

# **Sole of Foot**

## **Note:**

These is a preliminary consideration of the chapter for better & actual understanding of the topic kindly refer to the textbook for any missconcept teacher is not responsible.

**Sole:** It is the plantar aspect of the foot and corresponds to the palm of the hand.

## SKIN

### Features

1. Thick for protection
2. Firmly adherent to the underlying plantar aponeurosis
3. Creased

The nerves are:

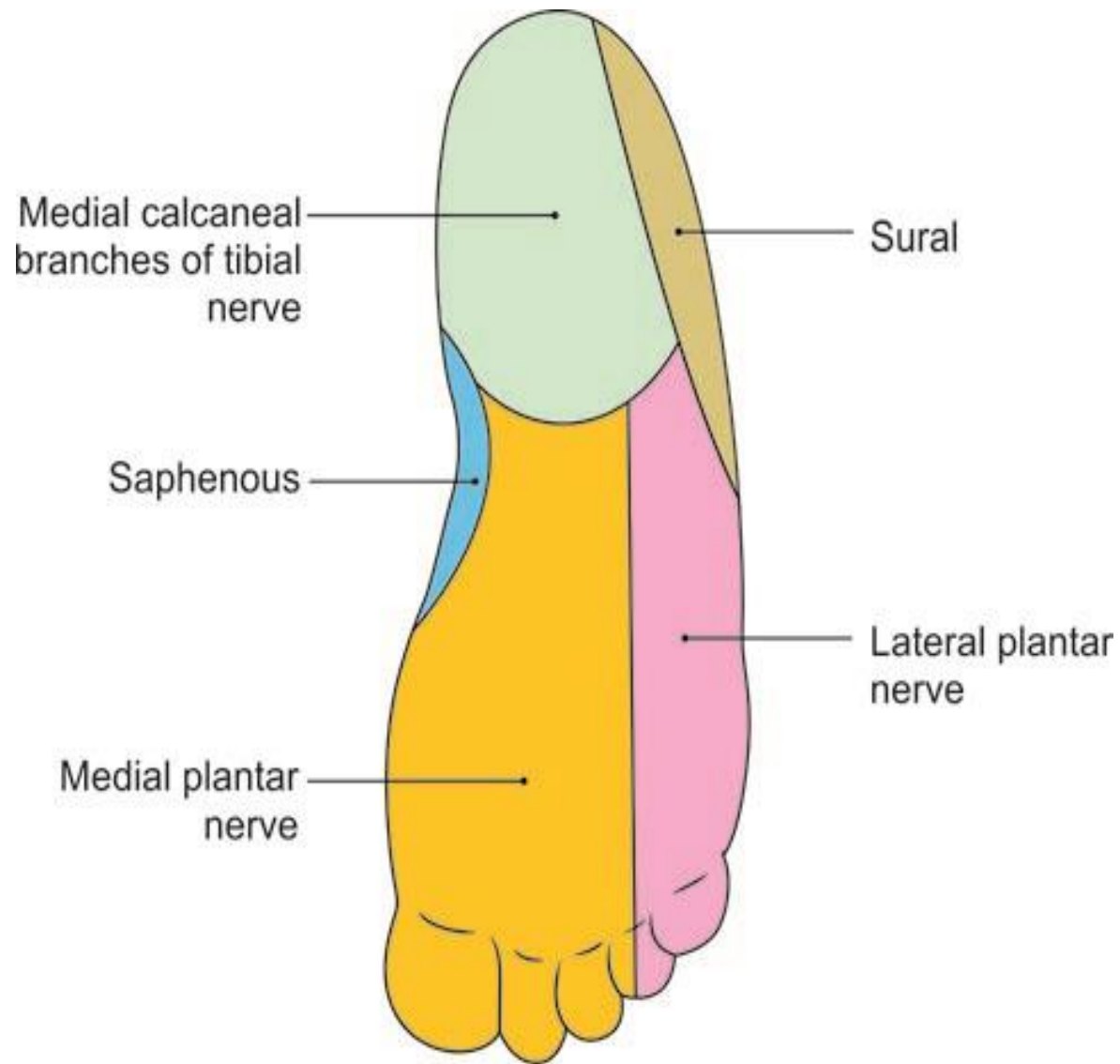
- Medial calcaneal branches of the tibial nerve
- Branches from the medial plantar nerve
- Branches from the lateral plantar nerve

- Small areas on medial and lateral sides are innervated by saphenous and sural nerves.

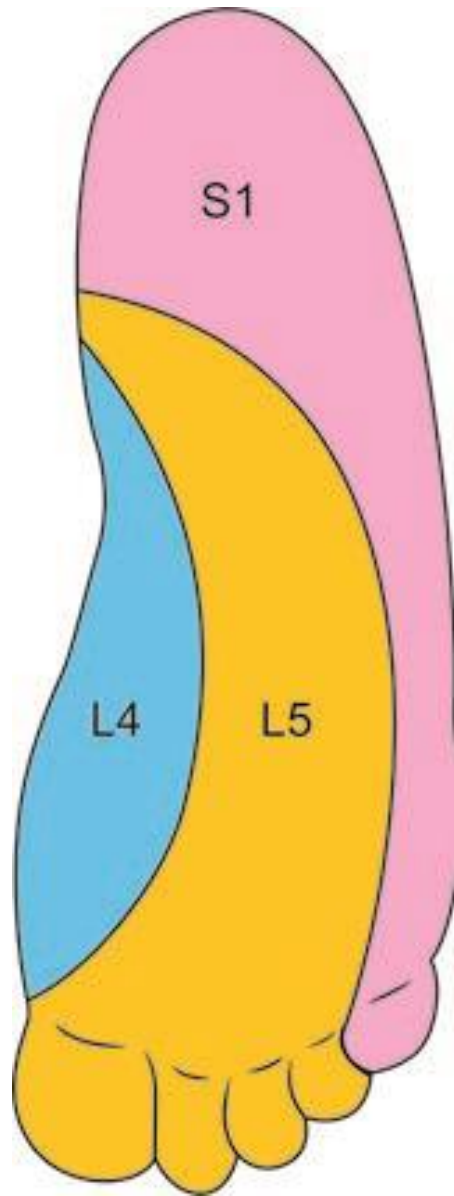
Dermatomes on the sole are shown in figure.

## **SUPERFICIAL FASCIA**

It contains cutaneous nerves and superficial transverse metatarsal ligaments.



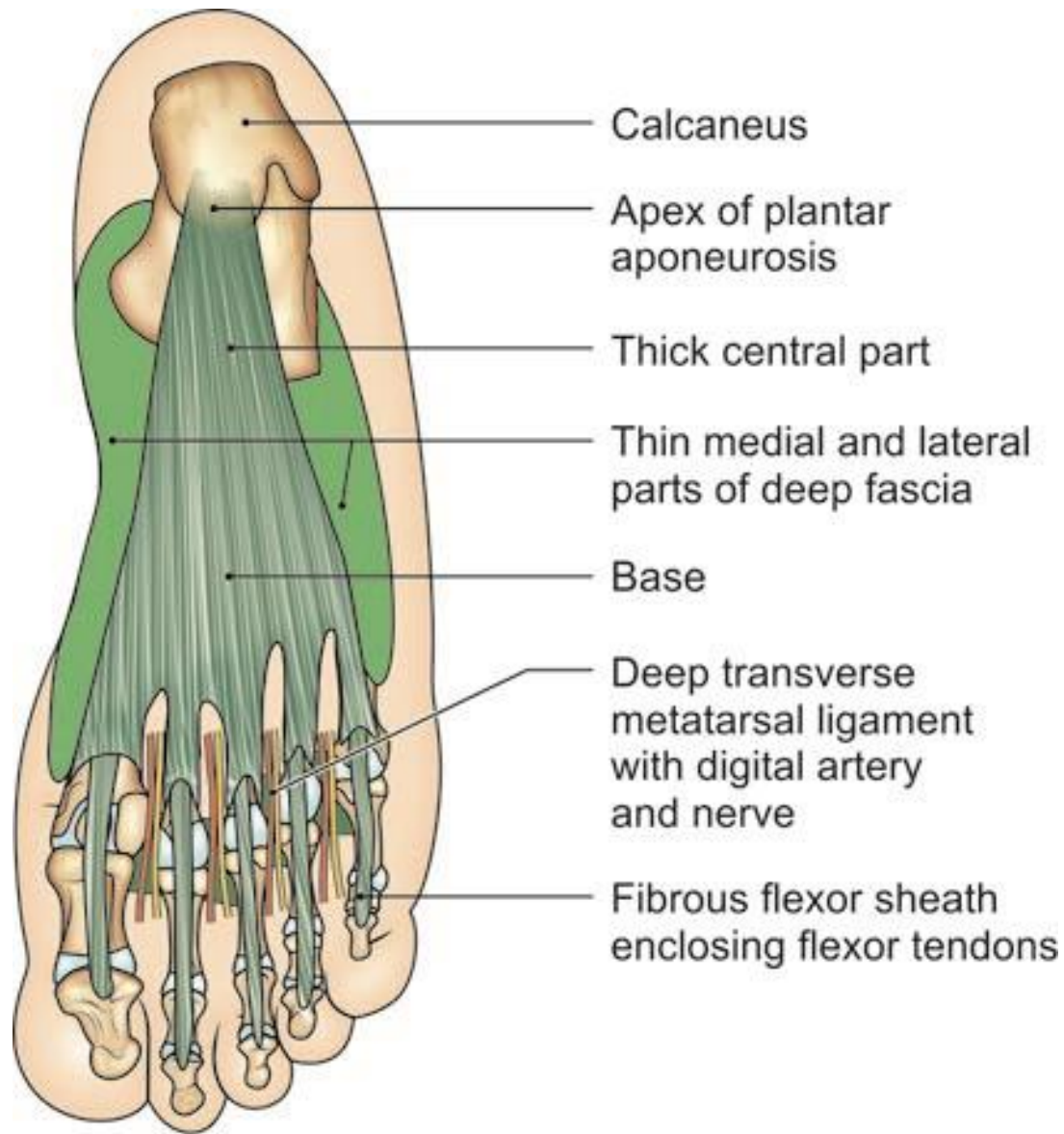
Cutaneous nerves supplying the sole



Dermatomes on the sole

## DEEP FASCIA

1. The plantar aponeurosis in the sole.
2. The deep transverse metatarsal ligaments
3. The fibrous flexor sheaths in the toes.

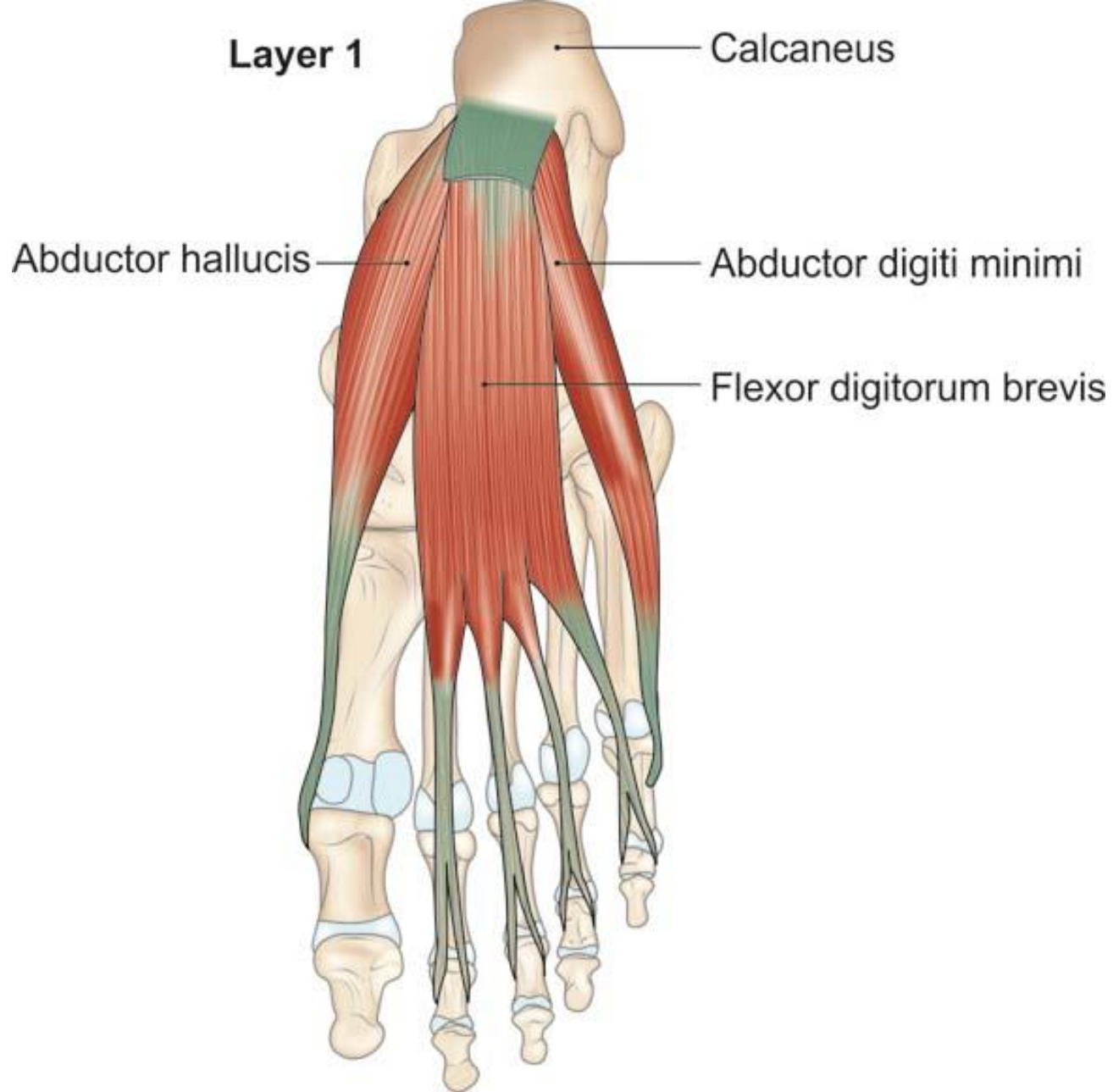


Deep fascia of the sole

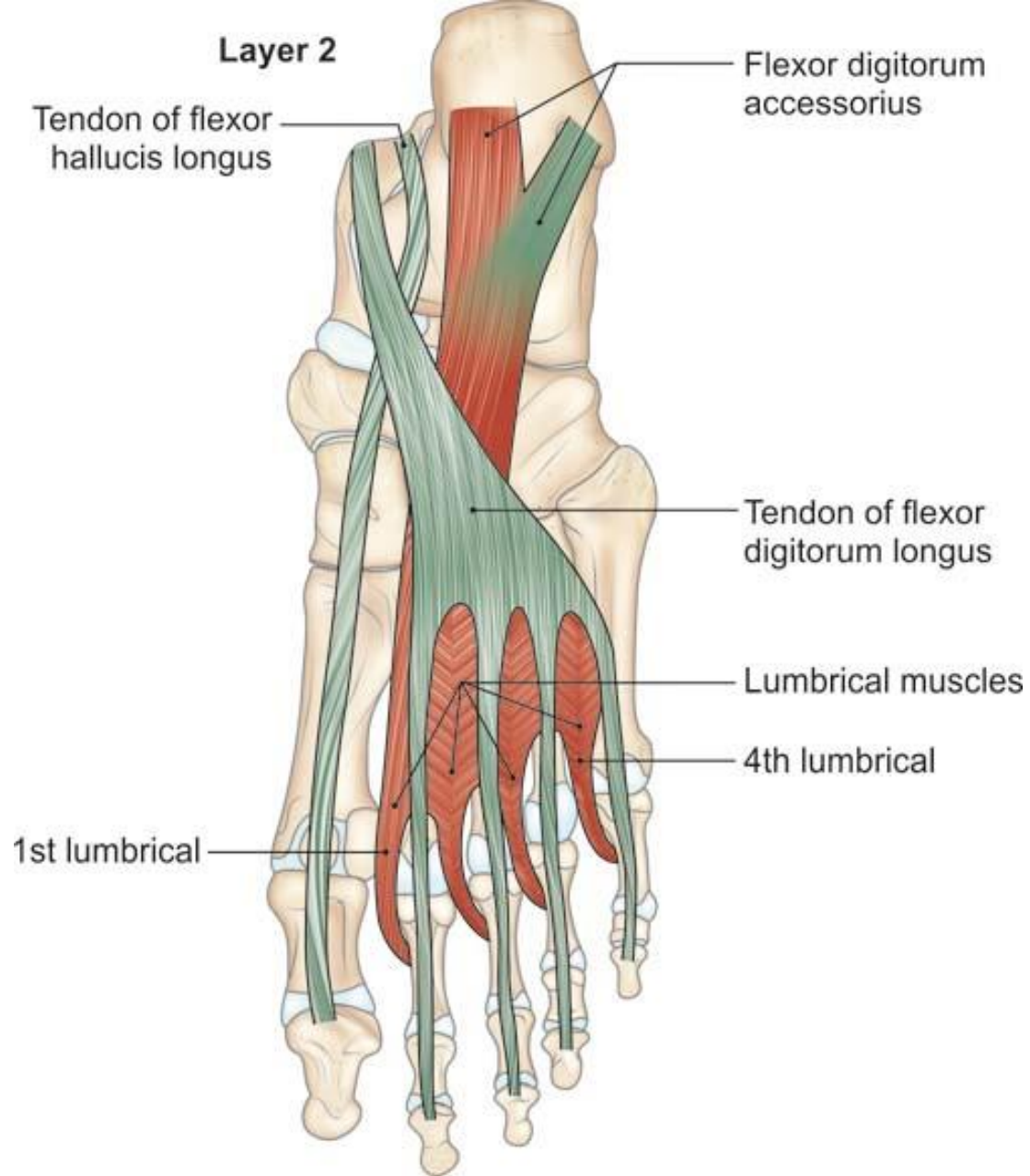


## **Muscles of Sole**

The muscles of the sole are arranged in four layers, which will be considered one by one.

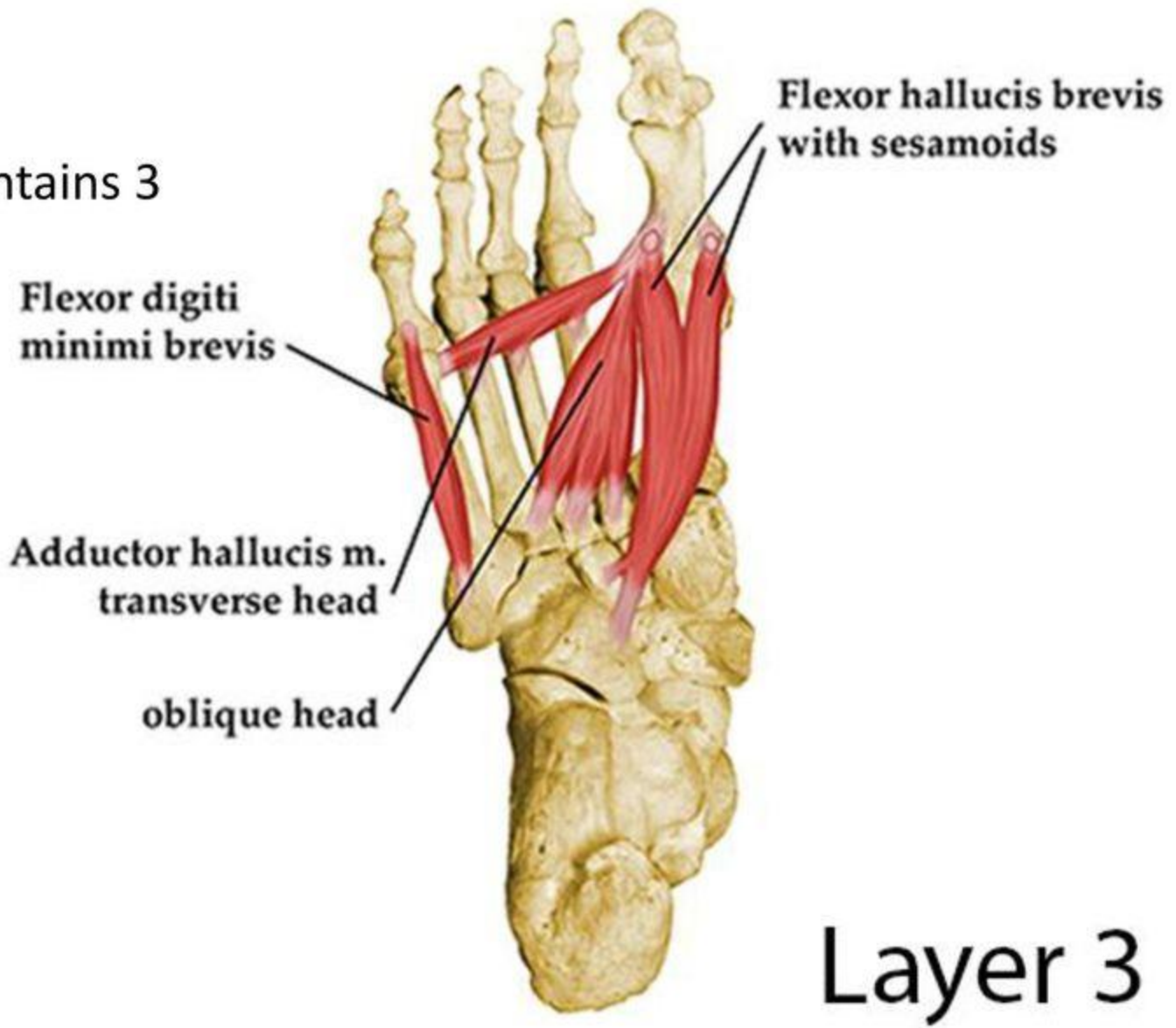


Muscles of the first layer of the sole



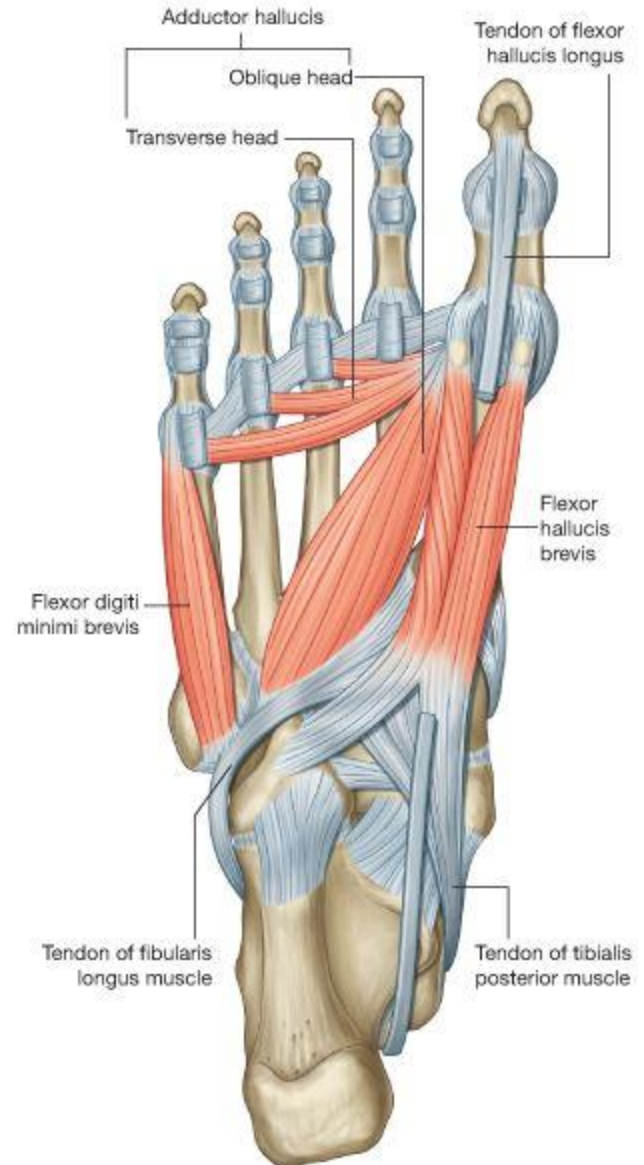
Muscles and tendons of the second layer of the sole

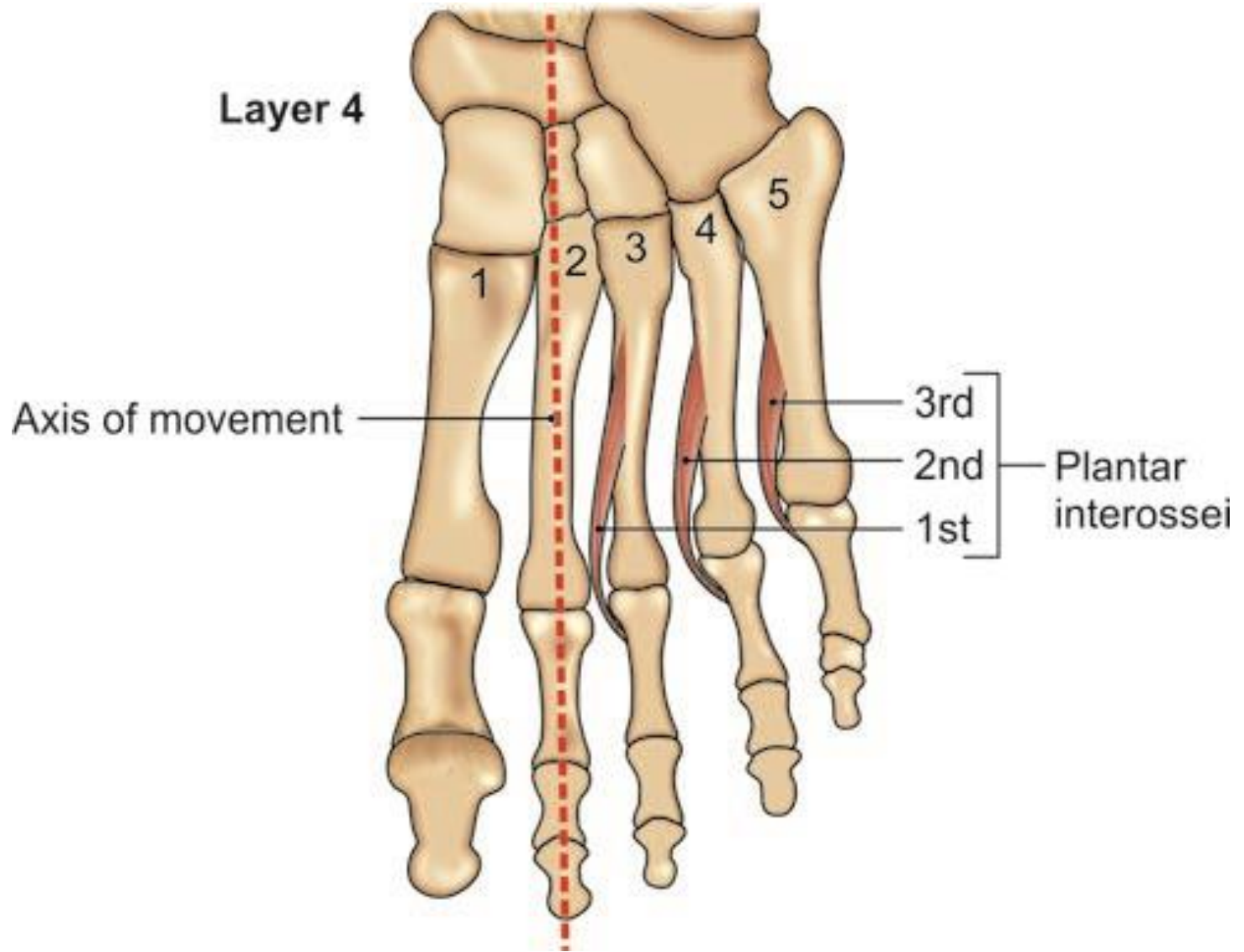
- 3- 3<sup>rd</sup> layer contains 3 muscles



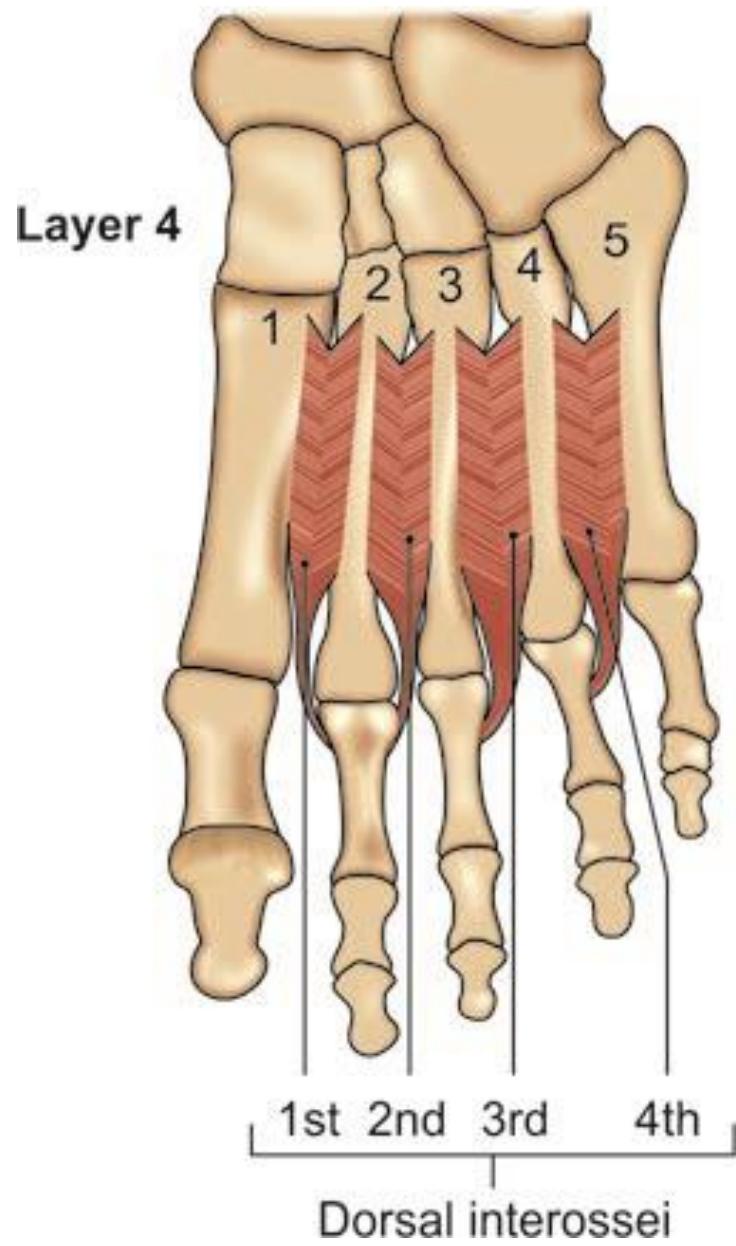
# 3<sup>rd</sup> Layer

- **Three Muscles:**
  - 1) Flexor hallucis brevis.
  - 2) Adductor hallucis
  - 3) Flexor digiti minimi brevis





The plantar interossei



The dorsal interossei

# MUSCLES AND TENDONS OF THE FIRST AND

Table 10.1: Muscles of the first layer of the sole

<i>Muscle</i>	<i>Origin</i>	<i>Insertion</i>
<b>1. Flexor digitorum brevis</b> This muscle lies deep to the plantar aponeurosis	a. Medial tubercle of calcaneum b. Plantar aponeurosis c. Medial and lateral intermuscular septa	The muscle ends in four tendons for the lateral four toes. Opposite the base of the proximal phalanx each tendon divides into two slips that are inserted into the margins of the middle phalanx. The tendon of the flexor digitorum longus (for that digit) passes through the gap between the two slips. Note that the insertion is similar to that of the flexor digitorum superficialis of the hand
<b>2. Abductor hallucis</b> This muscle lies along the medial border of foot, and covers the origin of the plantar vessels and nerves	a. Medial tubercle of calcaneum b. Flexor retinaculum c. Deep fascia covering it d. Medial intermuscular septum	The tendon fuses with the medial portion of the tendon of the flexor hallucis brevis. It is inserted into the medial side of the base of the proximal phalanx of the great toe
<b>3. Abductor digiti minimi</b> This muscle lies along the lateral border of foot	a. Medial and lateral tubercles of calcaneum b. Lateral intermuscular septum c. Deep fascia covering it	The tendon fuses with the tendon of the flexor digiti minimi brevis. It is inserted into the lateral side of the base of the proximal phalanx of the little toe



**Table 10.2: Nerve supply and actions of muscles of the first layer of the sole**

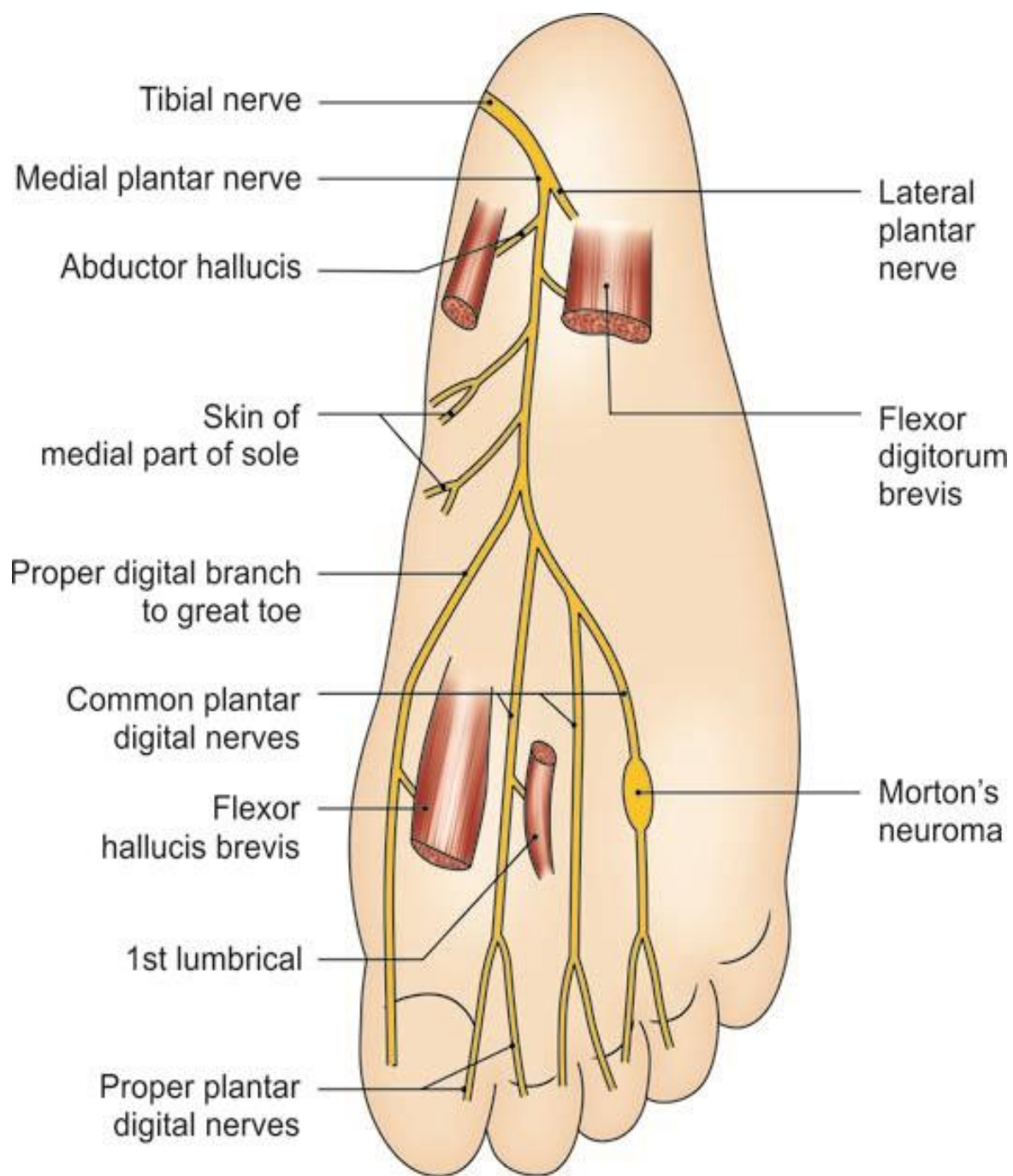
<i>Muscle</i>	<i>Nerve supply</i>	<i>Actions</i>
1. <b>Flexor digitorum brevis</b>	Medial plantar nerve	Flexion of the toes at the proximal interphalangeal joints and metatarsophalangeal joints
2. <b>Abductor hallucis</b>	Medial plantar nerve	Abduction of the great toe away from the second toe
3. <b>Abductor digiti minimi</b>	Main trunk of lateral plantar nerve	Abduction of the little toe

## Medial Plantar Nerve

It is the larger terminal branch of tibial nerve. Its distribution is similar to median nerve of the hand. It lies between abductor hallucis and flexor digitorum brevis and ends by giving muscular, cutaneous and articular branches.

*Branches:* The branches of medial plantar nerve are shown in Table A1.6.

Scheme to show the distribution of the medial plantar nerve with Morton's neuroma on one branch of the nerve



## Table A1.6

**Table A1.6: Branches of medial plantar nerve**

*Medial plantar nerve (L4, L5, S1)*

<b>Muscular</b>	—	Abductor hallucis	: 1st layer
	—	Flexor digitorum brevis	: 1st layer
	—	First lumbrical	: 2nd layer
	—	Flexor hallucis brevis	: 3rd layer
<b>Cutaneous and vascular</b>	—	Nail beds of medial 3½ toes	
	—	Sympathetic branches to medial plantar artery	
<b>Articular</b>	—	Tarsometatarsal, metatarsophalangeal and interphalangeal joints of medial 2/3rds of foot	

## Lateral Plantar Nerve

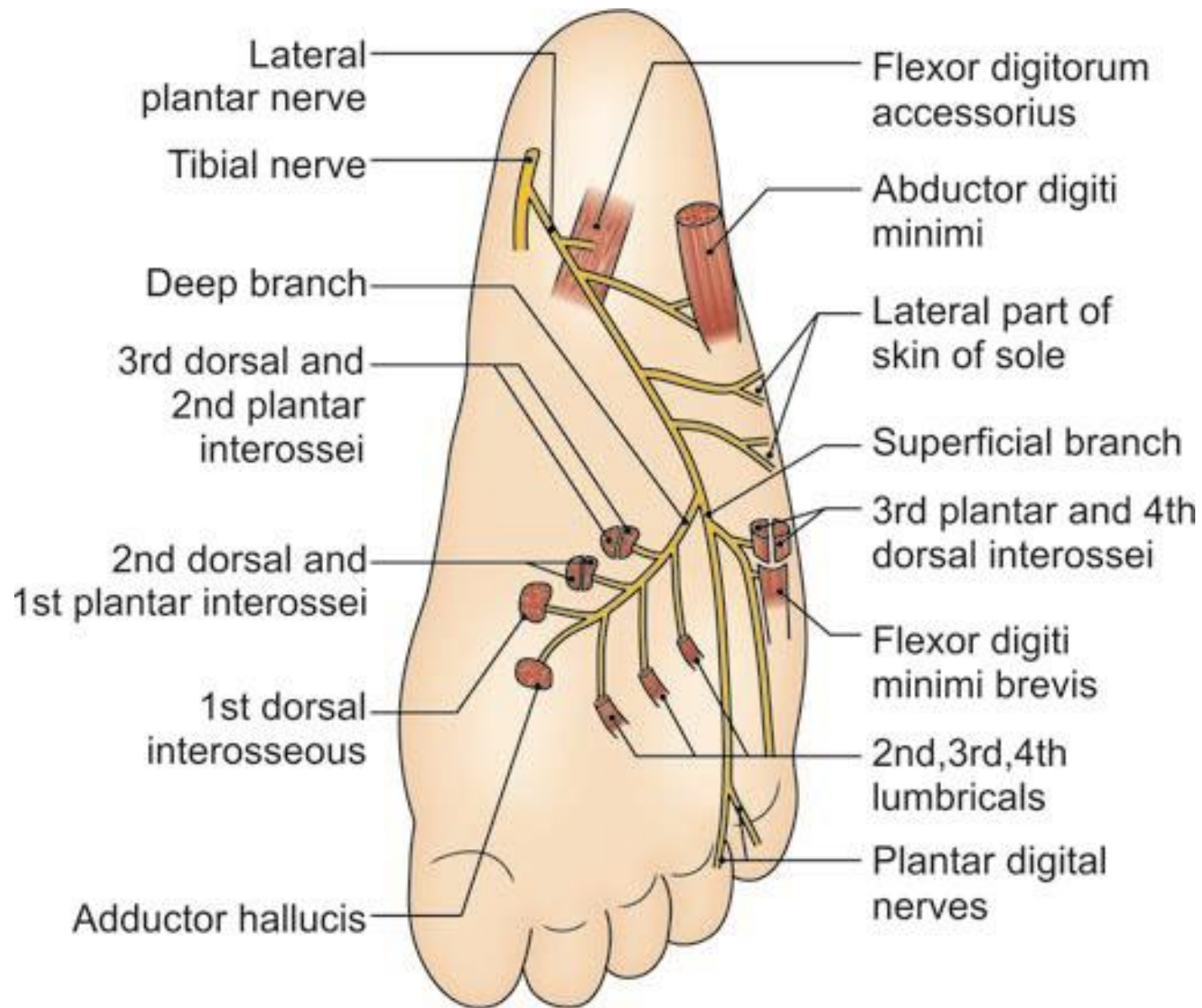
- It is the smaller terminal branch of tibial nerve, resembling the ulnar nerve of the hand in its distribution.
- It runs obliquely between the first and second layers of sole till the tuberosity of fifth metatarsal bone, where it divides into its superficial and deep branches.

*Branches:* The structures supplied by the trunk, and its two branches are given in Table A1.7.

# Table A1.7

**Table A1.7: Branches of lateral plantar nerve**

	<i>Trunk (S2, S3)</i>	<i>Superficial branch</i>	<i>Deep branch</i>
<b>Muscular</b>	<ul style="list-style-type: none"> <li>• Abductor digiti minimi: 1st layer</li> <li>• Flexor digitorum accessorius: 2nd layer</li> </ul>	<ul style="list-style-type: none"> <li>• Flexor digiti minimi brevis: 3rd layer</li> <li>• 3rd plantar interosseous: 4th layer</li> <li>• 4th dorsal interosseous: 4th layer</li> </ul>	1st and 2nd plantar interossei: 4th layer 1st, 2nd, 3rd, dorsal interossei: 4th layer 2nd, 3rd, 4th lumbricals: 2nd layer Adductor hallucis: 3rd layer
<b>Cutaneous and vascular</b>	—	Nail beds of lateral 1½ toes Sympathetic branches to lateral plantar artery	—
<b>Articular</b>	Tarsometatarsal	Interphalangeal	Metatarsophalangeal



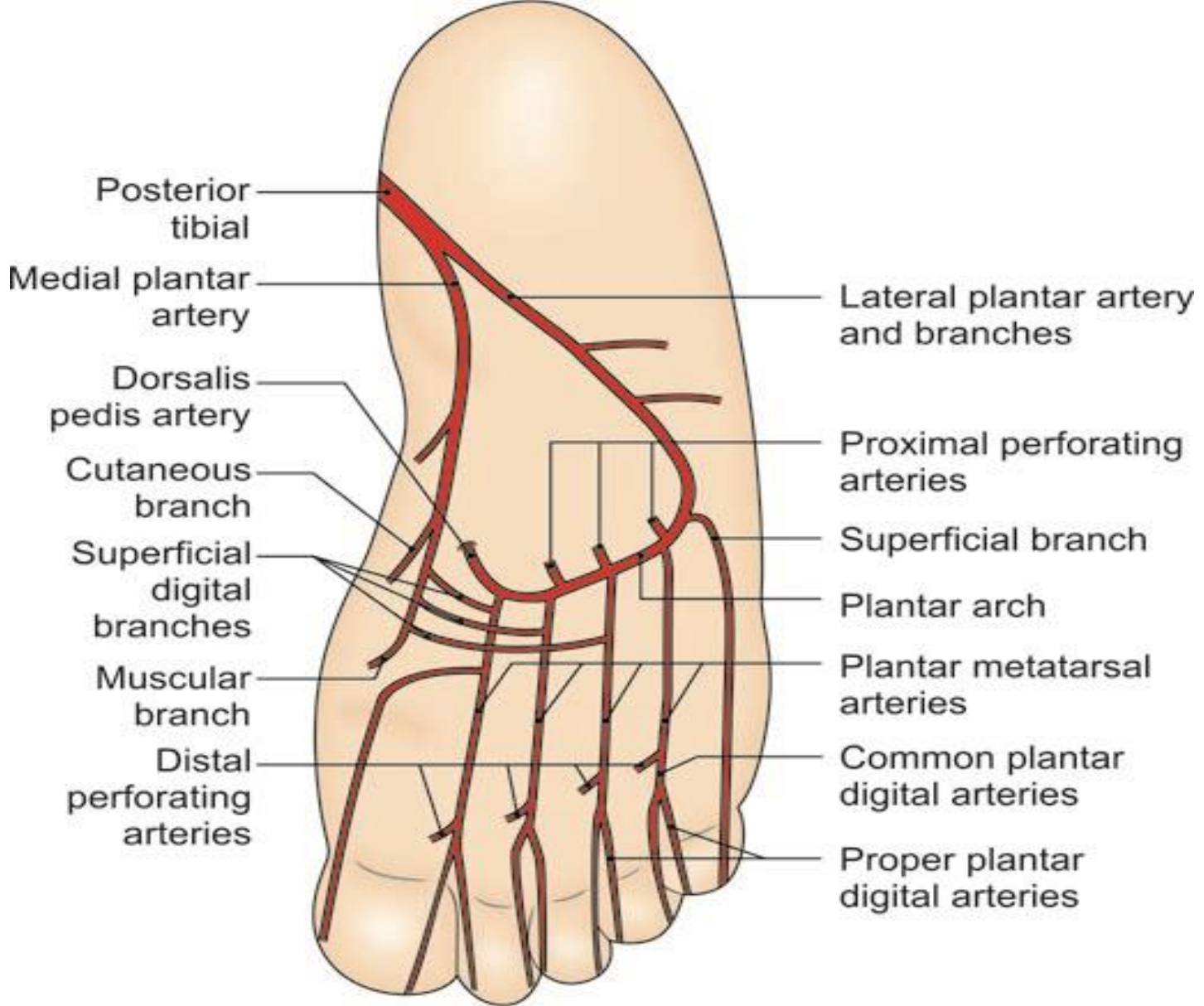
Scheme to show the distribution of the lateral plantar nerve

# Arteries of the sole

**Table A1.9: Arteries of lower limb**

<i>Artery</i>	<i>Beginning, course and termination</i>	<i>Area of distribution</i>
<b>Medial plantar artery</b>	The smaller terminal branch of posterior tibial artery given off under flexor retinaculum. Runs along the medial border of foot and ends by giving digital arteries	Muscular branches to muscles of medial side of foot. Cutaneous branches to medial side of sole and digital branches to medial 3½ digits. Also gives branches to the joints of foot
<b>Lateral plantar artery</b>	The large terminal branch of posterior tibial artery given off under the flexor retinaculum. It runs laterally between muscles of 1st and 2nd layers of sole till the base of 5th metatarsal bone by becoming continuous with the plantar arch	Muscular branches to muscles of sole, cutaneous branches to skin and fasciae of lateral side of sole
<b>Plantar arch</b>	It is the direct continuation of lateral plantar artery and is completed medially by dorsalis pedis artery The arch lies between 3rd and 4th layers of muscles of sole. The deep branch of lateral plantar nerve lies in its concavity	Four plantar metatarsal arteries, each of them gives two digital branches for adjacent sides of two digits, including medial side of big toe and lateral side of little toe





Medial plantar artery and its branches. Lateral plantar artery, plantar arch and their branches

**Table 10.5: Muscles of the third layer of the sole**

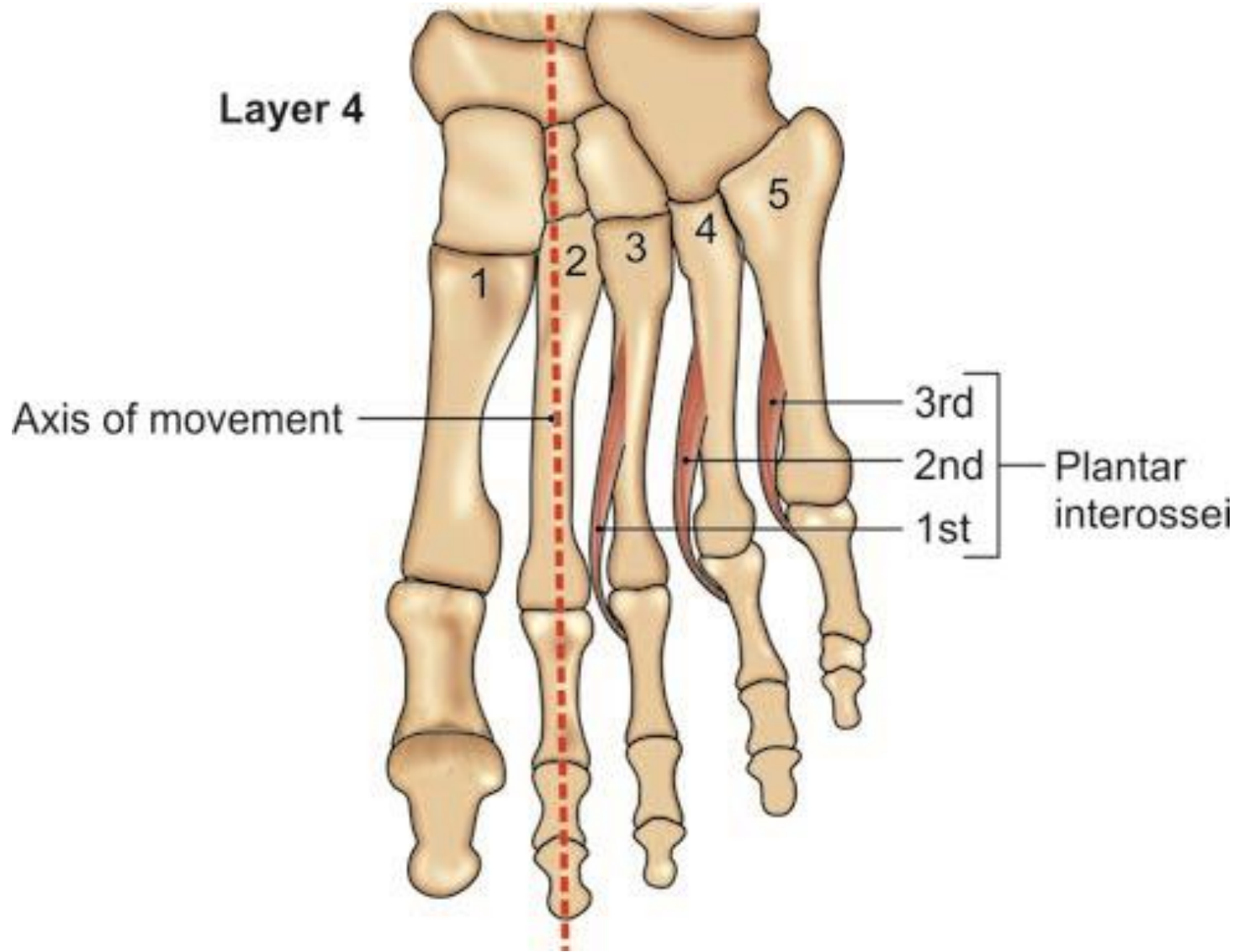
<i>Muscle</i>	<i>Origin</i>	<i>Insertion</i>
<b>1. Flexor hallucis brevis</b> It covers the plantar surface of the first metatarsal bone	It arises by a Y-shaped tendon: a. The <i>lateral limb</i> , from the medial part of the plantar surface of the cuboid bone, behind the groove for the peroneus longus and from the adjacent side of the lateral cuneiform bone b. The <i>medial limb</i> is a direct continuation of the tendon of tibialis posterior into the foot	The muscle splits into medial and lateral parts, each of which ends in a tendon. Each tendon is inserted into the corresponding side of the base of the proximal phalanx of the great toe
<b>2. Adductor hallucis</b>	It arises by two heads: a. The <i>oblique head</i> is large, and arises from the bases of the second, third, and fourth metatarsals, from the sheath of the tendon of the peroneus longus b. The <i>transverse head</i> is small, and arises from the deep metatarsal ligament, and the plantar ligaments of the metatarsophalangeal joints of the third, fourth and fifth toes (transverse head has no bony origin)	On the lateral side of the base of the proximal phalanx of the big toe, in common with the lateral tendon of the flexor hallucis brevis
<b>3. Flexor digiti minimi brevis:</b> It lies along the fifth metatarsal bone	a. Base of the fifth metatarsal bone b. Sheath of the tendon of the peroneus longus	Into the lateral side of the base of the proximal phalanx of the little toe

**Table 10.6: Nerve supply and actions of muscles of the third layer of the sole**

<i>Muscle</i>	<i>Nerve supply</i>	<i>Actions</i>
1. <b>Flexor hallucis brevis</b>	Medial plantar nerve	Flexes the proximal phalanx at the metatarsophalangeal joint of the great toe
2. <b>Adductor hallucis</b>	Deep branch of lateral plantar nerve, which terminates in this muscle	1. Adductor of great toe towards the second toe 2. Maintains transverse arches of the foot
3. <b>Flexor digiti minimi brevis</b>	Superficial branch of lateral plantar nerve	Flexes the proximal phalanx at the metatarsophalangeal joint of the little toe

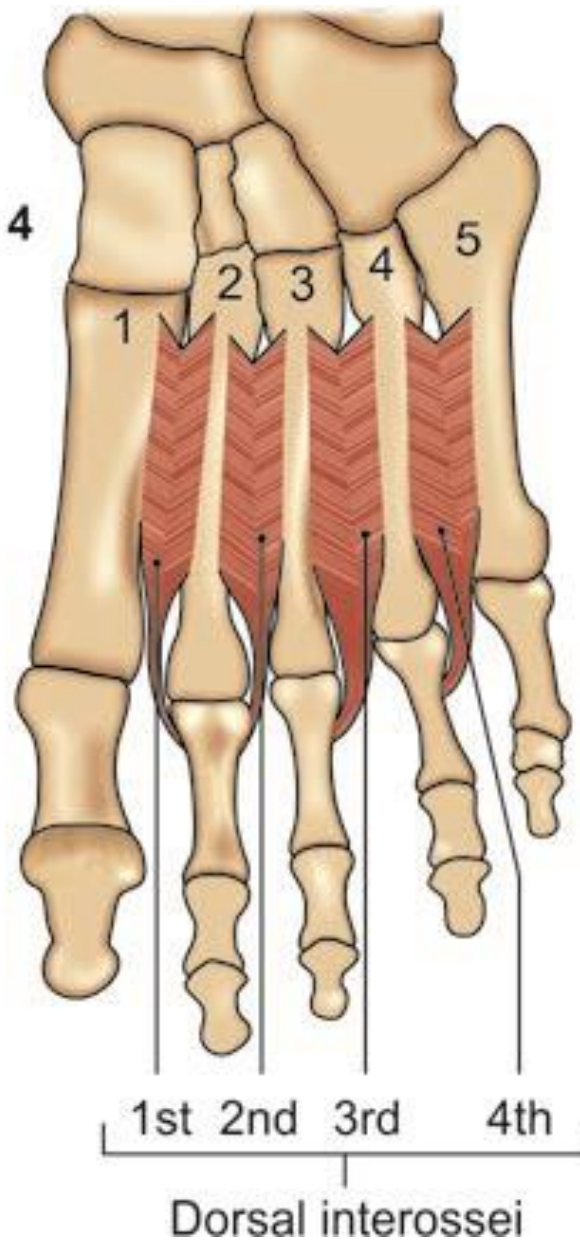
**Table 10.7: Muscles of the fourth layer of the sole**

<i>Muscle</i>	<i>Origin</i>	<i>Insertion</i>
1. <b>Plantar interossei</b> (three bellies), unipennate, slender muscle bellies. Tendons pass on medial sides of third, fourth and fifth toes	Bases and medial sides of third, fourth and fifth metatarsals	Medial sides of bases of proximal phalanges and dorsal digital/extensor expansions of 3rd, 4th and 5th toes
2. <b>Dorsal interossei</b> (four bellies), bipennate, muscle bellies, fills up gaps between metatarsals	Adjacent sides of metatarsal bones	Bases of proximal phalanges and dorsal digital expansion of toes; first on medial side of 2nd toe; second on lateral side of 2nd toe; third on lateral side of 3rd toe and fourth on lateral side of 4th toe
3. <b>Tibialis posterior</b>	Posterior surfaces of leg bones	Tuberosity of navicular (see Table 9.3)
4. <b>Peroneus longus</b>	Upper part of lateral surface of fibula	Base of 1st metatarsal (see Table 8.3)



The plantar interossei

Layer 4



The dorsal interossei

**Table 10.8: Nerve supply and actions of muscles of the fourth layer of the sole**

<i>Muscle</i>	<i>Nerve supply</i>	<i>Actions</i>
1. <b>Plantar interossei</b>	First and second by lateral plantar (deep branch). Third by lateral plantar (superficial branch)	Adductors of third, fourth and fifth toes toward the axis. Flexor of metatarsophalangeal and extensor of interphalangeal joints of third, fourth and fifth toes
2. <b>Dorsal interossei</b>	First, second, third by lateral plantar (deep branch), fourth dorsal interosseous by superficial branch of lateral plantar	Abductors of toes from axis of second toe. First and second cause medial and lateral abduction of second toe. Third and fourth for abduction of 3rd and 4th toes
3. <b>Tibialis posterior</b>	Tibial nerve	Plantar flexor of ankle (see Table 9.4)
4. <b>Peroneus longus</b>	Superficial peroneal nerve	Evertor of foot (see Table 8.4)

## FACTS TO REMEMBER

- Muscles of the sole are disposed in four layers.
- Medial plantar nerve supplies 4 intrinsic muscles. These are abductor hallucis, flexor digitorum brevis, flexor hallucis brevis and 1st lumbrical.
- Lateral plantar nerve supplies 14 intrinsic muscles. These are abductor digiti minimi, flexor digitorum accessories, 2nd–4th lumbricals, flexor digiti minimi brevis, adductor hallucis, 1–3 plantar and 1–4 dorsal interossei.
- Extrinsic muscles are supplied by the nerve of the respective compartments of the leg.
- Only one arterial arch, the plantar arch is present.



- The muscles of the sole maintain the arches of the foot.
- Between 1st and 2nd layers of muscles are the trunks of medial plantar and lateral plantar nerves and vessels.
- Between the 3rd and 4th layers are the plantar arch and deep branch of lateral plantar nerve.