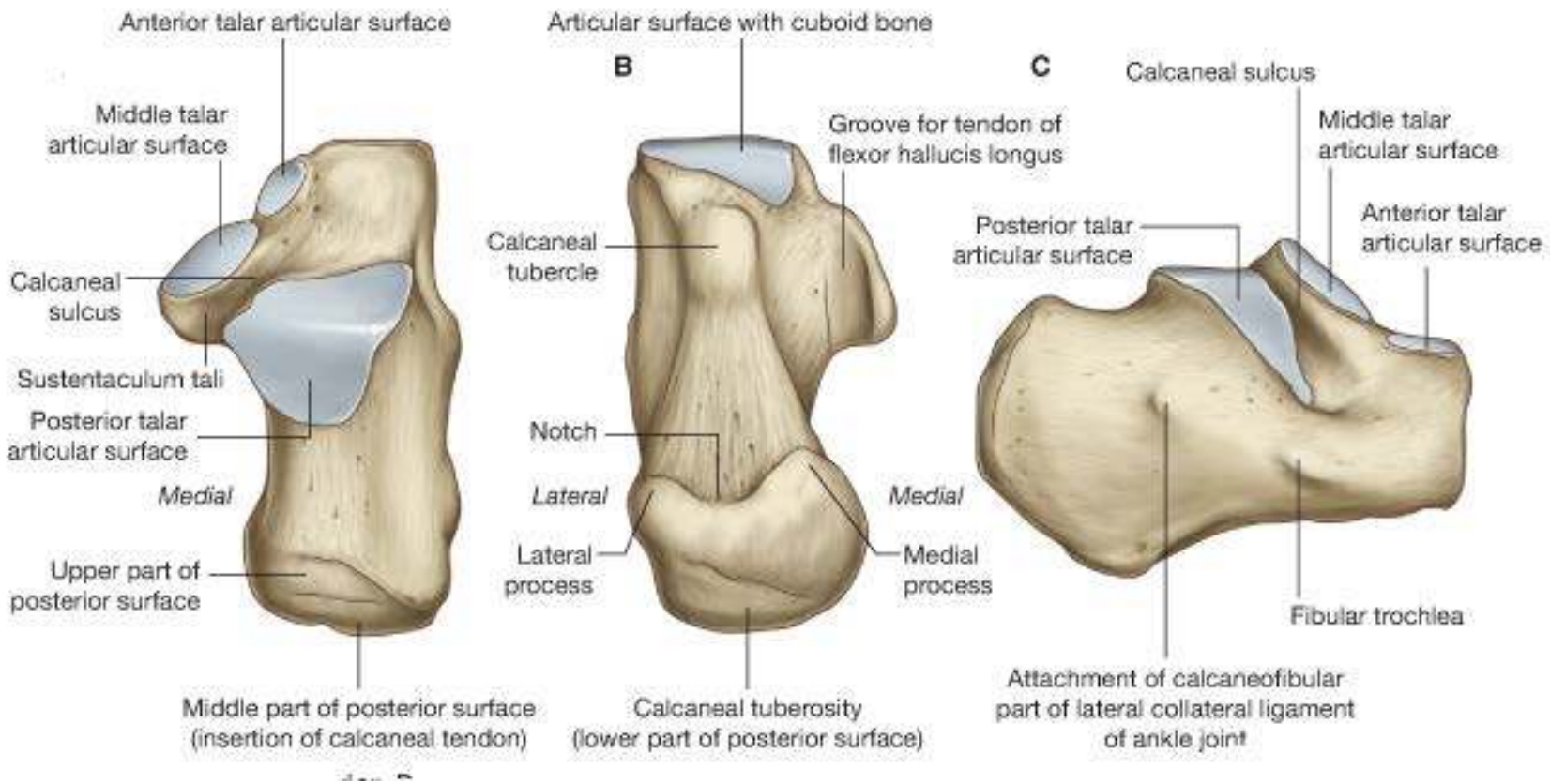
- 2nd largest tarsal bone
- Articulates with:
 - i. Tibia & Fibula : **Ankle**
 - ii. Calcaneus (Through posterior calcaneal facet): **Subtalar joint**
 - iii. Calcaneus, plantar calcaneonavicular ligament and Navicular (Through middle & Anterior calcaneal facets): **Talocalcaneonavicular joint**



Hindfoot: Talus

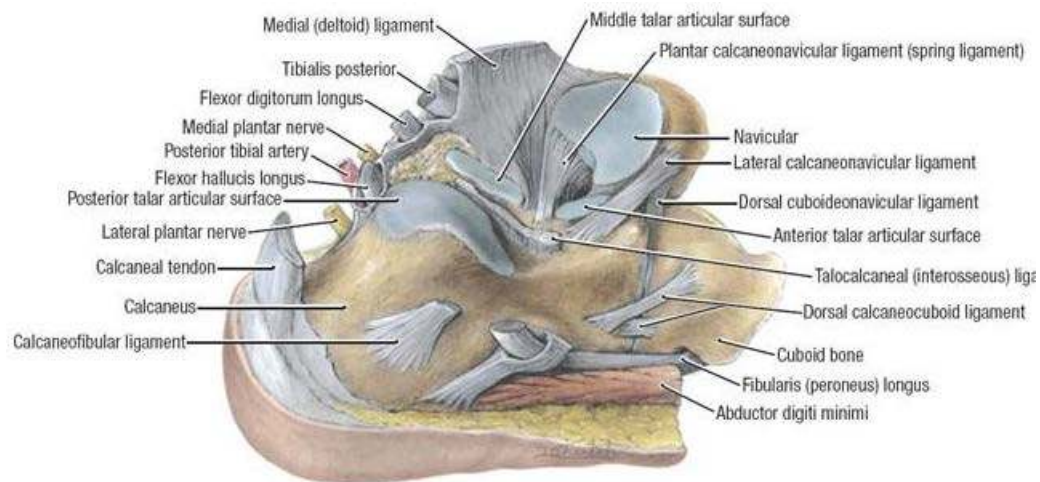


Calcaneus

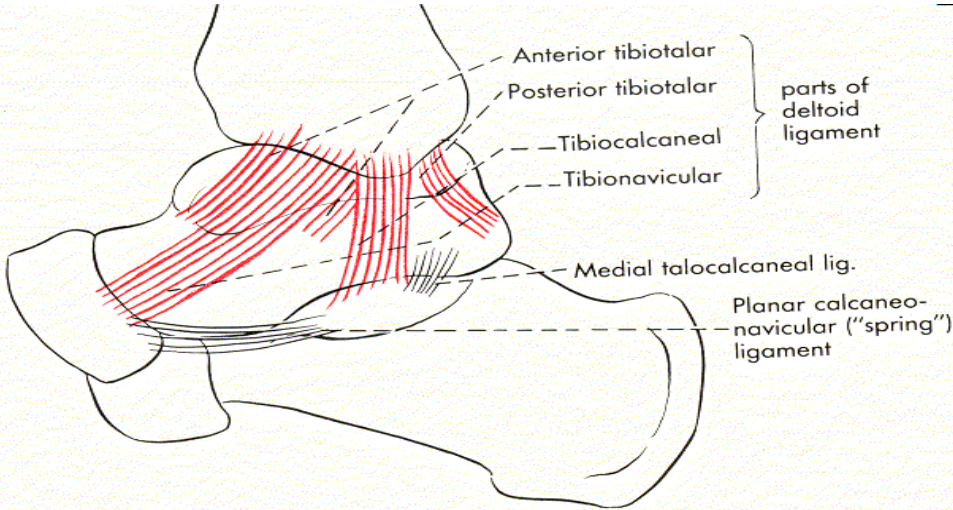


The subtalar joint

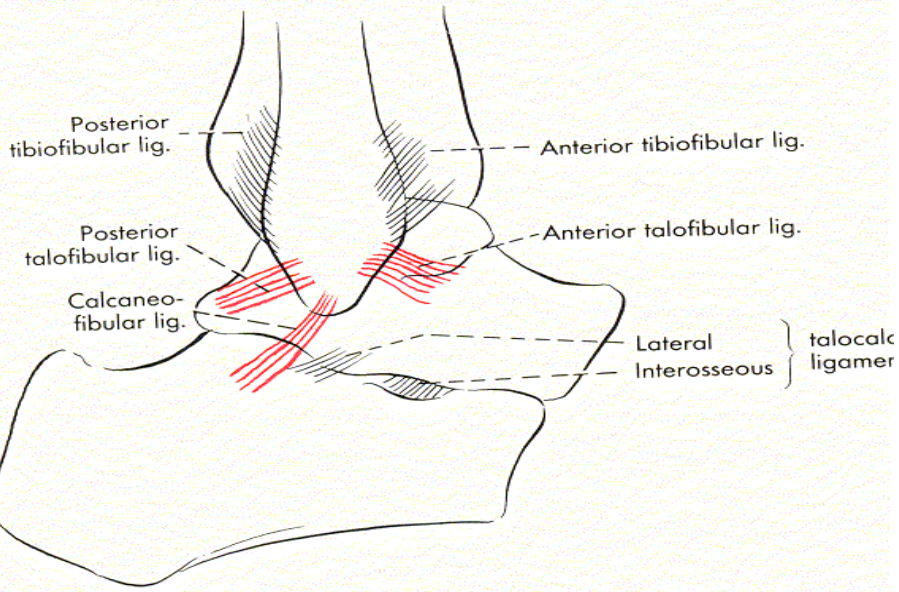
- The most posterior of the inter-tarsal joints
- Articulation between the posterior calcaneal facet of the talus and the posterior facet of the calcaneus
- Reinforced by the interosseous, medial, lateral and posterior talocalcaneal ligaments
- Responsible for inversion, eversion, pronation and supination (Together with the talocalcaneonavicular joints)



Hindfoot Articulations and Ligamentous Support



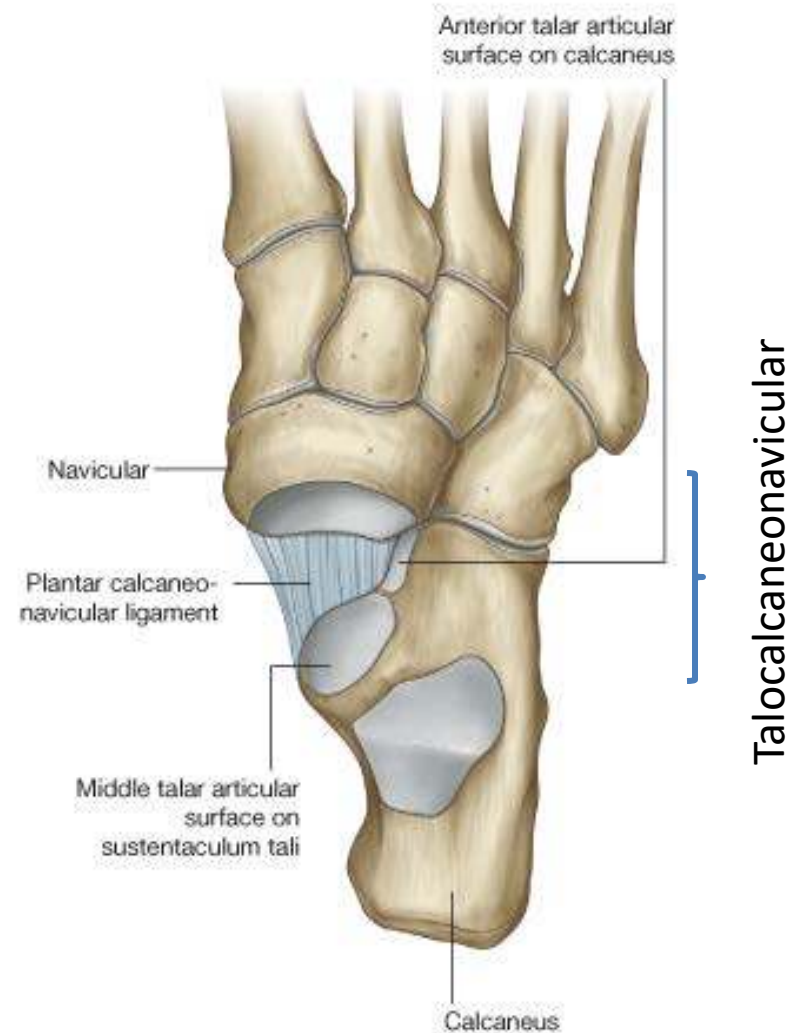
A



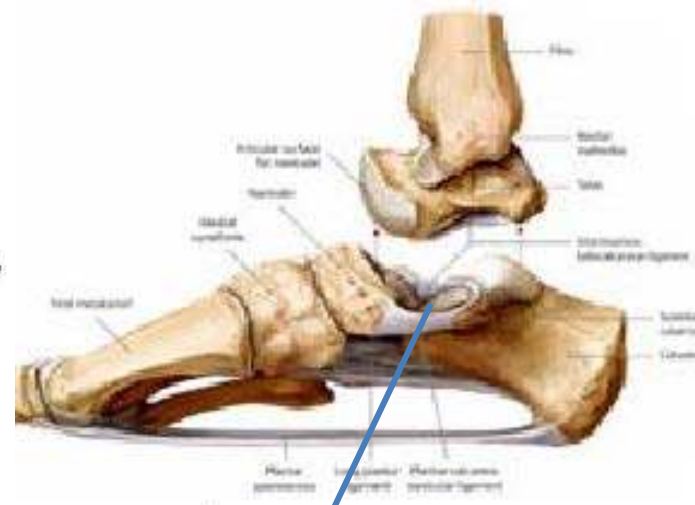
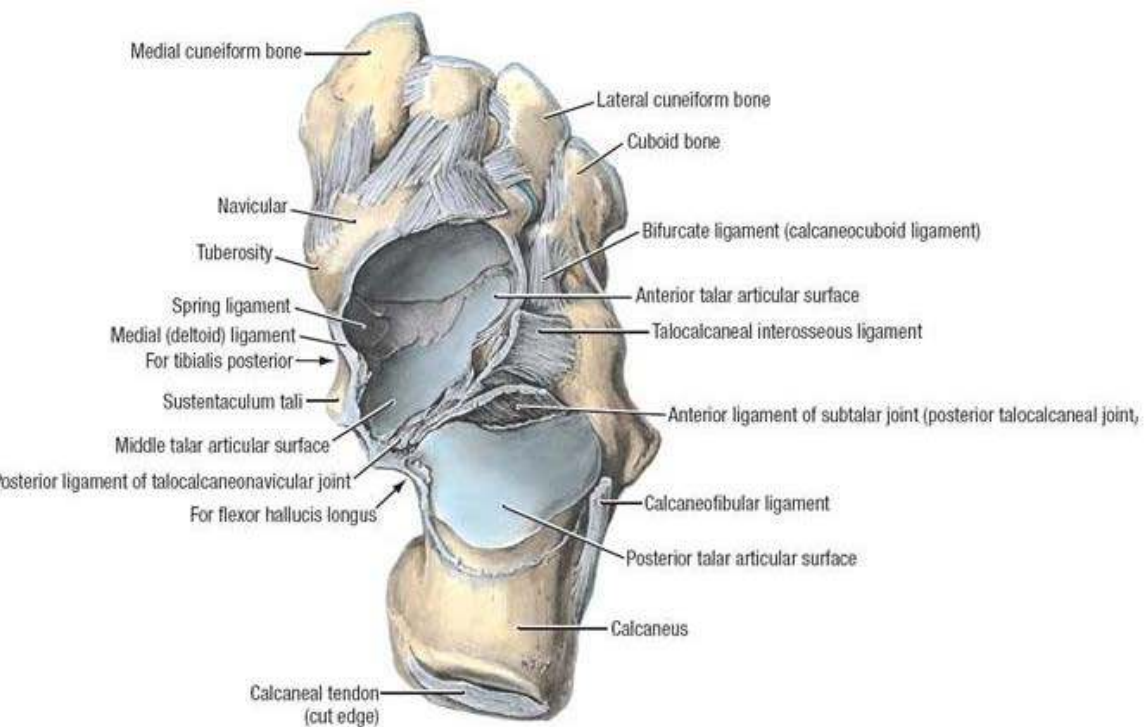
B

Talocalcaneonavicular joint

- Joint is between:
 - i. Talus
 - ii. Calcaneus
 - iii. Plantar calcaneonavicular (Spring) ligament which is between the sustentaculum tali and the navicular
 - iv. Navicular
- Also called transverse tarsal joints



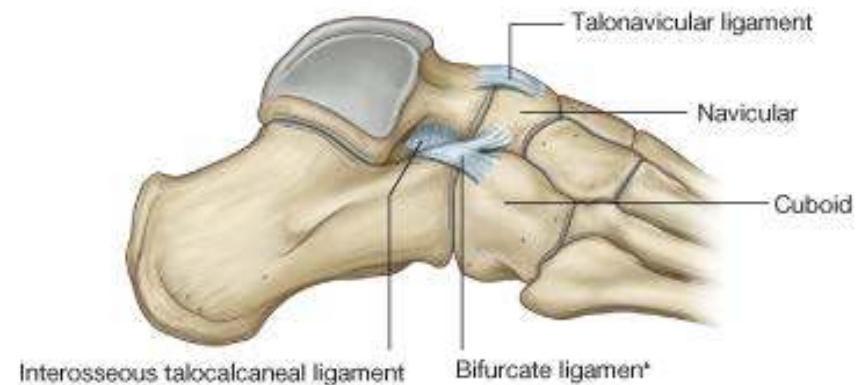
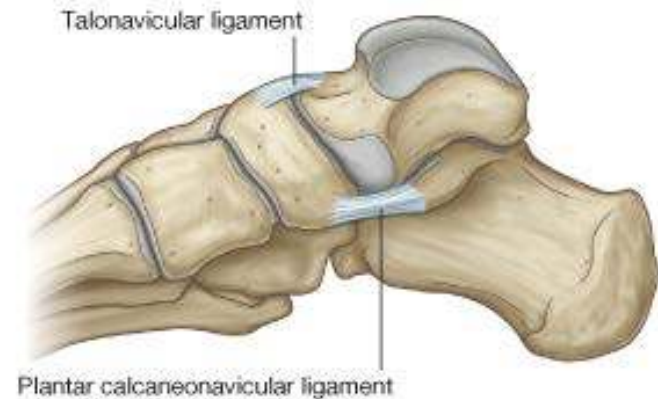
Talocalcaneonavicular joint



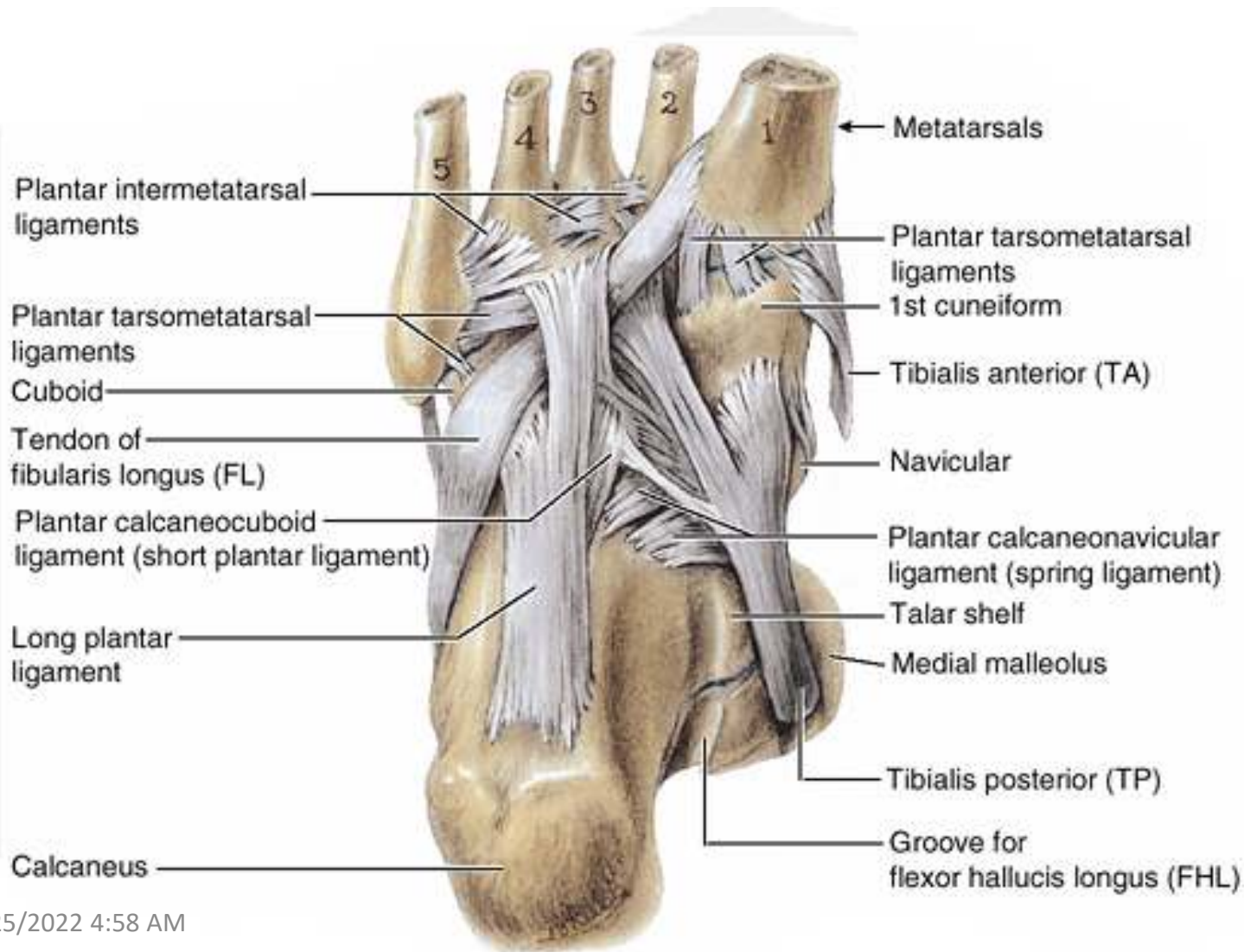
Talocalcaneonavicular

Ligaments of the talocalcaneonavicular joint

- **Inferiorly** by the Plantar calcaneonavicular (spring) ligament
- **Laterally** by the Bifurcate ligament (a Y-shaped ligament) between the calcaneus posteriorly and the cuboid/navicular anteriorly)
- **Superiorly** by the Talonavicular ligament
- Posteriorly by the Interosseous talocalcaneal ligament



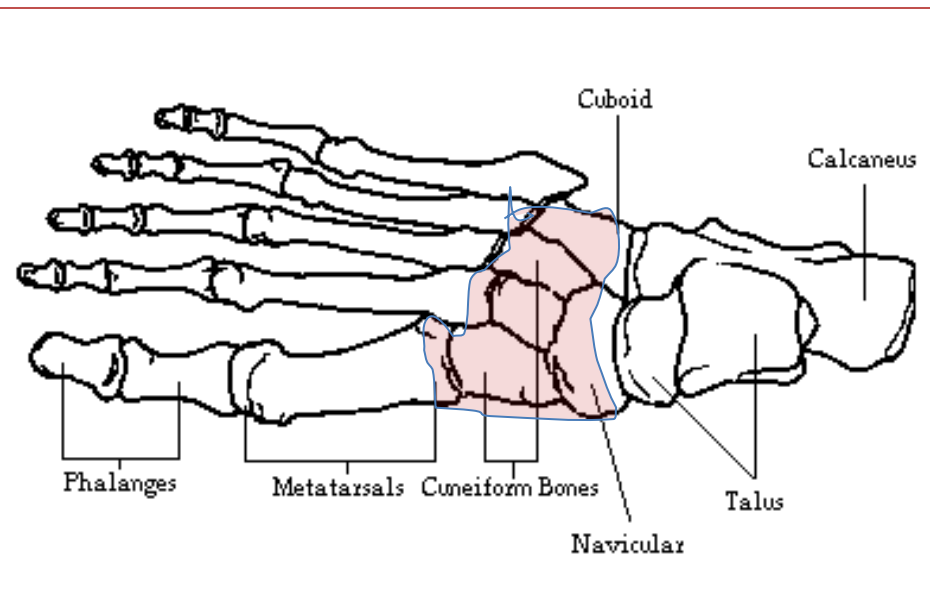
Hindfoot Articulations and Ligamentous Support



Midfoot

Composed of

- Navicular
- 3 Cuneiforms
 - i. Medial
 - ii. Intermediate
 - iii. Lateral
- Cuboid

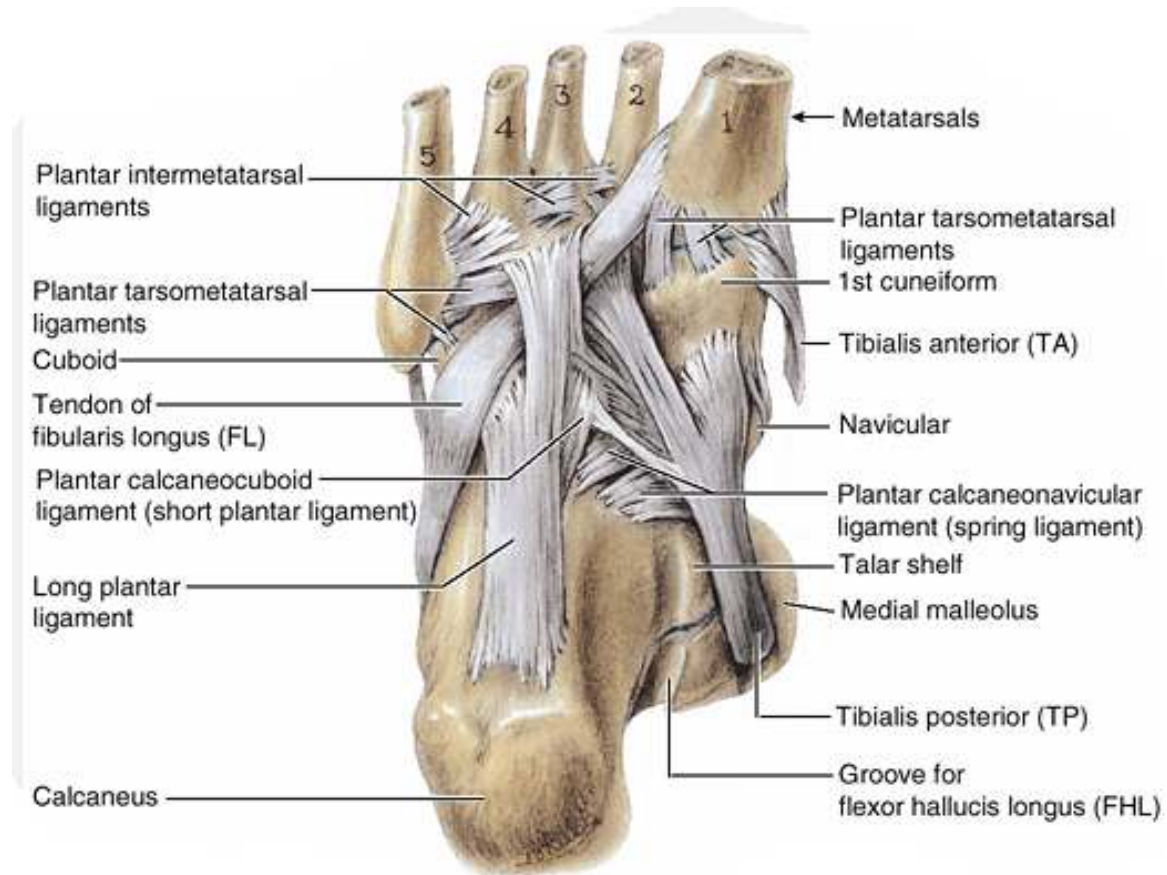


Calcaneocuboid joint

- Synovial joint between:
 - The facet on the anterior surface of the calcaneus;
 - The corresponding facet on the posterior surface of the cuboid.
- Contributes to eversion, inversion, pronation and supination

Ligaments of the Calcaneocuboid joint

- Long plantar ligament
- Bifurcate ligament
- Plantar calcaneocuboid ligament



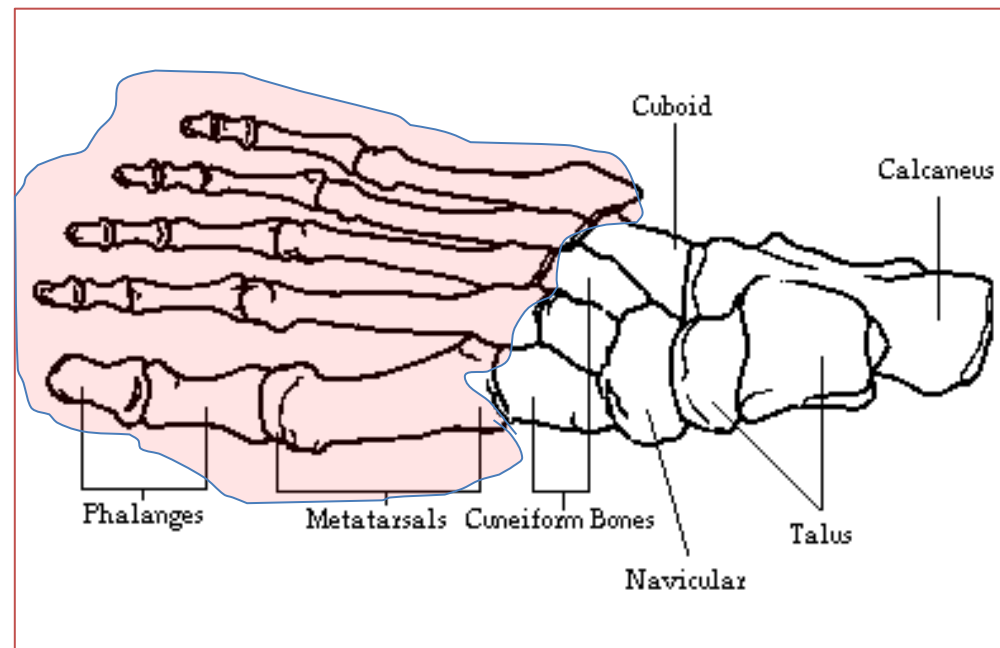
Long plantar ligament

- The longest ligament in the sole of the foot
- inferior to the plantar calcaneocuboid ligament
- **Posteriorly**, it attaches to the inferior surface of the calcaneus between the tuberosity and the calcaneal tubercle;
- **Anteriorly**, it attaches to the inferior surface of the cuboid bone behind the groove for the fibularis longus tendon.
- More superficial fibers extend to the bases of the metatarsal bones.
- Supports the calcaneocuboid joint and is the strongest ligament, resisting depression of the lateral arch of the foot.



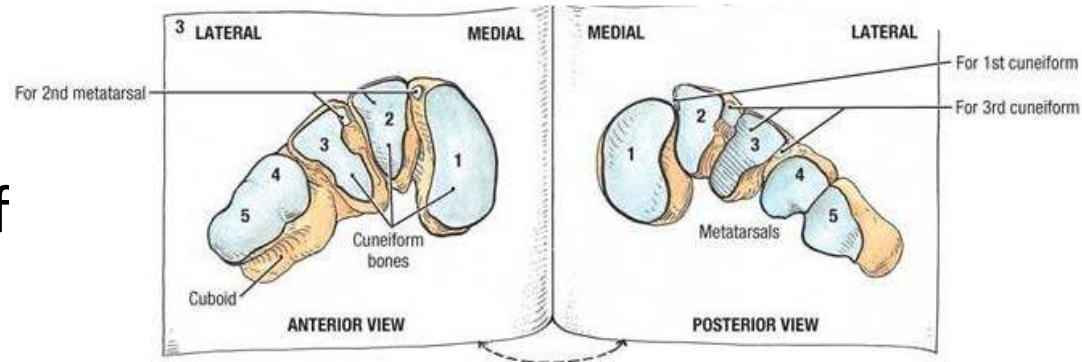
Forefoot

- **5 Metatarsals**
 - Proximally, metatarsals 1-3 articulate with cuneiforms
 - Proximally metatarsals 4-5 articulate with cuboid
 - Bases articulate with phalanges
- **5 Phalanges**



Tarsometatarsal joints

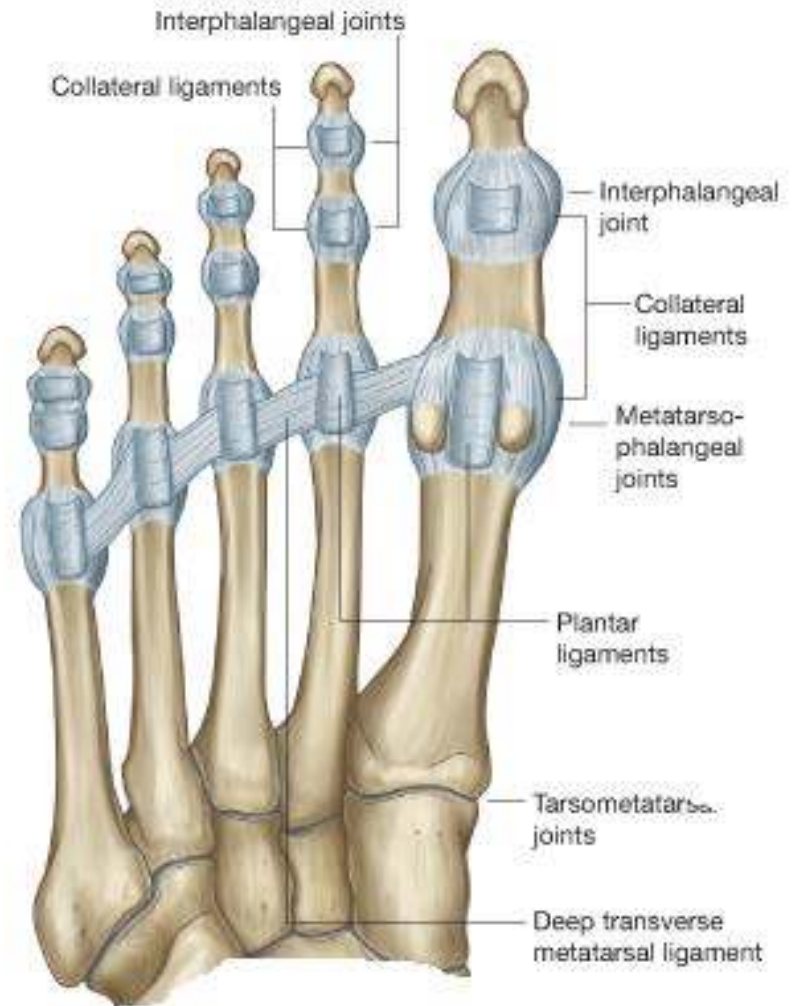
- Between the bases of the metatarsal bones and the cuneiform (1-3 metatarsal) and cuboid (4-5)
- Take part in pronation and supination of the f
- First TMJ is by far the most mobile allowing flexion, extension and rotation



Metatarsophalangeal joints

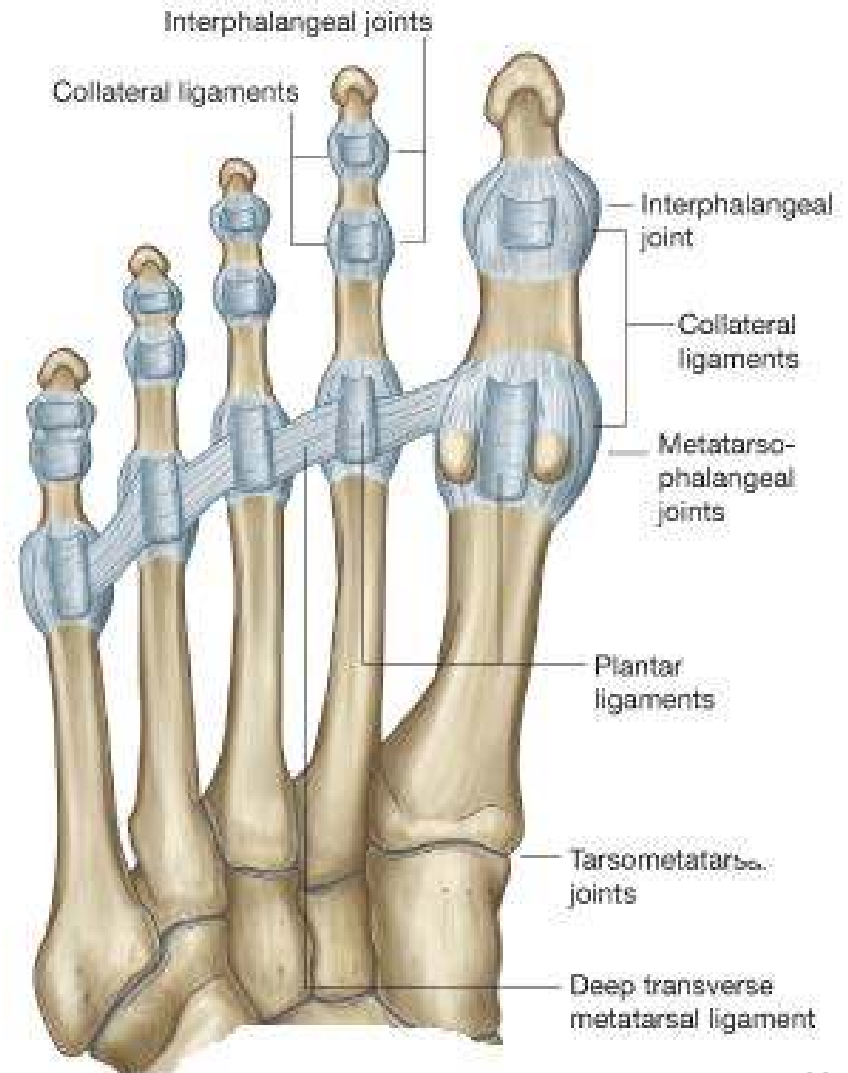
- Ellipsoid joints
- Major movements:
 - i. extension
 - ii. flexion
- Minor movements:
 - i. abduction
 - ii. adduction
 - iii. Rotation
 - iv. Circumduction

Deep transverse metatarsal ligament connects all the joints together making them to function as a unit



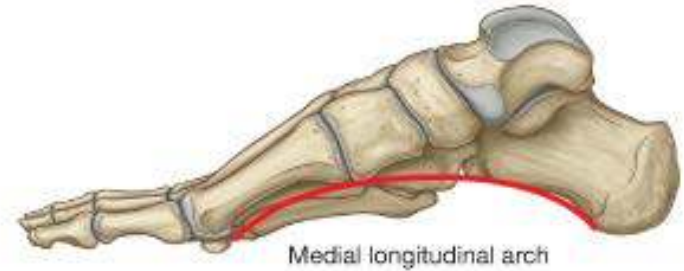
Interphalangeal joints

- Between the phalanges
- Reinforced by the collateral ligaments and the plantar ligaments
- Allows flexion and extension



Arches of the Foot

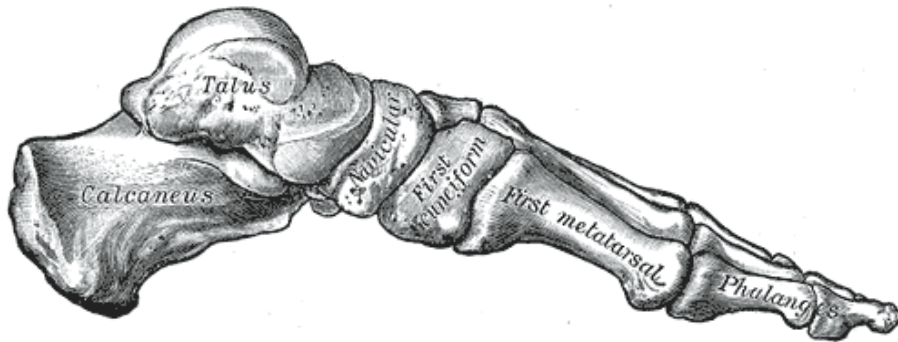
- Medial Longitudinal Arch
- Lateral Longitudinal Arch
- Transverse Arch



Arches of the Foot

- **Medial Longitudinal Arch**

- Calcaneus
- Talus
- Navicular
- 1-3 cuneiforms
- 1-3 Metatarsals

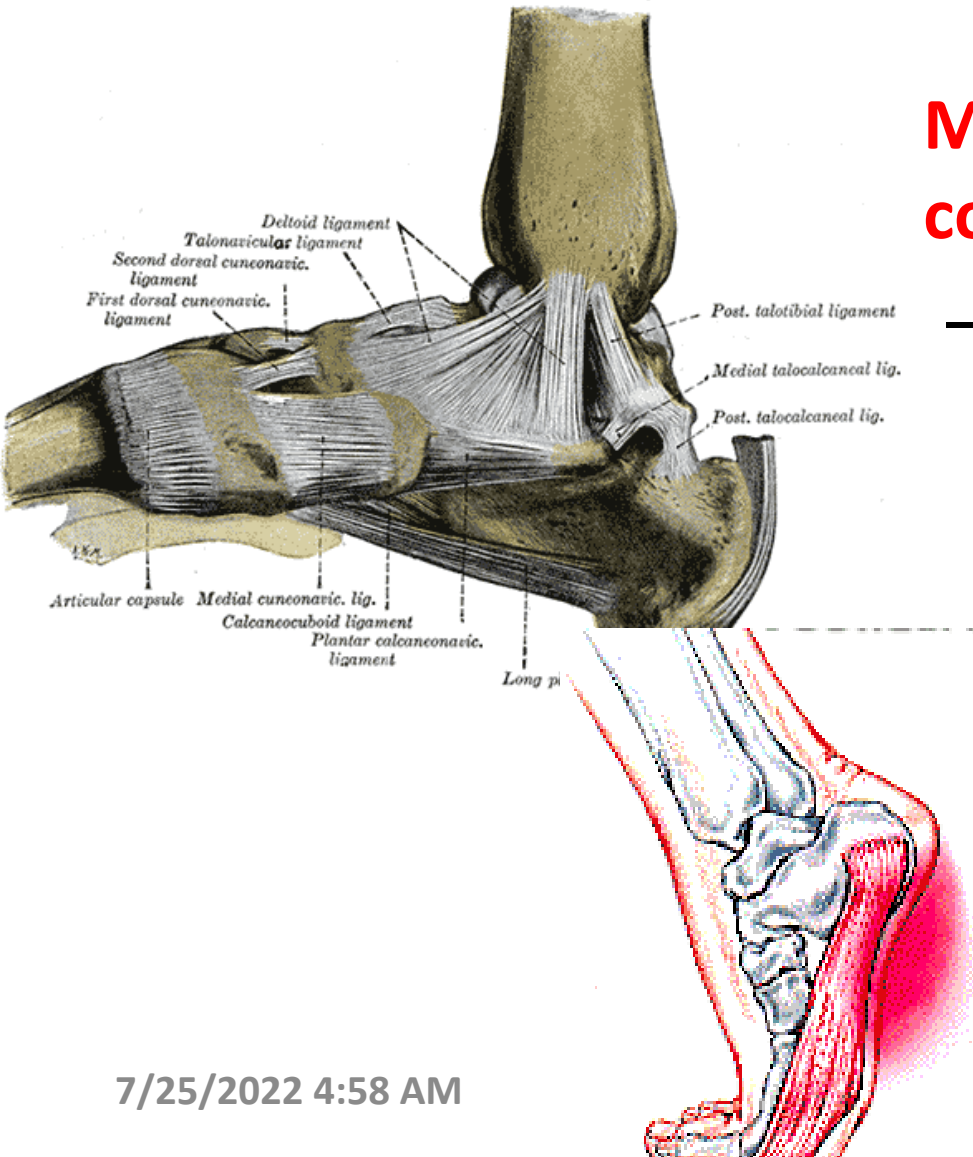


Arches of the Foot

Medial Longitudinal Arch continued

– Ligament Support

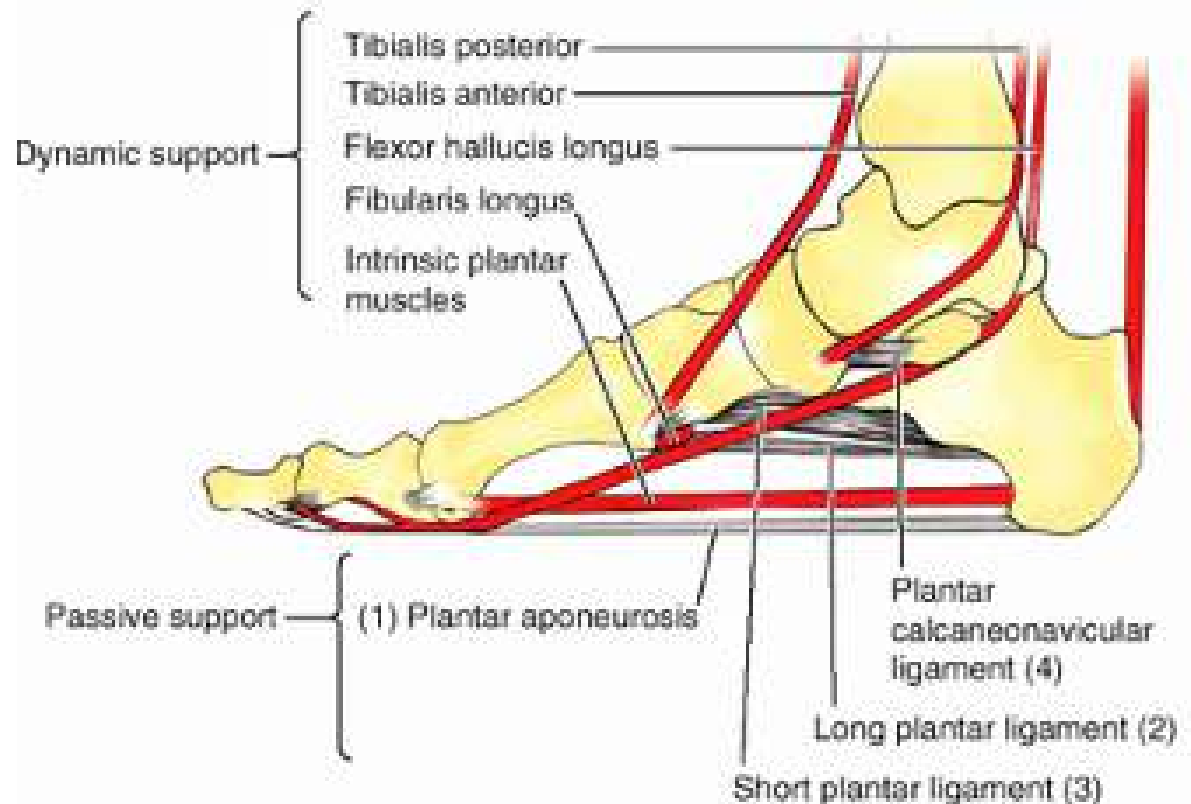
- Plantar Calcaneonavicular
- Long Plantar Ligament
- Deltoid
- Plantar fascia



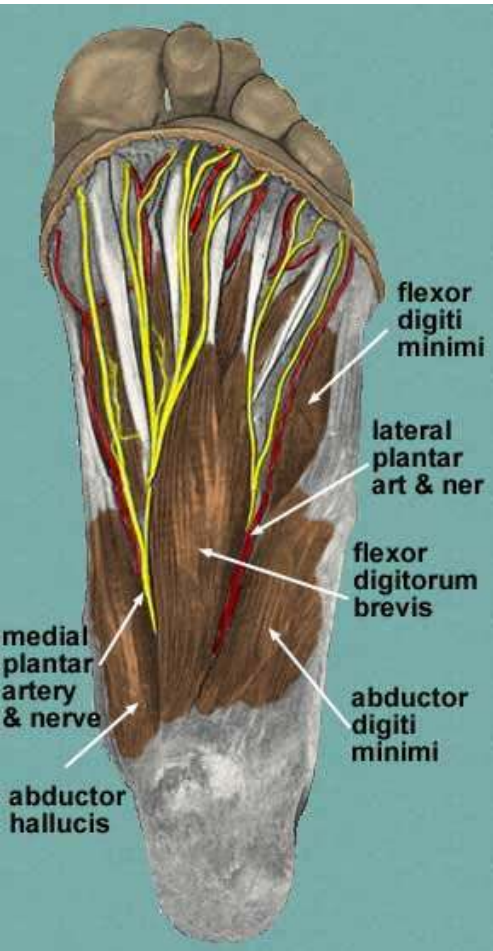
Arches of the Foot

Medial Longitudinal Arch continued

- Overview



Arches of the Foot



- **Medial Longitudinal Arch continued**
 - **Muscular Support**
 - Intrinsic
 - Abductor Hallucis
 - Flexor Digitorum Brevis
 - Extrinsic
 - Tibialis Posterior
 - Flexor Hallucis Longus
 - Flexor Digitorum Longus
 - Tibialis Anterior
 - Flexor Digitorum Longus

Arches of the Foot

- **Medial Longitudinal Arch continued**
 - **Muscular Support**
 - **Intrinsic**
 - Abductor Hallucis
 - Flexor Digitorum Brevis
 - **Extrinsic**
 - Tibialis Posterior
 - Flexor Hallucis Longus
 - Flexor Digitorum Longus
 - Tibialis Anterior
 - Flexor Digitorum Longus



Arches of the Foot

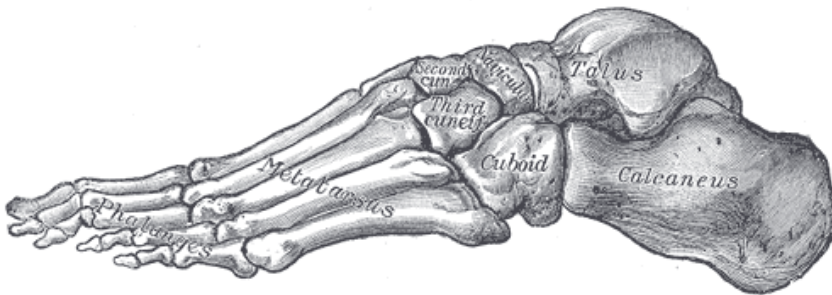
- **Lateral Longitudinal Arch**

- **Composed of**

- Calcaneus
- Cuboid
- 4-5th Metatarsals

- **Ligament Support**

- Long & Short Plantar ligaments
- Plantar Fascia



Arches of the Foot

- **Lateral Longitudinal Arch continued**

- **Muscle Support**

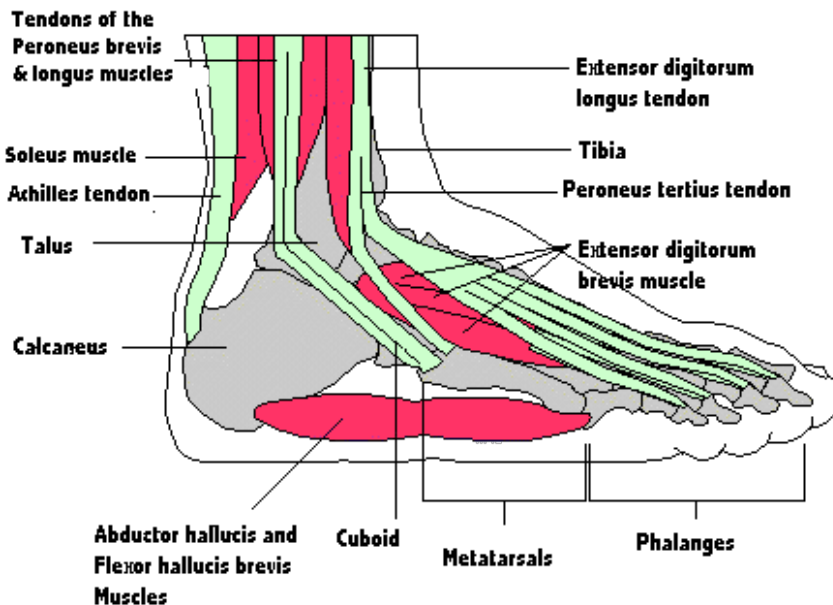
- **Intrinsic**

- Abductor Digiti Minimi

- Flexor Digitorum Brevis

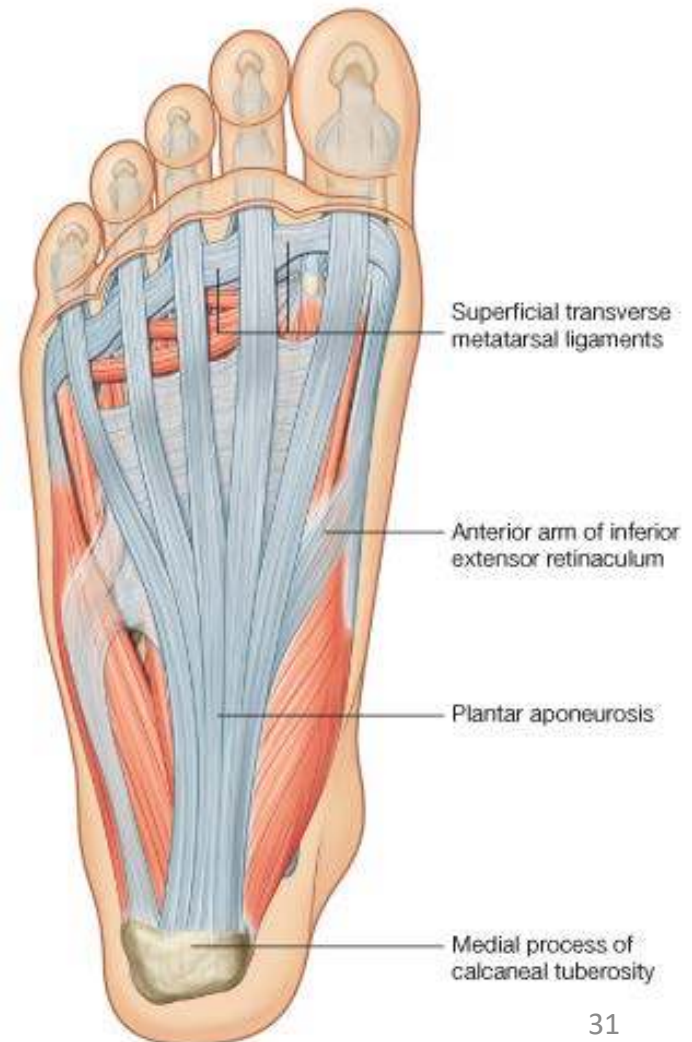
- **Extrinsic**

- Peroneus Longus, Brevis & Tertius



Plantar aponeurosis

- Thickening of the deep fascia
- Extends from the calcaneal tubercle posteriorly to the digits anteriorly
- Forms slips for the individual digits
- The slips are connected by transverse fibres forming the superficial transverse metatarsal ligaments
- Major support for the longitudinal arches
- Protects deeper tissues

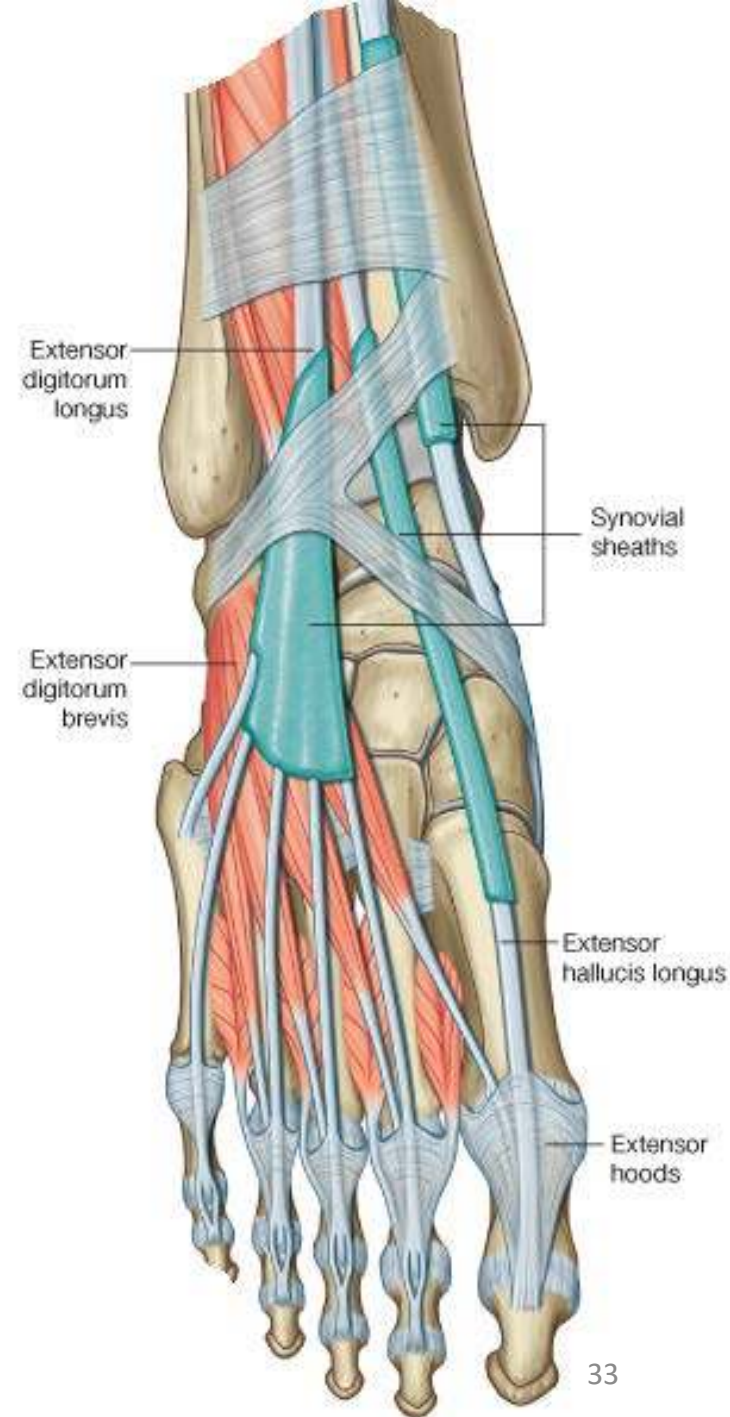


Intrinsic muscles of the foot

- Intrinsic muscles of the foot originate and insert in the foot
- There is only one intrinsic muscle-*extensor digitorum brevis*-on the dorsal aspect of the foot
- All others are in the plantar aspect of the foot
- They modify the actions of the long tendons and generate fine movements of the toes.
- All are innervated by the medial and lateral plantar branches of the tibial nerve except for the extensor digitorum, which is innervated by the deep fibular nerve

Extensor Digitorum Brevis

- **O**: Superolateral surface of the calcaneus
- **I**: Base of proximal phalanx of great toe and lateral sides of the tendons of extensor digitorum longus of toes II to IV
- **A**: Extension of metatarsophalangeal joint of great toe and flexion of toes II to IV
- **N**: Deep fibular nerve
- *It is the only intrinsic muscle on the dorsum of the foot and the only one not supplied by the plantar nerves*

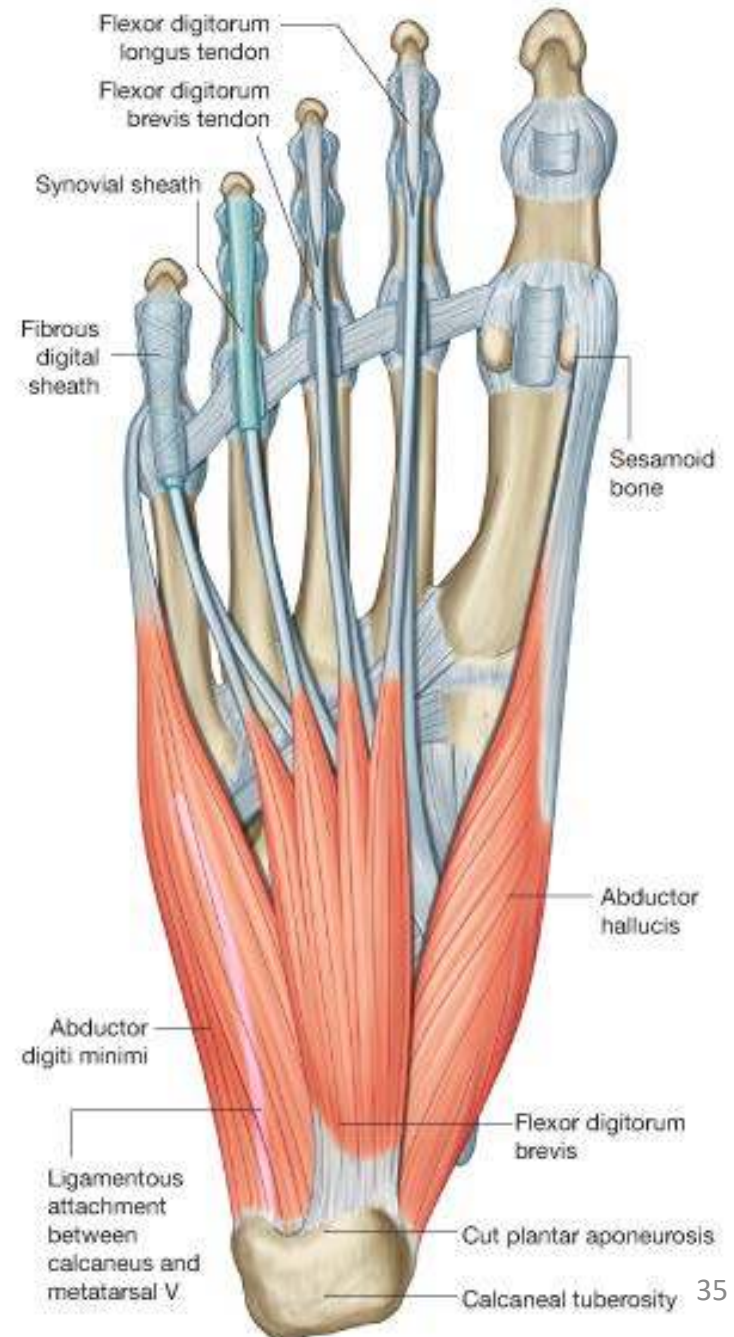


Muscles of the plantar Aspect

- Arranged in four layers
- All are supplied by the medial or lateral plantar branches of the tibial nerve
- They modify the actions of the long tendons and generate fine movements of the toes.
- They are also vital for the maintenance of the arches especially in the stance phase of the gait.

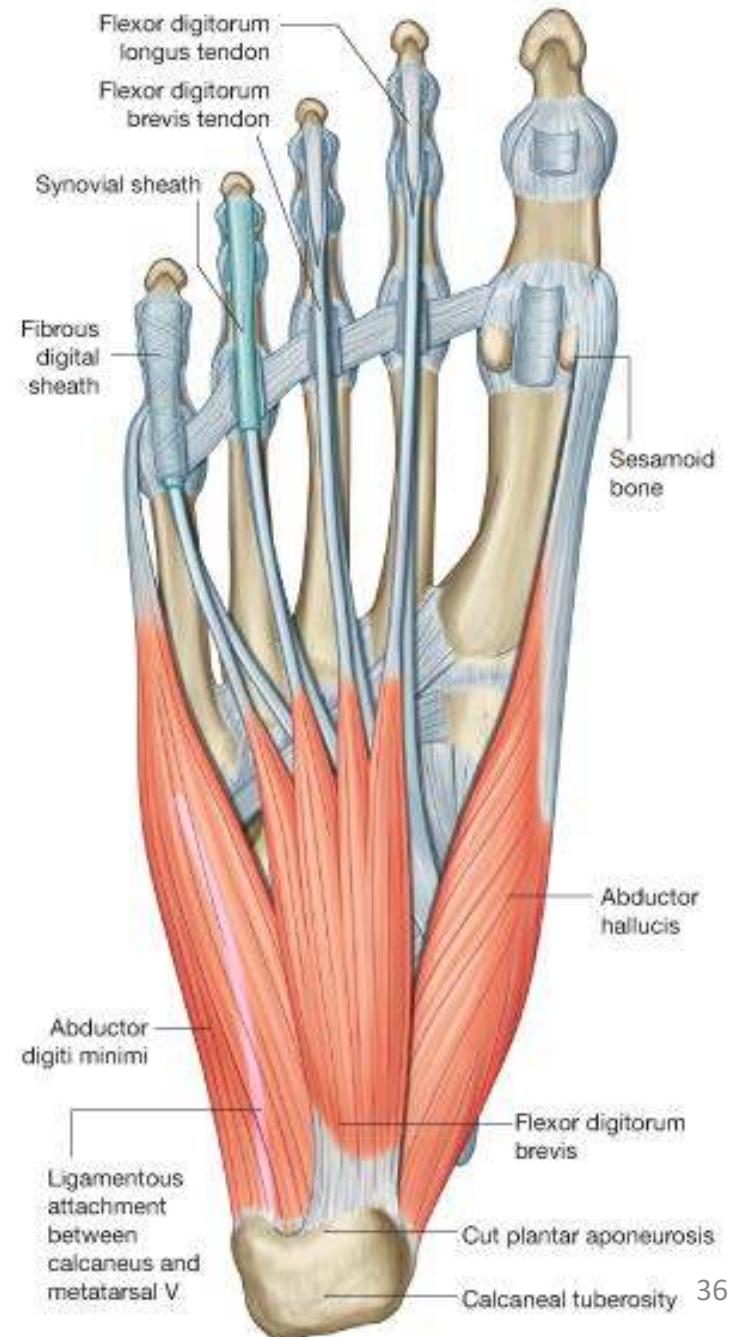
1st Layer: Abductor hallucis

- **O**: Medial process of calcaneal tuberosity
- **I**: Medial side of base of proximal phalanx of great toe
- **A**: Abducts and flexes great toe at metatarsophalangeal joint
- **N**: Medial plantar nerve from the tibial nerve



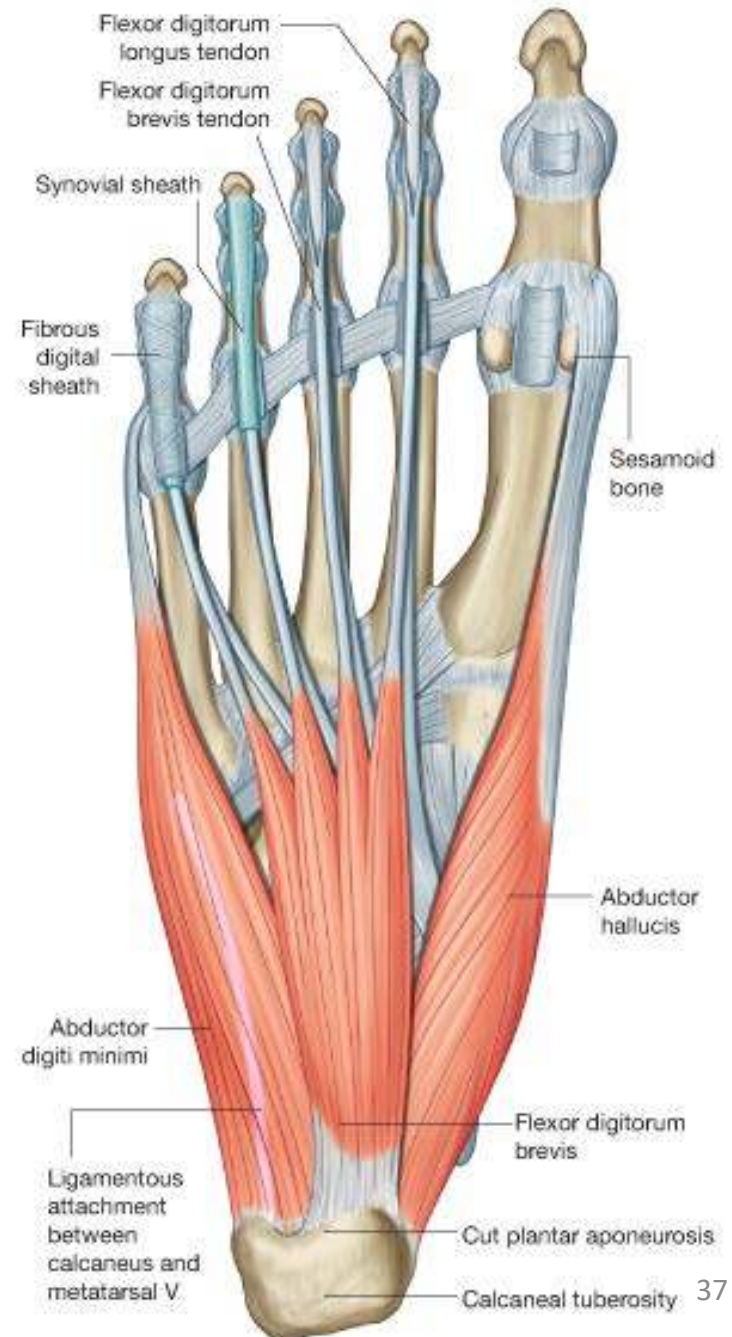
1st Layer: Flexor digitorum brevis

- **O**: Medial process of calcaneal tuberosity and plantar aponeurosis
- **I**: Plantar surface of middle phalanges of lateral four toes
- **A**: Flexes lateral four toes at proximal interphalangeal joint
- **N**: Medial plantar nerve from the tibial nerve



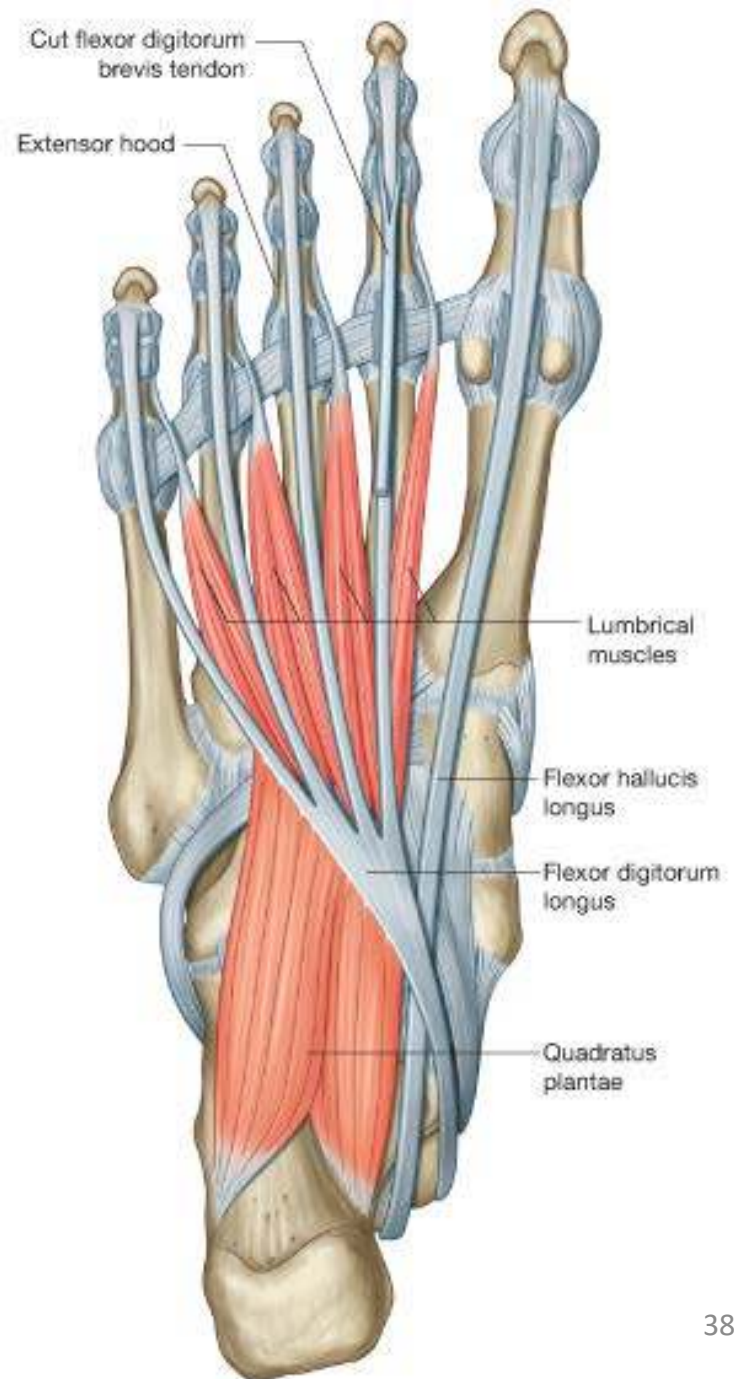
1st Layer: Abductor digiti minimi

- **O**: Lateral and medial processes of calcaneal tuberosity
- **I**: Lateral side of base of proximal phalanx of little toe
- **A**: Abducts the little toe at the interphalangeal joint
- **N**: Lateral Plantar Nerve



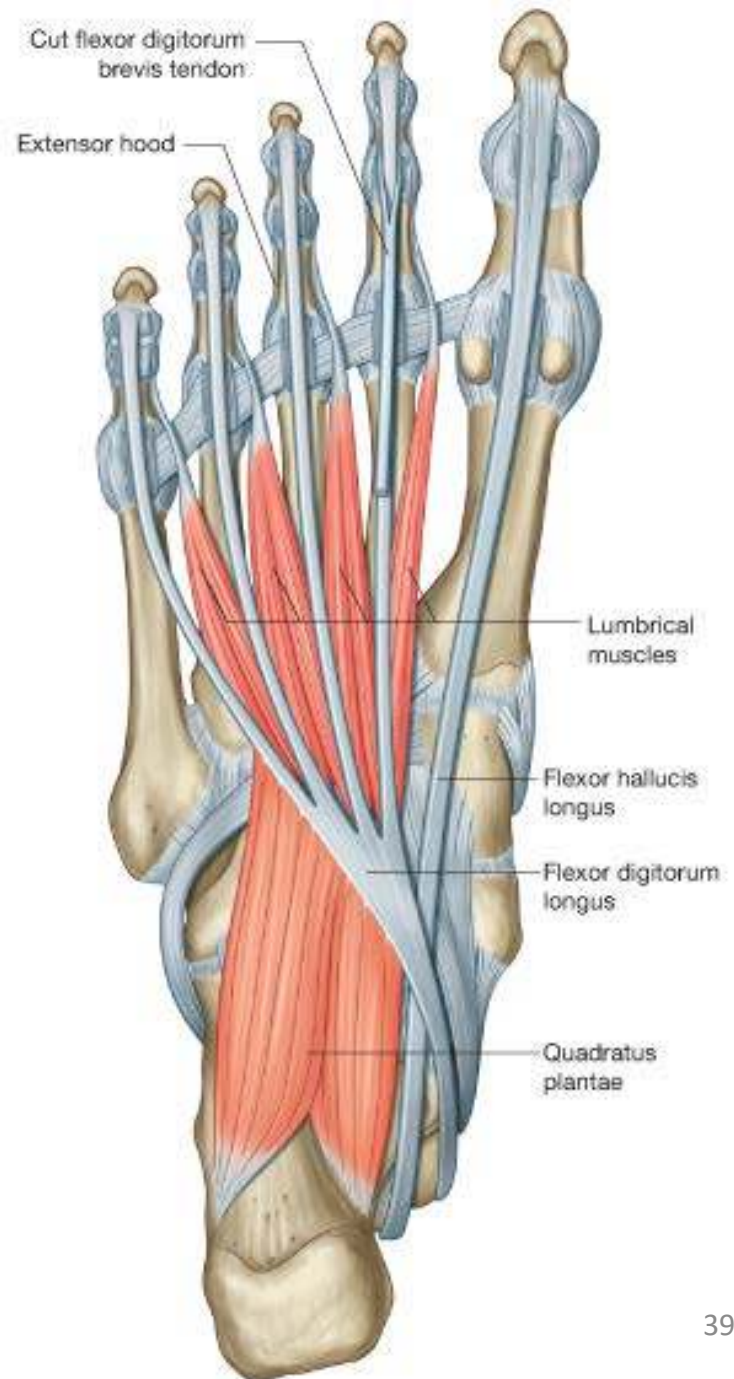
2nd Layer:

- **Two muscles**
- Both associated only with the lateral four toes
- Both are associated with the tendons of the extensor digitorum longus:
 - i. One inserts into it (Quadratus plantae) while
 - ii. The other originates from the tendons (lumbricals)



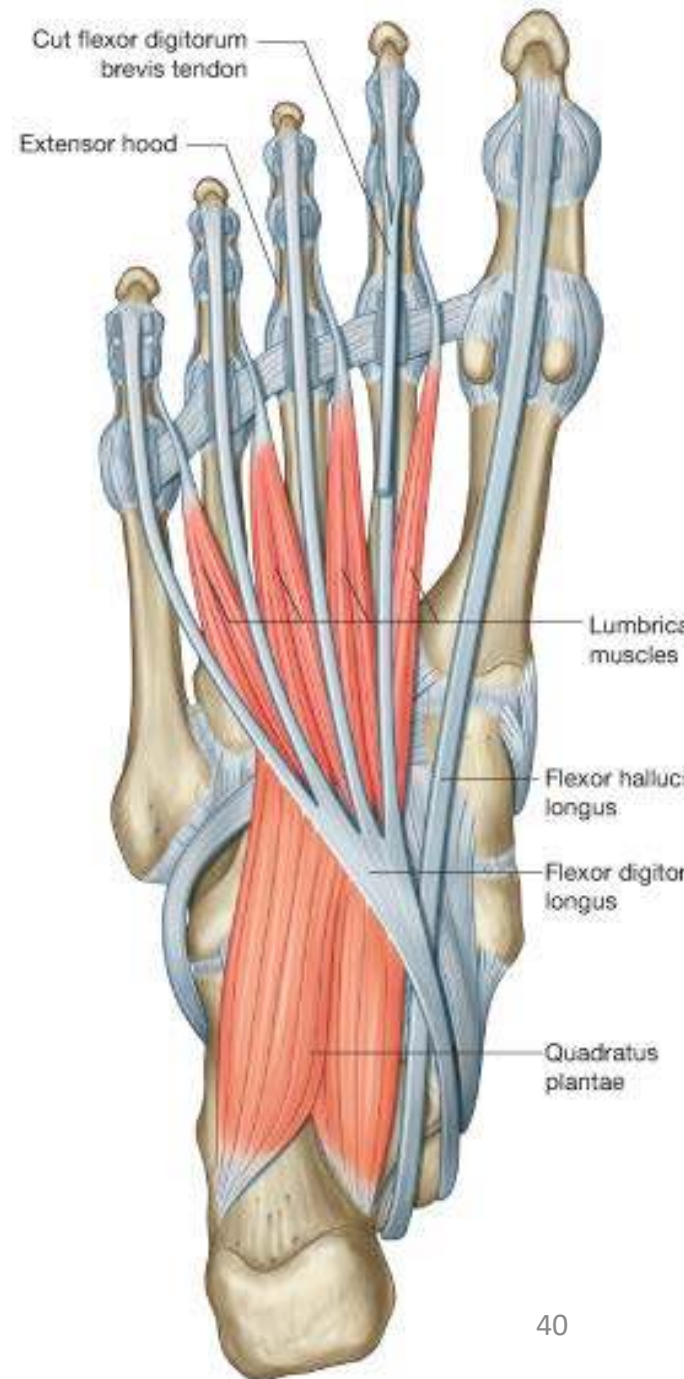
2nd Layer: Quadratus plantae

- **O: 2 heads:** Medial surface of calcaneus and lateral process of calcaneal tuberosity
- **I:** Lateral side of tendon of flexor digitorum longus in proximal sole of the foot
- **A:** Assists flexor digitorum longus tendon in flexing toes II to V
- **N:** Lateral Plantar Nerve



2nd Layer: Lumbricals

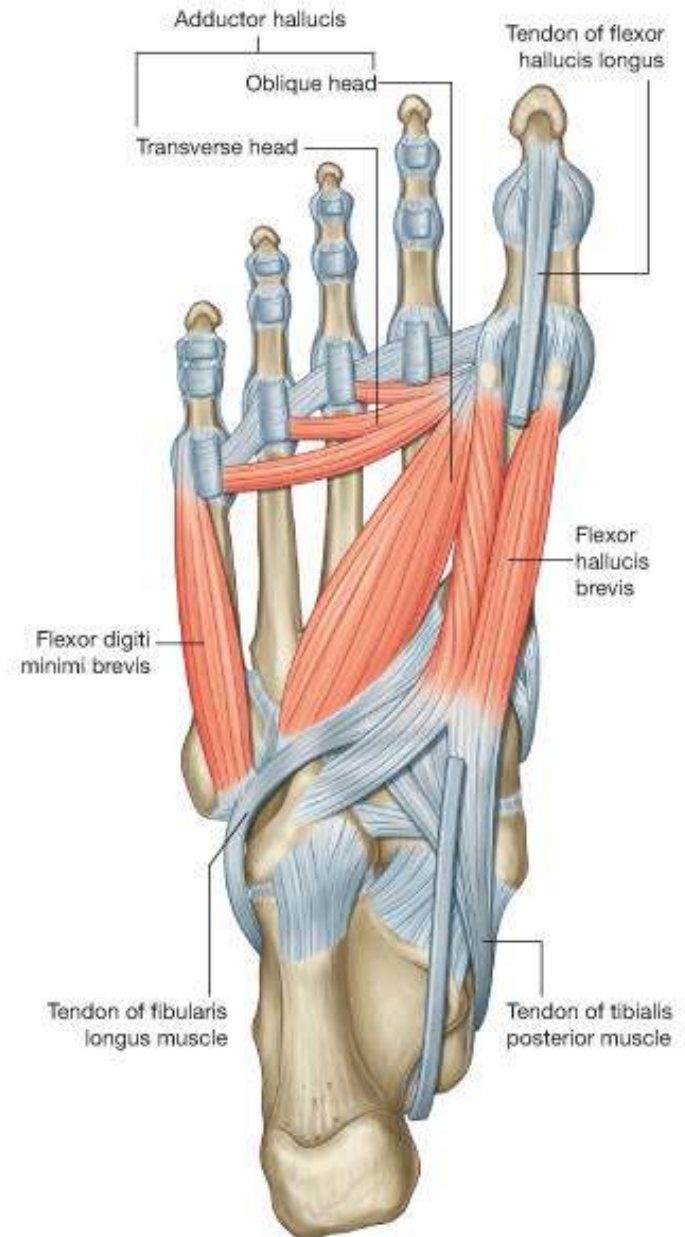
- **O**: 1st lumbrical:- (Unipennate) medial side of tendon of flexor digitorum longus associated with toe II
 - 2nd , 3rd and 4th lumbricals:- (Bipennate) adjacent surfaces of adjacent tendons of flexor digitorum longus
- **I**: Medial free margins of extensor hoods of toes II to V
- **A**: Flexion of metatarsophalangeal joint and extension of interphalangeal joints
- **N**: 1st lumbrical:-medial plantar nerve
All others:- lateral plantar nerve



3rd Layer

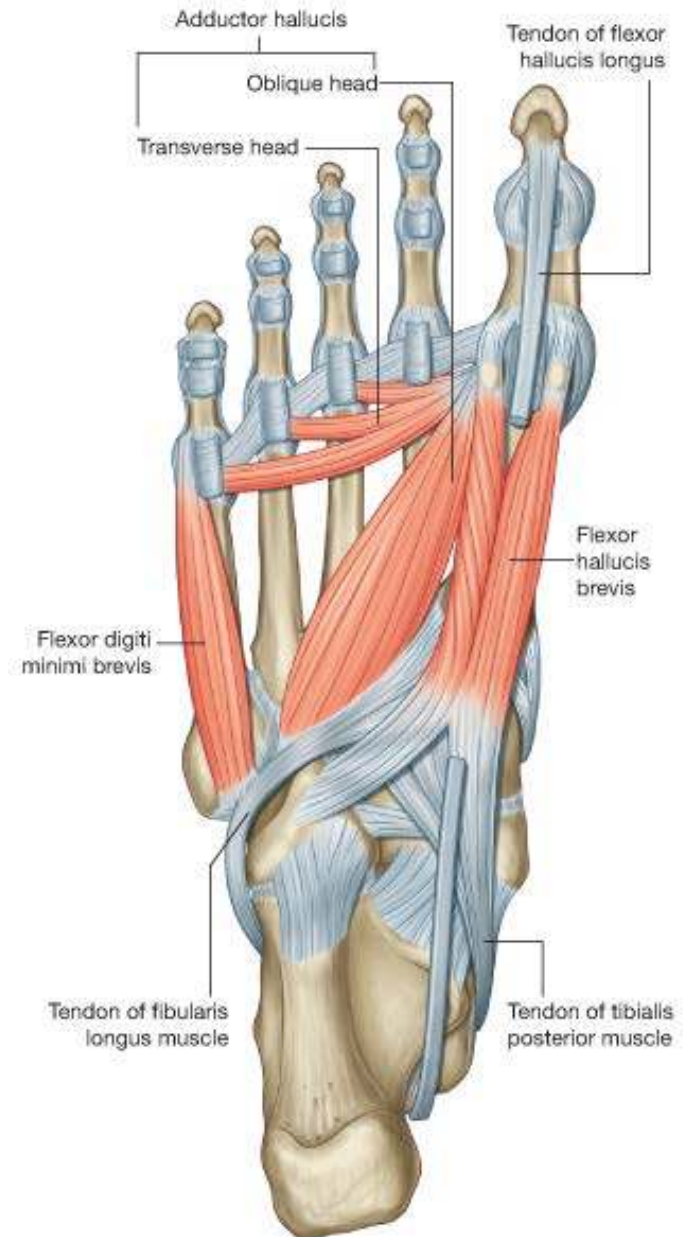
Three muscles

- Two (flexor hallucis brevis and adductor hallucis) are associated with the great toe;
- The third (flexor digiti minimi brevis) is associated with the little toe



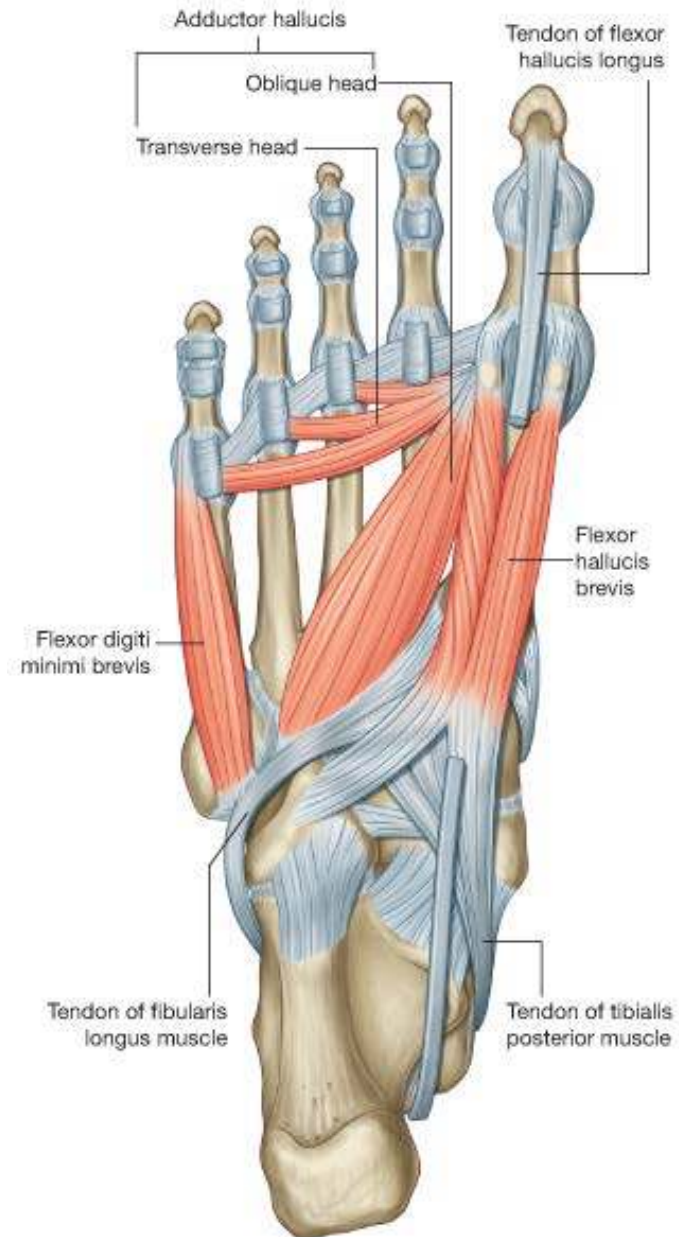
3rd Layer: Flexor hallucis brevis

- **O**: Plantar surface of cuboid and lateral cuneiform and tendon of tibialis posterior
- **I**: Lateral and medial sides of base of proximal phalanx of the great toe
- **A**: Flexes metatarsophalangeal joint of the great toe
- **N**: Medial plantar nerve
- Each of the tendons has a sesamoid bone between which the tendon of flexor hallucis longus lies.



3rd Layer: Adductor hallucis

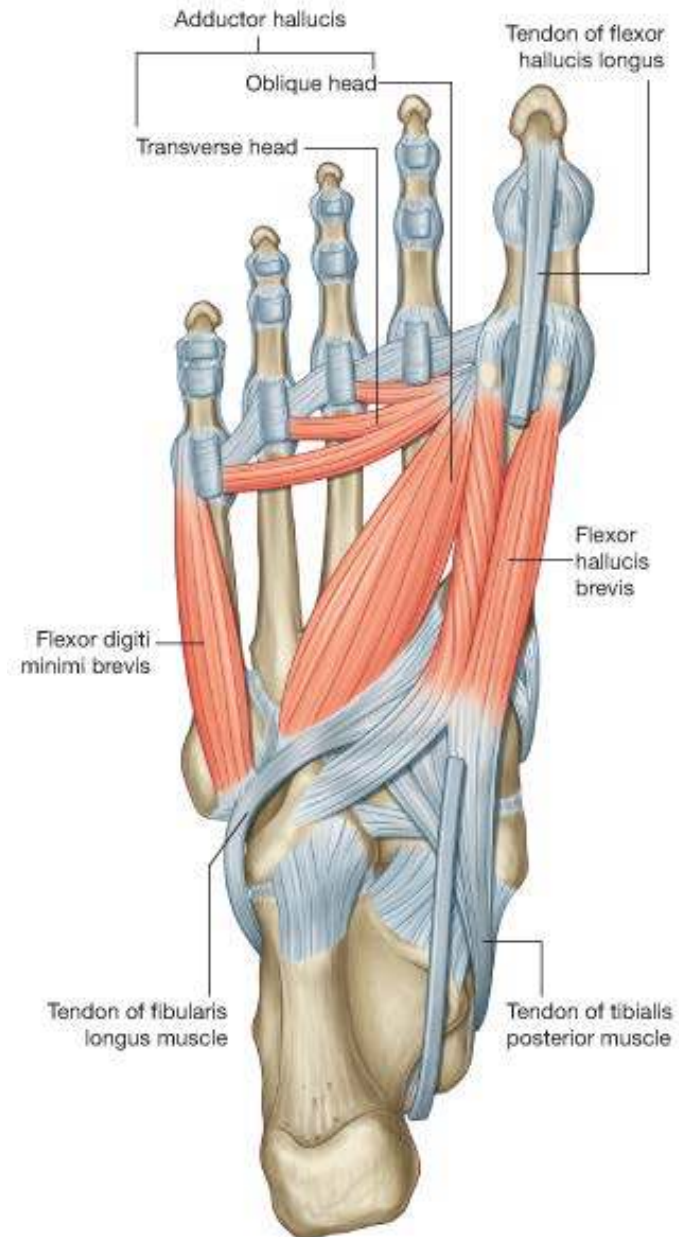
- **O**: **Transverse head**: -ligaments of the metatarsophalangeal joints of lateral three toes
Oblique head: -bases of metatarsals II to IV and from sheath covering fibularis longus
- **I**: Lateral side of base of proximal phalanx of great toe
- **A**: Adducts the great toe at the metatarsophalangeal joint
- **N**: Lateral plantar nerve



3rd Layer:

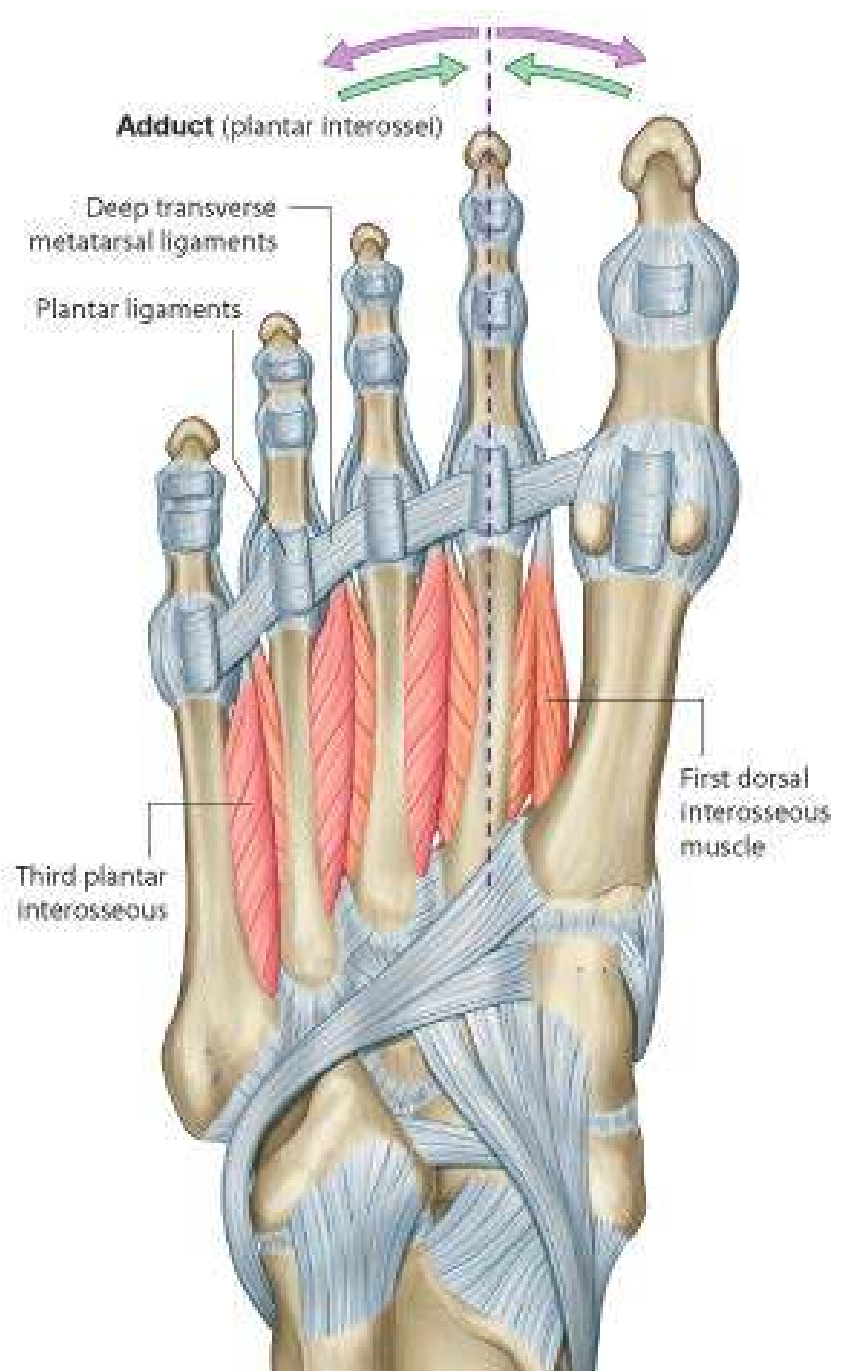
Flexor digiti minimi brevis

- **O**: Base of metatarsal V and related sheath of fibularis longus tendon
- **I**: Lateral side of base of proximal phalanx of little toe
- **A**: Flexes little toe at metatarsophalangeal joint
- **N**: Lateral plantar nerve



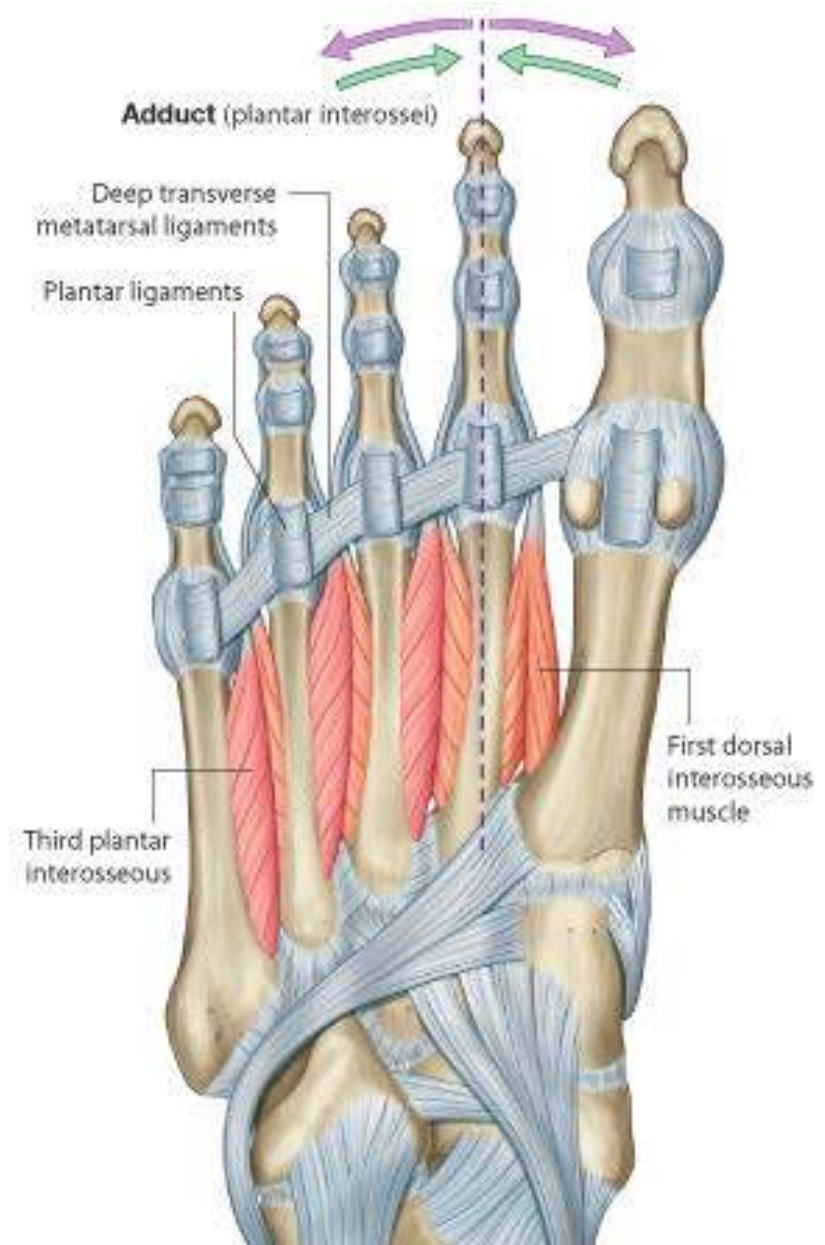
4th Layer:

- Two muscles
 - i. The dorsal interossei
 - ii. The plantar interossei



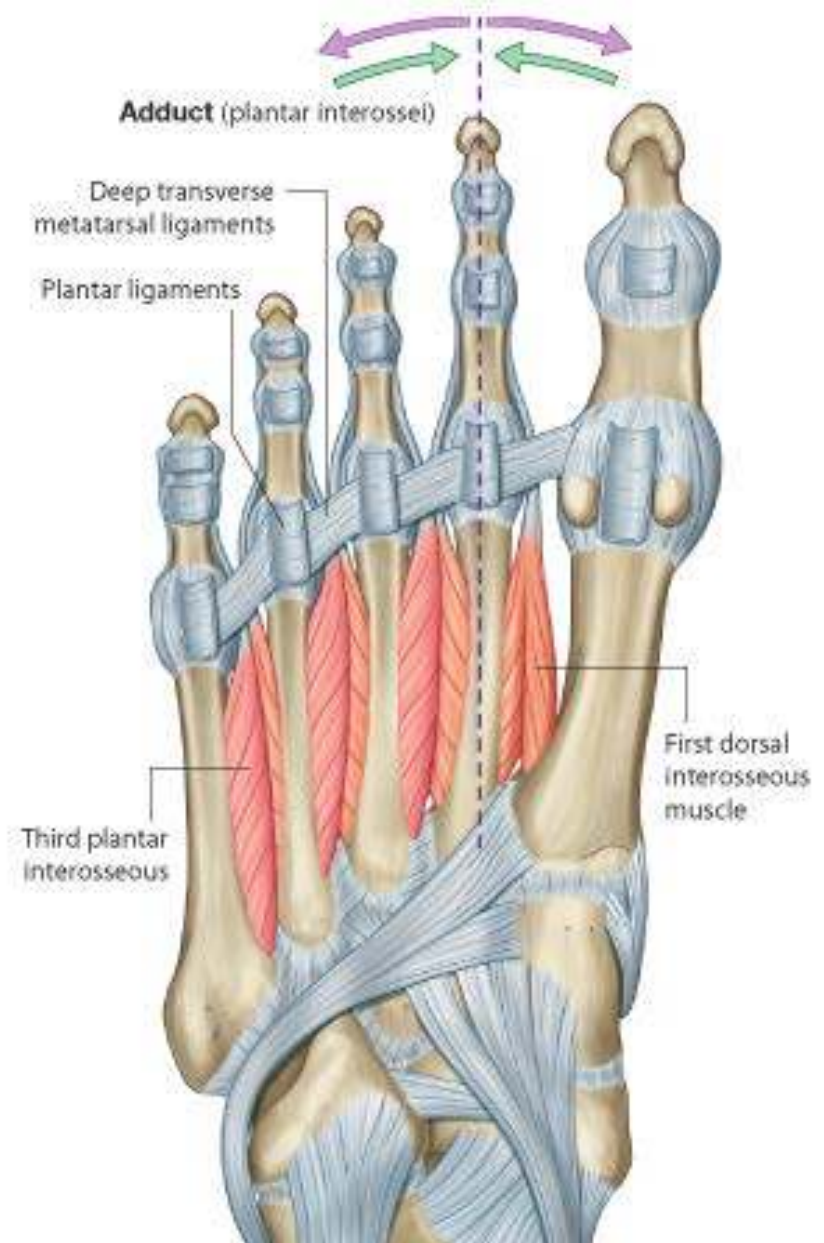
4th Layer: Dorsal interossei

- **O**: Sides of adjacent metatarsals
- **I**: Dorsal expansions and bases of proximal phalanges of toes II to IV
- **A**: Abduction of toes II to IV at metatarsophalangeal joints; resist extension of metatarsophalangeal joints and flexion of interphalangeal joints
- **N**: Lateral plantar nerve.
1st and 2nd dorsal interossei also innervated by deep fibular nerve



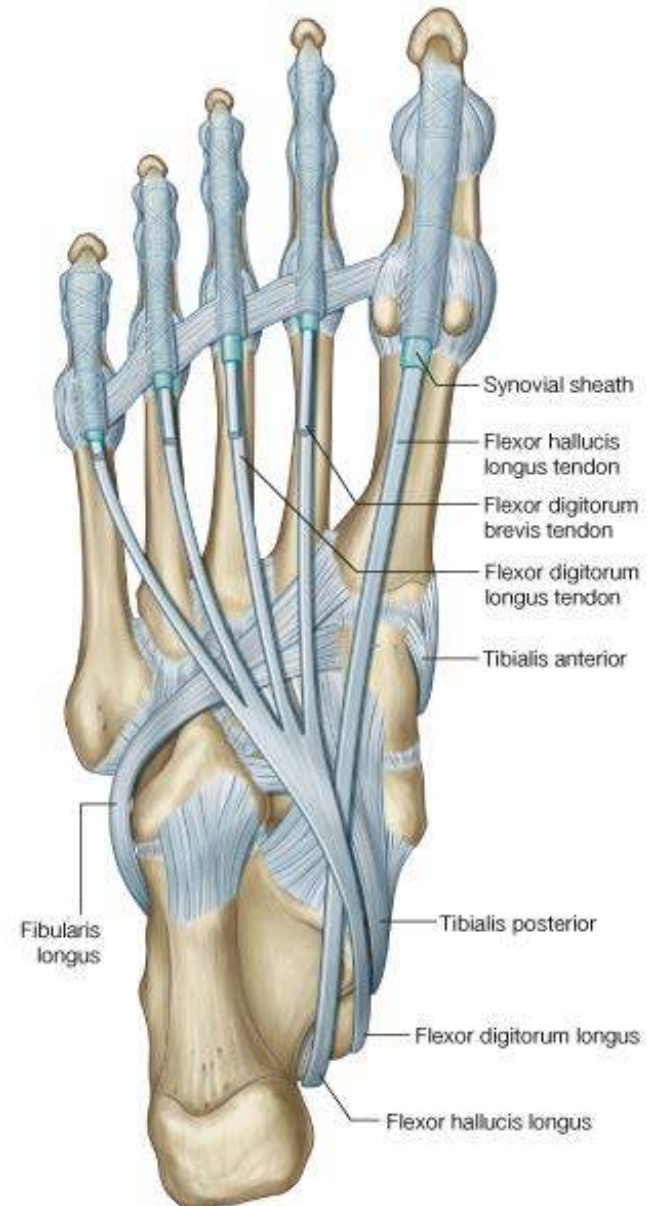
4th Layer: Plantar interossei

- **O**: Medial sides of metatarsals of toes III to V
- **I**: Dorsal expansions and bases of proximal phalanges of toes II to IV
- **A**: Adduction of toes III to V at metatarsophalangeal joints; resist extension of the metatarsophalangeal joints and flexion of the interphalangeal joints
- **N**: Lateral plantar nerve.



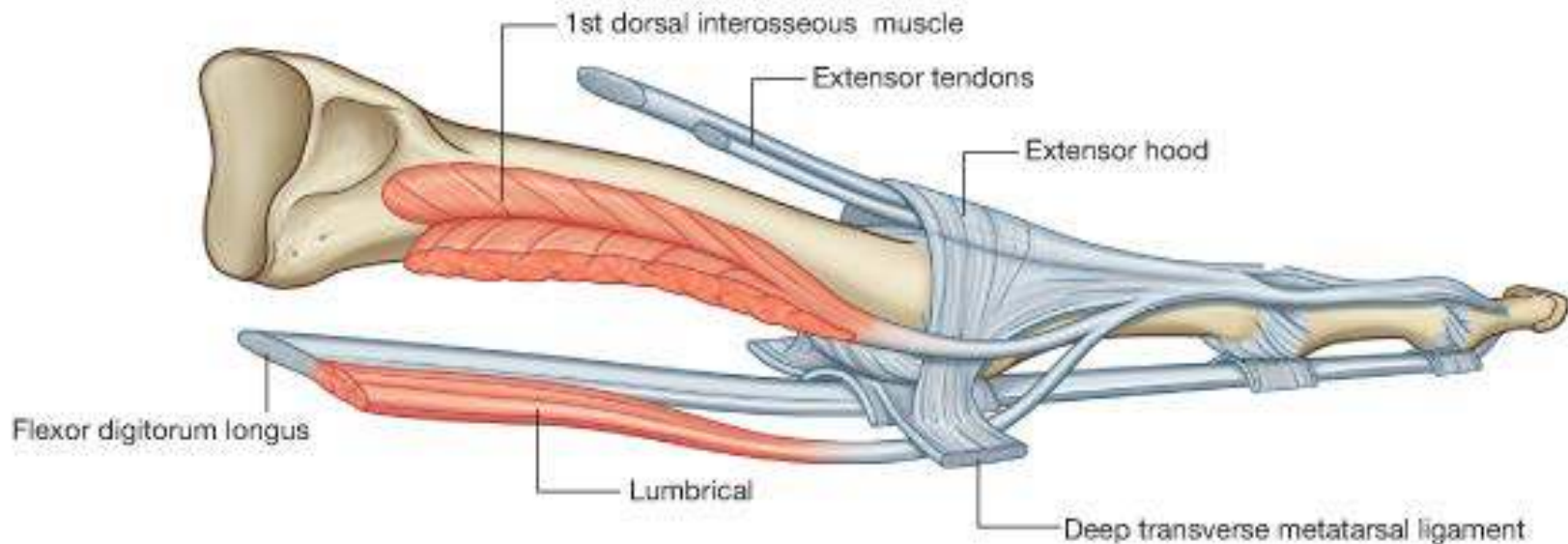
Flexor sheaths

- Formed by fibrous arches and cruciate ligaments
- Begin anterior to the metacarpophalangeal joints
- End at the distal phalanges
- Attached to the margins of the phalanges
- Contains:
 - Toes: Tendons of flexor digitorum longus, flexor digitorum brevis muscles.
 - Big Toe: Tendon of flexor hallucis longus muscle
- Prevents bowstringing of the tendons when toes are flexed



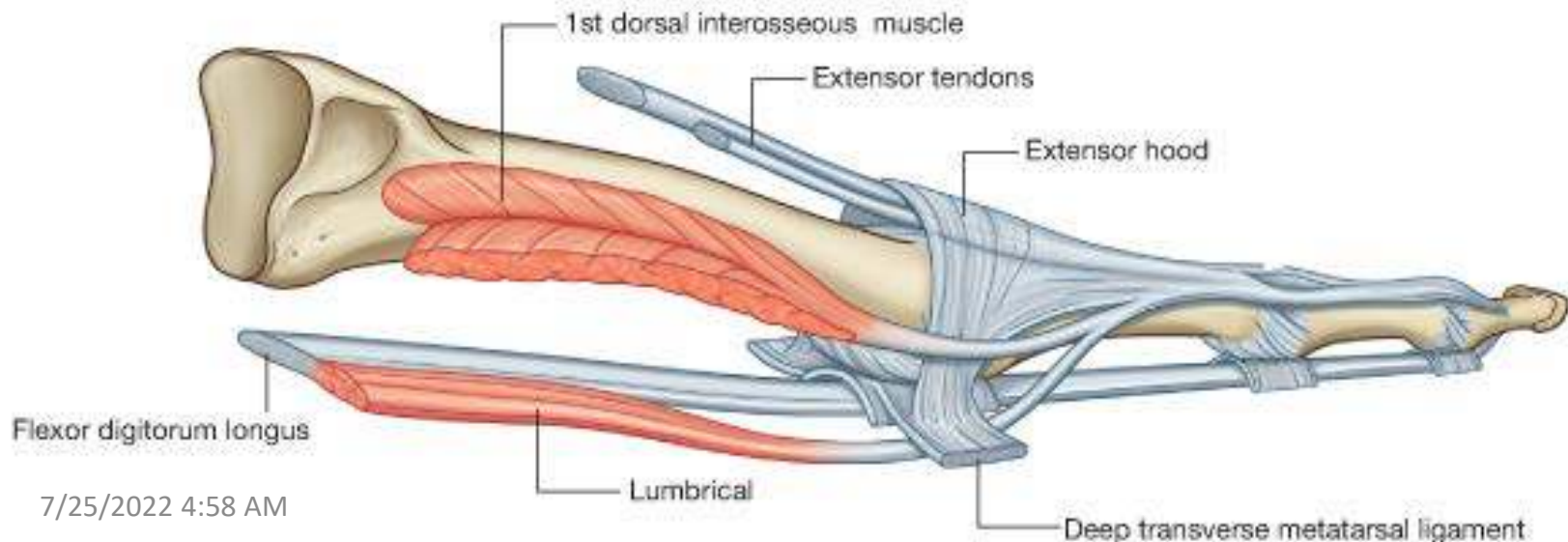
Extensor hood

- Extensor digitorum longus, extensor digitorum brevis, and extensor hallucis longus pass into the dorsal aspect of the digits and expand over the proximal phalanges to form complex dorsal digital expansions
- Intrinsic muscles of the foot insert into the free margin of the hood on each side



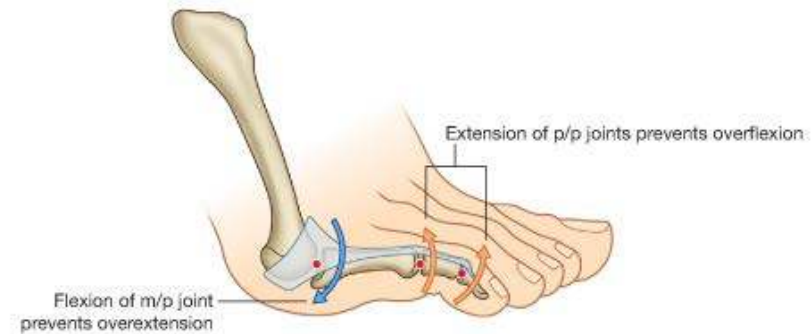
Extensor hood II

- Triangular in shape
- Apex attached to distal phalange
- Central region attached to the middle (toes II to V) or proximal (toe I) phalanx
- Corners of the base wrapped around the sides of the metatarsophalangeal joint and attaches to the deep transverse metatarsal ligaments on either side



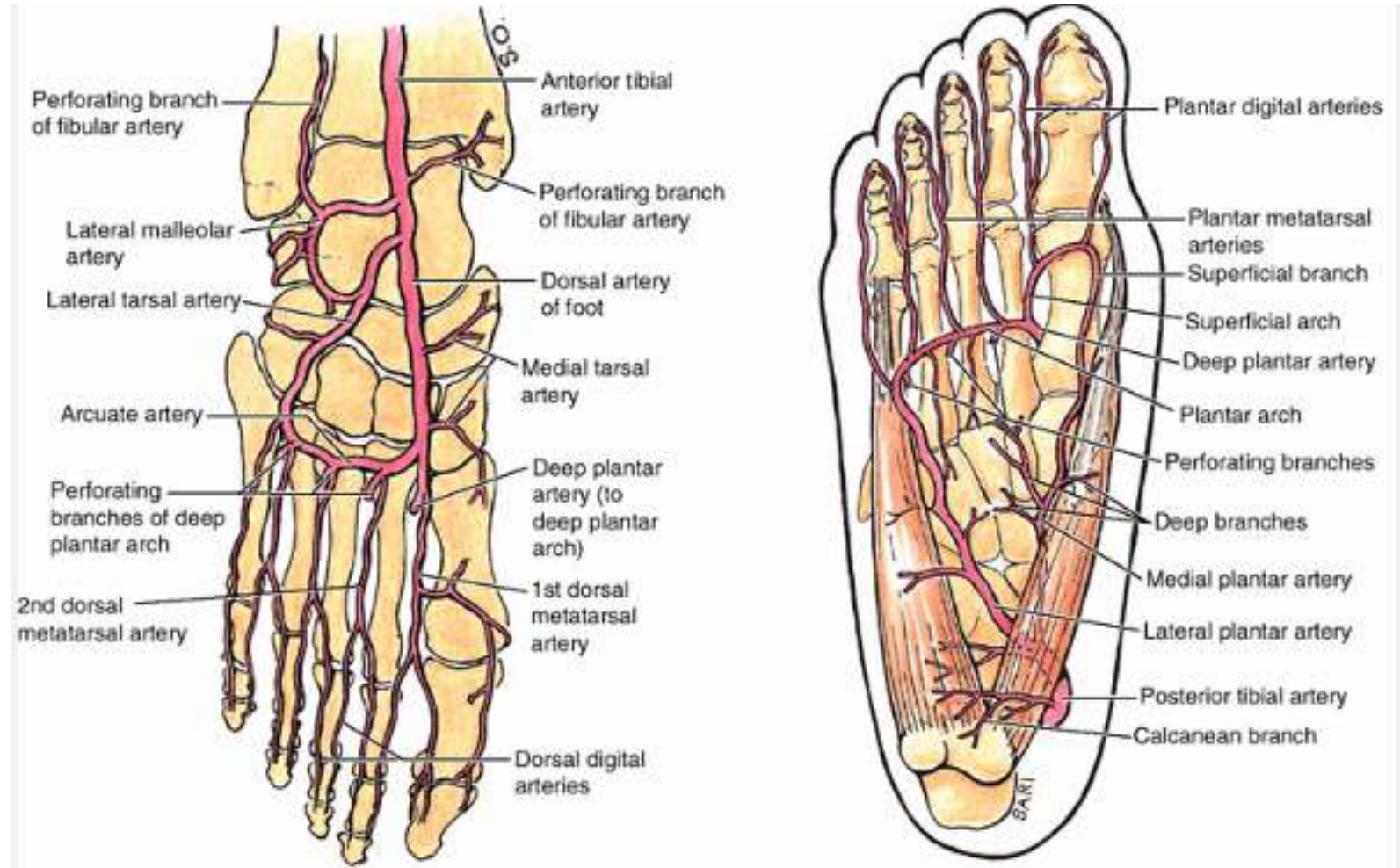
Extensor hood contd

- **Action:** The intrinsic muscles through the hood does the following:
 - i. Flexion of the metatarsophalangeal joints while at the same time extending the interphalangeal joints
 - ii. Prevents overextension of the metatarsophalangeal joints and flexion of the interphalangeal joints during toe off phase of the gait



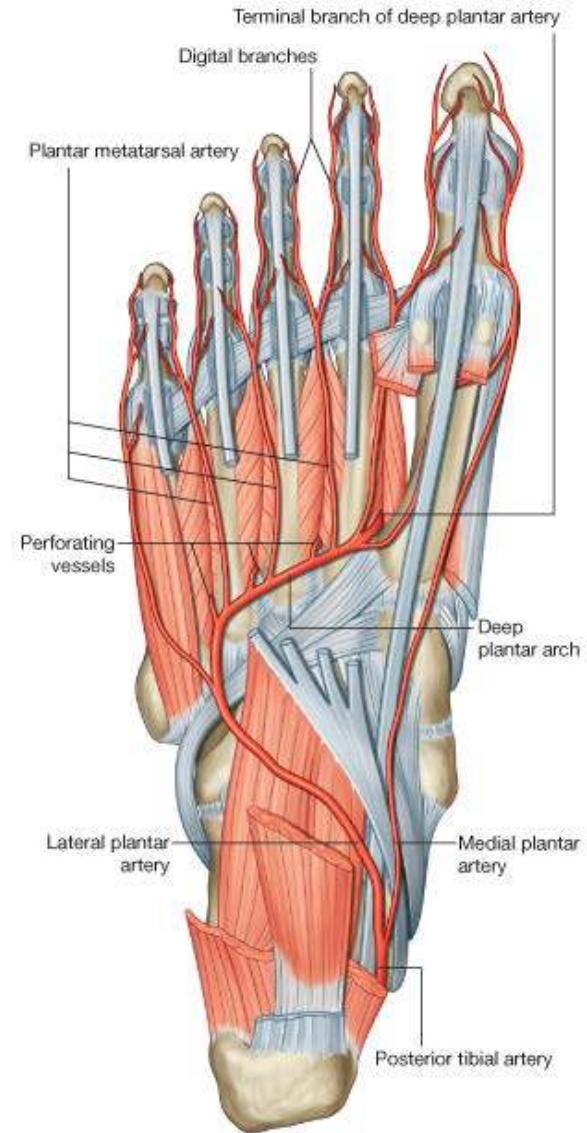
Arteries

Blood supply to the foot is by branches of the posterior tibial and dorsalis pedis



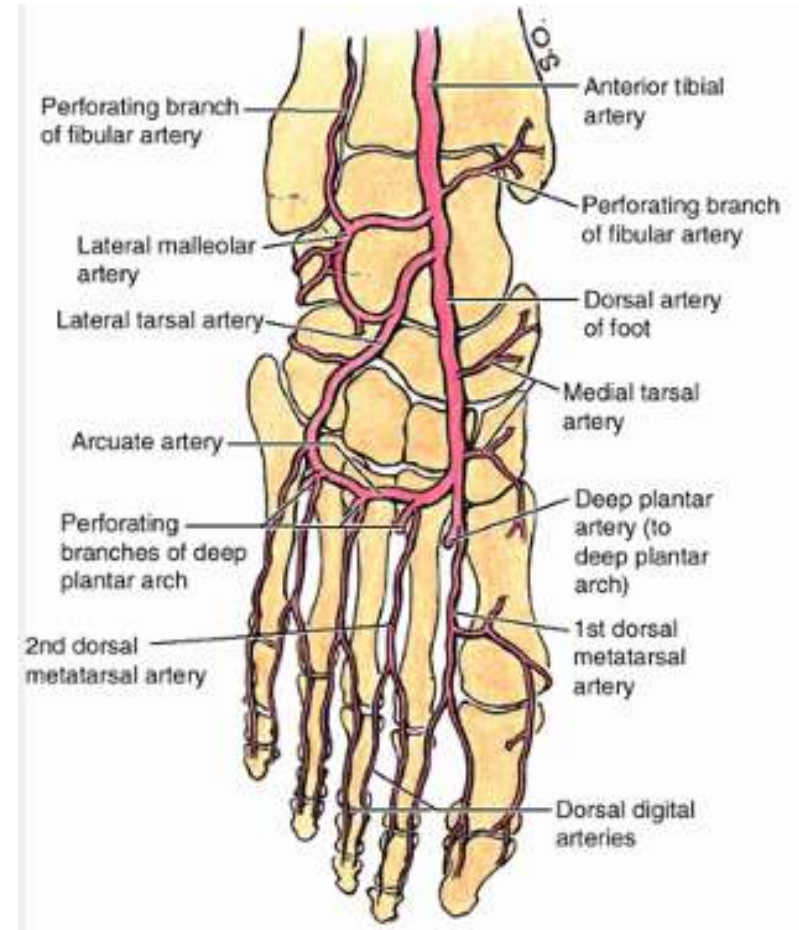
Arteries: Plantar

- Plantar arteries are the medial and lateral plantar arteries which are terminal branches of the posterior tibia artery
- The lateral plantar artery forms the deep plantar arch which terminally joins with the deep plantar branch of the dorsalis pedis artery



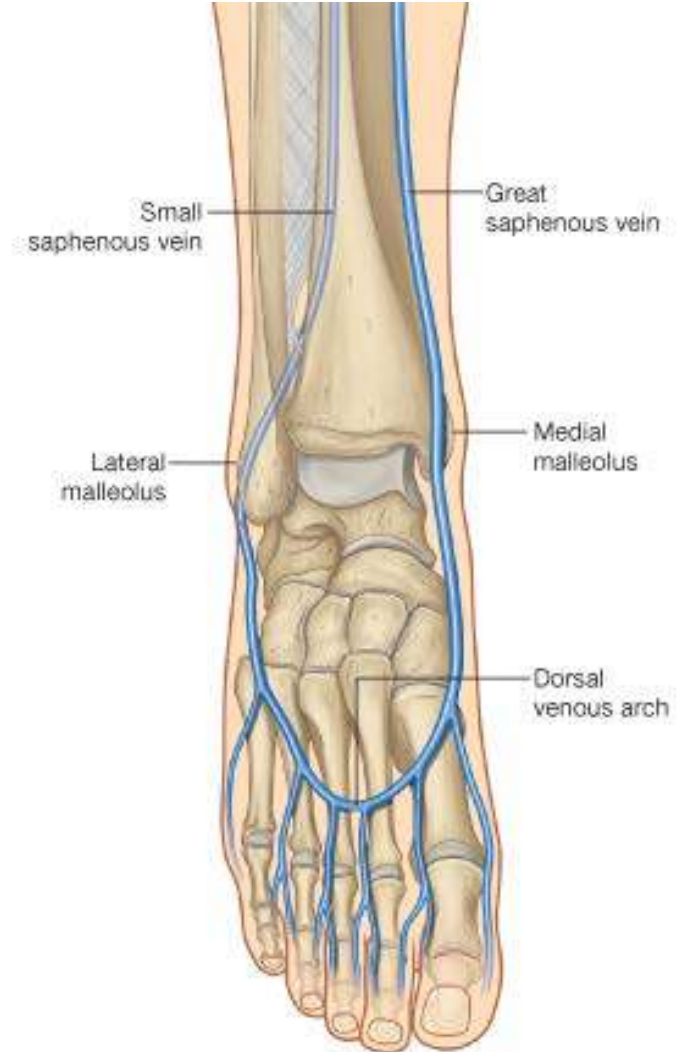
Arteries: Dorsal

- Dorsalis Pedis artery
- Continuation of the anterior tibial artery
- Have a lateral tarsal branch and an arcuate branch which together forms the major supply to the dorsum



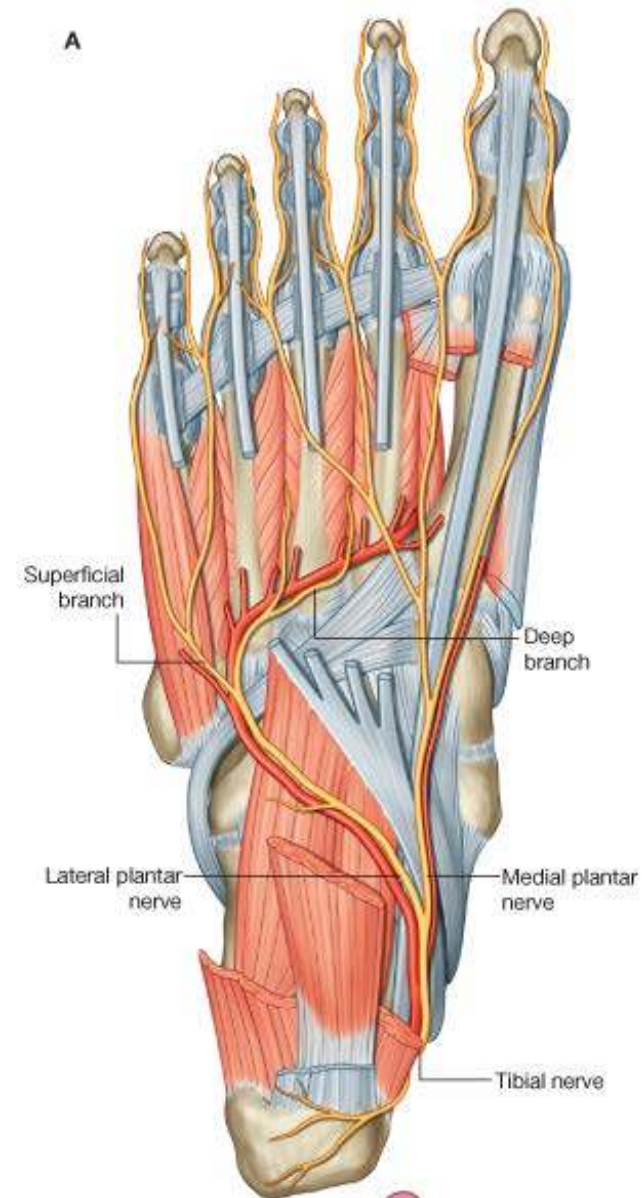
The Veins

- **Great saphenous vein** originates from the medial side of the arch and passes anterior to the medial malleolus and onto the medial side of the leg;
- **Small saphenous vein** originates from the lateral side of the arch and passes posterior to the lateral malleolus and onto the back of the leg.



The Nerves

- Tibia Nerve divides into
- Lateral and Medial plantar nerves
- Each accompany the eponymous artery
- (Note that while the lateral plantar artery is larger than the medial plantar artery, the reverse is the case with the nerves)



Arterial Supply of the lower limb: An Overview

- The **aorta** divides into the **common iliac arteries** in the abdomen which then divides in the pelvic region into the **internal iliac artery** and the **external iliac artery**. The internal iliac artery supplies the pelvis.
- The external iliac artery passes beneath the inguinal ligament in the groin to become the **femoral artery**. The femoral artery is the artery of the lower limb.
- The femoral artery gives off a large branch in the thigh called the **profunda femoris artery**. This is the artery of the thigh.
- After the profunda branch is given off, the femoral artery continues on the medial/anterior aspect of the thigh as the **superficial femoral artery**.
- As the superficial femoral artery passes around to the back of the knee it becomes the **popliteal artery**.
- The popliteal artery is relatively short and divides variably just below the knee into three arteries, the **posterior tibial artery**, the **anterior tibial artery** and the **peroneal artery**.
- The posterior tibial artery is the artery of the posterior compartment of the leg. It passes behind the medial malleolus of the ankle, where it forms one of the two important foot pulses. It divides in the foot to form the **medial and lateral plantar arteries**.
- The anterior tibial artery is the artery of the anterior compartment of the leg. It passes on the dorsum of the foot as the **dorsalis pedis artery**, and this is the second of the important foot pulses. The artery divides into a number of arteries to supply the foot.
- The peroneal artery is the artery of the lateral compartment of the leg. It is much smaller than the anterior and posterior tibial arteries and joins inconstantly into an anastomosis distally with the anterior tibial artery in the distal leg.
- The **plantar arch** in the foot is formed from the arteries derived from the anterior and posterior tibial arteries, to supply the foot and toes.

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