LOWER LIMB MUSCLES

BY FATIMA HAIDER

KGMC

MUSCLES OF GLUTEAL REGION

The gluteal region is an anatomical area located posteriorly to the pelvic girdle, at the proximal end of the femur. The muscles in this region move the lower limb at the hip joint.

The muscles of the gluteal region can be broadly divided into two groups:

- **Superficial abductors and extenders** – group of large muscles that abduct and extend the femur. Includes the gluteus maximus, gluteus medius, gluteus minimus and tensor fascia lata.
- **Deep lateral rotators** – group of smaller muscles that mainly act to laterally rotate the femur. Includes the quadratus femoris, piriformis, gemellus superior, gemellus inferior and obturator internus.

The arterial supply to these muscles is mostly via the superior and inferior gluteal arteries – branches of the **internal iliac artery**. Venous drainage follows the arterial supply.

The Superficial Muscles

The superficial muscles in the gluteal region consist of the three glutei and the tensor fascia lata. They mainly act to abduct and extend the lower limb at the hip joint.

1. Gluteus Maximus

The gluteus maximus is the largest of the gluteal muscles. It is also the most superficial, producing the shape of the buttocks.

Attachments: Originates from the gluteal (posterior) surface of the ilium, sacrum and coccyx. It slopes across the buttock at a 45 degree angle, then inserts into the iliotibial tract and the gluteal tuberosity of the femur.

Actions: It is the main extensor of the thigh, and assists with lateral rotation. However, it is only used when force is required, such as running or climbing.

Innervation: Inferior gluteal nerve.

2. Gluteus Medius

The gluteus medius muscle is fan-shaped and lies between to the gluteus maximus and the minimus. It is similar in shape and function to the gluteus minimus.

Attachments: Originates from the gluteal surface of the ilium and inserts into the lateral surface of the greater trochanter.

Actions: Abducts and medially rotates the lower limb. During locomotion, it secures the pelvis, preventing pelvic drop of the opposite limb. *(Note: the posterior fibres of the gluteus medius are also thought to produce a small amount of lateral rotation).*

Innervation: Superior gluteal nerve.

3. Gluteus Minimus

The gluteus minimus is the deepest and smallest of the superficial gluteal muscles. It is similar in shape and function to the gluteus medius.

Attachments: Originates from the ilium and converges to form a tendon, inserting to the anterior side of the greater trochanter.

Actions: Abducts and medially rotates the lower limb. During locomotion, it secures the pelvis, preventing pelvic drop of the opposite limb.

Innervation: Superior gluteal nerve.

4. Tensor Fascia Lata

Tensor fasciae lata is a small superficial muscle which lies towards the anterior edge of the iliac crest. It functions to tighten the fascia lata, and so abducts and medially rotates the lower limb.

Attachments: Originates from the anterior iliac crest, attaching to the anterior superior iliac spine (ASIS). It inserts into the iliotibial tract, which itself attaches to the lateral condyle of the tibia.

Actions: Assists the gluteus medius and minimus in abduction and medial rotation of the lower limb. It also plays a supportive role in the gait cycle.

Innervation: Superior gluteal nerve.

The Deep Muscles

The deep gluteal muscles are a set of smaller muscles, located underneath the gluteus minimus. The general action of these muscles is to laterally rotate the lower limb. They also stabilise the hip joint by 'pulling' the femoral head into the acetabulum of the pelvis.

1. Piriformis

The piriformis muscle is a key landmark in the gluteal region. It is the most superior of the deep muscles.

- **Attachments**: Originates from the anterior surface of the sacrum. It then travels infero-laterally, through the greater sciatic foramen, to insert into the greater trochanter of the femur.
- **Actions**: Lateral rotation and abduction.
- **Innervation**: Nerve to piriformis.

2. Obturator Internus

The obturator internus forms the lateral walls of the pelvic cavity. In some texts, the obturator internus and the gemelli muscles are considered as one muscle – the triceps coxae.

- **Attachments**: Originates from the pubis and ischium at the obturator foramen. It travels through the lesser sciatic foramen, and attaches to the greater trochanter of the femur.
- **Actions**: Lateral rotation and abduction.
- **Innervation**: Nerve to obturator internus.

3. The Gemelli – Superior and Inferior

The gemelli are two narrow and triangular muscles. They are separated by the obturator internus tendon.

- **Attachments**: The superior gemellus muscle originates from the ischial spine, the inferior from the ischial tuberosity. They both attach to the greater trochanter of the femur.
- **Actions**: Lateral rotation and abduction.
- **Innervation**: The superior gemellus muscle is innervated by the nerve to obturator internus, the inferior gemellus is innervated by the nerve to quadratus femoris.

4. Quadratus Femoris

The quadratus femoris is a flat, square-shaped muscle. It is the most inferior of the deep gluteal muscles, located below the gemelli and obturator internus.

- **Attachments**: It originates from the lateral side of the ischial tuberosity, and attaches to the quadrate tuberosity on the intertrochanteric crest.
- **Actions**: Lateral rotation.
- **Innervation**: Nerve to quadratus femoris.

MUSCLES OF THE THIGH

MUSCLES IN ANTERIOR COMPARTMENT OF THIGH

The musculature of the thigh can be split into three sections; anterior, medial and posterior. Each compartment has a distinct innervation and function.

The muscles in the anterior compartment of the thigh are innervated by the **femoral nerve** (L2-L4), and as a general rule, act to **extend** the leg at the knee joint.

There are three major muscles in the anterior thigh – the **pectineus**, **sartorius** and **quadriceps femoris**. In addition to these, the end of the **iliopsoas** muscle passes into the anterior compartment.

1. Iliopsoas

The iliopsoas is actually two muscles, the **psoas major** and the **iliacus**. They originate in different areas, but come together to form a tendon, hence why they are commonly referred to as one muscle.

Unlike many of the anterior thigh muscles, the iliopsoas does not extend the leg at the knee joint.

- **Attachments**: The psoas major originates from the lumbar vertebrae, and the iliacus originates from the iliac fossa of the pelvis. They insert together onto the lesser trochanter of the femur.
- **Actions**: Flexes the thigh at the hip joint.
- **Innervation**: The psoas major is innervated by anterior rami of L1-3, while the iliacus is innervated by the femoral nerve.

2. Quadriceps Femoris

The **quadriceps femoris** consists of four individual muscles; three vastus muscles and the rectus femoris. They form the main bulk of the thigh, and collectively are one of the most powerful muscles in the body.

The muscles that form the quadriceps femoris unite proximal to the knee and attach to the patella via the **quadriceps tendon**. In turn, the patella is attached to the tibia by the patella ligament. The quadriceps femoris is the main extensor of the knee.

3. Vastus Lateralis

Proximal attachment: Originates from the greater trochanter and the lateral lip of linea aspera.

Actions: Extends the knee joint and stabilises the patella.

Innervation: Femoral nerve.

4. Vastus Intermedius

Proximal attachment: Anterior and lateral surfaces of the femoral shaft.

Actions: Extends the knee joint and stabilises the patella.

Innervation: Femoral nerve.

5. Vastus Medialis

Proximal attachment: The intertrochanteric line and medial lip of the linea aspera.

Actions: Extends the knee joint and stabilises the patella, particularly due to its horizontal fibres at the distal end.

Innervation: Femoral nerve.

6. Rectus Femoris

Attachments: Originates from the anterior inferior iliac spine and the area of the ilium immediately superior to the acetabulum. It runs straight down the leg and attaches to the patella via the quadriceps femoris tendon.

Actions: The only muscle of the quadriceps to cross both the hip and knee joints. It flexes the thigh at the hip joint, and extends at the knee joint.

Innervation: Femoral nerve.

7. Sartorius

The sartorius is the longest muscle in the body. It is long and thin, running across the thigh in a inferomedial direction. The sartorius is positioned more superficially than the other muscles in the leg.

Attachments: Originates from the anterior superior iliac spine, and attaches to the superior, medial surface of the tibia.

Actions: At the hip joint, it is a flexor, abductor and lateral rotator. At the knee joint, it is also a flexor.

Innervation: Femoral nerve.

8. Pectineus

The pectineus muscle is a flat muscle that forms the base of the femoral triangle. It has a dual innervation, and thus can be considered a transitional muscle between the anterior thigh and medial thigh compartments.

Attachments: It originates from the pectineal line on the anterior surface of the pelvis, and attaches to the pectineal line on the posterior side of the femur, just inferior to the lesser trochanter.

Actions: Adduction and flexion at the hip joint.

Innervation: Femoral nerve. May also receive a branch from the obturator nerve

MUSCLES IN MEDIAL COMPARTMENT OF THIGH

The muscles in the medial compartment of the thigh are collectively known as the **hip adductors**. There are five muscles in this group; gracilis, obturator externus, adductor brevis, adductor longus and adductor magnus.

All the medial thigh muscles are innervated by the **obturator nerve**, which arises from the lumbar plexus. Arterial supply is via the **obturator artery.**

1. Adductor Magnus

The adductor magnus is the largest muscle in the medial compartment. It lies posteriorly to the other muscles.

Functionally, the muscle can be divided into two parts; the adductor part, and the hamstring part.

- **Attachments**
- Adductor part – Originates from the inferior rami of the pubis and the rami of ischium, attaching to the linea aspera of the femur.
- Hamstring part – Originates from the ischial tuberosity and attaches to the adductor tubercle and medial supracondylar line of the femur.
- **Actions**: They both adduct the thigh. The adductor component also flexes the thigh, with the hamstring portion extending the thigh.
- **Innervation**: Adductor part is innervated by the obturator nerve (L2-L4), the hamstring part is innervated by the tibial component of the sciatic nerve (L4-S3).

2. Adductor Longus

The adductor longus is a large, flat muscle. It partially covers the adductor brevis and magnus. The muscle forms the medial border of the femoral triangle.

- **Attachments**: Originates from the pubis, and expands into a fan shape, attaching broadly to the linea aspera of the femur
- **Actions**: Adduction of the thigh.
- **Innervation**: Obturator nerve (L2-L4).

3. Adductor Brevis

The adductor brevis is a short muscle, lying underneath the adductor longus.

It lies in between the anterior and posterior divisions of the obturator nerve. Therefore, it can be used as an anatomical landmark to identify the aforementioned branches.

- **Attachments**: Originates from the body of pubis and inferior pubic rami. It attaches to the linea aspera on the posterior surface of the femur, proximal to the adductor longus.
- **Actions**: Adduction of the thigh.
- **Innervation**: Obturator nerve (L2-L4).

4. Obturator Externus

This is one of the smaller muscles of the medial thigh, and it is located most superiorly.

- **Attachments**: It originates from the membrane of the obturator foramen, and adjacent bone. It passes under the neck of femur, attaching to the posterior aspect of the greater trochanter.
- **Actions**: Adduction and lateral rotation of the thigh.
- **Innervation**: Obturator nerve (L2-L4).

5. Gracilis

The gracilis is the most superficial and medial of the muscles in this compartment. It crosses at both the hip and knee joints. It is sometimes transplanted into the hand or forearm to replace a damaged muscle.

- **Attachments**: It originates from the inferior rami of the pubis, and the body of the pubis. Descending almost vertically down the leg, it attaches to the medial surface of the tibia, between the tendons of the sartorius (anteriorly) and the semitendinosus (posteriorly).
- **Actions**: Adduction of the thigh at the hip, and flexion of the leg at the knee.
- **Innervation**: Obturator nerve (L2-L4).

MUSCLES IN POSTERIOR COMPARTMENT OF THIGH

The muscles in the posterior compartment of the thigh are collectively known as the **hamstrings**. They consist of the biceps femoris, semitendinosus and semimembranosus, which form prominent tendons medially and laterally at the back of the knee.

As group, these muscles act to extend at the hip, and flex at the knee. They are innervated by the sciatic nerve (L4-S3).

*Note: The hamstring portion of the **adductor magnus** has a similar action to these muscles, but is located in the medial thigh.*

1. Biceps Femoris

Like the biceps brachii in the arm, the biceps femoris muscle has two heads – a long head and a short head.

It is the most lateral of the muscles in the posterior thigh – the common tendon of the two heads can be felt laterally at the posterior knee.

- **Attachments**: The long head originates from the ischial tuberosity of the pelvis. The short head originates from the linea aspera on posterior surface of the femur. Together, the heads form a tendon, which inserts into the head of the fibula.
- **Actions**: Main action is flexion at the knee. It also extends the thigh at the hip, and laterally rotates at the hip and knee.

- **Innervation**: Long head innervated by the tibial part of the sciatic nerve, whereas the short head is innervated by the common fibular part of the sciatic nerve.

2. Semitendinosus

The semitendinosus is a largely tendinous muscle. It lies medially to the biceps femoris, and covers the majority of the semimembranosus.

- **Attachments**: It originates from the ischial tuberosity of the pelvis, and attaches to the medial surface of the tibia.
- **Actions**: Flexion of the leg at the knee joint. Extension of thigh at the hip. Medially rotates the thigh at the hip joint and the leg at the knee joint.
- **Innervation**: Tibial part of the sciatic nerve.

3. Semimembranosus

The semimembranosus muscle is flattened and broad. It is located underneath the semitendinosus.

- **Attachments**: It originates from the ischial tuberosity, but does so more superiorly than the semitendinosus and biceps femoris. It attaches to the medial tibial condyle.
- **Actions**: Flexion of the leg at the knee joint. Extension of thigh at the hip. Medially rotates the thigh at the hip joint and the leg at the knee joint.
- **Innervation**: Tibial part of the sciatic nerve.

MUSCLES OF THE LEG

MUSCLES IN ANTERIOR COMPARTMENT OF LEG

There are four muscles in the anterior compartment of the leg: tibialis anterior, extensor digitorum longus, extensor hallucis longus and fibularis tertius.

Collectively, they act to **dorsiflex** and **invert** the foot at the ankle joint. The extensor digitorum longus and extensor hallucis longus also extend the toes. The muscles in this compartment are innervated by the **deep fibular nerve** (L4-S1), and blood is supplied via the **anterior tibial artery**.

1. Tibialis Anterior

The tibialis anterior muscle is located alongside the lateral surface of the tibia.

It is the strongest dorsiflexor of the foot.

To test the power of the tibialis anterior, the patient can be asked to stand on their heels.

- **Attachments**: Originates from the lateral surface of the tibia, attaches to the medial cuneiform and the base of metatarsal I.
- **Actions**: Dorsiflexion and inversion of the foot.
- **Innervation**: Deep fibular nerve.

1. Extensor Digitorum Longus

The extensor digitorum longus lies lateral and deep to the tibialis anterior. The tendons of the EDL can be palpated on the dorsal surface of the foot.

- **Attachments**: Originates from the lateral condyle of the tibia and the medial surface of the fibula. The fibres converge into a tendon, which travels to the dorsal surface of the foot. The tendon splits into four, each inserting onto a toe.
- **Actions**: Extension of the lateral four toes, and dorsiflexion of the foot.
- **Innervation**: Deep fibular nerve.

2. Extensor Hallucis Longus

The extensor hallucis longus is located deep to the EDL and TA.

- **Attachments**: Originates from the medial surface of the fibular shaft. The tendon crosses anterior to the ankle joint and attaches to the base of the distal phalanx of the great toe.
- **Action**: Extension of the great toe and dorsiflexion of the foot.
- **Innervation**: Deep fibular nerve.

3. Fibularis Tertius

The fibularis tertius muscles arises from the most inferior part of the EDL. It is not present in all individuals and is considered by some texts as a part of the extensor digitorum longus.

- **Attachments**: Originates with the extensor digitorum longus from the medial surface of the fibula. The tendon descends with the EDL, until they reach the dorsal surface of the foot. The fibularis tertius tendon then diverges and attaches to metatarsal V.
- **Actions**: Eversion and dorsiflexion of the foot.
- **Innervation**: Deep fibular nerve

MUSCLES IN LATERAL COMPARTMENT OF LEG

There are two muscles in the lateral compartment of the leg; the **fibularis longus** and **brevis** (also known as peroneal longus and brevis).

The common function of the muscles is **eversion** – turning the sole of the foot outwards. They are both innervated by the superficial fibular nerve.

Note: From the anatomical position, only a few degrees of eversion are possible. In reality, the job of these muscles is to 'fix' the medial margin of the foot during running, and prevent excessive inversion.

1. Fibularis Longus

- **Attachments**
  The fibularis longus originates from the superior and lateral surface of the fibula and the lateral tibial condyle.
  The fibres converge into a tendon, which descends into the foot, posterior to the lateral malleolus.
  The tendon crosses under the foot, and attaches to the bones on the medial side, namely the medial cuneiform and base of metatarsal I.
- **Actions**: Eversion and plantarflexion of the foot. Also supports the lateral and transverse arches of the foot.
- **Innervation**: Superficial fibular (peroneal) nerve, L4-S1.

2. Fibularis Brevis

The fibularis brevis muscles is deeper and shorter than the fibularis longus.

- **Attachments**:
  Originates from the inferolateral surface of the fibular shaft. The muscle belly forms a tendon, which descends with the fibularis longus into the foot.
  It travels posteriorly to the lateral malleolus, passing over the calcaneus and the cuboidal bones.
  The tendon then attaches to a tubercle on metatarsal V.
- **Actions**: Eversion of the foot.
- **Innervation**: Superficial fibular (peroneal) nerve, L4-S1.

MUSCLES OF POSTERIOR COMPARTMENT OF LEG

The posterior compartment of the leg contains seven muscles, organised into two layers – **superficial** and **deep**. The two layers are separated by a band of fascia.

The posterior leg is the largest of the three compartments. Collectively, the muscles in this area **plantarflex** and **invert** the foot. They are innervated by the **tibial nerve**, a terminal branch of the sciatic nerve**.**

Superficial Muscles

The superficial muscles form the characteristic 'calf' shape of the posterior leg. They all insert into the calcaneus of the foot (the heel bone), via the **calcaneal tendon**. The calcaneal reflex tests spinal roots S1-S2.

To minimise friction during movement, there are two bursae (fluid filled sacs) associated with the calcaneal tendon:

Subcutaneous calcaneal bursa – lies between the skin and the calcaneal tendon.

Deep bursa of the calcaneal tendon – lies between the tendon and the calcaneus.

1. Gastrocnemius

The gastrocnemius is the most superficial of all the muscles in the posterior leg. It has two heads – medial and lateral, which converge to form a single muscle belly.

- **Attachments**: The lateral head originates from the lateral femoral condyle, and medial head from the medial femoral condyle. The fibres converge, and form a single muscle belly. In the lower part of the leg, the muscle belly combines with the soleus to from the calcaneal tendon, with inserts onto the calcaneus (the heel bone).
- **Actions**: It plantarflexes at the ankle joint, and because it crosses the knee, it is a flexor there.
- **Innervation**: Tibial nerve.

2. Plantaris

The plantaris is a small muscle with a long tendon, which can be mistaken for a nerve as it descends down the leg. It is absent in 10% of people.

- **Attachments**: Originates from the lateral supracondylar line of the femur. The muscle descends medially, condensing into a tendon that runs down the leg, between the gastrocnemius and soleus. The tendon blends with the calcaneal tendon.
- **Actions**: It plantarflexes at the ankle joint, and because it crosses the knee, it is a flexor there. It is not a vital muscle for these movements.
- **Innervation**: Tibial nerve.

3. Soleus

The soleus is located deep to the gastrocnemius. It is large and flat, named soleus due to its resemblance of a sole – a flat fish.

- **Attachments**: Originates from the soleal line of the tibia and proximal fibular area. The muscle narrows in the lower part of the leg, and joins the calcaneal tendon.
- **Actions**: Plantarflexes the foot at the ankle joint.
- **Innervation**: Tibial Nerve.

Deep Muscles

There are four muscles in the deep compartment of the posterior leg. One muscle, the popliteus, acts only on the knee joint. The remaining three muscles (tibialis posterior, flexor hallucis longus and flexor digitorum longus) act on the ankle and foot.

1. Popliteus

The popliteus is located superiorly in the leg. It lies behind the knee joint, forming the base of the popliteal fossa.

There is a bursa (fluid filled sac) that lies between the popliteal tendon and the posterior surface of the knee joint. It is called the popliteus bursa.

- **Attachments**: Originates from the lateral condyle of the femur and the posterior horn of the lateral meniscus. From there, it runs inferomedially towards the tibia and inserts above the origin of the soleus muscle.
- **Actions**: Laterally rotates the femur on the tibia – 'unlocking' the knee joint so that flexion can occur.
- **Innervation**: Tibial nerve.

2. Tibialis Posterior

The tibialis posterior is the deepest out of the four muscles. It lies between the flexor digitorum longus and the flexor hallucis longus.

- **Attachments**: Originates from the interosseous membrane between the tibia and fibula, and posterior surfaces of the two bones. The tendon enters the foot posterior to the medial malleolus, and attaches to the plantar surfaces of the medial tarsal bones.
- **Actions**: Inverts and plantarflexes the foot, maintains the medial arch of the foot.
- **Innervation**: Tibial nerve.

3. Flexor Digitorum Longus

The FDL is (surprisingly) a smaller muscle than the flexor hallucis longus. It is located medially in the posterior leg.

- **Attachments**: Originates from the medial surface of the tibia, attaches to the plantar surfaces of the lateral four digits.
- **Actions**: Flexes the lateral four toes.
- **Innervation**: Tibial nerve.

4. Flexor Hallucis Longus

The flexor hallucis longus muscle is found on the lateral side of leg. This is slightly counter-intuitive, as it is opposite the great toe, which it acts on.

- **Attachments**: Originates from the posterior surface of the fibula, attaches to the plantar surface of the phalanx of the great toe.
- **Actions**: Flexes the great toe.
- **Innervation**: Tibial nerve

MUSCLES OF THE FOOT

The muscles acting on the foot can be divided into two distinct groups; **extrinsic** and **intrinsic** muscles.

- The **extrinsic** muscles arise from the anterior, posterior and lateral compartments of the leg. They are mainly responsible for actions such as eversion, inversion, plantarflexion and dorsiflexion of the foot.
- The **intrinsic** muscles are located within the foot and are responsible for the fine motor actions of the foot, for example movement of individual digits.

Here we shall be considering the anatomy of the intrinsic muscles of the foot. They can be divided into those situated on the **dorsum** of the foot, and those in the **sole** of the foot.

Dorsal Aspect

Whilst many of the extrinsic muscles attach to the dorsum of the foot, there are only two intrinsic muscles located in this compartment – the extensor digitorum brevis, and the extensor hallucis brevis.

They are mainly responsible for assisting some of the extrinsic muscles in their actions. Both muscles are innervated by the **deep fibular nerve**.

1. Extensor Digitorum Brevis

The extensor digitorum brevis muscle lies deep to the tendon of the extensor digitorum longus.

- **Attachments**: Originates from the calcaneus, the interosseous talocalcaneal ligament and the inferior extensor retinaculum. It attaches to proximal phalanx of the great toe and the long extensor tendons of toes 2-4.
- **Actions**: Aids the extensor digitorum longus in extending the medial four toes at the metatarsophalangeal and interphalangeal joints.
- **Innervation**: Deep fibular nerve.

2. Extensor Hallucis Brevis

The extensor hallucis brevis muscle is medial to extensor digitorum longus and lateral to extensor hallucis longus.

- **Attachments**: Originates from the calcaneus, the interosseous talocalcaneal ligament and the inferior extensor retinaculum. It attaches to the base of the proximal phalanx of the great toe.
- **Actions**: Aids the extensor hallucis longus in extending the great toe at the metatarsophalangeal joint.
- **Innervation**: Deep fibular nerve.

(Note – some texts consider the extensor hallucis brevis to be merely the medial part of the extensor digitorum brevis)

Plantar Aspect

There are 10 **intrinsic muscles** located in the sole of the foot. They act collectively to stabilise the arches of the foot, and individually to control movement of the digits. All the muscles are innervated either by the **medial plantar nerve** or the **lateral plantar nerve**, which are both branches of the tibial nerve.

The muscles of the plantar aspect are described in four layers (superficial to deep).

First Layer

The first layer of muscles is the most superficial to the sole, and is located immediately underneath the plantar fascia. There are three muscles in this layer.

1. Abductor Hallucis

The abductor hallucis muscle is located on the medial side of the sole, where it contributes to a small soft tissue bulge.

Attachments: Originates from the medial tubercle of the calcaneus, the flexor retinaculum and the plantar aponeurosis. It attaches to the medial base of the proximal phalanx of the great toe.

Actions: Abducts and flexes the great toe.

Innervation: Medial plantar nerve.

2. Flexor Digitorum Brevis

The flexor digitorum brevis muscle is located laterally to the abductor hallucis. It sits in the centre of the sole, sandwiched between the plantar aponeurosis and the tendons of flexor digitorum longus.

Attachments: Originates from the medial tubercle of the calcaneus and the plantar aponeurosis. It attaches to the middle phalanges of the lateral four digits.

Actions: Flexes the lateral four digits at the proximal interphalangeal joints.

Innervation: Medial plantar nerve.

3. Abductor Digiti Minimi

The abductor digiti minimi muscle is located on the lateral side of the foot. It is homologous with the abductor digiti minimi of the hand.

Attachments: Originates from the medial and lateral tubercles of the calcaneus and the plantar aponeurosis. It attaches to the lateral base of the proximal phalanx of the 5th digit.

Actions: Abducts and flexes the 5th digit.

Innervation: Lateral plantar nerve.

Second Layer

The second layer contains two muscles – the quadratus plantae, and the lumbricals. In addition, the tendons of the flexor digitorum longus (an extrinsic muscle of the foot) pass through this layer.

1. Quadratus Plantae

The quadratus plantae muscle is located superior to the flexor digitorum longus tendons. It is separated from the first layer of muscles by the lateral plantar vessels and nerve.

- **Attachments**: Originates from the medial and lateral plantar surface of the calcaneus. It attaches to the tendons of flexor digitorum longus.
- **Actions**: Assists flexor digitorum longus in flexing the lateral four digits.
- **Innervation**: Lateral plantar nerve.

2. Lumbricals

There are four lumbrical muscles in the foot. They are each located medial to their respective tendon of the flexor digitorum longus.

- **Attachments**: Originates from the tendons of flexor digitorum longus. Attaches to the extensor hoods of the lateral four digits.
- **Actions**: Flexes at the metatarsophalangeal joints, while extending the interphalangeal joints.
- **Innervation**: The most medial lumbrical is innervated by the medial plantar nerve. The remaining three are innervated by the lateral plantar nerve.

Third Layer

The third layer contains three muscles. The flexor hallucis brevis and adductor hallucis are associated with movements of the great toe. The remaining muscle, the flexor digiti minimi brevis, moves the little toe.

1. Flexor Hallucis Brevis

The flexor hallucis brevis muscle is located on the medial side of the foot. It originates from two places on the sole of the foot.

- **Attachments**: Originates from the plantar surfaces of the cuboid and lateral cuneiforms, and from the tendon of the posterior tibialis tendon. Attaches to the base of the proximal phalanx of the great toe.
- **Actions**: Flexes the proximal phalanx of the great toe at the metatarsophalangeal joint.
- **Innervation**: Medial plantar nerve.

2. Adductor Hallucis

The adductor hallucis muscle is located laterally to the flexor hallucis brevis. It consists of an oblique and transverse head.

- **Attachments**: The oblique head originates from the bases of the 2nd, 3rd and 4th metatarsals. The transverse head originates from the plantar ligaments of the metatarsophalangeal joints. Both heads attach to the lateral base of the proximal phalanx of the great toe.
- **Actions**: Adduct the great toe. Assists in forming the transverse arch of the foot.
- **Innervation**: Deep branch of lateral plantar nerve.

3. Flexor Digiti Minimi Brevis

The flexor digiti minimi brevis muscle is located on the lateral side of the foot, underneath the metatarsal of the little toe. It resembles the interossei in structure.

- **Attachments**: Originates from the base of the fifth metatarsal. Attaches to the base of the proximal phalanx of the fifth digit.
- **Actions**: Flexes the proximal phalanx of the fifth digit.
- **Innervation**: Superficial branch of lateral plantar nerve.

Fourth Layer

The plantar and dorsal interossei comprise the fourth and final plantar muscle layer. The plantar interossei have a unipennate morphology, while the dorsal interossei are bipennate.

1. Plantar Interossei

There are three plantar interossei, which are located between the metatarsals. Each arises from a single metatarsal.

- **Attachments**: Originates from the medial side of metatarsals three to five. Attaches to the medial sides of the phalanges of digits three to five.

- **Actions**: Adduct digits three to five and flex the metatarsophalangeal joints.
- **Innervation**: Lateral plantar nerve.

2. Dorsal Interossei

There are four dorsal interossei, which are located between the metatarsals. Each arises from two metatarsals.

- **Attachments**: Originates from the sides of metatarsals one to five. The first muscle attaches to the medial side of the proximal phalanx of the second digit. The second to fourth interossei attach to the lateral sides of the proximal phalanxes of digits two to four.
- **Actions**: Abduct digits two to four and flex the metatarsophalangeal joints.
- **Innervation**: Lateral plantar nerve.

Reference from: https://teachmeanatomy.info/lower-limb/muscles/