

First Plantar Layer Muscles

Plantar View

First Layer is the most superficial/plantar and contains 3 muscles

Lateral

Distal

Medial

Abductor Digiti Minimi (Quinti) Muscle

- the lateral muscle of the 1st layer
- lies deep to and takes partial origin from the lateral band of the plantar fascia

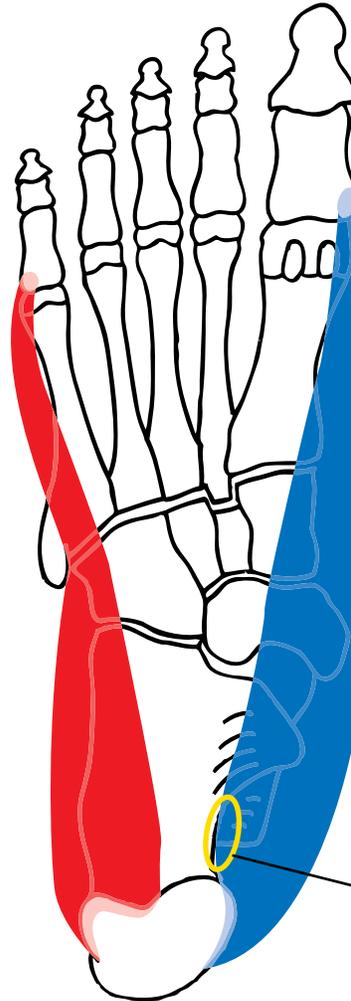
O: the lateral tubercle of the calcaneal tuberosity and the lateral edge of the medial tubercle of the calcaneal tuberosity

I: plantar lateral tubercle of the base of the proximal phalanx of the 5th toe
 - the muscle belly passes along the lateral longitudinal arch and the groove on the plantar surface of the 5th metatarsal base, it becomes tendinous near midshaft and passes along the plantar lateral aspect of the 5th metatarsophalangeal joint

A: abducts the 5th toe; aids in plantar flexion of the 5th toe

NS: lateral plantar nerve

AS: lateral plantar artery



Proximal

Abductor Hallucis Muscle

- the medial muscle of the 1st layer
- lies deep to and takes partial origin from the medial band of the plantar fascia
- often a visible bulge on the medial side of the foot during weight bearing (near the calcaneus)

O: medial tubercle (medial aspect) of the calcaneal tuberosity and the lacinate ligament

I: plantar medial tubercle of the base of the proximal phalanx of the hallux and some fibers insert onto the medial (tibial) sesamoid

- the muscle belly passes along the medial longitudinal arch of the foot and becomes tendinous at the midshaft of the 1st metatarsal bone and passes along the plantar medial aspect of the 1st metatarsophalangeal joint

A: abducts the hallux (moves it away from the midline of the foot); aids in plantar flexion of the hallux

NS: medial plantar nerve

AS: medial plantar artery

Porta Pedis

- the "door of the foot"
- the area (space) between the medial surface of the calcaneus and the abductor hallucis muscle belly
- the distal extent of the tarsal tunnel
- many neurovascular structures to the planta of the foot pass through this area

The muscles of the plantar aspect of the foot are arranged in layers with the neurovascular supply generally passing between these layers. There are four layers of muscles on the plantar aspect of the foot. The muscles of the first and second layers traverse the length of the foot. The muscles of the third and fourth layers are muscles of the forefoot. These muscles, in general terms, receive arterial supply and innervation from the medial and lateral plantar arteries and nerves.

First Plantar Layer Muscles

Plantar View

First Layer is the most superficial/plantar and contains 3 muscles

Lateral

Distal

Medial

Flexor Digitorum Brevis Muscle

- the central muscle of the 1st layer
- lies deep to and takes partial origin from the central band of the plantar fascia

O: plantar aponeurosis, central band and medial calcaneal tubercle, plantar aspect

I: plantar aspect of the bases of the middle phalanges of digits 2 through 5

- the tendons course with the flexor digitorum longus tendons, lying superficial or plantar to the flexor digitorum longus tendons; near the middle of the proximal phalanges the flexor digitorum brevis tendons divide, to allow passage of the flexor digitorum longus tendons, and reunite deep to the flexor digitorum longus tendons prior to inserting on the middle phalangeal bases.

The flexor digitorum longus tendons have a more distal insertion and must pass from a more dorsal to a more plantar position.

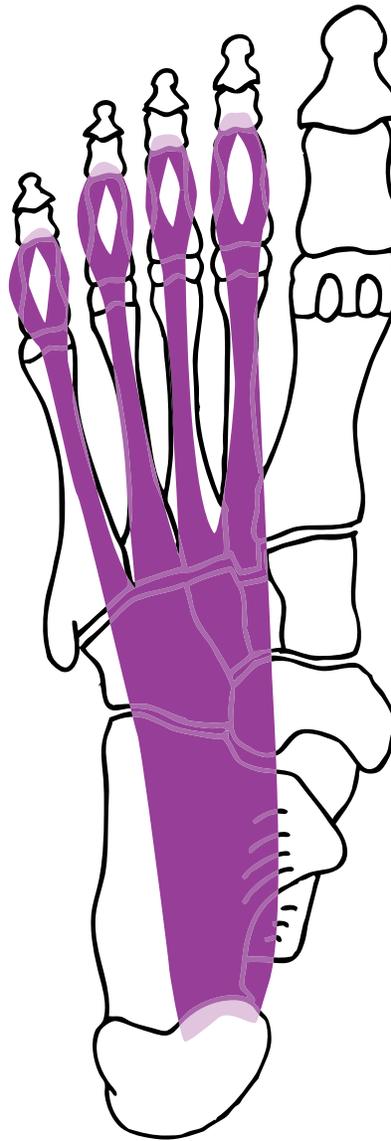
A: plantar flex the lesser digits, begins at the proximal interphalangeal joints then the metatarsophalangeal joints

NS: medial plantar nerve

AS: medial plantar artery

Variations:

- absence of the tendon to the 5th toe
- an extra tendon to the 5th toe
- very small tendon to the 5th toe that seems to arise from the deep surface of the muscle belly.



Proximal

Second Plantar Layer Muscles

Plantar View

- consists of 5 muscles
- all muscles are associated with the flexor digitorum longus tendon(s)
- flexor digitorum longus and flexor hallucis longus tendons pass in this layer

Lateral

Distal

Medial

Quadratus Plantae Muscle

- sometimes called flexor accessorius muscle
- proximal muscle of the 2nd layer
- lies deep to flexor digitorum brevis muscle belly
- has 2 heads of origin which are separated by the long plantar ligament

O: medial head - medial surface of the calcaneus (inferior to the groove for flexor hallucis longus tendon)

- the larger and more muscular part lateral head – trigonum plantare of calcaneus, proximolaterally (inferior aspect of the calcaneus, distal to the calcaneal lateral tubercle)

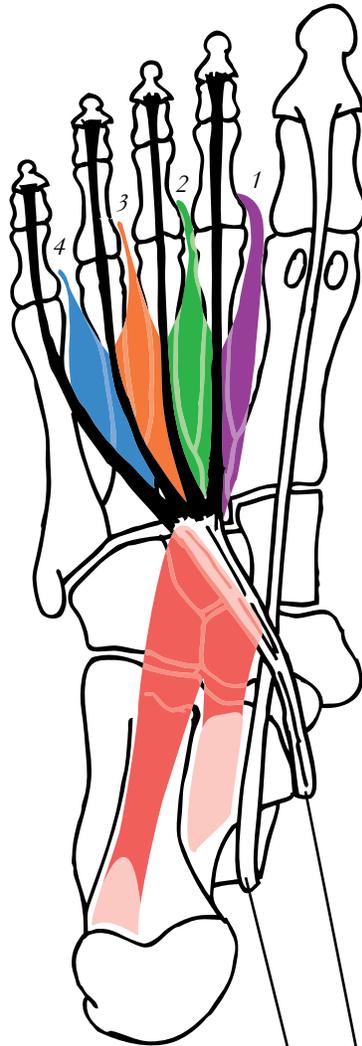
I: the tendon of flexor digitorum longus muscle

- the 2 heads unite and pass to the insertion

A: modifies the direction of pull of the flexor digitorum longus muscle (modifies the action of the flexor digitorum longus muscle); the flexor digitorum longus muscle will pull in a more posterior direction instead of a medial posterior direction

NS: lateral plantar nerve

AS: medial plantar and lateral plantar arteries



Lumbrical Muscles (1, 2, 3 and 4)

- distal muscles of the 2nd layer (at the forefoot)
- there are 4 lumbrical muscles
- one muscle for each intermetatarsal space

O: first - medial side of 1st tendon of flexor digitorum longus muscle

- second, third and fourth - adjacent sides of the tendons of flexor digitorum longus muscle; one between each two tendons
 - ex. the 2nd lumbricale originates from the lateral side of the 1st tendon and the medial side of the 2nd tendon of flexor digitorum longus muscle, etc.

I: the medial aspect of the extensor wing portion of the extensor expansion/ extensor hood apparatus at the proximal phalangeal base; the 1st lumbrical muscle inserts into the extensor wing of the 2nd metatarsophalangeal joint (MTPJ), etc.

- the tendons pass along the medial side of the respective metatarsals, then pass plantar to the deep transverse metatarsal ligament before inserting

A: plantar flex / flex the metatarsophalangeal joints and dorsiflex / extend the proximal and distal interphalangeal joints (PIPJs and DIPJs) of the lesser toes, simultaneously (the bye-bye muscles); ex. 1st lumbrical muscle acts upon the 2nd toe, etc.

NS: first - medial plantar nerve

- second, third and fourth - deep branch of the lateral plantar nerve

AS: plantar metatarsal arteries, respectively; ex. the 1st plantar metatarsal artery supplies the 1st lumbrical muscle, etc.

Variations:

- absence of one or more of the lumbricales
- the second lumbricale is rarely absent

Flexor Digitorum Longus Muscle

Flexor Hallucis Longus Muscle

Proximal

Third Plantar Layer Muscles

Plantar View

deep / dorsal to the 2nd layer
- contains 3 muscles

- tendons of peroneus longus and tibialis posterior muscles pass in this layer

Lateral

Distal

Medial

Flexor Digiti Minimi (Quinti) Brevis Muscle

- small muscle located at the plantar lateral aspect of the forefoot

O: plantar medial aspect of the base of 5th metatarsal and fibularis longus tendon sheath / fibular canal

I: plantar lateral aspect of the base of the proximal phalanx of 5th digit, with abductor digiti minimi muscle
- passes directly along the metatarsal shaft

A: plantar flexion (flexion) of the 5th digit at the metatarsophalangeal joint; some abduction of the 5th digit often occurs

NS: superficial branch of the lateral plantar nerve

AS: lateral plantar artery

Variation:

Opponens Digiti Minimi (Quinti) Muscle
- an insertion of the flexor digiti minimi brevis muscle on the plantar aspect of the 5th metatarsal head
- functions to plantar flex and adduct the 5th metatarsal
- to oppose the 1st metatarsal

Fibularis Longus Muscle

Flexor Hallucis Brevis Muscle

- the medial muscle of the 3rd layer
- this muscle has a Y-shaped tendinous origin

O: lateral part – adjacent plantar aspects of the cuboid (medial edge of the peroneal ridge) and the lateral cuneiform (adjacent plantar area)

medial part - tendon of tibialis posterior muscle (near the cuneiforms)

I: plantar medial and plantar lateral tubercles of the base of the hallux proximal phalanx

- the muscle fibers blend as they pass distally then separate into 2 tendons, each tendon surrounds a sesamoid bone before inserting onto the proximal phalanx;

ex. the medial tendon encloses the medial or tibial sesamoid then inserts onto the plantar medial aspect of the base of the proximal phalanx of the hallux, etc.

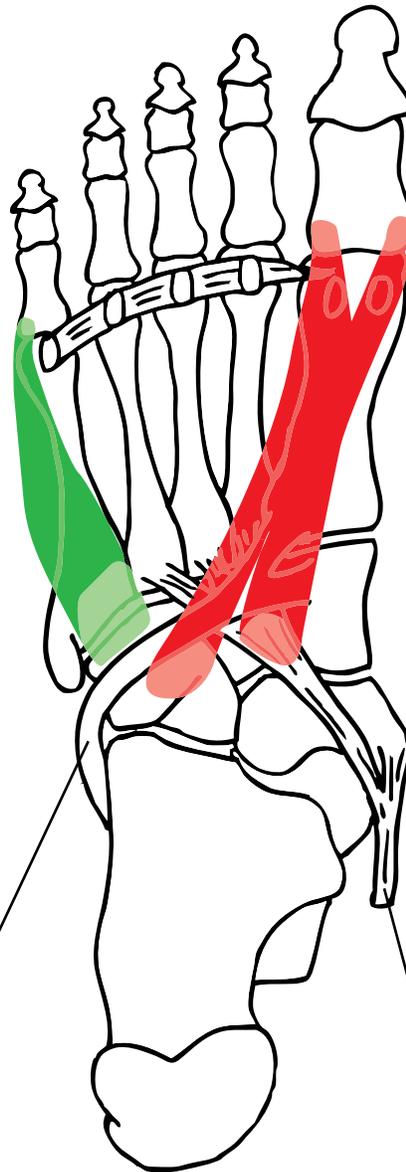
A: plantar flexes / flexes the hallux at the metatarsophalangeal joint

NS: medial plantar nerve

AS: first plantar metatarsal artery (from the plantar arch artery)

Tibialis Posterior Muscle

Proximal



Third Plantar Layer Muscles

Plantar View

deep / dorsal to the 2nd layer
 - contains 3 muscles

- tendons of peroneus longus and tibialis posterior muscles pass in this layer

Lateral

Distal

Medial

Adductor Hallucis Muscle

- the central muscle of the 3rd layer
- sometimes called the transverse pedis muscle
- has 2 heads of origin; transverse and oblique

O: transverse head - the 3rd through 5th plantar plates and the deep transverse metatarsal ligament, plantarly
 oblique head - plantar aspect of the bases of 2nd through 4th metatarsals and the fibularis longus tendon sheath / fibular canal

I: lateral / fibular sesamoid and lateral tubercle of the 1st proximal phalangeal base
 - the part of the tendon that attaches to the proximal phalanx passes dorsal to the deep transverse metatarsal ligament

A: adducts the hallux (toward the midline of the foot); aids in plantar flexion of the hallux

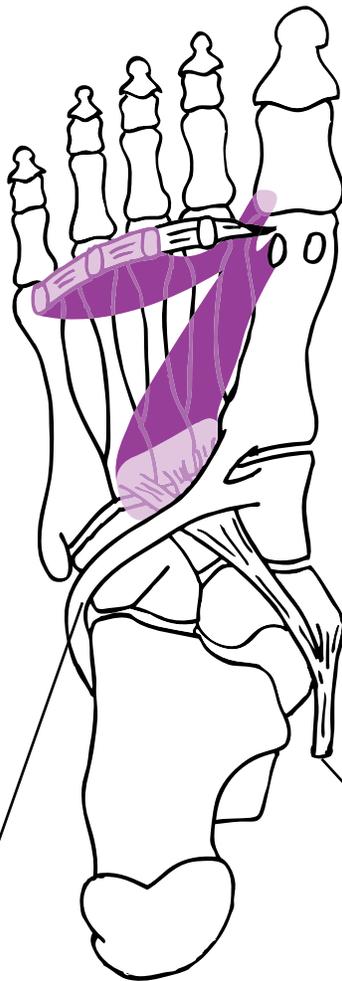
NS: deep branch of the lateral plantar nerve

AS: plantar metatarsal arteries (all 4)

Variation:

Opponens Hallucis Muscle

- an insertion of the adductor hallucis muscle on the plantar aspect of the 1st metatarsal head
- functions to adduct and plantar flex the first metatarsal
- to oppose the 5th metatarsal



Tibialis Posterior Muscle

Fibularis Longus Muscle

Proximal

Fourth Plantar Layer Muscles

Plantar View

- the deepest, most dorsal, layer of plantar muscles, the interossei
- located in the intermetatarsal spaces
- associated with the lesser digits only
- all tendons pass dorsal to the deep transverse metatarsal ligament

Lateral

Plantar Interossei Muscles (1, 2 and 3)

- 3 plantar interossei muscles
- none to 2nd digit
- are unipennate (muscle fibers all pass in the same manner from the origin to the same side of the muscle tendon)

O: plantar aspect of the bases and medial aspect of the shafts of the 3rd, 4th and 5th metatarsals;

- ex. the 1st plantar interosseous muscle arises from the plantar base and medial shaft of the 3rd metatarsal, the 2nd plantar interosseous muscle arises from the plantar base and medial shaft of the 4th metatarsal and the 3rd plantar interosseous muscle arises from the plantar base and medial shaft of the 5th metatarsal

I: medial aspect of the base of the proximal phalanx and extensor expansion of the respective digit;

- ex. the 3rd plantar interosseous muscle inserts medially onto the proximal phalanx and laterally to the extensor expansion of the 5th toe, the 2nd plantar interosseous muscle inserts medially onto the proximal phalanx and laterally to the extensor expansion of the 4th digit, and the 1st plantar interosseous muscle inserts medially onto the proximal phalanx and laterally to the extensor expansion of the 3rd toe

- the tendons pass dorsal (deep) to the extensor expansion

A: adduct digits 3, 4 and 5, respectively (toward the midline of the foot)

- ex. the 1st plantar interosseous muscle adducts the 3rd toe, the 2nd plantar interosseous muscle adducts the 4th toe and the 3rd plantar interosseous muscle adducts the 5th toe

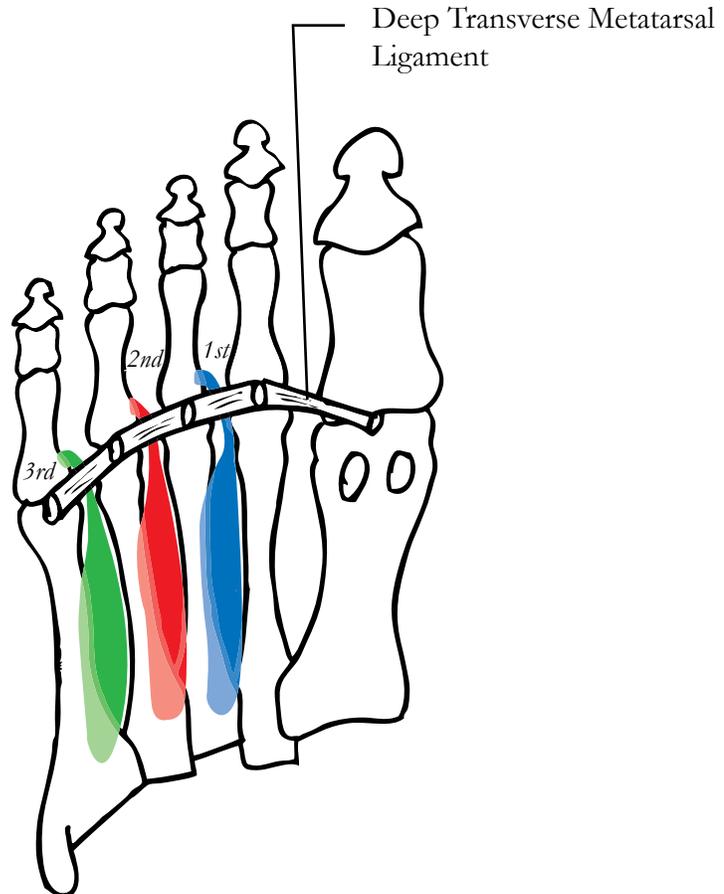
NS: lateral plantar nerve; superficial branch for the 3rd plantar interosseous, and deep branch for 1st and 2nd plantar interosseous muscles

AS: second, third and fourth plantar metatarsal arteries, respectively;

- ex. the 1st plantar interosseous muscle is supplied by the 2nd plantar metatarsal artery, the 2nd plantar interosseous muscle is supplied by the 3rd plantar metatarsal artery, and the 3rd plantar interosseous muscle is supplied by the 4th plantar metatarsal artery

Distal

Medial



Proximal

Fourth Plantar Layer Muscles

Plantar View

- the deepest, most dorsal, layer of plantar muscles, the interossei
- located in the intermetatarsal spaces
- associated with the lesser digits only
- all tendons pass dorsal to the deep transverse metatarsal ligament

Lateral

Dorsal Interossei Muscles (1, 2, 3 and 4)

- 4 dorsal interossei muscles
- none to 5th toe
- are bipennate (muscle fibers converge upon the central tendon from 2 sides)
- lie dorsal (deep) to the plantar interossei muscles
- in lab, often visible from the dorsum of the foot (between metatarsal bones) also

O: adjacent areas of the metatarsal shafts (one muscle is located in each intermetatarsal space),

ex. the 1st dorsal interosseous muscle originates from the lateral aspect of the 1st metatarsal shaft and the medial aspect of the 2nd metatarsal shaft, the 2nd dorsal interosseous muscle originates from the lateral shaft of the 2nd metatarsal and the medial shaft of the 3rd metatarsal, the 3rd dorsal interosseous muscle originates from adjacent aspects of the 3rd and 4th metatarsal shafts, and the 4th dorsal interosseous muscle originates from adjacent surfaces of the 4th and 5th metatarsal shafts

I: first - medial aspect of the 2nd proximal phalangeal base

second, third and fourth - lateral aspect of the base of the proximal phalanx of the respective toe

ex. the 2nd dorsal interosseous muscle inserts onto the lateral aspect of the 2nd proximal phalangeal base, the 3rd dorsal interosseous muscle inserts onto the lateral aspect of the proximal phalangeal base of the of the 3rd digit, and the 4th dorsal interosseous muscle inserts onto the lateral aspect of the base of the proximal phalanx of the 4th toe

- tendons pass within the extensor expansion

A: abduct toes 2, 3 and 4 (from the midline of the foot), 1st and 2nd abduct the 2nd toe, 3rd abducts the 3rd toe and 4th abducts the 4th toe

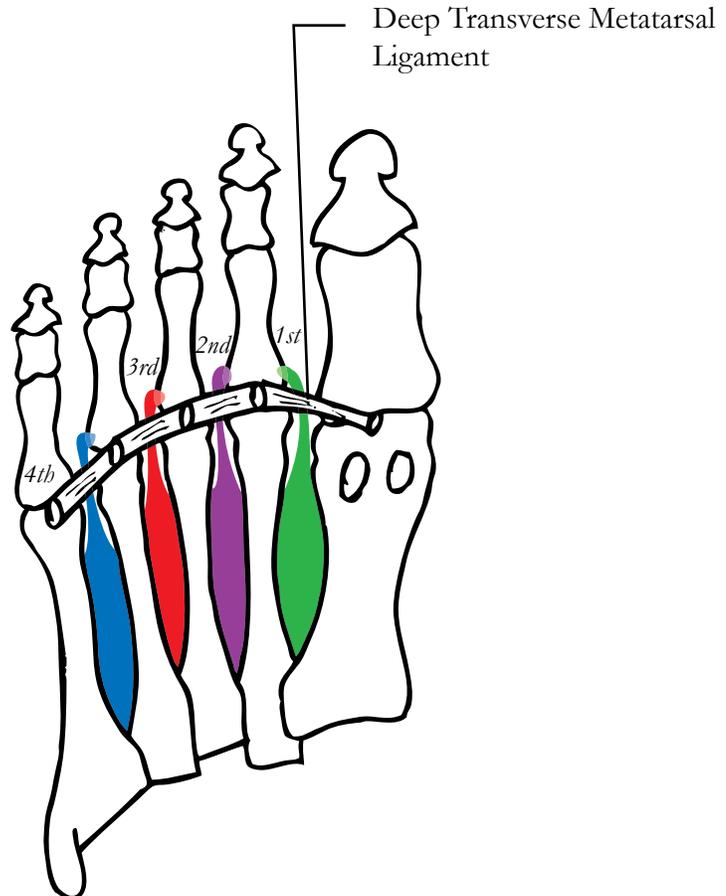
NS: lateral plantar nerve, 1st, 2nd and 3rd from the deep branch and 4th from the superficial branch; 1st and 2nd also receive some supply from the deep fibular / deep peroneal nerve

AS: the respective dorsal metatarsal artery

ex. the 4th dorsal interosseous muscle is supplied by the 4th dorsal metatarsal artery, the 3rd dorsal interosseous muscle is supplied by the 3rd dorsal metatarsal artery, the 2nd dorsal interosseous muscle is supplied by the 2nd dorsal metatarsal artery, and the 1st dorsal interosseous muscle is supplied by the 1st dorsal metatarsal artery

Distal

Medial



Proximal

The functions of the muscles in the fourth layer are most easily remembered by the mnemonic **PAD & DAB**. The first letter represents the interossei muscles; **P** for plantar and **D** for dorsal. The other letters represent the action (function) of the respective interossei; **AD** for adduct and **AB** for abduct. So PAD represents plantar interossei muscles adduct and DAB represents dorsal interossei muscles abduct

Arterial Supply Plantar View

Lateral

Distal

Medial

Common Digital Plantar Arteries 2 thru 9
- terminal divisions of the plantar metatarsal artery
- generally arise distal to the deep transverse metatarsal ligament

Proper Digital Plantar Artery 10 (of Fifth Digit)
- a small lateral branch from the lateral plantar artery as the course turns sharply medial near the 5th metatarsal base
- passes distally intermediate to the abductor digiti minimi muscle (plantar lateral) and flexor digiti minimi brevis muscle (dorsomedial); becomes more superficial near midshaft of the 5th metatarsal
- terminates in the 5th toe where it supplies the toe's plantar lateral aspect

First thru Fourth Distal Perforating Artery
- arises at the (1st, 2nd, 3rd or 4th) distal interspace and connects the (1st, 2nd, 3rd or 4th) dorsal and plantar metatarsal arteries

First thru Fourth Plantar Metatarsal Artery
- 1st arises at the anastomosis of the deep plantar artery / 1st proximal perforating artery and the plantar arterial arch
- passes distally in the (1st, 2nd, 3rd or 4th) intermetatarsal space; passes dorsal to the deep transverse metatarsal ligament

Second thru Fourth Proximal Perforating Artery
- arises at the (2nd, 3rd or 4th) proximal interspace and connects the (2nd, 3rd or 4th) dorsal and plantar metatarsal arteries

Plantar Arterial Arch (Arch Artery)
- the medially directed continuation of the lateral plantar artery
- passes medially at the metatarsal bases, dorsal to the oblique head of adductor hallucis muscle and plantar to the interossei muscles; intermediate to layers 3 and 4
- gives rise to 4 plantar metatarsal arteries and anastomoses with the deep plantar artery

Lateral Plantar Artery
- the posterior branch of the posterior tibial artery
- usually larger than the medial plantar artery
- passes anterolaterally toward the 5th metatarsal styloid process; dorsal to the flexor digitorum brevis muscle and plantar to the quadratus plantae muscle, intermediate to layers 1 and 2

Proper Digital Plantar Artery 1 (of hallux)
- the medial division of the superficial branch of the medial plantar artery
- supplies the medial plantar aspect of the hallux

Digital Branch of First Plantar Metatarsal Artery
- passes medially to anastomose with the proper digital plantar artery 1 (of the hallux)

First Proximal Perforating Artery (Deep Plantar Artery)
- arises at the First proximal interspace and connects the First dorsal and plantar metatarsal arteries

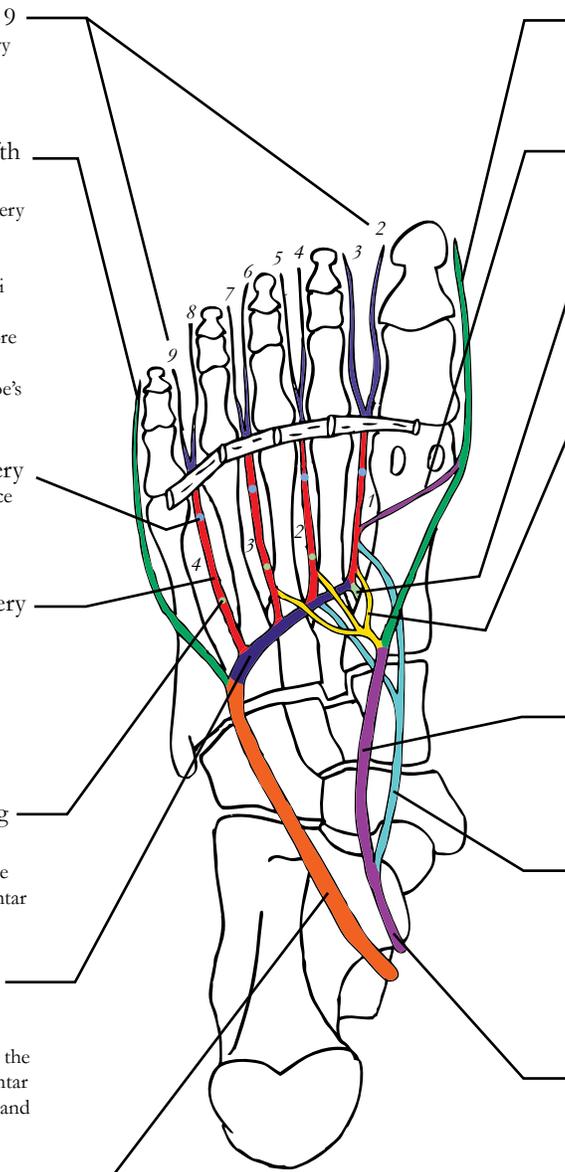
Superficial Digital Branch
- the lateral division of the superficial branch of the medial plantar artery
- anastomoses with the 1st, 2nd and 3rd plantar metatarsal arteries
- occasionally provides small common digital plantar arteries which pass plantar to the deep transverse metatarsal ligament in addition to the normal metatarsal arteries and common digital plantar arteries

Superficial Branch
- appears as the direct continuation of the medial plantar artery and passes distally intermediate to the abductor hallucis (medial) and the flexor digitorum brevis (lateral) muscles; within the 1st layer

Deep Branch / ramus profundus
- usually arises near the origin of the medial plantar artery
- passes along the plantar aspect of the medial foot bones and supplies them
- anastomoses with the plantar arch artery and the 1st plantar metatarsal artery

Medial Plantar Artery
- the anterior branch of the posterior tibial artery
- usually smaller than the lateral plantar artery
- enters the foot through the porta pedis intermediate to plantar layers 1 and 2
- the passes along the medial aspect of the foot intermediate to the abductor hallucis and flexor digitorum brevis muscles; within the 1st layer

Nutrient Artery to the 5th Metatarsal
- passes to the medial aspect of the 5th metatarsal shaft and pierces it in its proximal one-third



Proximal

The arterial supply to the plantar aspect of the foot is via the medial and lateral plantar arteries. These are the terminal branches of the posterior tibial artery.

These branches usually arise deep to the flexor retinaculum and pass into the foot via the tarsal tunnel and the porta pedis. Several small medial calcaneal arteries usually arise from the posterior tibial artery prior to this division and pierce the flexor retinaculum.

The lateral calcaneal arteries are terminal divisions of the peroneal artery, posterior to the lateral malleolus

Nerve Supply Plantar View

Lateral

Proper Digital Plantar Nerves 2 thru 9

- cutaneous branches which are terminal divisions of common digital plantar nerve 1 thru 4 and arise near the deep transverse metatarsal ligament
- one supplies the plantar lateral aspect of the digit while the other supplies the plantar medial aspect of the neighboring digit

Proper Digital Plantar Nerve 10 (of 5th digit)

- a cutaneous branch that supplies the plantar lateral aspect of the 5th toe
- becomes cutaneous near the 5th metatarsal midshaft

Communicating Branch

- from the superficial lateral plantar nerve
- joins the 3rd common digital plantar nerve, a branch of the medial plantar n.

Superficial Branch of Lateral Plantar Nerve

- arises near the base of the 5th metatarsal
- provides cutaneous, articular and muscular branches along its course
- provides muscular innervation to the flexor digiti minimi brevis muscle, 3rd plantar interosseous muscle, and the 4th dorsal interosseous muscle

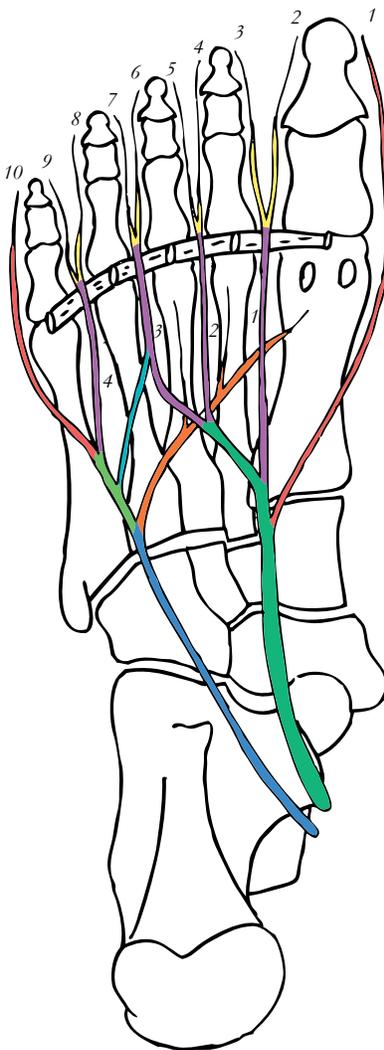
Deep Branch of Lateral Plantar Nerve

- passes medially from near the base of the 5th metatarsal with the plantar arterial arch
- passes intermediate to layers 3 and 4
- provides articular and muscular branches along its course
- provides muscular innervation to the 2nd, 3rd and 4th lumbrical muscles; adductor hallucis muscle; 1st and 2nd plantar interosseous muscles; and 1st, 2nd and 3rd dorsal interosseous muscles

Lateral Plantar Nerve

- the smaller posterior branch of the tibial nerve
- courses with the lateral plantar artery; deep to the flexor digitorum brevis muscle and superficial to the quadratus plantae muscle; intermediate to layers 1 and 2, lying just anterior (distal) to the lateral plantar artery in the foot, normally
- provides muscular innervation to the following: abductor digiti minimi muscle; quadratus plantae muscle; 2nd, 3rd and 4th lumbrical muscles; adductor hallucis muscle (transverse and oblique heads); flexor digiti minimi brevis muscle; opponens digiti minimi muscle (when present); the plantar interosseous muscles; the dorsal interosseous muscles;
- provides cutaneous innervation, plantarly to the lateral 1½ toes, and the lateral 1/3 of the midfoot and forefoot

Distal



Proximal

Medial

Proper Digital Plantar Nerve 1 (of the Hallux)

- provides cutaneous innervation to the plantar medial aspect of the hallux
- becomes cutaneous near the 1st metatarsal midshaft

Common Digital Plantar Nerve 1, 2, 3 & 4

- passes distally in the (1st, 2nd, 3rd or 4th) interspace (respectively), passes plantar to the deep transverse metatarsal ligament then divides
- becomes cutaneous near the (1st, 2nd, 3rd or 4th; respectively) metatarsal head
- 3 is joined by the communicating branch of the lateral plantar nerve

Medial Plantar Nerve

- the larger anterior branch of the tibial nerve
- courses with the medial plantar artery; intermediate to the abductor hallucis muscle (medial) and the flexor digitorum brevis muscle (lateral); within layer 1, lying anterior (distal) to the artery
- provides muscular innervation to the following: abductor hallucis muscle, flexor digitorum brevis muscle, flexor hallucis brevis muscle, and 1st lumbrical muscle
- provides cutaneous innervation, plantarly, to the medial 3½ toes, and the medial 2/3 of the midfoot and forefoot

Innervation to the plantar aspect of the foot is via the medial and lateral plantar nerves. These are branches of the tibial nerve and arise deep to the lacinate ligament. These nerves enter the foot deep to the abductor hallucis muscle belly through the tarsal tunnel and the porta pedis.

The medial calcaneal nerve arises in this area and pierces the lacinate ligament / flexor retinaculum to reach its area of innervation. This nerve supplies cutaneous innervation to the medial ½ of the calcaneal region. This may be a site of entrapment for the medial calcaneal nerve as it passes through the lacinate ligament. There may be more than one medial calcaneal nerve branch.

The lateral calcaneal nerves arise from the sural nerve, in the superficial fascia, approximately 1" proximal to the lateral malleolus. These branches pass inferiorly to supply the lateral ½ of the calcaneal region.