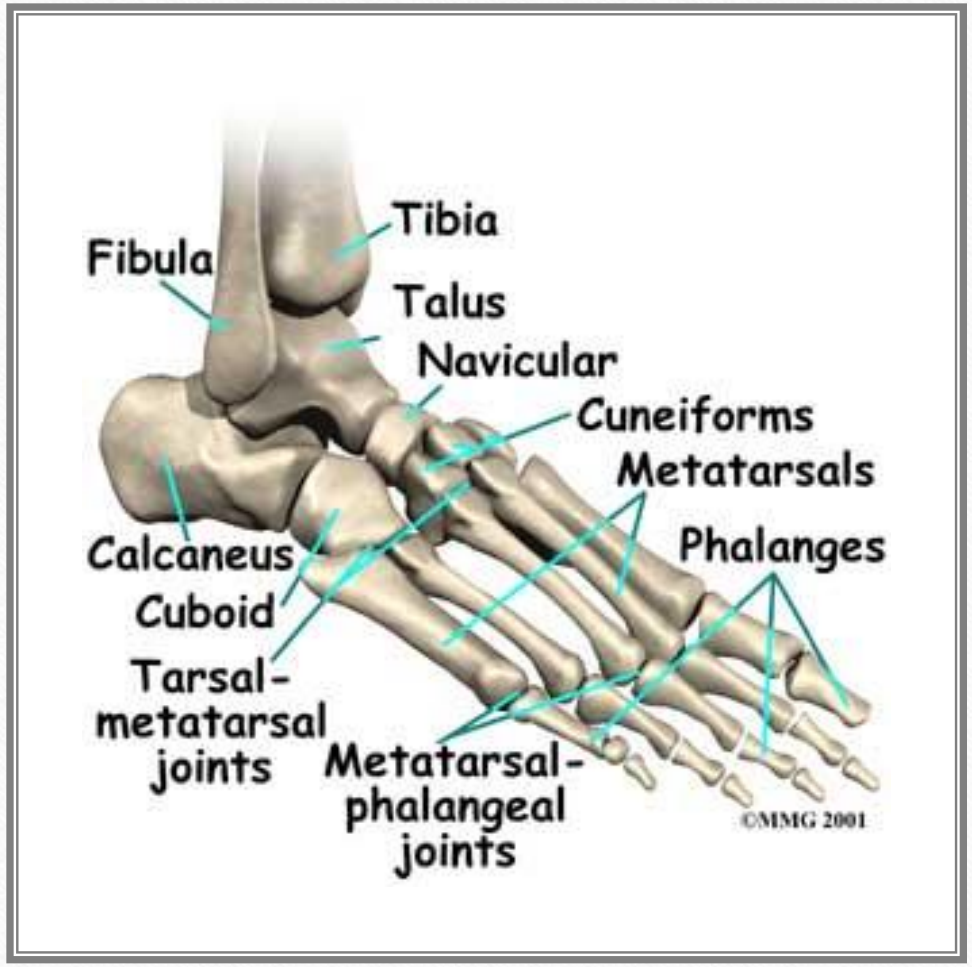
Foot



Anatomy of the Foot

- Tarsal Bones
  - Calcaneus
  - Cuboid
  - Navicular
  - 3 Cuneiforms
  - 5 metatarsals
  - 14 phalanges (proximal, middle, distal)
    - Exception

Mnemonic for Learning Tarsal Bones:

Tiger Cubs Need M I L C

Talus

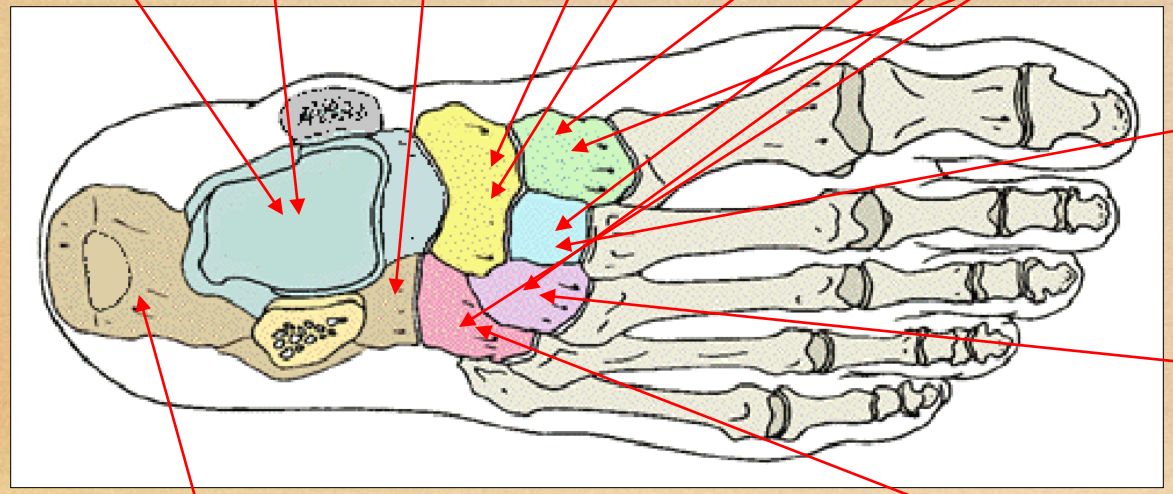
Navicular

A boat
It sails on the Cs

Medial cuneiform (1)

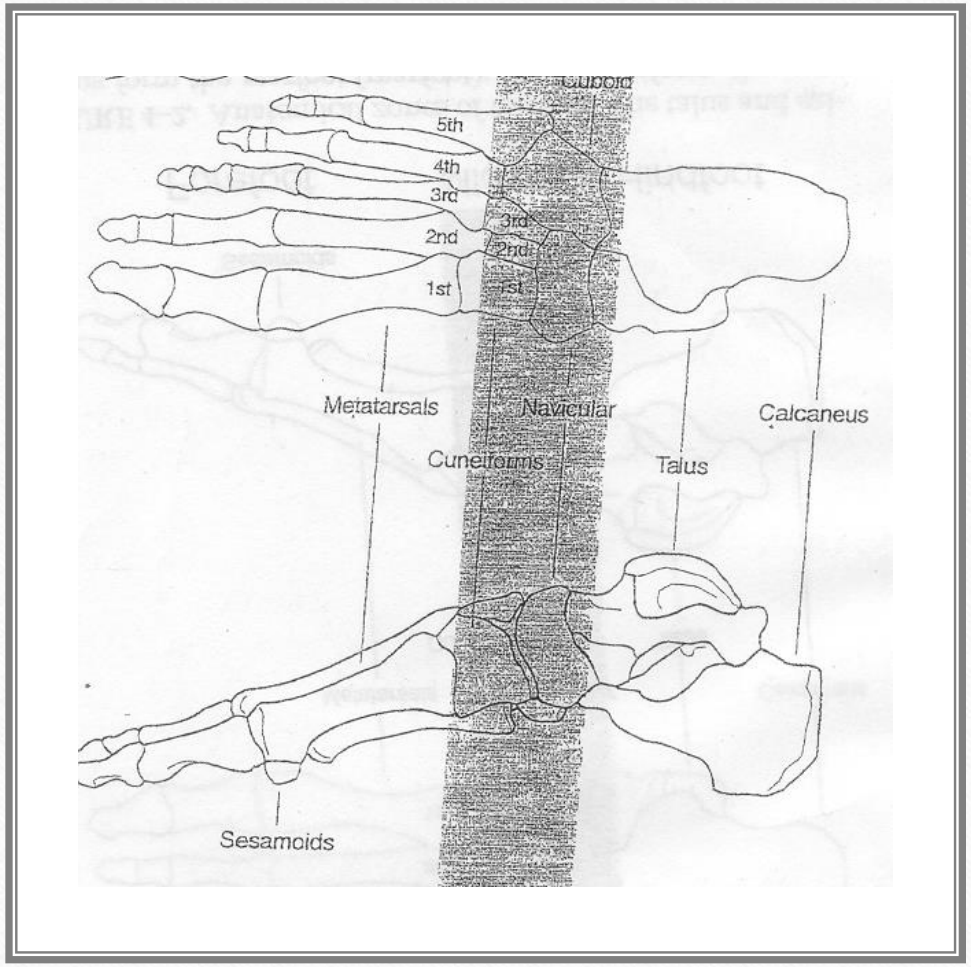
Intermediate cuneiform (2)

Lateral cuneiform (3)



Calcaneus

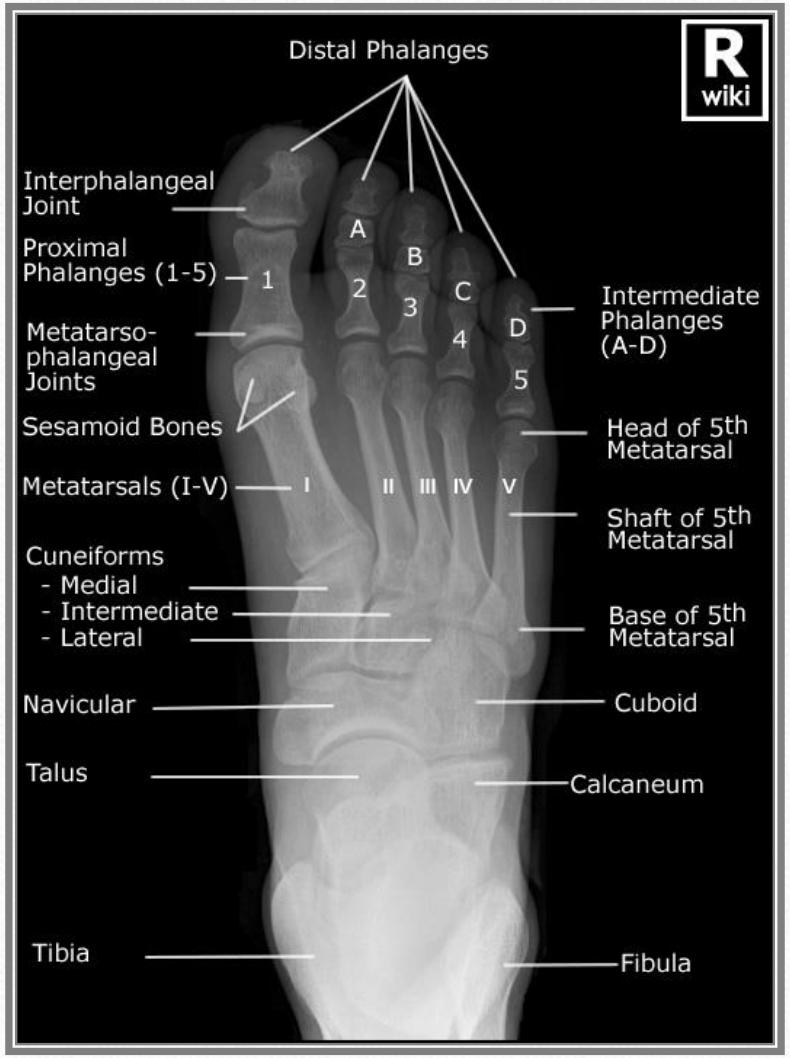
Cuboid



Division of the Foot

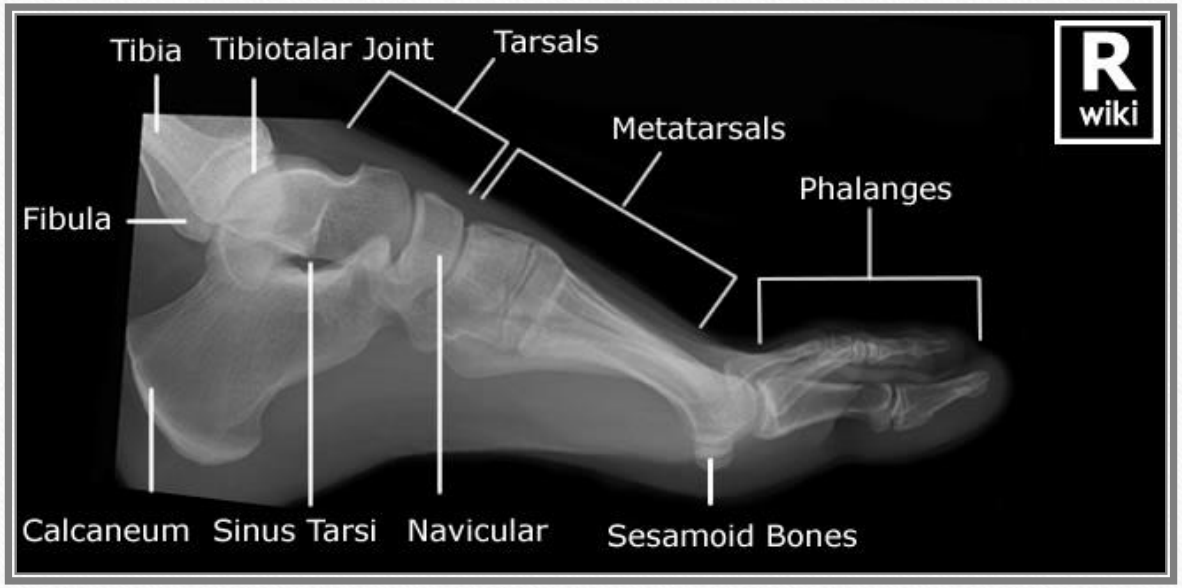
- Rearfoot
- Midfoot
- Forefoot

Dorsal Plantar View

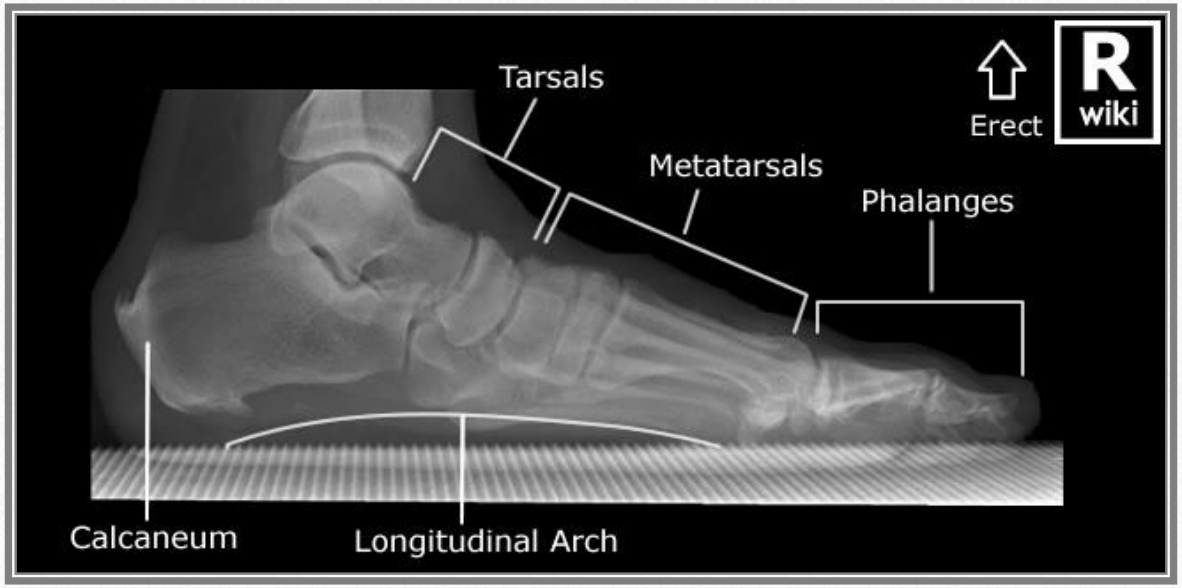


Oblique View

Lateral View

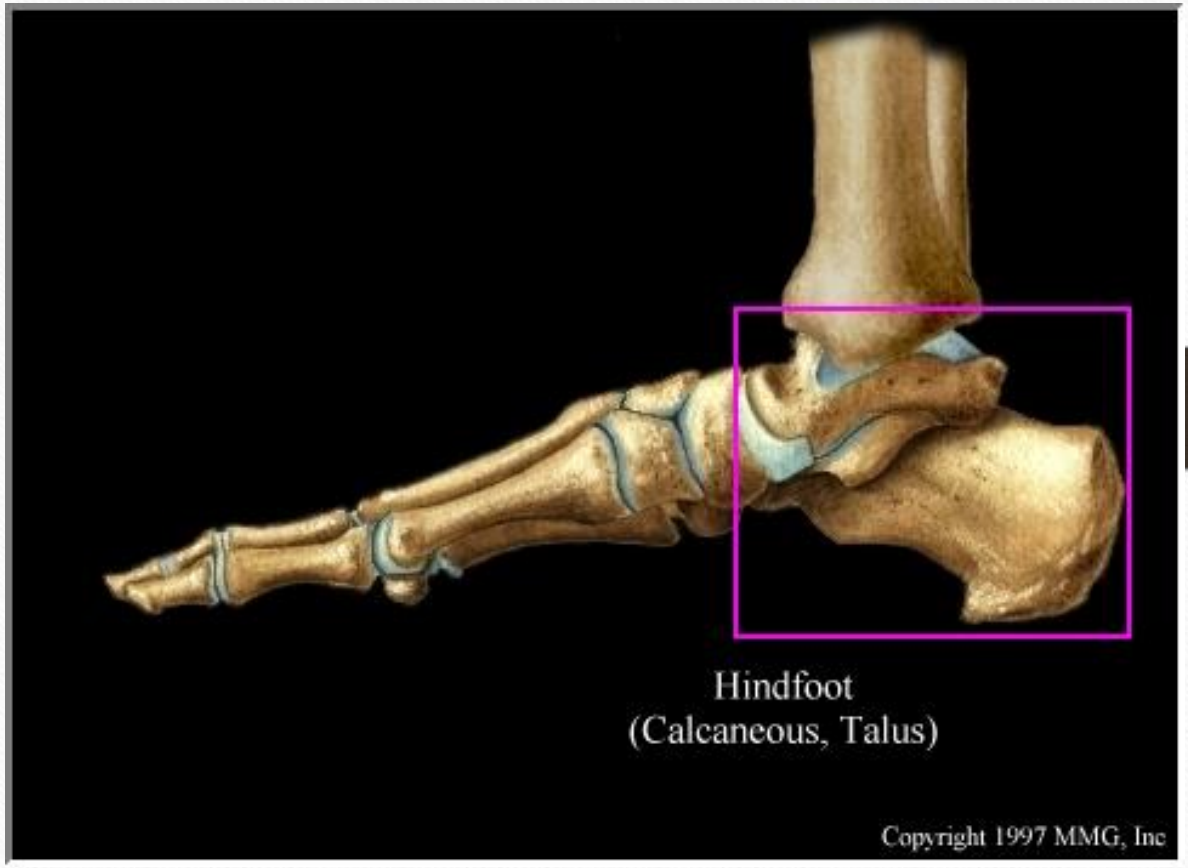


Lateral Weight Bearing View

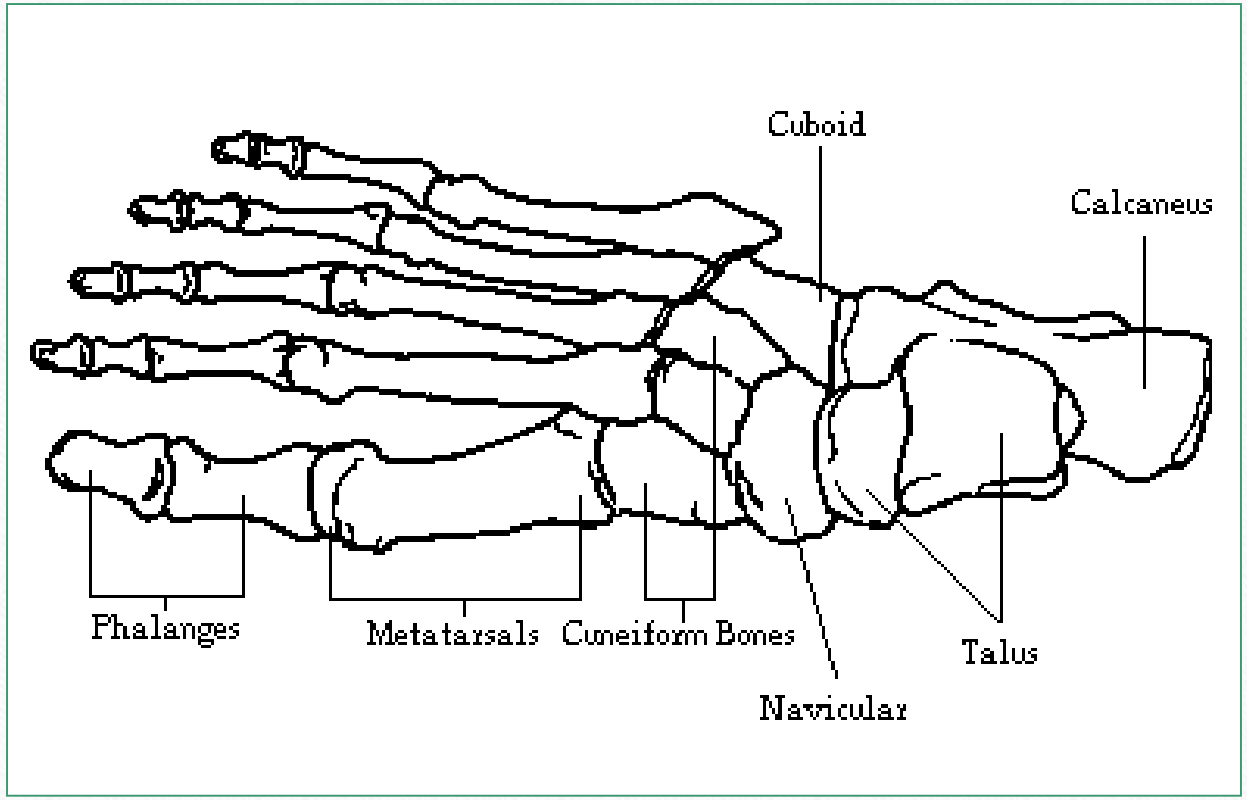


Hindfoot (Rearfoot)

- Subtalor Joint
  - Talus and calcaneus articulation
    - Calcaneus
    - Inferior Talus



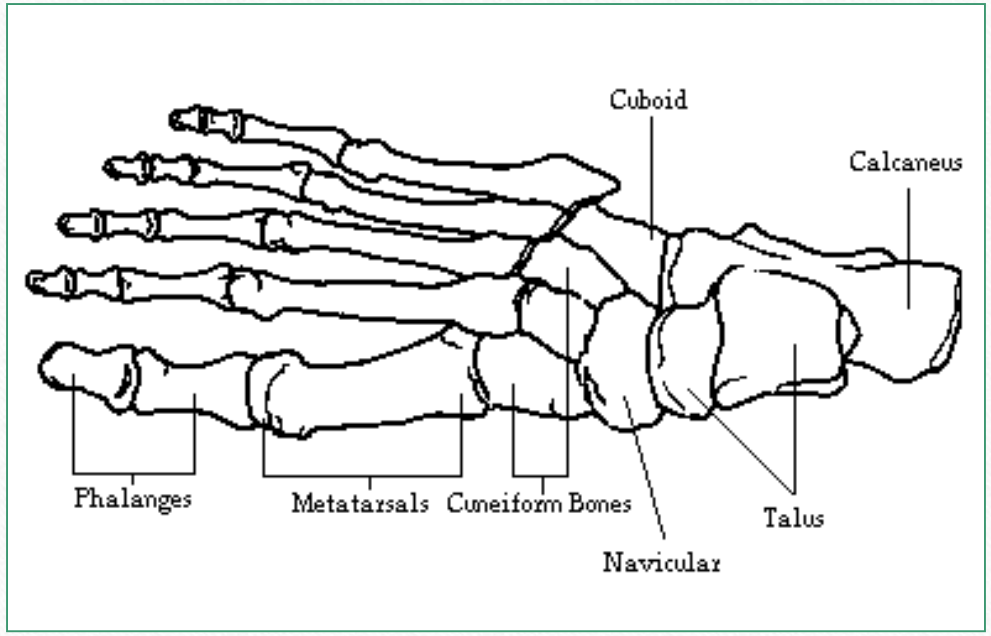
Midfoot

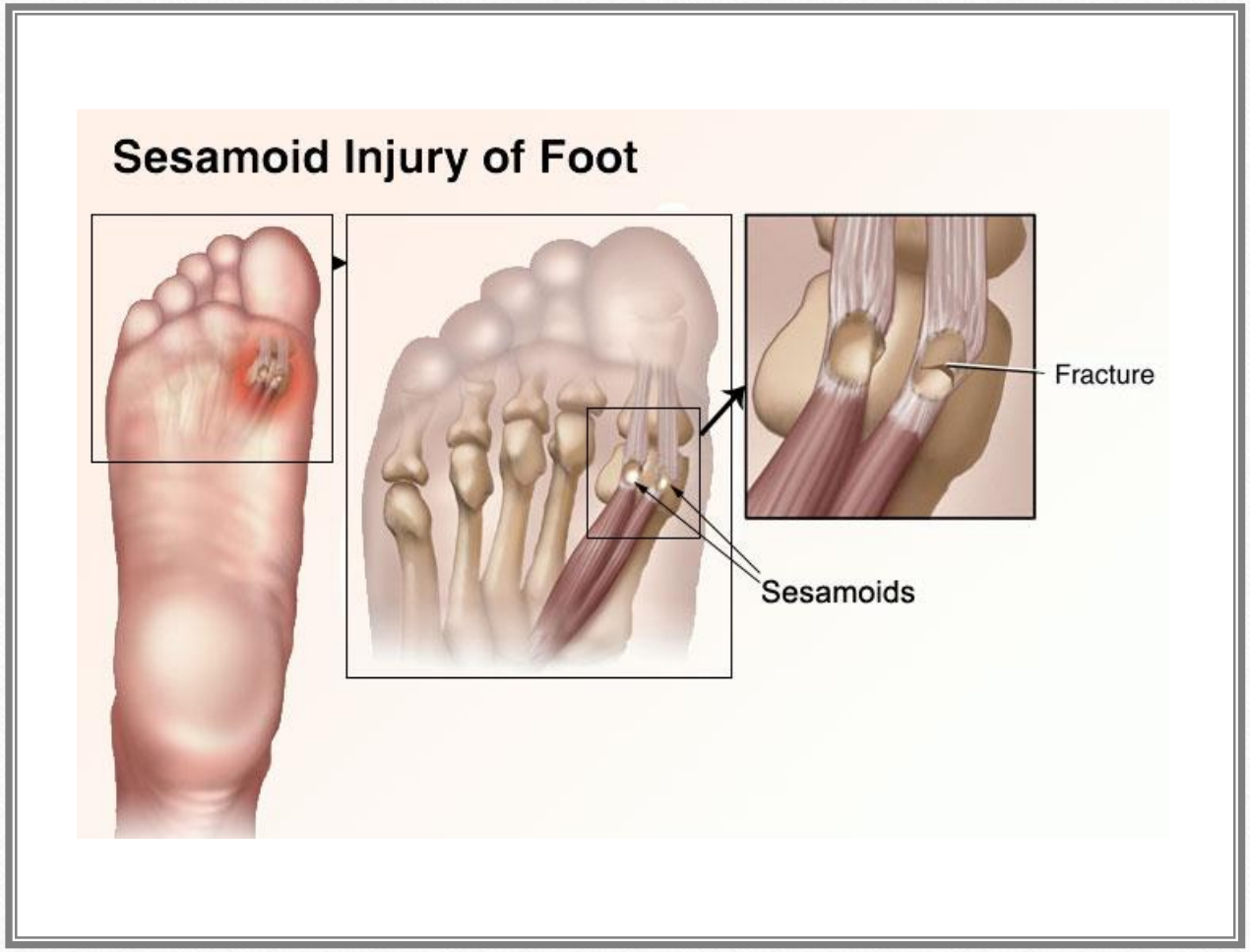


- Composed of
  - Navicular
  - 3 cuneiforms
  - cuboid

Forefoot

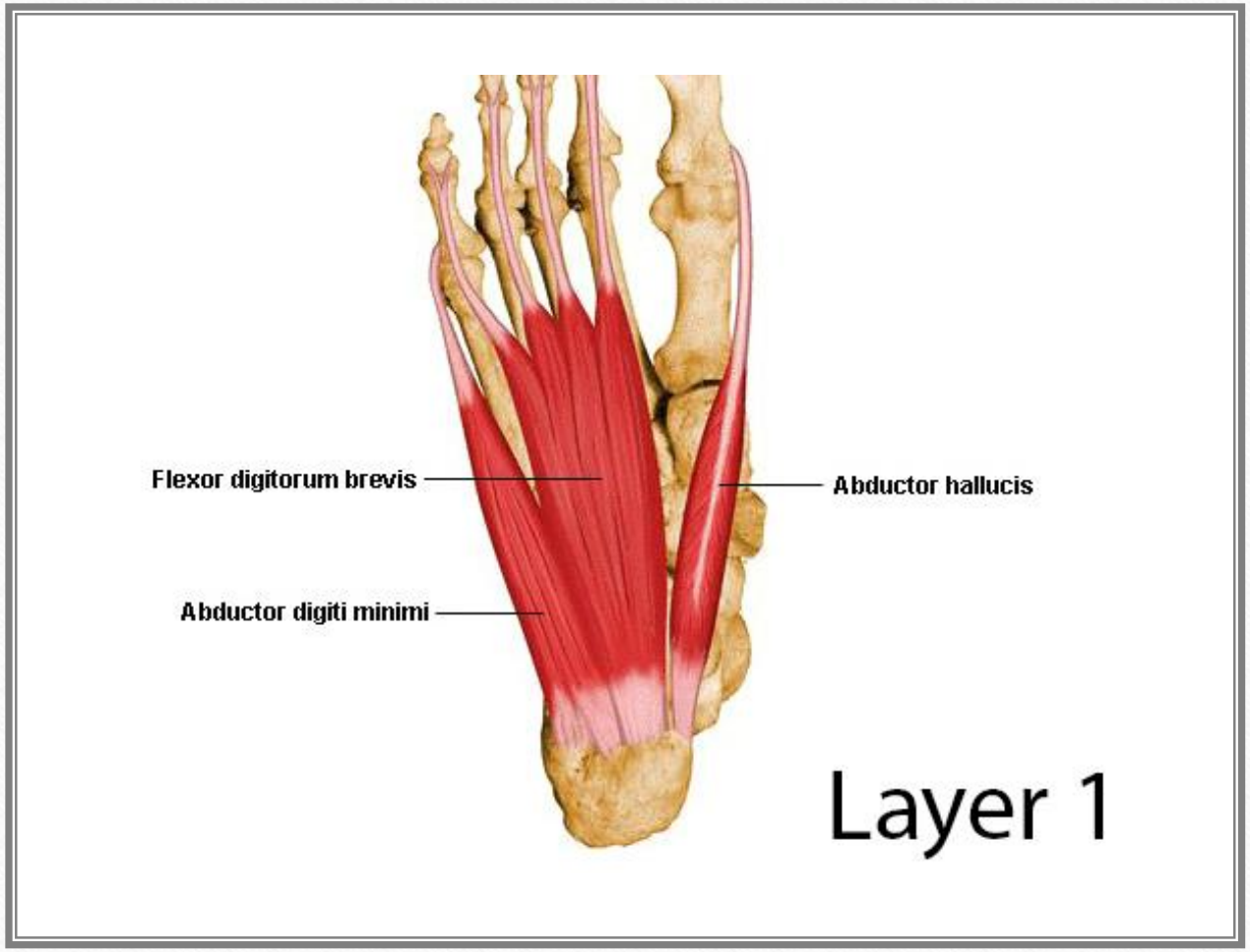
- 5 MT's
  - Proximally 1-3 articulate with cuneiforms
  - Proximally 4-5 articulate with cuboid
  - Bases articulate with:
- Phalanges





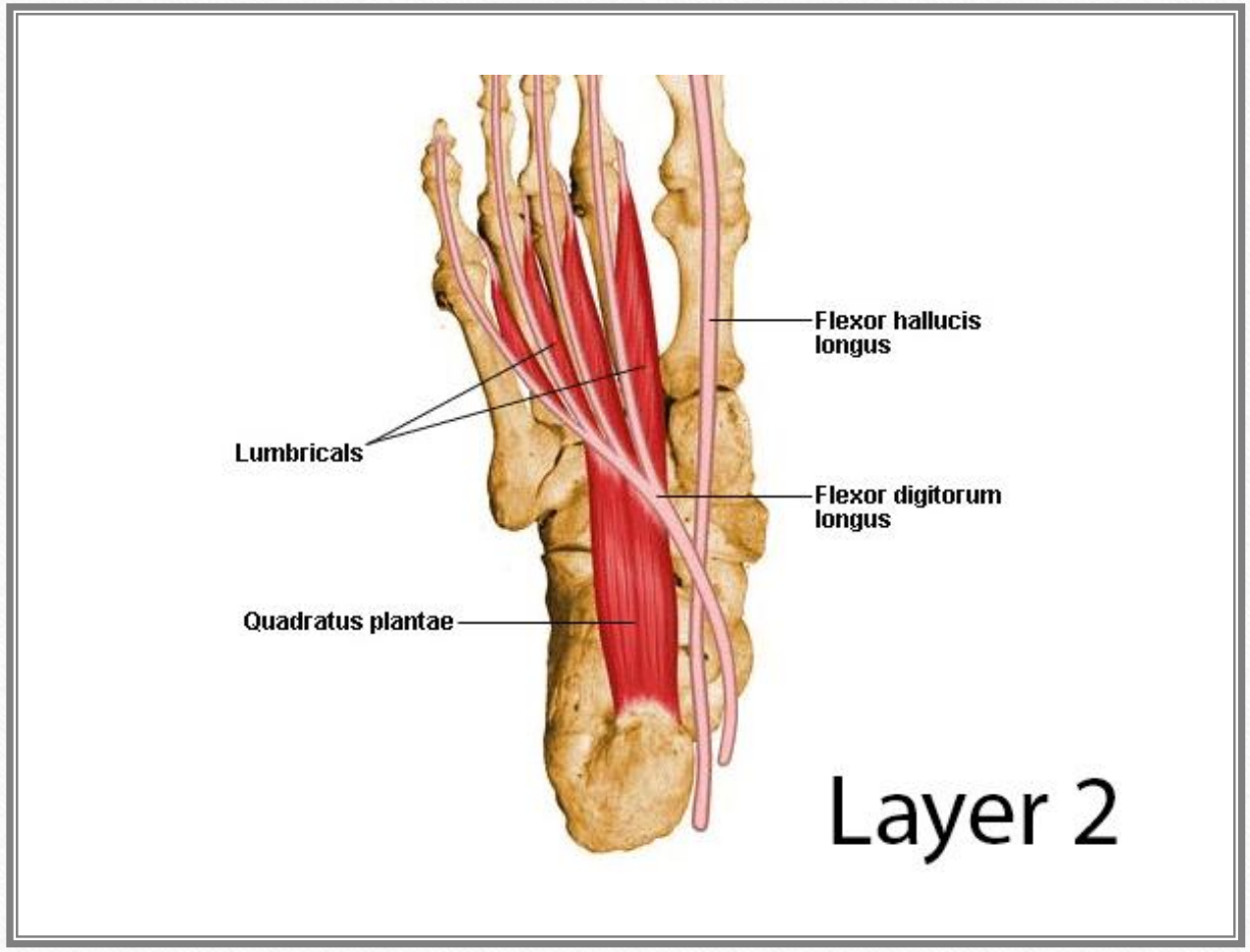
Sesamoid Injury of Foot

- Pain when you move your big toe, especially if you lift up the big toe
- Tenderness to touch on the ball of your foot
- Pain when you stand, walk, run, or jump
- Swelling of your foot



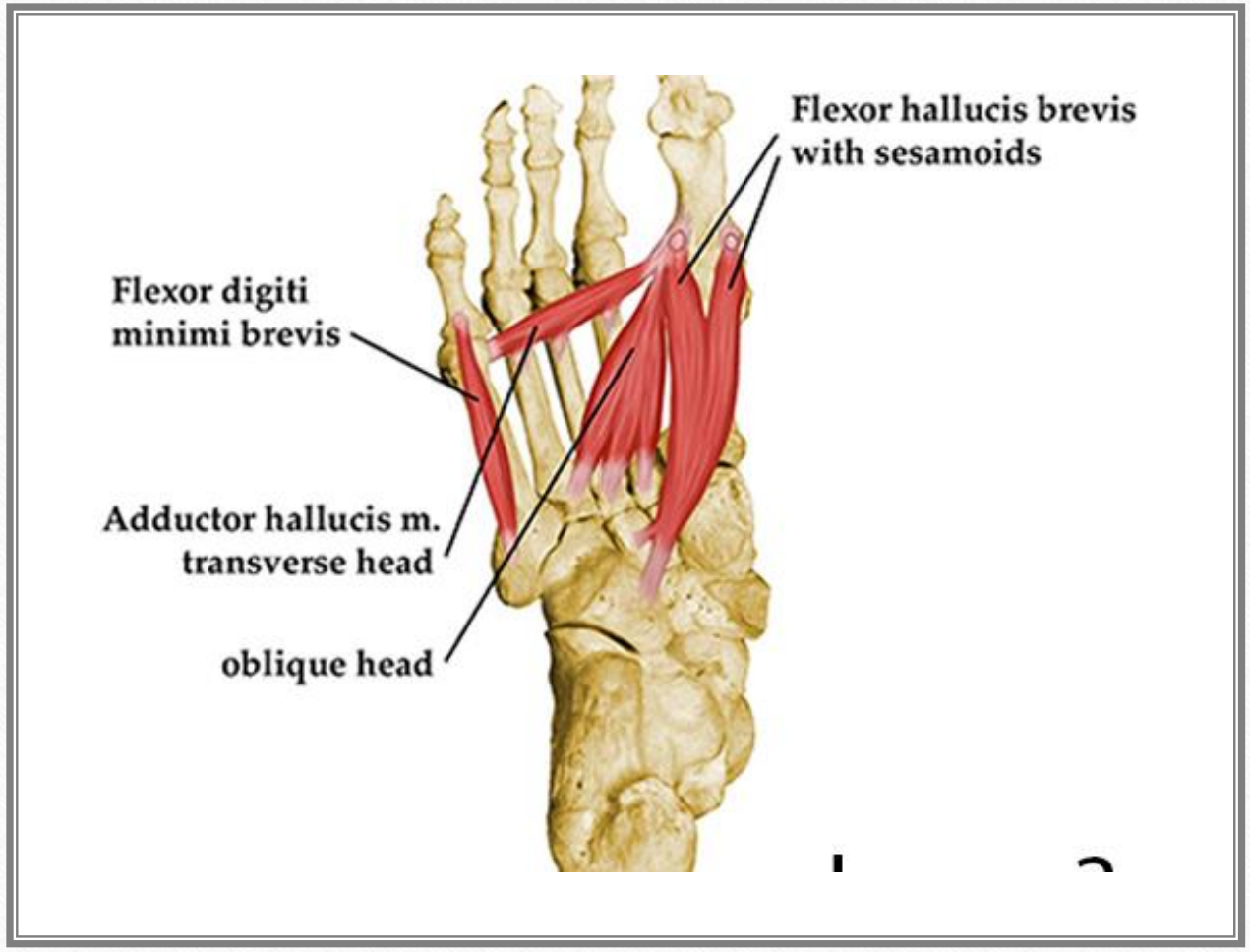
First Plantar Layer

- Most superficial of all the layers
- Muscles
  - abductor hallucis topic
  - flexor digitorum brevis (FDB) topic
  - abductor digiti minimi topic



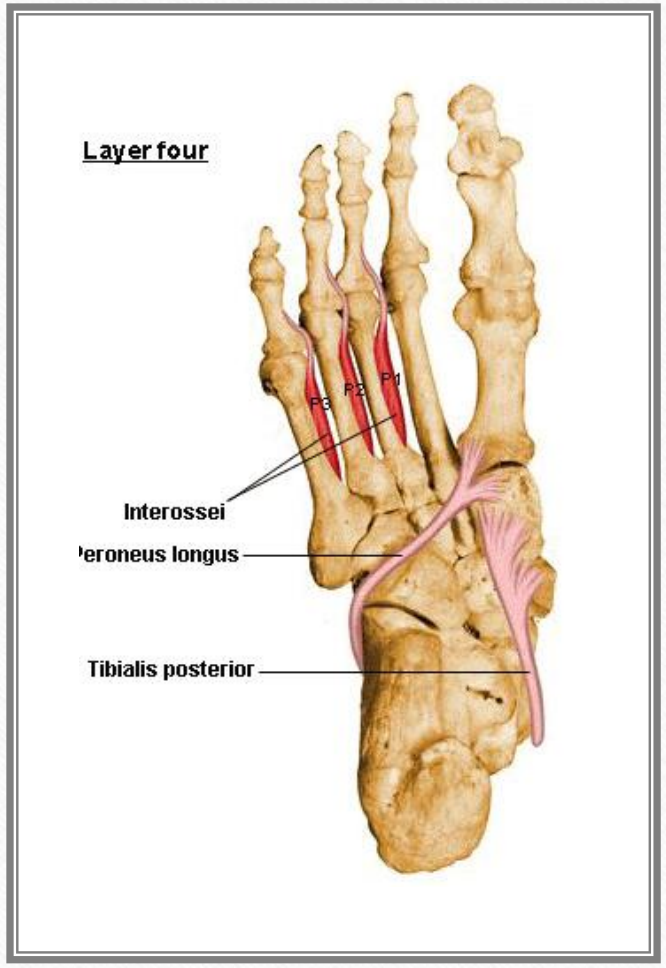
Second Plantar Layer

- Muscles
  - quadratus plantae topic
  - lumbrical muscles topic
- Tendons
  - flexor digitorum longus (FDL) topic
  - flexor hallucis longus (FHL) topic
- Neurovascular structures
  - medial and lateral plantar arteries



Third Plantar Layer

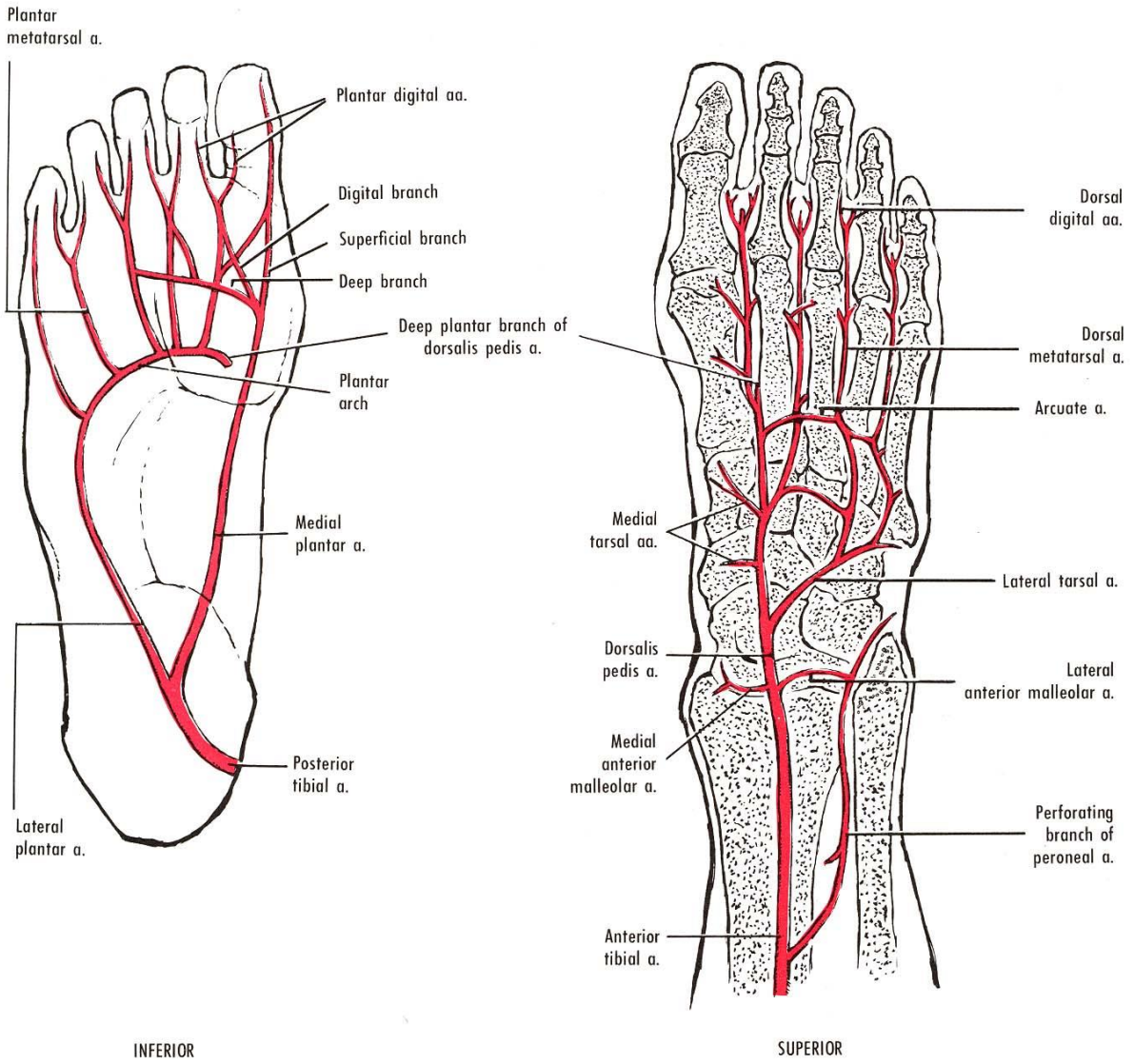
- Muscles
  - flexor hallucis brevis topic
  - oblique and transverse heads of the adductor hallucis topic
  - flexor digiti minimi brevis topic

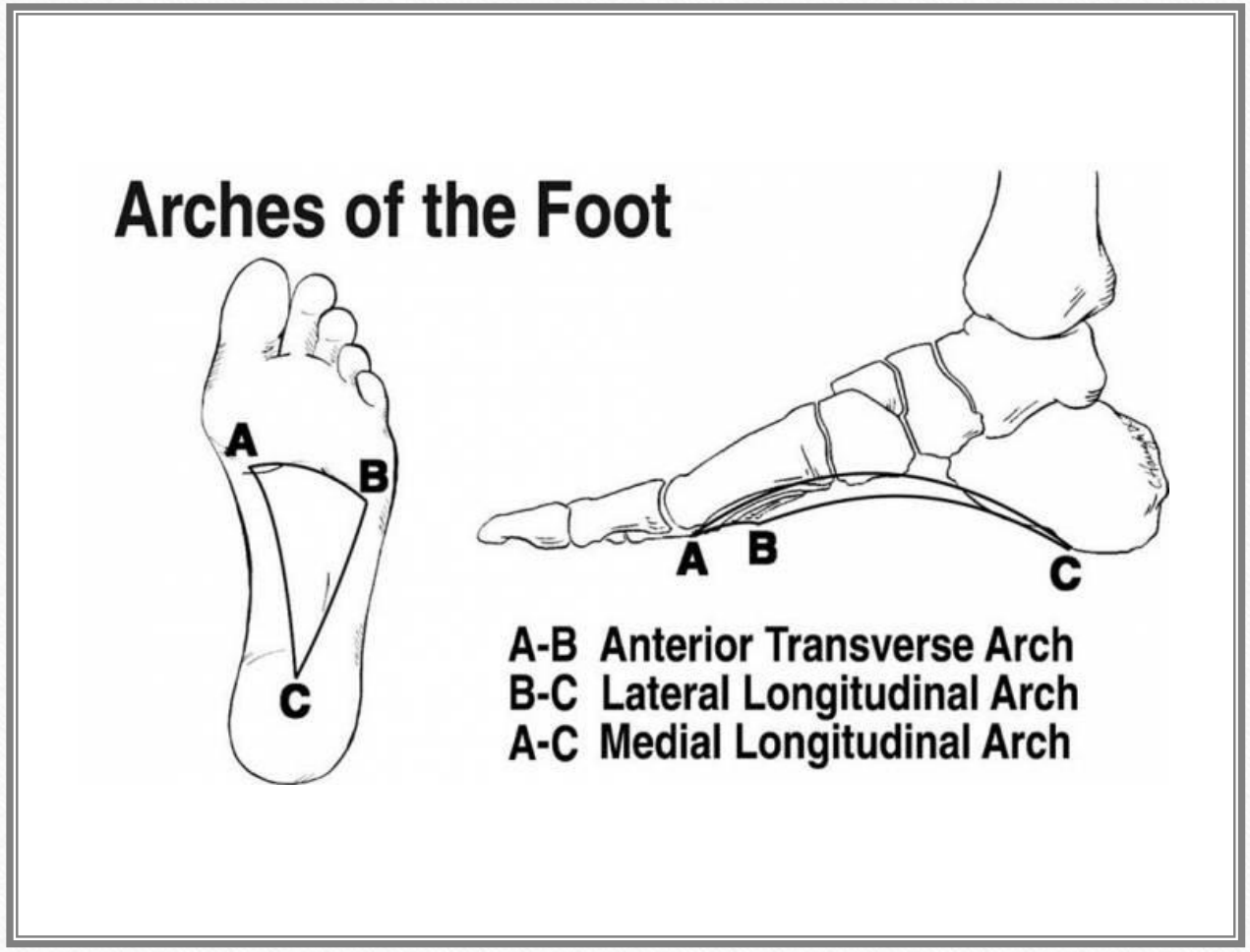


Fourth Plantar Layer

- Deepest layer
- Muscles
  - dorsal interosseous topic
  - plantar interosseus topic
- Tendons
  - peroneus longus topic
  - tibialis posterior topic
    - both tendons travel to their insertion point via fibro-osseus tunnels

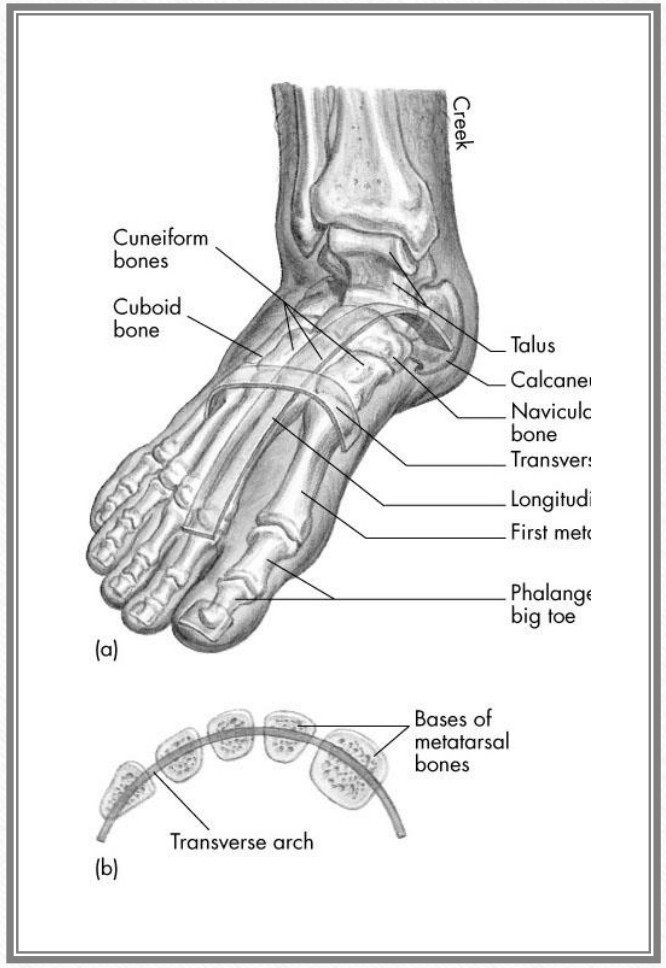
Arteries of the Sole





Arches of the Foot

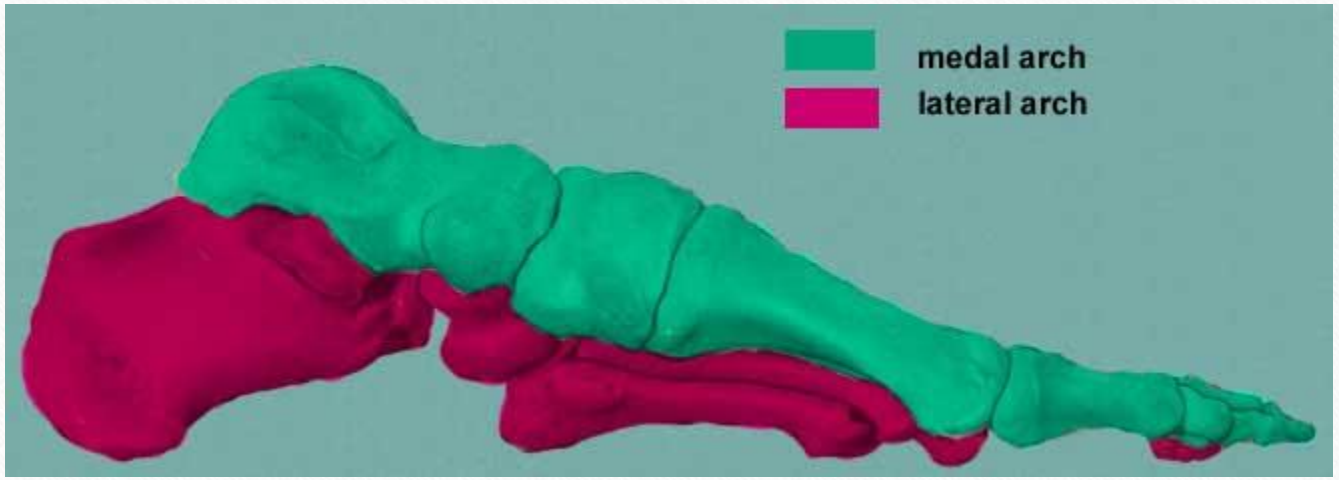
- Foot arches assist the foot in supporting the body weight; in absorbing shock of weight bearing; and in providing a space on the plantar aspect of the foot for the blood vessels, nerves, and muscles.



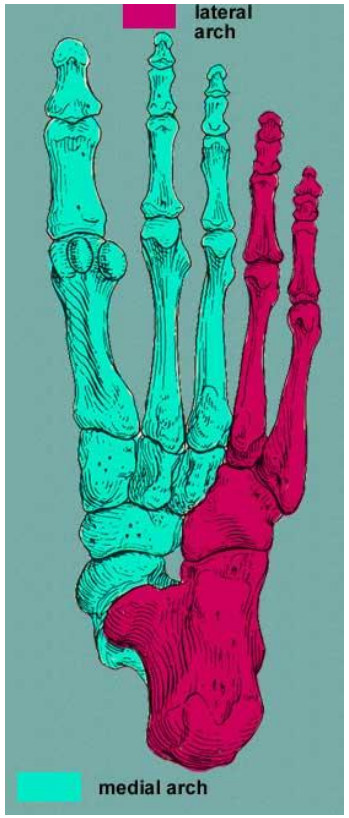
Arches

- Ligaments in foot & ankle maintain arches
- Two longitudinal arches
  - Medial longitudinal arch - extends from calcaneus bone to talus, navicular, 3 cuneiforms, and proximal ends of 3 medial metatarsals
  - Lateral longitudinal arch - extends from calcaneus to cuboid and proximal ends of 4th & 5th metatarsals
- Transverse arch
  - extends across foot from 1st metatarsal to the 5th metatarsal

Arches of the Foot



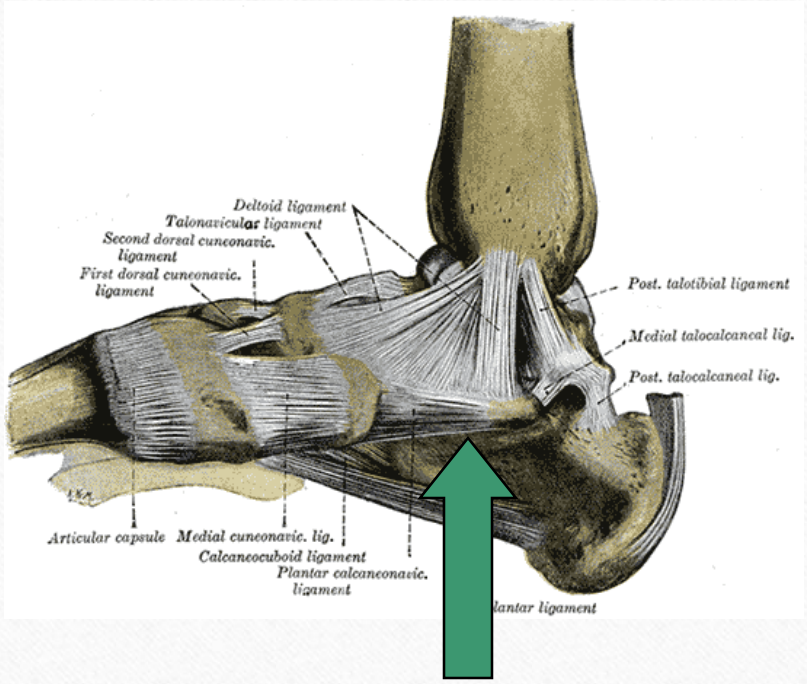
- Medial Longitudinal Arch
  - Calcaneus
  - Talus
  - Navicular
  - 1-3 cuneiforms
  - 1-3 MT's



Arch of Feet

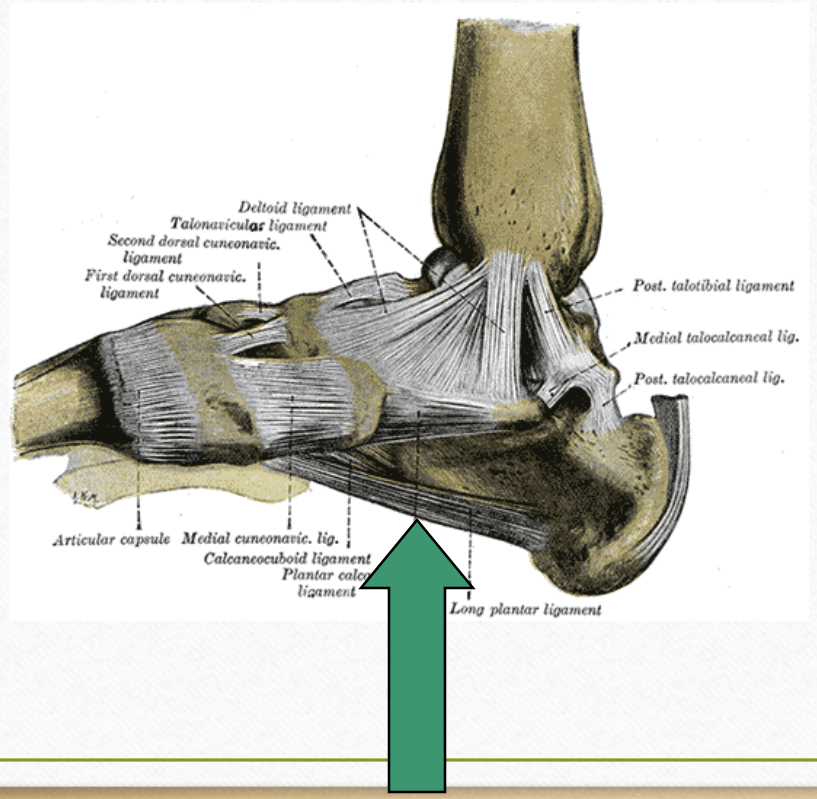
- The longitudinal arch of the foot is higher on the medial side, where it forms the instep as can be seen on a foot-print. It is made up of the 1st three digits and their metatarsals, the cuneiforms, the navicular bone and the talus.
- The lateral longitudinal arch is made up of digits 4 and 5 and their metatarsals, the cuboid and the calcaneum. It is much shallower than the medial arch.
- The transverse arch of the foot is primarily formed by the 5 metatarsal bones.

Arches of the Foot



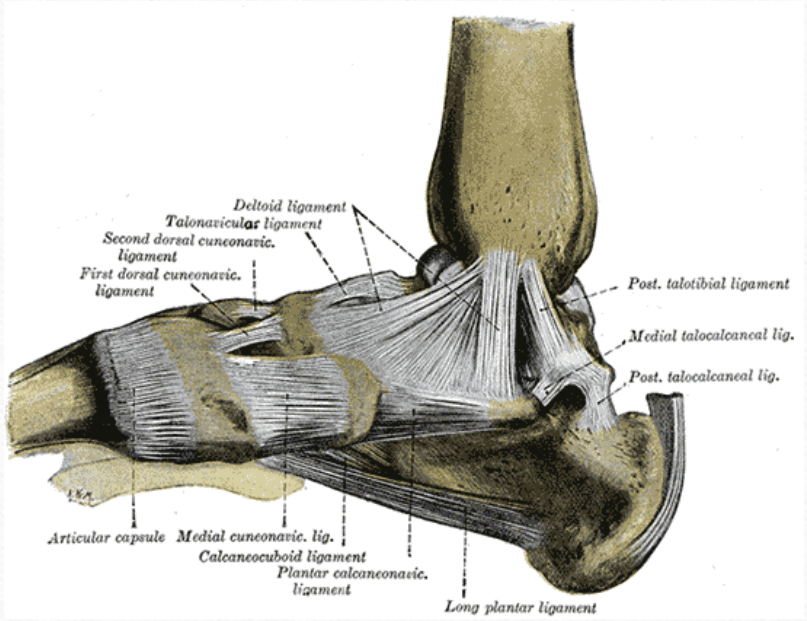
- Medial Longitudinal Arch continued
  - Ligament Support
    - Plantar Calcaneonavicular
    - Long Plantar Lig
    - Deltoid
    - Plantar fascia

Arches of the Foot



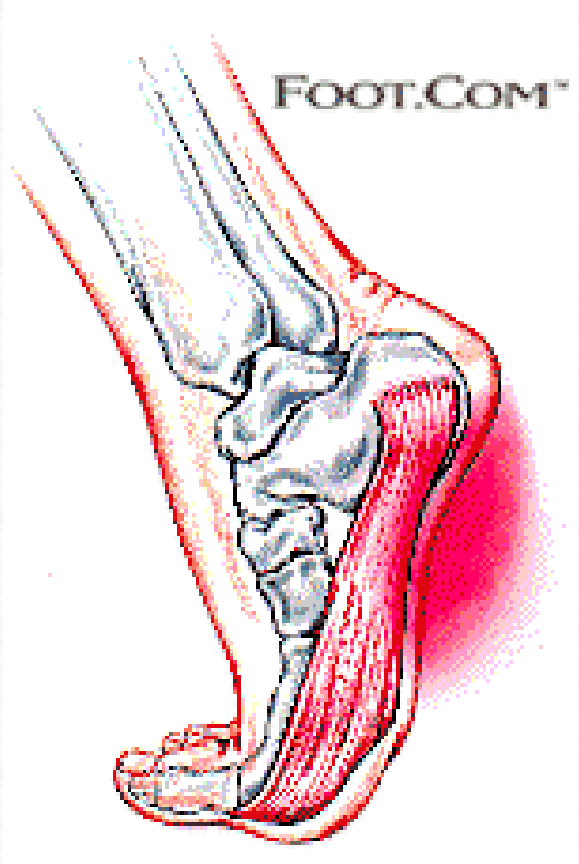
- Medial Longitudinal Arch continued
  - Ligament Support
    - Plantar Calcaneonavicular
    - Long Plantar Lig
    - Deltoid
    - Plantar fascia

Arches of the Foot



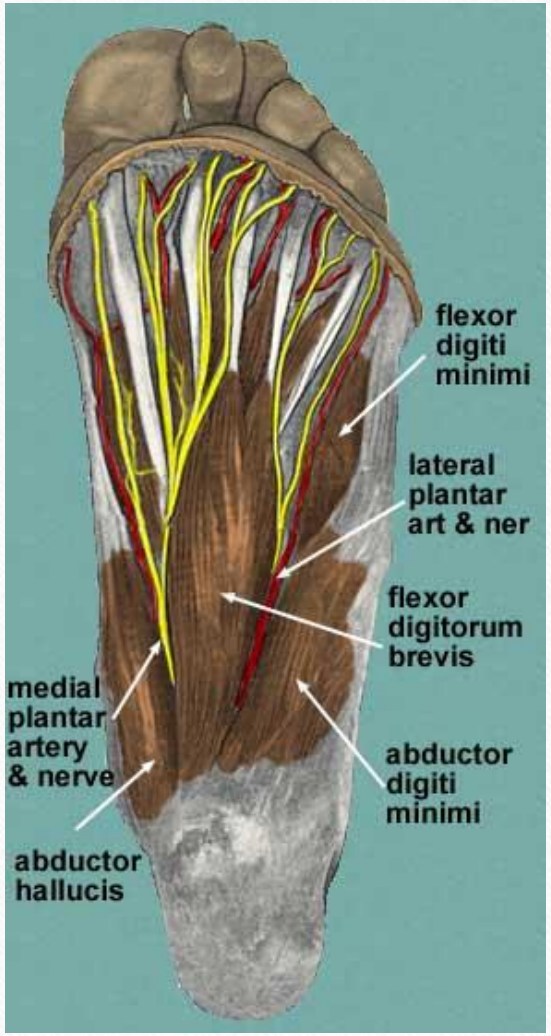
- Medial Longitudinal Arch continued
  - Ligament Support
    - Plantar Calcaneonavicular
    - Long Plantar Lig
    - Deltoid
    - Plantar fascia

Arches of the Foot



- Medial Longitudinal Arch continued
  - Ligament Support
    - Plantar Calcaneonavicular
    - Long Plantar Lig
    - Deltoid
    - Plantar fascia

Arches of the Foot

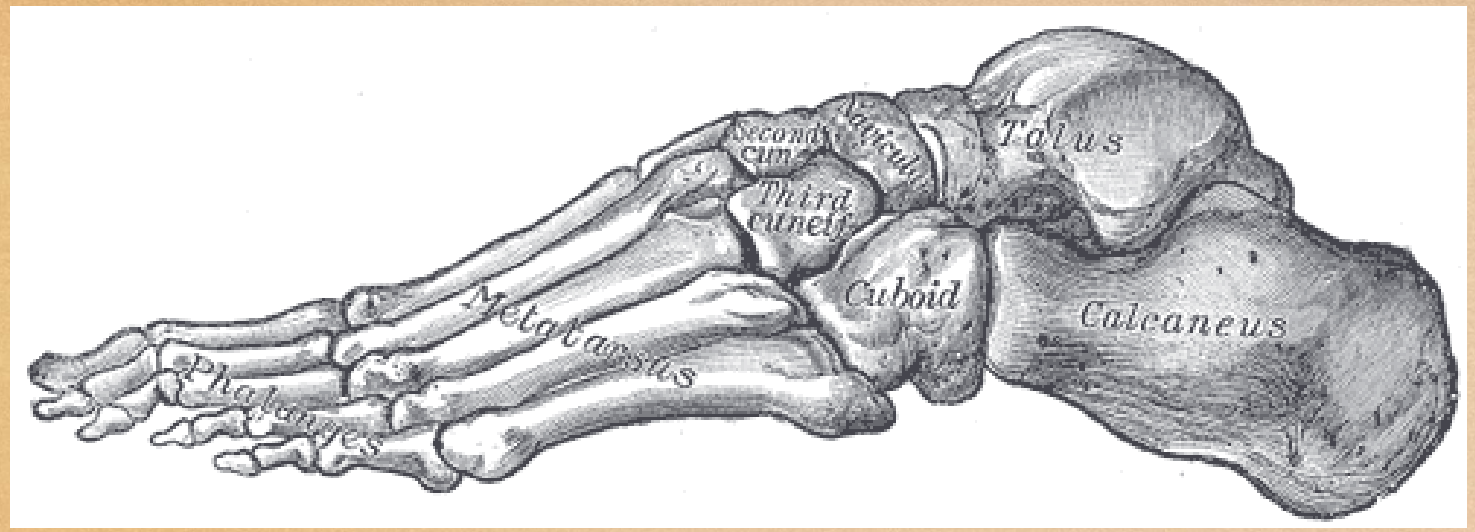


- Medial Longitudinal Arch continued
  - Muscular Support
    - Intrinsic
      - Abductor Hallucis
      - Flexor Hallucis Brevis
    - Extrinsic
      - Tibialis Posterior
      - Flexor Hallucis Longus
      - Flexor Digitorum Longus

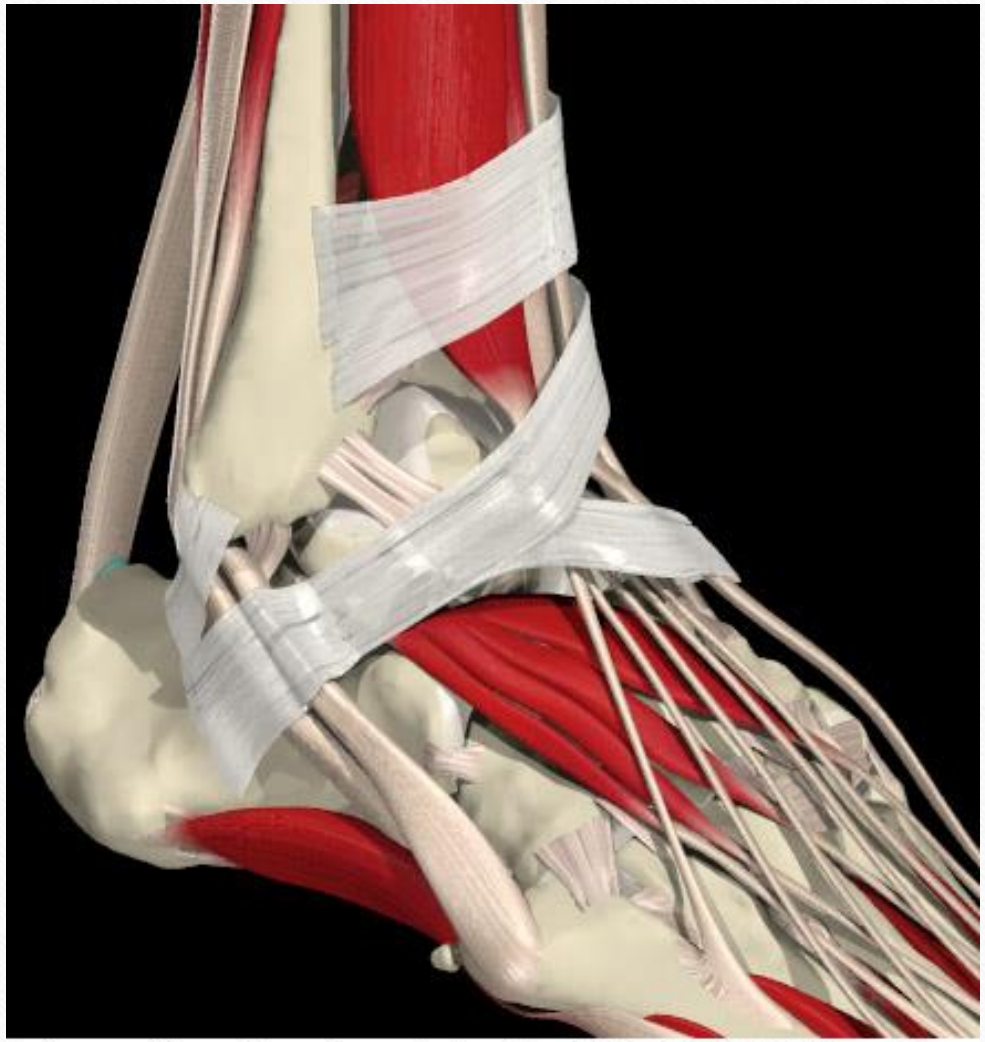
Arches of the Foot

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

Arches of the Foot



- Lateral Longitudinal Arch
  - Composed of
    - Calcaneus
    - Cuboid
    - 4-5th MT's
  - Ligament Support
    - Long & Short Plantar
    - Plantar Fascia



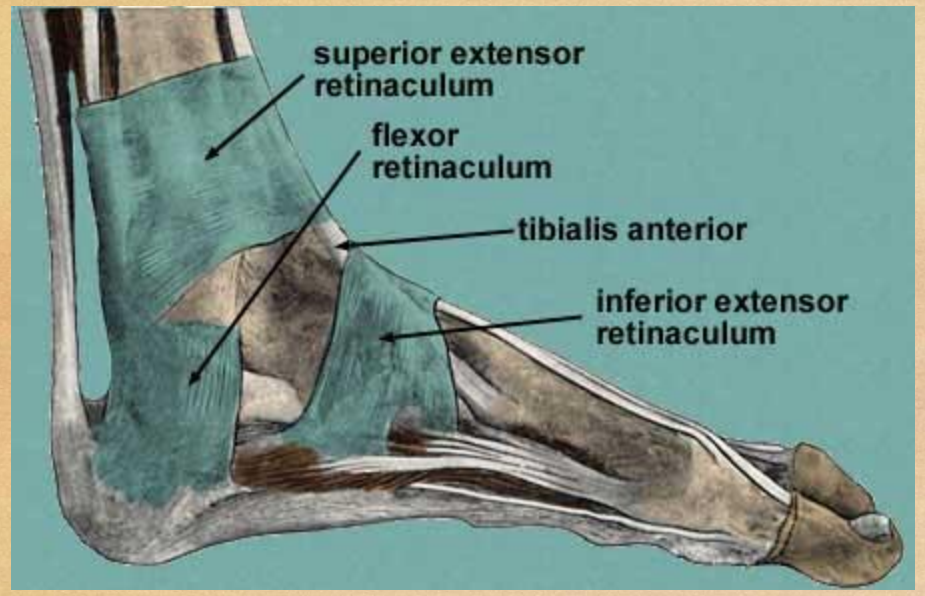
Interactive Foot and Ankle 2 © 2001 Primal Pictures Ltd

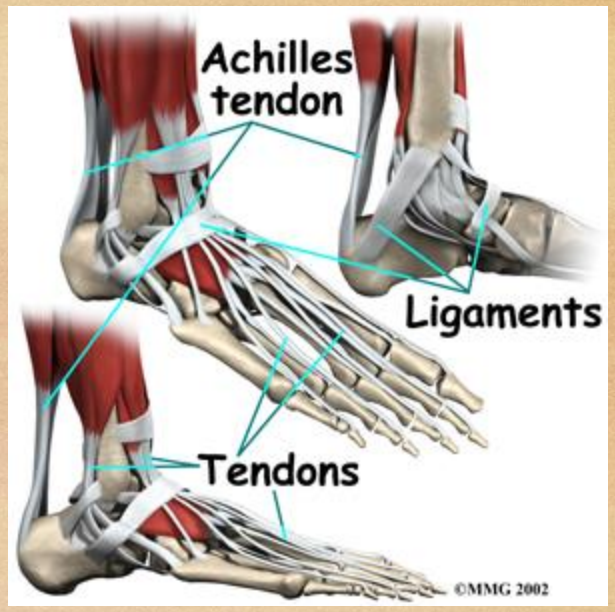
Arches of the Foot

- Lateral Longitudinal Arch continued
  - Muscle Support
    - Intrinsic
      - Abductor Digiti Minimi
      - Flexor Digitorum Brevis
    - Extrinisic
      - Peroneus Longus, Brevis & Tertius

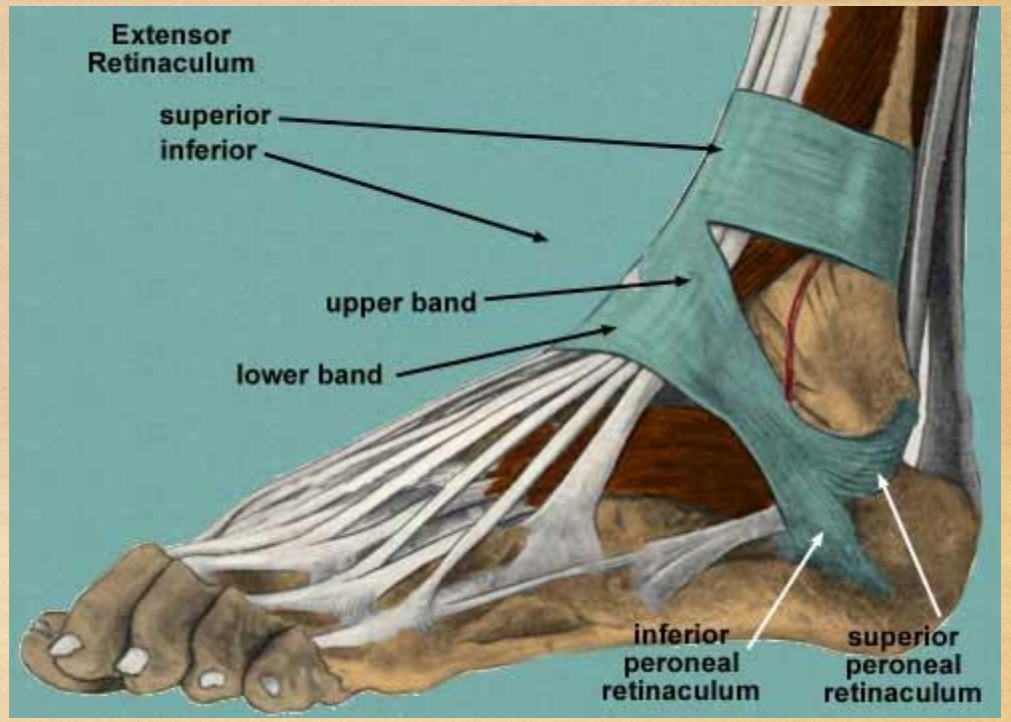
Arches of the Foot

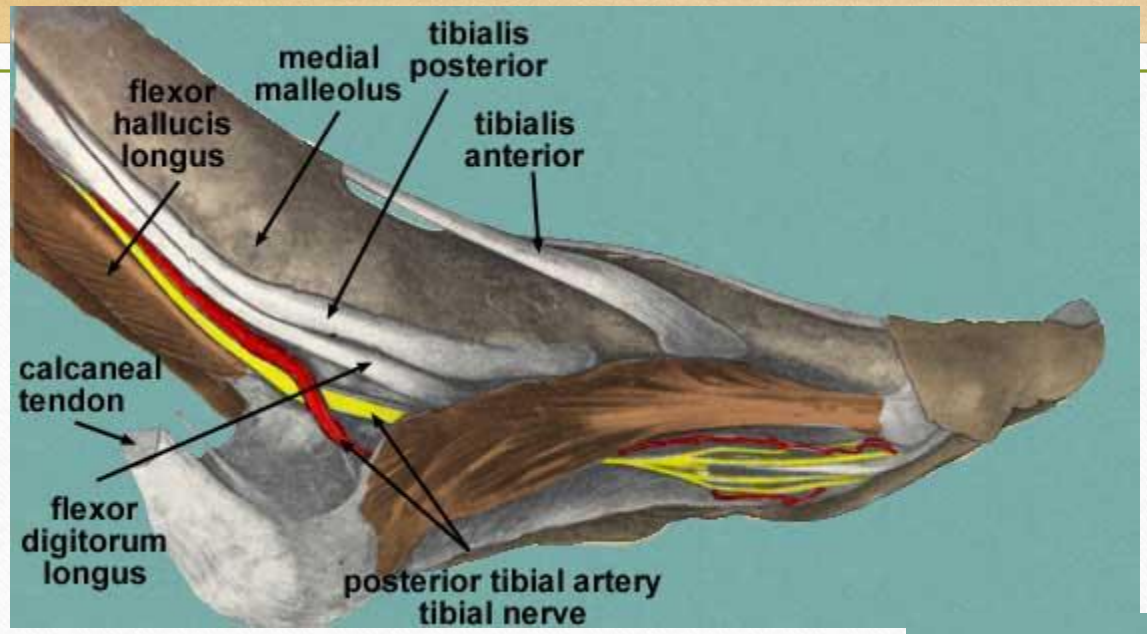
- Transverse Arch
  - Formed By:
  - Ligament Support
    - Intermetatarsal Ligaments
    - Plantar Fascia
  - Muscle Support
    - All intrinsic muscles
    - Extrinisic
      - Tibialis Posterior
      - Tibialis Anterior
      - Peroneus Longus

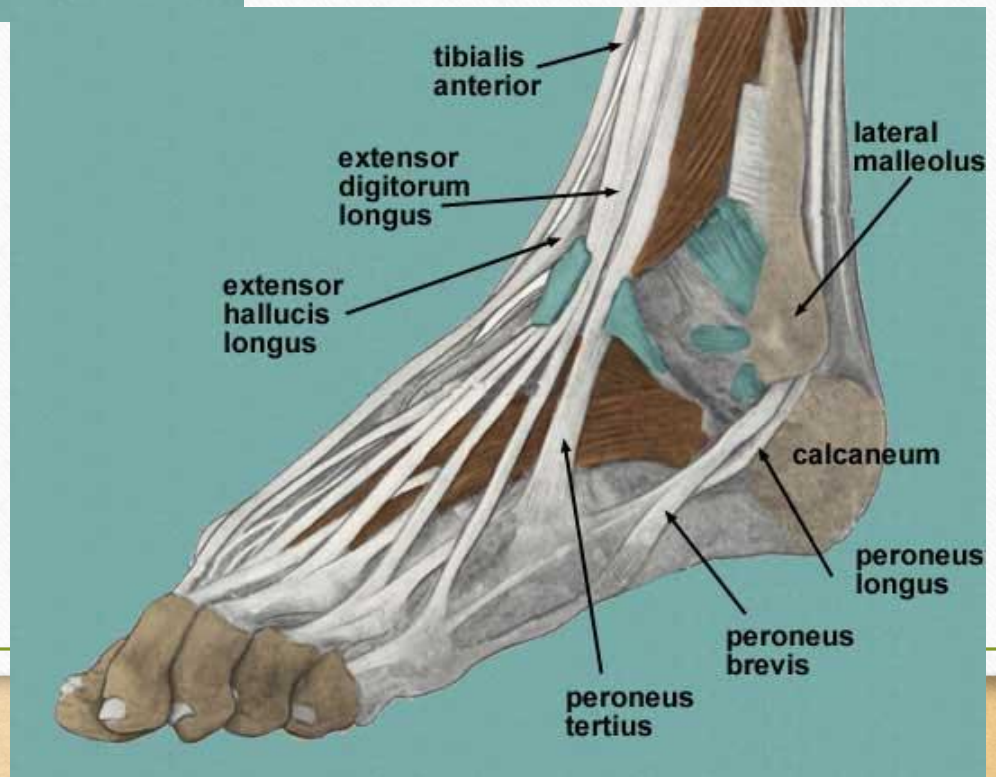




the superior and inferior peroneal retinaculaem keep the tendons of the peroneus longus and brevis close to the lateral malleolus.



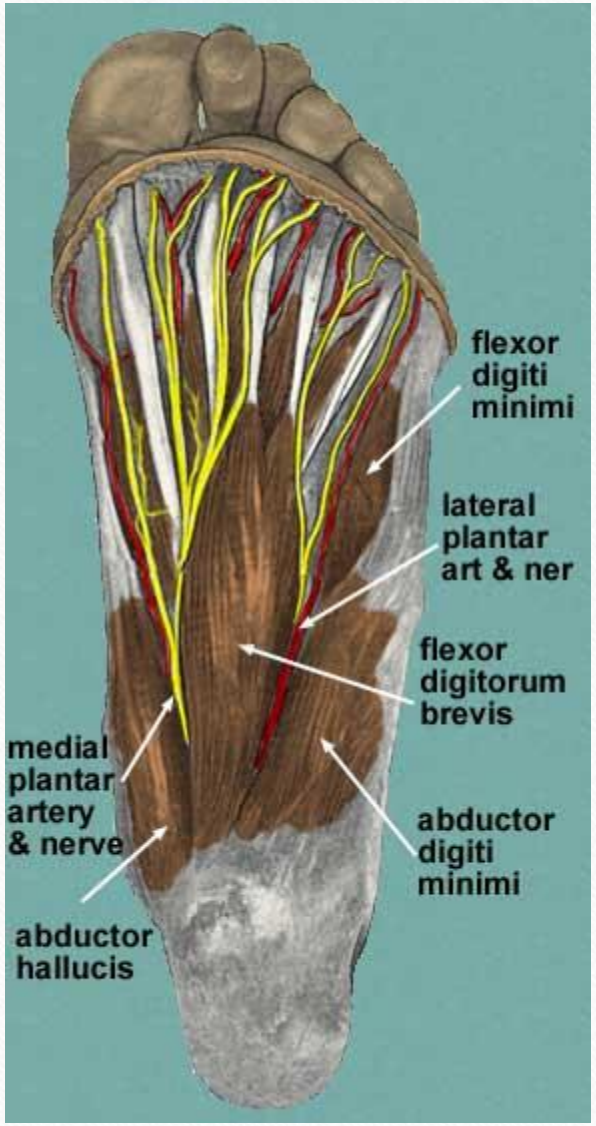

flexor
hallucis
longus
medial
malleolus
tibialis
posterior
tibialis
anterior
calcaneal
tendon
flexor
digitorum
longus
posterior tibial artery
tibial nerve

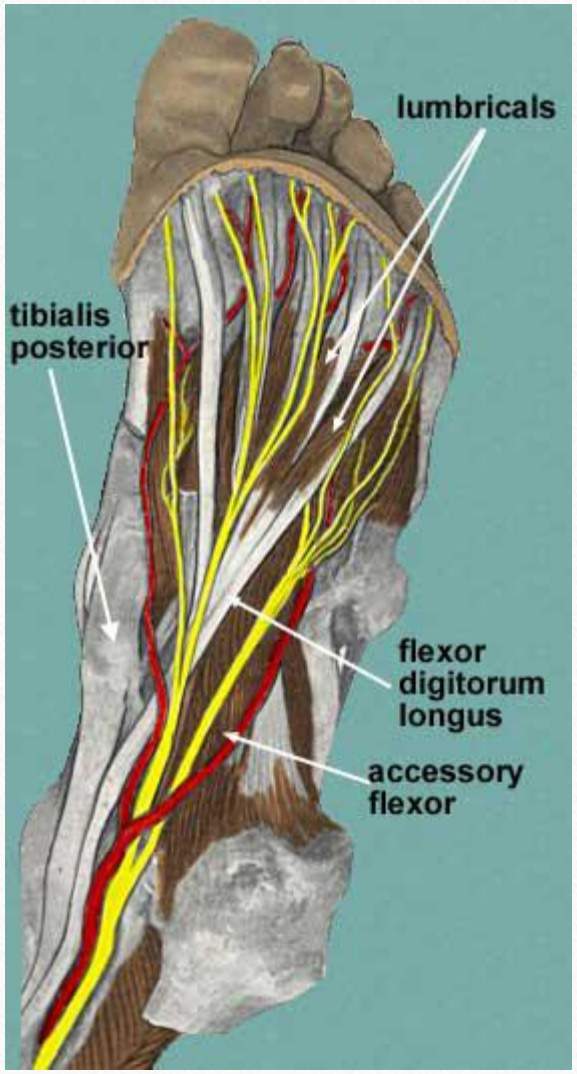

tibialis
anterior
extensor
digitorum
longus
extensor
hallucis
longus
lateral
malleolus
calcaneum
peroneus
longus
peroneus
brevis
peroneus
tertius

After the plantar aponeurosis has been removed you can see the muscles that make up the first layer of the sole of the foot and the arteries and nerves entering the foot.

The muscles of the first layer are:

abductor hallucis
flexor digitorum brevis
abductor digiti minimi



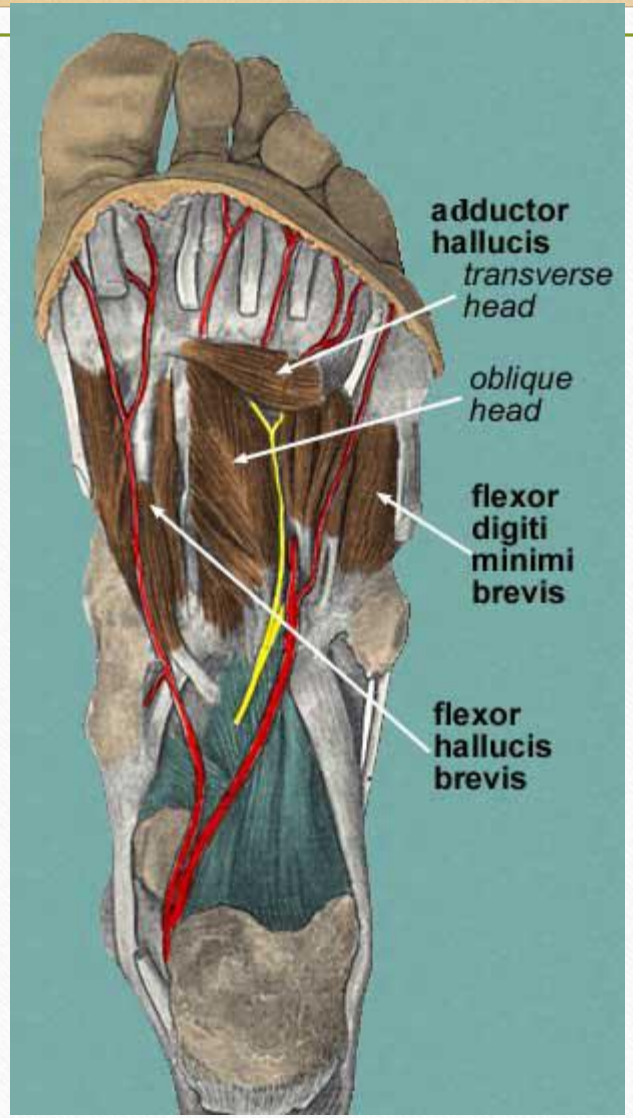


When the flexor digitorum brevis is removed, the muscles of the second layer can be seen:

accessory flexor (quadratus plantae)

lumbricals

tendons of the flexor digitorum longus from which the lumbricals arise



The muscles of the third layer include the:

flexor hallucis brevis

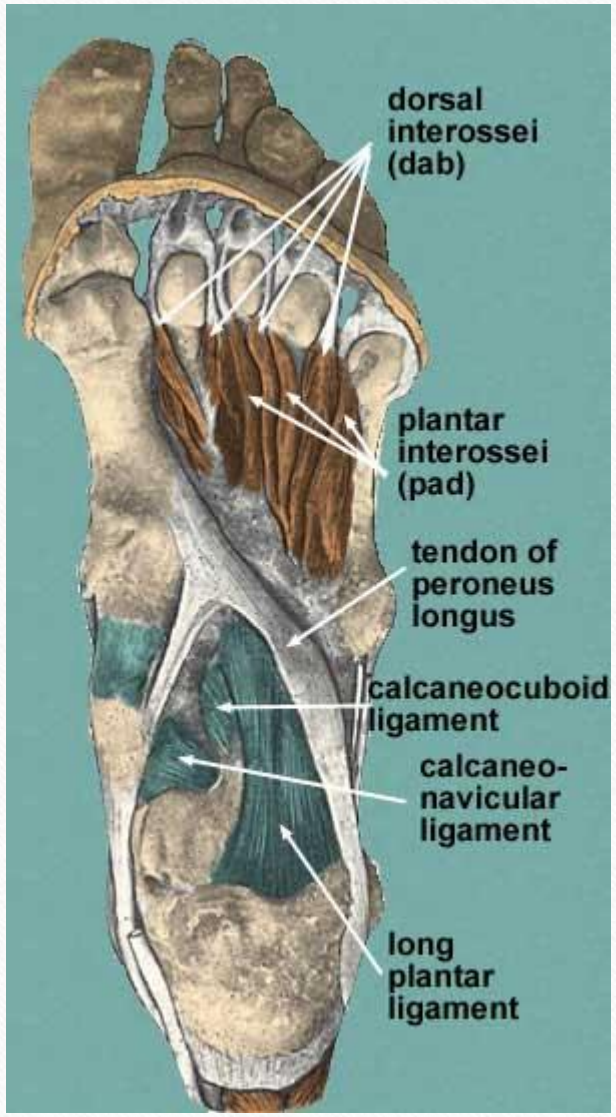
adductor hallucis

- oblique head
- transverse head

flexor digiti minimi brevis

The fourth layer of muscles are the:
dorsal interossei (dab) meaning
dorsal abduct
plantar interossei (pad) meaning
plantar adduct

At this level, you can also see the tendon of the peroneus longus crossing the sole of the foot.

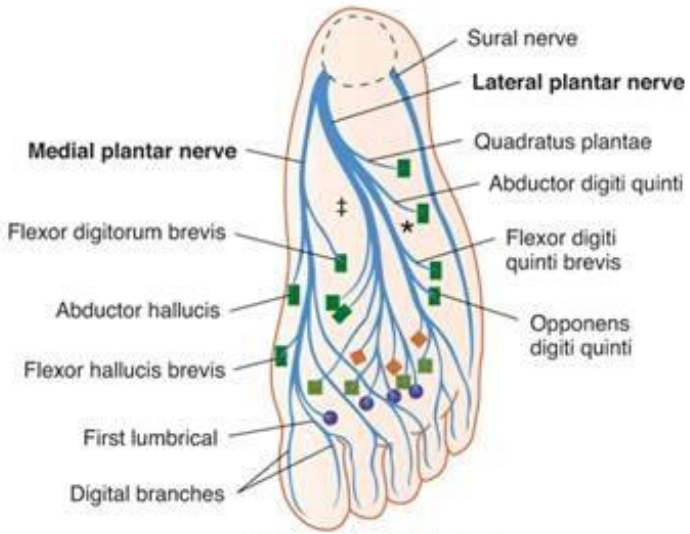


Nerve and Blood Supply

- Nerve Supply: The medial and lateral plantar nerves which are branches of the tibial nerve, supply all of the intrinsic muscles on the plantar surface of the foot. The deep peroneal nerve supplies the extensor.
- Blood Supply: The primary blood supply for the foot comes from the anterior tibial artery and posterior tibial arteries.

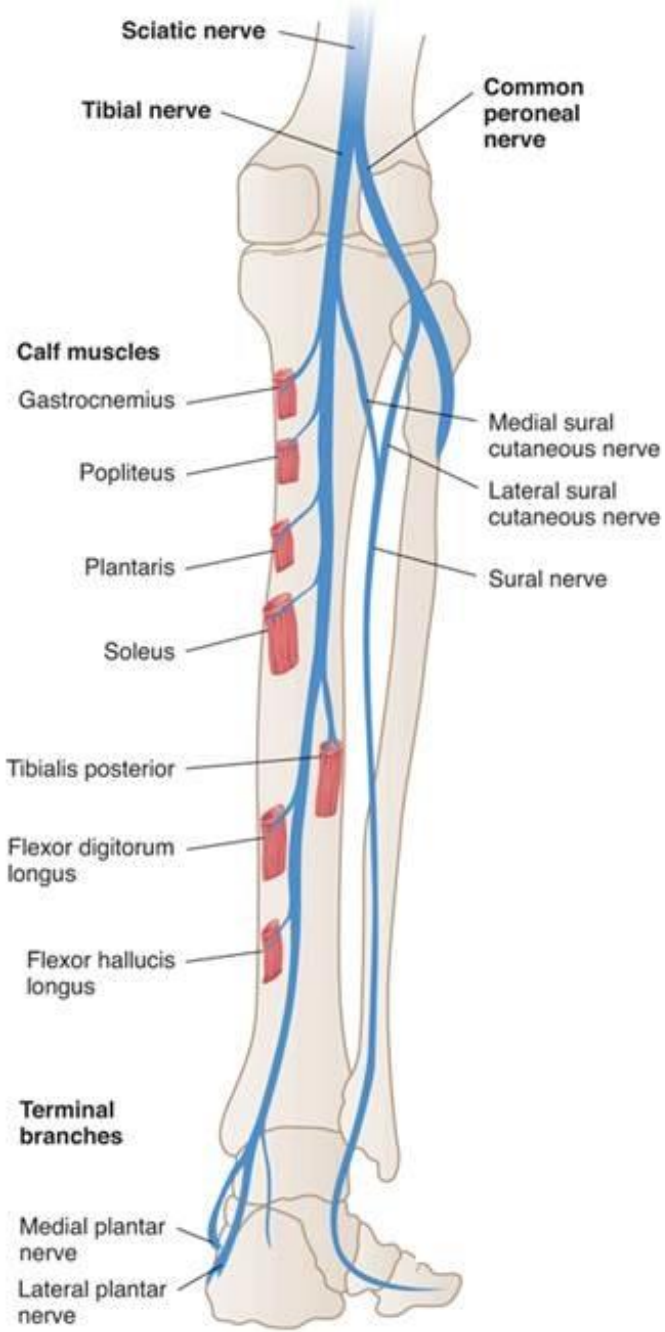
The Tibial Nerve

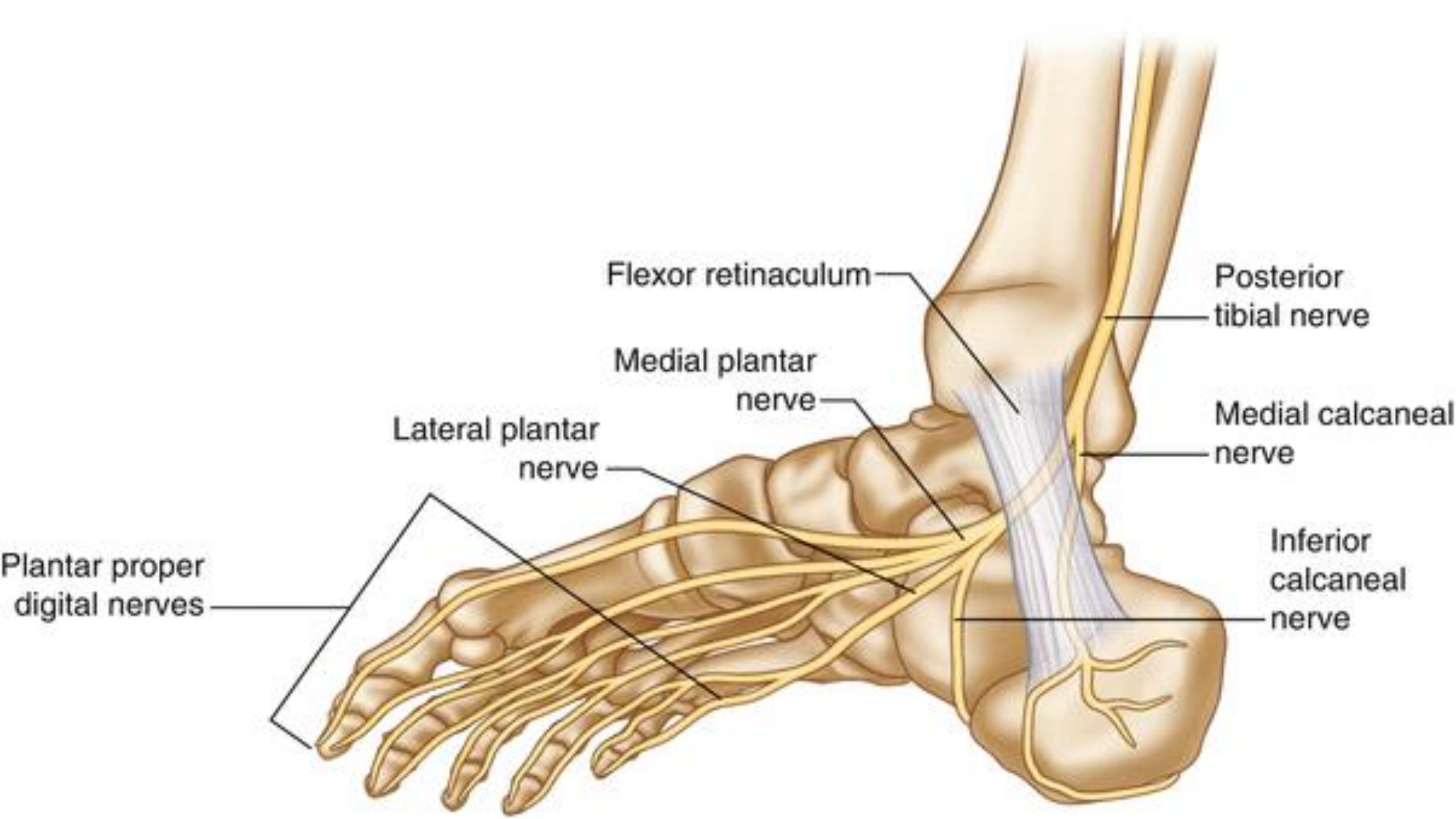
- Motor functions
  - Foot plantar flexion and inversion, toe flexion



Plantar view of the foot

★ Superficial branch of lateral plantar nerve
‡ Deep branch of lateral plantar nerve
Adductor hallucis (transverse and oblique)
Plantar interossei (3)
Dorsal interossei (4)
Lateral lumbricales (3)




Flexor retinaculum
Posterior tibial nerve
Medial plantar nerve
Medial calcaneal nerve
Lateral plantar nerve
Plantar proper digital nerves
Inferior calcaneal nerve

Nerves of the Feet

1. Sural
2. Superficial Peroneal
3. Saphenous
4. Deep Peroneal Nerve
5. Medial Plantar
6. Lateral Plantar
7. Medial/Lateral Calcaneal Branch of Posterior Tibial/Sural Nerves

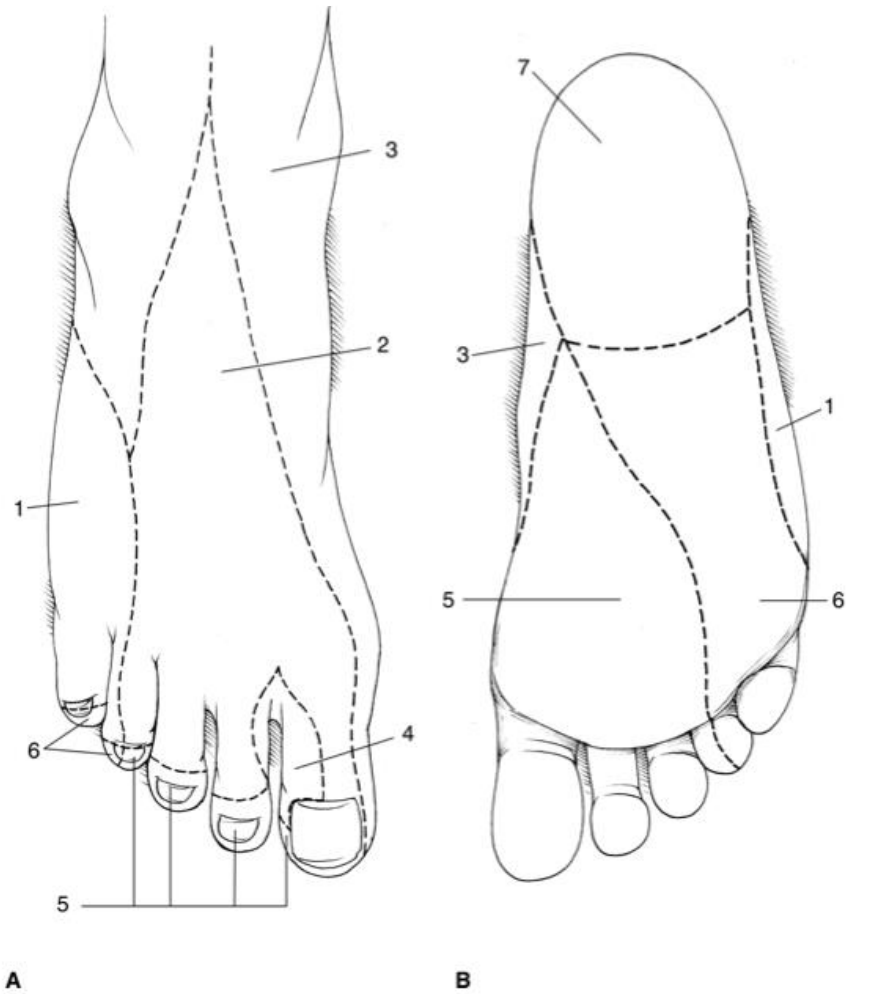
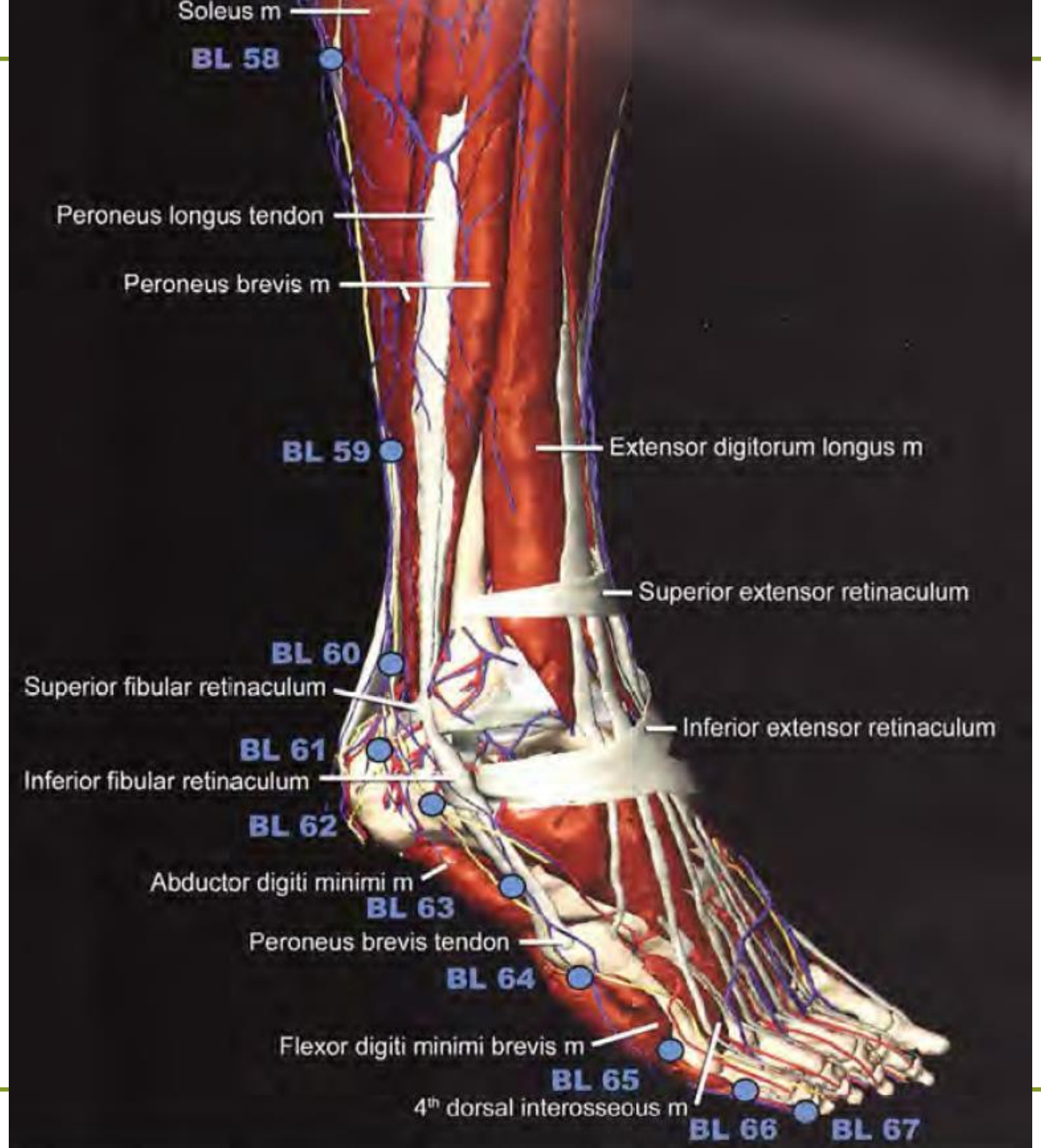


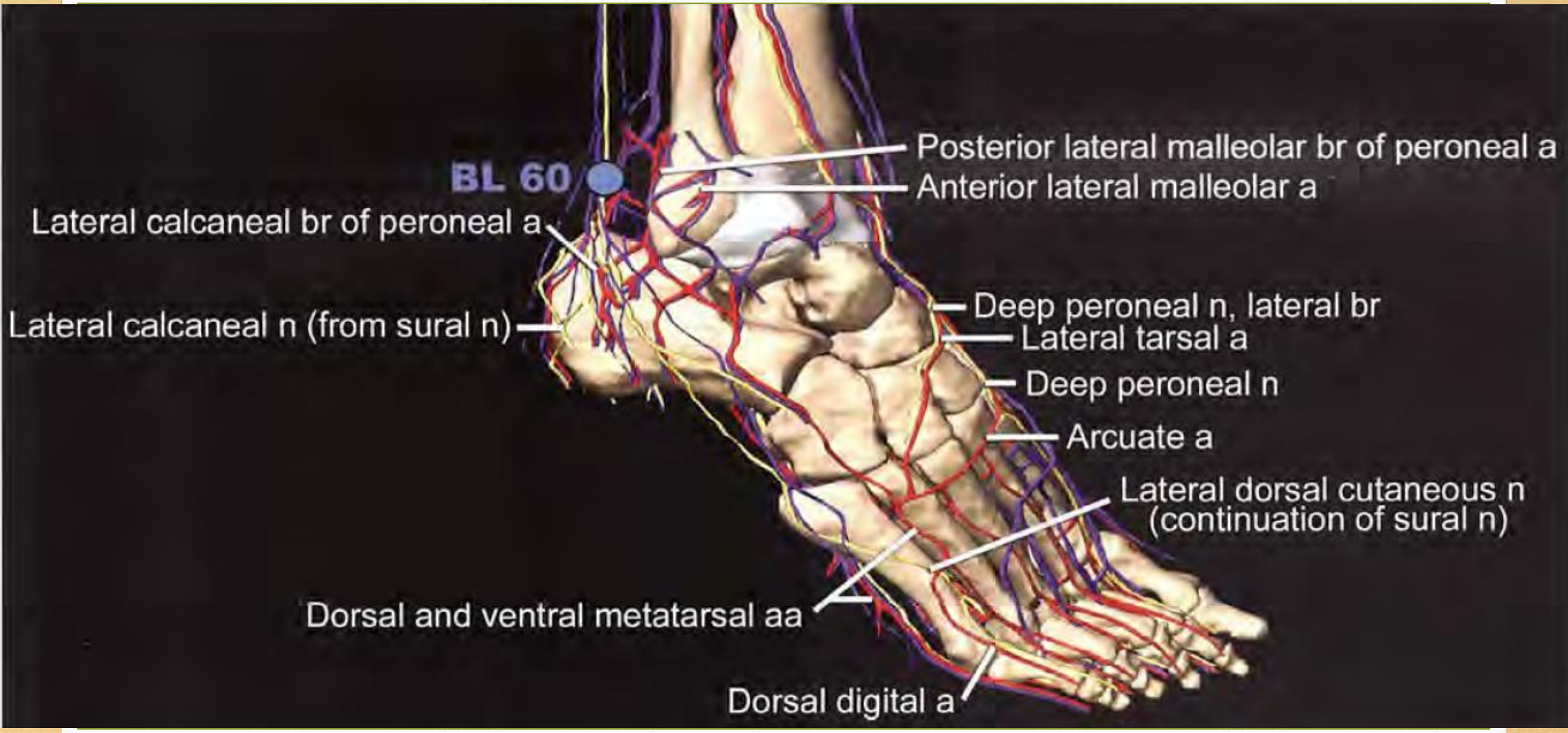
Figure 1 Dorsal **(A)** and plantar **(B)** aspects of the foot showing cutaneous innervation. Minor variability between the areas supplied by each nerve is frequently present. 1 = sural nerve, 2 = superficial peroneal nerve branches, 3 = saphenous nerve, 4 = deep peroneal nerve, 5 = medial plantar nerve, 6 = lateral plantar nerve, 7 = medial calcaneal nerve. (Adapted with permission from Sarrafian SK: Nerves, in *Foot and Ankle: Descriptive, Topographical, and Functional*, ed 2. Philadelphia, PA: JB Lippincott, 1993, p 370.)

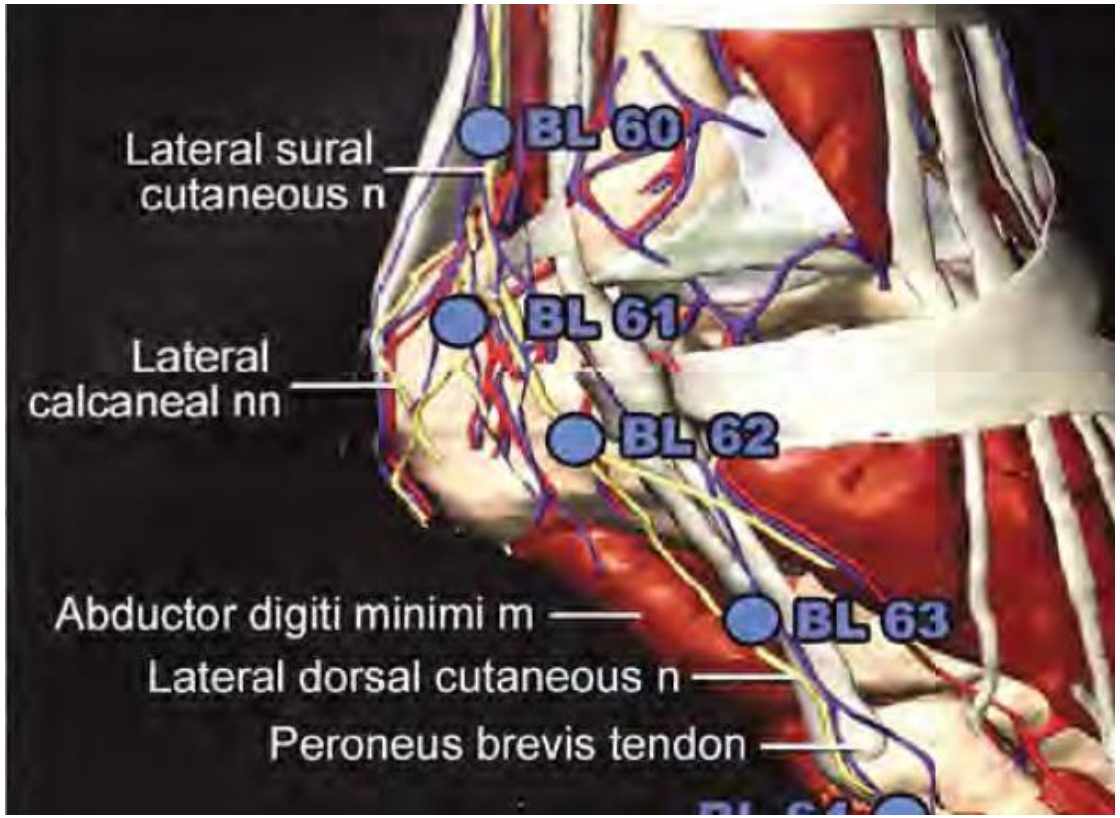

Soleus m
BL 58
Peroneus longus tendon
Peroneus brevis m
BL 59
Extensor digitorum longus m
Superior extensor retinaculum
BL 60
Superior fibular retinaculum
Inferior extensor retinaculum
BL 61
Inferior fibular retinaculum
BL 62
Abductor digiti minimi m
BL 63
Peroneus brevis tendon
BL 64
Flexor digiti minimi brevis m
BL 65
4th dorsal interosseous m
BL 66
BL 67

UB- - 60
KunLun Mountains

- Sural Nerve
- 崑崙，在外踝之後，跟骨之上，為經
- Spiritual Pivot: UB- - 60, behind The outer ankle bone, above The heel bone, Jing- - River point
- 崑崙，火也。在足外踝後，跟骨上陷中，細脈動應手，足太陽脈之所行也，為經。刺入五分，留十呼，灸三壯。
- Systematic Classic: UB - 60, fire element. Behind The outside Ankle bone, in depression above the heel bone, responds to fine pulsating vessel, where the Foot TaiYang Channel courses, Jing- - River point, puncture 5 fen, retain 10 exhalation, moxa 3 cones.

- Comment: The fine pulsating vessel likely refers to the Lateral Calcaneal Branch of the Peroneal Artery. The Sural Nerve is located anterior to the Peroneal Artery. The Sural Nerve separates into the Lateral Calcaneal Nerve and the Dorsal Lateral Cutaneous Nerve that provides sensory innervation to the lateral surface of the foot.
- The fascial sheath surrounding the caudal calf muscles will at times entrap the sural nerve as it emerges near BL 58. At the ankle, branches of the sural nerve can also experience compression. Heel pain accompanied by tingling, burning, or loss of sensation suggest neuropathic injury by compression, traction, or other causes


BL 60
Posterior lateral malleolar br of peroneal a
Anterior lateral malleolar a
Lateral calcaneal br of peroneal a
Lateral calcaneal n (from sural n)
Deep peroneal n, lateral br
Lateral tarsal a
Deep peroneal n
Arcuate a
Lateral dorsal cutaneous n
(continuation of sural n)
Dorsal and ventral metatarsal aa
Dorsal digital a



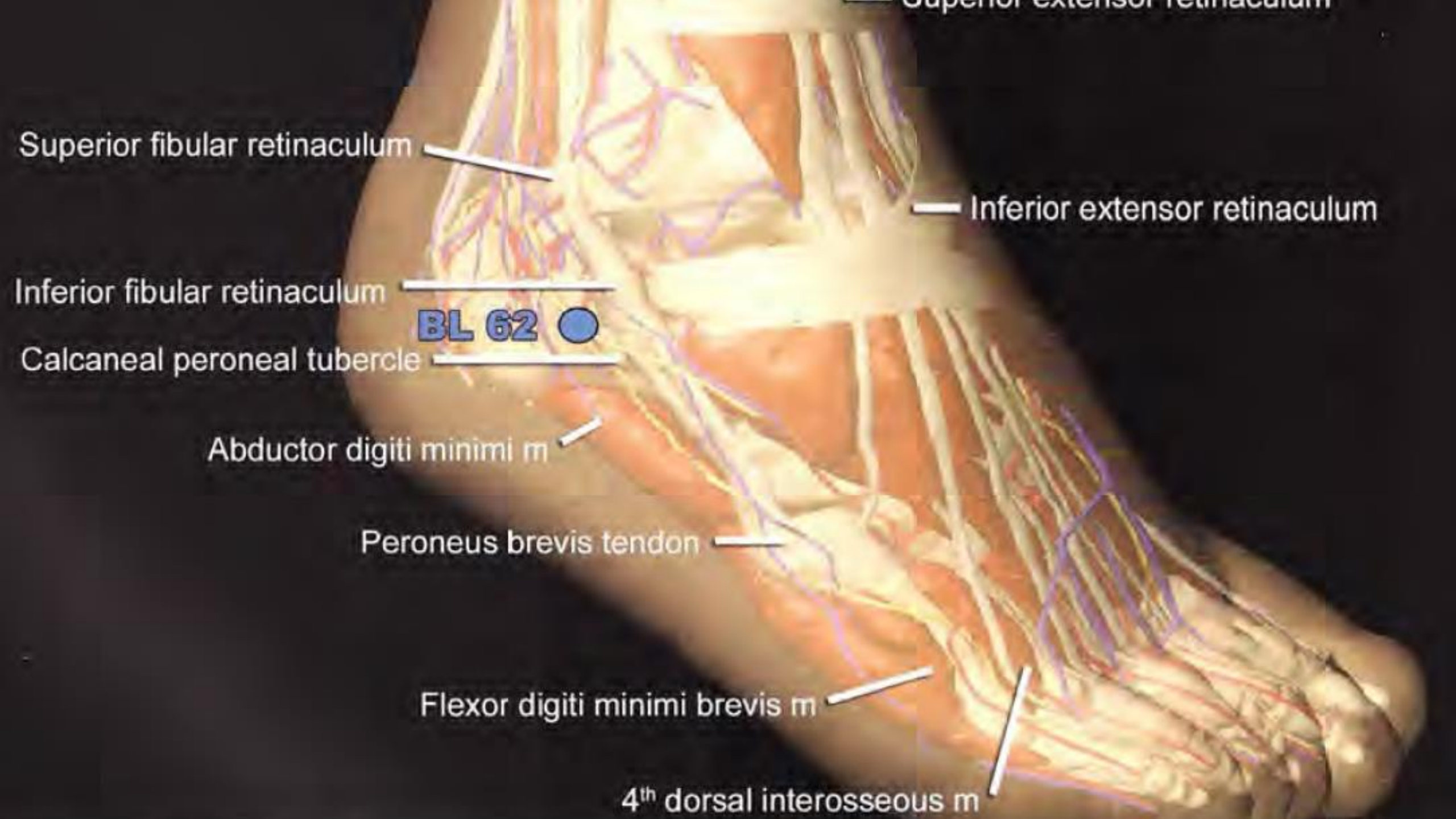
UB- - 61 PuCan Subservient Visitor

- Lateral Calcaneal Branch of Sural Nerve
- 僕參，一名安邪，在跟骨下陷者中，拱足得之
- Systematic Classic: UB- - 61, also known as Safe Evil, in depression below heel bone, obtained by arching the foot.
- Comment: Lateral Calcaneal branch of the Sural Nerve provides sensory innervation to the lateral heel. It is analogous to the Medial Calcaneal Branch of the Posterior Tibial Nerve, which can be stimulated via KD- - 4.

UB-﹣62 ShenMai
Extending Vessel

- Lateral Dorsal Cutaneous Nerve (LDCN) of Sural Nerve
- 申脈，陽蹻所生也，在足外踝下陷者中，容爪甲許，刺入三分，留六呼，灸三壯。
- Systematic Classic: UB-﹣62, where YangQiao arises, in depression below the outside ankle bone, allows a finger nail, puncture 3 fen, retain 6 exhalation, moxa 3 cones.
- Comment: Allows a finger nails means the size of the depression is big enough to permit a whole fingernail to fit inside. The apex of this depression is formed by the meeting of the fibularcalcaneal ligament on the posterior side and the Peroneus Longus tendon on the anterior side. This depression is about 1 cun directly below the lateral malleolus. In this depression, the Lateral Dorsal Cutaneous portion of the Sural Nerve can be stimulated. It innervates the lateral side of the foot.

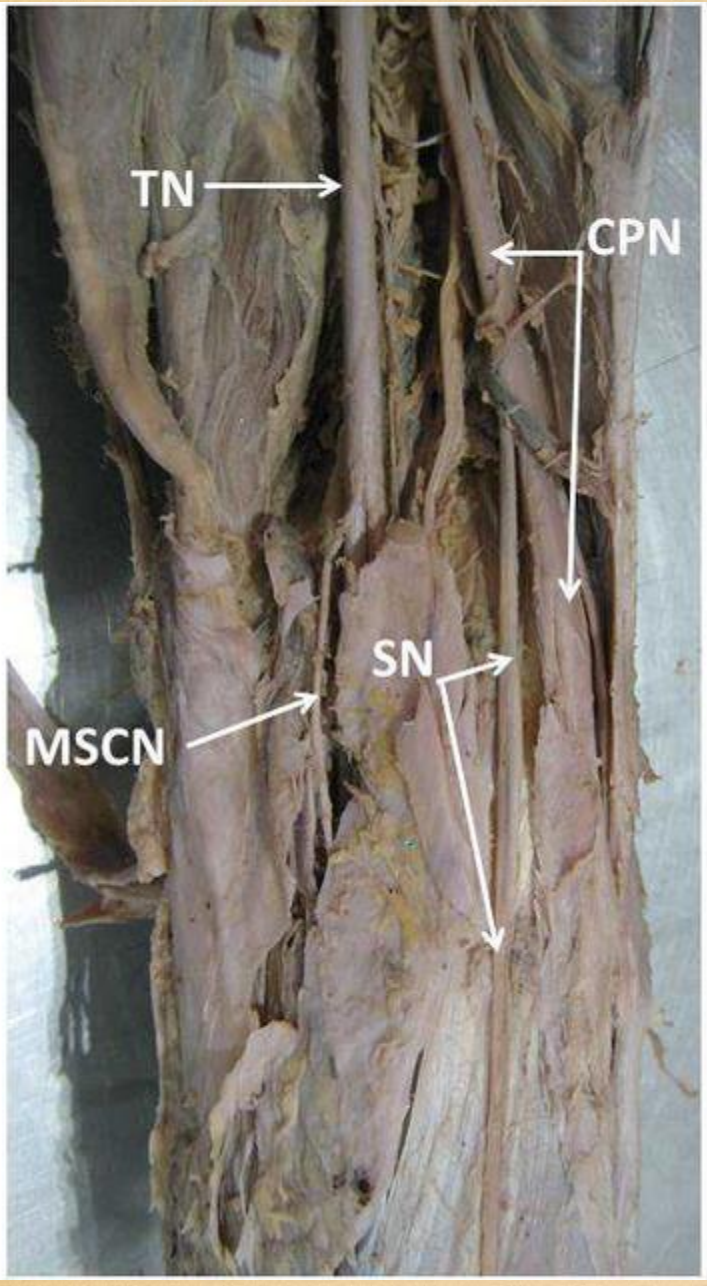
- From a functional perspective, mechanoreceptors located along the lateral foot and supplied by the sural nerve branches assist in maintaining upright stance and control over posture. The body accomplishes this by means of reflexes connecting cutaneous receptors of the foot (supplied by the lateral dorsal cutaneous nerve) with the erector spinae muscles of the lower back.
- Acupuncture and related techniques that activate nerve endings along the BL channel of the foot thus aid in balance and support of an upright posture and dynamic stabilization during gait and ground contact.


Superior extensor retinaculum
Superior fibular retinaculum
Inferior extensor retinaculum
Inferior fibular retinaculum
BL 62
Calcaneal peroneal tubercle
Abductor digiti minimi m
Peroneus brevis tendon
Flexor digiti minimi brevis m
4th dorsal interosseous m

UB- - 63 JinMen
Metal Gate

- Bifurcation of Dorsal Medial Branch and Dorsal Lateral Branch of Lateral Dorsal Cutaneous Nerve
- Systematic Classic: UB- - 63, in space of Foot TaiYang, below the outside ankle bone, also known as Gate Beam, where YangWei separately belongs, punctured 3 fen, moxa 3 cone.
- Comment: This space is over the cuboid bone, just inferior to the point of attachment of the Peroneous Brevis tendon to the tuberosity of the 5th metatarsal. The Dorsal Medial Branch of Lateral Dorsal Cutaneous Nerve provides cutaneous innervation for the distal portion of the lateral foot (all the way down to the 5th toe). The Dorsal Lateral Branch innervates lateral foot but does not reach the 5th toe.

- The yoga position "downward dog" may stretch the lateral sural cutaneous nerve and produce neuropathic pain or dysesthesia Entrapment and neuropathy of the inferior calcaneal nerve, the first branch of the lateral plantar nerve that supplies the abductor digitiminimi muscle, can produce medial heel pain

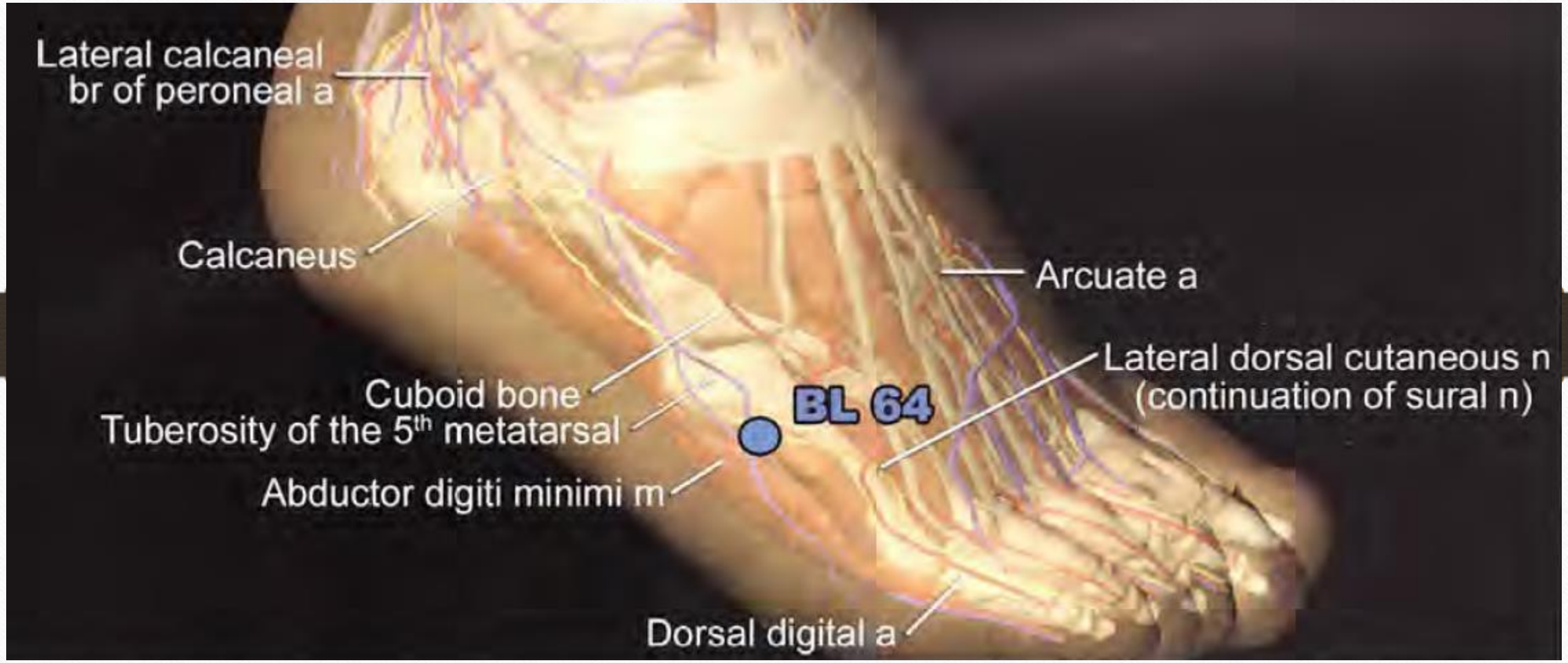

TN
CPN
SN
MSCN

SN
LCN
LDCN

UB- - 64 JingGu
Capital Bone

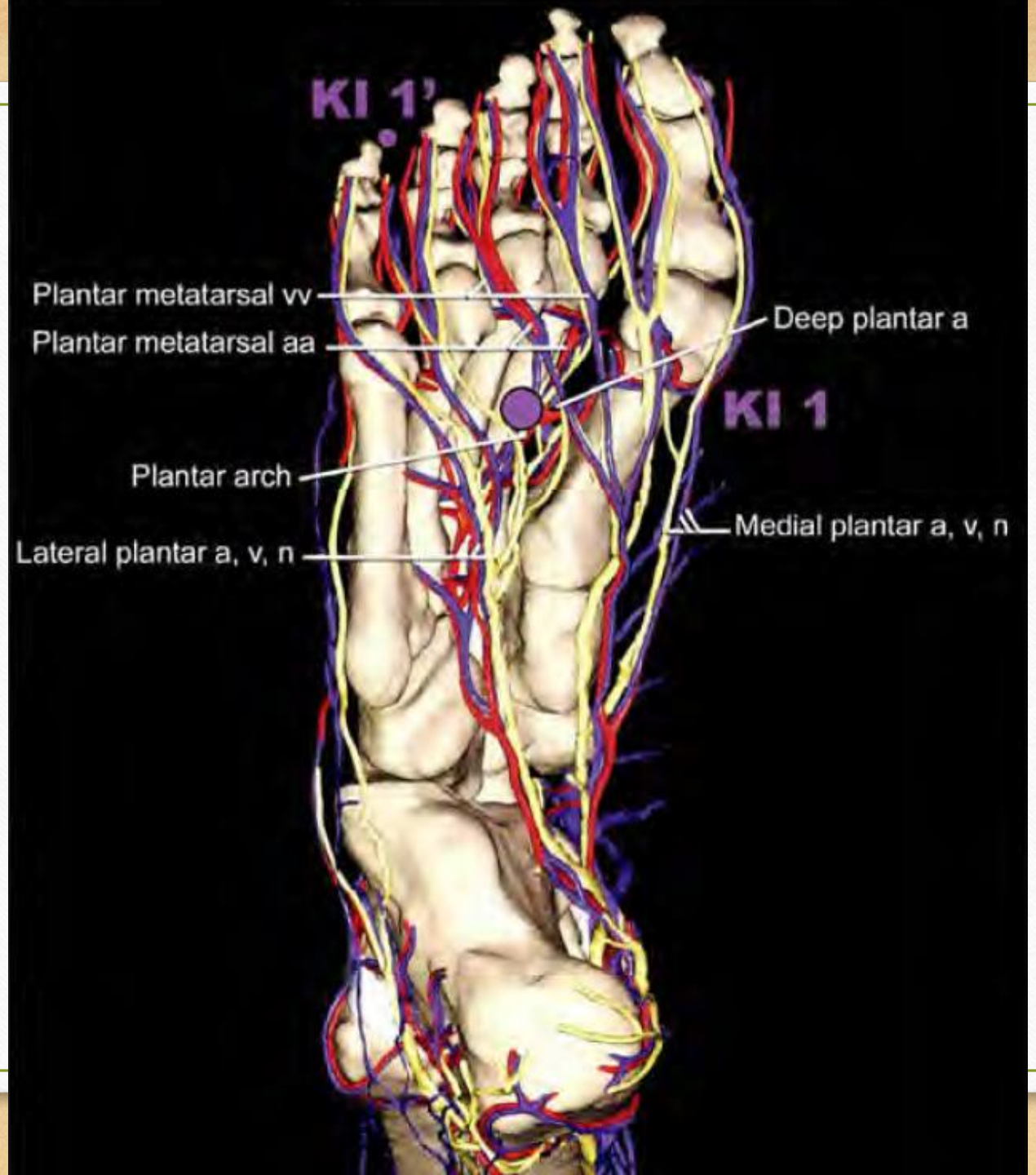
- Dorsal Lateral branches of LDCN (Sural Nerve); Abductor Digiti Minimi MP
- 京骨，足外側大骨之下，為原
- Spiritual Pivot: UB - 64, under the big bone on the outside of the foot, Yuan- - Source point.
- 京骨，在足外側大骨下，赤白肉際陷者中，按而得之，足太陽脈之所過也，為原。刺入三分留七呼，灸三壯。

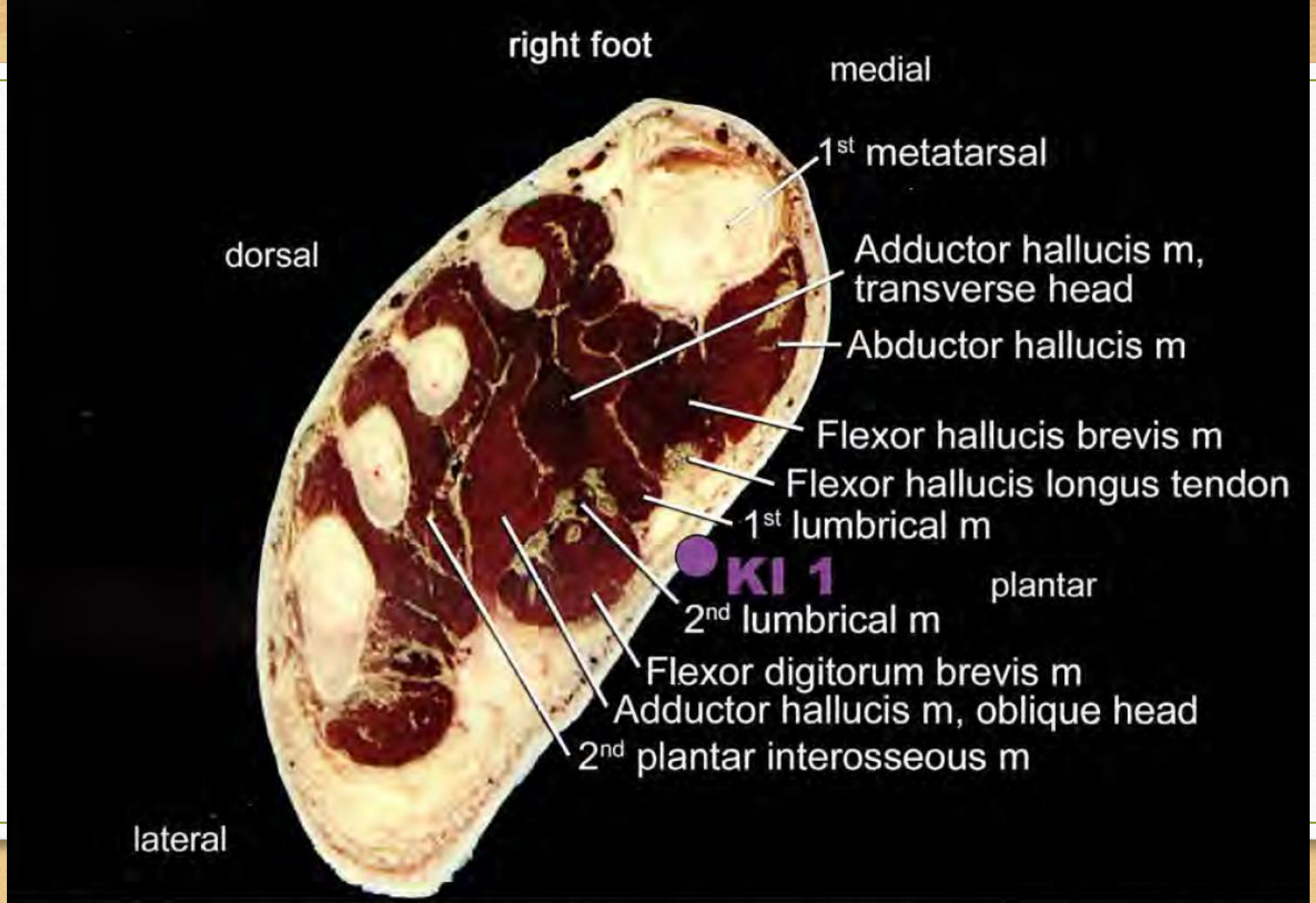
- Systematic Classic: UB- - 64, under the big bone on the outside of the foot, in depression at the border of the red and white flesh, obtained by pressing, where Foot TaiYang channel passes, Yuan- - Source point. Puncture 3 fen, retain 7 exhalation, moxa 3 cones.
- Comment: Both Spiritual Pivot and Systematic Classic location places this point under the tuberosity of the 5thmetatarsal bone, whereas in the modern TCM location it is distal to the bone.


Lateral calcaneal
br of peroneal a
Calcaneus
Arcuate a
Lateral dorsal cutaneous n
(continuation of sural n)
Cuboid bone
Tuberosity of the 5th metatarsal
BL 64
Abductor digiti minimi m
Dorsal digital a

KD-1 YongQuan
Gushing Spring

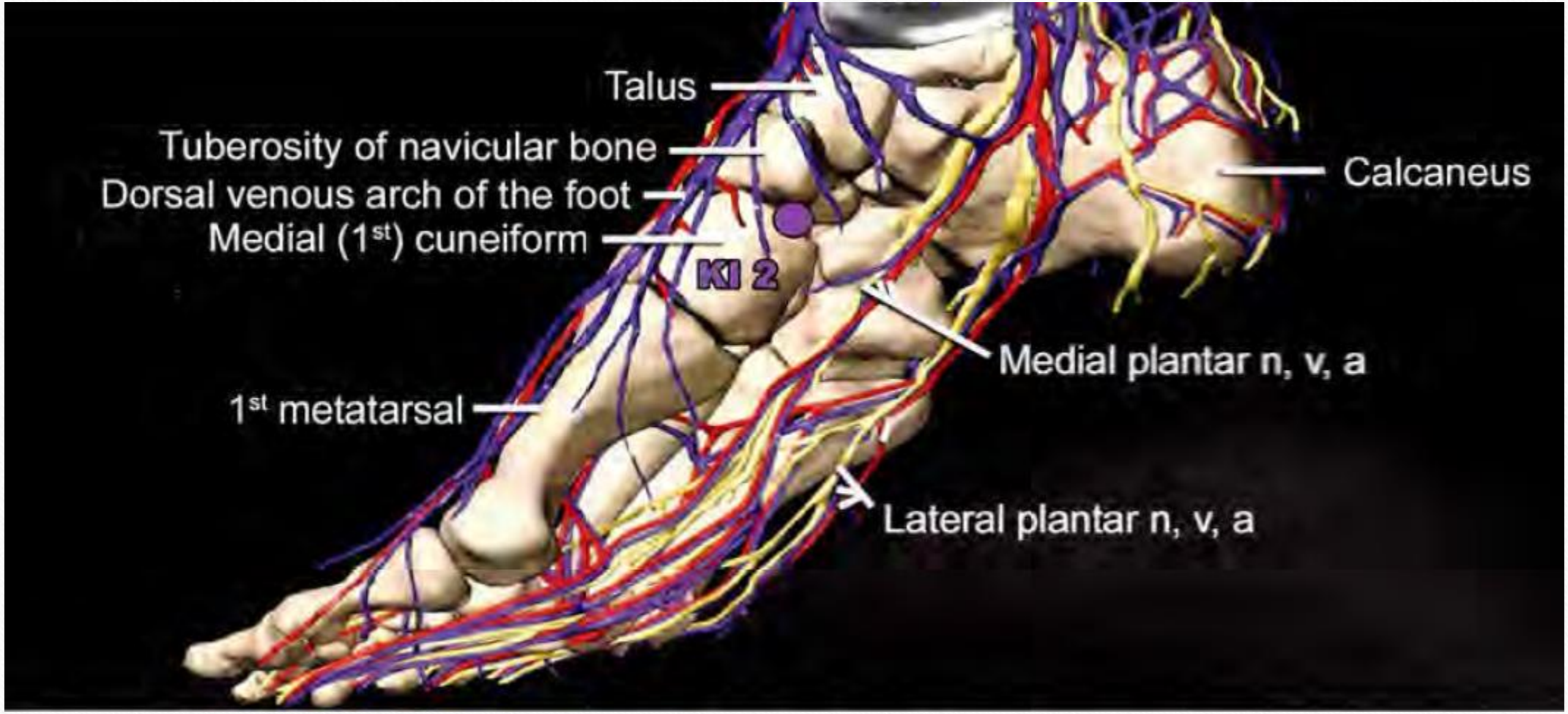
- Deep Branch of Lateral Plantar Nerve; Lateral Plantar Arch
- 湧泉者，水也。一名地衝，在足心陷者中 ，屈足卷指宛宛中，足少陰脈之所出也， 為井。刺入三分，留三呼，灸三壯。
- Systematic Classic: KD-1, water element. Also called Ground Surge, in depression in the center of the foot, in the middle of the curvature when foot is bent and toes are curled, where Foot ShaoYin channel exists, Jing--Well. Puncture 3 fen, retain 3 exhalation, moxa 3 cones.

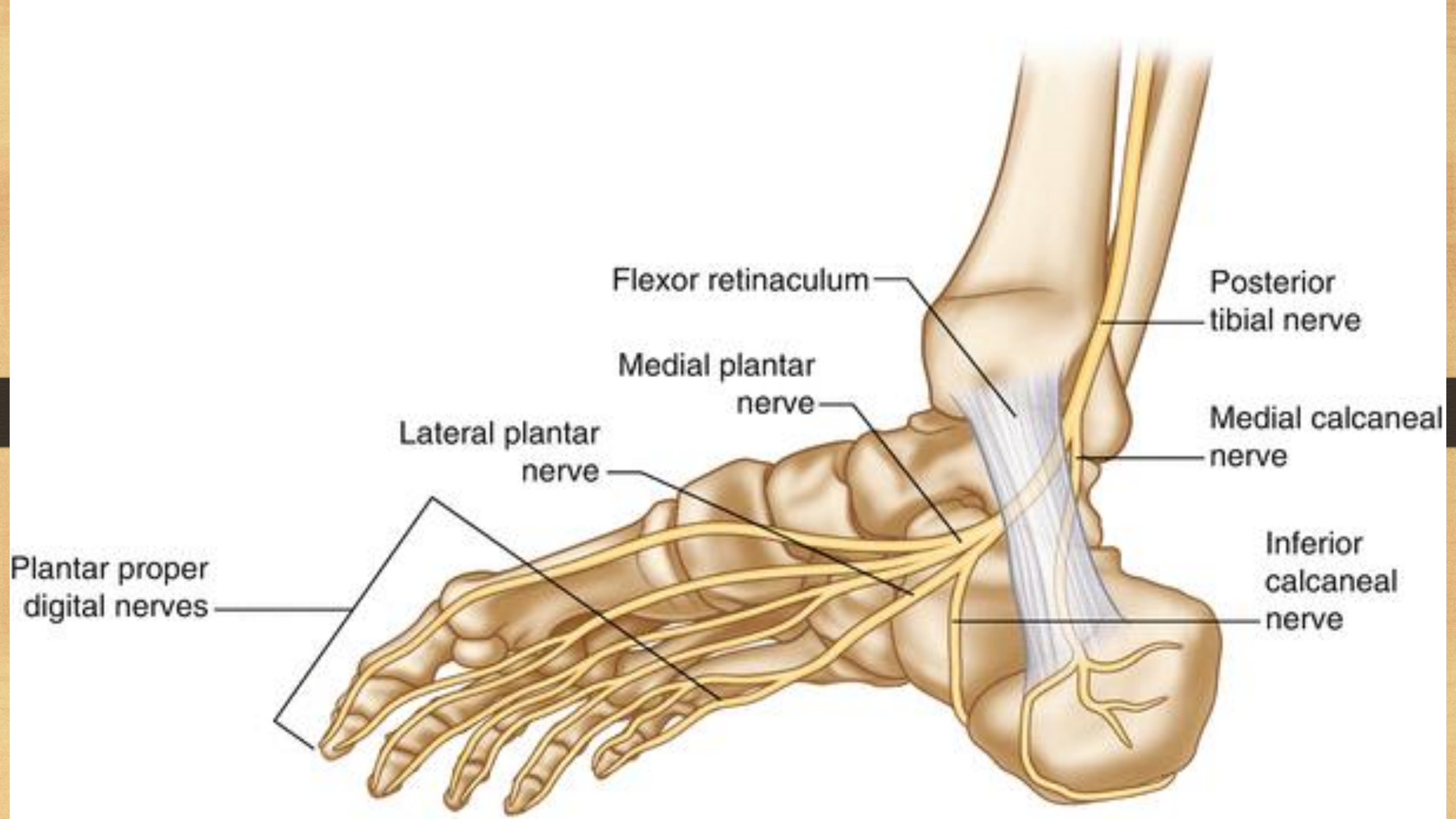

KI 1'
Plantar metatarsal vv
Plantar metatarsal aa
Deep plantar a
KI 1
Plantar arch
Medial plantar a, v, n
Lateral plantar a, v, n


right foot
medial
dorsal
1st metatarsal
Adductor hallucis m, transverse head
Abductor hallucis m
Flexor hallucis brevis m
Flexor hallucis longus tendon
1st lumbrical m
KI 1
plantar
2nd lumbrical m
Flexor digitorum brevis m
Adductor hallucis m, oblique head
2nd plantar interosseous m
lateral

KD-2 RanGu Blazing Valley

- Abductor Hallucis MP
- 然谷者，火也。一名龍淵，在足內踝前起大骨下陷者中，足少陰脈之所留也，為滎。刺入三分，留三呼，灸三壯。刺之多見血，使人立飢欲食。
- Systematic Classic: KD-2, Fire element. Also called Dragon Abyss, in depression below the protruding large bone in front of the inner ankle (malleolus), where the Foot ShaoYin meridian remains, Ying-Spring Point. Puncture 3 fen, retain 3 exhalation, moxa 3 cones. Commonly seen bleeding when needled, cause instant hunger and desire to eat (increase appetite).
- **Comment**: the protruding large bone is likely to be the navicular bone.


Talus
Tuberosity of navicular bone
Dorsal venous arch of the foot
Medial (1st) cuneiform
KI 2
1st metatarsal
Calcaneus
Medial plantar n, v, a
Lateral plantar n, v, a


Flexor retinaculum
Posterior tibial nerve
Medial plantar nerve
Medial calcaneal nerve
Lateral plantar nerve
Plantar proper digital nerves
Inferior calcaneal nerve

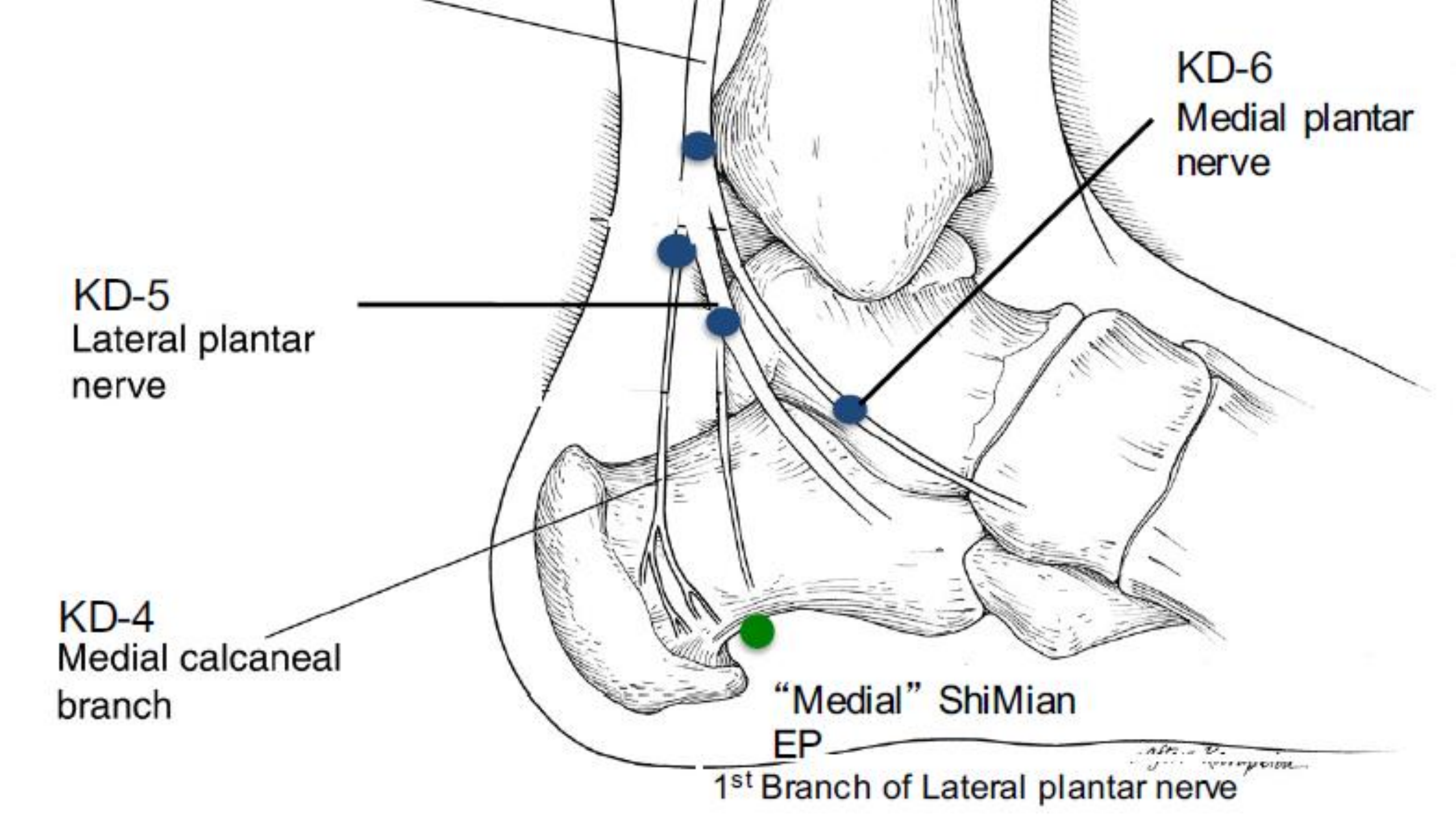
KD-3 TaiXi Great Ravine

- Posterior Tibial Nerve
- 太溪者，土也。在足內踝後跟骨上動脈陷者中，足少陰脈之所注也，為俞。刺入三分，留七呼，灸三壯。
- Systematic Classic: KD-3, Earth element. In the depression of the pulsating vessel behind the inner ankle bone (malleolus) above the heel bone (calcaneous), where the Foot ShaoYin vessel pours, Shu-Stream point. Puncture 3 fen, retain 7 exhalation moxa 3 cones.
- **Comment**: The pulsating vessel is likely to be the Posterior Tibial Artery. The Posterior Tibial Nerve is adjacent and posterior to the Artery.

- In addition to the saphenous nerve, the sural and tibial nerves contribute cutaneous sensory branches to the medial ankle. Branches from the saphenous nerve sometimes pierce the belly of the abductor hallucis muscle, leading to a connection with the medial plantar nerve by means of a small cutaneous branch. Iatrogenic injury to any of these nerves as in the case of tarsal tunnel release can lead to loss of sensation in the area of Kl 3

KD-4 DaZhong Large Goblet

- Medial Calcaneal Nerve
- 大鐘，在足跟後衝中，別走太陽足少陰絡，刺入二分，留七呼，灸三壯。
- Systematic Classic: KD-4, in the middle of the surging behind the heel, the Foot ShaoYin Luo-Connecting Collateral separating to the TaiYang, puncture 2 fen, retain 7 exhalation, moxa 3 cones.
- Comment: KD-4 is the Luo-Connecting point of the channel which is said to encircle the heel and connect with the UB channel. The Medial Calcaneal Nerve anastomoses with the Lateral Calcaneal Nerve (Sural) which satisfies this KD to UB connection.


KD-6
Medial plantar nerve
KD-5
Lateral plantar nerve
KD-4
Medial calcaneal branch
"Medial" ShiMian EP
1st Branch of Lateral plantar nerve

- The saphenous, sural and tibial nerves contribute cutaneous sensory branches to the medial ankle. 4 Branches from the sap he nous nerve sometimes pierce the belly of the abductor hallucis muscle, lead in g to a connection with the medial plantar nerve by means of a small cutaneous branch. Iatrogenic injury to any of these nerves as in the case of tarsal tunnel release can lead to loss of sensation in the area of Kl 4.

– Calcaneal (Achilles) tendon
KI 4

KD-5 ShuiQuan Water Spring

- Lateral Plantar Nerve
- 水泉，足少陰，去太谿下一寸，在足內踝下，刺入四分，灸五壯。
- Systematic Classic: KD-5, Foot ShaoYin, 1 cun below KD-3, below the inner ankle bone (malleolus), puncture 4 fen moxa 5 cones.