

5

Lower Limb

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OVERVIEW OF THE REGION

The lower limb is designed for weight-bearing, balance, and mobility. The bones and muscles of the lower limb are larger and stronger than those of the upper limb, which is necessary for the functions of weight-bearing and balance. Our lower limbs carry us, allow us to push forward, and also keep us standing still. Our sense of steadiness and strength often comes from our lower limbs.

The muscles of the thigh are thick and strong and can tolerate greater pressure during massage than the smaller muscles of the arm. *Pétrissage* is generally welcome and easy to perform in the thigh. The muscles of the posterior leg are also thick and strong, as they propel us forward. The anterior leg is less muscular and more suited to friction or deep *effleurage*.

The foot is our anchor, grounding us to the earth. Although composed of a complex structure of bones, joints, and muscles, the foot is also our steady connection to the ground.

BONES AND BONE MARKINGS OF THE REGION

The bones of the lower limb include the pelvic girdle, femur, patella, tibia, fibula, and bones of the foot. These are discussed below.

Pelvic Girdle

The pelvic girdle contains the hip bone and the sacrum. As already noted, the hip bone contains the ilium, ischium, and pubis (see Chapter 4). Recall that the iliac crest contains the anterior superior iliac spine (ASIS) and the posterior superior iliac spine (PSIS). The iliac spine contains the entire iliac crest and extends inferiorly in the front and back to include the anterior inferior iliac spine (AIIS) and posterior inferior iliac spine (PIIS), as well. The anterior aspect of the ilium is broad and curved, like a fossa. It is called the *iliac fossa*.

Recall that the ischium has a significant bone marking in the ischial tuberosity. The hamstring muscles connect to the

ischial tuberosity. In addition, the ischium contains a spine, which separates the greater sciatic notch from the lesser sciatic notch.

Remember that the pubis contains two rami, the superior pubic ramus and the inferior pubic ramus. The thigh adductors originate on the pubis.

Recall that the acetabulum is the name of the socket that articulates with the head of the femur to form the hip joint. The acetabulum is where the ilium, ischium, and pubis join together. Figure 5-1 shows bones and bone markings of the pelvis.

Femur

The femur, or thigh bone, is the longest and strongest bone in the body. Its rounded head, located on the proximal, medial aspect of the femur, fits beautifully in the acetabulum to form the hip joint. The greater trochanter is a sizable bone marking on the lateral aspect of the proximal femur. The lesser trochanter is smaller and is located distal and slightly posterior to the head of the femur on the medial aspect of the bone. Rounded medial and lateral condyles are located on the distal end of the femur and articulate with the tibia. A rough line called the *linea aspera* runs almost the full length of the posterior femur. The gluteal tuberosity is located on the proximal, posterior femur, very close to the proximal *linea aspera*. The pectineal line is located proximal and medial on the posterior femur, just inferior to the lesser trochanter. Figure 5-2 illustrates the femur and its bone markings, as well as the patella.

Patella

The patella or knee cap is a sesamoid bone that lies anterior to the junction of the femur and tibia. The patella is cartilaginous at birth and ossifies between 3 and 6 years of age. The patella is embedded in the quadriceps tendon and causes the tendon to be positioned more anteriorly, thus enhancing the leverage of the quadriceps tendon as it pulls on the tibial tuberosity to extend the knee. The patella slides up and

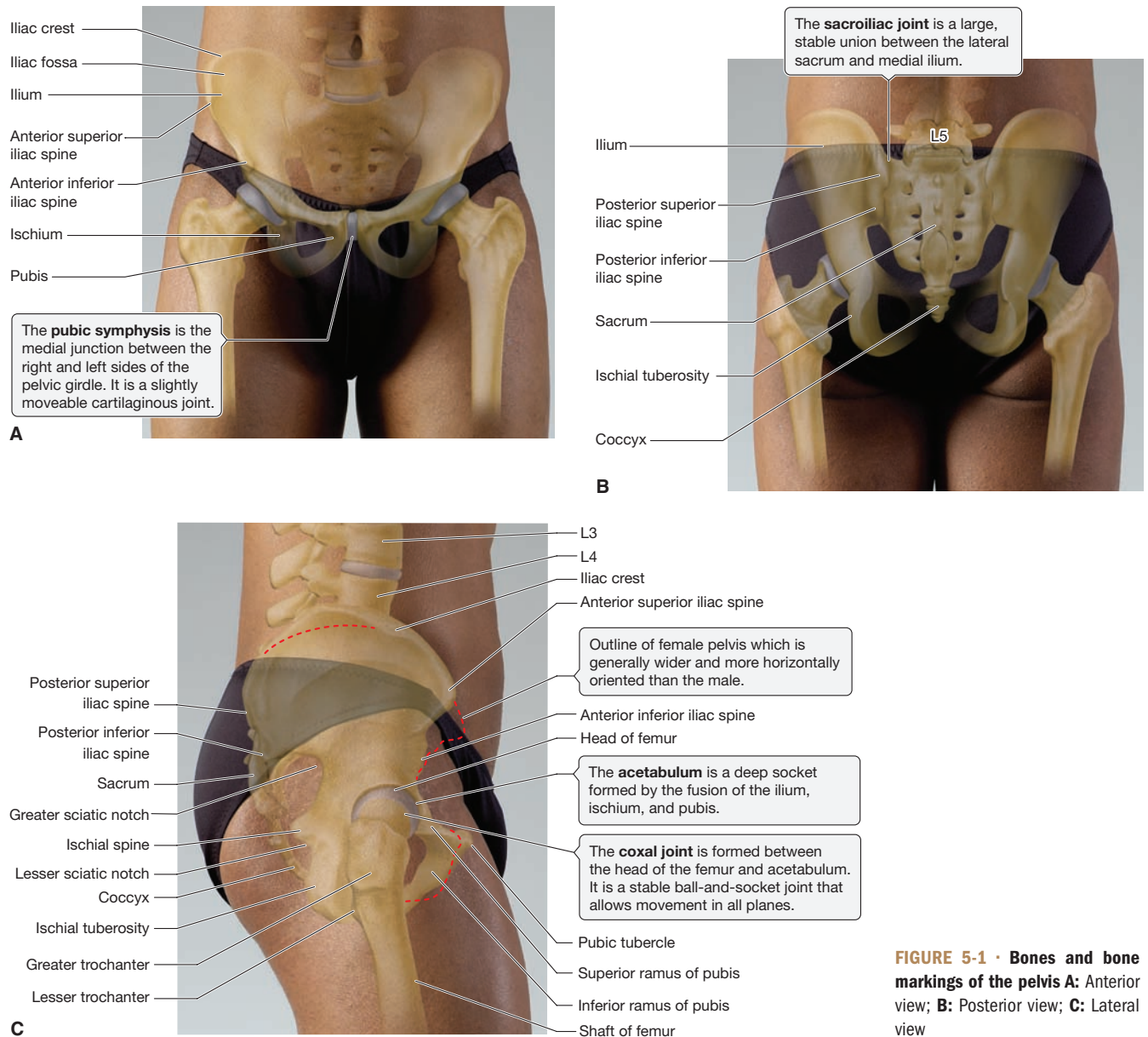


FIGURE 5-1 • Bones and bone markings of the pelvis **A:** Anterior view; **B:** Posterior view; **C:** Lateral view

down as we flex and extend the leg. Cartilage on the posterior aspect of the patella provides cushioning between the patella and the femur (see Fig. 5-2).

Tibia and Fibula

The tibia and fibula are the bones of the leg. The tibia is much the larger and is located medial to the fibula. The tibia is the weight-bearing bone and is part of the knee joint. Several important bone markings exist on the tibia and fibula. The proximal end of the tibia contains two condyles, a medial condyle and a lateral condyle. The tibial tuberosity is located on the proximal anterior aspect of the tibia, just inferior to the patella. As already noted, it serves as the insertion site for the quadriceps tendon. Pes anserinus, which

means “goose foot,” is the name given to a flat area on the proximal, anterior, medial tibia, just medial to the tibial tuberosity. Three muscles insert at pes anserinus, and the triplet of tendons looks somewhat like the three toes of a goose’s foot. On the distal medial side of the tibia is the medial malleolus, which is commonly referred to the “inner ankle bone” in lay terms.

The fibula contains some important bone markings, as well. The head of the fibula is the bone’s most proximal aspect. Two important muscles connect to this bone marking. Distally, the fibula has a lateral, rounded projection called the *medial malleolus* in anatomical language and called the “outer ankle bone” in common, everyday language. Figure 5-3 illustrates the bones and bone markings of the leg.

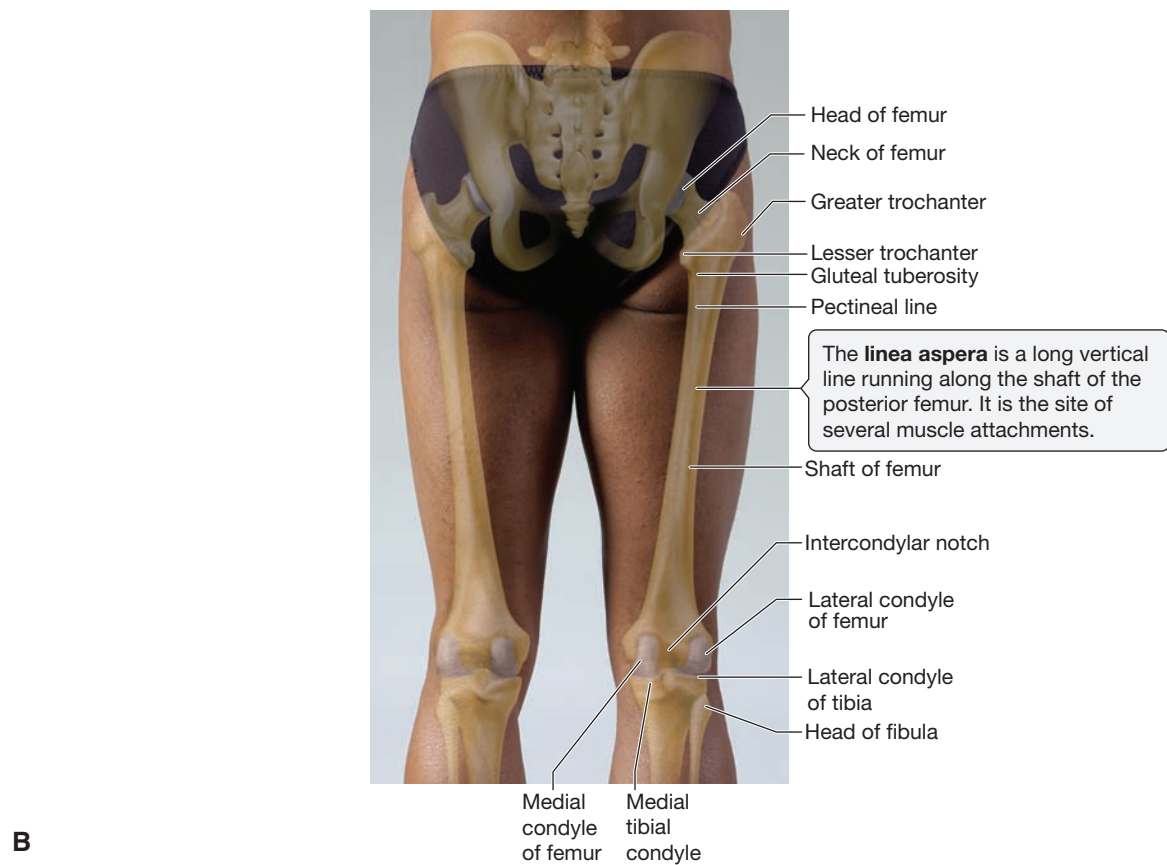
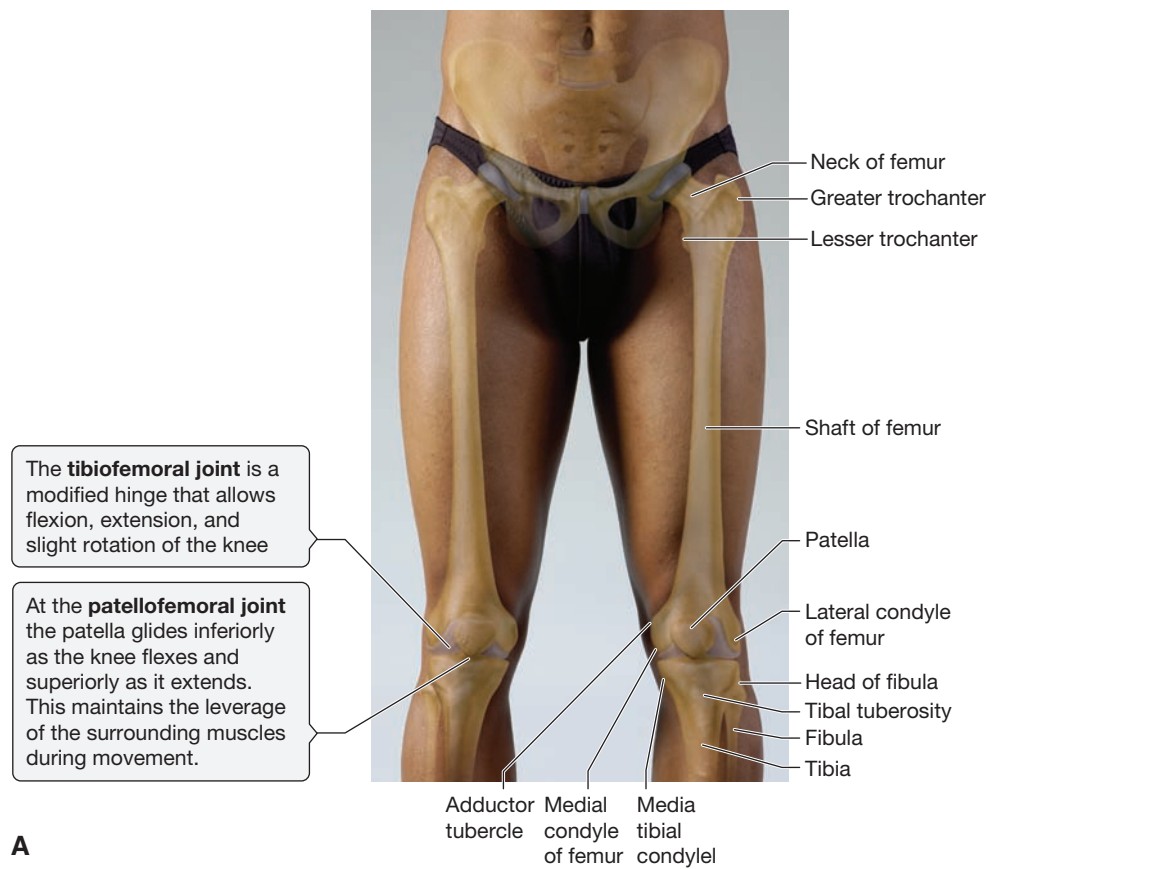


FIGURE 5-2 · Femur, femoral bone markings, and the patella. **A:** Anterior view; **B:** Posterior view

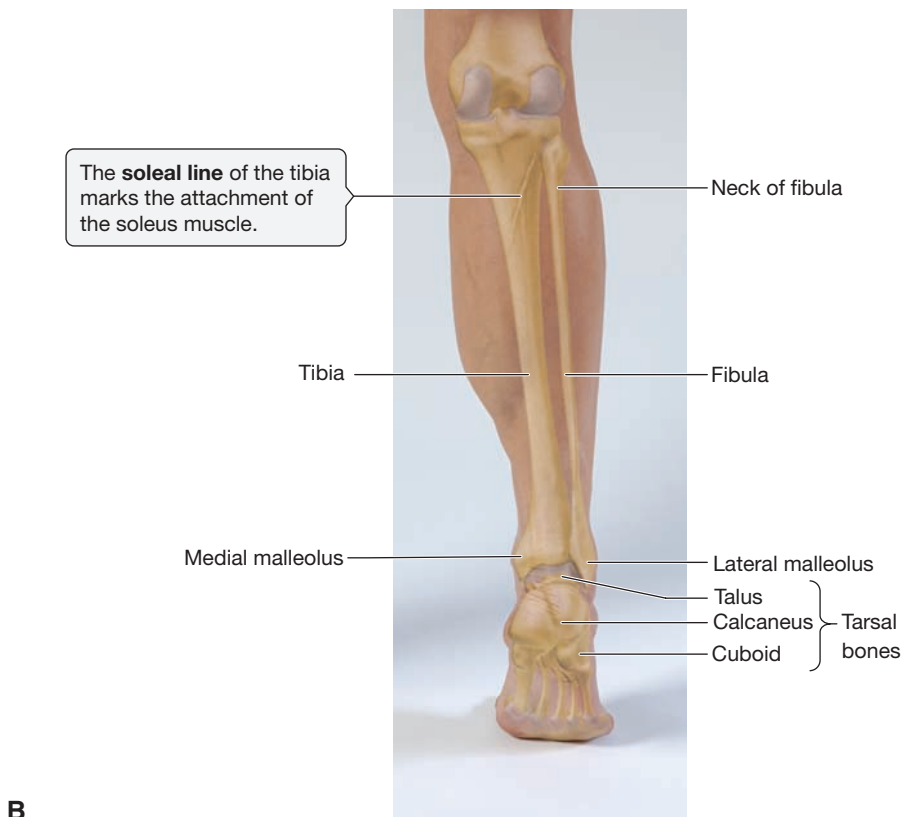
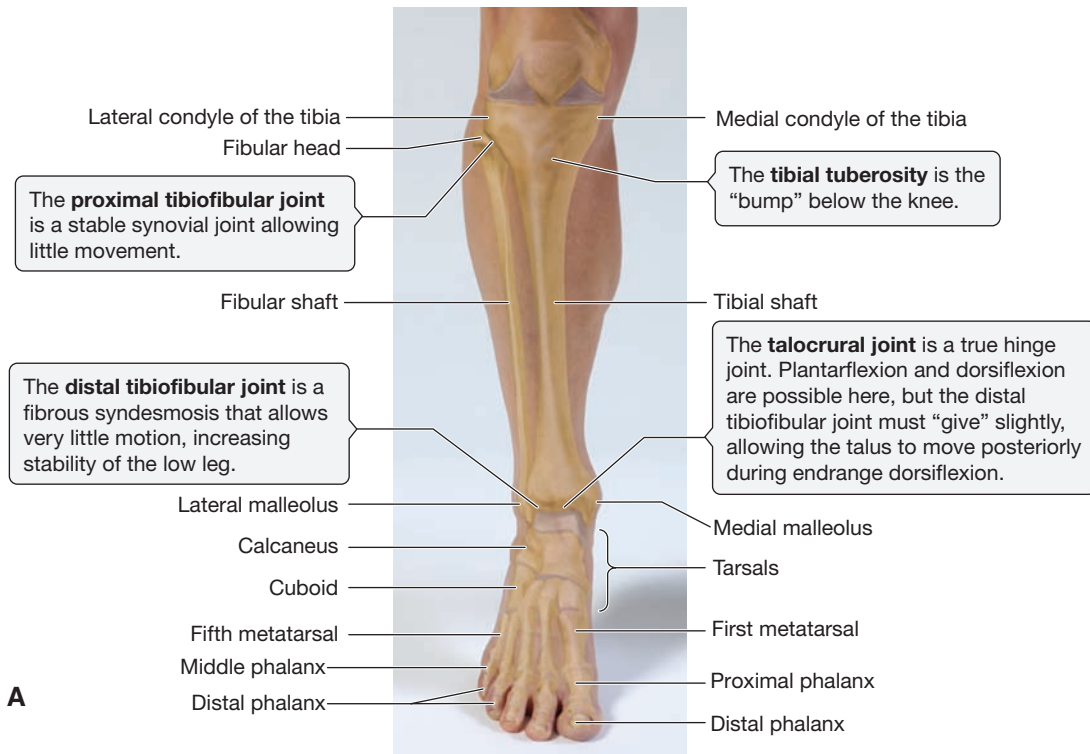


FIGURE 5-3 • Bones and bone markings of the leg. **A:** Anterior view; **B:** Posterior view

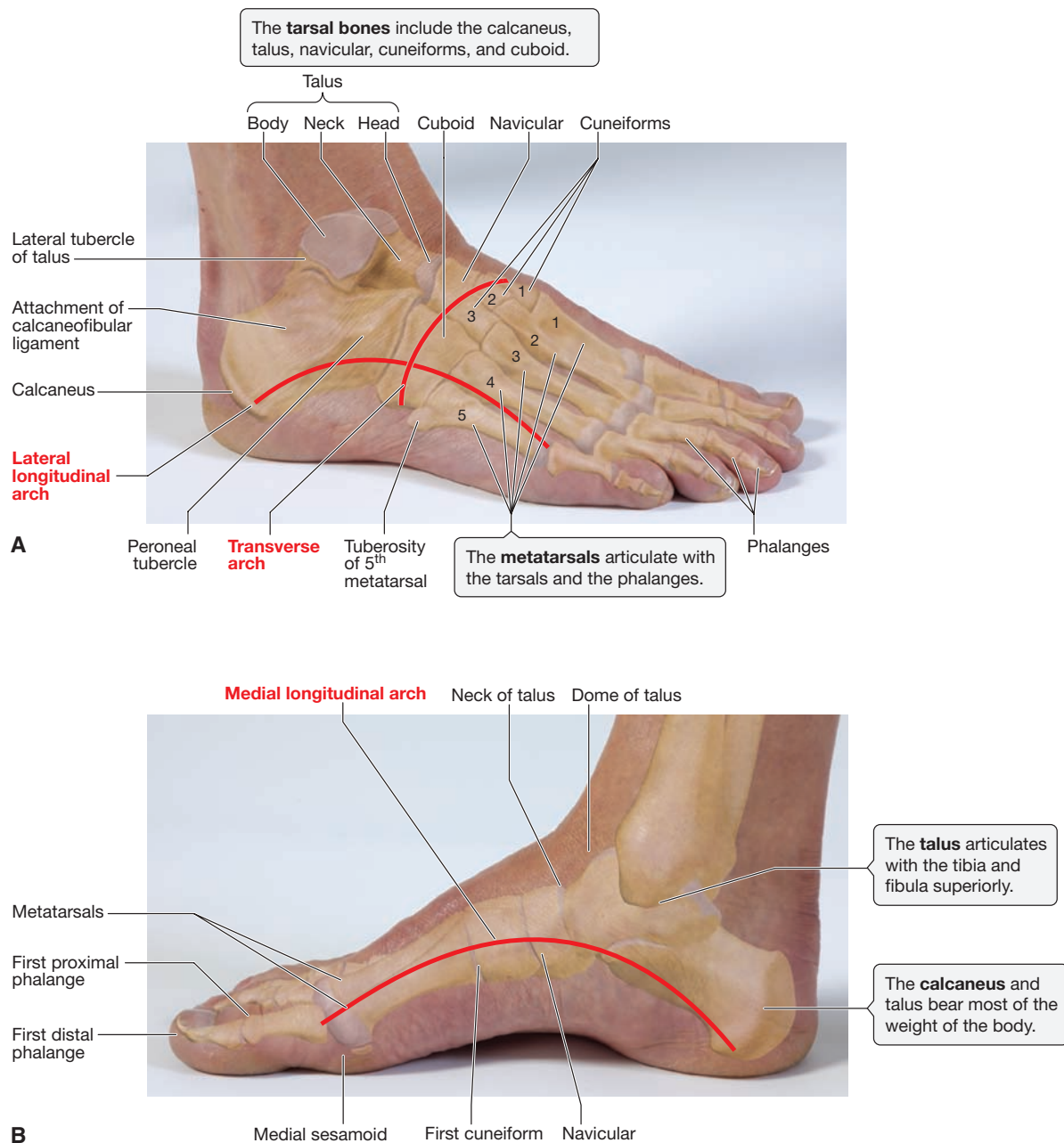


FIGURE 5-4 • Bones and arches of the foot. A: Lateral view; **B:** Medial view

Bones of the Foot

The bones of the foot are organized in a somewhat similar fashion to the bones of the hand. However, a major difference is that the tarsals do not lie in two fairly neat, distinguishable rows of four bones each, as do the carpals of the proximal hand. We have seven tarsals in each foot, a group of three and then a row of four distal to the group of three. The calcaneus is the heel bone and is the largest tarsal bone. The sizable Achilles tendon connects to the posterior aspect of the calcaneus. The calcaneus has a roughened tuberosity on its plantar aspect, where three muscles originate. The talus is superior to the calcaneus and joins with the distal tibia and

distal fibula to form the ankle joint. Anterior to the talus is the navicular. A row of four bones lies distal to the calcaneus and the navicular and includes the medial cuneiform, the middle cuneiform, the lateral cuneiform, and the cuboid. The three cuneiforms are frequently called cuneiform 1, 2, and 3, with the first cuneiform always the medial one and the third cuneiform always the lateral one.

Our metatarsals are located distal to the tarsal bones, one metatarsal per digit, thus matching the hand's metacarpals. The proximal aspect of each metatarsal is called the *base*, and the rounded, distal end of each metatarsal is called a *head*. Distal to the metatarsals are our phalanges, arranged in rows. Each of the

four lateral toes has a proximal, middle, and distal phalanx. Digit 1, or the big toe, has only two phalanges, a proximal and a distal. Figure 5-4 illustrates the bones and arches of the foot.

The shapes of our foot bones and their relative position to each other cause the foot to have both longitudinal and transverse arches. We have a longitudinal arch, which runs from the calcaneus to the heads of the metatarsals. The longitudinal arch is often separated into a medial longitudinal and a lateral longitudinal arch. We also have a transverse arch, which runs medially to laterally across the cuneiforms and cuboid. The wedge shape of many of our tarsal bones creates these arches. In addition, ligaments and the intrinsic foot muscles help to maintain our arches.

Our arches enhance our mobility and balance, and assist in the transfer of weight from one part of the foot to another. In addition, the arches serve as shock absorbers. *Pes planus*, or flat feet, occurs when our arches are flattened. This condition can be painful and limit mobility. Because *pes planus* can shift gait, it can cause muscular issues in the leg or thigh. Massage therapy may help address such muscular issues.

JOINTS, LIGAMENTS, AND BURSAE OF THE REGION

Joints of the lower limb include the sacroiliac joint, hip joint, knee joint, tibiofibular joints, ankle joints, joints that permit inversion and eversion, and other joints within the foot. These are discussed below.

Sacroiliac Joint

The sacrum articulates with the ilium at two sacroiliac (SI) joints. The articulating surfaces of the sacrum and ilium nestle against each other, so that the joints allow very little movement. Many strong ligaments support the SI joints. The anterior SI ligament joins the iliac fossa to the anterior sacrum. The posterior SI ligament joins the PSIS to the sacrum. The sacrotuberous ligament joins the ischial tuberosity to the sacrum. The sacrospinous ligament joins the ischial spine to the sacrum. Figure 5-5 shows the ligaments that support the SI joint.

Hip Joint

The hip joint is a ball-and-socket joint designed to have the stability needed for a weight-bearing joint. A strong ring of fibrocartilage, called the *acetabular labrum*, connects to the edge of the acetabulum, giving the socket greater depth and helping to hold the head of the femur in the socket. Many ligaments help support the hip joint. The ischiofemoral ligament, the iliofemoral ligament, and the pubofemoral ligament join each of the hip bones to the femur. In addition, the ligament of the head of the femur joins the head of the femur to the acetabulum.

Several bursae lie between structures in the area of the hip joint. The ischial bursa prevents friction between the gluteus maximus muscle and the ischial tuberosity. The iliopectineal

bursa separates the anterior hip joint capsule from the iliopsoas muscle. And the trochanteric bursa prevents friction between the greater trochanter and the gluteus maximus muscle.

The hip joint permits flexion, extension, abduction, adduction, as well as internal (medial) and external (lateral) rotation.

Knee Joint

The knee joint is the articulation between the proximal tibia and distal femur. The rounded condyles of the distal femur fit into concave condyles of the proximal tibia. The knee joint is classified as a hinge joint and permits a wide range of flexion and extension. The knee joint also allows a small amount of medial and lateral rotation, due to the difference in sizes between the medial and lateral condyles of the femur. The medial condyle of the femur is longer (from front to back) than the lateral condyle of the femur. Thus, as we extend our leg toward full extension, the lateral condyles of femur and tibia touch, forming a pivot around which a small amount of rotation occurs. When we bring our knee into full extension, the tibia rotates laterally to cause a perfect fit and “lock” to the knee joint. When flexing our knee from a fully extended position, the tibia must rotate a bit medially to allow flexion to begin. Rotation of the tibia is possible only when the tibia is free to move. When our weight is on a single leg, and the tibia is thus fixed, the femur rotates laterally to unlock the knee, or the femur rotates medially to “lock” the knee.

Many important muscles and ligaments stabilize the knee. The large quadriceps group and the large hamstring muscles provide stability to the joint. In addition, four ligaments play a major role in knee stabilization. The anterior cruciate ligament (ACL) joins the anterior aspect on the medial tibia to the medial side of the lateral condyle of the femur. The posterior cruciate ligament (PCL) joins the posterior medial tibia to the lateral side of the medial condyle of the femur. Cruciate means “cross,” which is an appropriate name, as these two ligaments cross over each other as they pass from the tibia to the femur. The cruciate ligaments prevent the femur from sliding off of the tibia anteriorly or posteriorly. The ACL is susceptible to injury when the knee is hit from the lateral side. A weakened or torn ACL leaves the knee joint lacking stability.

We have two ligaments that run vertically along the sides of the knee joint. The lateral or fibular collateral ligament joins the lateral epicondyle of the femur to the head of the fibula. The medial or tibial collateral ligament joins the medial epicondyle of the femur to the lateral aspect of the proximal tibia. The medial collateral ligament is more susceptible to injury than is the lateral collateral ligament, due to its vulnerability when a force pushes into the lateral side of the knee.

The patellar ligament completes the knee ligaments. This ligament runs from the patella to the tibial tuberosity and is a portion of the quadriceps tendon of insertion. The patellar ligament provides additional stability across the anterior aspect of the knee joint. Figure 5-6 shows the ligaments that stabilize the knee.

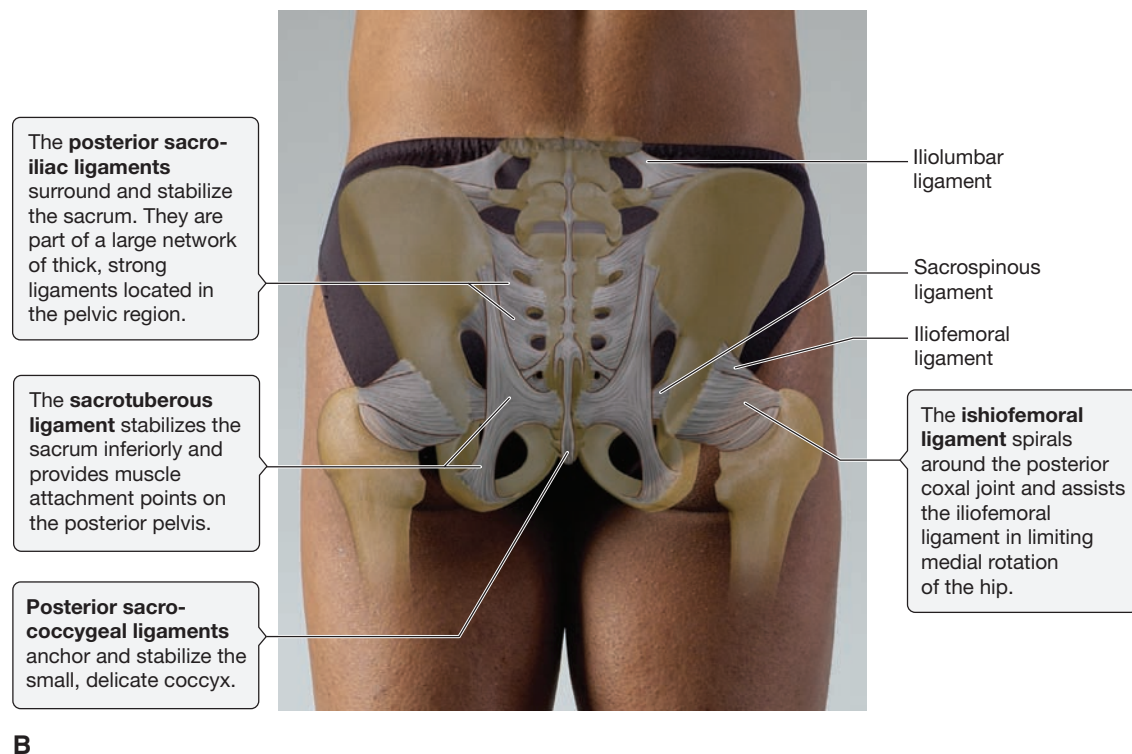
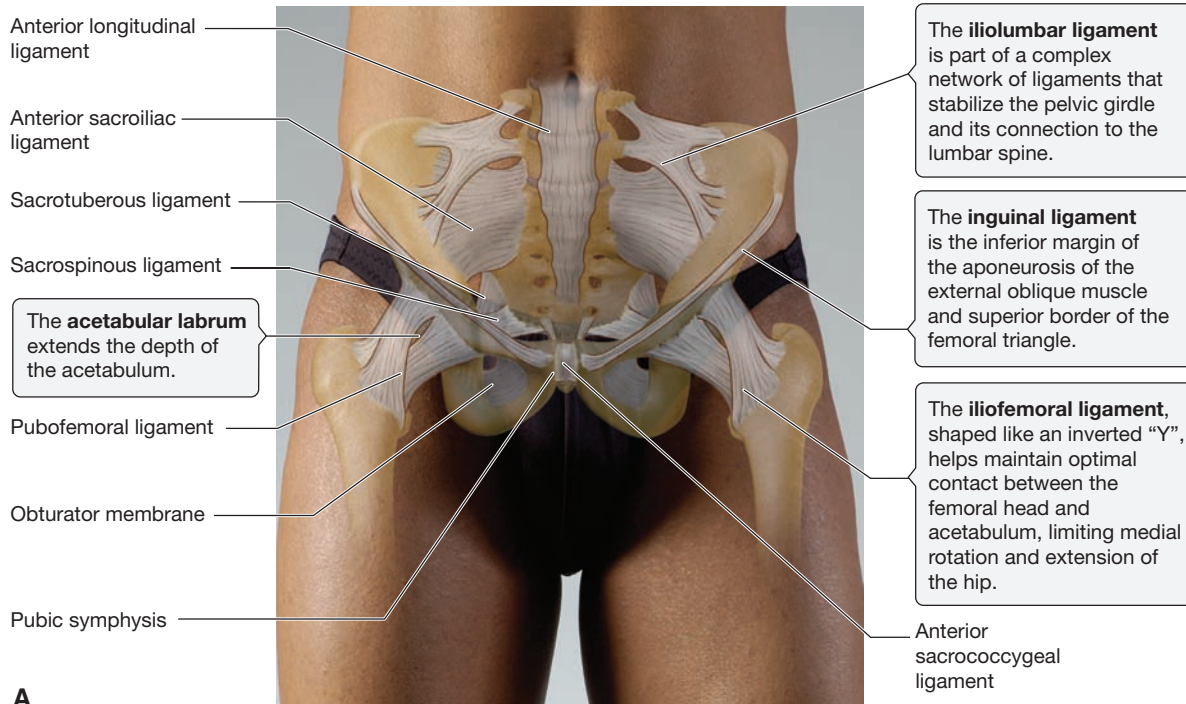


FIGURE 5-5 • Ligaments that support the sacroiliac joint. **A:** Anterior view; **B:** Posterior view

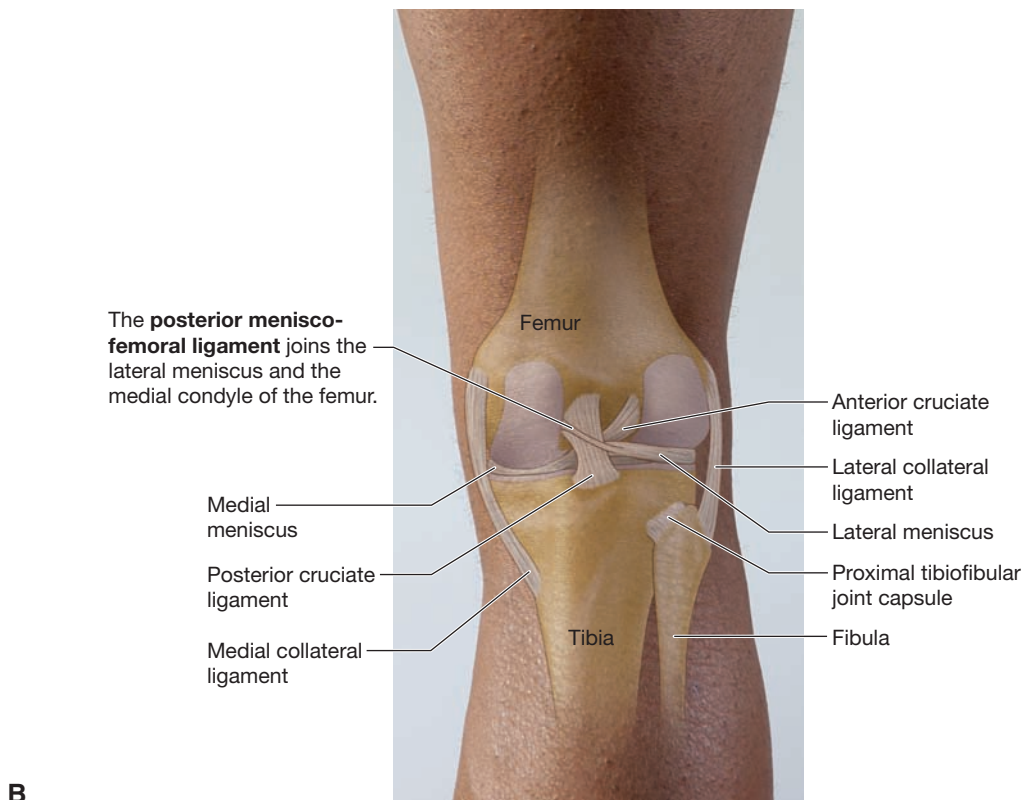
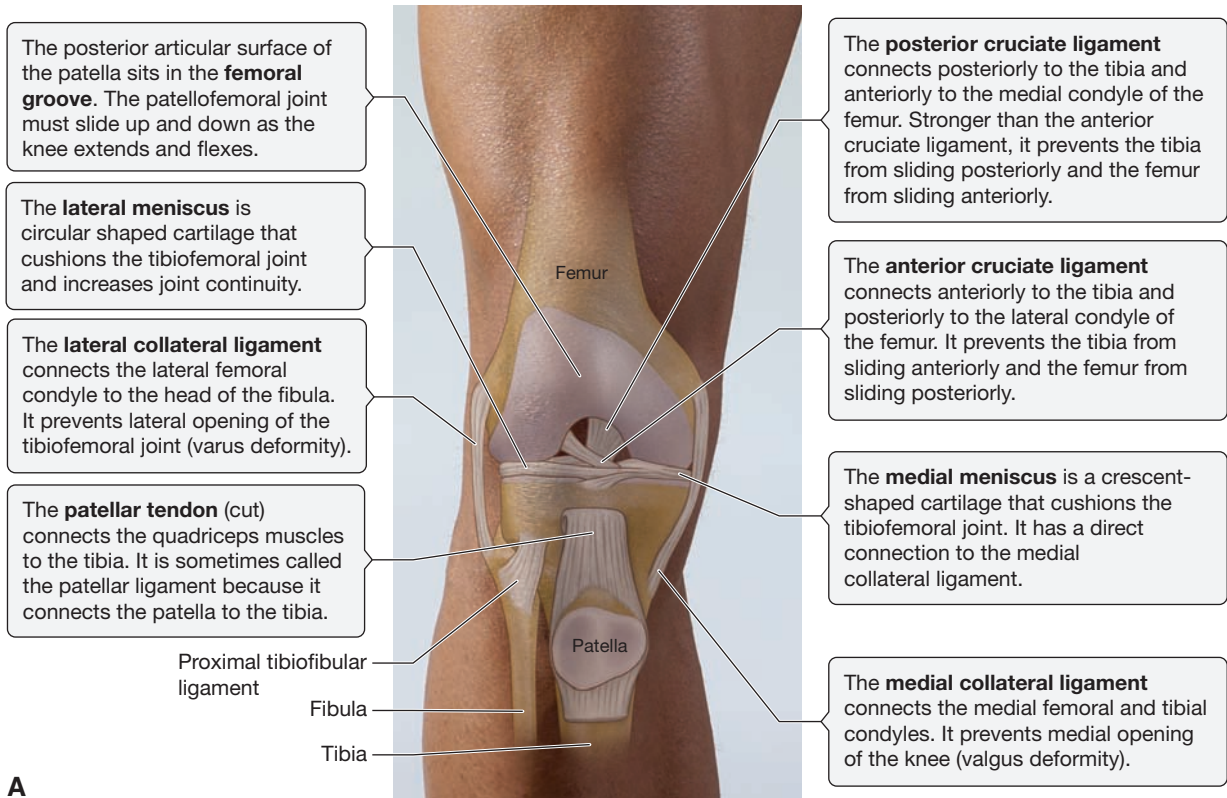


FIGURE 5-6 • Ligaments that stabilize the knee. **A:** Anterior view; **B:** Posterior view

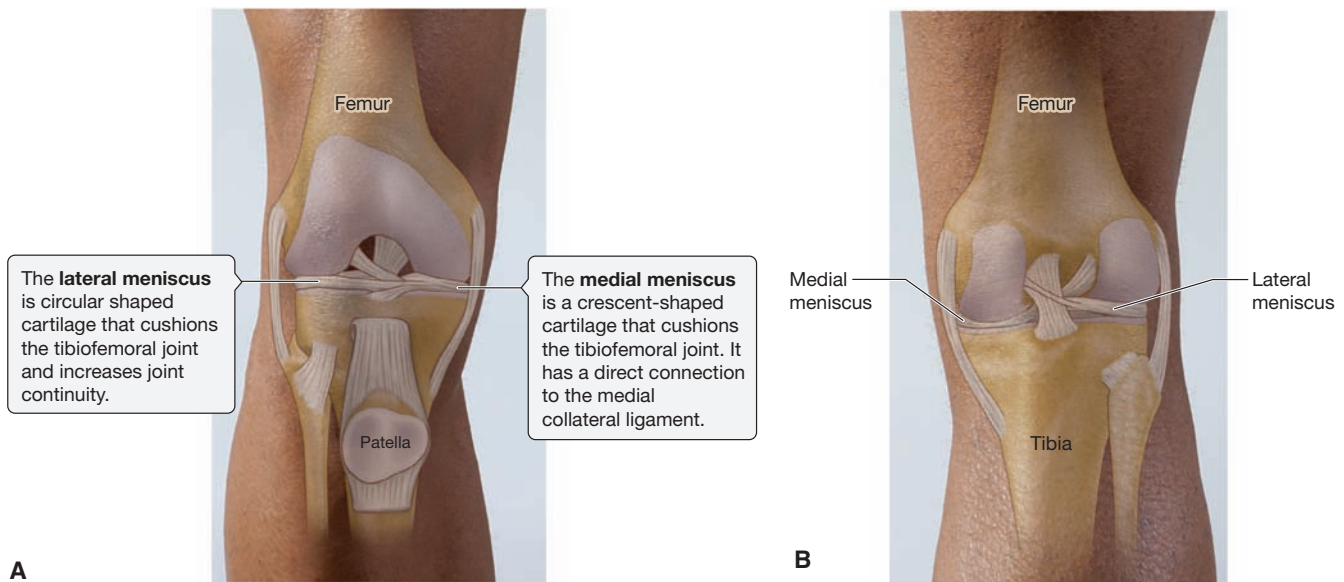


FIGURE 5-7 • Medial and lateral menisci of the knee

Two rings of fibrocartilage, called *menisci*, lie between the femur and the tibia and provide cushioning between these two bones. The lateral meniscus forms an almost complete ring, whereas the medial meniscus is more C-shaped. The menisci are susceptible to tears and do not self-repair easily. Figure 5-7 shows the medial and lateral menisci of the knee.

Several bursae help to prevent friction between structures close to the knee joint. The subcutaneous infrapatellar bursa facilitates movement of the skin over the tibial tuberosity as the knee joint moves. The suprapatellar bursa prevents friction between the patella and femur. The gastrocnemius bursa allows the proximal gastrocnemius muscle to move against the posterior femur. Irritation or inflammation of these bursae can be painful and produce swelling. Such bursitis is commonly caused by trauma to the area or overuse of the knee joint. Figure 5-8 shows several bursae of the knee joint.

Massage therapy can help prevent knee injuries by contributing to the health and flexibility of the muscles that help stabilize the knee. In addition, massage therapy can help the process of recovery from a knee injury by assisting in the reduction of adhesions and scar tissue.

Tibiofibular Joints

We have two joints between the tibia and fibula. The proximal tibiofibular joint is a plane joint and permits minimal gliding. The distal tibiofibular joint is an amphiarthrotic joint and permits almost no movement at all. An interosseus membrane adds further stability between the two bones of the leg (see Fig. 5-3).

Ankle Joints

The ankle joint is composed of the distal end of the tibia, the distal end of the fibula, and the talus. The distal ends of the tibia and fibula form a shape that is similar to three sides of a box. This structure fits perfectly with the talus, especially when the ankle is in a dorsiflexed position. When dorsiflexed, the portion of the talus that articulates with the distal tibia and fibula is wider, and thus the three bones fit snugly together. Figure 5-9 shows the ankle joint.

The ankle most resembles a hinge type of synovial joint, and it permits dorsiflexion and plantarflexion. A small amount of abduction, adduction, and rotation are possible, as well.

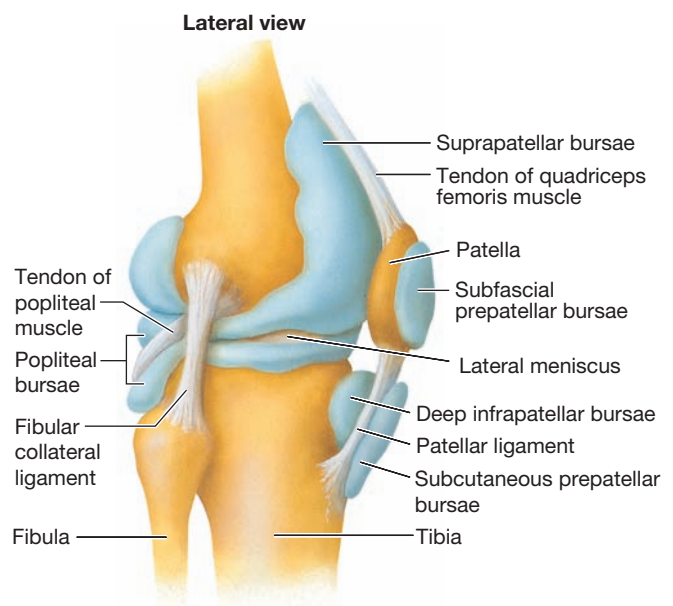
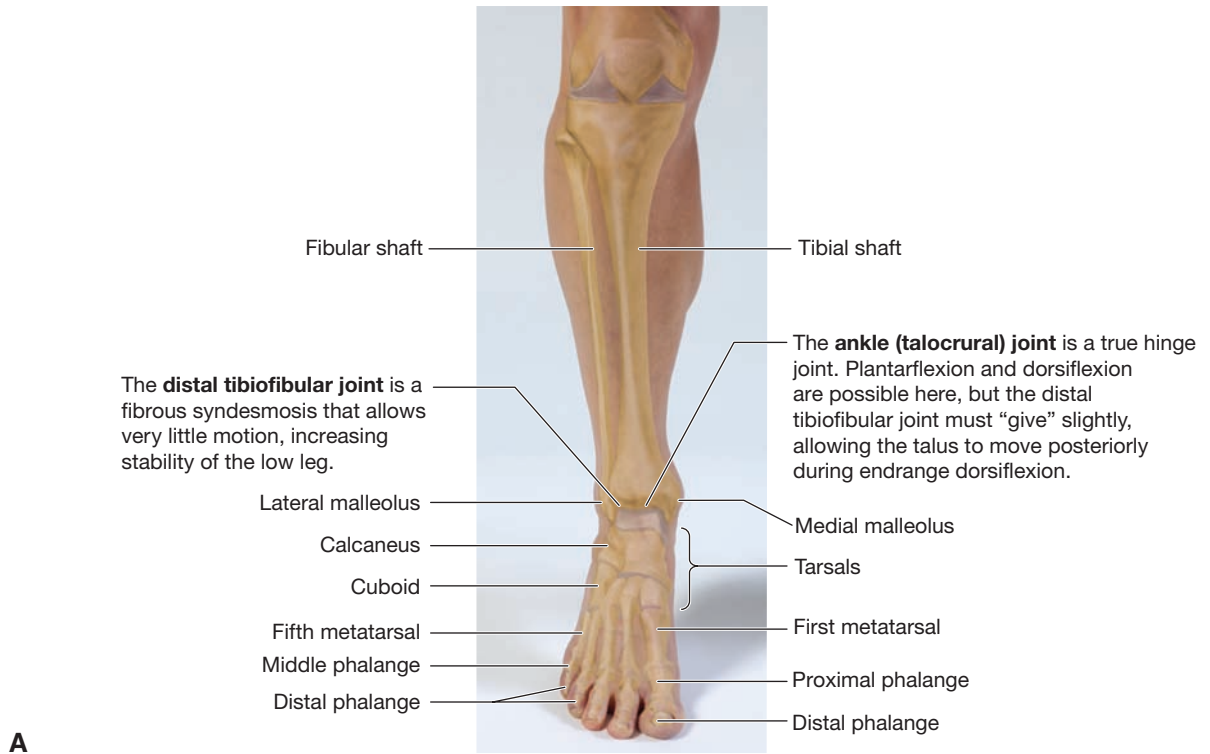
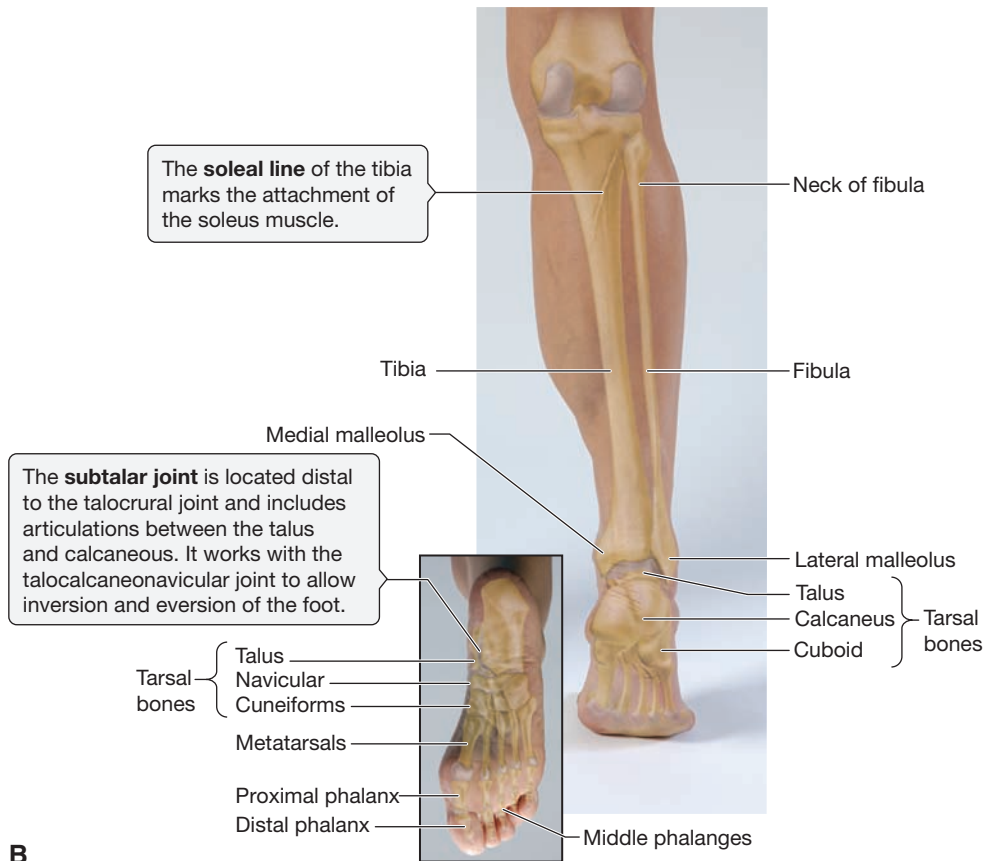


FIGURE 5-8 • Bursae of the knee joint



A



B

FIGURE 5-9 • Ankle joint. A: Anterior view; B: Posterior view

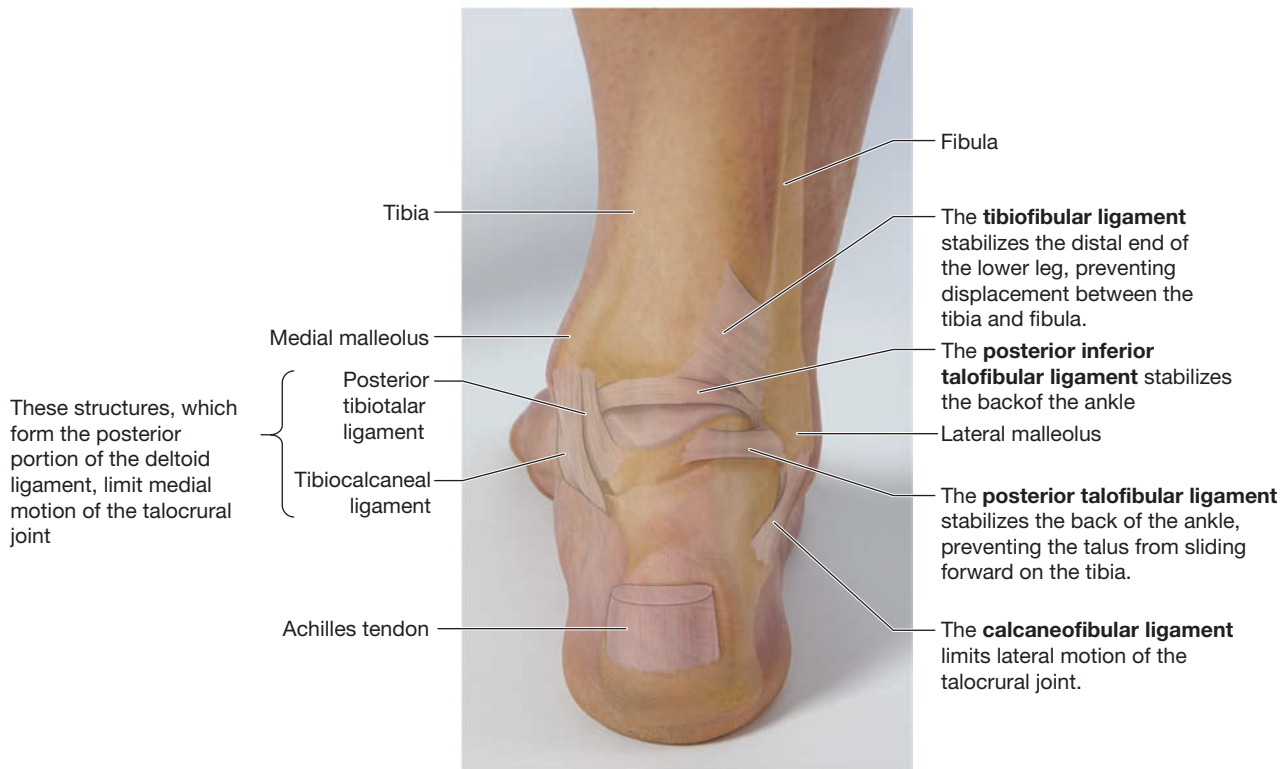


FIGURE 5-10 • Major ligaments of the foot and ankle

Many ligaments support the ankle joint. Among them are the deltoid ligament, a strong, triangular-shaped ligament that joins the medial malleolus to the talus, navicular, and calcaneus. The spring ligament joins the talus to the calcaneus. The posterior talofibular ligament joins the lateral malleolus to the talus. The calcaneofibular ligament joins the lateral malleolus to the calcaneus. Many other ligaments contribute to the stability of the ankle joint. Figure 5-10 shows the major ligaments of the foot and ankle.

Despite the significant number of ligaments helping to stabilize this joint, and despite the shapes of the articular surfaces of the bones that come together so well to form this joint, the ankle is the most commonly injured joint in the body. When we lose balance, we put huge amounts of stress on the ligaments that support this joint, often tearing or overstretching them. The ligaments positioned to cross the lateral side of the ankle joint are most vulnerable to injury. Massage therapy can provide benefits to those with chronic ankle weakness and sprains by working to remove adhesions and scar tissue and restoring range of motion to the joint.

Joints That Permit Inversion and Eversion

Recall that *inversion* is the foot movement that results in turning the plantar surface of the foot inward toward the midline. Eversion is the foot movement that causes the plantar surface

of the foot to turn outward. These movements are important in helping us to maintain balance when walking on uneven surfaces or as we shift our weight from one foot to the other.

Several intertarsal joints combine to permit the movements of eversion and inversion. The joint between the talus and calcaneus, the joint between the talus and the navicular, and the joint between the calcaneus and the cuboid are the major joints that allow the foot to invert and to evert.

Remaining Joints Within the Foot

The joints between the tarsals and metatarsals are plane or gliding joints, which permit limited side-to-side movement. The metatarsophalangeal (MP) joints are condyloid joints and allow flexion, extension, abduction, and adduction. The interphalangeal joints are hinge joints and permit flexion and extension only.

CONNECTIVE TISSUE STRUCTURES OF THE REGION

Connective tissue structures of the lower limb include the deep investing fascia, iliotibial band, fascial compartment divisions in the leg, and plantar fascia or aponeurosis.

Deep Investing Fascia and Iliotibial Band

The thigh contains a layer of fascia, which wraps all the muscles of the thigh. This fascia is substantially thicker on the

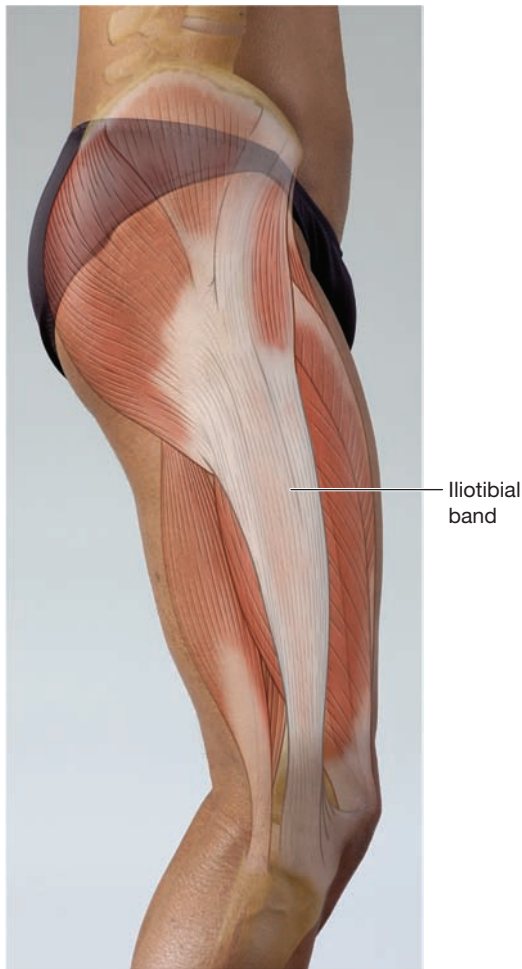


FIGURE 5-11 · Iliotibial (IT) band

lateral aspect of the thigh, forming the iliotibial (IT) tract. This dense band of connective tissue runs from the ilium to the lateral aspect of the lateral condyle of the tibia. The IT band serves as the tendon of insertion of gluteus maximus and the tensor fascia latae (TFL). The IT band or tract helps to stabilize the knee from a lateral perspective. Figure 5-11 shows the IT band.

Fascial Compartment Divisions in the Leg

The leg muscles are wrapped by investing fascia in a manner similar to the thigh. This crural (leg) fascia joins with intermuscular sheets of fascia called *septa*, to divide the leg into four rather distinct compartments. Two compartments are located in the posterior leg and are called the *deep posterior leg compartment* and the *superficial posterior leg compartment*. The deep posterior leg compartment contains three muscles. The superficial posterior leg compartment contains two

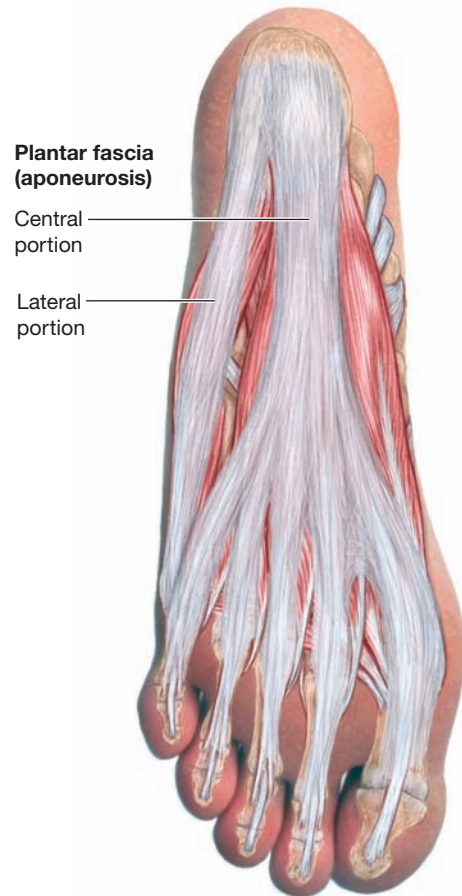


FIGURE 5-12 · Plantar fascia

muscles and the tendon of insertion of a third muscle. The anterior leg compartment lies between the anterior aspects of the tibia and fibula, and includes four muscles. The lateral leg compartment lies along the lateral fibula and houses two muscles. When describing the location of each of the muscles of the leg, the compartment in which each muscle is housed will be named.

Plantar Fascia or Aponeurosis

The plantar fascia runs from the calcaneus to the proximal phalanges of the plantar surface of the foot. Figure 5-12 illustrates the plantar fascia.

This structure provides support to the longitudinal arch of the foot. It can become inflamed, resulting in a condition called *plantar fasciitis*. Massage of the posterior leg muscle may provide symptomatic relief to those dealing with plantar fasciitis.

INDIVIDUAL MUSCLES

Hip Joint Muscles

The muscles that move the hip can be divided into many subgroups. We have a group of deep lateral rotators, located deep in the buttock region. Our hip adductors make up the medial

thigh. The hip abductors are located in the lateral hip area. The hip flexors cross the front of the hip joint, and the hip extensors cross the hip joint posteriorly.

PIRIFORMIS AND THE OTHER DEEP LATERAL ROTATORS OF THE HIP

The six deep lateral rotators of the hip include piriformis, gemellus superior, gemellus inferior, obturator internus, obturator externus, and quadratus femoris (Fig. 5-13).

pir-i-form-is

jem-e-lus su-per-e-or

jem-e-lus in-fer-e-or

ob-tu-ra-tor in-tern-us

ob-tu-ra-tor ek-stern-us

kwa-drat-us fem-o-ris

Meaning of Name

Piriformis means “pear-shaped.” The name *gemellus superior* indicates that there are two muscles (twins), and one is superior to the other. The name *gemellus inferior* indicates that there are two gemelli (twins) muscles and that this one is inferior to the other. Obturator internus and externus indicate the location of two muscles around the obturator foramen. Quadratus femoris indicates that the shape of the muscle is “square-like” and that it connects to the femur.

Location

All six of the deep lateral rotators of the thigh lie deep in the buttock region. Piriformis lies in the greater sciatic notch and is superficial to the sciatic nerve. Figure 5-14 shows the position of piriformis in relation to the sciatic nerve.

Origin and Insertion

Piriformis

Origin: anterior sacrum

Insertion: greater trochanter

Gemellus Superior

Origin: spine of the ischium

Insertion: greater trochanter

Gemellus Inferior and Quadrates Femoris

Origin: ischial tuberosity

Insertion: greater trochanter

Obturator Internus and Externus

Origin: obturator foramen

Insertion: greater trochanter

Actions

Laterally rotate the thigh

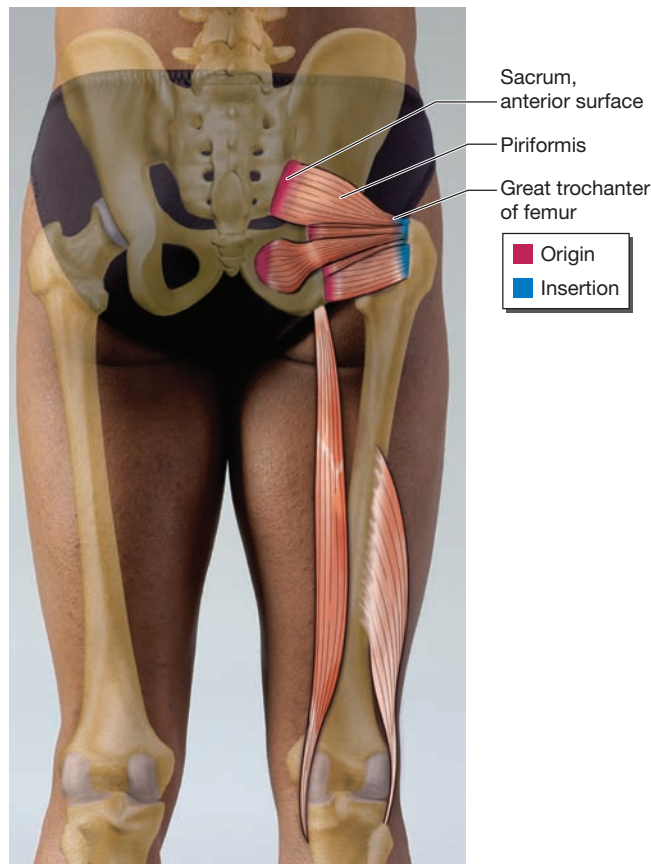


FIGURE 5-13 • Six deep lateral rotators of the hip

Explanation of Actions

All of the six deep lateral rotators are positioned to pull the greater trochanter posteriorly, thus causing the femur to rotate laterally.

Notable Muscle Facts

Piriformis is a thick muscle that lies directly superficial to the sciatic nerve. Thus, piriformis is in a position to impinge the sciatic nerve and cause a type of sciatica called *piriformis syndrome*.

Implications of Shortened and/or Lengthened/Weak Muscle

Shortened: The group of lateral rotators can cause a posture in which the toes point out to the sides. A shortened piriformis

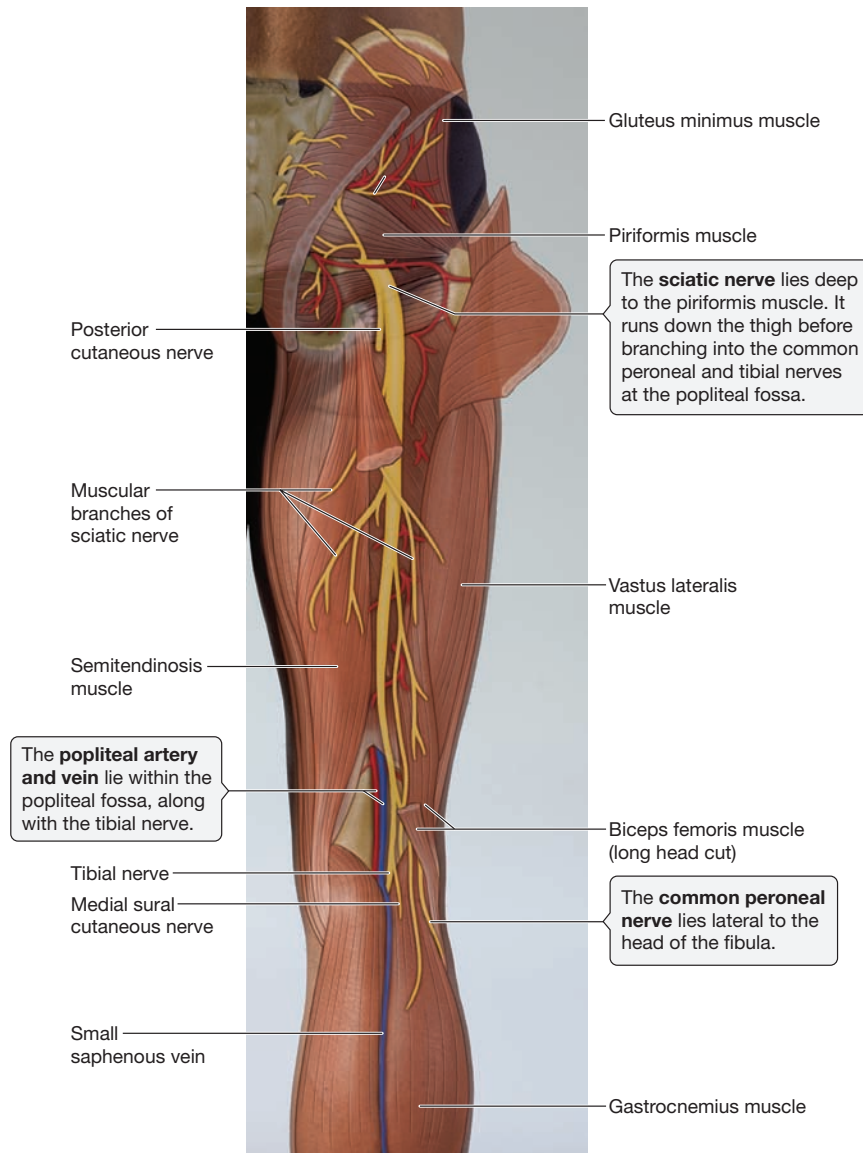


FIGURE 5-14 · Position of piriformis in relation to the sciatic nerve

can cause sciatica, as it lies superficial to the sciatic nerve, and when shortened, can impinge it

Lengthened: Reduced ability to laterally rotate the hip is noted.

Palpation and Massage

It is possible to find piriformis by locating the PSIS and moving an inch or two inferior to this spot. Feel through gluteus maximus for the density of piriformis. The other lateral rotators are not easy to distinguish but can be massaged deep in the buttock region. Friction and direct pressure are the easiest strokes to use.

How to Stretch This Muscle

Medially rotate the hip.

Synergists

Gluteus maximus, iliopsoas, and sartorius (laterally rotate hip/thigh)

Antagonists

Gluteus minimus, gluteus medius, and tensor fascia latae (medially rotate hip/thigh)

Innervation and Arterial Supply

Innervation: lumbosacral plexus, with the exception of obturator externus, which is innervated by the obturator nerve

Arterial supply: obturator artery and superior and inferior gluteal arteries

ADDUCTOR MAGNUS (a-duk-tor mag-nus)

Meaning of Name

The word “adductor” refers to the action of this muscle, and the term “magnus” refers to the large size of the muscle. Adductor magnus is the largest hip adductor.

Location

Adductor magnus comprises much of the medial thigh. It is the largest and deepest of the thigh adductors. This muscle has two distinct sections, an anterior section, which is more proximal, and a posterior section, which is more distal.

Origin and Insertion

Origin: inferior pubic ramus

Insertion: linea aspera and adductor tubercle. A space between these two insertion points is called the *adductor hiatus*. The femoral artery and femoral vein pass through the adductor hiatus on their way to the popliteal fossa. Once they enter the popliteal fossa, they become the popliteal artery and popliteal vein.

Actions

Adducts the hip. Some sources also cite that the anterior portion of adductor magnus allows hip flexion, and the posterior portion of adductor magnus permits hip extension.

Explanation of Actions

By pulling the insertion on the linea aspera medially toward the pubis and ischial tuberosity, the muscle performs adduction of the thigh. In addition, the origin of the more proximal, anterior section of this muscle on the pubis is anterior to the insertion on the linea aspera, and thus can pull the femur forward, causing hip flexion. On the other hand, the origin of the more posterior, distal section of the muscle is posterior to the insertion, and thus contraction pulls the femur posteriorly, resulting in hip extension.

Notable Muscle Facts

Adductor magnus plays a role in stabilization of the pelvis. When the weight is on the limb, contraction of adductor magnus helps to keep the pelvis centered over the foot. In addition, adductor magnus assists during walking by keeping the thigh adducted when our heel strikes the ground and when our lower limb swings forward with each step.

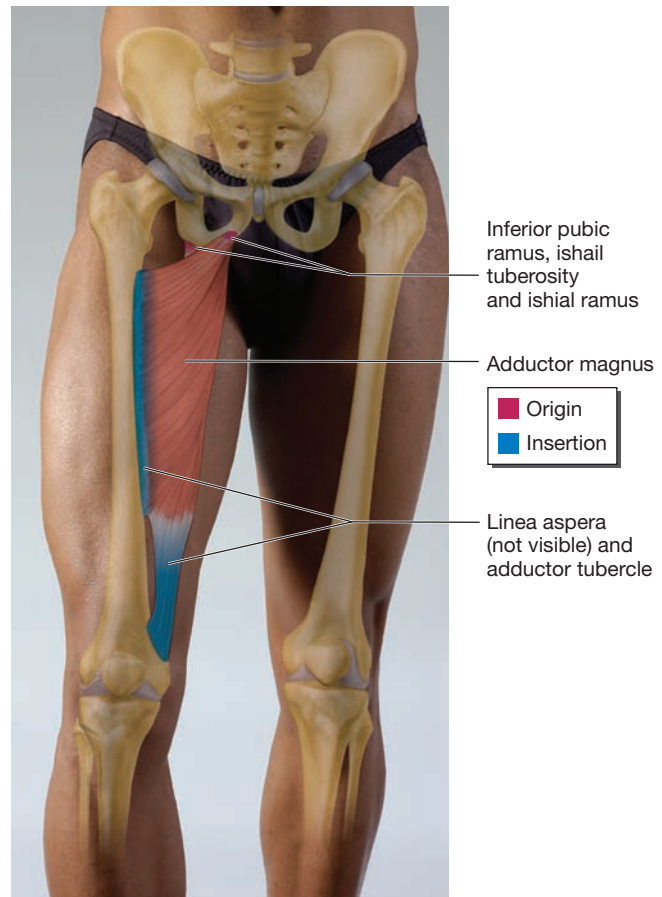


FIGURE 5-15 • Adductor magnus

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Limited ability to abduct the thigh and a posture in which the feet are close together is noted. When the hip adductor muscles are shortened, they are more susceptible to tearing, which is a common occurrence when the muscle is overstretched quickly. Such a tear is called a *groin pull*. Chronic groin pulls, or recent groin pulls that have healed to the extent that inflammation is no longer present, can be addressed. Friction to the area of the tear can assist healing, limit scar tissue formation, and reduce the likelihood of repeat injury.

Lengthened: Reduced ability to adduct the hip is noted.

Palpation and Massage

The adductors of the thigh are easy to palpate as a group. They comprise the bulk of the medial thigh. Effleurage and pétrissage are appropriate strokes to apply to the hip adductor muscles. In addition, friction can be applied with care, as

the medial thigh can be a tender, vulnerable area. Teaching your client to provide self-massage to the hip adductor muscles can be a useful way to address the more proximal aspect of these muscles.

How to Stretch This Muscle

Abduct the thigh.

Synergists

Adductor longus, adductor brevis, pectineus, and gracilis

Antagonists

Gluteus medius, gluteus minimus, tensor fascia latae, and sartorius

Innervation and Arterial Supply

Innervation: sciatic and obturator nerves

Arterial supply: femoral and obturator arteries

ADDUCTOR LONGUS AND ADDUCTOR BREVIS (a-duk-tor long-gus and a-duk-tor brev-is)

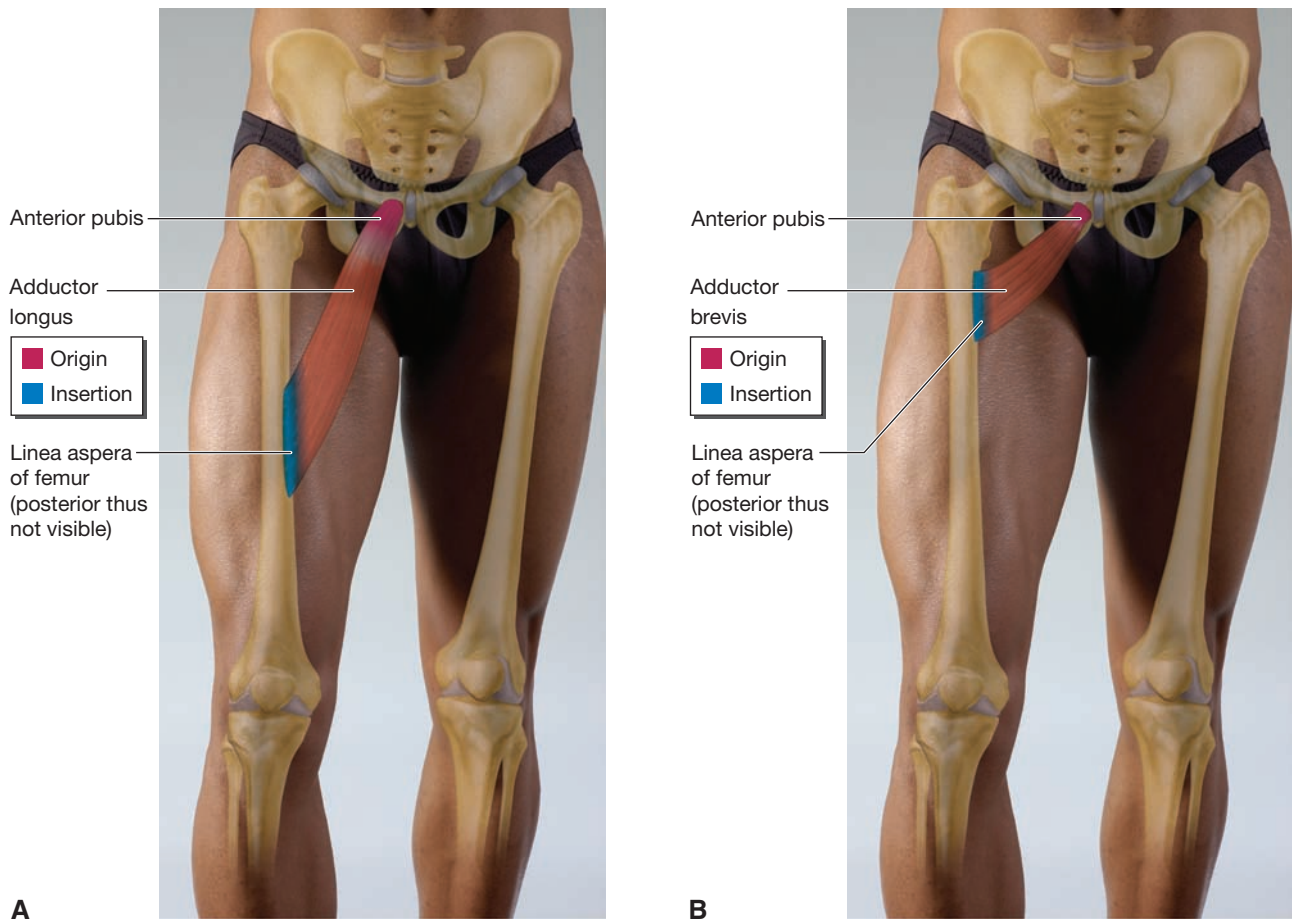


FIGURE 5-16 • Adductor longus and brevis. **A:** Adductor longus; **B:** Adductor brevis

Meaning of Name

Adductor refers to the adduction of hip action. *Longus* means longer than adductor brevis, and *brevis* means shorter than adductor longus.

Location

Adductor longus and brevis are medial thigh muscles. Adductor longus is the most anterior of the adductor muscles and forms the medial border of the femoral triangle. Figure 5-17 shows the femoral triangle. Adductor brevis is more proximal and deeper than adductor longus.

Origin and Insertion

Origin: anterior pubis

Insertion: linea aspera

Actions

Adduct the thigh; some sources state that adductor longus and adductor brevis assist in hip flexion.

Explanation of Actions

By pulling the insertion on the linea aspera medially toward the pubis, the muscles perform adduction of the thigh. A secondary action of adductor brevis and adductor longus, thigh flexion, is possible due to the fact that the origin on the pubis is anterior to the insertion on the linea aspera, and thus these two muscles can pull the femur forward, causing hip flexion.

Notable Muscle Facts

The thick tendon of the origin of adductor longus makes it the most palpable tendon in the area of the anterior pubis.

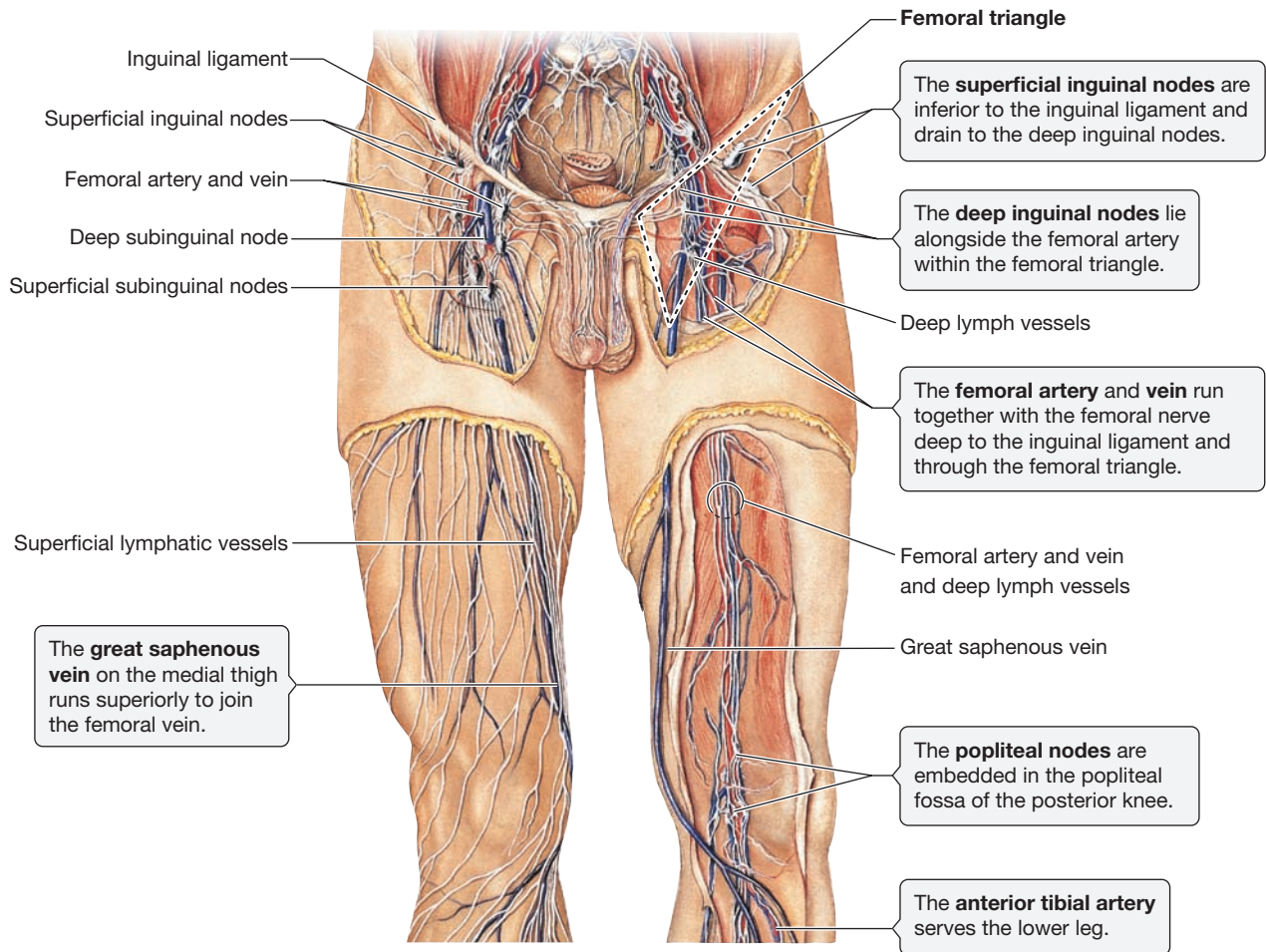


FIGURE 5-17 • Femoral triangle

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Inability to fully abduct the thigh is noted. When the hip adductor muscles are shortened, they are more susceptible to tearing, which is a common occurrence when the muscle is overstretched quickly. Such a tear is called a groin pull. Chronic groin pulls, or recent groin pulls that have healed to the extent that inflammation is no longer present, can be addressed. Friction to the area of the tear can assist healing, limit scar tissue formation, and reduce the likelihood of repeat injury.

Lengthened: Limited ability to adduct the thigh is noted.

Palpation and Massage

The adductors of the thigh are easy to palpate as a group. They comprise the bulk of the medial thigh. Effleurage and pétrissage are appropriate strokes to apply to the hip adductor muscles. In addition, friction can be applied with care, as

the medial thigh can be a tender, vulnerable area. Teaching your client to provide self-massage to the hip adductor muscles can be a useful way to address the more proximal aspect of these muscles.

How to Stretch This Muscle

Abduct the thigh.

Synergists

Adductor magnus, pectineus, and gracilis

Antagonists

Gluteus medius, gluteus minimus, tensor fascia latae, and sartorius

Innervation and Arterial Supply

Innervation: sciatic nerve

Arterial supply: femoral and obturator arteries

PECTINEUS (pek-tin-e-us)

Meaning of Name

Comb

Location

Pectineus is located in the femoral triangle.

Origin and Insertion

Origin: superior pubic ramus

Insertion: pectineal line on the proximal, posterior femur

Actions

Flexes and adducts the thigh

Explanation of Actions

Because the origin on the superior pubis is anterior and superior to the insertion on the femur, the femur is pulled anteriorly, causing flexion of the hip. In addition, the origin is medial to the insertion on the pectineal line of the femur. By pulling the femur medially, the muscle adducts the thigh.

Notable Muscle Facts

This muscle is designed to accomplish its actions of adduction and flexion with power, rather than speed.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: A shortened pectineus can cause an anterior pelvic tilt. In addition, when pectineus is shortened, one has limited ability to abduct the thigh and assumes a posture in which the feet are close together. When any of the hip adductor muscles are shortened, they are more susceptible to tearing, which is a common occurrence when a muscle is overstretched quickly. Such a tear is called a groin pull. Chronic groin pulls, or recent groin pulls that have healed to the extent that inflammation is no longer present, can be addressed. Friction to the area of the tear can assist healing, limit scar tissue formation, and reduce the likelihood of repeat injury. It may be best to teach your client to apply friction to this muscle on his or her own, rather than for you to touch this sensitive area so close to the genital area.

Lengthened: Reduced ability to flex and adduct the thigh is noted.

Palpation and Massage

This muscle lies right in the femoral triangle and thus is difficult to palpate or massage due to the femoral artery, vein, and nerve in this area (see Fig. 5-17). Find the inguinal ligament just lateral to the pubic symphysis, and palpate just inferior to the inguinal ligament. Gentle pressure to pectineus

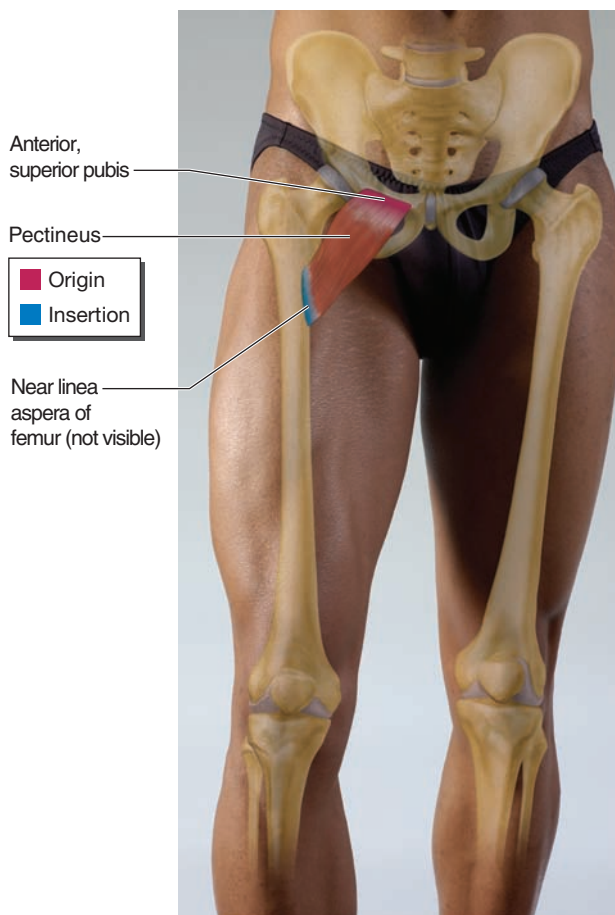


FIGURE 5-18 • Pectineus

is possible in this area, when done with care. Many times, it is more appropriate to teach self-massage to a client rather than massage in this delicate area.

How to Stretch This Muscle

Abduct the thigh with the knee flexed. Additional stretch can be achieved by extending the hip.

Synergists

Adductor magnus, adductor longus, adductor brevis, and gracilis

Antagonists

Gluteus medius, gluteus minimus, tensor fascia latae, and sartorius

Innervation and Arterial Supply

Innervation: femoral nerve

Arterial supply: femoral and obturator arteries

GRACILIS (gras-i-lis)

Meaning of Name

Slender

Location

Gracilis is the most superficial, medial thigh muscle.

Origin and Insertion

Origin: body and inferior ramus of the pubis

Insertion: pes anserinus

Actions

Adducts the hip and flexes and medially rotates the knee

Explanation of Actions

Gracilis is a hip adductor because the origin is medial to the insertion; thus, contraction pulls the femur medially, causing hip adduction. Gracilis crosses the posterior aspect of the knee, and its origin is above the insertion. Thus, this muscle flexes the knee. Finally, the proximal, medial, anterior tibia is pulled posteriorly, thus causing the tibia to rotate medially.

Notable Muscle Facts

Gracilis is the second longest muscle in the body, next to sartorius. Gracilis has a role in stabilizing the medial aspect of the knee, due to the placement of its tendon of insertion.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Limited ability to abduct the thigh is noted.

Lengthened: Due to the relative weakness of this muscle, lengthening of gracilis results in no substantial loss of function. In fact, gracilis is a common muscle for surgeons to use in muscle replacement surgery, especially to replace a muscle in the hand.

Palpation and Massage

This muscle can be palpated along the most medial superficial aspect of the thigh. It runs as a pant seam does, along the inner thigh and leg.

How to Stretch This Muscle

Abduct the thigh.

Synergists

Adductor magnus, adductor longus, adductor brevis, and pectineus (abduct the hip); hamstrings, gastrocnemius, sar-

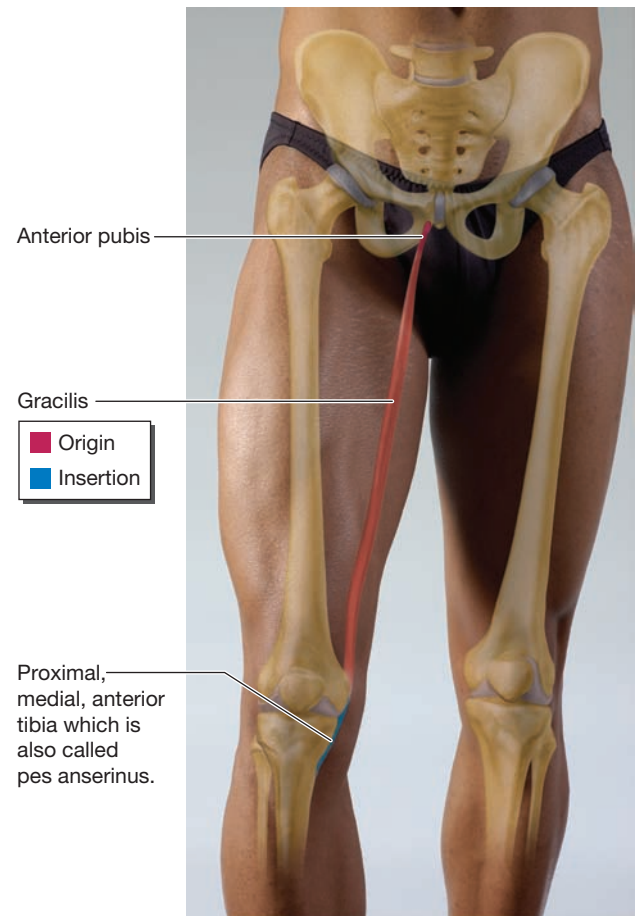


FIGURE 5-19 • Gracilis

torius, popliteus, and plantaris (flex the knee); semitendinosus and semimembranosus (medially rotate the knee)

Antagonists

Gluteus medius, gluteus minimus, tensor fascia latae, and sartorius (abduct the hip); quadriceps femoris group (extend the knee); biceps femoris (laterally rotates the knee)

Innervation and Arterial Supply

Innervation: obturator nerve

Arterial supply: deep femoral and obturator arteries

GLUTEUS MINIMUS (glut-e-us min-i-mis)

Meaning of Name

Gluteus refers to the buttock region, and *minimus* means that this muscle is smaller than gluteus medius and gluteus maximus.

Location

In the lateral hip, gluteus minimus covers a sizable portion of the external surface of the ilium. It is deep to gluteus medius.

Origin and Insertion

Origin: external surface of the lateral ilium

Insertion: greater trochanter

Actions

Gluteus minimus and gluteus medius perform the same actions: abduction and medial rotation of the hip. Only the anterior fibers of these muscles can medially rotate the thigh. In addition, both gluteus minimus and gluteus medius play an important role in stabilization of the hip, particularly when one is walking. On the weight-bearing side, gluteus medius and gluteus minimus contract to pull the ilium down, so that the other ilium rises, allowing the other limb to swing through when walking.

Explanation of Actions

The origin of gluteus minimus and gluteus medius on the lateral ilium is superior to the greater trochanter of the femur. In addition, these muscles cross the lateral side of the hip joint. Thus, the greater trochanter is pulled out to the side, resulting in hip abduction. It is the same line of pull that allows gluteus medius and gluteus medius to pull the ilium down when weight is on the limb and thus the femur cannot move. The anterior portions of gluteus medius and gluteus minimus perform medial rotation of the hip because the anterior aspect of the origin attachments of these muscles are more anterior than the greater trochanter. Thus, the muscles pull the greater trochanter forward, causing the femur to rotate medially.

Notable Muscle Facts

The anterior section of gluteus minimus is thicker and stronger than the posterior portion.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: When gluteus minimus and gluteus medius are shortened, a wider stance and medial rotation of hip, as shown by toes that point inwardly, may be noted. There is

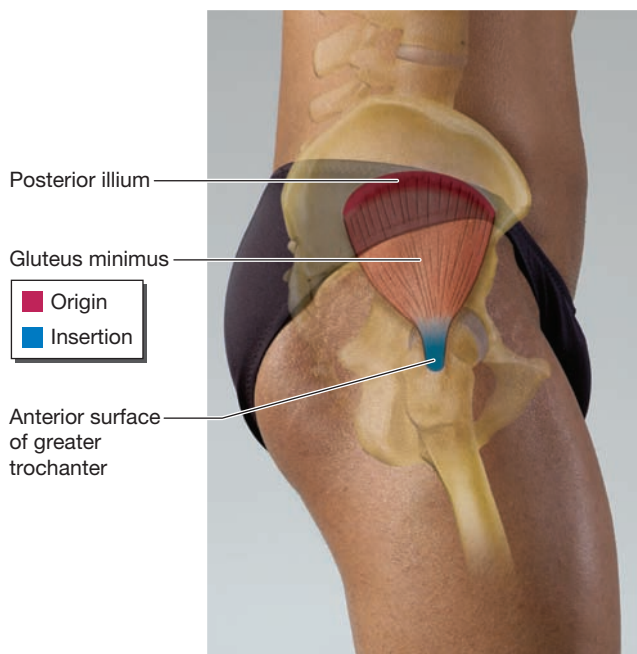


FIGURE 5-20 • Gluteus minimus

limited ability to adduct and laterally rotate the hip, and low back pain may be present.

Lengthened: Limited ability to abduct the thigh is noted.

Palpation and Massage

Gluteus minimus and medius can be palpated by pressing into the lateral ilium. Direct pressure and friction are easily applied to these muscles.

How to Stretch This Muscle

Adduct the hip.

Synergists

Gluteus medius, tensor fascia latae (medially rotate the hip), and sartorius (abducts the hip)

Antagonists

Piriformis, gemellus superior, gemellus inferior, obturator internus, obturator externus, quadratus femoris, iliopsoas, sartorius, and gluteus maximus (laterally rotate the hip); adductor magnus, adductor longus, adductor brevis, pectineus, and gracilis (adduct the hip)

Innervation and Arterial Supply

Innervation: superior gluteal nerve

Arterial supply: superior gluteal artery

GLUTEUS MEDIUS (glut-e-us me-de-us)

Meaning of Name

Gluteus refers to the buttock region, and *medius* refers to the fact that this muscle is the medium-sized gluteus muscle. It is smaller than gluteus maximus and larger than gluteus minimus.

Location

Gluteus medius is located on the lateral hip, on the external surface of the ilium. Gluteus medius is larger than and superficial to gluteus minimus.

Origin and Insertion

Origin: external surface of the lateral ilium

Insertion: greater trochanter

Actions

Gluteus minimus and gluteus medius perform the same actions: abduction and medial rotation of the hip. Only the anterior fibers of these muscles can medially rotate the thigh. In addition, both gluteus minimus and gluteus medius play an important role in stabilization of the hip, particularly when one is walking. On the weight-bearing side, gluteus medius and gluteus minimus contract to pull the ilium down, so that the other ilium rises, allowing the other limb to swing through when walking.

Explanation of Actions

The origin of gluteus minimus and gluteus medius on the lateral ilium is superior to the greater trochanter of the femur. In addition, these muscles cross the lateral side of the hip joint. Thus, the greater trochanter is pulled out to the side, resulting in hip abduction. It is the same line of pull that allows gluteus minimus and gluteus medius to pull the ilium down when the weight is on the limb, and thus the femur cannot move. The anterior portion of gluteus medius and gluteus minimus perform medial rotation of the hip because the anterior aspect of the origin attachments of these muscles is more anterior than the greater trochanter. Thus, the muscles pull the greater trochanter forward, causing the femur to rotate medially.

Notable Muscle Facts

Because gluteus medius pulls the ilium down, tension in the muscle can affect the SI joint and contribute to low back pain.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: A shortened gluteus medius results in a wider stance, medial rotation of the hip, as shown by toes that point inwardly, and low back pain.

Lengthened: Limited ability to abduct the thigh is noted.

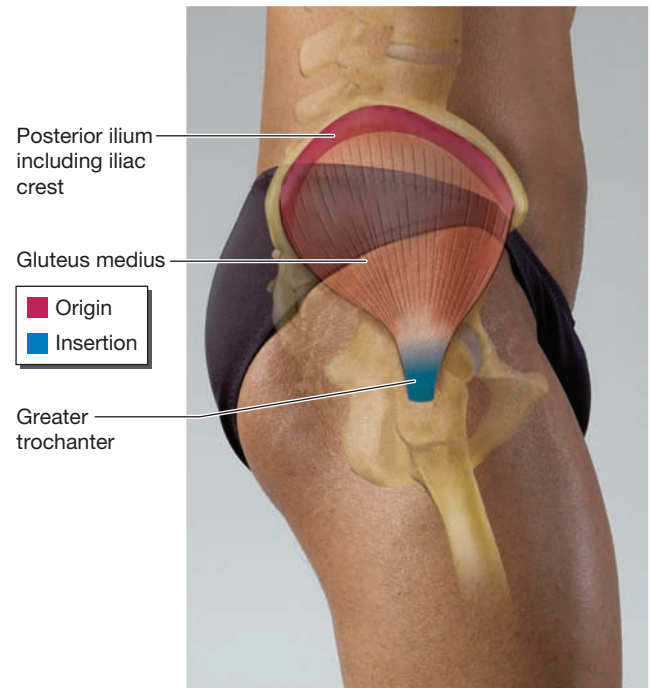


FIGURE 5-21 • Gluteus medius

Palpation and Massage

Gluteus minimus and medius can be palpated by pressing into the lateral ilium. Direct pressure and friction are easily applied to these muscles.

How to Stretch This Muscle

Adduct the hip.

Synergists

Gluteus minimus, tensor fascia latae (medially rotate the hip), and sartorius (abducts the hip)

Antagonists

Piriformis, gemellus superior, gemellus inferior, obturator internus, obturator externus, quadratus femoris, iliopsoas, sartorius, and gluteus maximus (laterally rotate the hip); adductor magnus, adductor longus, adductor brevis, pectineus, and gracilis (adduct the hip)

Innervation and Arterial Supply

Innervation: superior gluteal nerve

Arterial supply: superior gluteal artery

TENSOR FASCIA LATAE (ten-sor fash-e la-te)

Meaning of Name

Tensor means to tighten. *Fascia latae* refers to the broad (latae) band of fascia that surrounds all the muscles of the thigh.

Location

Tensor fascia latae is located in the anterolateral hip area. More specifically, it lies superficially between the ASIS and the IT band, and is superficial to the greater trochanter.

Origin and Insertion

Origin: ASIS and a small portion of the iliac crest just posterior to the ASIS

Insertion: IT band, which attaches distally to the lateral condyle of the tibia

Actions

The TFL works with gluteus medius and gluteus minimus to medially rotate the hip and abduct the hip. TFL also works with gluteus medius and gluteus minimus to pull the ilium down on the weight-bearing side, causing the opposite hip to rise, so that the leg can swing through without hitting the ground when walking. In addition, TFL is located anterior enough to flex the hip. And, TFL helps to keep the IT band tight enough to help stabilize the lateral aspect of the knee joint.

Explanation of Actions

Because the origin of TFL is both more medial and anterior to the final bony attachment on the lateral tibia, TFL pulls the lateral tibia anteriorly, thus causing medial rotation of the hip joint. TFL abducts the hip because the origin is superior or proximal to the insertion and crosses the lateral aspect of the joint. Thus, the lateral proximal tibia is pulled laterally, causing abduction of the hip. TFL is a hip flexor because the origin is superior to the insertion, and the muscle crosses the anterior (as well as lateral) aspect of the joint. Pulling the tibia anteriorly causes hip flexion. Even though the bone moved by the shortening of TFL is the tibia, the femur must move as well. TFL keeps tension in the IT band, which crosses the lateral aspect of the knee joint. This helps maintain the stability of the knee joint.

Notable Muscle Facts

The TFL's ability to tighten the fascia latae, particularly to the IT band, helps to keep the major thigh muscles, which are surrounded by the fascia latae, close to the femur, thus increasing their efficiency.

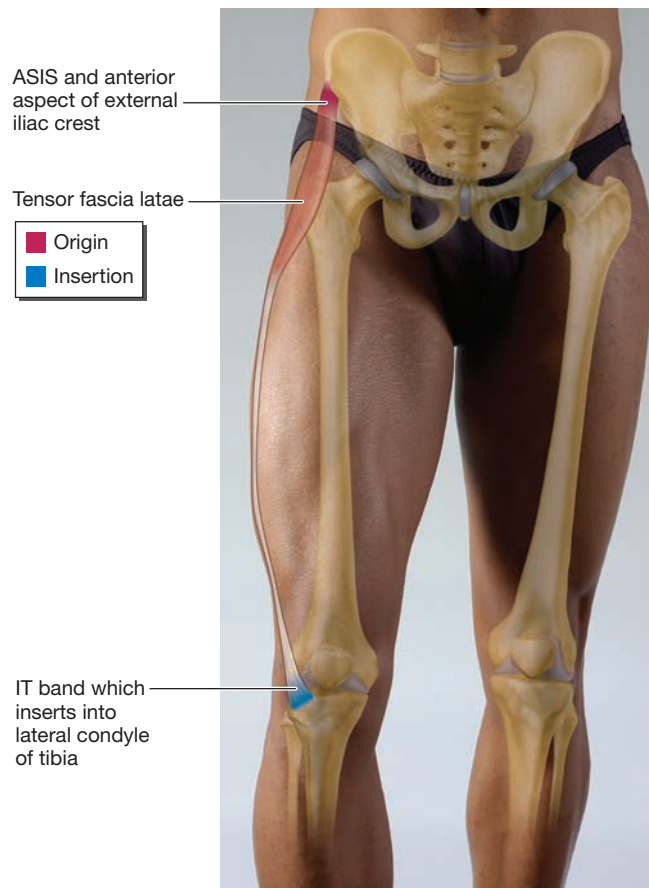


FIGURE 5-22 • Tensor fascia latae

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: A shortened TFL can cause an anterior pelvic tilt. It can also cause the hip to be medially rotated, as indicated by toes pointing inward. In addition, a wide stance is a possible manifestation of a short TFL, as the muscle is a hip abductor.

Lengthened: A lengthened TFL is not typically observed posturally or by a deficiency in the ability to perform the muscle's actions, but may contribute to instability in the lateral knee.

Palpation and Massage

The TFL can be palpated and massaged by finding the ASIS and pressing into the iliac crest just posterior to the ASIS, and by tracing the muscle toward the greater trochanter. Friction is an appropriate stroke to use for this muscle. It may be possible to note the fusiform nature of the muscle fibers.

How to Stretch This Muscle

Extend, laterally rotate, and adduct the thigh.

Synergists

Iliopsoas, rectus femoris, sartorius, and pectineus (flex the hip); gluteus medius and minimus (medially rotate the hip); and sartorius and gluteus medius and minimus (abduct the hip)

Antagonists

Gluteus maximus, semimembranosus, semitendinosus, and biceps femoris (extend the hip); gluteus maximus, piriformis, obturator internus, obturator externus, gemellus superior, gemellus inferior, quadrates femoris, iliopsoas, and sartorius (laterally rotate the hip); and adductor magnus, adductor longus, adductor brevis, pectineus, and gracilis (adduct the hip)

Innervation and Arterial Supply

Innervation: superior gluteal nerve

Arterial supply: superior gluteal artery

GLUTEUS MAXIMUS (glut-e-us maks-i-mus)

Meaning of Name

Gluteus means buttock region, and *maximus* indicates that this muscle is the largest muscle of the gluteal region.

Location

Gluteus maximus is located in the superficial buttock region.

Origin and Insertion

Origin: posterior ilium and posterior iliac crest, posterior sacrum, and posterior coccyx

Insertion: gluteal tuberosity and IT band

Actions

Laterally rotates and forcefully extends the hip

Explanation of Actions

Because the origin is superior to the insertion, and the muscle crosses the back of the hip joint, the gluteal tuberosity is pulled posteriorly, causing hip extension.

Because the origin is medial to the insertion, and the muscle crosses the posterior aspect of the hip joint, a shortening of gluteus maximus pulls the gluteal tuberosity on the posterior femur posteriorly or back, thus causing lateral rotation of the hip.

Notable Muscle Facts

Gluteus maximus allows forceful extension of the hip, as needed for running, climbing stairs, and rising up from a sitting position. Gluteus maximus is also important in walking, as it contracts each time the heel strikes the ground, to halt the forward moving momentum of the trunk and upper body, thus allowing us to remain upright. This muscle contains primarily slow-twitch muscle fibers, allowing for great endurance. Outside of the quadriceps group—which some consider a single muscle, gluteus maximus is the largest muscle of the body.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Posterior tilt of the pelvis and a posture of hip lateral rotation, with toes pointed out to the side is noted.

Lengthened: Potential anterior tilt of the pelvis and inability to forcefully extend and laterally rotate the hip is noted.

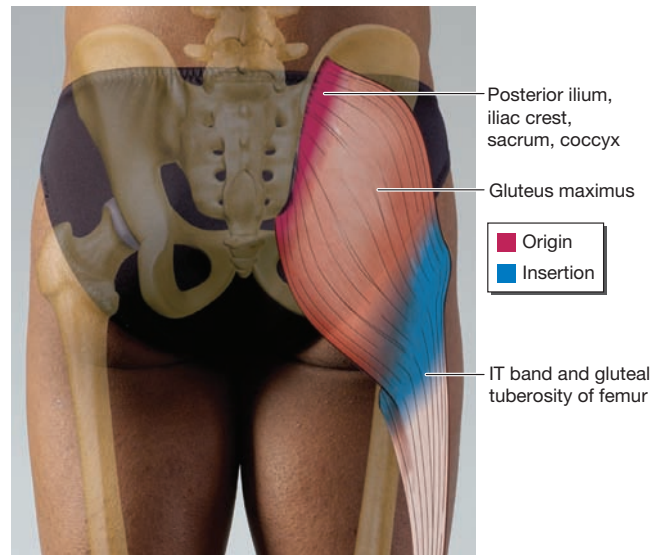


FIGURE 5-23 • Gluteus maximus

Palpation and Massage

Gluteus maximus is easy to palpate and massage, as it is large and superficial in the buttock region. Find the PSIS and sacrum and work laterally and inferiorly toward the proximal posterior femur. Effleurage, pétrissage, friction, and tapotement are all appropriate strokes to be used for this muscle. Of course, good communication is essential when working in this potentially emotionally sensitive area.

How to Stretch This Muscle

Medially rotate and flex the hip.

Synergists

Semimembranosus, semitendinosus, and biceps femoris (extend the hip); and piriformis, obturator internus, obturator externus, gemellus superior, gemellus inferior, quadratus femoris, iliopsoas, and sartorius (laterally rotate the hip)

Antagonists

Iliopsoas, rectus femoris, sartorius, and TFL (flex the hip); and gluteus medius and minimus (medially rotate the hip)

Innervation and Arterial Supply

Innervation: inferior gluteal nerve

Arterial supply: superior gluteal artery

HAMSTRINGS: SEMIMEMBRANOSUS (ham-strings: sem-e-mem-bra-no-sus)

Meaning of Name

The term “hamstrings” is due to the fact these three thick muscles, known as the *ham*, have long tendons of insertion. In abattoir and butcher shops, the muscles of hogs were hung by their tendons (strings). *Semi* refers to half and *membranosus* refers to the fact that the tendon of origin of the muscle is thick and wide and expands into a membrane-like aponeurosis that surrounds the proximal part of the muscle. This muscle is almost half membrane.

Location

The hamstrings are located in the posterior thigh. Semimembranosus is the deeper of the two medial hamstrings.

Origin and Insertion

Origin: ischial tuberosity

Insertion: proximal, medial, posterior tibia

Actions

All three hamstrings extend the hip and flex the knee. Depending on which opposing muscles are contracting simultaneously, hamstrings can perform hip extension only, knee flexion only, or both actions at once. To be more specific, if the quadriceps are contracting, the action of knee flexion will be held in check, and the hamstrings will extend the hip. If the hip flexors are contracting, the action of hip extension will be held in check, and the hamstrings will only be able to flex the knee. When no opposing muscles contract, the hamstrings can cause both knee flexion and hip extension simultaneously.

Explanation of Actions

Because the hamstrings cross the posterior aspect of the hip joint, they are hip extensors, and because they cross the posterior aspect of the knee, they flex the knee.

Notable Muscle Facts

Semimembranosus is the largest of the three hamstrings. Semimembranosus works with semitendinosus, popliteus, and gracilis to medially rotate the knee (see popliteus). All three hamstrings are active at heel strike, pulling the pelvis posteriorly and helping to keep the body upright.

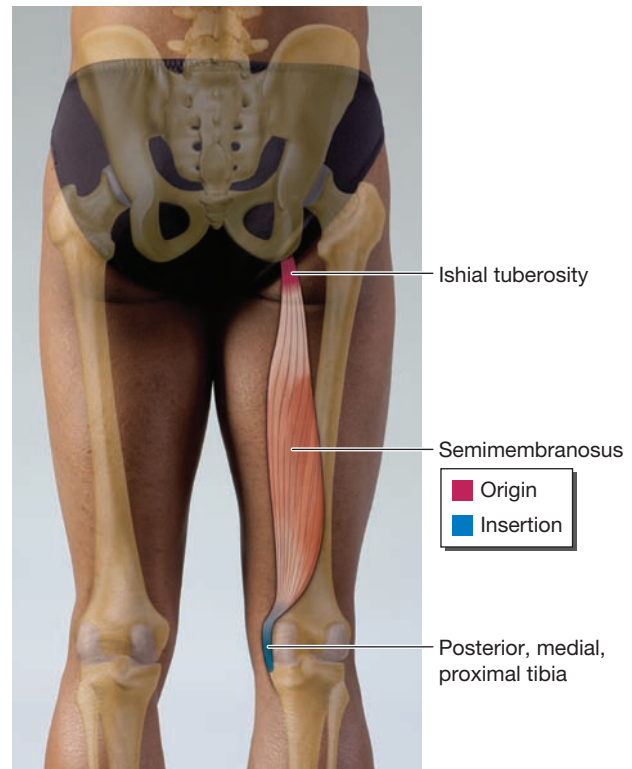


FIGURE 5-24 • Hamstrings: semimembranosus

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: A posterior pelvic tilt is noted. Shortened hamstrings can also cause difficulty flexing the hip when the knee is extended. This is frequently demonstrated as difficulty touching one's toes with knees extended.

Lengthened: Limited ability to flex the knee and/or extend the hip is noted.

Palpation and Massage

The hamstrings are easy to access in the posterior thigh. Find the ischial tuberosity. Friction is a good stroke to apply to the hamstring's thick tendons of origin. Effleurage, pétrissage, friction, and tapotement are all appropriate strokes to apply to the bellies of the muscles. The tendon of insertion can be palpated at the medial, posterior knee. The tendon is deep to the tendon of semitendinosus. It is recommended to apply pressure gently in this potentially sensitive area.

How to Stretch This Muscle

Flex the hip with the knee extended.

Synergists

The other hamstrings (semitendinosus and biceps femoris), gastrocnemius, plantaris, gracilis, sartorius, and popliteus (flex the knee); the other hamstrings (semitendinosus and biceps femoris) and gluteus maximus (extend the hip)

Antagonists

The quadriceps group: vastus intermedius, vastus medialis, vastus lateralis, and rectus femoris (extend the knee); and iliopsoas, rectus femoris, TFL, pectineus, and sartorius (flex the hip)

Innervation and Arterial Supply

Innervation: sciatic nerve

Arterial supply: inferior gluteal artery

HAMSTRINGS: SEMITENDINOSUS (ham-strings: sem-e-ten-di-no-sus)

Meaning of Name

Semi means one half, and *tendinosus* refers to the fact that this muscle has a long tendon of origin. Thus, the muscle is almost half tendon.

Location

Semitendinosus is located in the superficial, medial thigh, directly superficial to semimembranosus.

Origin and Insertion

Origin: ischial tuberosity

Insertion: pes anserinus, a flat area on the proximal, medial, anterior tibia

Actions

All three hamstrings extend the hip and flex the knee. Depending on which opposing muscles are contracting simultaneously, hamstrings can perform hip extension only, knee flexion only, or both actions at once. To be more specific, if the quadriceps are contracting, the action of knee flexion will be held in check, and the hamstrings will extend the hip. If the hip flexors are contracting, the action of hip extension will be held in check, and the hamstrings will only be able to flex the knee. When no opposing muscles contract, the hamstrings can cause both knee flexion and hip extension simultaneously.

Explanation of Actions

Because the hamstrings cross the posterior aspect of the hip joint, they are hip extensors, and because they cross the posterior aspect of the knee, they flex the knee.

Notable Muscle Facts

Semitendinosus works with semimembranosus, popliteus, and gracilis in medially rotating the tibia (see popliteus). All three hamstrings are active at heel strike, pulling the pelvis posteriorly and helping to keep the body upright.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Posterior pelvic tilt is noted. Shortened hamstrings can also cause difficulty flexing the hip when the knee is extended. This is frequently demonstrated as difficulty touching one's toes with knees extended.

Lengthened: Limited ability to flex the knee and/or extend the hip is noted.

Palpation and Massage

The hamstrings are easy to access in the posterior thigh. Find the ischial tuberosity. Friction is a good stroke to apply to the hamstring's thick tendons of origin. Effleurage, pétrissage,

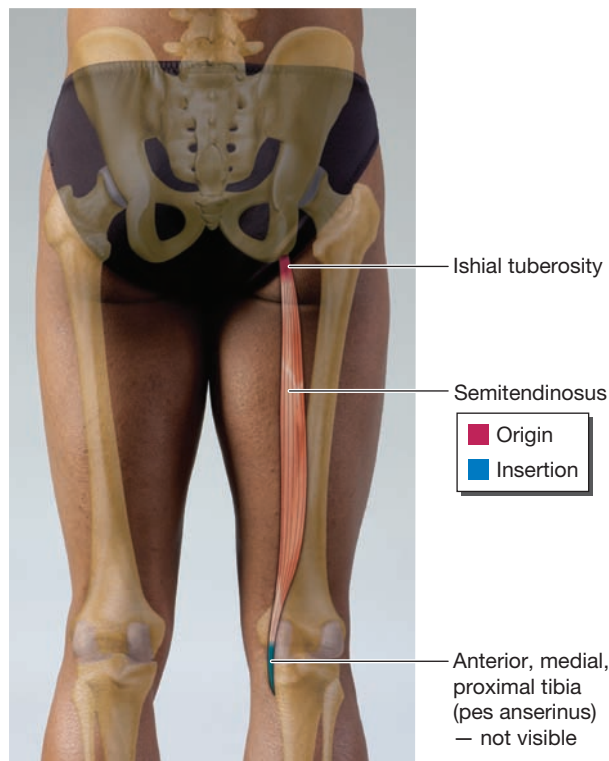


FIGURE 5-25 • Hamstrings: semitendinosus

friction, and tapotement are all appropriate strokes to apply to the bellies of the muscles. The tendon of insertion can be palpated at the medial, proximal, anterior tibia. The tendon is superficial to the tendon of semimembranosus.

How to Stretch This Muscle

Flex the hip with the knee extended.

Synergists

The other hamstrings (semimembranosus and biceps femoris), gastrocnemius, plantaris, gracilis, sartorius, and popliteus (flex the knee); and the other hamstrings (semimembranosus and biceps femoris) and gluteus maximus (extend the hip)

Antagonists

The quadriceps group: vastus intermedius, vastus medialis, vastus lateralis, and rectus femoris (extend the knee); and iliopsoas, rectus femoris, TFL, pectineus, and sartorius (flex the hip)

Innervation and Arterial Supply

Innervation: sciatic nerve

Arterial supply: inferior gluteal artery

HAMSTRINGS: BICEPS FEMORIS (ham-strings: bi-sepz fem-o-ris)

Meaning of Name

Biceps means two heads, and femoris referring to the femur.

Location

Biceps femoris is located in the lateral aspect of the posterior thigh.

Origin and Insertion

Origin: ischial tuberosity and distal half of the linea aspera

Insertion: head of the fibula

Actions

All three hamstrings extend the hip and flex the knee. Depending on which opposing muscles are contracting simultaneously, hamstrings can perform hip extension only, knee flexion only, or both actions at once. To be more specific, if the quadriceps are contracting, the action of knee flexion will be held in check, and the hamstrings will extend the hip. If the hip flexors are contracting, the action of hip extension will be held in check, and the hamstrings will only be able to flex the knee. When no opposing muscles contract, the hamstrings can cause both knee flexion and hip extension simultaneously.

Explanation of Actions

Because the hamstrings cross the posterior aspect of the hip joint, they are hip extensors, and because they cross the posterior aspect of the knee, they flex the knee.

Notable Muscle Facts

Biceps femoris performs lateral rotation of the knee. All three hamstrings are active at heel strike, pulling the pelvis posteriorly and helping to keep the body upright.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Posterior pelvic tilt is noted. Shortened hamstrings can also cause difficulty flexing the hip when the knee is extended. This is frequently demonstrated as difficulty touching one's toes with knees extended.

Lengthened: Limited ability to flex the knee and/or extend the hip is noted.

Palpation and Massage

The hamstrings are easy to access in the posterior thigh. Find the ischial tuberosity. Friction is a good stroke to apply to the hamstring's thick tendons of origin. Effleurage, pétrissage, friction, and tapotement are all appropriate strokes to apply to the bellies of the muscles. The tendon of insertion can be

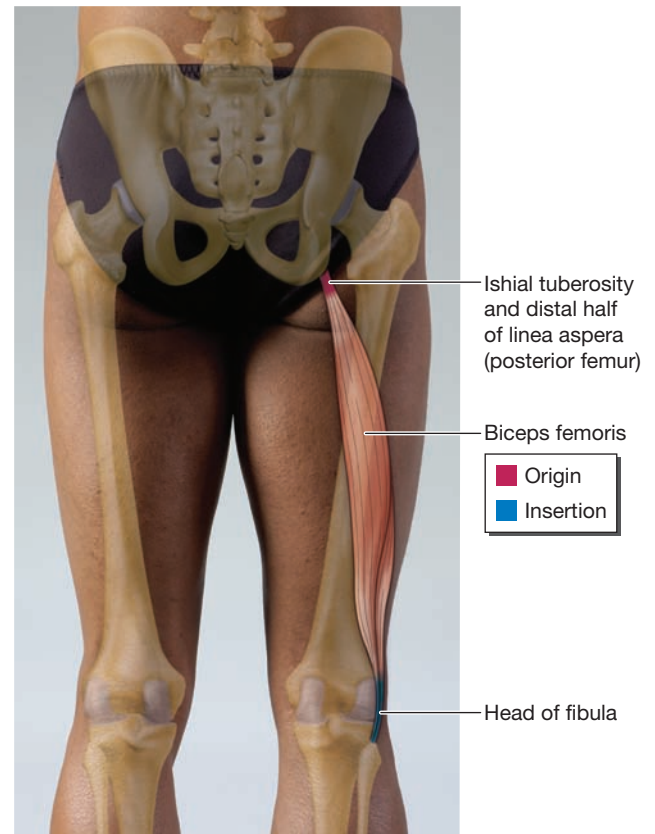


FIGURE 5-26 • Hamstrings: biceps femoris

palpated at the lateral, posterior knee. The tendon is easily palpable just proximal to the head of the fibula

How to Stretch This Muscle

Flex the hip with the knee extended.

Synergists

The other hamstrings (semimembranosus and semitendinosus), gastrocnemius, plantaris, gracilis, sartorius, and popliteus (flex the knee); and the other hamstrings (semimembranosus and semitendinosus) and gluteus maximus (extend the hip)

Antagonists

The quadriceps group: vastus intermedius, vastus medialis, vastus lateralis, and rectus femoris (extend the knee); and iliopsoas, rectus femoris, TFL, pectineus, and sartorius (flex the hip)

Innervation and Arterial Supply

Innervation: sciatic nerve

Arterial supply: inferior gluteal artery

ILIOPSOAS (PSOAS MAJOR AND ILIACUS) (il-e-o-so-as)

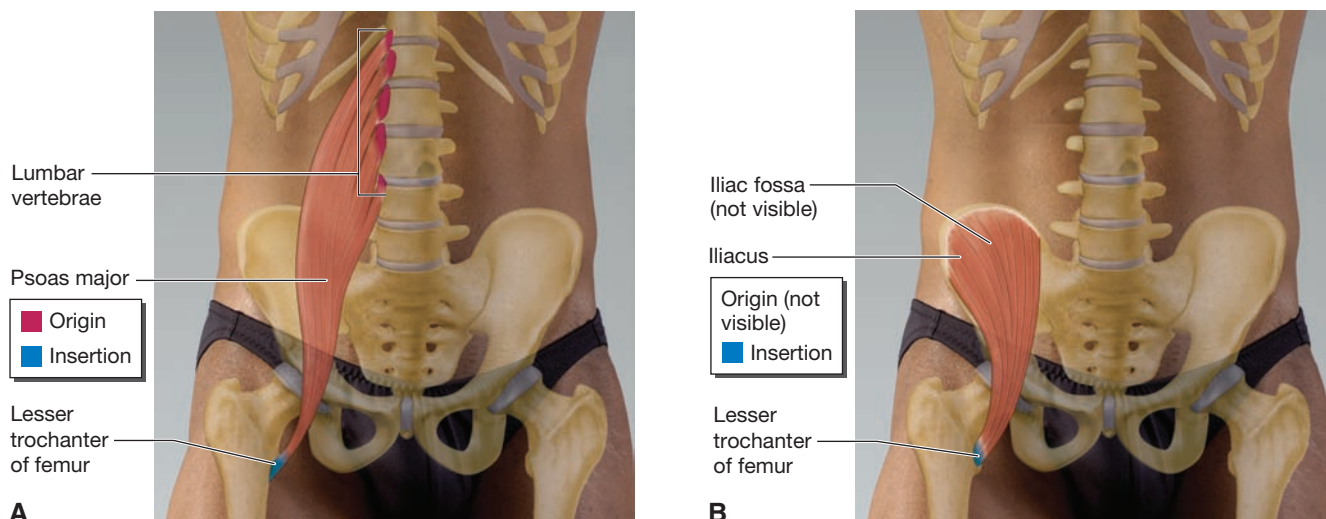


FIGURE 5-27 • Iliopsoas. **A:** psoas major **B:** iliacus

Meaning of Name

Ilio refers to the iliacus muscle and tells us that this muscle attaches to much of the ilium, namely the iliac fossa. *Psoas* means loins or the area of the lower trunk or low back between rib 12 and the ilium.

Location

Iliopsoas is located deep in the abdominal area. Noting a line between the navel and the ASIS and working deep to abdominal organs in this area will allow one to access the iliopsoas muscle.

Origin and Insertion

Origin of the iliacus portion: iliac fossa

Origin of the psoas major portion: bodies and transverse processes of T12–L5

Insertion: lesser trochanter

Actions

The actions of iliopsoas include hip flexion and lateral rotation of the hip. Iliopsoas is our strongest hip flexor.

Explanation of Actions

Because origin is superior to insertion, and because this muscle crosses the anterior aspect of the hip, shortening of iliopsoas pulls the femur forward, resulting in hip flexion. Because

the insertion attachment is on the lesser trochanter of the femur, and this bone marking is medial and a bit posterior on the femur, a forward pull to the insertion on the lesser trochanter will cause the femur to rotate laterally.

Notable Muscle Facts

There are differing opinions about how psoas major affects the position of the pelvis. When the lower limb is fixed, the shortening of psoas major shortens and pulls the lower lumbar vertebrae anteriorly, causing flexion. In some people with a significant lumbar curve, psoas major pulls on the upper lumbar vertebrae and T12 posteriorly, causing extension. Both psoas major and iliacus can cause an anterior pelvic curve by pulling the pelvis forward, iliacus directly and psoas major indirectly. Iliacus pulls the ilium forward, and psoas major pulls the lower lumbar spine forward, which is joined to the sacrum and additionally to the pelvis.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Anterior pelvic tilt and inability to fully extend the thigh is noted.

Lengthened: Limited hip flexion is noted.

Palpation and Massage

Iliopsoas can be a difficult muscle to palpate and massage. Good communication with your client is essential! Find the

navel and ASIS. With client supine, press gently into the linear space between the ASIS and navel as he or she exhales. Work around the intestinal organs to allow you to reach the dense fibers of the psoas major muscle. Asking the client to flex his or her hip can confirm that you have found the muscle.

How to Stretch This Muscle

Extend the hip.

Synergists

Rectus femoris, sartorius, pectineus, and TFL (flex the hip); and gluteus maximus, piriformis, obturator internus, obtura-

tor externus, gemellus superior, gemellus inferior, quadratus femoris, and sartorius (laterally rotate the hip)

Antagonists

Gluteus maximus and the three hamstrings (extend the hip); and gluteus medius, gluteus minimus, and TFL (medially rotate the hip)

Innervation and Arterial Supply

Innervation: lumbar plexus

Arterial supply: lumbar arteries

QUADRICEPS GROUP: VASTUS INTERMEDIUS (kwad-dri-cep grup: vas-tus in-ter-me-de-us)

Meaning of Name

Quad means four. The quadriceps group, commonly called *the quads*, is considered by some to be four muscles, and by others to be a single, large, four-headed muscle. *Vastus* means very large, and *intermedius* refers to the fact that the vastus intermedius muscle is located between vastus lateralis and vastus medialis.

Location

The quadriceps group is located in the anterior thigh. More specifically, vastus intermedius is the deepest quad, located centrally in the anterior thigh. Vastus intermedius is completely covered by the other three quadriceps muscles.

Origin and Insertion

Origin: anterior shaft of the femur

Insertion: tibial tuberosity via the patellar ligament

Actions

Extends the knee

Explanation of Actions

Because vastus intermedius crosses the anterior aspect of the knee joint, and because the origin is proximal to the insertion, this muscle pulls the anterior leg toward the anterior thigh, thus causing knee extension.

Notable Muscle Facts

Vastus intermedius contains a small amount of muscle and a long and wide tendon of insertion. As a group, the quadriceps muscles are strong knee extensors. Knee extension requires much strength when the knees are flexed and the lower limbs are fixed. In this instance, the quadriceps muscles lift the weight of the whole body. The quadriceps group is important in gait, as these muscles pull the knee into full extension (locked position) at heel strike, in order for the lower limb to support full weight. In addition, the quadriceps group determines the position of the patella. The position of the patella contributes to the efficiency of the pull of the quadriceps tendon of insertion. And the patella is designed to slide in the groove of the proximal femur. A quadriceps muscle can pull the patella out of its track, causing friction and pain.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: When the quadriceps group is shortened, limited knee flexion is noted. In addition, shortened quadriceps muscles can pull the patella out of line, causing anterior knee pain.

Lengthened: Limited ability to extend the knee is noted.

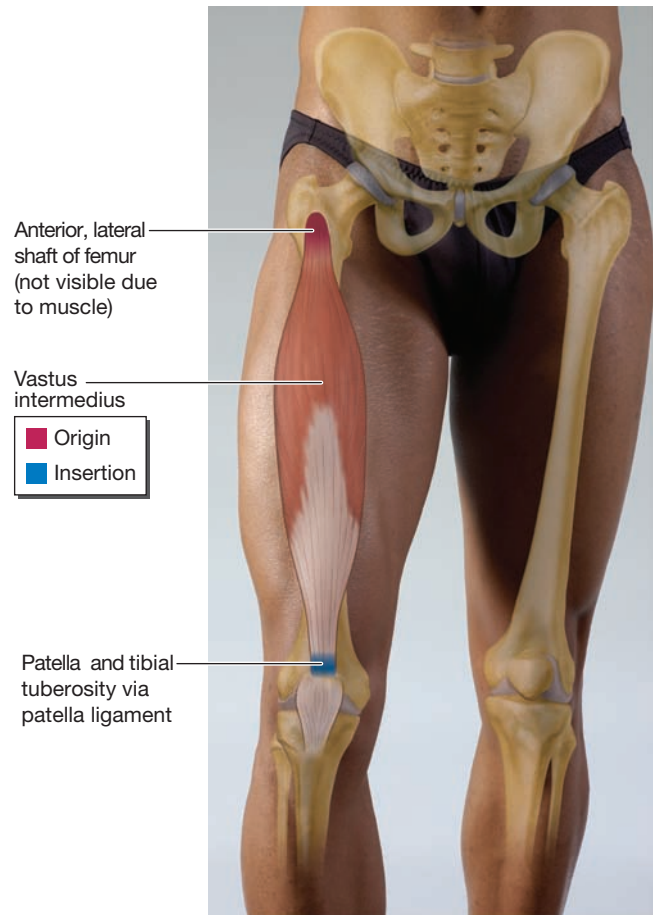


FIGURE 5-28 • Quadriceps group: vastus intermedius

Palpation and Massage

As a group, the quads are easy to palpate and massage in the anterior thigh. Effleurage, pétrissage, friction, and tapotement are all appropriate strokes for these muscles.

How to Stretch This Muscle

Flex the knee.

Synergists

The other quadriceps group muscles: vastus medialis, vastus lateralis, and rectus femoris

Antagonists

Semimembranosus, semitendinosus, biceps femoris, gastrocnemius, plantaris, gracilis, sartorius, and popliteus (flex the knee)

Innervation and Arterial Supply

Innervation: femoral nerve

Arterial supply: femoral and deep femoral arteries

QUADRICEPS GROUP: VASTUS MEDIALIS (kwad-dri-cep grup: vas-tus me-de-a-lis)

Meaning of Name

Vastus means very large, and *medialis* refers to the fact that this muscle is the most medial quadriceps muscle.

Location

The quadriceps group is located in the anterior thigh. More specifically, vastus medialis is in the anteromedial thigh, as it wraps around the medial aspect of the thigh from posterior to anterior.

Origin and Insertion

Origin: linea aspera

Insertion: tibial tuberosity via the patellar ligament

Actions

Extends the knee

Explanation of Actions

Because vastus medialis crosses the anterior aspect of the knee joint, and because the origin is proximal to the insertion, this muscle pulls the anterior leg toward the anterior thigh, thus causing knee extension.

Notable Muscle Facts

As a group, the quadriceps muscles are strong knee extensors. Knee extension requires much strength when the knees are flexed and the lower limbs are fixed. In this instance, the quadriceps muscles lift the weight of the whole body. The quadriceps group is important in gait, as these muscles pull the knee into full extension (locked position) at heel strike, in order for the lower limb to support full weight. In addition, the quadriceps group determines the position of the patella. The position of the patella contributes to the efficiency of the pull of the quadriceps tendon of insertion. And, the patella is designed to slide in the groove of the proximal femur. A quadriceps muscle can pull the patella out of its track, causing friction and pain.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: When the quadriceps group is shortened, limited knee flexion is noted. In addition, shortened quadriceps muscles can pull the patella out of line, causing anterior knee pain.

Lengthened: Limited ability to extend the knee is noted.

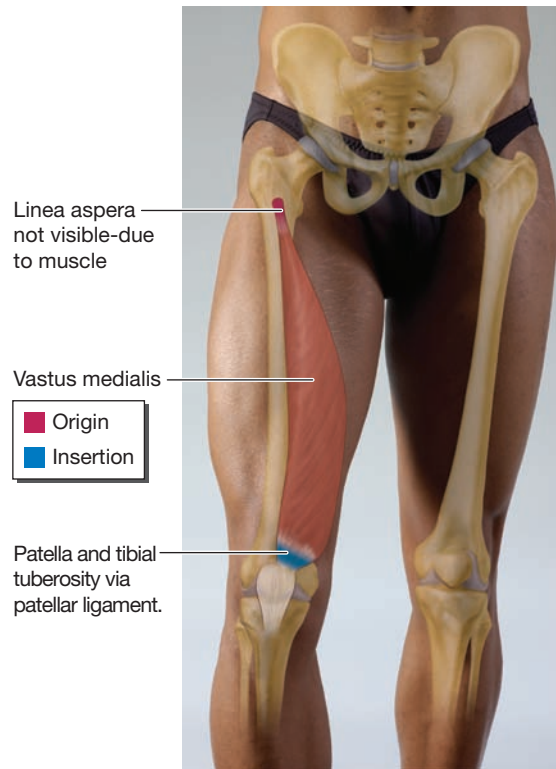


FIGURE 5-29 • Quadriceps group: vastus medialis

Palpation and Massage

As a group, the quads are easy to palpate and massage in the anterior thigh. Effleurage, pétrissage, friction, and tapotement are all appropriate strokes for these muscles.

How to Stretch This Muscle

Flex the knee.

Synergists

The other quadriceps group muscles: vastus intermedius, vastus lateralis, and rectus femoris

Antagonists

Semimembranosus, semitendinosus, biceps femoris, gastrocnemius, plantaris, gracilis, sartorius, and popliteus (flex the knee)

Innervation and Arterial Supply

Innervation: femoral nerve

Arterial supply: femoral and deep femoral arteries

QUADRICEPS GROUP: VASTUS LATERALIS (kwad-dri-cep grup: vas-tus lat-ar-a-lis)

Meaning of Name

Vastus means very large, and *lateralis* refers to the fact that this muscle is the most lateral quadriceps muscle.

Location

The quadriceps group is located in the anterior thigh. More specifically, vastus lateralis is in the anterolateral thigh, as it wraps around the lateral aspect of the thigh from posterior to anterior. Vastus lateralis is the only muscle in the lateral thigh.

Origin and Insertion

Origin: linea aspera

Insertion: tibial tuberosity via the patellar ligament

Actions

Extends the knee

Explanation of Actions

Because vastus lateralis crosses the anterior aspect of the knee joint, and because the origin is proximal to the insertion, this muscle pulls the anterior leg toward the anterior thigh, thus causing knee extension.

Notable Muscle Facts

Vastus lateralis can adhere to the more superficial IT band. Thus, friction in this area can be helpful. As a group, the quadriceps muscles are strong knee extensors. Knee extension requires much strength when the knees are flexed and the lower limbs are fixed. In this instance, the quadriceps muscles lift the weight of the whole body. The quadriceps group is important in gait, as these muscles pull the knee into full extension (locked position) at heel strike, in order for the lower limb to support full weight. In addition, the quadriceps group determines the position of the patella. The position of the patella contributes to the efficiency of the pull of the quadriceps tendon of insertion. And, the patella is designed to slide in the groove of the proximal femur. A quadriceps muscle can pull the patella out of its track, causing friction and pain.

Implications of Shortened and/or Lengthened/Weak Muscle

Shortened: When the quadriceps group is shortened, limited knee flexion is noted. In addition, shortened quadriceps muscles can pull the patella out of line, causing anterior knee pain.

Lengthened: Limited ability to extend the knee is noted.

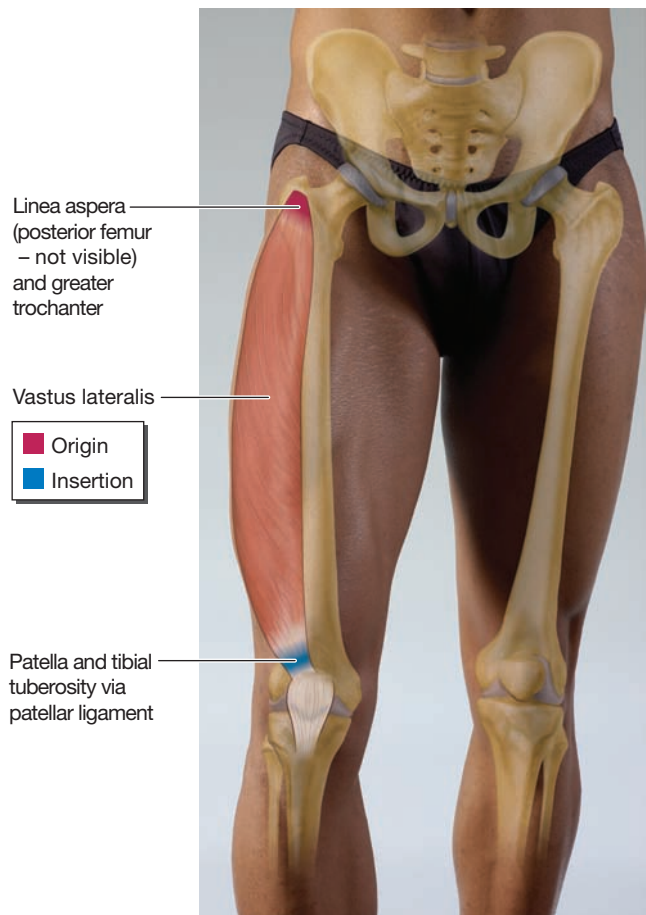


FIGURE 5-30 • Quadriceps group: vastus lateralis

Palpation and Massage

As a group, the quads are easy to palpate and massage in the anterior thigh. Effleurage, pétrissage, friction, and tapotement are all appropriate strokes for these muscles.

How to Stretch This Muscle

Flex the knee.

Synergists

The other quadriceps group muscles: vastus intermedius, vastus medialis, and rectus femoris

Antagonists

Semimembranosus, semitendinosus, biceps femoris, gastrocnemius, plantaris, gracilis, sartorius, and popliteus (flex the knee)

Innervation and Arterial Supply

Innervation: femoral nerve

Arterial supply: femoral and deep femoral arteries

QUADRICEPS GROUP: RECTUS FEMORIS (kwad-dri-cep grup: rek-tus fem-o-ris)

Meaning of Name

Rectus means straight and usually refers to the vertical or straight up and down orientation of a muscle. *Femoris* refers to the fact that this muscle is located in the area of the femur.

Location

Superficial anterior thigh

Origin and Insertion

Origin: AIIS and a small area close to the acetabulum

Insertion: tibial tuberosity via the patellar ligament

Actions

Extends the knee and flexes the hip

Explanation of Actions

Rectus femoris crosses the anterior aspect of the hip joint, with origin superior to insertion. Thus, it pulls the thigh anteriorly, resulting in hip flexion. In addition, rectus femoris crosses the anterior aspect of the knee joint, and because the origin is proximal to the insertion, this muscle pulls the anterior leg toward the anterior thigh, thus causing knee extension.

Notable Muscle Facts

Rectus femoris is the only quadriceps group member that crosses two joints. Thus, it has two actions. The quadriceps muscles are strong knee extensors. Knee extension requires much strength when the knees are flexed and the lower limbs are fixed. In this instance, the quadriceps muscles lift the weight of the whole body. The quadriceps group is important in gait, as these muscles pull the knee into full extension (locked position) at heel strike, in order for the lower limb to support full weight. In addition, the quadriceps group determines the position of the patella. The position of the patella contributes to the efficiency of the pull of the quadriceps tendon of insertion. And, the patella is designed to slide in the groove of the proximal femur. A quadriceps muscle can pull the patella out of its track, causing friction and pain.

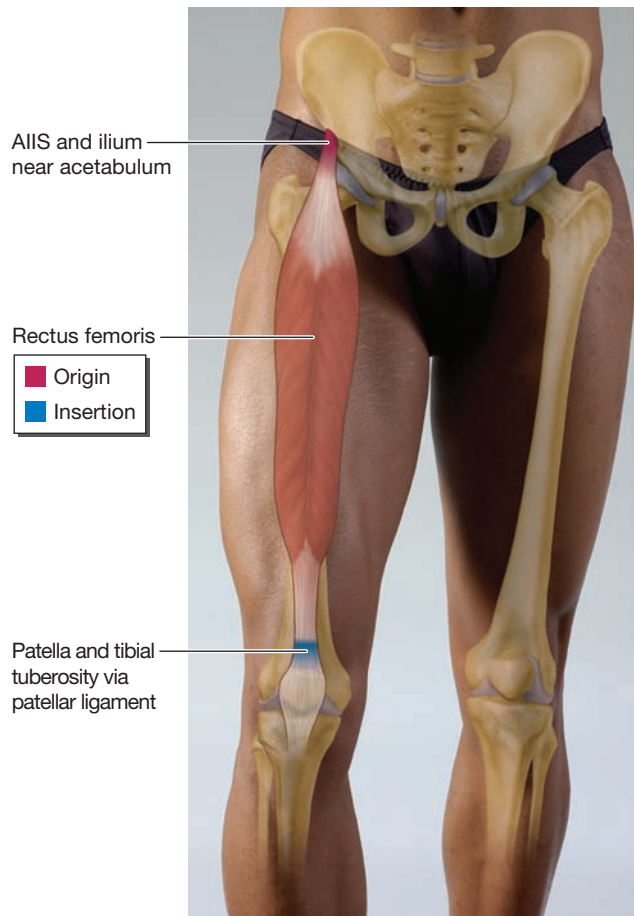


FIGURE 5-31 • Quadriceps group: rectus femoris

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: When the quadriceps group is shortened, limited knee flexion is noted. In addition, shortened quadriceps muscles can pull the patella out of line, causing anterior knee pain. A shortened rectus femoris can also cause an anterior pelvic tilt.

Lengthened: Limited ability to extend the knee is noted.

Palpation and Massage

To find the origin of rectus femoris, find the AIIS. Because the AIIS is difficult to palpate, find the ASIS first, and move about 2 inches inferiorly and about a 1/2-inch medially. You can feel the tendon of origin of rectus femoris, a bit deeper than the tendon of origin of sartorius. Effleurage, pétrissage, friction, and tapotement are all appropriate strokes for the belly of rectus femoris, located in the superficial anterior thigh.

How to Stretch This Muscle

Flex the knee while extending the hip.

Synergists

The other quadriceps group muscles: vastus intermedius, vastus medialis, and vastus lateralis; and the hip flexors: iliopsoas, sartorius, TFL, and pectineus

Antagonists

Semimembranosus, semitendinosus, biceps femoris, gastrocnemius, plantaris, gracilis, sartorius, and popliteus (flex the knee); and gluteus maximus, semimembranosus, semitendinosus, and biceps femoris (extend the hip)

Innervation and Arterial Supply

Innervation: femoral nerve

Arterial supply: femoral and deep femoral arteries

SARTORIUS (sar-to-re-us)

Meaning of Name

Sartor refers to a tailor. The muscle has this name because the combined movements of sartorius results in a sitting position with crossed knees that was commonly used by tailors as they sewed.

Location

Sartorius is a thin strip of muscle that runs from lateral to medial as it runs distally across the superficial, anterior thigh. As the muscle reaches the medial side of the distal thigh, its tendon of insertion passes behind the knee before emerging again anteriorly and inserting into pes anserinus. Sartorius forms the lateral border of the femoral triangle (see Fig. 5-17).

Origin and Insertion

Origin: ASIS

Insertion: pes anserinus, the flat area on the proximal, medial, anterior tibia

Actions

Sartorius performs hip flexion, lateral rotation of the hip, abduction of the hip, and flexion of the knee. These actions combine to create the movement of crossing one's legs, as was done by tailors when sewing.

Explanation of Actions

Because origin is superior to insertion, and sartorius crosses the anterior aspect of the hip joint, it flexes the hip. Because origin is more lateral than insertion, as well as superior to insertion, it performs abduction. Because origin is more lateral than insertion, and this muscles crosses the anterior thigh, and because the insertion is on the medial tibia, sartorius pulls the medial tibia anteriorly. This causes the hip joint to rotate laterally. Finally, because sartorius crosses the posterior aspect of the knee joint, this muscle flexes the knee.

Notable Muscle Facts

Sartorius is the longest muscle in the body.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Anterior pelvic tilt is noted.

Lengthened: A weak, lengthened sartorius will not typically cause functional deficits.

Palpation and Massage

Find the ASIS, and feel distally for the tendon of origin. It can be hard to distinguish the muscle belly of sartorius from

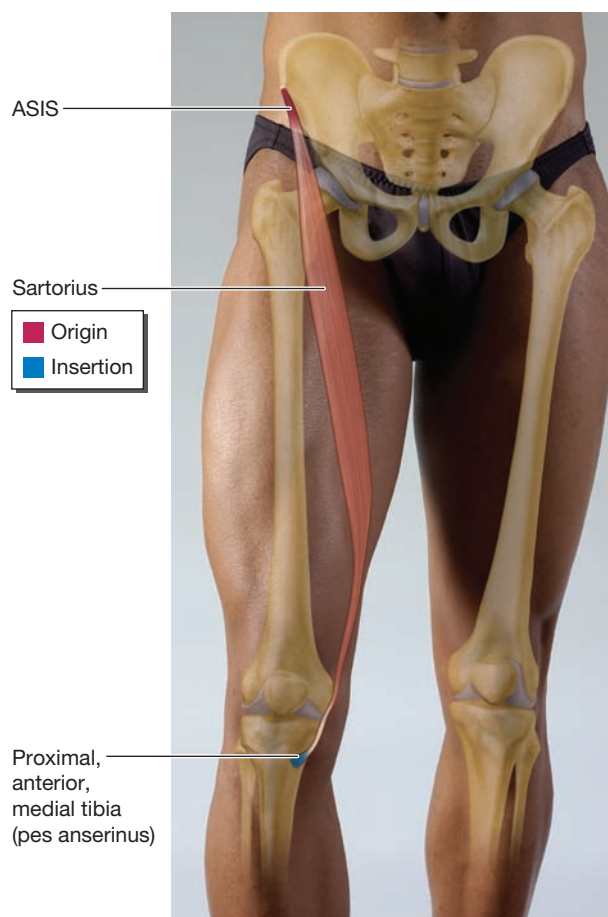


FIGURE 5-32 • Sartorius

the quadriceps muscles. However, providing effleurage, pétrissage, and friction to the entire anterior thigh will ensure that sartorius is addressed.

How to Stretch This Muscle

Sartorius can be difficult to stretch, as it performs so many actions. Extend the thigh, then adduct the thigh behind the opposite lower limb, while medially rotating it. Keep the knee extended.

Synergists

Lateral rotators of the hip: gluteus maximus, piriformis, obturator internus, obturator externus, gemellus superior, gemellus inferior, quadratus femoris, and iliopsoas; hip abductors: gluteus medius, gluteus minimus, and TFL; hip

flexors: iliopsoas, pectineus, rectus femoris, and TFL; knee flexors: semimembranosus, semitendinosus, biceps femoris, gastrocnemius, plantaris, gracilis, and popliteus

Antagonists

Medial rotators of the hip: gluteus medius, gluteus minimus, and TFL; hip adductors: adductor magnus, adductor longus, adductor brevis, pectineus, and gracilis; hip extensors: semimembranosus, semitendinosus, biceps femoris, and gluteus maximus; knee extensors: rectus femoris, vastus intermedius, vastus medialis, and vastus lateralis

Innervation and Arterial Supply

Innervation: femoral nerve

Arterial supply: femoral artery

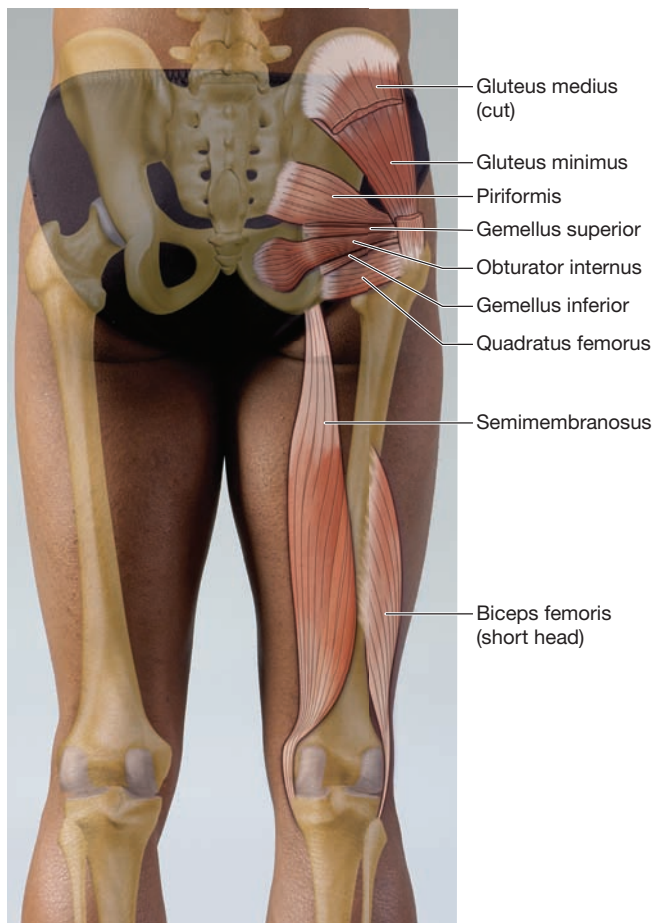


FIGURE 5-33 • Deep posterior thigh muscles

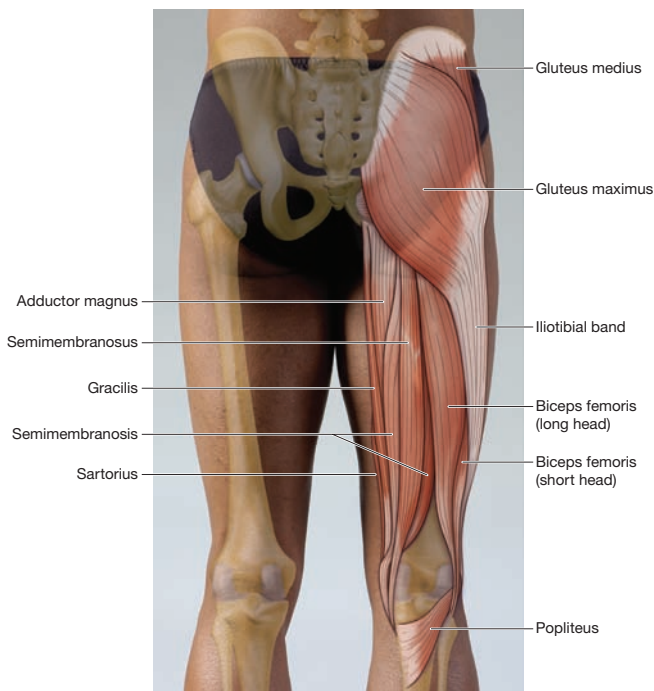


FIGURE 5-34 • Superficial posterior thigh muscles

Regional Illustrations of Muscles

Figure 5-33 shows the deep posterior thigh muscles. Figure 5-34 shows the superficial posterior thigh muscles. Figure 5-35 shows the deep anterior thigh muscles. Figure 5-36 shows the superficial anterior thigh muscles. Figure 5-37 shows the lateral thigh muscles.

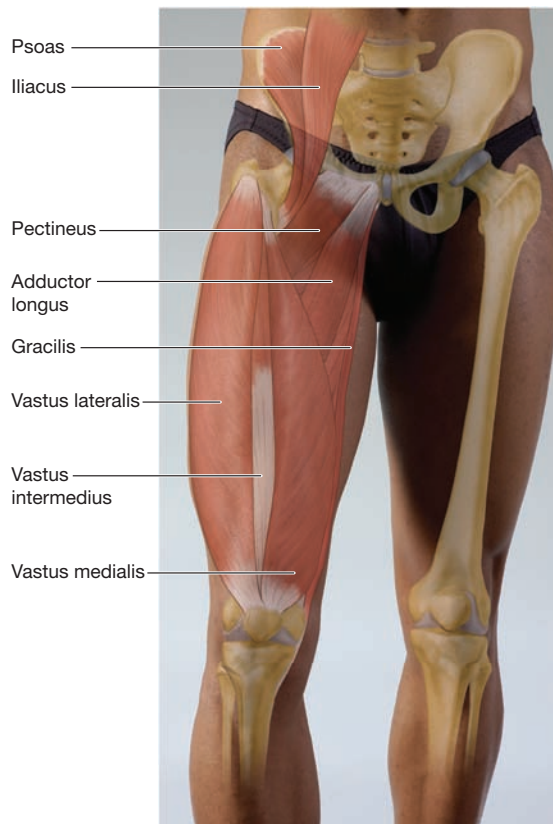


FIGURE 5-35 • Deep anterior thigh muscles

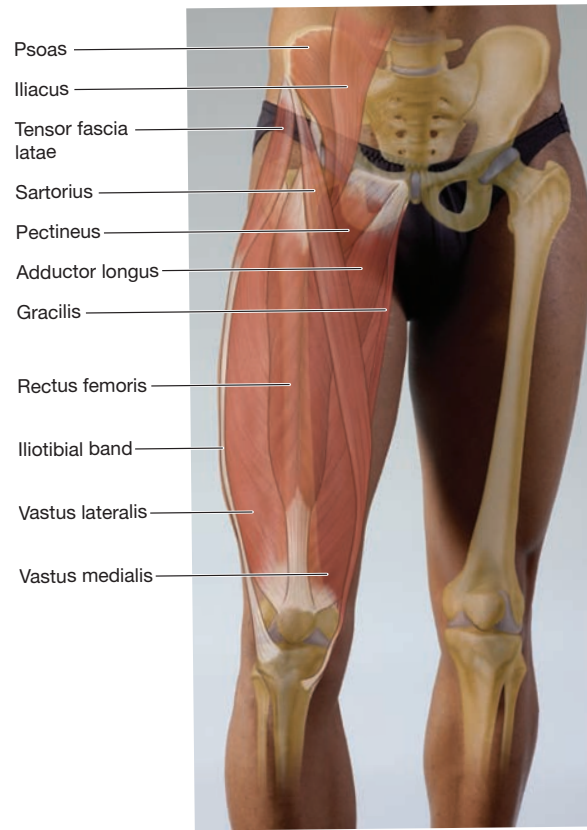


FIGURE 5-36 · Superficial anterior thigh muscles

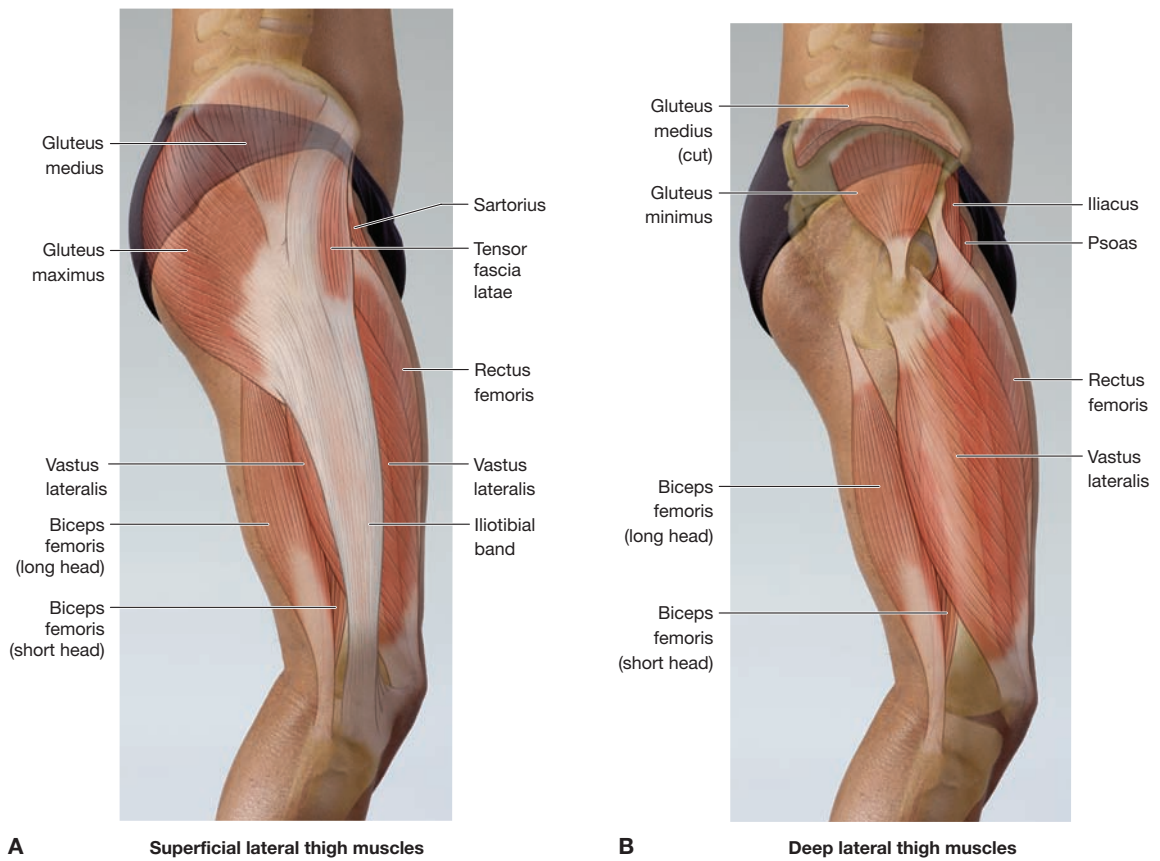


FIGURE 5-37 · Lateral thigh muscles

Posterior Knee and Superficial Posterior Leg Muscles

POPLITEUS (pop-lit-e-us)

Meaning of Name

Popliteus refers to the “ham” of the knee, which is another way of naming the posterior knee.

Location

Popliteus is a flat, triangular muscle, deep in the popliteal fossa, which is located in the posterior knee area.

Origin and Insertion

Origin: lateral epicondyle of the humerus

Insertion: proximal, medial, posterior tibia and lateral meniscus of the knee

Actions

This muscle medially rotates the knee, which is equivalent to lateral rotation of the femur when the tibia is fixed. This movement is necessary to “unlock” the knee from a fully extended position. In addition, popliteus is a weak flexor of the knee.

Explanation of Actions

Popliteus pulls the medial aspect of the tibia posteriorly, thus causing it to turn medially. Popliteus also flexes the knee because it crosses the knee joint posteriorly, and its insertion is inferior to origin.

Notable Muscle Facts

Popliteus has a role in stabilizing the knee joint. It reinforces the job of the posterior cruciate ligament in preventing the femur from moving too far anterior in relation to the tibia.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Limited lateral rotation of the tibia is noted. A short popliteus inhibits our ability to fully extend the knee.

Lengthened: Limited medial rotation of the tibia is noted.

Palpation and Massage

Popliteus is difficult to massage and/or palpate because it is located in the popliteal fossa, an endangerment site due to the presence of the popliteal artery, popliteal vein, and many lymph nodes in the area. In addition, the tibial and common fibular nerves and the small saphenous vein are present in this area.



FIGURE 5-38 • Popliteus

How to Stretch This Muscle

A pin-and-stretch technique is possible for popliteus, which requires pressure to the muscle with knee flexed and then extending the knee.

Synergists

Semimembranosus, semitendinosus, and gracilis (medially rotate and flex the knee)

Antagonists

Biceps femoris (laterally rotates the knee)

Innervation and Arterial Supply

Innervation: tibial nerve

Arterial supply: branches of the popliteal artery

PLANTARIS (plan-tar-is)

Meaning of Name

Plantaris refers to the plantar surface of the foot and the action of plantarflexion.

Location

Plantaris is located superficially in the posterior knee area. This muscle has a small, fleshy muscle belly and a long tendon of insertion that lies between gastrocnemius and soleus in the superficial posterior leg compartment. At its distal aspect, plantaris' tendon of insertion becomes part of the Achilles tendon. The muscle belly of plantaris is located superficial to popliteus.

Origin and Insertion

Origin: lateral epicondyle of the femur

Insertion: posterior calcaneus via the Achilles tendon

Actions

The actions of plantaris include knee flexion and plantarflexion of the ankle.

Explanation of Actions

Because plantaris crosses the posterior aspect of the knee, and the origin is superior to the insertion, plantaris pulls the posterior leg toward the posterior thigh, resulting in knee flexion. Plantaris crosses the posterior aspect of the ankle joint, with its origin proximal to insertion. Thus, plantaris pulls the calcaneus posteriorly, resulting in plantarflexion.

Notable Muscle Facts

Plantaris is variably present, and occasionally can be doubly present. Its long tendon of insertion can be surgically transplanted to replace other damaged tissue.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Possible pain or tension in the superficial posterior knee is noted.

Lengthened: No consequences, as this muscle has very limited functional purpose.

Palpation and Massage

Palpate and/or massage this muscle carefully, as it is located in the popliteal fossa. Recall that this area in the posterior knee is an endangerment site, as the popliteal artery and vein are superficial.

How to Stretch This Muscle

Dorsiflex the ankle with the knee extended.



FIGURE 5-39 • Plantaris

Synergists

Knee flexors: semimembranosus, semitendinosus, biceps femoris, gastrocnemius, popliteus, gracilis, sartorius, and sartorius; plantarflexors: gastrocnemius, soleus, tibialis posterior, flexor hallucis longus, flexor digitorum longus, peroneus longus, and peroneus brevis

Antagonists

Knee extensors: rectus femoris, vastus intermedius, vastus medialis, and vastus lateralis; dorsiflexors: tibialis anterior, extensor digitorum longus, extensor hallucis longus, and peroneus tertius

Innervation and Arterial Supply

Innervation: tibial nerve

Arterial supply: branches of the popliteal artery

GASTROCNEMIUS (gas-trok-ne-me-us)

Meaning of Name

Gastro means belly, and *cnemius* refers to the leg.

Location

Gastrocnemius is located superficially in the posterior knee.

Origin and Insertion

Origin of medial head: medial epicondyle of the femur

Origin of lateral head: lateral epicondyle of the femur

Insertion: posterior aspect of the calcaneus via the Achilles tendon

Actions

Flexes the knee and plantarflexes the ankle

Explanation of Actions

Because gastrocnemius crosses the posterior aspect of the knee, and the origin is superior to the insertion, this muscle pulls the posterior leg toward the posterior thigh, resulting in knee flexion. Gastrocnemius crosses the posterior aspect of the ankle joint, with its origin proximal to insertion. Thus, gastrocnemius pulls the calcaneus posteriorly, resulting in plantarflexion.

Notable Muscle Facts

This muscle is a very strong plantarflexor and is engaged when forceful plantarflexion is needed. When minimal strength of plantarflexion is required, gastrocnemius may not be involved, especially if the knee is flexed. Gastrocnemius plays an important role in stabilization of the ankle joint. It stabilizes the ankle joint from a posterior perspective, preventing the tibia from sliding forward over the talus. In addition, the gastrocnemius muscle is a frequent site of muscle cramps, particularly at night. Such cramps may be relieved by stretching the muscle and by engaging the opposing muscles. Finally, gastrocnemius is notable as it forms the contour of the posterior leg.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Limited dorsiflexion is noted when the knee is extended.

Lengthened: Limited ability to perform forceful plantarflexion is noted.

Palpation and Massage

Gastrocnemius is a fleshy muscle that is easy to palpate and massage. The two proximal parts of the muscle emerge be-

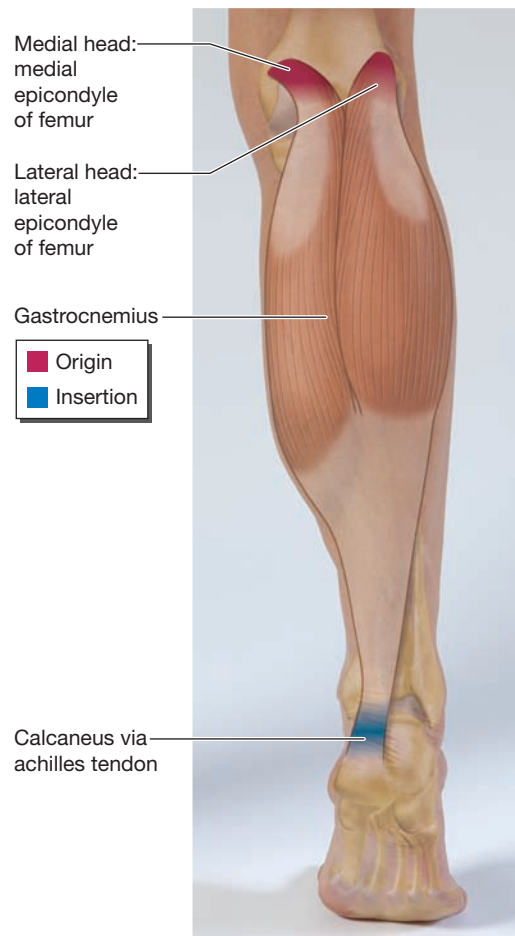


FIGURE 5-40 • Gastrocnemius

tween the distal aspects of the hamstrings. Gastrocnemius is the most superficial muscle in the posterior leg. Effleurage, pétrissage, and friction are all appropriate strokes to apply to this muscle. Friction to a taut Achilles tendon can be helpful to relieve adhesions and relax the muscle.

How to Stretch This Muscle

Dorsiflex the ankle while the knee is extended.

Synergists

Knee flexors: semimembranosus, semitendinosus, biceps femoris, plantaris, popliteus, gracilis, and sartorius; plan-

tarflexors: soleus, plantaris, tibialis posterior, flexor hallucis longus, flexor digitorum longus, peroneus longus, and peroneus brevis

Antagonists

Knee extensors: rectus femoris, vastus intermedius, vastus medialis, and vastus lateralis; dorsiflexors: tibialis anterior, extensor digitorum longus, extensor hallucis longus, and peroneus tertius

Innervation and Arterial Supply

Innervation: tibial nerve

Arterial supply: branches of the popliteal artery

SOLEUS (so-le-us)

Meaning of Name

Soleus refers to the fish named sole, which is flat like the soleus muscle.

Location

Most of soleus is directly deep to gastrocnemius and is thus the deepest muscle in the superficial posterior leg compartment. However, the distal portion of soleus is wider than gastrocnemius, and thus is superficial and easier to palpate.

Origin and Insertion

Origin: soleal line of the tibia and the head and posterior proximal shaft of the fibula

Insertion: posterior calcaneus, via the Achilles tendon

Actions

Plantarflexes the ankle

Explanation of Actions

Soleus crosses the posterior ankle joint, with its origin superior to the insertion on the calcaneus. Thus, soleus pulls the calcaneus posteriorly, causing plantarflexion.

Notable Muscle Facts

Soleus has been dubbed “the second heart,” as this muscle is well positioned to assist venous return from the posterior leg. Contraction of the soleus helps push blood from the posterior legs back toward the heart. In addition, soleus assists gastrocnemius in stabilizing the ankle joint from a posterior perspective. Soleus, in combination with gastrocnemius, results in a “three-headed” muscular structure called *triceps surae*. Because soleus crosses the ankle joint, and no other joint, it is able to plantarflex the ankle regardless of the position of the knee or any other joint. Finally, soleus and the other plantarflexors work with the dorsiflexors to help us maintain balance as we shift our weight on our feet.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Inability to dorsiflex the ankle, both while the knee is flexed and while the knee is extended.

Lengthened: A lengthened soleus can limit ability to plantarflex the ankle.

Palpation and Massage

Soleus can be palpated and massaged through the gastrocnemius in the posterior leg. As already mentioned, the distal edges of soleus are palpable, as they are wider than gastrocnemius.

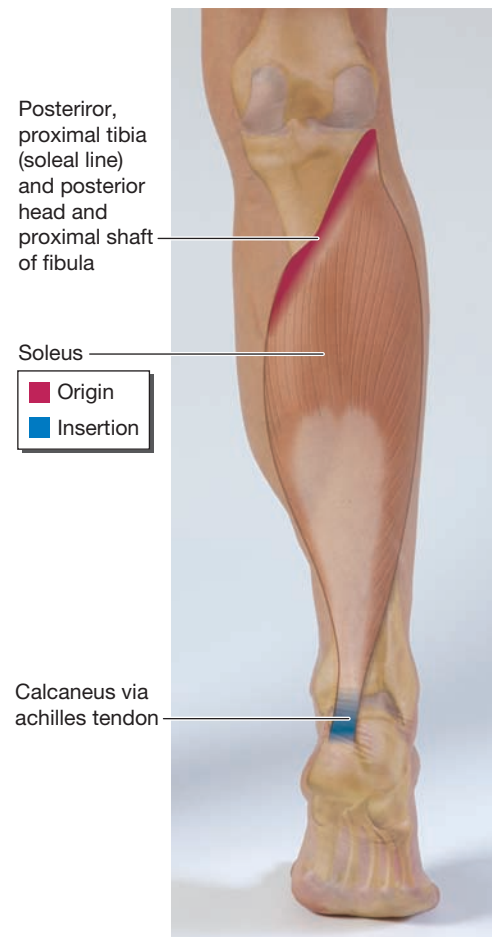


FIGURE 5-41 • Soleus

When a client contracts his or her plantarflexors isometrically, the border between gastrocnemius and soleus is more palpable. Massage to the posterior leg with the intention to address the deeper muscles can affect the soleus muscle. Effleurage, pétrissage, and friction are all appropriate strokes to apply to this area.

How to Stretch This Muscle

Dorsiflex the ankle with the knee flexed. Flexion of the knee gives slack to gastrocnemius, so that the stretch is focused on soleus.

Synergists

Plantarflexors: gastrocnemius, plantaris, tibialis posterior, flexor hallucis longus, flexor digitorum longus, peroneus longus, and peroneus brevis

Antagonists

Dorsiflexors: tibialis anterior, extensor digitorum longus, extensor hallucis longus, and peroneus tertius

Innervation and Arterial Supply

Innervation: tibial nerve

Arterial supply: branches of the popliteal artery

Muscles of the Leg That Move the Foot and Toes

Muscles of the leg that move the foot and toes are covered in this section. These include the tibialis posterior, flexor digitorum longus, flexor hallucis longus, peroneus longus, peroneus brevis, peroneus tertius, extensor digitorum longus, extensor hallucis longus, and tibialis anterior.

TIBIALIS POSTERIOR (tib-e-a-lis po-ster-e-or)

Meaning of Name

Tibialis refers to the tibia, and *posterior* reflects the fact that this muscle is located in the posterior leg, covering much of the tibia.

Location

Tibialis posterior is the deepest muscle in the deep posterior leg compartment. Its tendon of insertion passes posterior and inferior to the medial malleolus as it continues toward the plantar surface of the foot.

Origin and Insertion

Origin: posterior tibia, fibula, and interosseus membrane

Insertion: plantar surface of the navicular, all three cuneiforms, and the cuboid, and the bases of the second, third, and fourth metatarsals.

Actions

Inverts the foot and plantarflexes the ankle

Explanation of Actions

Tibialis posterior crosses the posterior ankle joint with its origin proximal to insertion. Thus, the muscle pulls the plantar surface of the foot toward the posterior leg, which results in plantarflexion of the ankle. In addition, the tendon of insertion of tibialis posterior crosses the medial side of the foot. Thus, the muscle pulls the plantar surface of the foot medially, which results in inversion of the foot.

Notable Muscle Facts

Tibialis posterior has a very unique tendon of insertion, which attaches to 8 bones. The placement of this tendon serves to support the medial longitudinal arch.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: A shortened tibialis posterior can cause a higher medial longitudinal arch. Difficulty dorsiflexing and inverting can also result.

Lengthened: A lengthened tibialis posterior can cause difficulty inverting the foot and could cause a weakened medial longitudinal arch.

Palpation and Massage

Because tibialis posterior is located deep in the posterior leg, the muscle can be addressed by massaging the posterior leg with the intention to address the deeper muscles. Effleurage, pétrissage, and friction are all appropriate strokes to apply to this muscle.

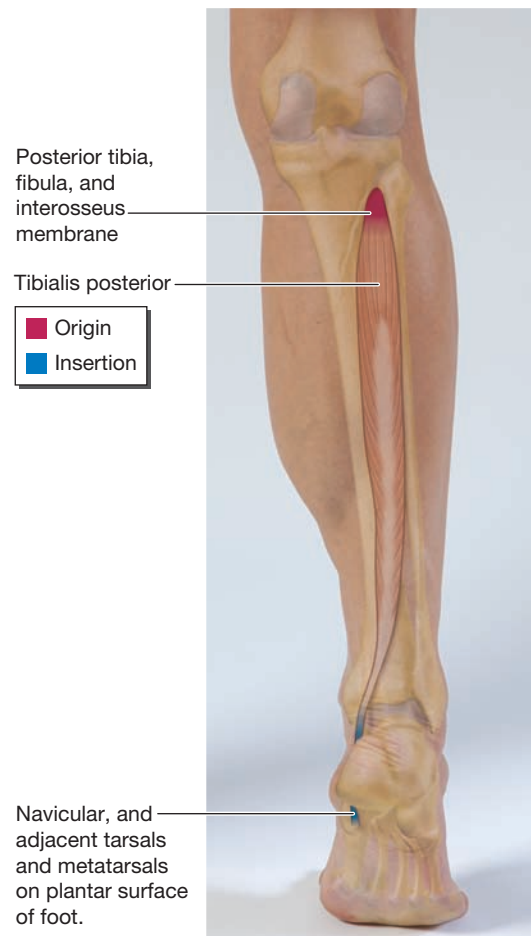


FIGURE 5-42 • Tibialis posterior

How to Stretch This Muscle

Dorsiflex the ankle while everting the foot.

Synergists

Plantarflexors: gastrocnemius, soleus, plantaris, flexor hallucis longus, flexor digitorum longus, peroneus longus, and peroneus brevis

Antagonists

Dorsiflexors: tibialis anterior, extensor digitorum longus, extensor hallucis longus, and peroneus tertius

Innervation and Arterial Supply

Innervation: tibial nerve

Arterial supply: posterior tibial artery

FLEXOR DIGITORUM LONGUS (flex-or dij-i-to-rum long-gus)

Meaning of Name

Flexor indicates the action of flexion. *Digitorum* indicates that the muscle moves four digits, in this case the four lateral toes. *Longus* refers to the fact that the muscle is longer than flexor digitorum brevis.

Location

This muscle is located in the deep posterior leg compartment. The tendon of insertion passes posterior and inferior to the medial malleolus as it continues toward the plantar surface of the foot.

Origin and Insertion

Origin: midsection of the posterior tibia

Insertion: plantar surface of the distal phalanges of the four lateral toes

Actions

Flexes the four lateral toes and plantarflexes the ankle

Explanation of Actions

The muscle originates on the posterior leg, crosses the posterior side of the ankle joint, and inserts onto the plantar side of the foot. Thus, contraction pulls the plantar surface of the foot toward the origin on the posterior leg, resulting in plantarflexion. In addition, the muscle crosses the plantar surface of all joints within the toes. Thus, muscle contraction causes flexion of the toes.

Notable Muscle Facts

The curling or flexing action of flexor digitorum longus helps us maintain balance when standing and helps us to push off when walking. This muscle flexes the distal phalanges of the four lateral toes with much more force than the proximal or middle phalanges.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Limited ability to dorsiflex the ankle and/or extend the four lateral toes is noted. A shortened flexor digitorum longus can increase susceptibility to toe cramps.

Lengthened: A lengthened flexor digitorum longus can weaken the action of push-off when walking.

Palpation and Massage

Because flexor digitorum longus is located deep in the posterior leg, the muscle can be addressed by massaging the posterior leg with the intention of addressing the deeper muscles. Effleurage, pétrissage, and friction are all appropriate strokes to apply to this muscle.

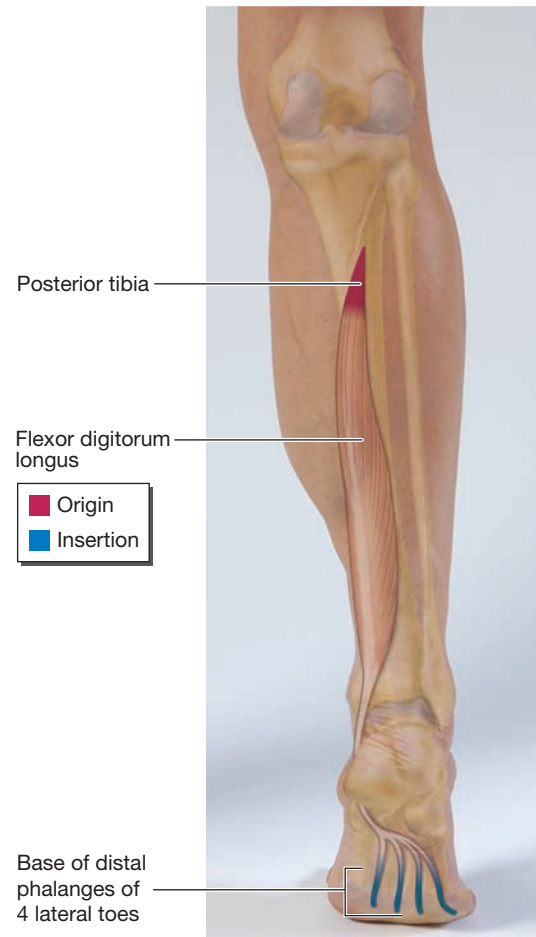


FIGURE 5-43 • Flexor digitorum longus

How to Stretch This Muscle

Dorsiflex the ankle and extend the toes.

Synergists

Plantarflexors: gastrocnemius, soleus, plantaris, tibialis posterior, flexor hallucis longus, peroneus longus, and peroneus brevis; toe flexor: flexor digitorum brevis

Antagonists

Dorsiflexors: tibialis anterior, extensor digitorum longus, extensor hallucis longus, and peroneus tertius; toe extensors: extensor digitorum longus and extensor digitorum brevis

Innervation and Arterial Supply

Innervation: tibial nerve

Arterial supply: posterior tibial artery

FLEXOR HALLUCIS LONGUS (fleks-or hal-u-sis long-gus)

Meaning of Name

Flexor indicates the action of flexion. *Hallucis* refers to the big toe or first digit of the foot. *Longus* refers to the fact that the muscle is longer than flexor hallucis brevis.

Location

This muscle is located in the deep posterior leg compartment. The tendon of insertion passes posterior and inferior to the medial malleolus as it continues toward the plantar surface of the foot.

Origin and Insertion

Origin: midsection of the posterior fibula

Insertion: plantar surface of the distal phalanx of the big toe

Actions

Flexes the big toe and plantarflexes the ankle

Explanation of Actions

The muscle originates on the posterior leg, crosses the posterior side of the ankle joint, and inserts onto the plantar side of the foot. Thus, contraction pulls the plantar surface of the foot toward the origin on the posterior leg, resulting in plantarflexion. In addition, the muscle crosses the plantar surface of all joints of the big toe. Thus, muscle contraction causes flexion of the big toe.

Notable Muscle Facts

The curling or flexing action of flexor hallucis longus helps us maintain balance when standing and helps us to push off when walking. This muscle flexes the distal phalanges of the great toe with greater strength than the proximal or middle phalanx of the great toe.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Limited ability to dorsiflex the ankle and/or extend the great toe is noted. A shortened flexor hallucis longus can increase susceptibility to cramps in the big toe.

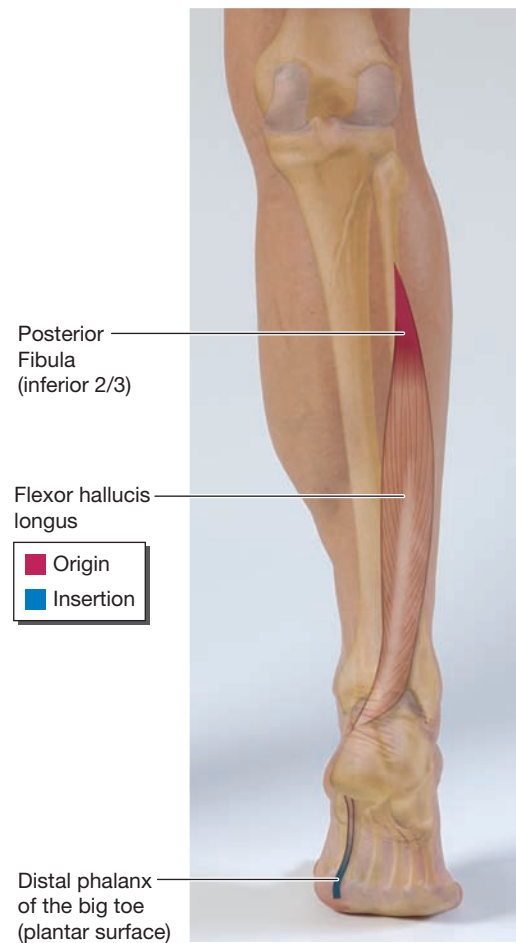


FIGURE 5-44 • Flexor hallucis longus

Lengthened: A lengthened flexor hallucis longus can weaken the action of push-off when walking.

Palpation and Massage

Because flexor hallucis longus is located deep in the posterior leg, the muscle can be addressed by massaging the posterior leg, with the intention of addressing the deeper muscles. Effleurage, pétrissage, and friction are all appropriate strokes to apply to this muscle.

How to Stretch This Muscle

Dorsiflex the ankle and extend the big toe.

Synergists

Plantarflexors: gastrocnemius, soleus, plantaris, tibialis posterior, flexor hallucis longus, peroneus longus, and peroneus brevis; flexor of the big toe: flexor hallucis brevis

Antagonists

Dorsiflexors: tibialis anterior, extensor digitorum longus, extensor hallucis longus, and peroneus tertius; extensors of the first digit of the foot: extensor hallucis longus and extensor hallucis brevis

Innervation and Arterial Supply

Innervation: tibial nerve

Arterial supply: posterior tibial artery

PERONEUS LONGUS (per-o-ne-us long-gus)

Meaning of Name

Peroneus refers to the fibula, and *longus* indicates that this muscle is longer than *peroneus brevis*. *Peroneus longus* is also called *Fibularis longus*.

Location

Both *peroneus longus* and *peroneus brevis* are located in the lateral leg compartment, along the lateral fibula. *Peroneus longus* covers the proximal portion of the lateral fibula and is superficial to *peroneus brevis*. The tendon of insertion of *peroneus longus* runs distally along the fibula, posterior to the lateral malleolus, and all the way across the plantar surface of the foot to the medial cuneiform and first metatarsal. This muscle is sometimes called the *stirrup muscle* due to the fact that the long tendon of insertion can be compared to a stirrup that runs along the bottom of the foot.

Origin and Insertion

Origin: head of the fibula and the lateral, proximal fibula

Insertion: base of the first metatarsal and the medial cuneiform

Actions

Everts the foot and plantarflexes the ankle

Explanation of Actions

Because *peroneus longus* is located along the lateral leg and its tendon of insertion crosses the lateral aspect of the ankle and inserts on the plantar surface of the foot, the muscle pulls the plantar surface of the foot toward the lateral leg. This causes eversion of the foot. In addition, because the tendon of insertion passes posterior to the lateral malleolus, the plantar surface of the foot is pulled posteriorly, resulting in plantarflexion.

Notable Muscle Facts

The long tendon of insertion of *peroneus longus* provides support to the transverse arch. Both *peroneus longus* and *brevis* play a role in allowing the feet to be placed flat upon the floor. Because the hips are often wider than the feet, the angle of the lower limbs, when walking or standing, is such that the feet will not land or rest flat upon the floor unless eversion of the foot occurs. *Peroneus longus* and *brevis* cause this eversion. Finally, *peroneus longus* and *brevis* support the lateral aspect of the ankle joint.

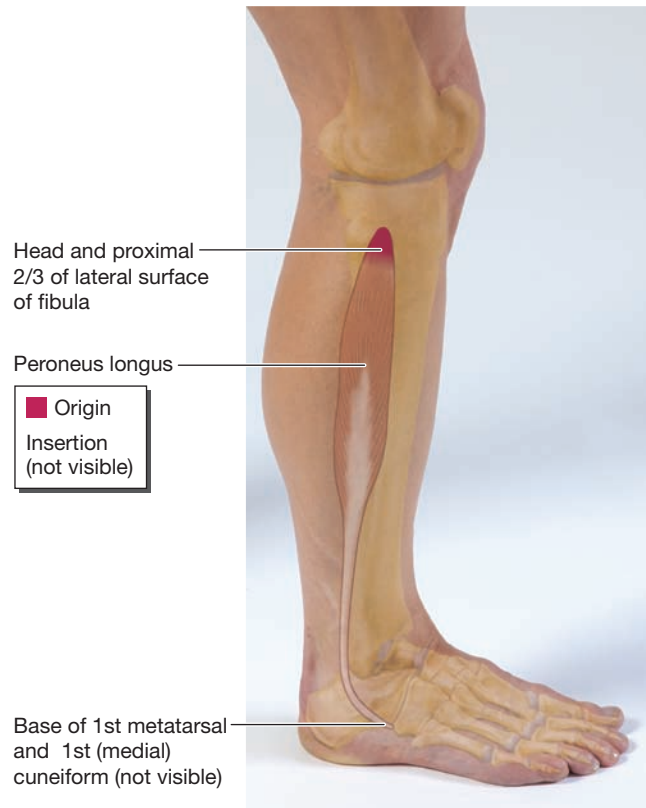


FIGURE 5-45 • *Peroneus longus*

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Lower medial longitudinal arch is noted. One's shoes can become more worn on the insides with shortened foot evertors.

Lengthened: Limited ability to evert the foot is noted.

Palpation and Massage

Peroneus longus can be palpated along the proximal, lateral fibula. Friction to this area and gentle cross-fiber friction just distal to the head of the fibula are effective ways to address the muscle.

How to Stretch This Muscle

Inverting the foot while the ankle is dorsiflexed can stretch peroneus longus and peroneus brevis.

Synergists

Evertors of the foot: peroneus brevis and peroneus tertius; plantarflexors: gastrocnemius, soleus, plantaris, tibialis posterior, flexor digitorum longus, flexor hallucis longus, and peroneus brevis

Antagonists

Dorsiflexors: tibialis anterior, extensor digitorum longus, extensor hallucis longus, and peroneus tertius; invertors of the foot: tibialis anterior and tibialis posterior

Innervation and Arterial Supply

Innervation: superficial fibular (peroneal) nerve

Arterial supply: fibular artery

PERONEUS BREVIS (per-o-ne-us bre-vis)

Meaning of Name

Peroneus refers to the fibula, and *brevis* indicates that this muscle is shorter than *peroneus longus*. *Peroneus brevis* is also called *Fibularis brevis*.

Location

Both *peroneus longus* and *peroneus brevis* are located in the lateral leg compartment, along the lateral fibula. *Peroneus brevis* covers the distal portion of the lateral fibula and is deep to *peroneus longus*. The tendon of insertion runs distally along the fibula, posterior to the lateral malleolus, to the lateral base of the fifth metatarsal.

Origin and Insertion

Origin: distal lateral aspect of the fibula

Insertion: lateral side of the base of the fifth metatarsal

Actions

Everts the foot and plantarflexes the ankle

Explanation of Actions

Because *peroneus brevis* is located along the lateral leg, and its tendon of insertion crosses the lateral aspect of the ankle and inserts on the lateral side of the fifth metatarsal, the muscle pulls the fifth metatarsal toward the lateral leg. This causes eversion of the foot. In addition, because the tendon of insertion passes posterior to the lateral malleolus, the foot is pulled posteriorly, resulting in plantarflexion.

Notable Muscle Facts

Both *peroneus longus* and *brevis* play a role in allowing the feet to be placed flat upon the floor. Because the hips are often wider than the feet, the angle of the lower limbs, when walking or standing, is such that the feet will not land or rest flat upon the floor unless eversion of the foot occurs. *Peroneus longus* and *brevis* cause this eversion. Finally, *peroneus longus* and *brevis* support the lateral aspect of the ankle joint.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: When *peroneus longus* and *brevis* are shortened, the medial longitudinal arch can be higher.

Lengthened: Limited ability to evert the foot and possible ankle instability when lengthened, one can experience lateral ankle instability and difficulty everting the foot.

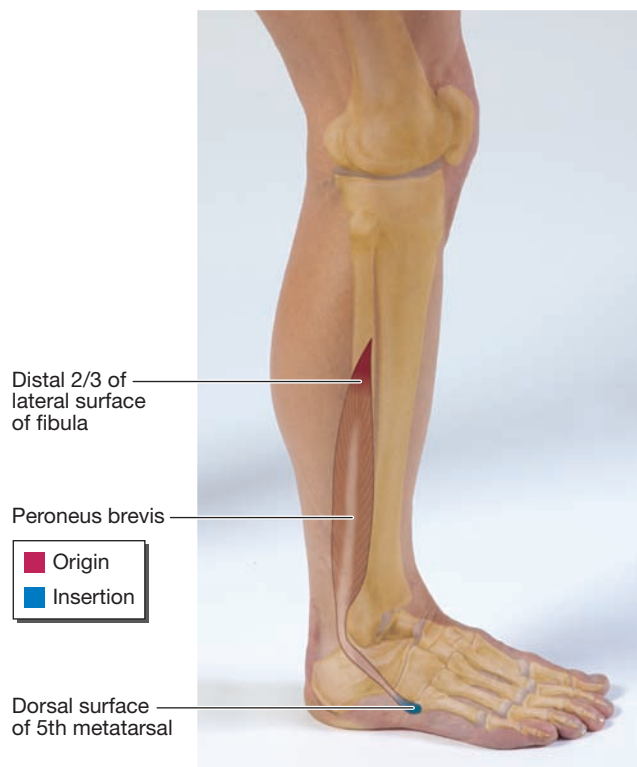


FIGURE 5-46 • Peroneus brevis

Palpation and Massage

Peroneus brevis can be palpated along the distal, lateral fibula. Friction to this area is an effective way to address the muscle.

How to Stretch This Muscle

Invert the foot while the ankle is dorsiflexed.

Synergists

Evertors of the foot: *peroneus brevis* and *peroneus tertius*; plantarflexors: *gastrocnemius*, *soleus*, *plantaris*, *tibialis posterior*, *flexor digitorum longus*, *flexor hallucis longus*, and *peroneus longus*

Antagonists

Dorsiflexors: *tibialis anterior*, *extensor digitorum longus*, *extensor hallucis longus*, and *peroneus tertius*; invertors of the foot: *tibialis anterior* and *tibialis posterior*

Innervation and Arterial Supply

Innervation: superficial fibular (peroneal) nerve

Arterial supply: fibular artery

PERONEUS TERTIUS (per-o-ne-us ter-shus)

Meaning of Name

Peroneus refers to the fibula, and *tertius* means third. Peroneus tertius is also called Fibularis tertius.

Location

Peroneus tertius is located along the distal aspect of the anterior fibula. The tendon of insertion runs anterior to the lateral malleolus. This muscle often blends in with the distal end of the extensor hallucis muscle. Peroneus tertius is located within the anterior leg compartment.

Origin and Insertion

Origin: distal anterior fibula

Insertion: anterior aspect of the base of the fifth metatarsal

Actions

Everts the foot and dorsiflexes the ankle

Explanation of Actions

Because peroneus tertius crosses the lateral aspect of the ankle and its origin is proximal to insertion, this muscle causes foot eversion. Because the tendon of insertion of peroneus tertius crosses the anterior aspect of the ankle joint, it causes dorsiflexion of the ankle.

Notable Muscle Facts

Peroneus tertius blends with the extensor digitorum longus muscle.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Lower medial longitudinal arch is noted.

Lengthened: No notable movement limitations is noted.

Palpation and Massage

Peroneus tertius can be palpated along the distal anterior fibula. It is nearly impossible to distinguish from the distal portion of extensor digitorum longus. Direct pressure to the anterior distal fibula is one way to address this muscle.

How to Stretch This Muscle

Invert the foot while plantarflexing the ankle.

Synergists

Evertors of the foot: peroneus longus and peroneus brevis; dorsiflexors: tibialis anterior, extensor digitorum longus and extensor hallucis longus

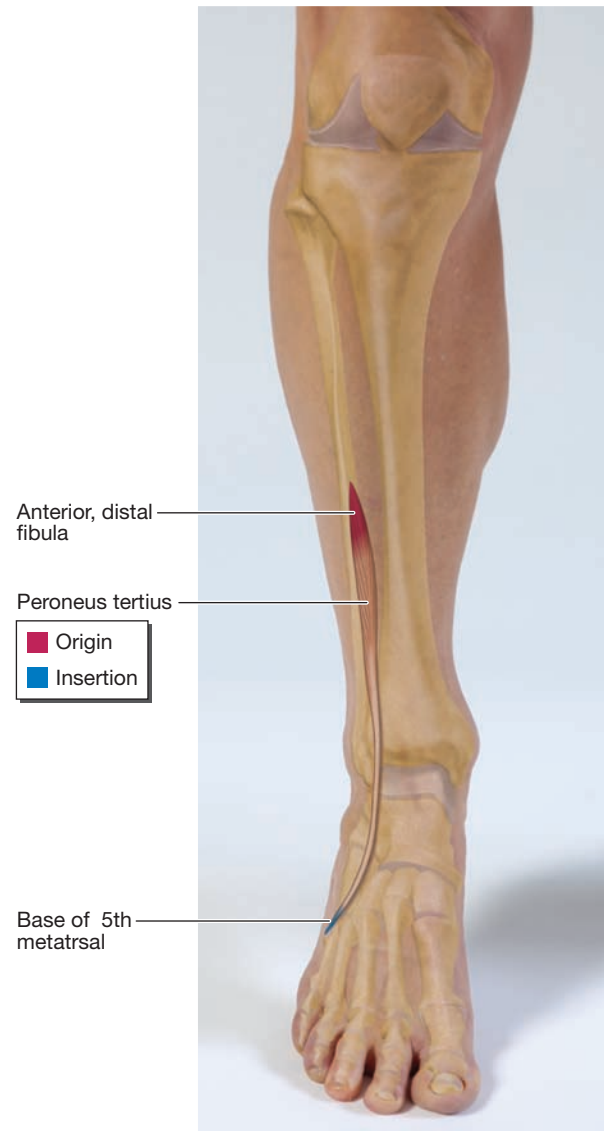


FIGURE 5-47 • Peroneus tertius

Antagonists

Plantarflexors: gastrocnemius, soleus, plantaris, tibialis posterior, flexor digitorum longus, flexor hallucis longus, peroneus longus, and peroneus brevis; invertors of the foot: tibialis anterior and tibialis posterior

Innervation and Arterial Supply

Innervation: deep fibular (peroneal) nerve

Arterial supply: anterior tibial artery

EXTENSOR DIGITORUM LONGUS (eks-ten-sor dij-i-to-rum long-gus)

Meaning of Name

Extensor indicates the action of extension. *Digitorum* refers to four digits, and *longus* means that this muscle is longer than extensor digitorum brevis.

Location

Extensor digitorum longus is the most lateral muscle of the anterior leg compartment. It lies along the entire anterior fibula. The proximal part of the muscle is deep to tibialis anterior, but the distal portion is superficial. The tendon of insertion crosses the anterior aspect of the ankle joint and then splits into four distinct tendons, one per digit of the four lateral toes. The tendons are surrounded by a synovial sheath.

Origin and Insertion

Origin: lateral condyle of the tibia and the proximal three-fourths of the anterior fibula

Insertion: dorsal side of the middle and distal phalanges of the four lateral toes

Actions

Extends the four lateral toes and dorsiflexes the ankle

Explanation of Actions

Because extensor digitorum longus crosses the anterior aspect of the ankle, with the origin on the anterior leg and the insertion more distal on the dorsal surface of the toes, the muscle pulls the dorsal side of the foot toward the anterior leg, thus causing dorsiflexion. In addition, extensor digitorum longus pulls the dorsal aspect of the four lateral toes toward the anterior leg, thus extending the toes.

Notable Muscle Facts

Extensor digitorum longus is important during the swing phase of walking, as it helps to keep the foot lifted off of the floor. Likewise, this muscle helps to control the rate of descent of the foot as it comes to the floor just after heel strike.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Limited ability to flex the toes is noted

Lengthened: Weakness in extension of the metatarsophalangeal joints of the four lateral toes.

Palpation and Massage

Extensor digitorum longus can be palpated easily along the anterior fibula. Friction and direct pressure are reasonable strokes to apply to this muscle.

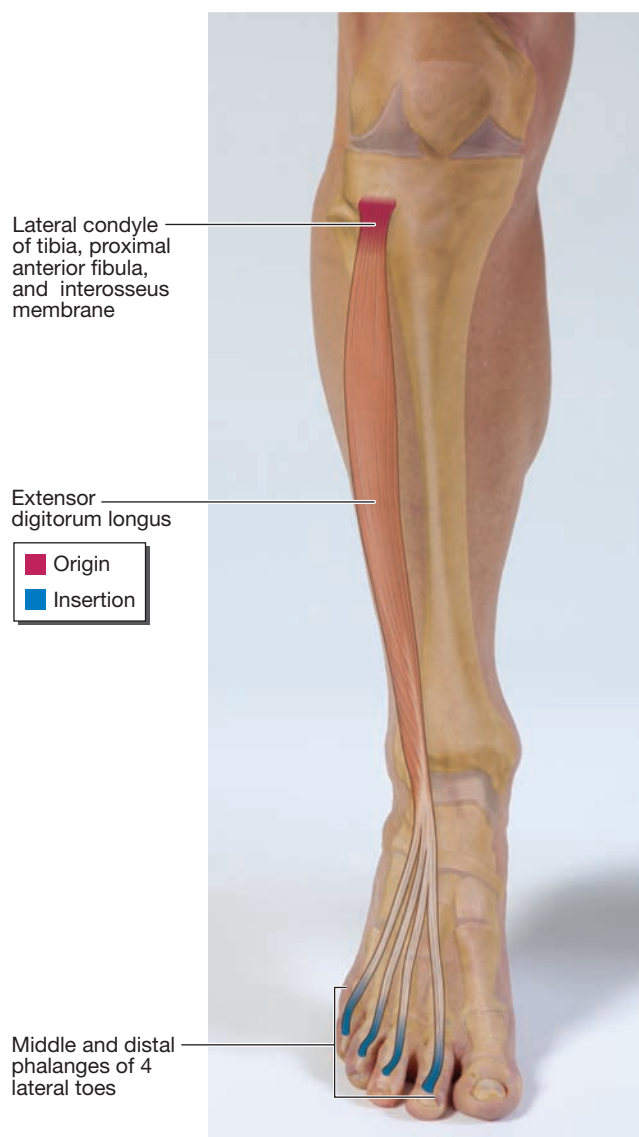


FIGURE 5-48 • Extensor digitorum longus

How to Stretch This Muscle

Plantarflex the ankle while flexing the toes.

Synergists

Extensor of the four lateral toes: extensor digitorum brevis, which acts on the metacarpophalangeal (MP) joints of the foot; dorsiflexors of the ankle: tibialis anterior, extensor hallucis longus, and peroneus tertius

Antagonists

Toe flexors: flexor digitorum longus and flexor digitorum brevis; plantarflexors: gastrocnemius, soleus, plantaris, tibialis posterior, flexor hallucis longus, flexor digitorum longus, peroneus longus, and peroneus brevis

Innervation and Arterial Supply

Innervation: deep peroneal nerve

Arterial supply: anterior tibial artery

EXTENSOR HALLUCIS LONGUS (eks-ten-sor hal-u-sis long-gus)

Meaning of Name

Extensor indicates the action of extension. *Hallucis* refers to the big toe or the first digit of the foot. And *longus* means that this muscle is longer than extensor hallucis brevis.

Location

Extensor hallucis longus is located in the anterior leg compartment, deep to extensor digitorum longus and tibialis anterior. The tendon of insertion of extensor hallucis longus crosses the anterior aspect of the ankle joint and runs along the dorsal surface of the big toe to the distal phalanx.

Origin and Insertion

Origin: middle of the shaft of the anterior fibula and the interosseus membrane

Insertion: dorsal aspect of the distal phalanx of the big toe

Actions

Extends the great (big) toe and dorsiflexes the ankle

Explanation of Actions

Because extensor hallucis longus crosses the anterior aspect of the ankle, with the origin on the anterior leg and the insertion more distal on the dorsal surface of big toe, the muscle pulls the dorsal side of the foot toward the anterior leg, thus causing dorsiflexion. In addition, extensor digitorum longus pulls the dorsal aspect of the big toe toward the anterior leg, thus extending the first digit.

Notable Muscle Facts

Extensor hallucis longus is important during the swing phase of walking, as it helps to keep the foot lifted off of the floor. Likewise, this muscle helps to control the rate of descent of the foot as it comes to the floor just after heel strike.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Limited ability to flex the great/big toe is noted.

Lengthened: Limited ability to extend the big/great toe is noted.

Palpation and Massage

Extensor hallucis longus may be palpated and massaged deep in the anterior leg compartment. Friction and direct pressure are reasonable strokes to apply to this muscle.

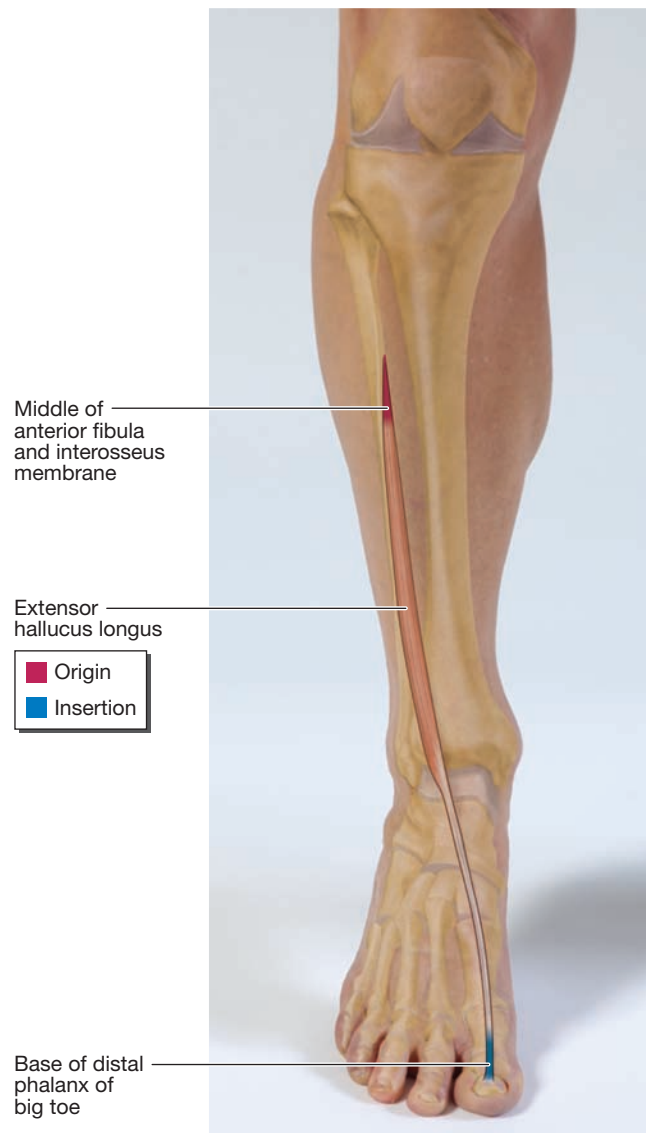


FIGURE 5-49 • Extensor hallucis longus

How to Stretch This Muscle

Plantarflex the ankle while flexing the great toe.

Synergists

Extensor of the first digit: extensor hallucis brevis, which acts on the MP joint of the big toe; dorsiflexors of the ankle: tibialis anterior, extensor digitorum longus, and peroneus tertius

Antagonists

Toe flexors: flexor hallucis longus and flexor hallucis brevis; plantarflexors: gastrocnemius, soleus, plantaris, tibialis posterior, flexor hallucis longus, flexor digitorum longus, peroneus longus, and peroneus brevis

Innervation and Arterial Supply

Innervation: deep peroneal nerve

Arterial supply: anterior tibial artery

TIBIALIS ANTERIOR (tib-e-a-lis an-ter-e-or)

Meaning of Name

Tibialis anterior attaches to a significant portion of the front of the tibia.

Location

Tibialis anterior is the largest and most superficial muscle in the anterior leg compartment. It is one of the strongest muscles per volume unit in the body. The tendon of insertion of tibialis anterior crosses the anterior aspect of the ankle joint on its way to the medial side of the foot.

Origin and Insertion

Origin: lateral condyle and lateral shaft of the tibia and interosseus membrane

Insertion: base of the first metatarsal and medial cuneiform

Actions

Dorsiflexes the ankle and inverts the foot

Explanation of Actions

Because tibialis anterior crosses the anterior aspect of the ankle, it is a dorsiflexor. Because it inserts on the medial aspect of the foot, it pulls the medial aspect of the foot superiorly, causing inversion. As the strongest dorsiflexor, tibialis anterior is important in walking. It is used concentrically when we pull the dorsal side of the foot closer to the anterior leg as we swing our leg with each step. Also, we use tibialis anterior eccentrically right after our heel strikes the ground, to control the rate of descent of the foot to the ground. We use tibialis anterior even more when going uphill and more eccentric contraction is required when going downhill.

Notable Muscle Facts

Tibialis anterior is one of the strongest muscles in the body (per unit of volume). Along with the plantarflexors, tibialis anterior helps us maintain balance as we shift our weight on our feet.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: A shortened tibialis anterior can cause a high medial longitudinal arch, as well as difficulty everting the foot and plantarflexing the ankle.

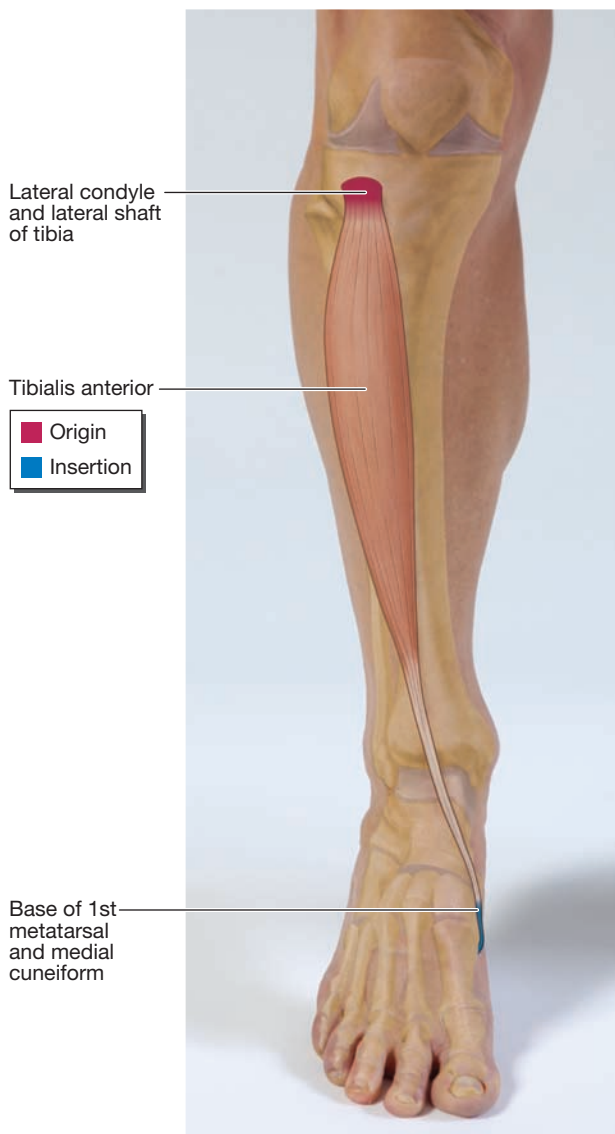


FIGURE 5-50 • Tibialis anterior

Lengthened: Inability to fully dorsiflex the foot; this limitation can be noticed during gait. A lengthened or weakened tibialis anterior causes the foot to slap or drop to the ground, just after heel strike when walking.

Palpation and Massage

Tibialis anterior is easy to palpate and massage in the anterior leg, between the tibia and fibula. Effleurage, friction, and direct pressure are all effective strokes to apply to this muscle.

How to Stretch This Muscle

Plantarflex the ankle while everting the foot.

Synergists

Dorsiflexors: extensor digitorum longus, extensor hallucis longus, and peroneus tertius; inverter: tibialis posterior

Antagonists

Plantarflexors: gastrocnemius, soleus, plantaris, tibialis posterior, flexor hallucis longus, flexor digitorum longus, peroneus longus, and peroneus brevis; evertors of the foot: peroneus longus, peroneus brevis, and peroneus tertius

Innervation and Arterial Supply

Innervation: deep peroneal nerve

Arterial supply: anterior tibial nerve

Regional Illustrations of Muscles

Figure 5-51 shows a deep view of the posterior leg.

Figure 5-52 shows a superficial view of the posterior leg.

Figure 5-53 shows a superficial view of the lateral leg.

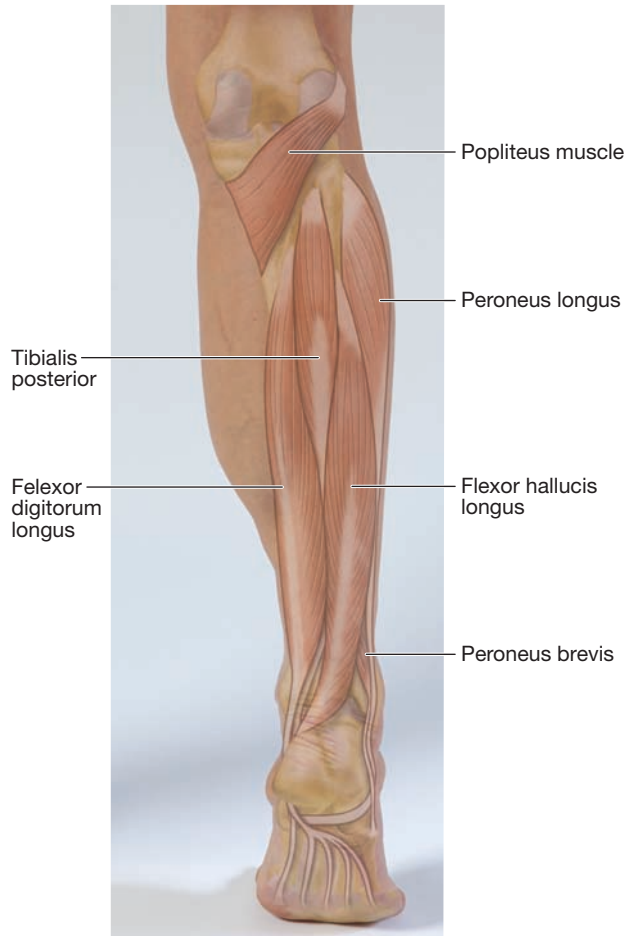


FIGURE 5-51 • A deep view of the posterior leg

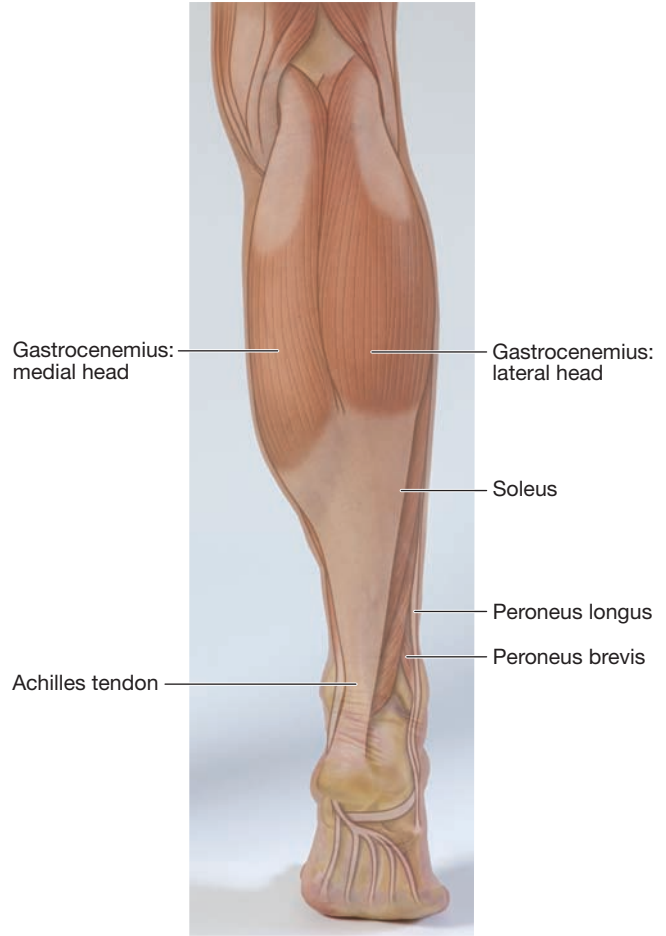


FIGURE 5-52 • A superficial view of the posterior leg

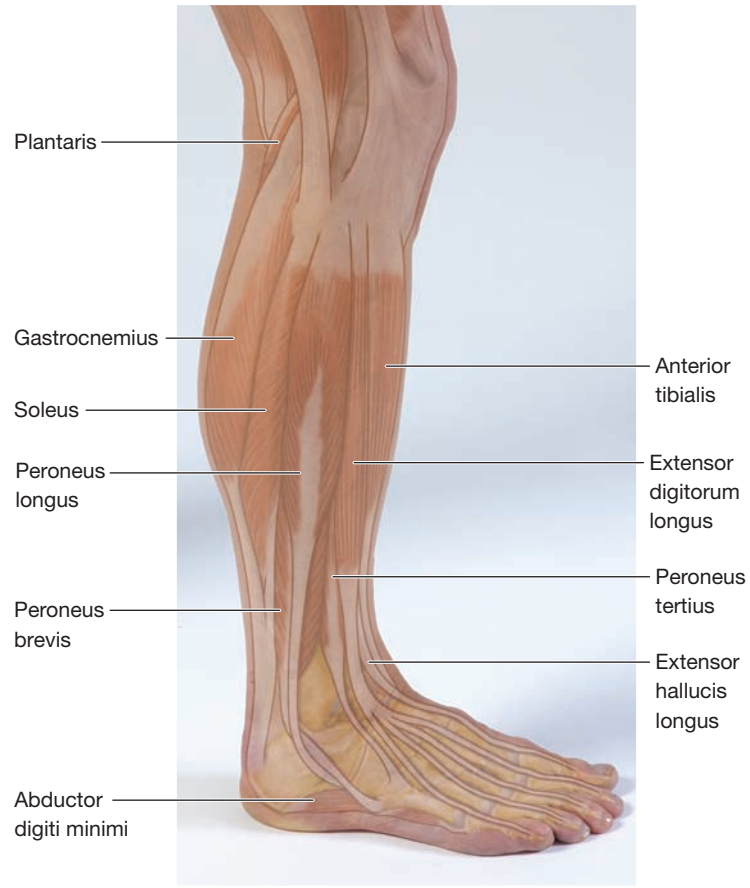


FIGURE 5-53 · A superficial view of the lateral leg

Intrinsic Foot Muscles

Intrinsic muscles of the foot include the dorsal interossei, plantar interossei, flexor hallucis brevis, adductor hallucis,

flexor digiti minimi brevis, lumbricals, quadratus plantae, abductor hallucis, flexor digitorum brevis, and abductor digiti minimi. These are discussed below.

DORSAL INTEROSSEI (dor-sal in-ter-ahs-e-i)

Meaning of Name

Dorsal refers to the top of the foot, where this muscle is located. *Interossei* means between bones. These muscles are located between the metatarsals. They are a group of four interosseus muscles, each of which moves a single digit in one direction.

Location

These muscles are located between the metatarsals on the dorsal side of the foot. They are part of the fourth and deepest layer of intrinsic foot muscles.

Origin and Insertion

Origin of each dorsal interosseus: adjacent sides of the metatarsals it lies between

Insertion of each dorsal interosseus: base of the proximal phalanx of either the second, third, or fourth digit

Actions

The sum of the actions of dorsal interossei is said to be abduction of the toes, which is the movements of the digits away from the midline of the foot, defined as the second digit. In reality, each interosseus muscle moves a single digit either medially or laterally. One muscle moves the fourth digit laterally, one moves the third digit laterally, one moves the second digit medially, and one moves the second digit laterally.

Explanation of Actions

Each interosseus muscle is located on one particular side (either the medial or lateral side) of the proximal phalanx it moves, and it inserts into that same side of the proximal phalanx. The three interossei located on the lateral side of digits 2, 3, and 4 pull the proximal phalanges of those digits laterally, and the interosseus muscle that is located on the medial side of the proximal phalanx of digit 2 pulls the proximal phalanx of digit 2 medially.

Notable Muscle Facts

“DAB” is a useful acronym for remembering that the Dorsal interossei ABduct the toes.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Limited ability to adduct the toes is noted.

Lengthened: Limited ability to abduct the toes is noted.

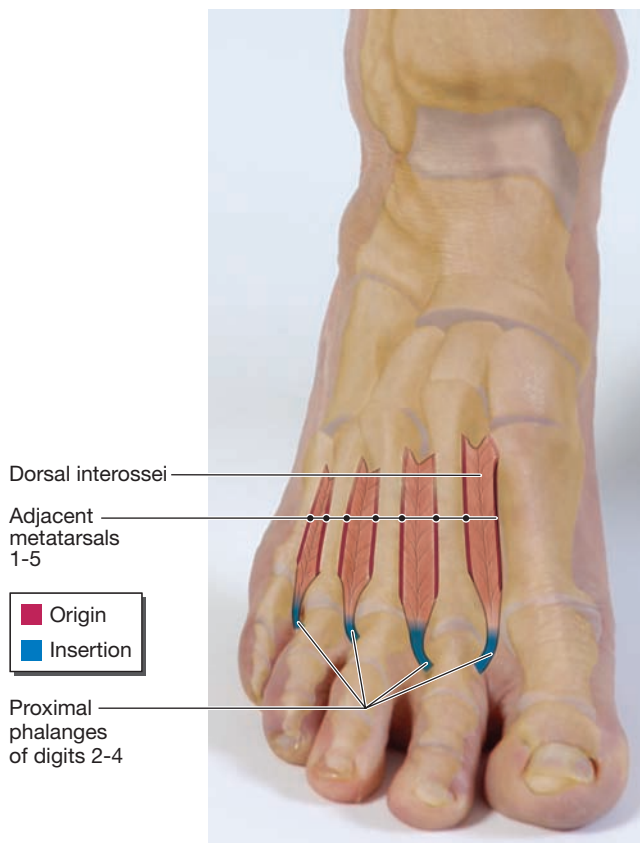


FIGURE 5-54 • Dorsal interossei

Palpation and Massage

Palpating and frictioning deep between the metatarsals on the dorsal side of the foot will find and address dorsal interossei.

How to Stretch This Muscle

Adduct the toes.

Synergists

There are no other abductors of digits 2, 3, and 4 of the foot.

Antagonists

Plantar interossei (adducts the toes)

Innervation and Arterial Supply

Innervation: lateral plantar nerve

Arterial supply: branches of the plantar arch

PLANTAR INTEROSSEI (plan-tar in-ter-ahs-e-i)

Meaning of Name

Plantar refers to the plantar side of the foot, and *interossei* means between bones. In this case, the bones of reference are the metatarsals.

Location

The plantar interossei are located on the plantar side of the foot, deep between the metatarsals. They are part of the fourth and deepest layer of intrinsic foot muscles.

Origin and Insertion

Origin: metatarsals 3, 4, and 5

Insertion: plantar sides of the proximal phalanges of digits 3, 4, and 5

Actions

As a group, the plantar interossei adduct the toes. Individually, each plantar interosseus moves either the third, fourth, or fifth digit toward the second digit, which is the midline of the foot.

Explanation of Actions

One plantar interosseus muscle originates on the medial side of the third metatarsal. This interosseus muscle inserts on the medial side of the proximal phalanx of the third digit. When the muscle shortens, it pulls the proximal phalanx of the second digit medially. The plantar interosseus muscle that originates on the medial side of the fourth metatarsal inserts on the medial side of the proximal phalanx of the fourth digit. Thus, when it shortens, it pulls the proximal phalanx of the fourth digit medially. The plantar interosseus muscle that originates on the medial side of the fifth metatarsal inserts on the medial side of the proximal phalanx of the fifth digit, and thus pulls the fifth digit medially when it shortens. The combined movements of the three interosseus muscles is to bring digits 3, 4, and 5 closer to digit 2, which is the same as adducting the toes.

Notable Muscle Facts

“PAD” is a useful acronym to remember: the Plantar interossei ADduct the toes.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Limited ability to abduct the toes is noted.

Lengthened: Limited ability to adduct the toes is noted.

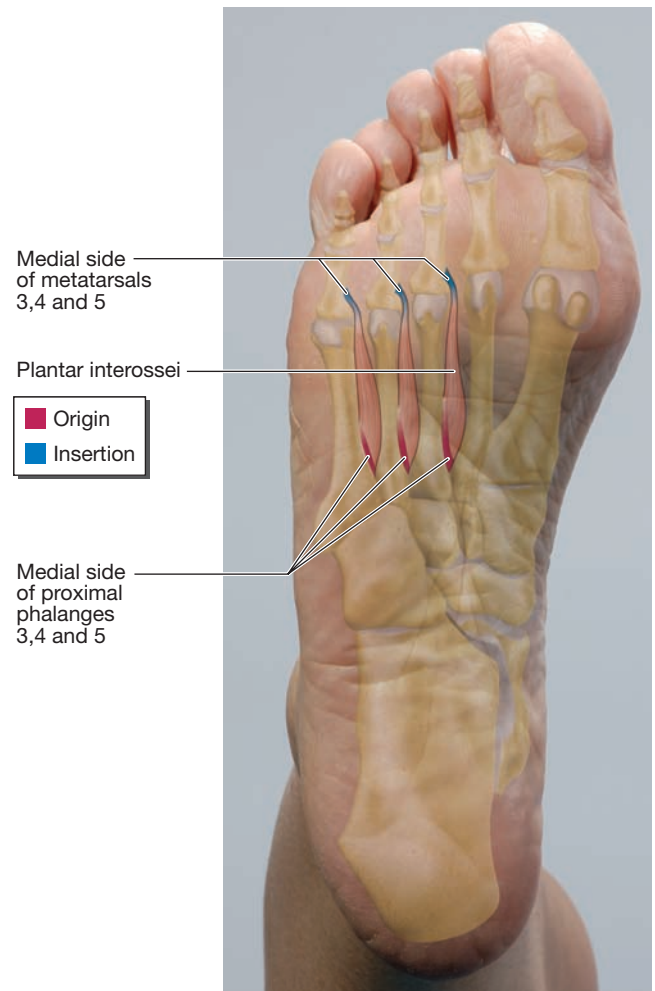


FIGURE 5-55 • Plantar interossei

Palpation and Massage

Palpating and providing friction to the plantar side of the foot, deep between the metatarsals, allows us to access and massage the plantar interossei.

How to Stretch This Muscle

Abduct the toes.

Synergists

There are no other adductors of digits 3, 4, and 5 of the foot.

Antagonists

Dorsal interossei (abducts the toes)

Innervation and Arterial Supply

Innervation: lateral plantar nerve

Arterial supply: branches of the plantar arch

LAYER 3 INTRINSIC FOOT MUSCLES

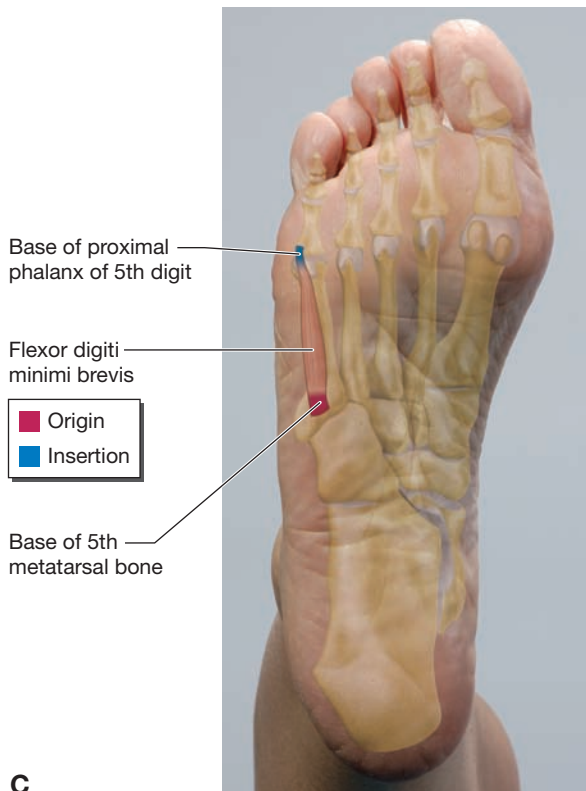
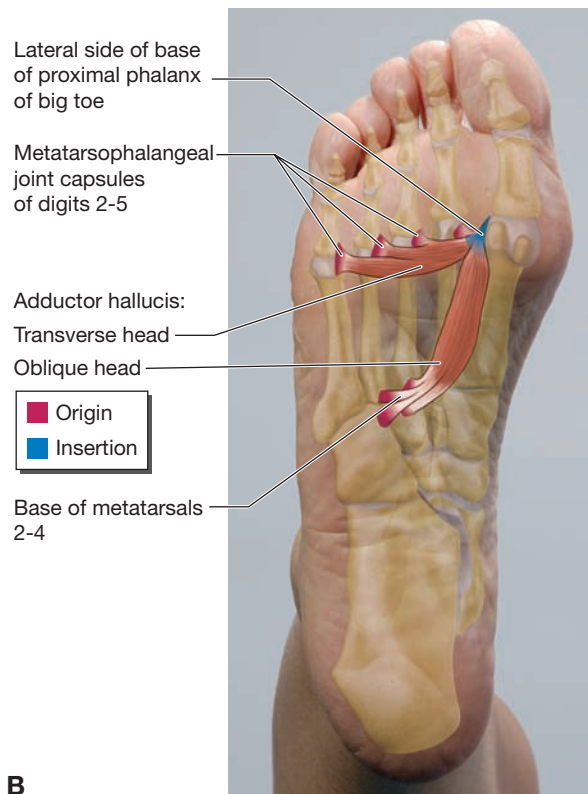
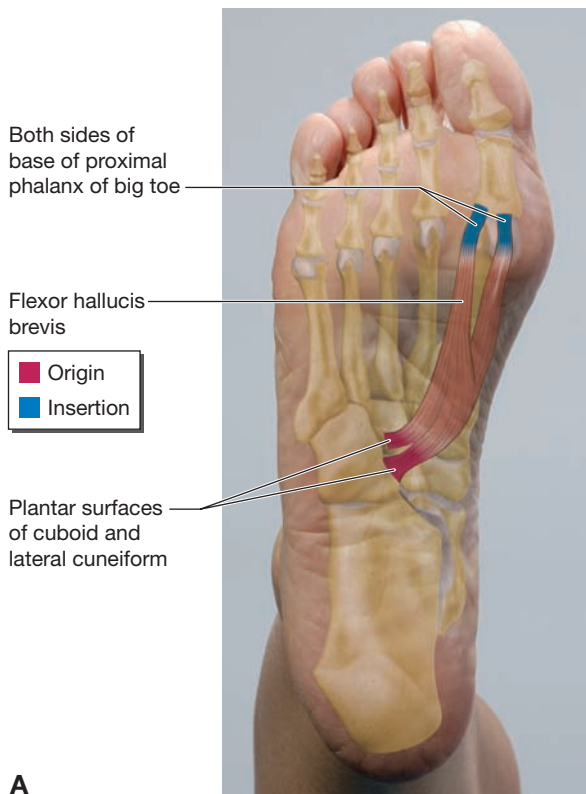


FIGURE 5-56 • Layer 3 intrinsic foot muscles **A:** Flexor hallucis brevis; **B:** Adductor hallucis; **C:** Flexor digiti minimi brevis.

FLEXOR HALLUCIS BREVIS (fleks-or hal-u-sis bre-vis)

Meaning of Name

Flexor refers to the action of flexion. *Hallucis* refers to the big toe. The word *brevis* informs us that this muscle is shorter than flexor hallucis longus.

Location

Flexor hallucis brevis is a third-layer intrinsic foot muscle, located on the plantar surface of the foot and covering the first metatarsal.

Origin and Insertion

Origin: plantar surfaces of the cuboid and the lateral cuneiform

Insertion: both sides of the base of the proximal phalanx of the big toe

Actions

Flexes the MP joint of the big toe at the MP joint

Explanation of Actions

Because the muscle crosses the plantar side of the MP joint, and because the insertion on the plantar surface of the proximal phalanx of the big toe is pulled toward the origin on the plantar surface of the cuboid and lateral cuneiform, flexion of the big toe results.

Notable Muscle Facts

There are two tendons of insertion of flexor hallucis brevis, each of which contains a sesamoid bone.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Limited ability to extend the MP joint of the great toe is noted.

Lengthened: Limited ability to flex the MP joint of the great toe is noted.

Palpation and Massage

This muscle can be palpated on the plantar side of the first metatarsal. Direct pressure and friction are appropriate strokes to apply to this muscle.

How to Stretch This Muscle

Extend the MP joint of the big toe.

Synergists

Flexor hallucis longus (flexes the big toe)

Antagonists

Extensor hallucis longus and brevis (extend the big toe)

Innervation and Arterial Supply

Innervation: medial plantar nerve

Arterial supply: medial plantar artery

ADDUCTOR HALLUCIS (a-duk-tor hal-u-sis)

Meaning of Name

Adductor refers to the action of adduction, and *hallucis* refers to the big toe.

Location

Adductor hallucis is a third-layer intrinsic foot muscle, located on the plantar surface of the foot. It covers the MP joint capsules and much of the second and third metatarsals of the foot (see Fig. 5-57).

Origin and Insertion

Origin of the oblique head: base of metatarsals 2–4

Origin of the transverse head: joint capsules of the MP joints

Insertion: lateral side of the base of the proximal phalanx of the big toe

Actions

Adducts and flexes the big toe at the MP joint

Explanation of Actions

Because the origin is medial to the insertion, and because adductor hallucis crosses the MP joints on the plantar surface of the foot, this muscle adducts the big toe. Because the origin is proximal to the insertion, and the muscle crosses the plantar surface of the big toe, adductor hallucis also flexes the big toe.

Notable Muscle Facts

Adductor hallucis helps to support the transverse arch of the foot. Adductor hallucis is similar to adductor pollicis in that both muscles have a transverse head and an oblique head.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Inability to abduct the great toe is noted.

Lengthened: Limited ability to adduct the bit toe.

Palpation and Massage

Adductor hallucis may be palpated on the plantar surface of the foot, focusing on the areas of the MP joint capsules and metatarsals 2 and 3. Friction and direct pressure are appropriate strokes for this muscle.

How to Stretch This Muscle

Abduct the big toe.

Synergists

There are no other major adductors of the big toe.

Antagonists

Abductor hallucis (abducts the big toe)

Innervation and Arterial Supply

Innervation: lateral plantar nerve

Arterial supply: branches of the planter arch

FLEXOR DIGITI MINIMI BREVIS (flexs-or dij-i-ti min-i-mi bre-vis)

Meaning of Name

Flexor refers to the action of flexion. *Digiti minimi* refers to the smallest digit, the fifth digit. *Brevis* indicates that the digiti minimi of the foot is smaller than that of the hand. Not all sources include the word *brevis* in this muscle's name.

Location

Flexor digiti minimi brevis is a third-layer intrinsic foot muscle, located on the plantar surface of the foot. It covers the fifth metatarsal of the foot (see Fig. 5-57).

Origin and Insertion

Origin: base of the fifth metatarsal

Insertion: base of the proximal phalanx of the fifth digit

Actions

Flexes the fifth digit of the foot at the MP joint

Explanation of Actions

Flexor digiti minimi brevis crosses the plantar surface of the MP joint of the fifth digit, with its origin more proximal than insertion. Thus, the plantar surface of the proximal phalanx is pulled toward the fifth metatarsal. The result is flexion of the fifth digit.

Notable Muscle Facts

It is unusual that this muscle name includes the word “brevis,” as muscles with “brevis” are typically paired with muscles with the word “longus,” and there is no flexor digiti minimi longus in the foot.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Limited ability to extend the MP joint of the fifth digit is noted.

Lengthened: Limited ability to flex the MP joint of the fifth digit is noted.

Palpation and Massage

Flexor digiti minimi brevis can be palpated and massaged by applying direct pressure or friction to the muscle on the plantar surface of the fifth digit.

How to Stretch This Muscle

Extend the fifth digit of the foot.

Synergists

Flexor digitorum longus and flexor digitorum brevis (flex the MP joint of the fifth digit)

Antagonists

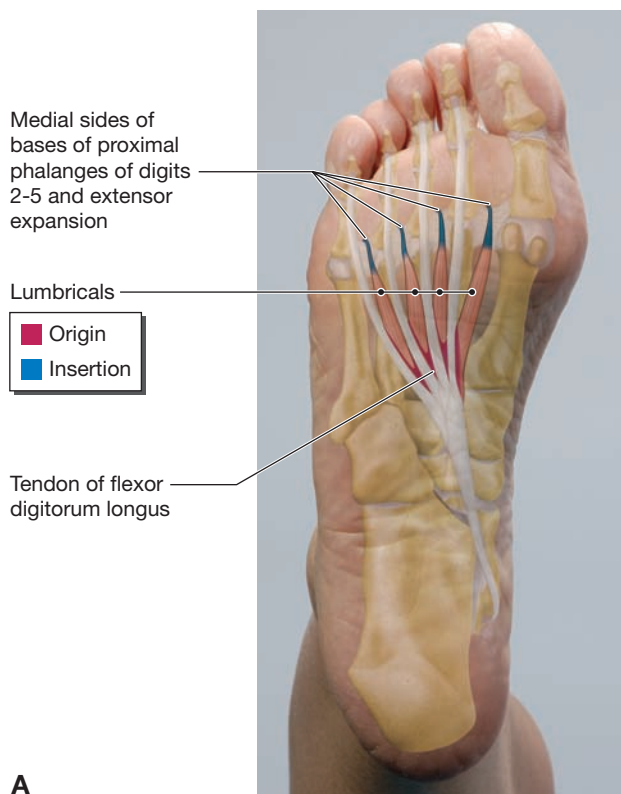
Extensor digitorum longus and extensor digitorum brevis (extend the fifth digit of the foot at the MP joint)

Innervation and Arterial Supply

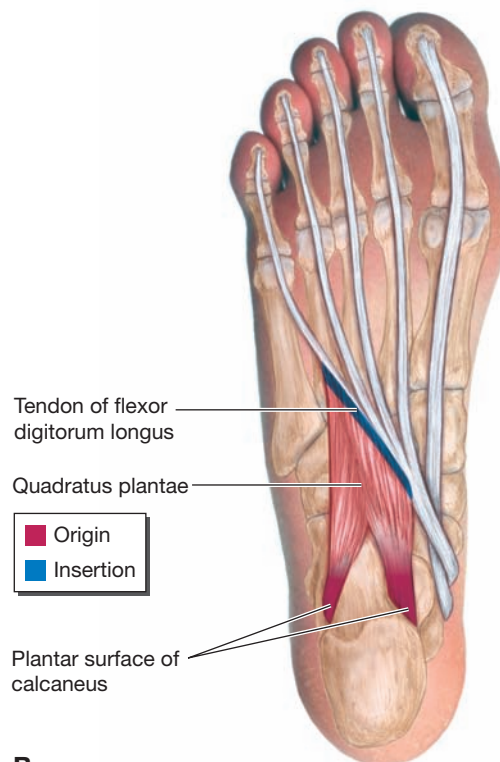
Innervation: lateral plantar nerve

Arterial supply: lateral plantar artery

LUMBRICALS (lum-bri-kals)



A



B

FIGURE 5-57 • Layer 2 intrinsic foot muscles. **A:** Lumbricals **B:** Quadratus plantae

Meaning of Name

Earthworms

Location

Lumbricals are located quite centrally on the plantar surface of the foot. They are part of the second layer of intrinsic foot muscles.

Origin and Insertion

Origin: tendon of origin of flexor digitorum longus

Insertion: plantar aspect of the proximal phalanges of digits 2–5 and the extensor expansion, which covers the dorsal surface of the toes

Actions

Flex the MP joints of digits 2–5 and extend the proximal interphalangeal (PIP) and distal interphalangeal (DIP) joints of digits 2–5

Explanation of Actions

Lumbricals flex the MP joints of the four lateral toes because the tendons of origin cross the plantar aspect of these joints, with origin more proximal to insertion. Lumbricals extend the DIP and PIP joints of digits 2–5 because they pull on the extensor expansion, which pulls the dorsal sides of the toes toward the dorsal side of the foot.

Notable Muscle Facts

Lumbrical muscles in the hand have the same actions as the lumbricals of the foot. However, the lumbricals of the hand typically have greater mobility. Lumbricals in the foot add stability to the distal joints of the foot.

Implications of Shortened and/or Lengthened/ Weak Muscle

There are no common or obvious implications of shortened or lengthened lumbrical muscles.

Palpation and Massage

Lumbricals can be palpated and massaged by providing direct pressure or friction to the central area on the plantar side of the foot.

How to Stretch This Muscle

Extend the MP joints of digits 2–5 of the foot while flexing the DIP joints and PIP joints of the same digits.

Synergists

Flexor digitorum longus and flexor digitorum brevis (flex the MP joints of the four lateral toes) and extensor digitorum (extends the PIP and DIP joints of these digits)

Antagonists

Extensor digitorum longus and extensor digitorum brevis (extend the MP joints of the four lateral toes) and flexor digitorum longus (flexes the PIP and DIP joints of these digits)

Innervation and Arterial Supply

Innervation: medial and lateral plantar nerves

Arterial supply: medial and lateral plantar arteries

QUADRATUS PLANTAE (kwah-drat-us plan-te)

Meaning of Name

Quadratus refers to square, which is the shape of this muscle. *Plantae* refers to the fact that this muscle is located on the plantar surface of the foot (see Fig. 5-58).

Location

Quadratus plantae is located on the proximal or posterior third of the plantar surface of the foot. This muscle is part of the second layer of intrinsic foot muscles.

Origin and Insertion

Origin: calcaneus

Insertion: tendon of insertion of flexor digitorum longus

Actions

Quadratus plantae assists flexor digitorum longus in flexing the four lateral toes by providing additional pull on the flexor digitorum longus' tendon of insertion and by adjusting the angle of pull on this tendon to make it more efficient.

Explanation of Actions

By anchoring on the calcaneus and by pulling the tendon of flexor digitorum longus directly toward the calcaneus, quadratus plantae helps to flex the toes.

Notable Muscle Facts

Quadratus plantae's ability to flex the four lateral toes is especially important when the ankle is dorsiflexed, as such an ankle position decreases the strength of flexor digitorum longus.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Tension is felt in the heel area.

Lengthened: Reduced ability to flex the four lateral toes is noted, particularly when the ankle is dorsiflexed.

Palpation and Massage

Quadratus plantae can be palpated and massaged by applying friction and direct pressure to the plantar surface of the calcaneus.

How to Stretch This Muscle

Extend the four lateral toes.

Synergists

Toe flexors: flexor digitorum longus and flexor digitorum brevis

Antagonists

Toe extensors: extensor digitorum longus and extensor digitorum brevis

Innervation and Arterial Supply

Innervation: lateral plantar nerve

Arterial supply: medial and lateral plantar arteries

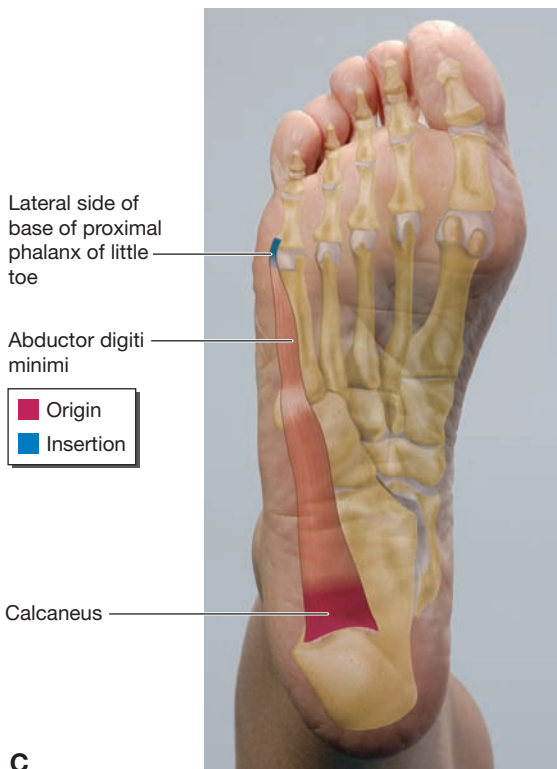
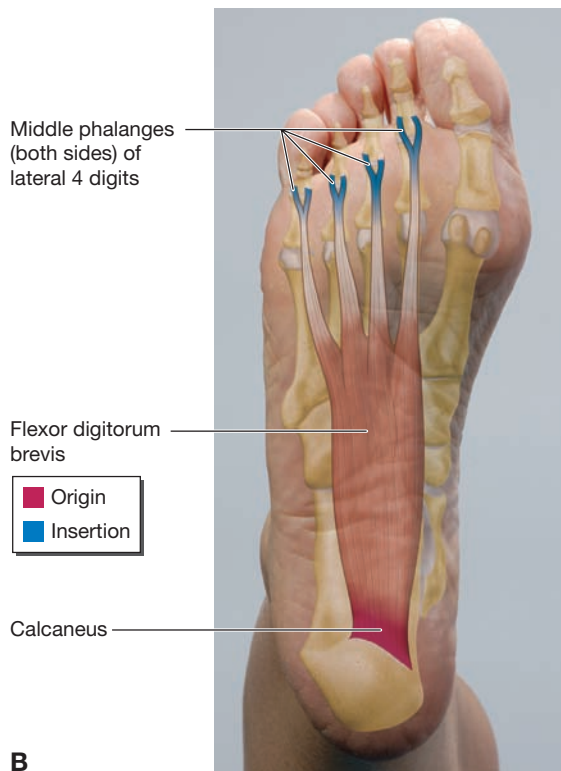
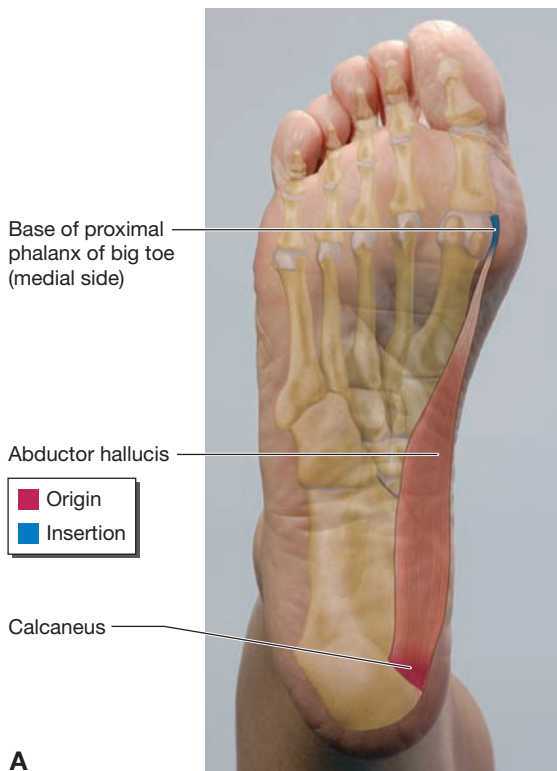


FIGURE 5-58 • Layer 1 intrinsic foot muscles. A: Abductor hallucis; **B:** Flexor digitorum brevis; **C:** Abductor digiti minimi

ABDUCTOR HALLUCIS (ab-duk-ter hal-u-sis)

Meaning of Name

Abduction refers to the action of abduction, and *hallucis* refers to the big toe.

Location

Abductor hallucis is located on the medial side of the plantar surface of the foot. It is a first-layer intrinsic foot muscle. The muscular portion lies between the calcaneus and the medial cuneiform.

Origin and Insertion

Origin: tuberosity of the calcaneus

Insertion: medial side of the base of the proximal phalanx of the big toe

Actions

Abducts and flexes the big toe

Explanation of Actions

Because abductor hallucis attaches to the medial side of the proximal phalanx of the big toe and because the origin is proximal to the insertion, the muscle has the leverage to pull the proximal phalanx of the big toe medially, thus causing abduction. Because the origin is proximal to the insertion, abductor hallucis flexes the MP joint of the big toe.

Notable Muscle Facts

Abductor hallucis supports the medial longitudinal arch. This muscle is a stronger flexor than abductor of the MP joint of the big toe.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Limited ability to adduct and/or extend the big toe is noted.

Lengthened: When abductor hallucis is weak or overlengthened, one can experience difficulty abducting the big toe fully.

Palpation and Massage

Abductor hallucis can be palpated and massaged by applying friction and direct pressure to the medial side of the calcaneus.

How to Stretch This Muscle

Adduct and extend digit one of the foot.

Synergists

There is no other major abductor of the great toe.

Antagonists

Adductor hallucis (adducts the big toe)

Innervation and Arterial Supply

Innervation: medial plantar nerve

Arterial supply: medial and plantar artery

FLEXOR DIGITORUM BREVIS (fleks-or dij-i-to-rum bre-vis)

Meaning of Name

Flexor refers to the action of flexion. *Digitorum* tells us that this muscle acts upon the four digits, in this case the four lateral toes. Also, *brevis* tells us that the flexor digitorum brevis is shorter than the flexor digitorum longus.

Location

Flexor digitorum brevis is located on the plantar surface of the foot, from the calcaneus to the PIP joints of the four lateral toes (see Fig. 5-59). It is a first-layer intrinsic foot muscle.

Origin and Insertion

Origin: tuberosity of the calcaneus

Insertion: medial and lateral sides of the proximal phalanges of digits 2–5

Actions

Flexes digits 2–5 of the foot at the PIP joints

Explanation of Actions

Because flexor digitorum brevis crosses the plantar side of the PIP joints of the four lateral toes, and because its origin is proximal to the insertion, the plantar sides of the middle phalanges are pulled toward the plantar side of the foot. The result is toe flexion at the PIP joints.

Notable Muscle Facts

Flexor digitorum brevis helps to stabilize the longitudinal arch. The tendons of insertion of flexor digitorum brevis can

be compared to the tendons of insertion of flexor digitorum superficialis (located in the hand), as both split to create a tunnel for a deeper tendon to pass beneath.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Limited ability to extend the PIP joints of the four lateral toes is noted.

Lengthened: A weak or overlengthened flexor digitorum brevis will weaken the action of toe flexion at the PIP joints.

Palpation and Massage

Flexor digitorum brevis can be palpated and massaged by applying direct pressure and friction to the plantar surface of the foot from the calcaneus to the MP joints.

How to Stretch This Muscle

Extend the four lateral toes.

Synergists

Flexor digitorum longus (flexes four lateral toes)

Antagonists

Extensor digitorum longus (extends PIP joints of the four lateral toes)

Innervation and Arterial Supply

Innervation: medial plantar nerve

Arterial supply: medial and lateral plantar arteries

ABDUCTOR DIGITI MINIMI (ab-duk-ter dij-i-ti min-i-mi)

Meaning of Name

Abduction refers to the action of abduction, and *digiti minimi* refers to the smallest digit, in this case the fifth digit of the foot.

Location

Abductor digiti minimi is located on the lateral side of the plantar surface of the foot, from the calcaneus to the MP joint of the fifth digit (see Fig. 5-59). It is a first-layer intrinsic foot muscle.

Origin and Insertion

Origin: tuberosity of the calcaneus

Insertion: lateral side of the base of the proximal phalanx of the fifth digit of the foot

Actions

Abducts the fifth digit of the foot

Explanation of Actions

Because abductor digiti minimi inserts on the lateral aspect of the proximal phalanx of the fifth digit, and because the origin is proximal to this insertion, the muscle pulls the proximal phalanx of the fifth digit laterally, thus causing abduction of the smallest toe.

Notable Muscle Facts

Abductor digiti minimi helps stabilize the lateral portion of the longitudinal arch.

Implications of Shortened and/or Lengthened/ Weak Muscle

Shortened: Limited ability to adduct the fifth digit is noted.

Lengthened: Limited ability to abduct the fifth digit is noted.

Palpation and Massage

Abductor digiti minimi can be palpated and massaged by applying direct pressure and friction to the lateral plantar aspect of the foot.

How to Stretch This Muscle

Adduct the fifth digit of the foot.

Synergists

There is no other muscle that abducts the fifth digit of the foot.

Antagonists

Plantar interossei

Innervation and Arterial Supply

Innervation: lateral plantar nerve

Arterial supply: lateral plantar artery

Regional Illustrations of Muscles

Figure 5-59 shows the muscle attachment sites on bones of the pelvis, thigh & knee.

Figure 5-60 shows the muscle attachment sites on anterior pelvis, thigh, leg and dorsal side of foot.

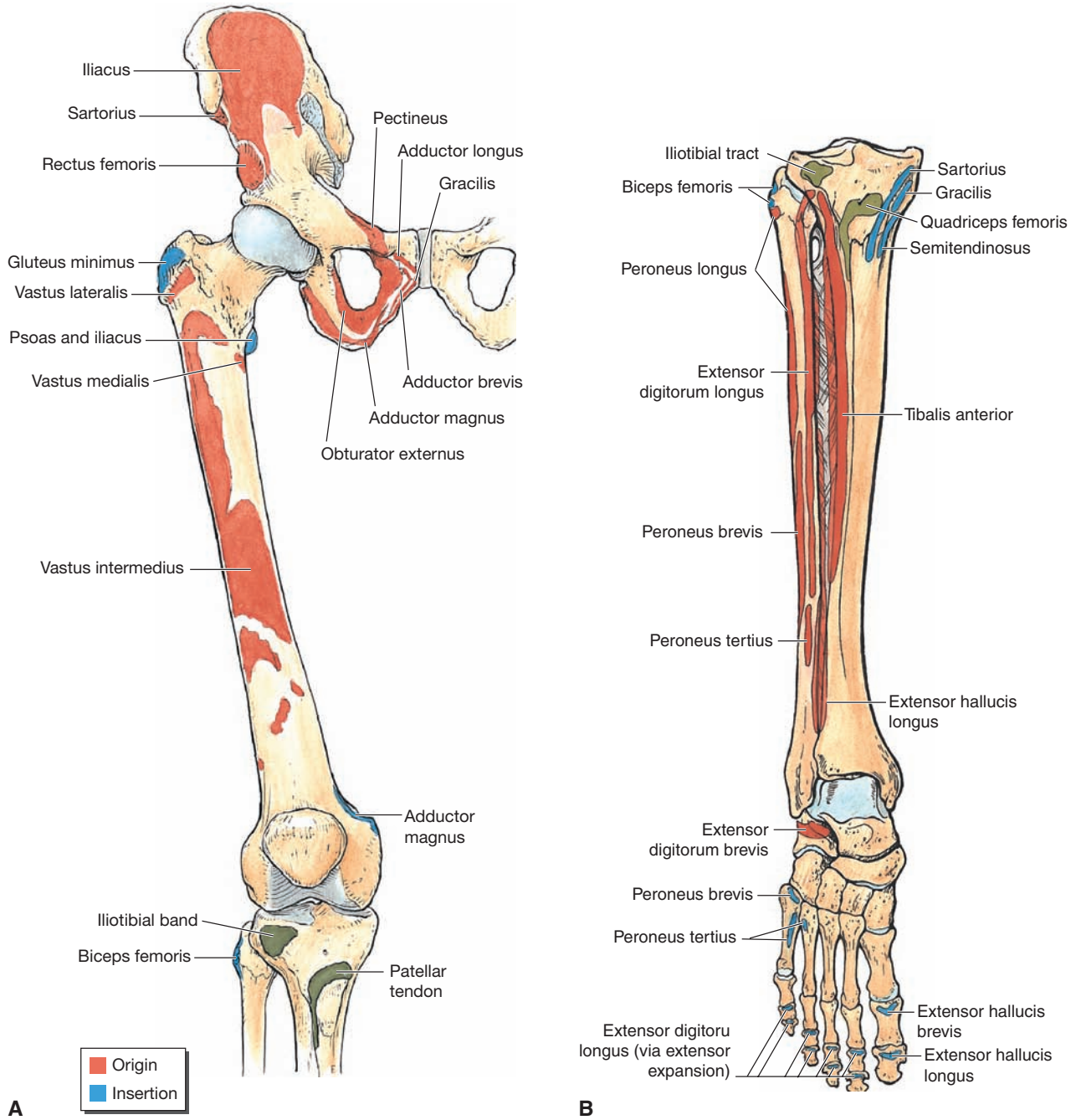


FIGURE 5-59 • Muscle attachment sites on bones of the pelvis, thigh, and knee. **A:** Anterior view of thigh; **B:** Anterior view of leg and dorsal side of foot.

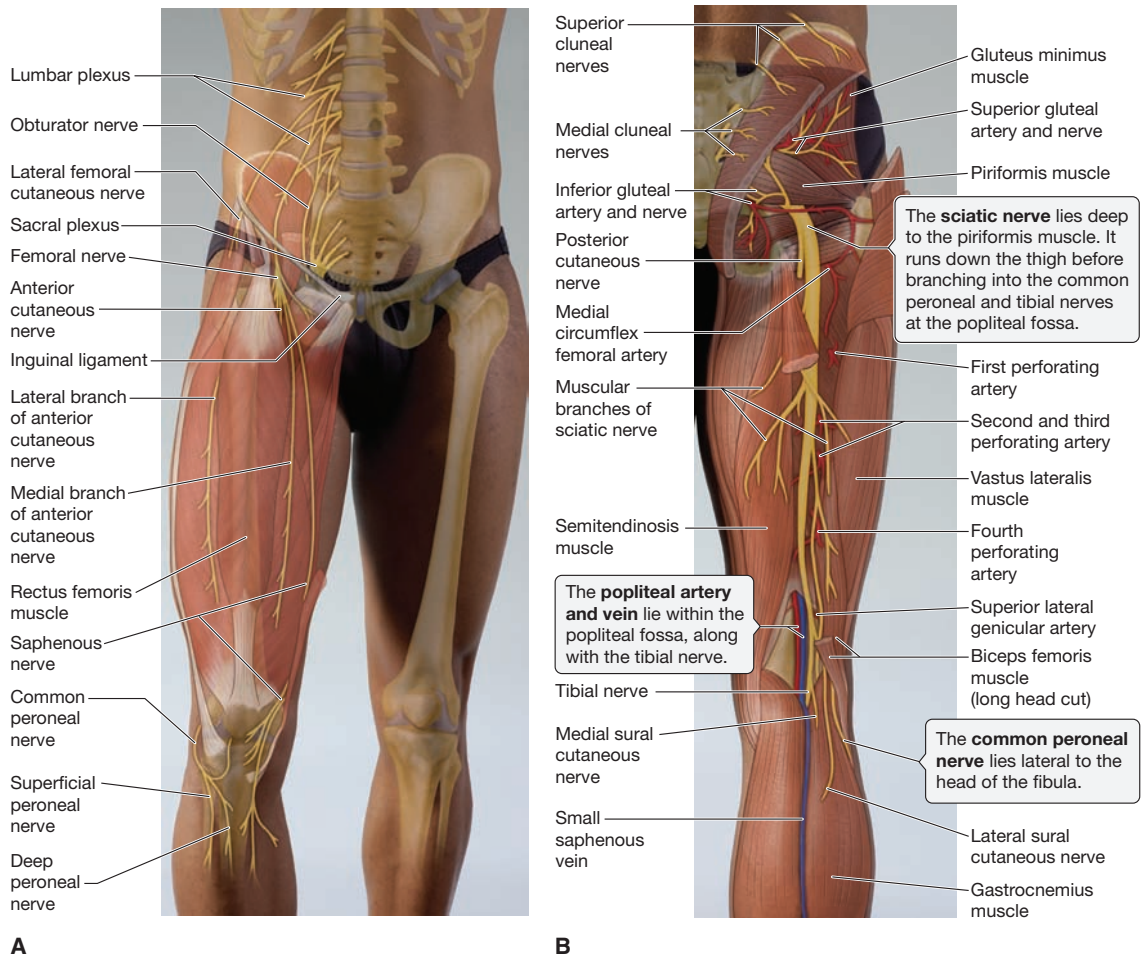


FIGURE 5-60 • Nerves that serve the lower extremity **A**: Anterior thigh; **B**: Posterior thigh (continued)

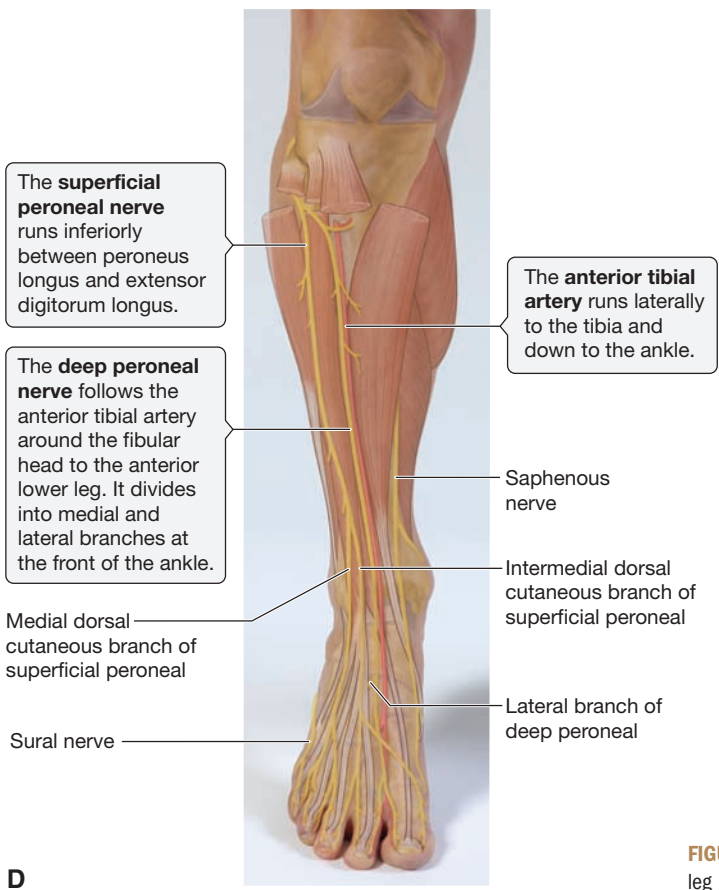
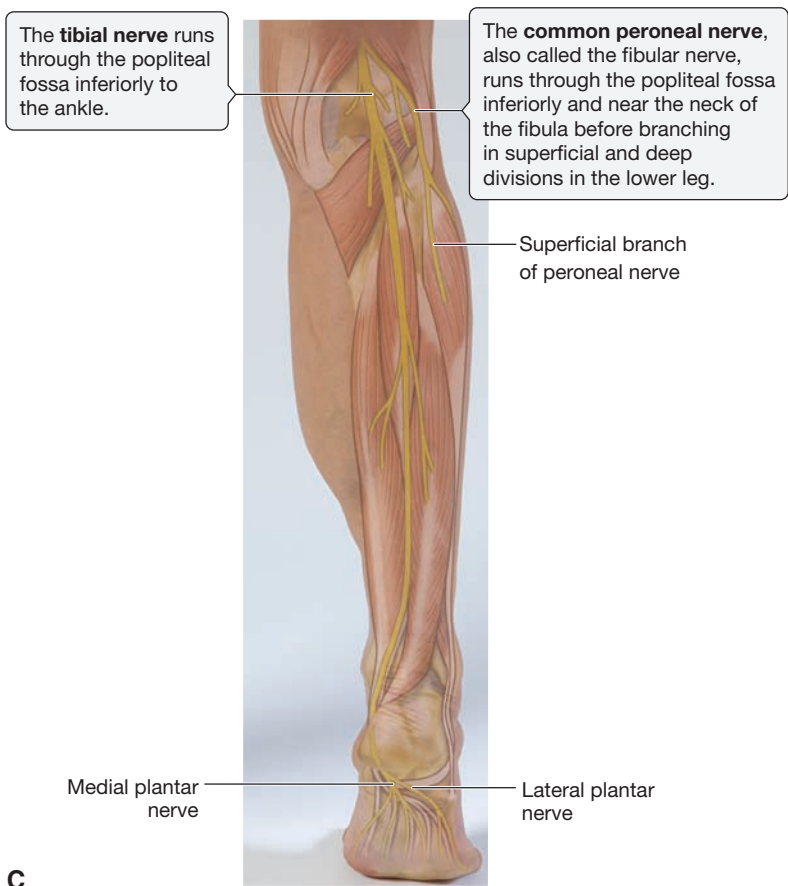


FIGURE 5-60 • C: Posterior leg; D: Anterior leg

ILLUSTRATIONS OF NERVE SUPPLY AND ARTERIAL SUPPLY TO LOWER LIMB

Figure 5-61 shows both arterial supply and veins of the lower limb

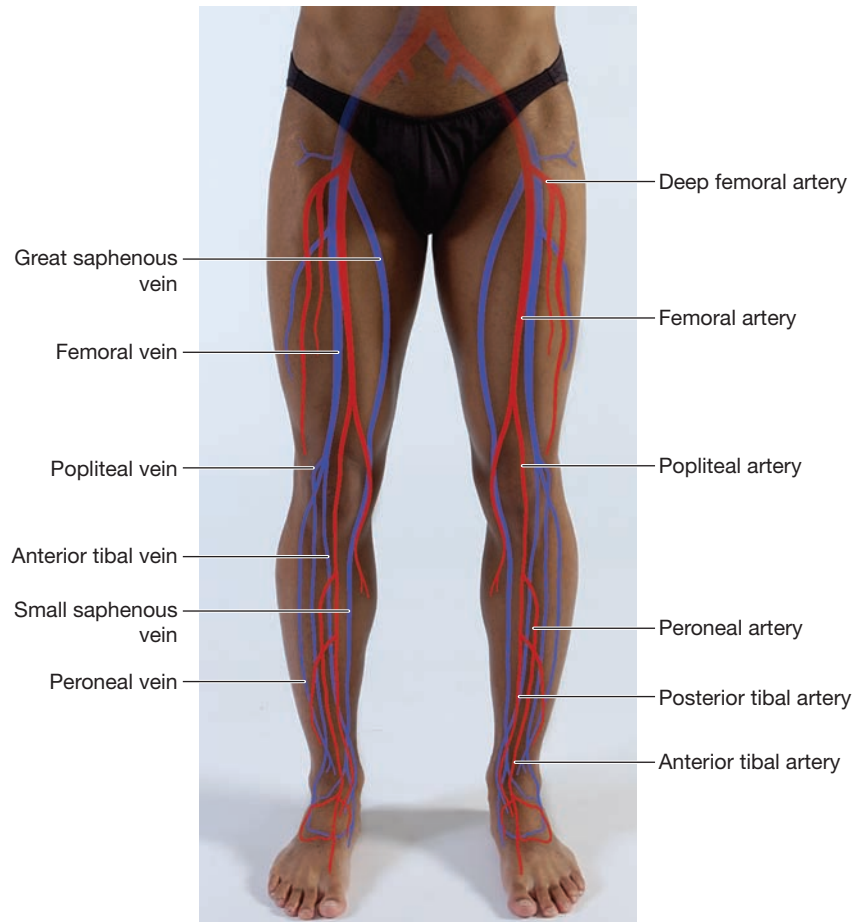


FIGURE 5-61 · Vessels of the lower limb.

■ CHAPTER SUMMARY

This chapter has provided you with much information about the bones and joints of the lower extremity and the muscles that move the hip, knee, ankle, foot, and toes.

Memorizing the names, locations, and actions of the muscles covered is important. However, a true understanding of

how these muscles affect our posture and our ability to move is essential to use this information to guide our massage therapy treatments to best assist our clients.

■ WORKBOOK

Muscle Drawing Exercises

PIRIFORMIS AND THE OTHER DEEP LATERAL ROTATORS OF THE HIP



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

ADDUCTOR MAGNUS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

ADDUCTOR LONGUS AND BREVIS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

PECTINEUS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

GRACILIS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

GLUTEUS MINIMUS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

GLUTEUS MEDIUS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

TENSOR FASCIA LATAE



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

GLUTEUS MAXIMUS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

HAMSTRINGS: SEMIMEMBRANOSUS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

HAMSTRINGS: SEMITENDINOSUS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

HAMSTRINGS: BICEPS FEMORIS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

ILIOPSOAS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

QUADRICEPS GROUP: VASTUS INTERMEDIUS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

QUADRICEPS GROUP: VASTUS MEDIALIS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

QUADRICEPS GROUP: VASTUS LATERALIS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

QUADRICEPS GROUP: RECTUS FEMORIS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

SARTORIUS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

POPLITEUS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

PLANTARIS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

GASTROCNEMIUS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

SOLEUS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

TIBIALIS POSTERIOR



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

FLEXOR DIGITORUM LONGUS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

FLEXOR HALLUCIS LONGUS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

PERONEUS LONGUS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

PERONEUS BREVIS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

PERONEUS TERTIUS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

EXTENSOR DIGITORUM LONGUS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

EXTENSOR HALLUCIS LONGUS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

TIBIALIS ANTERIOR



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

DORSAL INTEROSSEI



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

PLANTAR INTEROSSEI



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

FLEXOR HALLUCIS BREVIS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

ADDUCTOR HALLUCIS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

FLEXOR DIGITI MINIMI BREVIS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

LUMBRICALS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

QUADRATUS PLANTAE



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

ABDUCTOR HALLUCIS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

FLEXOR DIGITORUM BREVIS



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

ABDUCTOR DIGITI MINIMI



ORIGIN: _____

INSERTION: _____

ACTION(S): _____

NERVE: _____

ARTERIAL SUPPLY: _____

LOCATION AND/OR HOW TO PALPATE:

WHEN MUSCLE IS SHORTENED:

WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

NOTES: _____

Palpation Exercises

Palpation of the muscles is important to reinforce their locations and to prepare for the application of muscle knowledge to massage therapy settings.

Palpation Exercise #1

This palpation exercise will require you to palpate the six deep lateral rotators of the hip and the hip adductors.

1. **Piriformis:** Have your partner lie prone, and find the greater sciatic notch. You can get a close idea of where the greater sciatic notch is located by bringing your partner's heel to his or her buttocks. The area where the heel contacts the buttocks will be the general location. To locate piriformis very specifically, find the PSIS, move about 2 inches inferiorly, and begin to press in through the thick gluteus maximus muscle, working your way laterally toward the greater trochanter. Piriformis lies between the greater sciatic notch and the greater trochanter. You can tell that you have found piriformis when you feel a thin strip of dense tissue, deep to gluteus maximus. What does this muscle have to do with sciatica?
2. The other lateral rotators in the group of the six all run from the ischium and obturator foramen toward the greater trochanter. Their names are the gemellus inferior and superior, obturator internus and externus, and quadratus femoris. Palpate this general area. The individual muscles are difficult to isolate.
3. **Adductors of the thigh:** Have your partner lie supine. Ask your partner to adduct the thigh against resistance by placing your hand on the medial thigh just proximal to the knee and asking your partner to press his or her thigh into your hand. Can you feel the adductors tighten? Remind yourself of the names of all five adductors, and note their basic locations, beginning with adductor magnus, the deepest and largest thigh adductor, which inserts quite distally on the linea aspera of the femur. Recall adductor longus and brevis, which lie more proximal in the medial thigh. Recall that pectineus is located within the femoral triangle and that this is an endangerment site. Finally, end by reviewing gracilis, the slender, most medial and superficial muscle of the thigh. The proximal attachments of the hip adductor muscles are in a sensitive area, as they are so close to the genitals. It is possible to instruct your client to perform friction to the tendons of origin of the adductors (near the pubis) as homework, rather than working in that area yourself, as it may not be appropriate for you to address this area.

Recall the insertion of gracilis? What actions, other than adduction, can pectineus and gracilis perform?

Review

List three everyday actions you do that involve adduction of the femur:

1. _____
2. _____
3. _____

List three everyday actions you do that involve lateral rotation of the hip:

1. _____
2. _____
3. _____

Palpation Exercise #2

This palpation exercise will require you to palpate the gluteus muscles and tensor fascia latae.

1. **Gluteus medius and gluteus minimus:** Palpate gluteus medius. Have your partner in a supine position. Palpate just inferior to the iliac crest from just posterior to the ASIS over to the PSIS. Find the greater trochanter. Gluteus medius is a triangular-shaped muscle that lies between the iliac crest and the greater trochanter. Pressing right into the external surface of the ilium allows us to apply friction and direct pressure to these muscles with ease. All of gluteus minimus is deep to gluteus medius, and much of gluteus medius is deep to gluteus maximus. Find the small section of gluteus medius (just inferior to the anterior iliac crest) that is superficial. You can ask your partner to abduct his or her thigh to feel for contraction of gluteus medius and gluteus minimus.
2. **Gluteus maximus:** Have your partner lie prone. Find the lateral border of the sacrum and the posterior iliac crest. You have found most of the origin of gluteus maximus. Gluteus maximus inserts into the IT band and the gluteal tuberosity on the proximal, posterior femur. Gluteus maximus is entirely superficial and thus easy to palpate and massage. It is a thick, strong muscle and other than the quadriceps group, is the largest muscle in the body.
3. **Tensor fascia latae:** Have your partner lie supine. Find the iliac crest just posterior to the ASIS. TFL is located between this portion of the iliac crest and the IT band. If your partner has a tight TFL, it is probably a good idea to massage the IT band.

Palpation Exercise #3

This palpation exercise will require you to palpate the hamstrings and their related bone markings.

Bones/Bony Landmarks

1. **Ischial tuberosity:** Find this bone marking on the inferior ischium. It is sometimes called the "sits" bone, as we sit on our ischial tuberosities.
2. **Pes anserinus:** Revisit this flat area on the proximal, anterior, medial tibia.
3. **Head of fibula:** Find this rounded bone marking on the most proximal aspect of the fibula.
4. **Proximal, posterior, medial tibia:** Look for the insertion spot of semimembranosus. Can you feel the tendon of insertion, deep and just medial to the tendon of semitendinosus in the medial posterior knee area? Can you trace the tendon as it approaches its spot of insertion on the tibia?

Muscles

1. **Semimembranosus and semitendinosus:** Palpate the medial posterior thigh. Offer these muscles a nice pétrissage massage. Remember that semimembranosus is deep to semitendinosus. Semitendinosus inserts at pes anserinus.
2. **Biceps femoris:** Palpate the lateral aspect of the posterior thigh. This muscle runs from the ischial tuberosity to the head of the fibula.
3. After you have massaged your partner's hamstrings, have him or her turn over into a supine position and stretch the hamstrings. Why must the knee be extended (at least somewhat) to stretch the hamstrings? Make sure you check in with your partner, so you do not stretch the muscles too far.

Palpation Exercise #4

This palpation exercise will require you to palpate the iliopsoas, the quads, and related bone markings.

Bones/Bony Landmarks

1. **Lesser trochanter:** Note the location of the lesser trochanter on the proximal, medial femur. Why is this bone marking not palpable?
2. **ASIS and AIIS:** Once again, palpate the ASIS. Recall that the AIIS is inferior to the ASIS, but not easily palpable due to the inward curve of the ilium between the ASIS and AIIS, as well as the soft tissue in this area. But note the location of this bone marking, even though you cannot actually feel it.
3. **Linea aspera:** Recall the rough line that runs almost the entire length of the posterior femur. This bone marking is impossible to palpate, as it is covered by the hamstring muscles, most notably biceps femoris.
4. **Tibial tuberosity:** Find the patella and move directly distal about an inch or an inch and a half. Feel for the rough bump that is the tibial tuberosity. The quadriceps muscles insert here.
5. **Pes anserinus:** Revisit this flat area on the proximal, anterior, medial tibia once more. Look at the colored illustration of origin and insertion sites earlier in this chapter. Find the area indicating insertions of gracilis, semitendinosus, and sartorius. Palpate this relatively flat area on the medial, proximal anterior tibia.

Muscles

1. **Psoas major:** Work with your partner in a supine position. The psoas major originates on the transverse processes and bodies of the lumbar vertebrae and T12. It inserts on the lesser trochanter. Psoas major is deep to abdominal muscles and organs. Find the navel and ASIS, and slowly press with your fingertips along the line between these two landmarks. You may have to adjust the angle of your pressure or direction of your fingers to move through digestive organs as you work your way to the psoas major muscle. Press in on your partner's exhalations. When you feel you have reached the depth required to contact psoas major, ask your partner to flex his or her hip to see if you can feel fibers contract. *Note:* Palpation/massage of psoas major must be done with great care and clear communication with the client. If the client feels pain, stop your work.

2. **Iliacus:** Have your partner lie supine. Iliacus fills the iliac fossa on the anterior aspect of the ilium and inserts at the lesser trochanter. Find the anterior iliac spine between the ASIS and AIIS. Curl your fingers around the anterior iliac spine, pressing gently and medially into the iliac fossa. Ask your partner to flex his or her hip and try to feel the fibers contract.
3. **Quadriceps: Rectus Femoris:** Have your partner lie supine. The rectus femoris originates on the AIIS and just superior to the acetabulum. Rectus femoris inserts on the tibial tuberosity. The muscle is located superficially in the anterior thigh. Trace the AIIS to the tibial tuberosity, and you have traced rectus femoris. Again, ask your partner to flex his or her hip and feel for the contracting fibers, distal to the AIIS and in the anterior thigh.
4. **Quadriceps: Vastus Medialis:** Have your partner lie supine. The lateral portion of vastus medialis is deep to rectus femoris. Palpate just medially to rectus femoris. The origin of this muscle is the linea aspera on the posterior femur. The muscle wraps around the medial side of the femur, anterior to the adductors.

It is possible to distinguish vastus medialis from the hip adductor muscles by isometrically contracting the quadriceps group. Have your partner flex his or her knee a bit. Then, position your hand on the anterior distal leg and have your partner press his or her anterior leg into your hand. This will cause the quadriceps to tighten, but will not affect the adductors. You should be able to feel the distinction between the contracted quadriceps and relaxed adductor muscles.
5. **Quadriceps: Vastus Lateralis:** Have your partner lie supine. The medial portion of vastus lateralis is deep to rectus femoris, but the lateral aspect is easily palpable. Remember that this muscle makes up the anterolateral aspect of the thigh.

Palpation Exercise #5

This palpation exercise will require you to palpate the posterior leg muscles and relevant bone markings that are attachment sites.

Bones/Bony Landmarks

Palpate the following bone markings:

1. Posterior aspect of the epicondyles of the femur. Feel for the rounded distal ends on the medial and lateral sides of the femur. Palpate posteriorly, noting the tendons of insertion of the hamstrings. Continue to move posteriorly, and palpate gently into the edges of the popliteal fossa to feel for the attachment sites of gastrocnemius.
2. Calcaneus and Achilles tendon: Find the thick Achilles tendon on the posterior, distal leg. Trace the tendon to its attachment point on the posterior calcaneus.
3. Posterior head and shaft of the fibula: Find the head of the fibula at the bone's most proximal aspect. Palpate just distal to the posterior aspect of the head of the fibula.
4. Proximal, posterior tibia (review the location of the soleal line)

Muscles

Gastrocnemius is the most superficial muscle in the posterior leg. It is a fleshy muscle with two heads. It is easy to pétrissage. Deep to gastrocnemius is soleus, a flat muscle whose inferior aspect is more distal than gastrocnemius. Plantaris, a variably present muscle is located in the posterior knee area. The tendon of insertion of plantaris lies between gastrocnemius and soleus. This tendon is long and extends distally to join the Achilles tendon and attach to the calcaneus. Deep to soleus are the muscles of the deep, posterior leg compartment.

1. **Gastrocnemius and soleus:** Have your partner lie prone with feet hanging off the end of the table. Palpate gently in the posterior knee area to find the most proximal portion of gastrocnemius between the hamstring's tendons of insertion. Trace the muscle distally toward the Achilles tendon. Ask your partner to plantarflex while you provide resistance. (You can lean gently into the bottom of the foot.) Palpate the central part of the posterior leg, feeling for both bellies of the gastrocnemius and the point at which they join. This point can be extremely tender. Feel distal to gastrocnemius to find soleus, which creates the contour of the distal leg. Palpate the Achilles tendon, the insertion of both muscles. Friction to the Achilles tendon can be helpful to clients who walk, run, or play sports. Make sure you hold the tendon in a taut position before providing friction to it.
2. **Soleus:** Test for flexibility of the soleus. Have your partner lie prone with knee flexed to 90 degrees. Ask your partner to dorsiflex the foot as much as possible. How is the range of motion? Why is restriction of dorsiflexion in this position likely to be caused by a shortened soleus muscle?
3. **Plantaris:** Palpate the plantaris, if your partner has one. Have your partner lie prone with knee flexed. *Gently* press into the popliteal space, between the two heads of the gastrocnemius muscle. Feel for muscle fibers running from the lateral epicondyle of the femur distally and medially. Remember that this muscle also inserts into the calcaneus via the Achilles tendon.
4. **Tibialis posterior, flexor digitorum longus, and flexor hallucis longus:** These muscles make up the deep, posterior leg compartment. They are difficult to isolate, but can be addressed by massaging the posterior leg, with the intention of affecting the deepest muscles.

Palpation Exercise #6

This palpation exercise will require you to palpate the peroneal muscles, anterior leg muscles, and relevant bone markings.

Bones/Bony Landmarks

1. Find the origin and insertion sites of all six muscles listed below in the illustration provided earlier in the chapter.
2. Note the location on the fibula of each of the peroneal's origins. Find the insertions of the peroneals on the foot.
3. Find the origin of extensor hallucis longus on the fibula and the interosseus membrane. Find the origin of extensor digitorum longus on the anterior fibula, tibia, and interosseus membrane. Find the origin of tibialis anterior on the anterior tibia and interosseus membrane. Find the insertion spots of these three muscles on the foot.

Muscles

1. **Peroneus longus and brevis:** Have your partner lie supine. The peroneus longus runs from the head of the fibula distally. The tendon of insertion passes posterior to the lateral malleolus and across the plantar surface of the foot to the base of the first metatarsal and medial cuneiform. The bulk of the muscle is between the head of the fibula and the lateral malleolus. As you palpate this region, have your partner evert against resistance, so that you can feel the muscle fibers tighten. The peroneus brevis is deep to the peroneus longus, running from the lateral shaft of the fibula to the fifth metatarsal. It is difficult to distinguish the fibers of these two muscles. Try to feel where both tendons pass behind the lateral malleolus.
2. **Peroneus tertius:** The peroneus tertius arises from the distal, anterior fibula and passes in front of the lateral malleolus to insert right near the brevis on the fifth metatarsal. Try to palpate the tendon of this muscle on the dorsal surface of the fifth metatarsal while everting and dorsiflexing.
3. **Extensor hallucis longus:** Have your partner lie supine. Look at the dorsal surface of the foot and note the tendon that heads for the big toe. This muscle is deep in the anterior leg compartment, which is located between the lateral tibia and the fibula. It is difficult to distinguish the muscles within the anterior leg compartment.
4. **Extensor digitorum longus:** Have your partner lie supine. Look at the dorsal surface of the foot and note the four tendons heading for the four lateral toes. This muscle is palpable in the most lateral aspect of the anterior leg compartment. However, it can be difficult to isolate.
5. **Tibialis anterior:** Have your partner lie supine. Palpate the medial side of the tibia, where there is little muscle. Move to the lateral aspect of the tibia and sink into the belly of the muscle. Tibialis anterior is the most superficial muscle in the anterior leg compartment. The tendon passes medially and inserts at the base of the first metatarsal and medial cuneiform.

Palpation Exercise #7

This palpation exercise will require you to palpate the intrinsic foot muscles. These all support longitudinal arches.

1. **Abductor hallucis:** Have your partner lie supine. Press into the tissue from the medial side of the heel to the medial side of the big toe.
2. **Flexor digitorum brevis:** Have your partner lie supine. Press into the plantar surface of the heel and move distally to the four lateral toes.
3. **Abductor digiti minimi:** Have your partner lie supine. Press into the tissue from the middle of the calcaneus to the lateral aspect of the fifth digit.

As you further palpate/massage your partner's foot, please review the following:

Deep to layer one lies layer two:

1. Lumbricals arise from the tendon of flexor digitorum longus and insert into the bases of the proximal phalanges and the extensor expansion. Lumbricals flex the MP joints and extend the PIP and DIP joints.

2. Quadratus plantae runs from the calcaneus to the tendon of flexor digitorum longus. This muscle helps flex the toes by adjusting the angle of pull on its tendon of insertion.

Deep to layer two is layer three:

1. Adductor hallucis adducts the big toe and supports the transverse arch of the foot.
2. Flexor hallucis brevis flexes the big toe.
3. Flexor digiti minimi (brevis) flexes the fifth digit.

Deep to layer three is layer four (deepest layer):

1. Plantar interossei lie deep between the metatarsals on the plantar surface of the foot and adduct the toes.
2. Dorsal interossei lie between the metatarsals on the dorsal side of the foot and abduct the toes.

Review

1. Palpate the iliac crest. What bone contains this crest? What three bones comprise the hip bones? What muscles attach to the iliac crest? Find the ASIS and PSIS.
2. Palpate/massage the adductors of the hip. What are their names? What is their collective origin and insertion? What is different about gracilis?
3. Palpate/massage your partner's hamstrings. What are the three names of the hamstrings? Where is their common origin spot? Where does each insert? How do you stretch them?
4. Palpate/massage the gastrocnemius and soleus. Review their actions. Can you stretch them independently of each other?

Clay Work Exercises

These exercises help reinforce names and locations of muscles. They require the use of small plastic skeletons and clay. In each exercise below, create each of the listed muscles out of clay, one at a time, and attach it to the plastic skeleton where appropriate. Also,

list the origin, insertion, and action of each muscle in the spaces provided. Share your understanding of the muscles with your partner as you build them.

Clay Work Exercise #1: Piriformis and Hip Adductors

Muscle Name	Origin	Insertion	Action(s)	Location
1. Piriformis				
2. Adductor Magnus				
3. Adductor Longus				
4. Adductor Brevis				
5. Pectineus				
6. Gracilis				

Clay Work Exercise #2: Gluteal Region

Muscle Name	Origin	Insertion	Action(s)	Location
1. Gluteus Minimus				
2. Gluteus Medius				
3. Tensor Fascia Latae				
4. Gluteus Maximus				

Clay Work Exercise #3: Hamstrings, Quadriceps, Iliopsoas, and Sartorius

Muscle Name	Origin	Insertion	Action(s)	Location
1. Semimembranosus				
2. Semitendinosus				
3. Biceps Femoris				
5. Iliopsoas				
6. Vastus Intermedius				
7. Vastus Medialis				
8. Vastus Lateralis				
9. Rectus Femoris				
10. Sartorius				

Clay Work Exercise #4: Muscles of the Leg

Muscle Name	Origin	Insertion	Action(s)	Location
1. Popliteus				
2. Soleus				
3. Plantaris				
4. Gastrocnemius				
5. Tibialis Posterior				
6. Flexor Digitorum Longus				
7. Flexor Hallucis Longus				
8. Peroneus Tertius				
9. Peroneus Brevis				
10. Peroneus Longus				
11. Extensor Digitorum Longus				
12. Extensor Hallucis Longus				
13. Tibialis Anterior				

Clay Work Exercise #5: Intrinsic Foot Muscles

Muscle Name	Origin	Insertion	Action(s)	Location
1. Dorsal Interossei				
2. Palmar Interossei				
3. Adductor Hallucis				
4. Flexor Hallucis Brevis				
5. Flexor Digiti Minimi Brevis				
6. Lumbricals				
7. Quadratus Plantae				
8. Abductor Hallucis				
9. Flexor Digitorum Brevis				
10. Abductor Digiti Minimi				

Case Study Exercises

Case Study #1

A client comes into your office, and you notice that she has an anterior pelvic tilt.

What muscles might be shortened and contributing to this issue?

What muscles might be lengthened and contributing to this problem?

Case Study #2

A client comes in to your office. As you observe his standing posture, you notice that his feet are not pointing forward, but rather they point to the sides (hip lateral rotation).

What muscles might be shortened and contributing to this issue?

What muscles might be lengthened and contributing to this problem?

Case Study #3

Your client lets you know that she cannot fully flex her knee.

What muscles might be shortened and contributing to this issue?

What muscles might be lengthened and contributing to this problem?

Case Study #4

The outsides of your clients' shoes are noticeably more worn than the medial or inner sides. What muscles might be shortened and contributing to this phenomenon?

What muscles might be lengthened and contributing to this phenomenon?

Case Study #5

Your client has limited ability to fully abduct his thighs.

What muscles might be shortened and contributing to this issue?

What muscles might be lengthened and contributing to this problem?

Case Study #6

Your client has limited ability to dorsiflex her ankle.

What muscles might be shortened and contributing to this issue?

What muscles might be lengthened and contributing to this problem?

Review Exercises

These review exercises help you to recall what you have learned in this chapter and reinforce your learning.

Review Charts to Study

Piriformis and Adductors of Thigh				
Muscle Name	Origin	Insertion	Action(s)	Location
Piriformis	Anterior sacrum	Greater trochanter	Lateral rotation of hip	Deep buttock region
Adductor Magnus	Inferior pubic ramus and ischial tuberosity	Linea aspera of femur	Adduction of hip	Medial thigh
Adductor Longus	Anterior pubis	Linea aspera	Adduction of hip	Medial thigh
Adductor Brevis	Anterior pubis	Linea aspera	Adduction of hip	Medial thigh
Pectineus	Anterior pubic ramus	Linea aspera	Flexion and adduction of hip	Medial thigh
Gracilis	Anterior pubis	Pes anserinus	Adduction of hip, flexion of knee, and medial rotation of knee	Medial thigh (most superficial, medial thigh muscle)

Gluteal Region				
Muscle Name	Origin	Insertion	Action(s)	Location
Gluteus Minimus	Posterior or external ilium	Greater trochanter	Abduction and medial rotation of the hip	Lateral hip
Gluteus Medius	Posterior or external ilium	Greater trochanter	Abduction and medial rotation of the hip	Lateral hip
Tensor Fascia Latae	ASIS and anterior iliac crest	Iliotibial band	Abduction, medial rotation, and flexion of the hip; helps stabilize knee	Anterolateral hip
Gluteus Maximus	Posterior ilium and sacrum	Gluteal tuberosity and iliotibial band	Extension and lateral rotation of the hip	Superficial buttock region

Hamstrings, Quadriceps, Iliopsoas, and Sartorius				
Muscle Name	Origin	Insertion	Action(s)	Location
Semimembranosus	Ischial tuberosity	Proximal, posterior, medial tibia	Extend hip and flex knee	Deep, medial posterior thigh
Semitendinosus	Ischial tuberosity	Pes anserinus	Extend hip and flex knee	Superficial, medial posterior thigh
Biceps Femoris	Ischial tuberosity and linea aspera	Head of the fibula	Extend hip and flex knee	Posterior lateral thigh
Iliopsoas	Transverse processes and bodies of T12–L5 and iliac fossa	Lesser trochanter	Flexion of hip (strongest) and lateral rotation of hip	Deep abdomen
Vastus Intermedius	Anterior femur	Tibial tuberosity via the patellar tendon	Extend knee	Deep anterior thigh
Vastus Medialis	Linea aspera	Tibial tuberosity via the patellar tendon	Extend knee	Anteromedial thigh
Vastus Lateralis	Linea aspera	Tibial tuberosity via the patellar tendon	Extend knee	Anterolateral thigh
Rectus Femoris	AIS and close to acetabulum	Tibial tuberosity via the patellar tendon	Extend knee and flex hip	Superficial anterior thigh
Sartorius	ASIS	Pes anserinus	Flex, laterally rotate, and abduct hip and flex knee	Superficial anterior thigh

Muscles of the Leg				
Muscle Name	Origin	Insertion	Action(s)	Location
Popliteus	Lateral epicondyle of the femur	Proximal, medial, posterior tibia	Medial rotation of tibia and flexion of knee	Deep, posterior knee
Soleus	Soleal line of tibia and posterior head of fibula	Calcaneus via Achilles tendon	Plantarflexion of the ankle	Deep to gastrocnemius in superficial posterior leg compartment
Plantaris	Lateral epicondyle of femur	Calcaneus via Achilles tendon	Flexion of knee and plantarflexion of ankle	Posterior knee
Gastrocnemius	Lateral and medial condyles of femur	Calcaneus via Achilles tendon	Flexion of knee and plantarflexion of ankle	Superficial, posterior leg
Tibialis Posterior	Posterior tibia, fibula, and interosseus membrane	Navicular, cuneiform bones, cuboid, and metatarsals 2, 3, and 4	Inversion of foot and plantarflexion of ankle	Deep posterior leg compartment
Flexor Digitorum Longus	Posterior tibia	Distal phalanges of four lateral toes, plantar surface	Flexion of four lateral toes and plantarflexion of ankle	Deep posterior leg compartment
Flexor Hallucis Longus	Posterior fibula	Distal phalanx of digit 1, plantar surface	Flexion of big toe and plantarflexion of ankle	Deep posterior leg compartment
Peroneus Tertius	Distal, anterior fibula	Base of the fifth metacarpal	Eversion of foot and dorsiflexion of ankle	Anterior leg compartment
Peroneus Brevis	Inferior two thirds of lateral fibula	Base of the fifth metacarpal	Eversion of foot and plantarflexion of ankle	Lateral leg compartment
Peroneus Longus	Lateral fibula including head of fibula	Base of first metacarpal and medial cuneiform	Eversion of foot and plantarflexion of ankle	Lateral leg compartment
Extensor Digitorum Longus	Lateral condyle of tibia and entire anterior fibula	Distal phalanges of four lateral toes, dorsal side	Extension of four lateral toes and dorsiflexion of ankle	Anterior leg compartment
Extensor Hallucis Longus	Anterior fibula and interosseus membrane	Distal phalanx of digit 1, dorsal surface	Extension of big toe and dorsiflexion of ankle	Anterior leg compartment
Tibialis Anterior	Lateral condyle and proximal half of anterior tibia	Base of first metatarsal and medial cuneiform	Inversion of foot and dorsiflexion of ankle	Anterior leg compartment

Intrinsic Foot Muscles				
Muscle Name	Origin	Insertion	Action(s)	Location
Dorsal Interossei	Adjacent sides of metatarsals 1–5	Medial side of base of proximal phalanx of digit 1 and lateral sides of bases of proximal phalanges of digits 2–4	Abduct toes (digits 2–4)	Layer four (deepest) dorsal side of foot
Palmar Interossei	Medial sides of metatarsals 3, 4, and 5	Medial sides of bases of proximal phalanges of digits 3, 4, and 5	Adduct toes (digits 3–5)	Layer four (deepest) plantar side of foot
Adductor Hallucis	Oblique head: base of metatarsals 2–4; Transverse head: metatarsophalangeal joint capsules	Lateral side of base of proximal phalanx of digit 1	Adduct digit 1 (big toe)	Layer three plantar side of foot
Flexor Hallucis Brevis	Cuboid and lateral cuneiform, plantar surfaces	Base of proximal phalanx of digit 1	Flex digit 1 (big toe)	Layer three plantar side of foot
Flexor Digiti Minimi Brevis	Base of fifth metatarsal	Base of proximal phalanx of fifth digit	Flex fifth digit (little toe)	Layer three plantar side of foot
Lumbricals	Tendon of insertion of flexor digitorum longus	Bases of proximal phalanges of digits 2–5 and extensor expansion	Flex MP joints and extend DIP joints and PIP joints of the foot	Layer two plantar side of foot
Quadratus Plantae	Calcaneus	Tendon of insertion of flexor digitorum longus	Flex four lateral toes	Layer two plantar side of foot
Abductor Hallucis	Calcaneus	Medial side of proximal phalanx of digit 1	Adduct digit 1 (big toe)	Layer one (most superficial) plantar side of foot
Flexor Digitorum Brevis	Calcaneus	Medial and lateral sides of the middle phalanges of digits 2–5	Flex four lateral toes	Layer one (most superficial) plantar side of foot
Abductor Digiti Minimi	Calcaneus	Lateral side of the base of the proximal phalanx of the fifth digit	Abduct fifth digit (little toe)	Layer one (most superficial) plantar side of foot

Action Charts of Hip, Knee, Ankle, and Foot Movers

Please fill in the muscles that perform the hip, knee, ankle, and foot movements indicated:

HIP FLEXORS	HIP EXTENSORS
1.	1.
2.	2.
3.	3.
4.	4.
5.	

HIP LATERAL ROTATORS	HIP MEDIAL ROTATORS
1.	1.
2.	2.
3.	3.
4.	
5.	
6.	
7.	
8.	
9.	

HIP ADDUCTORS	HIP ABDUCTORS
1.	1.
2.	2.
3.	3.
4.	4.
5.	

KNEE FLEXORS	KNEE EXTENSORS
1.	1.
2.	2.
3.	3.
4.	4.
5.	
6.	
7.	
8.	

ANKLE PLANTARFLEXORS	ANKLE DORSIFLEXORS
1.	1.
2.	2.
3.	3.
4.	4.
5.	
6.	
7.	
8.	

FOOT EVERTORS	FOOT INVERTERS
1.	1.
2.	2.
3.	

TOE FLEXORS	TOE EXTENSORS
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.

TOE ABDUCTORS	TOE ADDUCTORS
1.	1.
2.	2.
3.	

Review Exercise for Muscles Located in the Hip and Thigh Region

Fill in the appropriate muscle or bone marking in the space provided.

- _____ is a deep buttock region muscle and laterally rotates the hip. It can cause sciatica when short.
- _____ is the largest, deepest medial thigh muscle and adducts the thigh.
- _____ is the larger of the two lateral hip muscles and performs abduction and medial rotation of the hip. It pulls the hip down when the weight is on the limb, so the other hip rises and the other limb can swing through when walking.
- _____ is the largest muscle in the body (by volume). It performs lateral rotation and forceful extension of the hip.
- _____ is the small lateral hip muscle that flexes, abducts, and medially rotates the hip, and it plays a role in stabilization of the knee. It inserts into the IT band.
- _____ is the anterolateral quadriceps group muscle; it originates on the linea aspera.
- _____ is the anteromedial quadriceps group muscle; it originates on the linea aspera.
- _____ is the superficial quadriceps group muscle; it flexes the hip as well as extends the knee.
- The insertion of all four quadriceps group muscles is on the _____.
- The action of all four quadriceps group muscles is _____.
- _____ is the lateral hamstring muscle, which inserts on the head of the fibula.
- _____ is the deeper of the two medial hamstring muscles, which inserts on the proximal, medial posterior tibia.
- _____ is the superficial of the two medial hamstring muscles, which inserts at pes anserinus.
- The origin of the three hamstrings is _____.
- The actions of all three hamstrings are _____ and _____.
- _____ is the *tailor muscle*, the longest muscle in the body. It performs lateral rotation, abduction and flexion of the hip, and knee flexion.

Review Exercise for Muscles Located in the Knee Area and Leg

Fill in the appropriate muscle in the space provided.

- _____ is the small, deep muscle in the posterior knee region that performs medial rotation of the tibia.
- _____ is the small muscle in the posterior knee region that is variably present. This muscle has a long tendon of insertion, which joins the calcaneus via the Achilles tendon.
- _____ is the most superficial muscle in the posterior leg and performs knee flexion and plantarflexion of the ankle.
- _____ is the ankle plantarflexor and is located directly deep to gastrocnemius.
- _____ is the deep posterior leg compartment muscle that inverts the foot and plantarflexes the ankle.
- _____ is the deep posterior leg compartment muscle that flexes the four lateral toes and plantarflexes the ankle.
- _____ is the deep posterior leg compartment muscle that flexes the big toe and plantarflexes the ankle.
- _____ is the lateral leg compartment muscle that everts the foot and plantarflexes the ankle. It is the shorter of a pair.
- _____ is the lateral leg compartment muscle that everts the foot and plantarflexes the ankle. It is the longer of a pair.
- _____ is the anterior leg compartment muscle that everts the foot and dorsiflexes the ankle.
- _____ is the anterior leg compartment muscle that extends the four lateral toes and dorsiflexes the ankle.
- _____ is the anterior leg compartment muscle that extends the big toe and dorsiflexes the ankle.
- _____ is the anterior leg compartment muscle that inverts the foot and dorsiflexes the ankle.

Review Exercise for the Intrinsic Foot Muscles

Fill in the appropriate muscle in the space provided.

1. _____ is the muscle located in the fourth layer, deep between the metatarsals on the dorsal side of the foot; it abducts the toes.
2. _____ is the muscle located in the fourth layer, deep between the metatarsals on the plantar side of the foot; it adducts the toes.
3. _____ is the muscle located in the third layer on the plantar side of the foot; it flexes the big toe.
4. _____ is the muscle located in the third layer on the plantar side of the foot; it adducts the big toe.
5. _____ is the muscle located in the third layer on the plantar side of the foot; it flexes the fifth digit.
6. _____ is the muscle located in the second layer on the plantar side of the foot; it flexes the MP joints and extends the PIP and DIP joints of the four lateral toes.
7. _____ is the muscle located in the second layer on the plantar side of the foot; it helps flex the four lateral toes.
8. _____ is the muscle located in the first layer on the plantar side of the foot; it abducts the big toe.
9. _____ is the muscle located in the first layer on the plantar side of the foot; it flexes the four lateral toes.
10. _____ is the muscle located in the first layer on the plantar side of the foot; it abducts the fifth digit.