

Anatomy of the lower limb

Front of the leg and dorsum of the foot

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Surface bony landmarks

- **Medial and lateral condyles of tibia:** These are visible and palpable landmarks at the sides of the ligamentum patellae. They are easily felt in a flexed knee.
- **Tibial tuberosity:** a bony prominence on the front of the upper part of tibia, 2.5 cm distal to the knee joint.
- **Anterior border (shin) of the tibia:** It is easily felt as a sharp curved bony crest extending downward from the tibial tuberosity to the anterior margin of the medial malleolus.
- **Medial subcutaneous surface of tibia:** It is subcutaneous throughout except in the uppermost part where it provides attachment to the tendons of pes anserinus.
- **Head of the fibula:** It lies posterolaterally at the level of the tibial tuberosity. It serves as a guide to locate common peroneal nerve which winds around the posterolateral aspect of the neck of fibula.
- **Medial malleolus:** It is the bony prominence on the medial side of the ankle.
- **Lateral malleolus:** It is the bony prominence on the lateral side of the ankle. It is longer but narrower than the medial malleolus, its tip lies about 0.5 cm below the med. malleolus.

Superficial fascia

Cutaneous nerves

- 1- **Saphenous nerve:** a branch from femoral nerve in the thigh, it supplies the medial side of the leg from the level of knee joint to the level of ankle and supplies the skin over medial malleolus and part of medial side of foot.
- 2- **Lateral cutaneous nerve of calf:** a branch from common peroneal nerve, it supplies the upper 2/3rds of the lateral aspect of leg (anteriorly & posteriorly).
- 3- **Superficial peroneal nerve:** it arises from common peroneal nerve and supplies the lower 1/3rd of the lateral aspect of the leg (anteriorly) and the whole skin of the dorsum of the foot except:
 - cleft between first & second toe (first interdigital cleft) supplied by deep peroneal.
 - lateral border of the foot supplied by sural nerve
 - medial border of the foot to the big toe supplied by saphenous nerve
- 4- **Deep peroneal nerve:** a branch from common peroneal nerve supplies the first interdigital cleft (adjacent sides of the first & second toes).

The deep fascia, interosseous membrane and muscular compartments of the leg

The deep fascia of the leg is very strong and encloses the leg like a tight sleeve. It does not cover the subcutaneous bony surfaces and is attached to their borders, i.e. it is fused with the periosteum where the bones are subcutaneous.

The deep fascia is thick in the upper and lower parts of the leg. In the upper part, it gives origin to the underlying muscles. Whereas in the lower part, it forms large thick fibrous bands called retinacula around the ankle.

Two intermuscular septa, anterior and posterior, extend inward from the fascial sleeve and get attached to the anterior and posterior borders of the fibula. These together with interosseous membrane divide the leg into three fascial compartments each having its own muscles, arteries and nerves: anterior, lateral, and posterior. In the

posterior compartment, the muscles are divided into three layers by the superficial and deep transverse fascial septa.

ANTERIOR (EXTENSOR) COMPARTMENT OF THE LEG

Boundaries:

Anterior: deep fascia of the leg

Medial: lateral surface of the shaft of the tibia

Lateral: anterior intermuscular septum

Posterior: interosseous membrane

Contents

Muscles: Four muscles (tibialis anterior, extensor hallucis longus, extensor digitorum longus, and peroneus tertius).

Artery: Anterior tibial artery.

Nerve: Deep peroneal nerve (anterior tibial nerve).

Muscles of the anterior compartment

Muscle	Origin	Insertion	Innervation	Action
Tibialis anterior (TA)	Upper half of the lateral surface of tibia and adjacent interosseous membrane	Medial cuneiform & the first metatarsal base	Deep peroneal nerve	Dorsiflexion of the foot at ankle j. inversion of the foot, dynamic support & maintenance of medial arch of foot
Extensor hallucis longus (EHL)	Middle half of shaft of fibula & adjacent surface of interosseous membrane	Base of the distal phalanx of the big toe	Deep peroneal nerve	Extension of the big toe Dorsiflexion of the foot at ankle j.
Extensor digitorum longus (EDL)	Proximal one half of medial surface of fibula and related surface of lateral tibial condyle	Dorsal digital expansions into bases of distal and middle phalanges of lateral four toes	Deep peroneal nerve	Extension of lateral four toes and dorsiflexion of foot at ankle j.
Peroneus tertius	Distal one 1/4 th of the shaft of fibula	Base of the fifth metatarsal bone	Deep peroneal nerve	Dorsiflexion & eversion of foot
Extensor digitorum brevis	Anterior part of the upper surface of the calcaneum & the inferior extensor retinaculum	Dorsal digital expansions into the bases of the distal & middle phalanges of the medial 4 toes	Deep peroneal nerve	Extension of the medial 4 toes

Extensor digitorum brevis lies on the dorsum of the foot and causes the fleshy bulge at that area. Its most medial tendon, inserted to the big toe, is sometimes referred to as an individual muscle called **extensor hallucis brevis**

Extensor retinacula

They are two in number – superior and inferior

Superior extensor retinaculum

It is a rectangular broad band of the deep fascia, just above the ankle joint.

Attachments:

- 1- Medially: it is attached to the lower part of the anterior border of the tibia
- 2- Laterally: it is attached to the lower part of the anterior border of the fibula

Relations:

- Medially, it splits to enclose tibialis anterior tendon with its synovial sheath
- Deep to the retinaculum, other structures of the anterior compartment (anterior tibial artery, deep peroneal nerve, extensor hallucis longus, extensor digitorum longus) here the tendons of these muscles are not surrounded by synovial sheath.

Superior extensor retinaculum

It is a Y-shaped band of the deep fascia, situated in the front of the ankle joint and the proximal part of the dorsum of the foot.

Attachments:

- Laterally, it's stem is attached to the upper surface of the anterior part of the calcaneum.
- Medially, the upper limb of the band is attached to the medial malleolus while the lower limb continues and is fused with the deep fascia of the foot inferomedially.

Relations:

The band is split into two layers by the tendons of tibialis anterior, extensor digitorum longus, extensor hallucis longus and peroneus tertius. The two layers enclose the tendons and separate them from each other by fibrous septa. The tendons of these muscles are also enclosed by synovial sheaths as they pass deep to the retinaculum.

Structure which pass deep or posterior to the extensor retinacula, from medial to lateral, are;

Tibialis anterior tendon

- Extensor hallucis longus tendon
- Anterior tibial artery (superior retinaculum) / Dorsalis pedis artery (inferior retinaculum)
- Deep peroneal nerve
- Extensor digitorum longus tendon
- Peroneus tertius tendon

Anterior tibial artery

The anterior tibial artery is the main artery of the anterior compartment of the leg. The anterior tibial artery is accompanied by two venae comitantes. It is the smaller terminal branch of popliteal artery given at the lower border of popliteus muscle.

Course

- It begins in the back of the leg at the lower border of popliteus muscle.
- It enters the anterior compartment of the leg by passing through an opening in the upper part of the interosseous membrane.
- In the anterior compartment, it runs vertically downward to a point midway between the medial and lateral malleoli, where it enters the dorsum of the foot and changing its name to **dorsalis pedis artery**, which ends near the web between the big and second toes.

Relations

- In the upper one-third of the leg it lies between the tibialis anterior and extensor digitorum longus.
- In the middle one-third of the leg it lies between the tibialis anterior and extensor hallucis longus.
- In the lower one-third of the leg it lies between extensor hallucis longus and extensor digitorum longus.

It is crossed from the lateral to medial side by the tendon of extensor hallucis longus. As a result, the deep peroneal nerve lies lateral to it in its upper one-third and lower one-third, and anterior to it in its middle one-third.

Branches

1. Anterior and posterior tibial recurrent arteries: They take part in the arterial anastomosis around the knee joint.
2. Muscular branches to adjacent muscles.
3. Anterior medial and anterior lateral malleolar arteries: They take part in the anastomosis around the ankle joint.

Dorsalis pedis artery

Course

It is the chief artery of the dorsum of the foot and it is the continuation of the anterior tibial artery and begins in front of the ankle midway between medial & lateral malleoli. It runs anteriorinferiorly with the deep peroneal nerve underneath the inferior extensor retinaculum and the tendons of extensor hallucis brevis.

Relations

- *Superficially*: extensor hallucis brevis crosses the artery from lateral to medial
- *Deep*: ankle joint & tarsal bones
- *Medial*: tendon of extensor hallucis longus
- *Lateral*: first tendon of extensor digitorum longus

Branches

- 1- **Medial & lateral tarsal arteries**: contribute in the formation of medial & lateral malleolar retes (arterial networks)
- 2- **Arcuate artery**: arises at the base of the second metatarsal bone & curves laterally, it gives rise to 3 dorsal metatarsal arteries (2nd, 3rd & 4th) each gives 2 dorsal digital arteries to each side of the lateral 3 and ½ toes (the 4th metatarsal artery also gives off a twig to the lateral aspect of little toe).
- 3- **1st dorsal metatarsal artery**: arises from dorsalis pedis artery, it divides into dorsal digital arteries to supply both sides of the big toe & the medial aspect of the second toe.

Clinical correlation: *The dorsalis pedis artery pulse can be easily felt between the tendons of extensor hallucis longus and first tendon of extensor digitorum longus. It is often palpated in patients suffering from vaso-occlusive diseases of the lower limb (diseases that cause narrowing of lower limb vessels).*

The clinicians feeling this pulse should know that the dorsalis pedis artery is congenitally absent in about 14% of the cases. In such cases the absence of dorsalis pedis pulse should be confirmed by the posterior tibial artery pulse. In these cases it may be replaced by the perforating branch of the peroneal artery.

Deep peroneal nerve

It is one of the two terminal branches of the common peroneal nerve at the neck of the fibula. It enters the anterior compartment of the leg by piercing the anterior intermuscular septum. It pierces extensor digitorum longus and descends in this compartment with the anterior tibial artery.

In the upper and lower thirds of the leg it lies lateral to the anterior tibial artery and anterior to the artery in the middle third (*It is said that in the middle one-third the nerve hesitates to cross the artery from lateral to medial side, the reason why deep peroneal nerve sometimes called nervus hesitans!*).

The nerve ends in front of the ankle by dividing into the lateral and medial terminal branches.

Branches:

- **Muscular branches:** the deep peroneal nerve supplies all the muscles of anterior compartment of the leg, muscles of the dorsum of the foot (extensor digitorum brevis & extensor hallucis brevis) & the first dorsal interosseous muscles of the sole of the foot.
- **Cutaneous branch:** lateral terminal branch supplies the skin over the first interdigital cleft.
- **Articular branches:** supply the ankle joint & small joints of the foot.

LATERAL COMPARTMENT OF THE LEG**Muscles of the lateral compartment of the leg**

Muscle	Origin	Insertion	Innervation	Action
Peroneus longus	Upper lateral surface of the fibula & head of fibula	Planter surface of the medial cuneiform & the base of first metatarsal bone	Superficial peroneal nerve	Eversion and planter flexion of the foot at ankle joint Dynamic support & maintenance of transverse & lateral arch of foot.
Peroneus brevis	Lower two thirds of lateral surface of shaft of fibula	Base of the 5 th metatarsal bone	Superficial peroneal nerve	Eversion and planter flexion of the foot at ankle joint

Peroneal retinacula

The peroneal retinacula are two thick bands of the deep fascia on the lateral side of ankle which keep the long tendons of peroneus longus and peroneus brevis in position and act as pulley for them.

Superior peroneal retinaculum

It is a thick band of deep fascia just behind the lateral malleolus

Attachments:

- Anteriorly: attached to the back of the lateral malleolus
- Posteriorly: attached to the lateral surface of the calcaneum

Relations:

The tendons of both peroneus longus and peroneus brevis lie deep to this retinaculum in a single compartment, both tendons in a common synovial sheath.

Inferior peroneal retinaculum

It is a thickened fibrous band of deep fascia situated anteroinferior to the lateral malleolus.

Attachments points of the inferior peroneal retinaculum in 3 points on the calcaneum forming two loops, one for the tendon of peroneus longus (inferior loop) and the other for peroneus brevis (superior loop). Each tendon is enclosed in a separate synovial sheath which are continuing with common synovial sheath underneath the superior retinaculum.

Superficial peroneal nerve

It is the main nerve of the lateral compartment of the leg. It is one of the two terminal branches of the common peroneal nerve given at the lateral aspect of the neck of the fibula.

Course

It begins on the lateral side of the neck of fibula descends for a short distance between the peroneus longus and peroneus brevis, and then in a groove between the peroneus brevis and extensor digitorum longus.

At the level of the upper two thirds of the leg it pierces the deep fascia and becomes a cutaneous nerve.

Branches

- Muscular branches: to peroneus longus & brevis muscles
- Cutaneous branches: supply the skin of the lower one third of the lateral side of the leg and dorsum of the foot with some exceptions (refer to page no.1).

Clinical correlation

• *Following an injury to superficial peroneal nerve, the paralysis of peroneal muscles and associated overactivity of the invertor muscles of the foot produces a clinical condition called **talipes varus**.*

• *The overactivity of peroneal muscles following paralysis of the anterior tibial muscles (invertors of foot) produces a clinical condition called **talipes valgus**.*