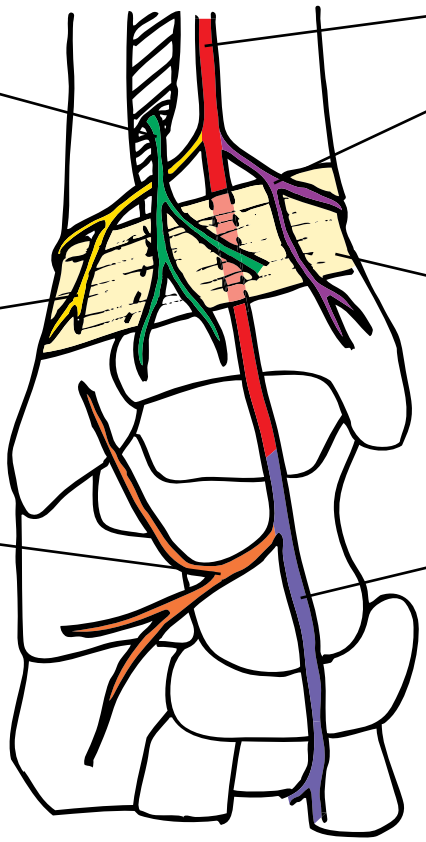
Arterial Supply
Malleolar Arterial Network*
Anterior View

Lateral **Proximal** **Medial**

Perforating Fibular (Peroneal) Artery*
- a branch of the fibular artery that passes anteriorly through the inferior opening in interosseous membrane and continues inferior to reach the tarsus
- supplies tarsal bones dorsally

Anterior Lateral Malleolar Artery*
- normally a branch of the anterior tibial artery that passes laterally around the ankle and anastomoses with the posterior lateral malleolar artery

Lateral Tarsal Artery*
- a branch of either the anterior tibial artery or the dorsalis pedis artery that passes laterally across the tarsus, then recurs and anastomoses with the anterior lateral malleolar artery



Anterior Tibial Artery

Anterior Medial Malleolar Artery*
- a branch of the anterior tibial artery that passes medially around the ankle and anastomoses with the posterior medial malleolar artery

Superior Extensor Retinaculum

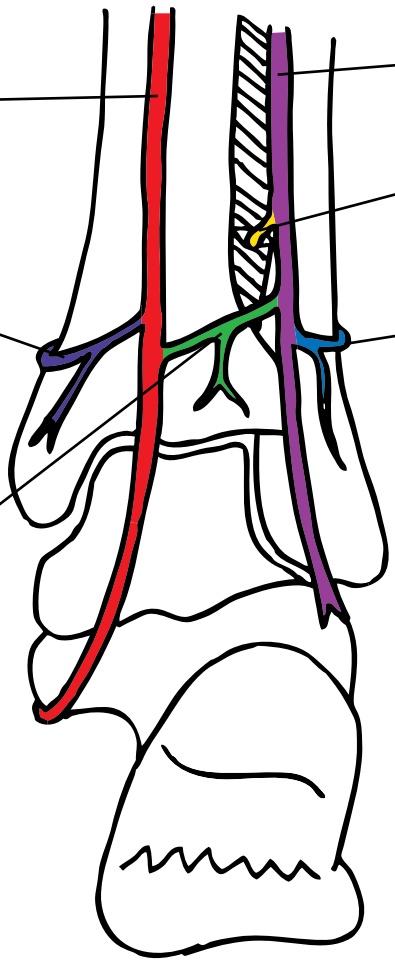
Dorsalis Pedis Artery

The arterial supply to the ankle region is extensive and includes branches from the anterior tibial, posterior tibial, fibular and dorsalis pedis arteries. This includes the malleolar arterial network and the arterial supply to the talus. This extensive supply makes it rare to have necrosis of the bones from severe ankle injuries.

Arteries to the ankle joint arise from malleolar branches of the anterior tibial and peroneal arteries.

Arterial Supply
Malleolar Arterial Network*
Posterior View

Medial **Proximal** **Lateral**



Posterior Tibial Artery

Fibular Artery

Perforating Fibular Artery*

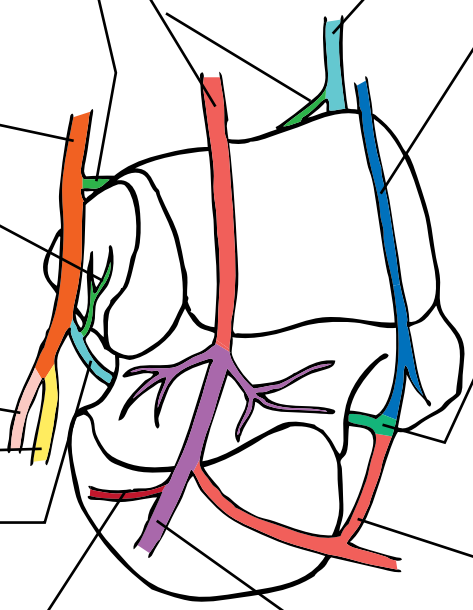
Posterior Medial Malleolar Artery*
- a branch of the posterior tibial artery that passes medially around the ankle and anastomoses with the anterior medial malleolar artery

Posterior Lateral Malleolar Artery*
- a branch of the peroneal artery that passes laterally around the ankle and anastomoses with the anterior lateral malleolar artery
- helps supply the ankle joint

Fibular (Peroneal) Communicating Artery *
- a branch between the posterior tibial artery and the fibular artery that sends a branch to the ankle joint

Arterial Supply to the Talus
Anterior View

Medial **Proximal** **Lateral**



Anterior Tibial Artery

Fibular Communicating Artery
- helps to supply the posterior process of the talus

Posterior Tibial Artery

Deltoid Artery
- branch of the artery of the tarsal canal that directly supplies the talar body
- deep to the deltoid ligament

Medial Plantar Artery

Lateral Plantar Artery

Artery of the Tarsal Canal
- branch of the posterior tibial artery that enters the canalis tarsi
- anastomoses with the artery of the sinus tarsi and this anastomosis helps to supply the talar head and neck

Medial Tarsal Artery
- branch of the dorsalis pedis artery that helps to supply the head and neck of the talus

Fibular Artery

Perforating Fibular (Peroneal) Artery
- branch of the fibular artery that passes through the inferior opening of the interosseous membrane
- anastomoses with the lateral tarsal artery to form the artery of the sinus tarsi

Artery of the Sinus Tarsi
- branch from the anastomosis of the lateral tarsal and the perforating fibular arteries that enters the sinus tarsi from the lateral end to supply the neck of talus
- may be a branch of the dorsalis pedis artery

Lateral Tarsal Artery
- branch of the dorsalis pedis artery that gives off direct branches to the talar head and neck as it recurs

Dorsalis Pedis Artery
- gives off direct branches to the talar head and neck as it passes dorsally across the midfoot

Innervation to the Ankle Joint

Innervation to the ankle joint is supplied by branches from four nerves that pass superficial to the ankle joint. In general, the branches arise at the ankle joint (the level of the malleoli).

Tibial Nerve
- sends branches to the ankle joint as it passes along the postero-medial aspect; it is deep to the fascia cruris

Deep Fibular (Peroneal) Nerve
- sends branches to the ankle joint as it passes along the anterior aspect; it is deep to the fascia cruris at this level

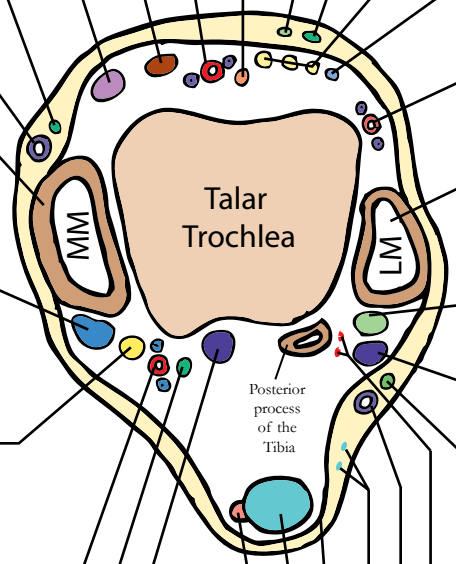
Sural Nerve
- sends branches to the ankle joint as it passes over the posterior lateral aspect; it is in the superficial fascia

Saphenous Nerve
- sends branches to the ankle joint as it passes over the anterior medial aspect; it is in the superficial fascia

Superficial Fibular (Peroneal) Nerve
- crosses the ankle joint at the anterior lateral aspect, but normally does not provide innervation to the ankle joint (probably because it would be easily injured from an inversion ankle sprain)

Ankle Cross Section at the Trochlea Tali
Superior View

Medial **Anterior** **Lateral**



Deep Fibular Nerve
- the anterior central structure

Dorsalis Pedis Artery

Extensor Hallucis Longus Tendon

Tibialis Anterior Tendon
- at the anteromedial ankle

Saphenous Nerve
- the terminations are at this level and around the great saphenous vein
- the nerve is usually slightly anterior to the vein at this level

Great Saphenous Vein
- anterior and superficial to the medial malleolus

Medial Malleolus of the Tibia
- the most medial bone
- the fascia cruris attaches to it anteriorly, medially and posteriorly

Tibialis Posterior Tendon
- from the T in **Tom**
- just posterior to the medial malleolus
- the muscle belly is deep and centrally located; its tendon passes deep /anterior to the flexor digitorum longus tendon to become most medial

Flexor Digitorum Longus Tendon
- from the D in **Dick**
- posterior and slightly lateral to the medial malleolus
- muscle belly is more superficial and medial; its tendon passes superficial (posterior) to the tibialis posterior tendon proximal to the medial malleolus

Posterior Tibial Artery & venae comitantes
- from the A in **and**; for artery
- pulse is palpated here

Tibial Nerve
- from the N in **and**; for nerve
- can often palpate the nerve at this level
- the medial calcaneal nerve usually arises distal to this level

Flexor Hallucis Longus Tendon
- from the H in **Harry**
- passes just medial to the midline of the talus along the groove of the posterior process
- muscle belly is more superficial and lateral
- its tendon remains lateral to the tendons of both the tibialis posterior and flexor digitorum longus at the ankle region

Medial Dorsal Cutaneous Nerve
- the medial branch of the superficial fibular (superficial peroneal) nerve at the anterolateral aspect of the ankle joint

Intermediate Dorsal Cutaneous Nerve
- the lateral branch of the superficial fibular nerve at the anterolateral aspect of the ankle joint

Tendons of Extensor Digitorum Longus
- only 3 tendons are usually present at this level as the 4th has not yet separated

Fibularis Tertius Tendon
- immediately lateral to and with the extensor digitorum longus tendons

Perforating Fibular Artery
- just anterior to the fibula, near the lateral corner of the talus

Lateral Malleolus of the Fibula
- the most lateral bone
- the fascia cruris attaches to it anteriorly, laterally and posteriorly.

Fibularis Brevis Tendon
- just posterior to the lateral malleolus
- the more anterior structure

Fibularis Longus Tendon
- the more posterior structure, posterior to the lateral malleolus

Sural Nerve
- courses with the small saphenous vein
- distal to the ankle region it becomes the lateral dorsal cutaneous nerve

Lateral Calcaneal Arteries

Small Saphenous Vein
- posterior and superficial to the lateral malleolus

Lateral Calcaneal Nerves
- arise proximal to this level, usually
- located anterior to the Achilles tendon, but in subcutaneous layer

Deep Fascia / Fascia Cruris
- blends with the fascia dorsalis pedis on the dorsum of the foot and with the plantar aponeurosis on the plantar aspect of the foot

Tendo Calcaneus / Achilles Tendon

Plantaris Tendon
- the small medial structure

Posterior

- Superficial Fascia/ Subcutaneous Layer

Topic 6

Foot Region

The foot is a complex unit which functions to support body weight during standing and movement. Improper foot function can affect the function of the lower limbs. Improper foot function can create pain in the foot, ankle, leg, knee, thigh, hip or back. Improper function in any region proximal to the foot can create improper foot function or foot pain, also.

Pictures and notes used from Dr. Kathy Siesel's lecture note packet and lecture materials

Tarsal Tunnel
Ankle, Rearfoot, and Medial Column
Medial View

Anterior **Superior** **Posterior**

Borders:

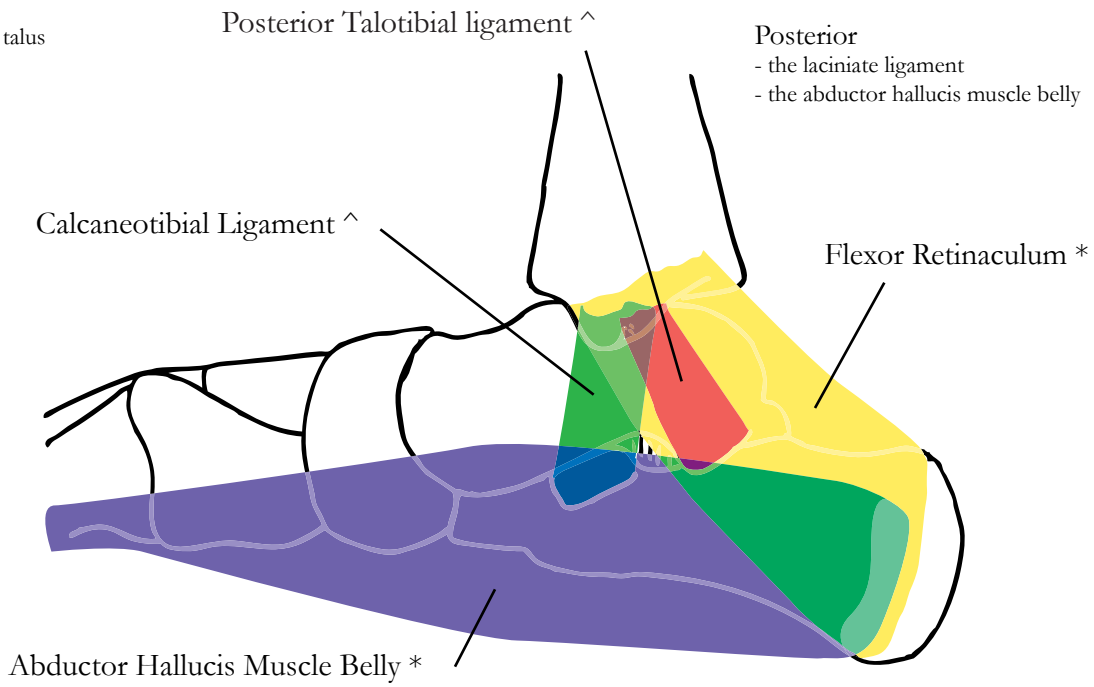
Medial / Superficial *
- the laciniate ligament / flexor retinaculum, proximal
- the abductor hallucis muscle belly, distal

Anterior
- the medial malleolus
- the posterior process of talus
- the sustentaculum tali

Borders:

Lateral / Deep ^
- the posterior talotibial ligaments, proximal
- the calcaneotibial ligament with the ankle joint capsule, superior and distal
- the medial surface of the calcaneus, inferior and distal

Posterior
- the laciniate ligament
- the abductor hallucis muscle belly



Inferior

The tarsal tunnel is an anatomic area at the posteromedial aspect of the ankle. It extends from the proximal edge of the flexor retinaculum to the distal edge of the porta pedis. It is an osseofibrous tunnel and several structures that pass into the plantar region of the foot also pass through the tarsal tunnel.

Contents
- Several soft tissue structures traverse the tarsal tunnel, each in its own compartment. They are listed from anterior to posterior. This is the site of tarsal tunnel syndrome.
- Tibialis Posterior Tendon
- Flexor Digitorum Longus Tendon
- Posterior Tibial Artery & its venae comitantes
  - becomes the medial and lateral plantar arteries within the tarsal tunnel, usually near the porta pedis
  - Medial Calcaneal Arteries
    - arise within the tarsal tunnel
    - normally exit by piercing the flexor retinaculum
    - may also continue through the tarsal tunnel
- Tibial Nerve
  - becomes the medial and lateral plantar nerves within the tarsal tunnel, usually at the proximal end
  - Medial Calcaneal Nerve
    - arises within the tarsal tunnel
    - exits by piercing the flexor retinaculum
- Flexor Hallucis Longus Tendon
  - passes along the inferior aspect of the sustentaculum tali

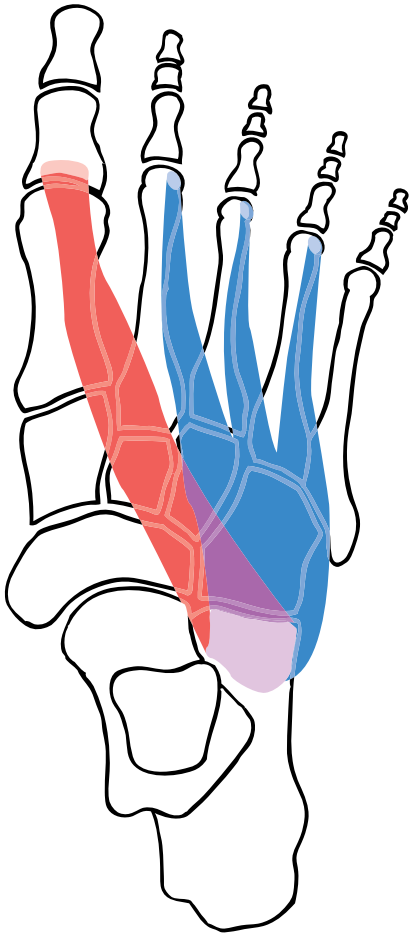
Variation – Anomalous Muscle

Flexor Digitorum Accessorius Longus Muscle
- occasionally present (7%) and may cause tibial nerve entrapment
- passes through the tarsal tunnel with the tibial nerve

O: may arise at any level in the posterior crural compartment, from soft tissue or osseous structures
I: inserts into the flexor digitorum longus tendon with the quadratus plantae muscle, normally
A: supinates the subtalar joint
NS: tibial nerve
AS: posterior tibial artery and fibular artery

Dorsum of the Foot
Intrinsic Muscles
Dorsal View

Medial **Distal** **Lateral**



Extensor Hallucis Brevis Muscle

- the distinct medial belly and tendon of the extensor digitorum brevis muscle
O: (anterolateral) floor of the sinus tarsi and the anterior process of the calcaneus
I: dorsal aspect of the base of the proximal phalanx of the hallux
- the muscle belly passes distomedially and is longer than the extensor digitorum brevis muscle belly; the tendon passes over the dorsal aspect of the first metatarsal head to its insertion
- its tendon passes superficially over the dorsalis pedis artery
- its tendon is often palpable during contraction and sometimes visible over the forefoot
A: dorsiflex the hallux at the metatarsophalangeal joint
NS: lateral terminal branch of the deep fibular nerve
AS: lateral tarsal artery

Extensor Digitorum Brevis Muscle

- a small muscle located over the dorsolateral aspect of the foot
O: (anterolateral) floor of the sinus tarsi and the anterior process of the calcaneus
I: lateral aspect of the extensor digitorum longus tendons 2, 3, 4, within the extensor expansion
- the muscle belly passes in a distomedial direction and is relatively short; the tendons then pass to the dorsolateral aspect of the respective digit
- can palpate the muscle belly during contraction; in some individuals can see the muscle belly and tendons during contraction
A: dorsiflex digits 2, 3 and 4 at the metatarsophalangeal joints
NS: lateral terminal branch of the deep fibular nerve / deep peroneal nerve
AS: lateral tarsal artery

Variations:

- an additional tendon to the 5th digit
- fewer than 3 tendons

Proximal

The dorsum of the foot has one intrinsic muscle with two distinct parts. An intrinsic muscle has both its origin and its insertion in the foot. We have already discussed the extrinsic muscles of the foot. The tendons of the extrinsic muscles are superficial or dorsal to the bellies of the intrinsic muscle. The muscle of the dorsum of the foot receives innervation from the lateral terminal branch of the deep fibular nerve / deep peroneal nerve and nourishment from the lateral tarsal artery. The muscle functions to dorsiflex digits one through four.

Neurovascular - Foot
Dorsal View

Arterial Supply
- arteries lie deep to the muscles and tendons
- often confusing because there is very little subcutaneous soft tissue in this area

Deep Fibular Nerve (1)

Lateral Tarsal Artery (2)
- branch of the dorsalis pedis artery which passes distolaterally, deep to the extensor digitorum brevis and extensor hallucis brevis muscle bellies and supplies them
- anastomoses with the arcuate artery, the lateral plantar artery and the perforating fibular artery
- supplies tarsal bones, extensor digitorum brevis and extensor hallucis brevis muscles, and deep soft tissue structures
- its pulse can be palpated near the proximomedial edge of the extensor digitorum brevis muscle belly

Lateral Terminal Deep Fibular Nerve (3)
- similar course as the arcuate artery or the lateral tarsal artery
- passes deep to and innervates the extensor digitorum brevis and extensor hallucis brevis muscle bellies
- sends minute branches into the 2nd through 4th interspaces which supply the intertarsal, tarsometatarsal and metatarsophalangeal joints of these toes

Arcuate Artery (4)
- a branch of the dorsalis pedis artery near the base of the 2nd metatarsal which passes laterally across the bases of the metatarsal bones 2 through 5
- anastomoses with the lateral tarsal artery
- gives rise to 3 dorsal metatarsal arteries

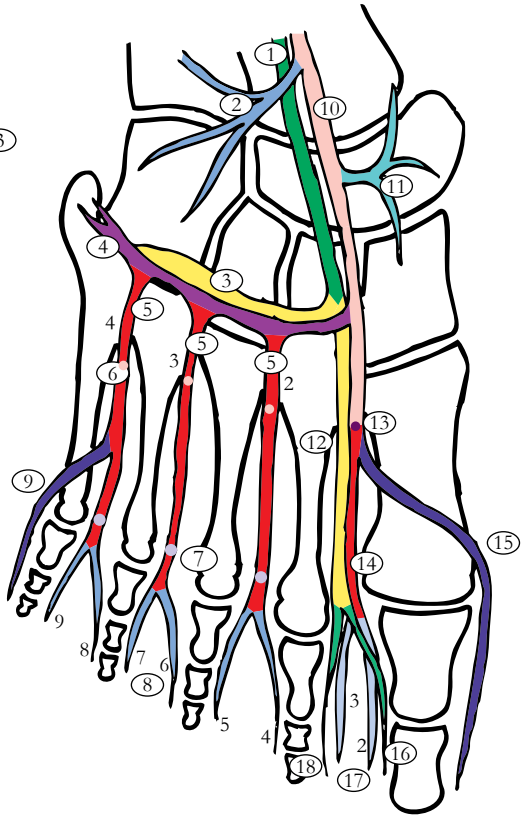
Variations:
- if the arcuate artery is absent, the dorsal metatarsal arteries arise from either the lateral tarsal artery or the proximal perforating arteries (between the dorsal and plantar metatarsal arteries at the proximal end of the intermetatarsal space)
- when the dorsal metatarsal arteries arise from the lateral tarsal artery, then the lateral tarsal artery is in a more distal position
- the lateral tarsal artery position can be normal when the dorsal metatarsal arteries arise from the proximal perforating arteries

Dorsal Metatarsal Arteries 2, 3, 4 (5)
- arises between the metatarsal bases and passes distally within the intermetatarsal space, dorsally
- rests on the belly of the (2,3,4) dorsal interosseous muscle

Proximal Perforating Arteries 2, 3, 4 (6)
- a branch of the (2,3,4) dorsal metatarsal artery that passes plantarly at the (2,3,4) proximal intermetatarsal space
- provides anastomosis between the (2,3,4) dorsal metatarsal artery and the (2,3,4) plantar metatarsal artery

Nutrient Artery to the First Metatarsal
- passes into the lateral aspect of the metatarsal shaft near the center

Nerve Supply
- The other proper dorsal digital nerves are branches from the medial, intermediate and lateral dorsal cutaneous nerves of the foot. These are branches of the superficial fibular and sural nerves. Along the dorsum of the foot, these nerves are superficial to the muscles and are found within the subcutaneous layer. The proper dorsal digital nerves are also deep to the superficial veins.



Distal Perforating Arteries 1, 2, 3, 4 (7)
- a branch of the (1,2,3,4) dorsal metatarsal artery which passes plantarly at the distal interspace
- provides anastomosis between the (1,2,3,4) dorsal metatarsal artery and the (1,2,3,4) plantar metatarsal artery

Common Dorsal Digital Artery 4 *thru* 9
- terminations of the dorsal metatarsal artery; one (8) supplies the the lateral side of the toe and another supplies the medial side of the toe

Proper Dorsal Digital Artery 10 (9)
- branch of the 4th dorsal metatarsal artery, courses dorsally over the 5th metatarsal and supplies the dorsolateral side of the 5th toe
- may be a branch of the arcuate artery

Dorsalis Pedis Artery (10)
- continuation of the anterior tibial artery, courses dorsally over the medial midfoot (usually the navicular and intermediate cuneiform)
- its pulse can be palpated at this level, intermediate to the extensor hallucis longus and extensor digitorum longus muscle tendons
- it lies deep to the muscle bellies at the transverse crural ligament and passes deep to the cruciate crural ligament

Variation:
- if the anterior tibial artery is absent, the dorsalis pedis artery arises from the perforating fibular artery

Medial Tarsal Artery (11)
- anastomoses with the medial part of the malleolar arterial network and the medial plantar artery
- supplies medial tarsal bones and deep soft tissue structures

Medial Terminal Deep Fibular Nerve (12)
- at the 1st web space it pierces the fascia dorsalis pedis and becomes subcutaneous
- innervates 1st metatarsal-medial cuneiform joint and the 1st metatarsophalangeal joint
- innervates part of the 1st dorsal interosseous muscle

Deep Plantar Artery Medial (first proximal perforating artery) (13)
- terminal branch of the dorsalis pedis artery
- arises at the proximal end of the 1st interspace and passes plantarly to anastomose with the 1st plantar metatarsal artery

First Dorsal Metatarsal Artery (14)
- terminal branch of the dorsalis pedis artery
- passes distally within the 1st interspace, dorsally
- rests on the dorsal surface of the 1st dorsal interosseous muscle

Proper Dorsal Digital Artery 1 (15)
- branch of first dorsal metatarsal artery, courses dorsally over the first metatarsal and supplies the medial side of the hallux

Proper Dorsal Digital Nerve 2 (16)
- the medial branch of the nerve after it exits the deep fascia
- innervates the lateral aspect of the hallux

Common Dorsal Digital Artery 2 & 3
- terminations of the 1st dorsal metatarsal artery (17)
- two supplies the lateral side of the hallux and three supplies the medial side of the 2nd toe

Proper Dorsal Digital Nerve 3 (18)
- the lateral branch of the nerve after it exits the deep fascia
- innervates the medial aspect of the 2nd toe

Plantar Aponeurosis
Dorsal Foot
Plantar View

Lateral **Distal** **Medial**

Deep Fascia

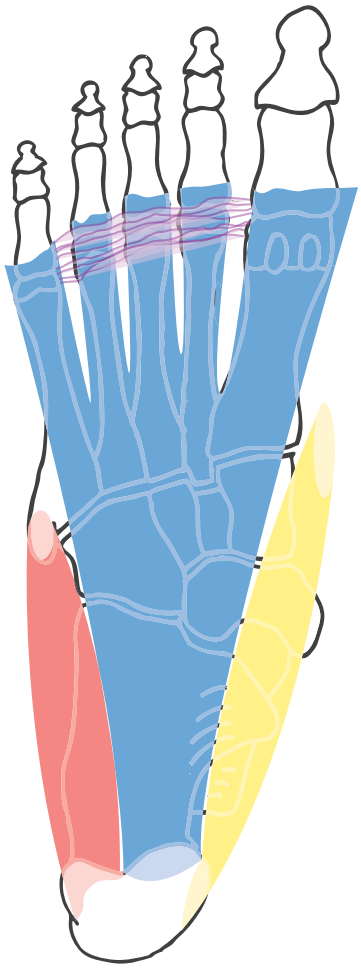
The deep fascia of the plantar aspect of the foot is the plantar fascia or plantar aponeurosis. It is a very strong, thick layer of tissue that attaches to the plantar skin and provides partial attachment for some of the muscles of the plantar aspect of the foot.

Superficial Transverse Metatarsal Ligament

Lateral Band (slip, part)

Distal Attachment
- the styloid process of the 5th metatarsal
- it blends with fascia dorsalis pedis laterally, and with the central band of plantar fascia medially
- attaches bone to bone
- septae pass to skin along this course and contain the fat pad

Proximal attachment
- the lateral tubercle of the calcaneal tuberosity



Proximal

The plantar aspect of the foot is covered with a thick cutaneous layer / skin as well as a thick subcutaneous layer of adipose tissue called the plantar fat pad. The layer of adipose tissue is generally less thick in the area of the medial longitudinal arch. The plantar fat pad is generally kept in place by fibers of the plantar aponeurosis called septae. The septae pass to the skin and create small compartments to contain the adipose tissue. The fat pad is thickest in weight-bearing areas: the metatarsophalangeal joints, the lateral column and the calcaneus. The subcutaneous layer provides shock absorption and cushioning for osseous and soft tissue structures.

Central Band (part, slip)

Distal Attachment
- divides into 5 bands (one for each metatarsal) and then into superficial and deep layers before attaching near the metatarsal heads

Superficial Layer
- most plantar, septae pass to skin along course and contain the fat pad
- attaches bone to skin

Longitudinal Fibers
- the skin of the sulcus between the digits and the forefoot

Transverse Fibers
- transverse fibers arise near the attachment at the sulcus and course from one digital band to another forming the metatarsal ligament at the level of the metatarsophalangeal joints

Proximal Attachment
- the medial tubercle of the calcaneal tuberosity, plantar aspect
- the thickest and strongest part

Medial Band (slip, part)

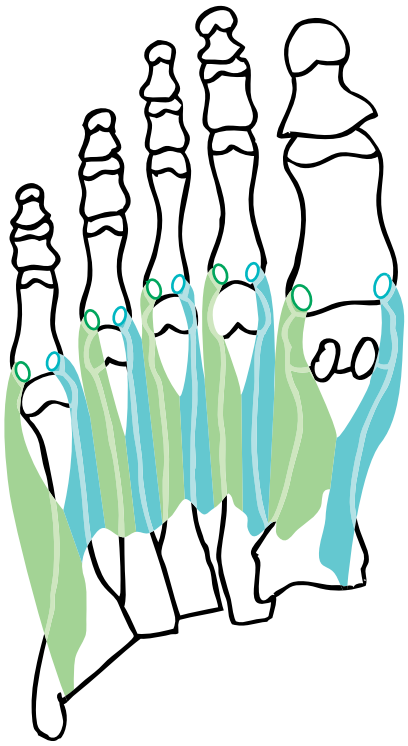
Distal Attachment
- thinnest part of the plantar fascia
- no true bony attachments distally
- it blends with the fascia dorsalis pedis and the lower band of the inferior extensor retinaculum medially, and with the central band of the plantar laterally
- attaches bone to deep fascia
- septae pass to skin along this course and contain the fat pad

Proximal Attachment
- the medial tubercle of the tuberosity of the calcaneus, medial aspect
- the thinnest part

Deep Layer of Central Band of Plantar Fascia Plantar View

Lateral **Distal** **Medial**

Deep Layer of Central Band
- splits into medial and lateral slips that pass along either side of the long and short flexor tendons and attach to the proximal phalangeal bases
- at the 1st metatarsophalangeal joint, these slips attach to the respective sesamoid, too
- attaches bone to bone
- creates the *flexor sheaths*



Central Band - Lateral Slip
- attaches to the lateral aspect of the base of the proximal phalanx of the respective digit, ex. the 3rd band attaches to the lateral proximal phalangeal base of the 3rd toe

Central Band - Medial Slip
- attaches to the medial aspect of the base of the proximal phalanx of the respective digit, ex. the 2nd band attaches to the medial proximal phalangeal base of the 2nd toe

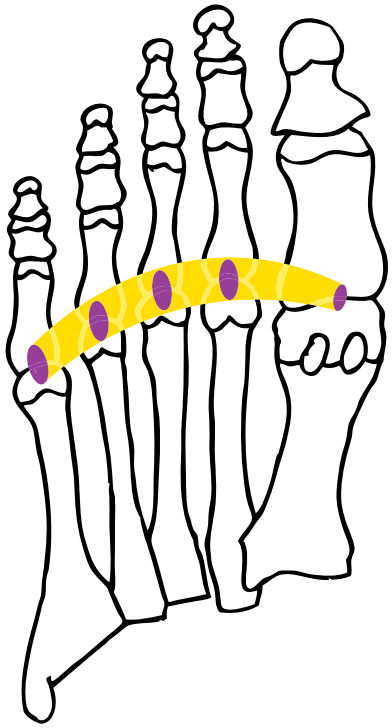
Proximal

Flexor Sheaths
- fibrous tunnels that protect the long and short flexor tendons
- formed as the slips blend with surrounding structures
- *Dorsal Border* – deep transverse metatarsal ligament
- *Medial Border* – medial slip of deep layer of central band of plantar aponeurosis for the respective toe
- *Plantar Border* – superficial transverse metatarsal ligament
- *Lateral Border* – lateral slip of deep layer of central band of plantar fascia for the respective toe

Deep Transverse Metatarsal Ligament
Plantar View

Lateral **Distal** **Medial**

Plantar (Volar) Plate
- a thickening of the plantar aspect of the capsule and the plantar metatarsophalangeal ligament of the metatarsophalangeal joints that serves as a site of attachment for the deep transverse metatarsal ligament
- 1st metatarsophalangeal joint plate is less thick due to the presence of sesamoids



Deep Transverse Metatarsal Ligament
- a relatively firm ligament that connects one metatarsal head to another at the volar plate
- the ligament between the 1st and 2nd metatarsal heads is often thinner and occasionally absent

Proximal