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### Lower Limb

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(Continued)
## 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. 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 down the patellar groove of the femur.
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.
At the patellofemoral joint the patella glides inferiorly as the knee flexes and superiorly as it extends. This maintains the leverage of the surrounding muscles during movement.

The tibiofemoral joint is a modified hinge that allows flexion, extension, and slight rotation of the knee.

The linea aspera is a long vertical line running along the shaft of the posterior femur. It is the site of several muscle attachments.

**FIGURE 5-2** Femur, femoral bone markings, and the patella. **A:** Anterior view; **B:** Posterior view
The proximal tibiofibular joint is a stable synovial joint allowing little movement.

The distal tibiofibular joint is a fibrous syndesmosis that allows very little motion, increasing stability of the low leg.

The tibial tuberosity is the “bump” below the knee.

The talocrural joint is a true hinge joint. Plantarflexion and dorsiflexion are possible here, but the distal tibiofibular joint must “give” slightly, allowing the talus to move posteriorly during endrange dorsiflexion.

The soleal line of the tibia marks the attachment of the soleus muscle.
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 talar 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 BURSÆ 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 iliac fossa to the anterior sacrum. The posterior sacrotuberous ligament joins the ischial tuberosity to the sacrum. The sacrospinous ligament joins the ischial tuberosity to the sacrum. The ligamentum teres, or 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.

**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.
The iliolumbar ligament is part of a complex network of ligaments that stabilize the pelvic girdle and its connection to the lumbar spine.

The inguinal ligament is the inferior margin of the aponeurosis of the external oblique muscle and superior border of the femoral triangle.

The iliofemoral ligament, shaped like an inverted “Y”, helps maintain optimal contact between the femoral head and acetabulum, limiting medial rotation and extension of the hip.

The sacrospinous ligament stabilizes the sacrum inferiorly and provides muscle attachment points on the posterior pelvis.

The sacrotuberous ligament stabilizes the sacrum inferiorly and provides muscle attachment points on the posterior pelvis.

The posterior sacroiliac ligaments surround and stabilize the sacrum. They are part of a large network of thick, strong ligaments located in the pelvic region.

The ischiofemoral ligament spirals around the posterior coxal joint and assists the iliofemoral ligament in limiting medial rotation of the hip.

Posterior sacro-coccygeal ligaments anchor and stabilize the small, delicate coccyx.

The acetabular labrum extends the depth of the acetabulum.

The iliofemoral ligament helps maintain optimal contact between the femoral head and acetabulum, limiting medial rotation and extension of the hip.
The posterior articular surface of the patella sits in the **femoral groove**. The patellofemoral joint must slide up and down as the knee extends and flexes.

The **lateral meniscus** is circular shaped cartilage that cushions the tibiofemoral joint and increases joint continuity.

The **lateral collateral ligament** connects the lateral femoral condyle to the head of the fibula. It prevents lateral opening of the tibiofemoral joint (varus deformity).

The **patellar tendon** (cut) connects the quadriceps muscles to the tibia. It is sometimes called the patellar ligament because it connects the patella to the tibia.

The posterior menisco-femoral ligament joins the lateral meniscus and the medial condyle of the femur.

The **posterior cruciate ligament** connects posteriorly to the tibia and anteriorly to the medial condyle of the femur. Stronger than the anterior cruciate ligament, it prevents the tibia from sliding posteriorly and the femur from sliding anteriorly.

The **anterior cruciate ligament** connects anteriorly to the tibia and posteriorly to the lateral condyle of the femur. It prevents the tibia from sliding anteriorly and the femur from sliding posteriorly.

The **medial meniscus** is a crescent-shaped cartilage that cushions the tibiofemoral joint. It has a direct connection to the medial collateral ligament.

The **medial collateral ligament** connects the medial femoral and tibial condyles. It prevents medial opening of the knee (valgus deformity).

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The **anterior cruciate ligament** connects anteriorly to the tibia and posteriorly to the lateral condyle of the femur. It prevents the tibia from sliding anteriorly and the femur from sliding posteriorly.

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The **medial collateral ligament** connects the medial femoral and tibial condyles. It prevents medial opening of the knee (valgus deformity).

**FIGURE 5-6** - Ligaments that stabilize the knee. **A**: Anterior view; **B**: Posterior view
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.
The distal tibiofibular joint is a fibrous syndesmosis that allows very little motion, increasing stability of the low leg.

The ankle (talocrural) joint is a true hinge joint. Plantarflexion and dorsiflexion are possible here, but the distal tibiofibular joint must “give” slightly, allowing the talus to move posteriorly during endrange dorsiflexion.

The soleal line of the tibia marks the attachment of the soleus muscle.

The subtalar joint is located distal to the talocrural joint and includes articulations between the talus and calcaneous. It works with the talocalcaneonavicular joint to allow inversion and eversion of the foot.

**FIGURE 5-9 • Ankle joint.** A: Anterior view; B: Posterior view
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
The 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 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.
The six deep lateral rotators of the hip include piriformis, gemellus superior, gemellus inferior, obturator internus, obturator externus, and quadratus femoris (Fig. 5-13).

**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.

**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...
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
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.
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
**Meaning of Name**

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

**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.
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
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 their 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 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
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, sartorius, 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
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 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
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.

Palpation and Massage

Gluteus minimis 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
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.
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
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 quadricep 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.
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
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 membranosis 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.
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
Meaning of Name
Semi means one half, and tendinosis 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, 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 illoposas, rectus femoris, TFL, pectineus, and sartorius (flex the hip)

Innervation and Arterial Supply
Innervation: sciatic nerve
Arterial supply: inferior gluteal artery
**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 extendors, 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 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
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, obturator externus, gemellus superior, gemellus inferior, quadrates 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
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.

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
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 extensoes. 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.

Palpation and Massage
As a group, the quads are easy to palpate and massage in the anterior thigh. Effleurage, pêtrissage, 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
Seminembranosus, 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
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.
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
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.
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
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 muscle 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
the quadriceps muscles. However, providing effleurage, pêtrissage, 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 iliopectineus; 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
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.
CHAPTER 5 Lower Limb

Tensor fascia latae
Sartorius
Pectineus
Adductor longus
Gracilis
Rectus femoris
Iliotibial band
Vastus lateralis
Vastus medialis

Psoas
Iliacus
Gluteus minimus
Biceps femoris (long head)
Biceps femoris (short head)

Gluteus medius
Sartorius
Tensor fascia latae
Rectus femoris
Vastus lateralis
Biceps femoris (long head)
Biceps femoris (short head)

FIGURE 5-36 • Superficial anterior thigh muscles

Gluteus medius
Gluteus maximus
Sartorius
Tensor fascia latae
Rectus femoris
Vastus lateralis
Biceps femoris (long head)
Biceps femoris (short head)

Gluteus medius (cut)
Gluteus minimus
Iliacus
Psoas
Rectus femoris
Vastus lateralis

FIGURE 5-37 • Lateral thigh muscles
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
Meaning of Name
Plantaris refers 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.

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
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-
between 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; plantarflexors: 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
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.
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.
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
“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

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.

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.
**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.
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
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.
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
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

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
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
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.
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
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 stake.

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.
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
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 inverting the foot and plantarflexing the ankle.
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 5-53 • 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 forth 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.

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
CHAPTER 5  Lower Limb

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 metacarpal 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 interossei 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.

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
FIGURE 5-56  • Layer 3 intrinsic foot muscles

A: Flexor hallucis brevis;
B: Adductor hallucis;
C: Flexor digiti minimi brevis.
**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 adds 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 big 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
Meaning of Name

*Flexor* refers to the action of flexion. *Digit 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
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 lumbral 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
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
PART 2  INDIVIDUAL MUSCLES BY BODY REGION

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
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 digit 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.
The sciatic nerve lies deep to the piriformis muscle. It runs down the thigh before branching into the common peroneal and tibial nerves at the popliteal fossa.

The common peroneal nerve lies lateral to the head of the fibula.

The popliteal artery and vein lie within the popliteal fossa, along with the tibial nerve.
The **tibial nerve** runs through the popliteal fossa inferiorly to the ankle.

The **common peroneal nerve**, also called the fibular nerve, runs through the popliteal fossa inferiorly and near the neck of the fibula before branching in superficial and deep divisions in the lower leg.

The **superficial peroneal nerve** runs inferiorly between peroneus longus and extensor digitorum longus.

The **deep peroneal nerve** follows the anterior tibial artery around the fibular head to the anterior lower leg. It divides into medial and lateral branches at the front of the ankle.

The **anterior tibial artery** runs laterally to the tibia and down to the ankle.

**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.
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:

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WHEN MUSCLE IS SHORTENED:

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WHEN MUSCLE IS LENGTHENED:

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HOW TO STRETCH THIS MUSCLE:

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SYNERGIST(S):

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ANTAGONIST(S):

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NOTES:

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ADDUCTOR LONGUS AND BREVIS

ORIGIN: ____________________________

INSERTION: ________________________

ACTION(S): ________________________

NERVE: ___________________________

ARTERIAL SUPPLY: __________________

LOCATION AND/OR HOW TO PALPATE:
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WHEN MUSCLE IS SHORTENED:
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WHEN MUSCLE IS LENGTHENED:
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HOW TO STRETCH THIS MUSCLE:
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SYNERGIST(S): ______________________

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ANTAGONIST(S): _____________________

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NOTES: ____________________________

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PECTINEUS

ORIGIN: __________________________

INSERTION: ______________________

ACTION(S): _______________________

NERVE: __________________________

ARTERIAL SUPPLY: ________________

LOCATION AND/OR HOW TO PALPATE:

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WHEN MUSCLE IS SHORTENED:

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WHEN MUSCLE IS LENGTHENED:

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HOW TO STRETCH THIS MUSCLE:

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SYNERGIST(S):

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ANTAGONIST(S):

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NOTES: _________________________________________
GRACILIS

ORIGIN: _________________________________________

INSERTION: _______________________________________

ACTION(S): _______________________________________

NERVE: ___________________________________________

ARTERIAL SUPPLY: ________________________________

LOCATION AND/OR HOW TO PALPATE:

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WHEN MUSCLE IS SHORTENED:

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WHEN MUSCLE IS LENGTHENED:

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HOW TO STRETCH THIS MUSCLE:

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ANTAGONIST(S):

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NOTES: ____________________________________________

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GLUTEUS MEDIUS

ORIGIN: _________________________________________

INSERTION: ______________________________________

ACTION(S): ______________________________________

NERVE: _________________________________________

ARTERIAL SUPPLY: ________________________________

LOCATION AND/OR HOW TO PALPATE:
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WHEN MUSCLE IS SHORTENED:
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WHEN MUSCLE IS LENGTHENED:
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HOW TO STRETCH THIS MUSCLE:
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SYNERGIST(S):
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NOTES: _________________________________________
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**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:**

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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: SEMITENDINOSUS

ORIGIN: _________________________________________

INSERTION: _________________________________________

ACTION(S): _________________________________________

NERVE: _________________________________________

ARTERIAL SUPPLY: ________________________________

LOCATION AND/OR HOW TO PALPATE:
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WHEN MUSCLE IS SHORTENED:
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HOW TO STRETCH THIS MUSCLE:
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SYNERGIST(S):
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ANTAGONIST(S):
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NOTES: _________________________________________
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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: ____________________________________
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ORIGIN: _________________________________________
INSERTION: ______________________________________
ACTION(S): ______________________________________
NERVE: _________________________________________
ARTERIAL SUPPLY: ________________________________

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QUADRICEPS GROUP: VASTUS INTERMEDIUS

ORIGIN: _________________________________________
INSERTION: _______________________________________
ACTION(S): _______________________________________
NERVE: _________________________________________
ARTERIAL SUPPLY: ________________________________

LOCATION AND/OR HOW TO PALPATE:
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HOW TO STRETCH THIS MUSCLE:
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SYNERGIST(S):
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NOTES: _________________________________________
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QUADRICEPS GROUP: VASTUS MEDIALIS

ORIGIN: ____________________________
INSERTION: _______________________
ACTION(S): _______________________
NERVE: ___________________________
ARTERIAL SUPPLY: __________________

LOCATION AND/OR HOW TO PALPATE:
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WHEN MUSCLE IS SHORTENED:
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HOW TO STRETCH THIS MUSCLE:
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SYNERGIST(S):
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NOTES: __________________________________
QUADRICEPS GROUP: VASTUS LATERALIS

ORIGIN: _________________________________________
INSERTION: ______________________________________
ACTION(S): ______________________________________
NERVE: __________________________
ARTERIAL SUPPLY: __________________________

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QUADRICEPS GROUP: RECTUS FEMORIS

ORIGIN: _________________________________________

INSERTION: ______________________________________

ACTION(S): ______________________________________

NERVE: _________________________________________

ARTERIAL SUPPLY: ________________________________

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SARTORIUS

ORIGIN: ________________________________

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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):

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POPLITEUS

ORIGIN: ________________________________

INSERTION: ________________________________

ACTION(S): ________________________________

NERVE: ________________________________

ARTERIAL SUPPLY: ________________________________

LOCATION AND/OR HOW TO PALPATE:

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HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

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PLANTARIS

ORIGIN: ________________________________

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GASTROCNEMIUS

ORIGIN: ________________________________

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SOLEUS

ORIGIN: ________________________________

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ARTERIAL SUPPLY: ________________________________

LOCATION AND/OR HOW TO PALPATE:

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WHEN MUSCLE IS LENGTHENED:

HOW TO STRETCH THIS MUSCLE:

SYNERGIST(S):

ANTAGONIST(S):

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TIBIALIS POSTERIOR

ORIGIN: ________________________________

INSERTION: ________________________________

ACTION(S): ________________________________

NERVE: ________________________________

ARTERIAL SUPPLY: ________________________________

LOCATION AND/OR HOW TO PALPATE:

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FLEXOR DIGITORUM LONGUS

ORIGIN: ________________________________

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ACTION(S): ______________________________

NERVE: ________________________________

ARTERIAL SUPPLY: ________________________________

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WHEN MUSCLE IS SHORTENED:
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PERONEUS LONGUS

ORIGIN: _________________________________________

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NERVE: _________________________________________

ARTERIAL SUPPLY: ________________________________

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ANTAGONIST(S):
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PERONEUS BREVIS

ORIGIN: ________________________________

INSERTION: ________________________________

ACTION(S): ________________________________

NERVE: ________________________________

ARTERIAL SUPPLY: ________________________________

LOCATION AND/OR HOW TO PALPATE:

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WHEN MUSCLE IS SHORTENED:

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HOW TO STRETCH THIS MUSCLE:

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SYNERGIST(S):

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ANTAGONIST(S):

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PERONEUS TERTIUS

ORIGIN: ________________________________

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ACTION(S): ________________________________

NERVE: ________________________________

ARTERIAL SUPPLY: ________________________________

LOCATION AND/OR HOW TO PALPATE:

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EXTENSOR DIGITORUM LONGUS

ORIGIN: _________________________________________

INSERTION: _______________________________________

ACTION(S): _______________________________________

NERVE: _________________________________________

ARTERIAL SUPPLY: ________________________________

LOCATION AND/OR HOW TO PALPATE:
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WHEN MUSCLE IS SHORTENED:
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HOW TO STRETCH THIS MUSCLE:
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EXTENSOR HALLUCIS LONGUS

ORIGIN: ____________________________
INSERTION: ________________________
ACTION(S): ________________________
NERVE: ___________________________
ARTERIAL SUPPLY: __________________

LOCATION AND/OR HOW TO PALPATE:
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WHEN MUSCLE IS SHORTENED:
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WHEN MUSCLE IS LENGTHENED:
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HOW TO STRETCH THIS MUSCLE:
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SYNERGIST(S):
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ANTAGONIST(S):
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NOTES: ____________________________________________
TIBIALIS ANTERIOR

ORIGIN: ______________________________

INSERTION: ___________________________

ACTION(S): __________________________

NERVE: ______________________________

ARTERIAL SUPPLY: ____________________

LOCATION AND/OR HOW TO PALPATE:
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WHEN MUSCLE IS SHORTENED:
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SYNERGIST(S):
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ANTAGONIST(S):
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NOTES: ____________________________________________
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DORSAL INTEROSSEI

ORIGIN: ______________________________

INSERTION: ________________________________

ACTION(S): ________________________________

NERVE: ________________________________

ARTERIAL SUPPLY: ________________________________

LOCATION AND/OR HOW TO PALPATE:

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WHEN MUSCLE IS SHORTENED:

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SYNERGIST(S):

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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:

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WHEN MUSCLE IS SHORTENED:

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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: ____________________________

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LUMBRICALS

ORIGIN: _________________________________________

INSERTION: _______________________________________

ACTION(S): _______________________________________

NERVE: _________________________________________

ARTERIAL SUPPLY: ________________________________

LOCATION AND/OR HOW TO PALPATE:
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WHEN MUSCLE IS SHORTENED:
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WHEN MUSCLE IS LENGTHENED:
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HOW TO STRETCH THIS MUSCLE:
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SYNERGIST(S):
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ANTAGONIST(S):
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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:
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WHEN MUSCLE IS SHORTENED:
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WHEN MUSCLE IS LENGTHENED:
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HOW TO STRETCH THIS MUSCLE:
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SYNERGIST(S):
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ANTAGONIST(S):
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NOTES: _________________________________________
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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 feel 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. ____________________________

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 minimis.

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 iliopeas, 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 through 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 périssager. 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 interosseous membrane. Find the origin of extensor digitorum longus on the anterior fibula, tibia, and interosseous membrane. Find the origin of tibialis anterior on the anterior tibia and interosseous membrane. Find the insertion spots of these three muscles on the foot.

**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 digitii 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

<table>
<thead>
<tr>
<th>Muscle Name</th>
<th>Origin</th>
<th>Insertion</th>
<th>Action(s)</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Piriformis</td>
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<tr>
<td>2. Adductor Magnus</td>
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<tr>
<td>3. Adductor Longus</td>
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<td>4. Adductor Brevis</td>
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<tr>
<td>5. Pectineus</td>
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<td>6. Gracilis</td>
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</table>

Clay Work Exercise #2: Gluteal Region

<table>
<thead>
<tr>
<th>Muscle Name</th>
<th>Origin</th>
<th>Insertion</th>
<th>Action(s)</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Gluteus Minimus</td>
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<tr>
<td>2. Gluteus Medius</td>
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<tr>
<td>3. Tensor Fascia Latae</td>
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<tr>
<td>4. Gluteus Maximus</td>
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</tbody>
</table>
Clay Work Exercise #3: Hamstrings, Quadriceps, Iliopsoas, and Sartorius

<table>
<thead>
<tr>
<th>Muscle Name</th>
<th>Origin</th>
<th>Insertion</th>
<th>Action(s)</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Semimembranosus</td>
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<tr>
<td>2. Semitendinosus</td>
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<tr>
<td>3. Biceps Femoris</td>
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<tr>
<td>5. Iliopsoas</td>
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<tr>
<td>6. Vastus Intermedius</td>
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<tr>
<td>7. Vastus Medialis</td>
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<tr>
<td>8. Vastus Lateralis</td>
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<tr>
<td>9. Rectus Femoris</td>
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<tr>
<td>10. Sartorius</td>
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</tbody>
</table>
### Clay Work Exercise #4: Muscles of the Leg

<table>
<thead>
<tr>
<th>Muscle Name</th>
<th>Origin</th>
<th>Insertion</th>
<th>Action(s)</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Popliteus</td>
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<tr>
<td>2. Soleus</td>
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<tr>
<td>3. Plantaris</td>
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<tr>
<td>4. Gastrocnemius</td>
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<tr>
<td>5. Tibialis Posterior</td>
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<tr>
<td>6. Flexor Digitorum Longus</td>
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<td>7. Flexor Hallucis Longus</td>
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<td>8. Peroneus Tertius</td>
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<tr>
<td>9. Peroneus Brevis</td>
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<td>10. Peroneus Longus</td>
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<tr>
<td>11. Extensor Digitorum Longus</td>
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<tr>
<td>12. Extensor Hallucis Longus</td>
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<tr>
<td>13. Tibialis Anterior</td>
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</tbody>
</table>
Clay Work Exercise #5: Intrinsic Foot Muscles

<table>
<thead>
<tr>
<th>Muscle Name</th>
<th>Origin</th>
<th>Insertion</th>
<th>Action(s)</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dorsal Interossei</td>
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<tr>
<td>2. Palmar Interossei</td>
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<tr>
<td>3. Adductor Hallucis</td>
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<tr>
<td>4. Flexor Hallucis Brevis</td>
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<tr>
<td>5. Flexor Digiti Minimi Brevis</td>
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<tr>
<td>6. Lumbricals</td>
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<td>7. Quadratus Plantae</td>
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<td>8. Abductor Hallucis</td>
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<tr>
<td>9. Flexor Digitorum Brevis</td>
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<tr>
<td>10. Abductor Digit Minimi</td>
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</tbody>
</table>
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

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

### Gluteal Region

<table>
<thead>
<tr>
<th>Muscle Name</th>
<th>Origin</th>
<th>Insertion</th>
<th>Action(s)</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gluteus Minimus</td>
<td>Posterior or external ilium</td>
<td>Greater trochanter</td>
<td>Abduction and medial rotation of the hip</td>
<td>Lateral hip</td>
</tr>
<tr>
<td>Gluteus Medius</td>
<td>Posterior or external ilium</td>
<td>Greater trochanter</td>
<td>Abduction and medial rotation of the hip</td>
<td>Lateral hip</td>
</tr>
<tr>
<td>Tensor Fascia Latae</td>
<td>ASIS and anterior iliac crest</td>
<td>Iliotibial band</td>
<td>Abduction, medial rotation, and flexion of the hip; helps stabilize knee</td>
<td>Anterolateral hip</td>
</tr>
<tr>
<td>Gluteus Maximus</td>
<td>Posterior ilium and sacrum</td>
<td>Gluteal tuberosity and iliotibial band</td>
<td>Extension and lateral rotation of the hip</td>
<td>Superficial buttock region</td>
</tr>
</tbody>
</table>
# Hamstrings, Quadriceps, Iliopsoas, and Sartorius

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

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

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

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

<table>
<thead>
<tr>
<th>HIP FLEXORS</th>
<th>HIP EXTENSORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
<td>2.</td>
</tr>
<tr>
<td>3.</td>
<td>3.</td>
</tr>
<tr>
<td>4.</td>
<td>4.</td>
</tr>
<tr>
<td>5.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HIP LATERAL ROTATORS</th>
<th>HIP MEDIAL ROTATORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
<td>2.</td>
</tr>
<tr>
<td>3.</td>
<td>3.</td>
</tr>
<tr>
<td>4.</td>
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<td>5.</td>
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<tr>
<td>6.</td>
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<tr>
<td>7.</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HIP ADDUCTORS</th>
<th>HIP ABDUCTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
<td>2.</td>
</tr>
<tr>
<td>3.</td>
<td>3.</td>
</tr>
<tr>
<td>4.</td>
<td>4.</td>
</tr>
<tr>
<td>5.</td>
<td></td>
</tr>
</tbody>
</table>
### KNEE FLEXORS

1.  
2.  
3.  
4.  
5.  
6.  
7.  
8.  

### KNEE EXTENSORS

1.  
2.  
3.  
4.  

### ANKLE PLANTARFLEXORS

1.  
2.  
3.  
4.  
5.  
6.  
7.  
8.  

### ANKLE DORSIFLEXORS

1.  
2.  
3.  
4.  

### FOOT EVERTORS

1.  
2.  
3.  

### FOOT INVERTERS

1.  
2.  

## Part 2 Individual Muscles by Body Region

<table>
<thead>
<tr>
<th>Toe Flexors</th>
<th>Toe Extensors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Toe Abductors</th>
<th>Toe Adductors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
Review Exercise for Muscles Located in the Hip and Thigh Region

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

1. ___________________________ is a deep buttock region muscle and laterally rotates the hip. It can cause sciatica when short.

2. ____________________________________ is the largest, deepest medial thigh muscle and adducts the thigh.

3. ______________________ 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.

4. ___________________________ is the largest muscle in the body (by volume). It performs lateral rotation and forceful extension of the hip.

5. ________________ 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.

6. ___________________________ is the anterolateral quadriceps group muscle; it originates on the linea aspera.

7. __________________________ is the anteromedial quadriceps group muscle; it originates on the linea aspera.

8. ___________________________ is the superficial quadriceps group muscle; it flexes the hip as well as extends the knee.

9. The insertion of all four quadriceps group muscles is on the ____________________________________________.

10. The action of all four quadriceps group muscles is ____________________________.

11. ___________________________ is the lateral hamstring muscle, which inserts on the head of the fibula.

12. ___________________________ is the deeper of the two medial hamstring muscles, which inserts on the proximal, medial posterior tibia.

13. ___________________________ is the superficial of the two medial hamstring muscles, which inserts at pes anserinus.

14. The origin of the three hamstrings is ____________________________________________________________________________.

15. The actions of all three hamstrings are ____________________________ and ____________________________.

16. ___________________________ 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.

1. ________________________________________ is the small, deep muscle in the posterior knee region that performs medial rotation of the tibia.

2. ________________________________________ 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.

3. ________________________________________ is the most superficial muscle in the posterior leg and performs knee flexion and plantarflexion of the ankle.

4. ________________________________________ is the ankle plantarflexor and is located directly deep to gastrocnemius.

5. ________________________________________ is the deep posterior leg compartment muscle that inverts the foot and plantarflexes the ankle.

6. ________________________________________ is the deep posterior leg compartment muscle that flexes the four lateral toes and plantarflexes the ankle.

7. ________________________________________ is the deep posterior leg compartment muscle that flexes the big toe and plantarflexes the ankle.

8. ________________________________________ is the lateral leg compartment muscle that everts the foot and plantarflexes the ankle. It is the shorter of a pair.

9. ________________________________________ is the lateral leg compartment muscle that everts the foot and dorsiflexes the ankle. It is the longer of a pair.

10. ______________________________________ is the anterior leg compartment muscle that everts the foot and dorsiflexes the ankle.

11. ______________________________________ is the anterior leg compartment muscle that extends the four lateral toes and dorsiflexes the ankle.

12. ______________________________________ is the anterior leg compartment muscle that extends the big toe and dorsiflexes the ankle.

13. ______________________________________ 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.