7 The hip joint and pelvic girdle

Objectives

- To identify on a human skeleton or subject the important bone features of the hip joint and pelvic girdle.
- To label on a skeletal chart the important bone features of the hip joint and pelvic girdle.
- To draw on a skeletal chart the individual muscles of the hip joint.
- To demonstrate, using a human subject, all of the movements of the hip joint and pelvic girdle and list their respective planes of movement and axes of motion.
- To palpate on a human subject the muscles of the hip joint and pelvic girdle.
- To list and organize the primary muscles that produce movement of the hip joint and pelvic girdle and list their antagonists.

Bones FIGS. 7.1 to 7.3

The hip joint is the ball and socket joint that consists of the head of the femur connecting with the acetabulum of the pelvic girdle. The pelvic girdle consists of a right and left pelvic bone joined together posteriorly by the sacrum. The femur is the longest bone in the body. The sacrum can be considered an extension of the spinal column with five fused vertebrae. Extending inferior to the sacrum is the coccyx. The pelvic bones are made up of three bones: the ilium, the ischium, and the pubis. At birth and during growth and development they are three distinct bones. At maturity they are fused to form one pelvic bone.

The pelvic bone can be divided roughly into three areas starting from the acetabulum:

Upper two-fifths = ilium
Posterior and lower two-fifths = ischium
Anterior and lower one-fifth = pubis

Joints FIGS. 7.1 to 7.3

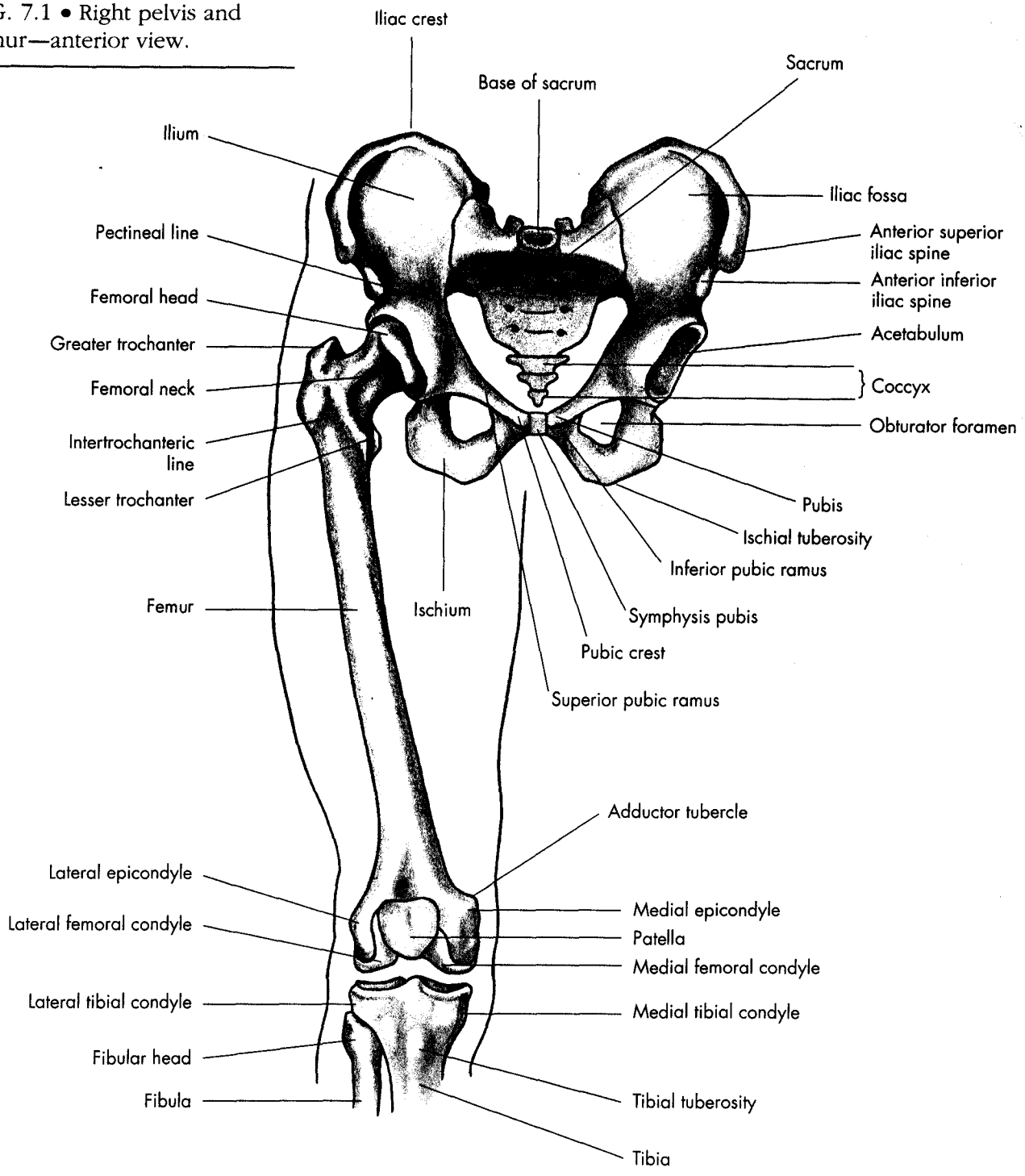
In the anterior area, the pelvic bones are joined to form the symphysis pubis, an amphiarthrodial joint. In the posterior area, the sacrum is located between the two pelvic bones and forms the sacroiliac joints. Strong ligaments unite these bones to form rigid, slightly movable joints. The bones are large and heavy and for the most part are covered by thick, heavy muscles. Very minimal oscillating-type movements can occur in these joints, as in walking or in hip flexion when lying on one's back. However, movements usually involve the entire pelvic girdle and hip joints. In walking, there is hip flexion and extension with rotation of the pelvic girdle, forward in hip flexion and backward in hip extension. Jogging and running result in faster movements and in a greater range of movement.

Sport skills, such as kicking a football or soccer ball, are other good examples of hip and pelvic movements. Pelvic rotation helps increase the length of the stride in running; in kicking it results in a greater distance or more speed to the kick.

Except for the glenohumeral joint, the hip or acetabulofemoral joint is one of the most mobile joints of the body, largely because of its multiaxial arrangement. Unlike the glenohumeral, the hip joint's bony architecture provides a great deal of stability, resulting in relatively few hip joint subluxations and dislocations. The hip joint is classified as an enarthrodial-type joint and is formed by the femoral head inserting into the socket provided by the acetabulum of the pelvis. An extremely strong and dense ligamentous capsule reinforces the joint, especially anteriorly.

Because of individual differences, there is

FIG. 7.1 • Right pelvis and femur—anterior view.



some disagreement about the exact possible range of each movement in the hip joint, but the ranges are generally 0 to 130 degrees of flexion, 0 to 30 degrees of extension, 0 to 35 degrees of abduction, 0 to 30 degrees of adduction, 0 to 45 degrees of internal rotation, and 0 to 50 degrees of external rotation.

The pelvic girdle moves back and forth within three planes for a total of six different movements. To avoid confusion, it is important to analyze the pelvic girdle activity to determine the exact location of the movement. All pelvic girdle rotation actually results from motion at one or more of the following locations: the right hip, the left hip, or the lumbar spine. Although it is not essential for movement to occur in all three of these areas, it must occur in at least one for the pelvis to rotate in any direction. Table 7.1 lists the motions at the hips and lumbar spine that can often accompany rotation of the pelvic girdle.

FIG. 7.3 • Right pelvis and femur—posterior view.

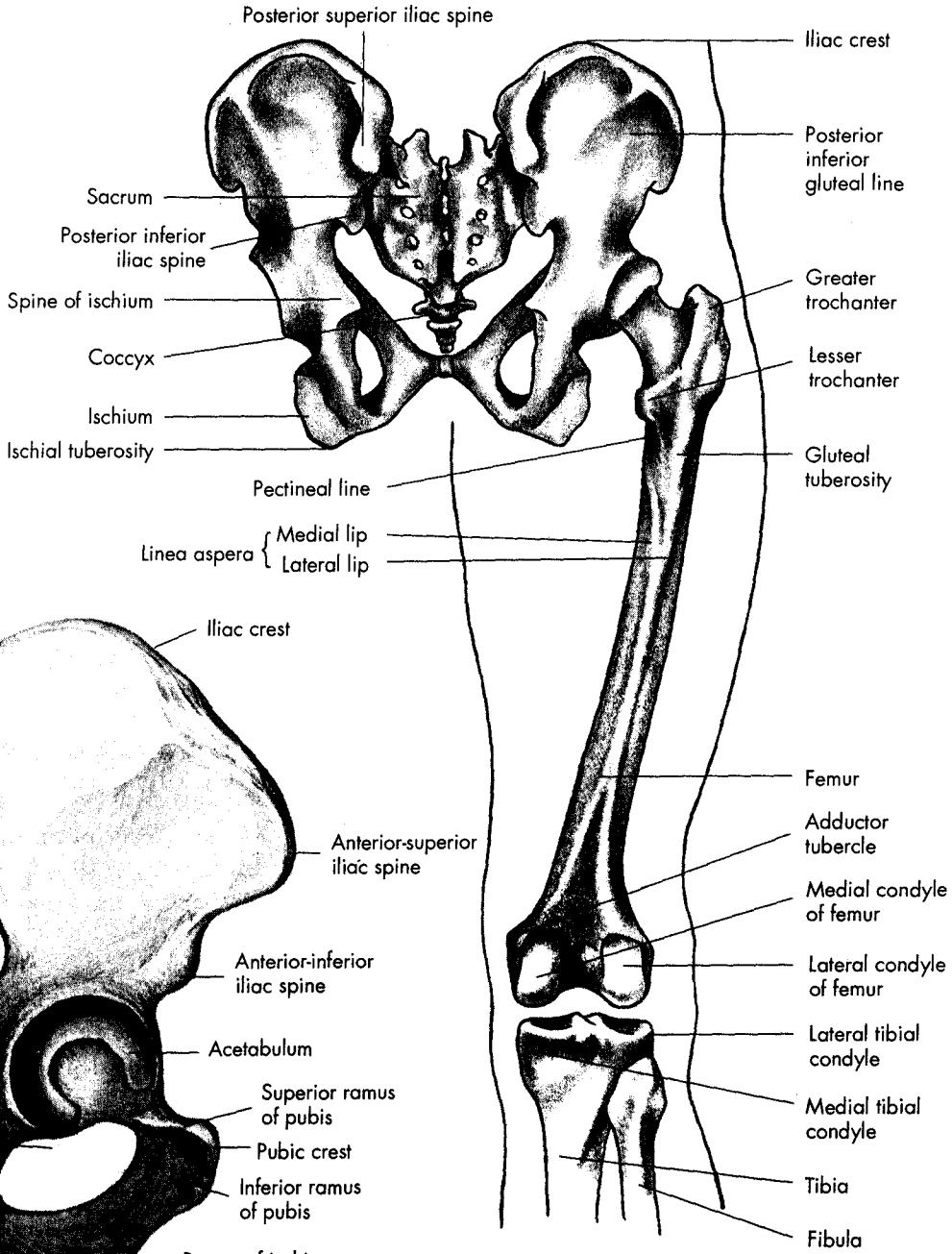


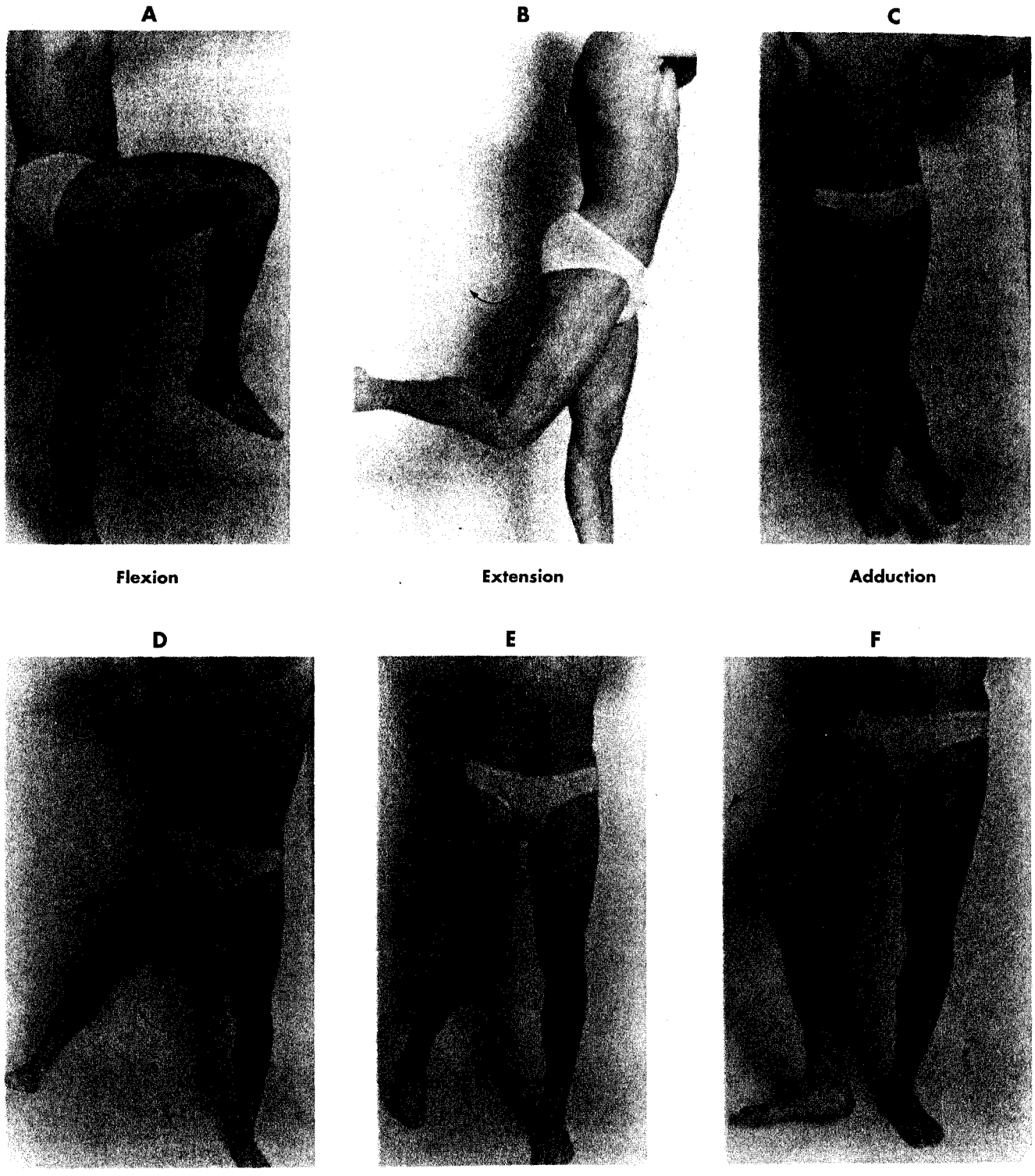
FIG. 7.2 • Right pelvic bone—lateral view.

Modified from Anthony CP, Kolthoff NJ: *Textbook of anatomy and physiology*, ed 9, St. Louis, 1975, Mosby.

TABLE 7.1 • Motions accompanying pelvic rotation.

PELVIC ROTATION	LUMBAR SPINE MOTION	RIGHT HIP MOTION	LEFT HIP MOTION
Anterior rotation	Extension	Flexion	Flexion
Posterior rotation	Flexion	Extension	Extension
Right lateral rotation	Right lateral flexion	Adduction	Abduction
Left lateral rotation	Left lateral flexion	Abduction	Adduction
Right transverse rotation	Left lateral rotation	Internal rotation	External rotation
Left transverse rotation	Right lateral rotation	External rotation	Internal rotation

FIG. 7.4 • Movements of the hip.



Movements FIGS. 7.4 and 7.5

Anterior and posterior pelvic rotation occur in the sagittal or anteroposterior plane, whereas right and left lateral rotation occur in the lateral or frontal plane. Right transverse (clockwise) rotation and left transverse (counterclockwise) rotation occur in the horizontal or transverse plane of motion.

Hip flexion: movement of the femur straight anteriorly toward the pelvis.

Hip extension: movement of the femur straight posteriorly away from the pelvis.

Hip abduction: movement of the femur laterally to the side away from the midline.

Hip adduction: movement of the femur medially toward the midline.

Hip external rotation: rotary movement of the femur laterally around its longitudinal axis away from the midline.

Hip internal rotation: rotary movement of the femur medially around its longitudinal axis toward the midline.

Anterior pelvic rotation: anterior movement of the upper pelvis; the iliac crest tilts forward in a sagittal plane.

Posterior pelvic rotation: posterior movement of the upper pelvis; the iliac crest tilts backward in a sagittal plane.

Left lateral pelvic rotation: in the frontal plane the left pelvis moves superiorly in relation to the right pelvis; either the left pelvis rotates upward or the right pelvis rotates downward.

Right lateral pelvic rotation: in the frontal plane the right pelvis moves superiorly in relation to the left pelvis; either the right pelvis rotates upward or the left pelvis rotates downward.

Left transverse pelvic rotation: in a horizontal plane of motion the pelvis rotates to the body's left; the right iliac crest moves anteriorly in relation to left iliac crest, which moves posteriorly.

Right transverse pelvic rotation: in a horizontal plane of motion the pelvis rotates to the body's right; the left iliac crest moves anteriorly in relation to right iliac crest, which moves posteriorly.

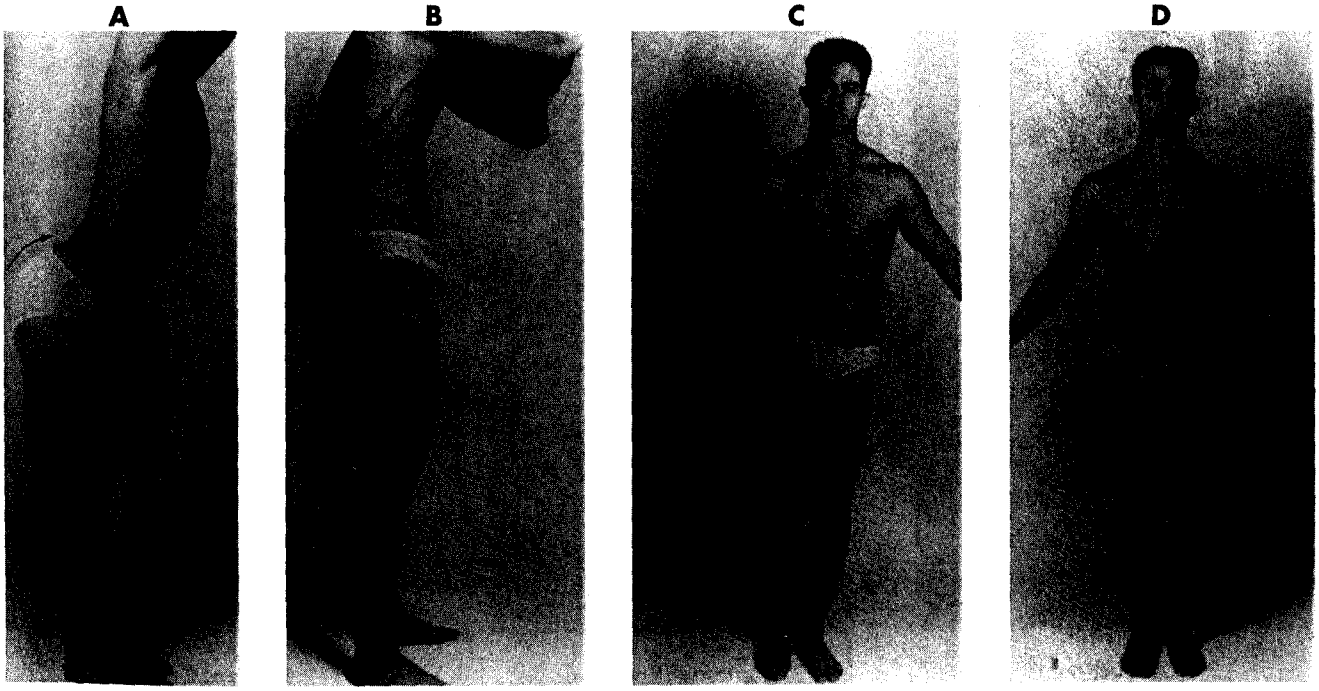


FIG. 7.5 • Pelvic girdle motions.

Muscles

At the hip joint there are six two-joint muscles that have one action at the hip and another at the knee. The muscles actually involved in hip and pelvic girdle motions depend largely on the direction of the movement and the position of the body in relation to the earth and its gravitational forces. In addition, it should be noted that the body part that moves the most will be the part least stabilized. For example, when standing on both feet and contracting the hip flexors, the trunk and pelvis will rotate anteriorly; but when lying supine and contracting the hip flexors, the thighs will move forward into flexion on the stable pelvis.

In another example, the hip flexor muscles are used in moving the thighs toward the trunk, but the extensor muscles are used eccentrically when the pelvis and the trunk move downward slowly on the femur and concentrically when the trunk is raised on the femur—this, of course, in rising to the standing position.

In the downward phase of the knee-bend exercise, the movement at the hips and knees is flexion. The muscles primarily involved are the hip and knee extensors in eccentric contraction.

Hip joint and pelvic girdle muscles—location

Muscle location largely determines the muscle action. Sixteen or more muscles are found in the area (the six external rotators are counted as one muscle). Most hip joint and pelvic girdle muscles are large and strong.

Anterior

Primarily hip flexion
- Iliopsoas
- Pectineus
- Rectus femoris*
- Sartorius

Lateral

Primarily hip abduction
- Gluteus medius
- Gluteus minimus
- External rotators
- Tensor fasciae latae

Posterior

Primarily hip extension
- Gluteus maximus
- Biceps femoris*
- Semitendinosus*
- Semimembranosus*
- External rotators

Medial

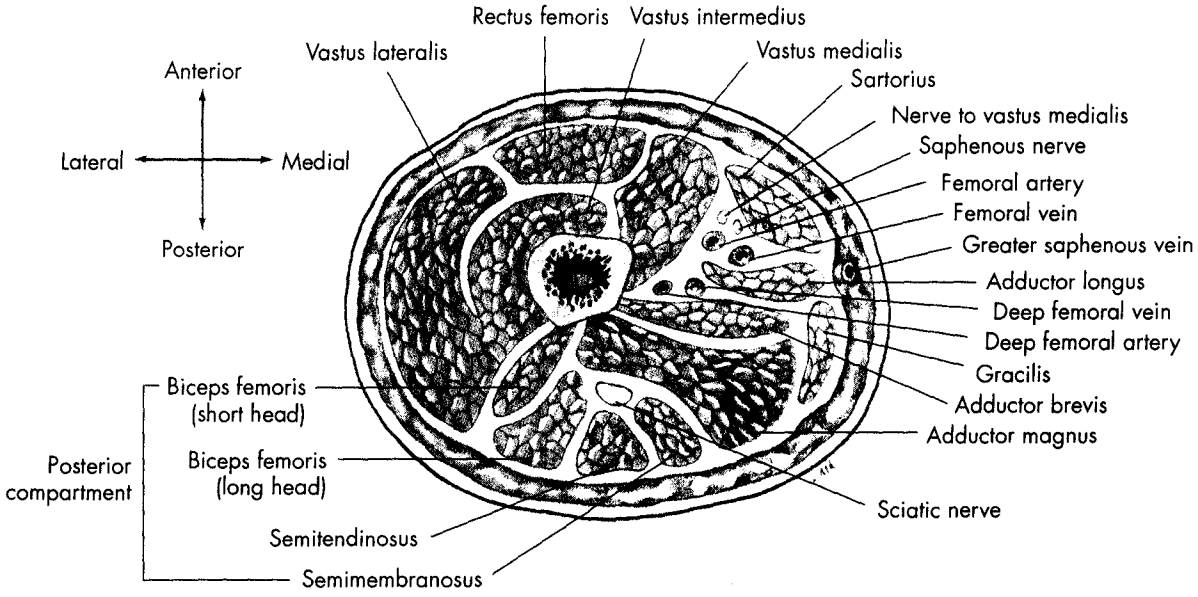
Primarily hip adduction
- Adductor brevis
- Adductor longus
- Adductor magnus
- Gracilis

*Two-joint muscles; knee actions are discussed in Chapter 8.

The muscles of the pelvis that act on the hip joint may be divided into two regions—the iliac and gluteal regions. The iliac region contains the iliopsoas muscle, which flexes the hip. The iliopsoas actually is three different muscles—the iliacus, the psoas major, and the psoas minor. The ten muscles of the gluteal region function primarily to extend and rotate the hip. Located in the gluteal region are the gluteus maximus, gluteus medius, gluteus minimi, tensor fasciae latae, and the six deep external rotators—piriformis, obturator externus, obturator internus, gemellus superior, gemellus inferior, and quadratus femoris.

The thigh is divided into three compartments by the intermuscular septa (Fig. 7.6). The anterior compartment contains the rectus femoris, vastus medialis, vastus intermedius, vastus lateralis, and sartorius. The hamstring muscle group, consisting of the biceps femoris, semitendinosus, and semimembranosus, is located in the posterior compartment. The medial compartment contains the thigh muscles primarily responsible for adduction of the hip, which are the adductor brevis, adductor longus, adductor magnus, pectineus, and gracilis.

FIG 7-6 • Transverse section of the mid-thigh detailing the anterior, posterior, and medial compartments.



Iliopsoas muscle FIG. 7.7

(il'e-o-so'as)

Origin

Iliacus: inner surface of the ilium.

Psoas major and minor: lower borders of the transverse processes (L1-5), sides of the bodies of the last thoracic vertebrae (T12), the lumbar vertebrae (L1-5), intervertebral fibrocartilages, and base of the sacrum.

Insertion

Iliacus and psoas major: lesser trochanter of the femur and the shaft just below.

Psoas minor: pectineal line and iliopectineal eminence.

Action

Flexion of the hip.

External rotation of the femur.

Palpation

Impossible to palpate except with almost complete relaxation of the rectus abdominis muscle.

Innervation

Lumbar nerve and femoral nerve (L2-4).

Application, strengthening, and flexibility

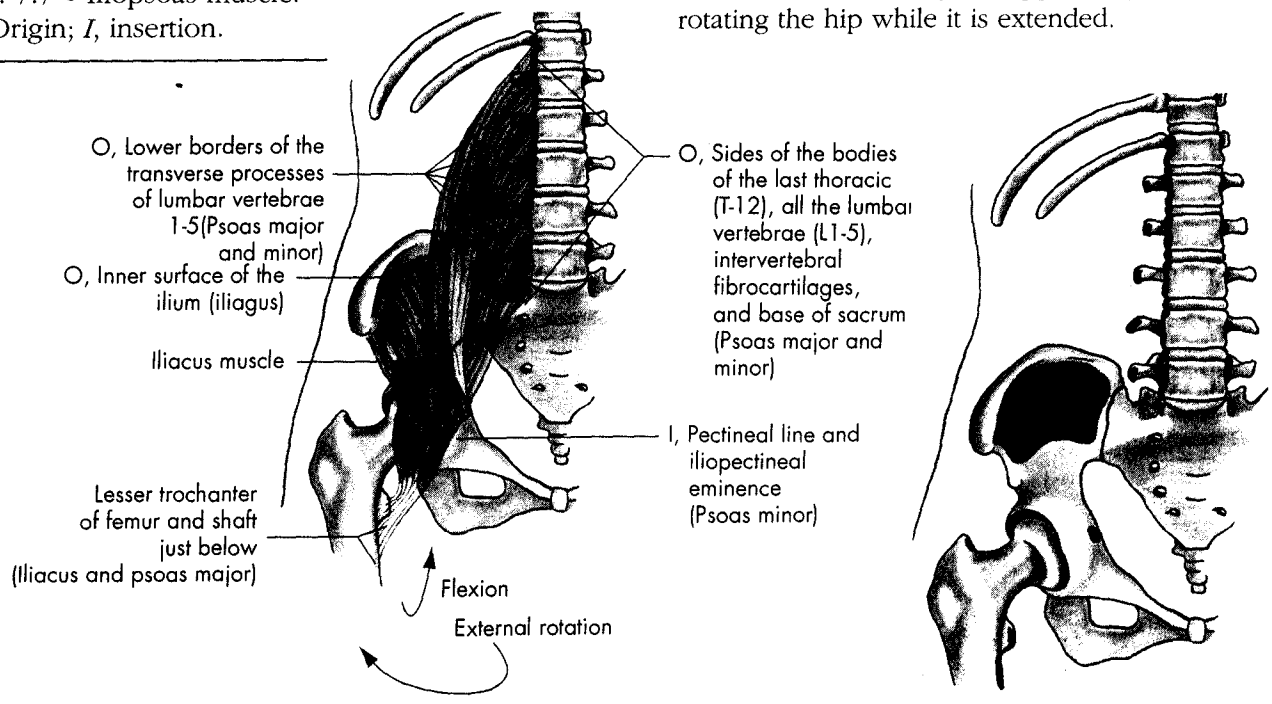
The iliopsoas is commonly referred to as if it were one muscle, but it is actually composed of the iliacus, the psoas major, and the psoas minor. Some anatomy texts make this distinction and list each muscle individually.

The iliopsoas muscle is powerful in actions such as raising the legs from the floor while in a supine position. The psoas major's origin in the lower back tends to move the lower back anteriorly or, in the supine position, pulls the lower back up as it raises the legs. For this reason, lower back problems are often aggravated by this activity and bilateral six-inch leg raises are usually not recommended. The abdominals are the muscles that can be used to prevent this lower back strain by pulling up on the front of the pelvis and thus flattening the back. Leg raising is primarily hip flexion and not abdominal action. Backs may be injured by strenuous and prolonged leg-raising exercises. The iliopsoas contracts strongly, both concentrically and eccentrically, in sit-ups, particularly if the hip is not flexed.

The iliopsoas may be exercised by supporting the arms on a dip bar or parallel bars and then flexing the hips to lift the legs. This may be done initially with the knees flexed in a tucked position to lessen the resistance. As the muscle becomes more developed, the knees can be straightened, which increases the resistance arm length to add more resistance. This concept of increasing or decreasing the resistance by modifying the resistance arm is explained further in Chapter 12.

To stretch the iliopsoas the hip must be extended so that the femur is behind the plane of the body. In order to somewhat isolate the iliopsoas, full knee flexion should be avoided. Slight additional stretch may be applied by internally rotating the hip while it is extended.

FIG. 7.7 • Iliopsoas muscle.
O, Origin; *I*, insertion.



Sartorius muscle FIG. 7.8

(sar-to'ri-us)

Origin

Anterior superior iliac spine and notch just below the spine.

Insertion

Anterior medial condyle of the tibia.

Action

Flexion of the hip.
Flexion of the knee.
External rotation of the thigh as it flexes the hip and knee.

Palpation

Easiest to palpate at the anterior superior spine of the ilium; impossible to palpate on subjects with medium and heavy legs.

Innervation

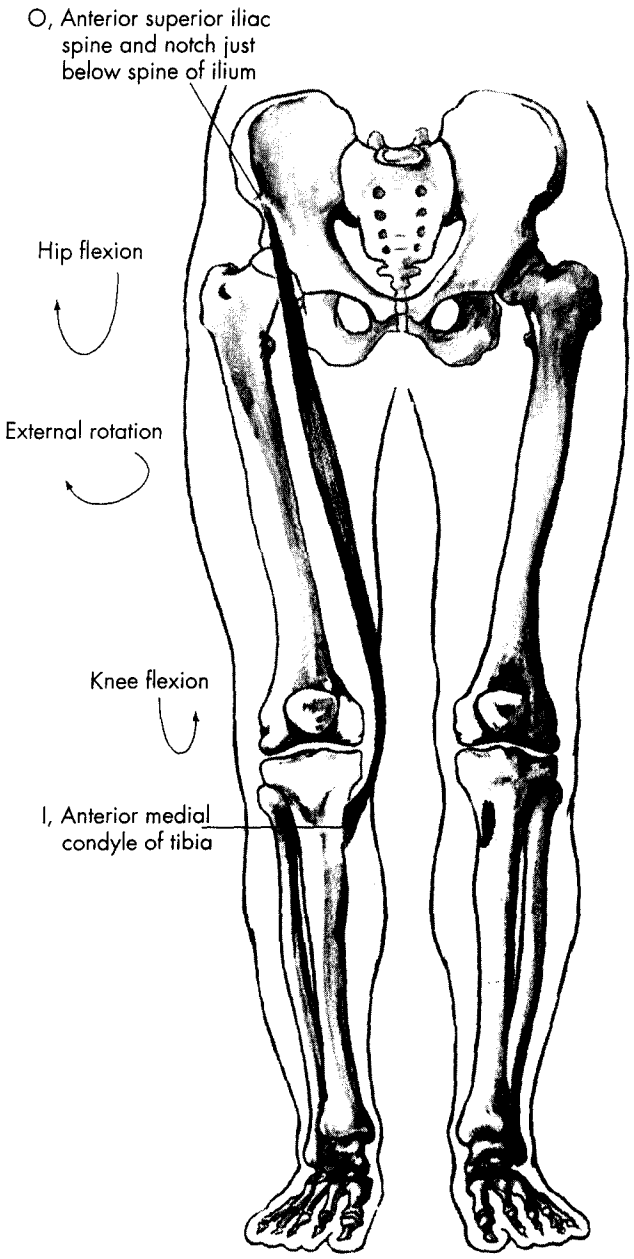
Femoral nerve (L2-3).

Application, strengthening, and flexibility

Pulling from the anterior superior iliac spine and the notch just below it, the tendency again is to tilt the pelvis anteriorly (down in front) as this muscle contracts. The abdominal muscles must prevent this tendency by posteriorly rotating the pelvis (pulling up in front) and thus flattening the lower back.

The sartorius, a two-joint muscle, is effective as a hip flexor or as a knee flexor. It is weak when both actions take place at the same time. Observe that, in attempting to cross the knees when in a sitting position, one customarily leans well back, thus raising the origin to lengthen this muscle, making it more effective in flexing and crossing the knees. With the knees held extended, the sartorius becomes a more effective hip flexor. It is the longest muscle in the body and is strengthened when hip flexion activities are performed as described for developing the iliopsoas. Stretching may be accomplished by a partner passively taking the hip into extreme extension, adduction, and internal rotation with the knee extended.

FIG. 7.8 • Sartorius muscle. *O*, Origin; *I*, insertion.



Rectus femoris muscle FIG. 7.9

(rek'tus fem'or-is)

Origin

Anterior inferior iliac spine of the ilium and groove (posterior) above the acetabulum.

Insertion

Superior aspect of the patella and patellar tendon to the tibial tuberosity.

Action

Flexion of the hip.
Extension of the knee.

Palpation

Any place on the anterior surface of the femur.

Innervation

Femoral nerve (L2-4).

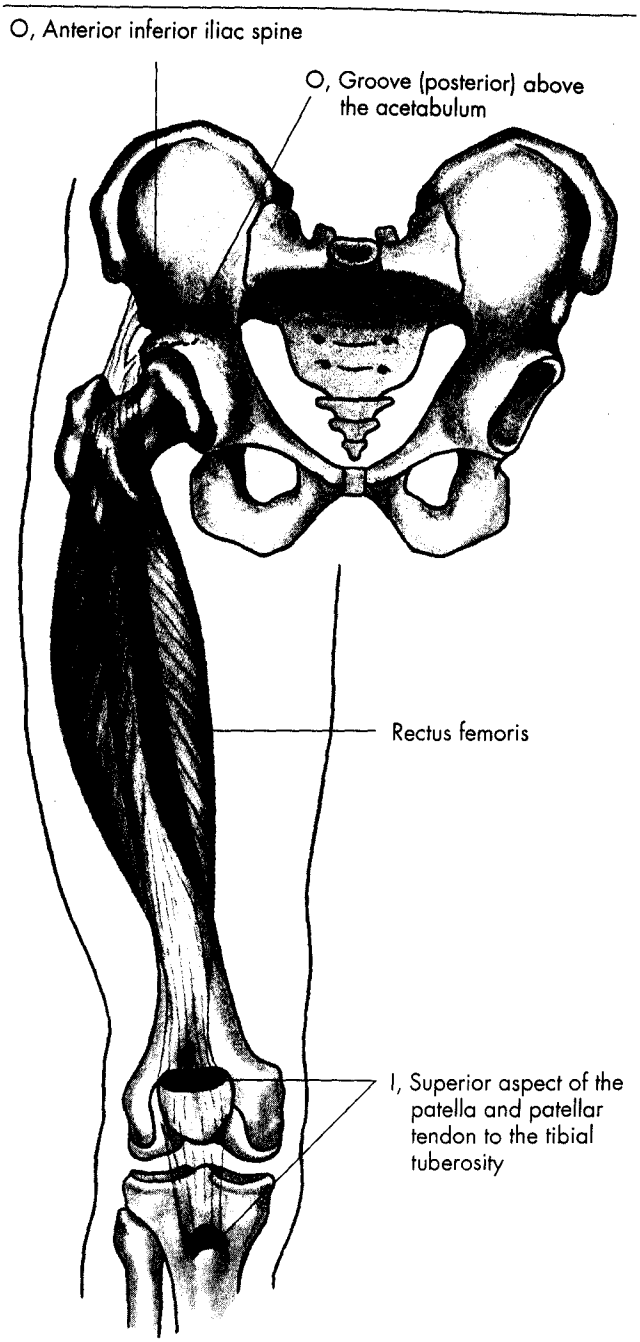
Application, strengthening, and flexibility

Pulling from the anterior inferior iliac spine of the ilium, the rectus femoris muscle has the same tendency to anteriorly rotate the pelvis (down in front and up in back). Only the abdominal muscles can prevent this from occurring. In speaking of the hip flexor group in general, it may be said that many people permit the pelvis to be permanently tilted forward as they get older. The relaxed abdominal wall does not hold the pelvis up, and therefore an increased lumbar curve results.

Generally, a muscle's ability to exert force decreases as it shortens. This explains why the rectus femoris muscle is a powerful extensor of the knee when the hip is extended but is weak when the hip is flexed. This muscle is exercised, along with the vastus group, in running, jumping, hopping, and skipping. In these movements, the hips are extended powerfully by the gluteus maximus and the hamstring muscles, which counteract the tendency of the rectus femoris muscle to flex the hip while it extends the knee. It can be remembered as one of the quadriceps muscle group. The rectus femoris is developed by performing hip flexion exercises or knee extension exercises against manual resistance.

The rectus femoris is stretched by fully flexing the knee while extending the hip.

FIG. 7.9 • Rectus femoris muscle. *O*, Origin; *I*, insertion.



Tensor fasciae latae muscle FIG. 7.10

(ten'sor fas'i-e la'te)

Origin

Anterior iliac crest and surface of the ilium just below the crest.

Insertion

One-fourth of the way down the thigh into the iliotibial tract, which in turn inserts onto Gerdy's tubercle of the anterolateral tibial condyle.

Action

Abduction of the hip.
Flexion of the hip.
Tendency to rotate the hip internally as it flexes.

Palpation

Slightly in front of the greater trochanter.

Innervation

Superior gluteal nerve (L4-5, S1).

Application, strengthening, and flexibility

The tensor fasciae latae muscle aids in preventing external rotation of the femur as it is flexed by other flexor muscles.

The tensor fasciae latae muscle is used when flexion and internal rotation take place. This is a weak movement but is important in helping to direct the leg forward so that the foot is placed straight forward in walking and running. Thus, from the supine position, raising the leg with definite internal rotation of the femur will call it into action.

The tensor fasciae latae may be developed by performing hip abduction exercises against gravity and resistance while in a side-lying position. This is done simply by abducting the hip that is up and then slowly lowering it back to rest against the other leg. Stretch may be applied by remaining on the side and having a partner passively move the downside hip into full extension, adduction, and external rotation.

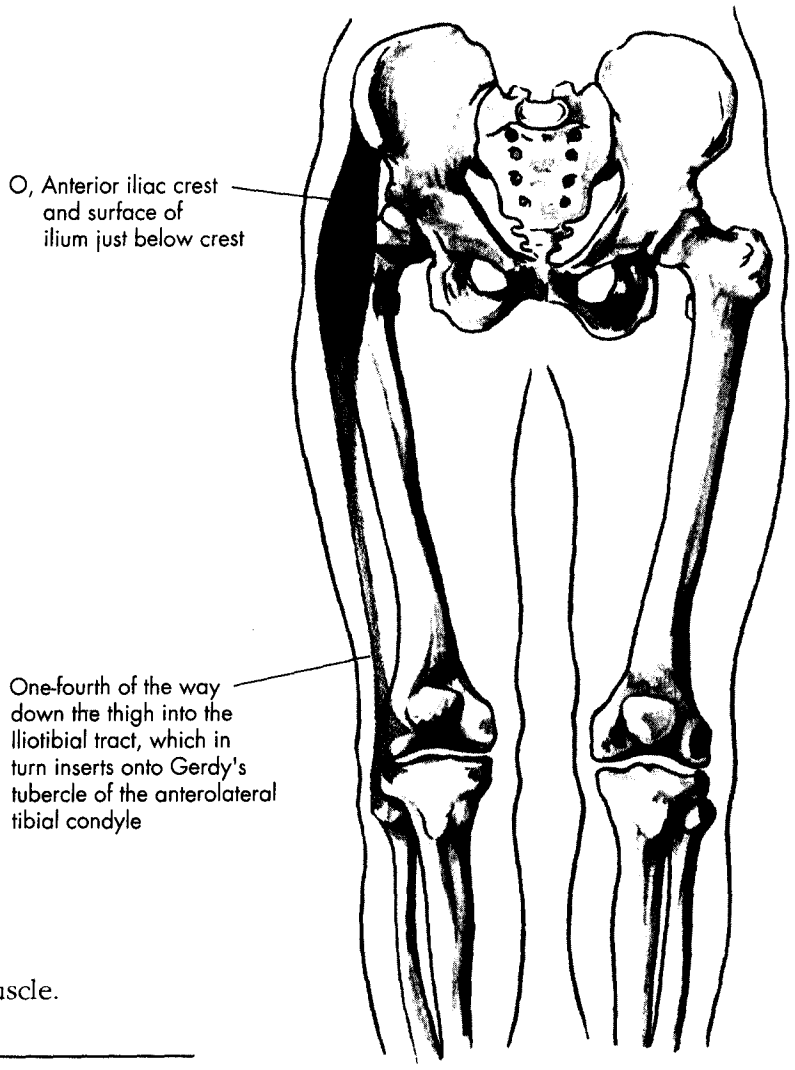


FIG. 7.10 • Tensor fasciae latae muscle.
O, Origin; *I*, insertion.

The six deep lateral rotator muscles—

piriformis

(pi-ri-for'mis),

gemellus superior

(je-mel'us su-pe'ri-or),

gemellus inferior

(je-mel'us in-fe'ri-or),

obturator externus

(ob-tu-ra'tor eks-ter'nus),

obturator internus

(ob-tu-ra'tor in-ter'nus),

quadratus femoris

(kwad-ra'tus fem'or-is) FIG 7.11

Origin

Anterior sacrum, posterior portions of the ischium, and obturator foramen.

Insertion

Superior and posterior aspect of the greater trochanter.

Action

External rotation of the hip.

Palpation

Cannot be palpated.

Innervation

Piriformis: first or second sacral nerve (S1-2).
Gemellus superior: sacral nerve (L5, S1-2).
Gemellus inferior: branches from sacral plexus (L4-5, S1-2).
Obturator externus: obturator nerve (L3-4).
Obturator internus: branches from sacral plexus (L4-5, S1-2).
Quadratus femoris: branches from sacral plexus (L4-5, S1).

Application, strengthening, and flexibility

The six lateral rotators are used powerfully in movements of external rotation of the femur, as in sports in which the individual takes off on one leg from a preliminary internal rotation. Throwing a baseball and swinging a baseball bat, in which there is rotation of the hip, are typical examples.

Standing on one leg and forcefully turning the body away from that leg is accomplished by contraction of these muscles, and it may be repeated for strengthening purposes. A partner may provide resistance as development progresses. The six deep lateral rotators may be stretched in the supine position with a partner passively internally rotating and slightly flexing the hip.

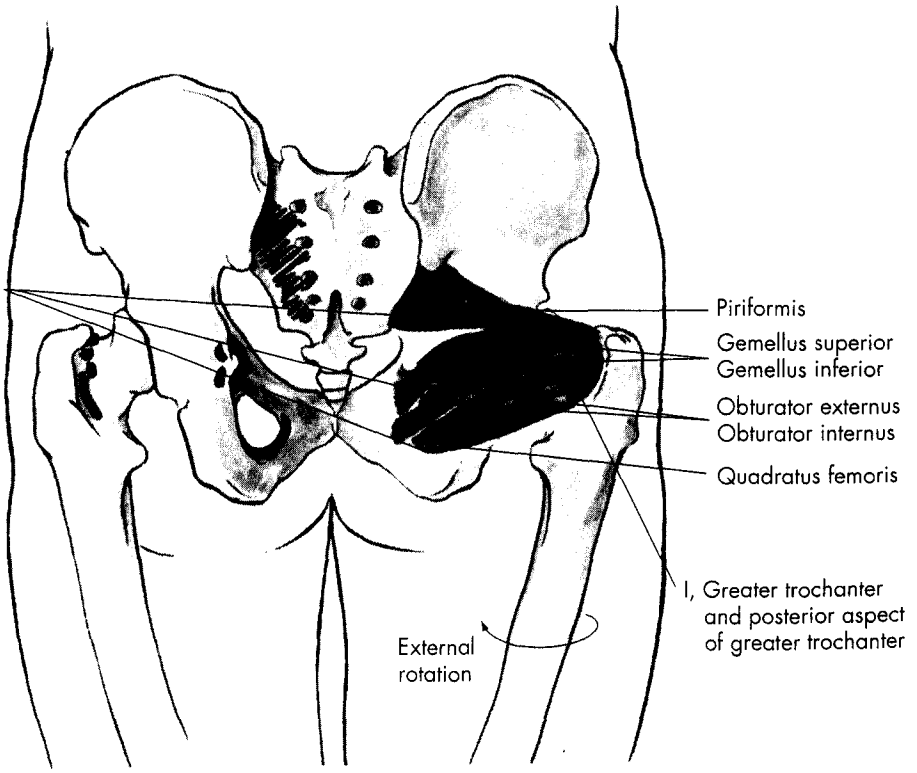


FIG. 7.11 • The six deep lateral rotator muscles: piriformis, gemellus superior, gemellus inferior, obturator externus, obturator internus, and quadratus femoris.

Gluteus minimus muscle FIG. 7.12

(glu'te-us min'i-mus)

Origin

Lateral surface of the ilium just below the origin of the gluteus medius.

Insertion

Anterior surface of the greater trochanter of the femur.

Action

Abduction of the hip.
Internal rotation as the femur abducts.

Palpation

Cannot be palpated.

Innervation

Superior gluteal nerve (L4-5, S1).

Application, strengthening, and flexibility

Both the gluteus minimus and the gluteus medius are used in powerfully maintaining proper hip abduction while running. As a result, both of these muscles are exercised effectively in running, hopping, and skipping, in which weight is transferred forcefully from one foot to the other. As the body ages, the gluteus medius and gluteus minimus muscles tend to lose their effectiveness. The spring of youth, as far as the hips are concerned, resides in these muscles. To have great drive in the legs, these muscles must be fully developed.

The gluteus minimus is best strengthened by performing hip abduction exercises similar to the ones described for the tensor fasciae latae and gluteus medius muscles. It may also be developed by performing hip internal rotation exercises against manual resistance. Stretching of this muscle is accomplished by extreme hip adduction with slight external rotation.

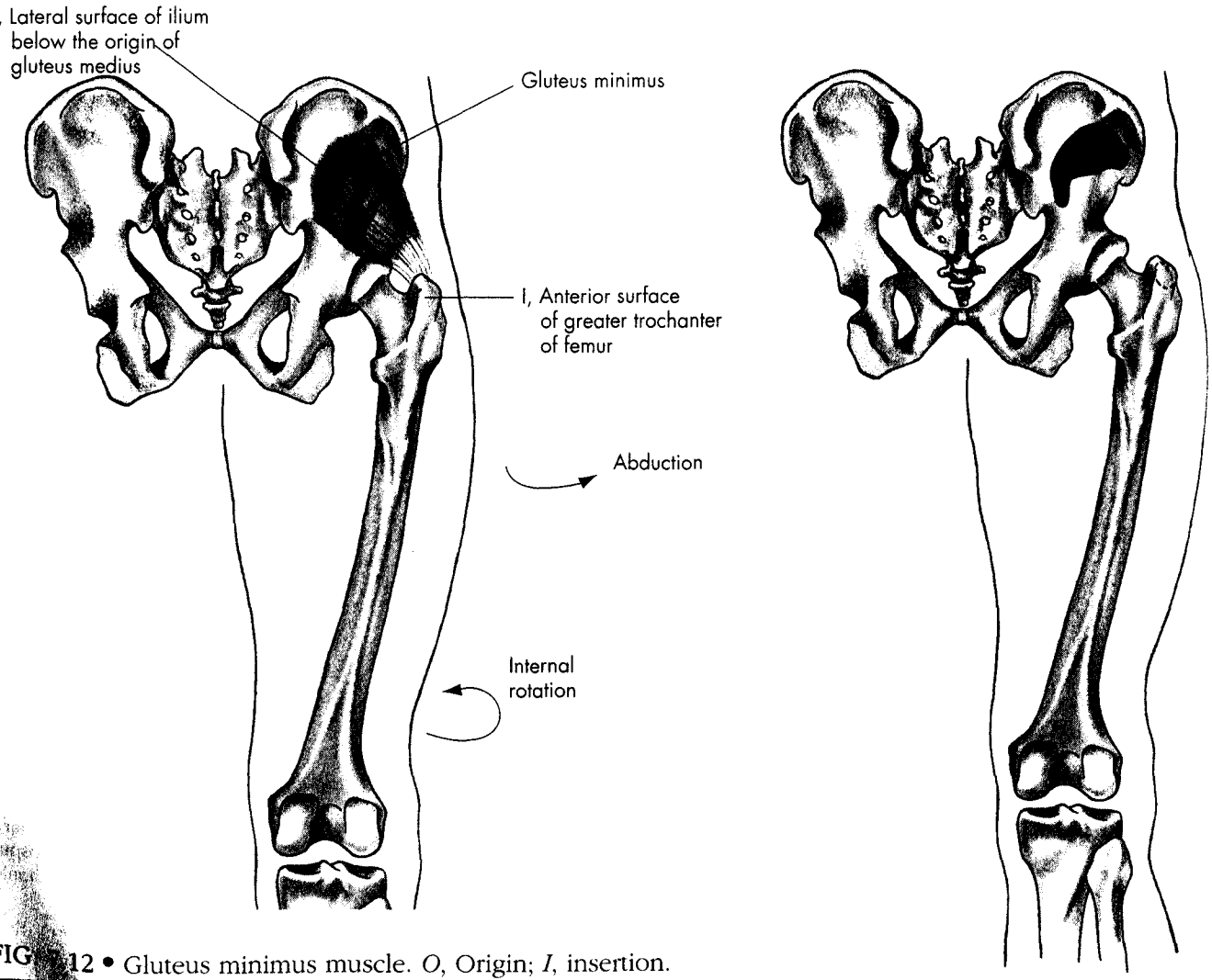


FIG. 7.12 • Gluteus minimus muscle. *O*, Origin; *I*, insertion.

Gluteus medius muscle FIG. 7.13

(glu'te-us me'di-us)

Origin

Lateral surface of the ilium just below the crest.

Insertion

Posterior and middle surfaces of the greater trochanter of the femur.

Action

Abduction of the hip.
External rotation as the hip abducts (posterior fibers).
Internal rotation (anterior fibers).

Palpation

Slightly in front of and a few inches above the greater trochanter.

Innervation

Superior gluteal nerve (L4-5,S1).

Application, strengthening, and flexibility

Typical action of the gluteus medius and gluteus minimus muscles is seen in walking. As the weight of the body is suspended on one leg, these muscles prevent the opposite hip from sagging. Weakness in the gluteus medius and gluteus minimus can result in the Trendelenburg gait. With this weakness, the individual's opposite hip will sag upon weight bearing because the hip abductors cannot maintain proper alignment.

Hip external rotation exercises performed against resistance can provide some strengthening for the gluteus medius, but it is best strengthened by performing the side-lying leg raises or hip abduction exercises as described for the tensor fasciae latae. The gluteus medius is best stretched by moving the hip into extreme adduction in front of the opposite extremity and then behind it.

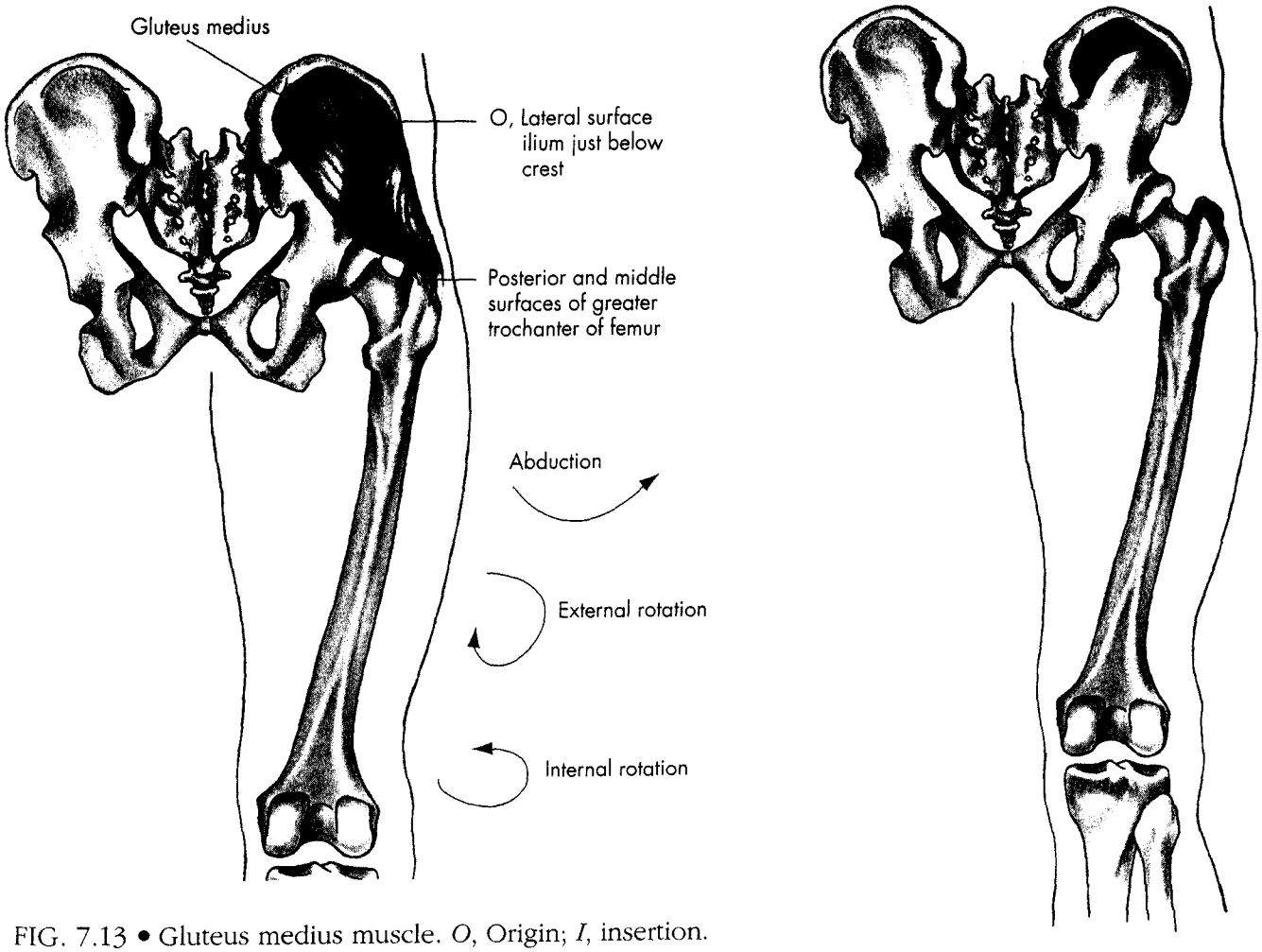


FIG. 7.13 • Gluteus medius muscle. *O*, Origin; *I*, insertion.

Gluteus maximus muscle FIG. 7.14

(glu'te-us maks'i-mus)

Origin

Posterior one-fourth of the crest of the ilium, posterior surface of the sacrum and coccyx near the ilium, and fascia of the lumbar area.

Insertion

Oblique ridge on the lateral surface of the greater trochanter and the iliotibial band of the fasciae latae.

Action

Extension of the hip.
External rotation of the hip.
Lower fibers, which assist in adduction.

Palpation

Wide area on the posterior surface of the pelvis.

Innervation

Inferior gluteal nerve (L5, S1-2).

Application, strengthening, and flexibility

The gluteus maximus muscle comes into action when movement between the pelvis and the femur approaches and goes beyond 15 degrees of extension. As a result, it is not used extensively in ordinary walking. It is important in extension of the thigh with external rotation.

Strong action of the gluteus maximus muscle is seen in running, hopping, skipping, and jumping. Powerful extension of the thigh is secured in the return to standing from a squatting position, especially if a barbell with weights is placed on the shoulders.

Hip extension exercises from a forward-leaning or prone position may be used to develop this muscle. This muscle is most emphasized when the hip starts from a flexed position and moves to full extension with the knee flexed 30 degrees or more to reduce the hamstrings' involvement in the action.

The gluteus maximus is stretched in the supine position with full hip flexion to the ipsilateral axilla and then to the contralateral axilla with the knee in flexion. Simultaneous internal hip rotation accentuates this stretch.

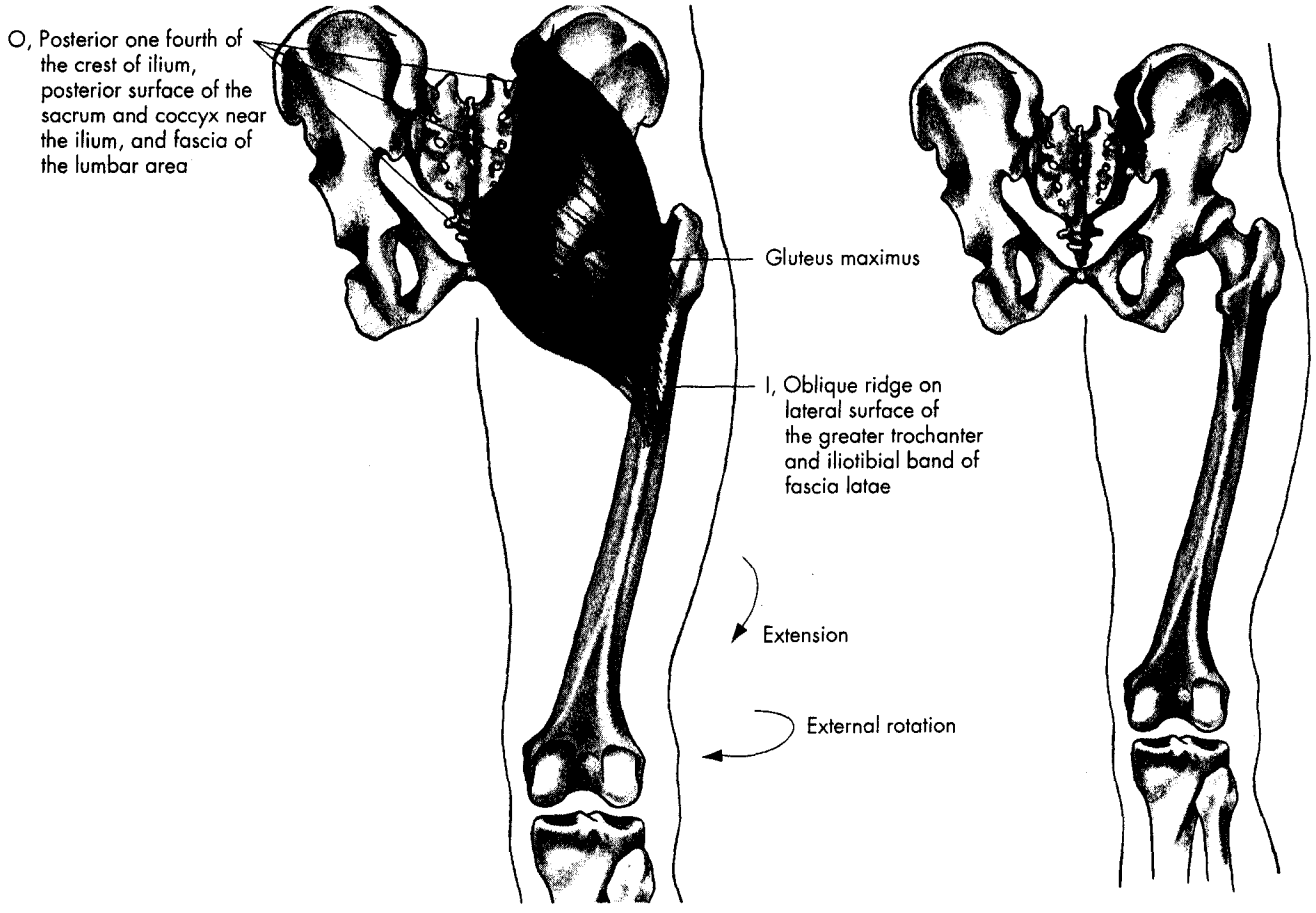


FIG. 7.14 • Gluteus maximus muscle. *O*, Origin; *I*, insertion.

Biceps femoris muscle FIG. 7.15

(bi'seps fem'or-is)

Origin

Long head: ischial tuberosity.
Short head: lower half of the linea aspera, and lateral condyloid ridge.

Insertion

Lateral condyle of the tibia and head of the fibula.

Action

Extension of the hip.
Flexion of the knee.
External rotation of the hip.
External rotation of the knee.

Palpation

Lateral posterior side of the femur, near the knee.

Innervation

Long head: sciatic nerve—tibial division (S1-3).
Short head: sciatic nerve—peroneal division (L5, S1-2).

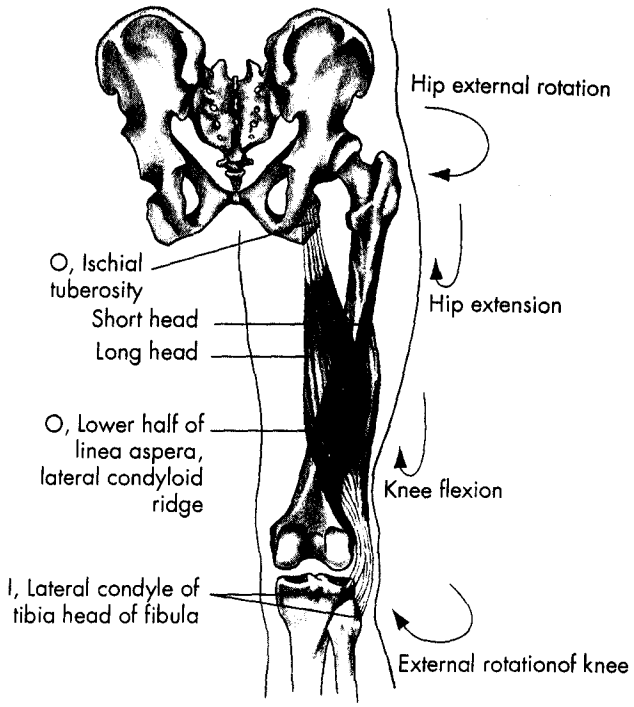
Application, strengthening, and flexibility

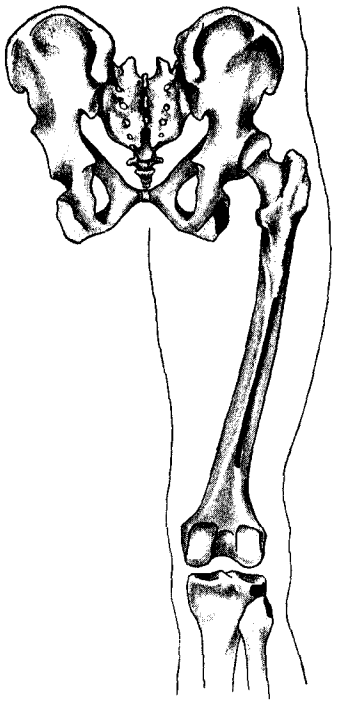
The semitendinosus, semimembranosus, and biceps femoris muscles are known as the hamstrings. These muscles, together with the gluteus maximus muscle, are used in extension of the thigh when the knees are straight or nearly so. Thus in running, jumping, skipping, and hopping, these muscles are used together. The hamstrings are used without the aid of the gluteus maximus, however, when one is hanging from a bar by the knees. Similarly, the gluteus maximus is used without the aid of the hamstrings when the knees are flexed while the hips are being extended. This occurs when rising from a knee-bend position to a standing position.

The biceps femoris is best developed through knee flexion exercises against resistance. Commonly known as hamstring curls or leg curls, they may be performed in a prone position on a knee table or standing with ankle weights attached. This muscle is emphasized when performing hamstring curls while attempting to maintain the knee joint in external rotation. This externally rotated position brings its insertion in alignment with its origin.

The biceps femoris is best stretched by maximally extending the knee while flexing the internally rotated and slightly adducted hip.

FIG. 7.15 • Biceps femoris muscle. *O*, Origin; *I*, insertion.





Semitendinosus muscle FIG. 7.16

(sem'i-ten-di-no'sus)

Origin

Ischial tuberosity.

Insertion

Upper anterior medial surface of the tibia.

Action

Extension of the hip.
Flexion of the knee.
Internal rotation of the hip.
Internal rotation of the knee.

Palpation

Near the knee on the posteromedial side.

Innervation

Sciatic nerve—tibial division (L5, S1-2).

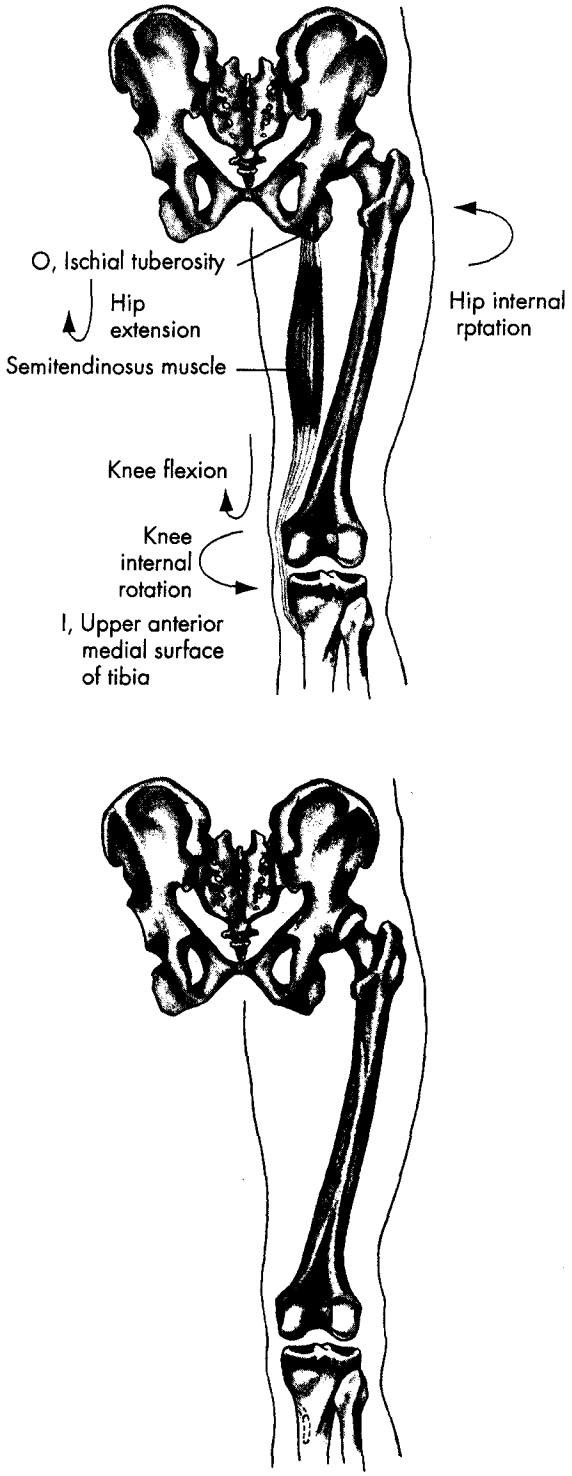
Application, strengthening, and flexibility

This two-joint muscle is most effective when contracting to either extend the hip or flex the knee. When there is extension of the hip and flexion of the knee at the same time, both movements are weak. When the trunk is bent forward with the knees straight, the hamstring muscles have a powerful pull on the rear pelvis and tilt it down in back by full contraction. If the knees are flexed when this movement takes place, one can observe that the work is done chiefly by the gluteus maximus muscle.

On the other hand, when the muscles are used in powerful flexion of the knees, as in hanging by the knees from a bar, the flexors of the hip come into play to raise the origin of these muscles and make them more effective as knee flexors. By full extension of the hips in this movement, the knee flexion movement is weakened. These muscles are used in ordinary walking as extensors of the hip and allow the gluteus maximus to relax in the movement.

The semitendinosus is best developed through hamstring curls as described for the biceps femoris, but it is emphasized more if the knee is maintained in internal rotation throughout the range of motion, which brings the origin and insertion more in line with each other. The semitendinosus is stretched by maximally extending the knee while flexing the externally rotated and slightly abducted hip.

FIG. 7.16 • Semitendinosus muscle. *O*, Origin; *I*, insertion.



Semimembranosus muscle FIG. 7.17

(sem'i-mem'bra-no'sus)

Origin

Ischial tuberosity.

Insertion

Posteromedial surface of the medial tibial condyle.

Action

Extension of the hip.
Flexion of the knee.
Internal rotation of the hip.
Internal rotation of the knee.

Palpation

Largely covered by other muscles, the tendon can be felt at the posterior aspect of the tibia on the medial side.

Innervation

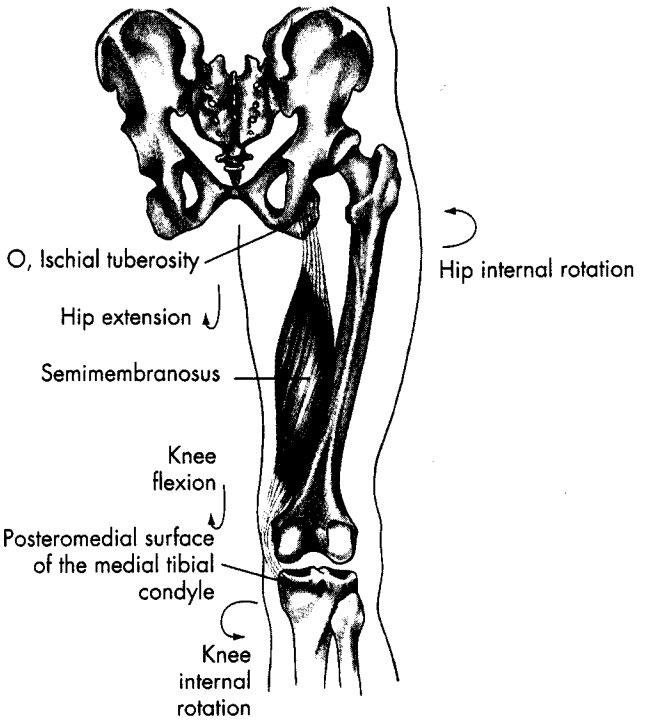
Sciatic nerve—tibial division (L5, S1-2).

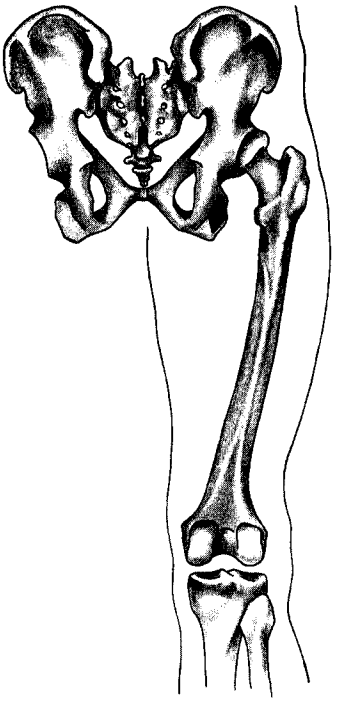
Application, strengthening, and flexibility

Both the semitendinosus and semimembranosus are responsible for internal rotation of the knee, along with the popliteus muscle, which is discussed in the next chapter. Because of the manner in which they cross the joint, the muscles are very important in providing dynamic medial stability to the knee joint.

The semimembranosus is best developed by performing leg curls. Internal rotation of the knee throughout the range accentuates the activity of this muscle. The semimembranosus is stretched in the same manner as the semitendinosus.

FIG. 7.17 • Semimembranosus muscle. O, Origin; *I*, insertion.





Pectineus muscle FIG. 7.18

(pek-tin'e-us)

Origin

Space 1 inch wide on the front of the pubis just above the crest.

Insertion

Rough line leading from the lesser trochanter down to the linea aspera.

Action

Flexion of the hip.
Adduction of the hip.
Internal rotation of the hip.

Palpation

Angle between the pubic bone and the femur; hard to distinguish from the adductor longus muscle.

Innervation

Femoral nerve (L2-4).

Application, strengthening, and flexibility

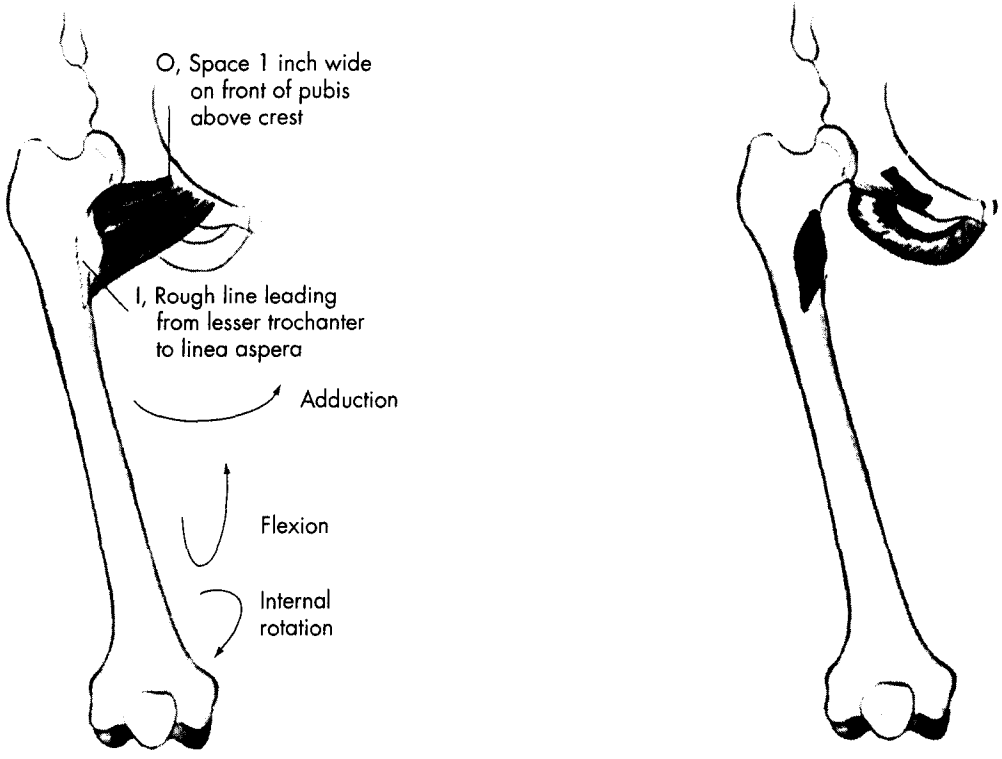
As the pectineus contracts, it also tends to rotate the pelvis anteriorly. The abdominal muscles pulling up on the pelvis in front prevent this tilting action.

The pectineus muscle is exercised together with the iliopsoas muscle in leg raising and lowering. Hip flexion exercises and hip adduction exercises against resistance may be used for strengthening this muscle.

The pectineus is stretched by fully abducting the extended and externally rotated hip.

FIG. 7.18 • Pectineus muscle. *O*, Origin; *I*, insertion.

Modified from Anthony CP, Kolthoff NJ: *Textbook of anatomy and physiology*, ed 9, St. Louis, 1975, Mosby.



Adductor brevis muscle Fig. 7.19

(ad-duk'tor bre'vis)

Origin

Front of the inferior pubic ramus just below the origin of the longus.

Insertion

Lower two-thirds of the pectineal line of the femur and the upper half of the medial lip of the linea aspera.

Action

Adduction of the hip.
External rotation as it adducts the hip.

Palpation

Cannot be palpated.

Innervation

Obturator nerve (L3-4).

Application, strengthening, and flexibility

The adductor brevis muscle, along with the other adductor muscles, provides powerful movement of the thighs toward each other. Squeezing the legs together toward each other against resistance is effective in strengthening the adductor brevis. Abducting the extended and internally rotated hip provides stretching of the adductor brevis.

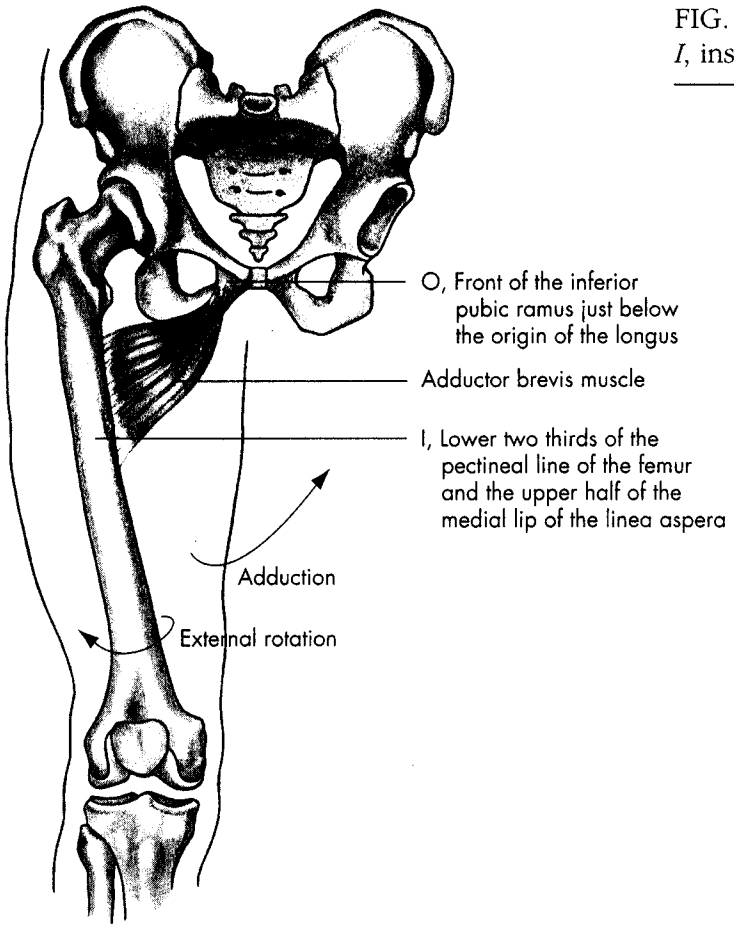
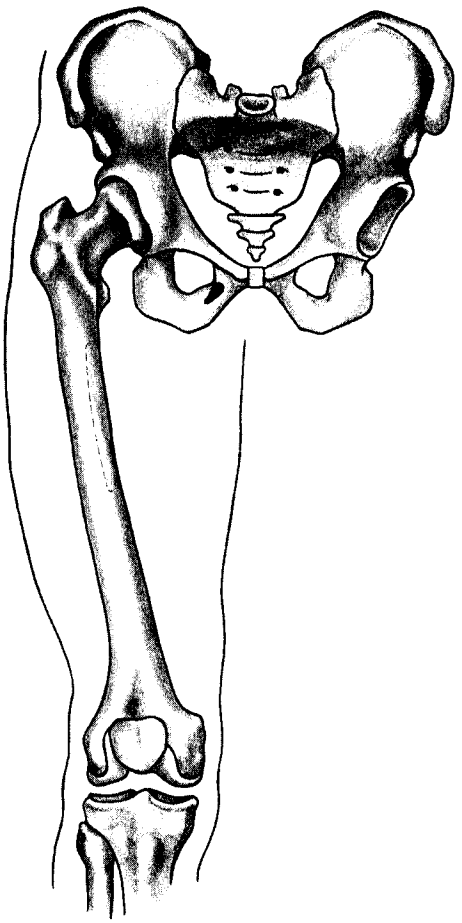


FIG. 7.19 • Adductor brevis muscle. *O*, Origin; *I*, insertion.



Adductor longus muscle FIG. 7.20

(ad-duk'tor long'gus)

Origin

Anterior pubis just below its crest.

Insertion

Middle third of the linea aspera.

Action

Adduction of the hip.
Assists in flexion of the hip.

Palpation

Just below the pubic bone on the medial side.

Innervation

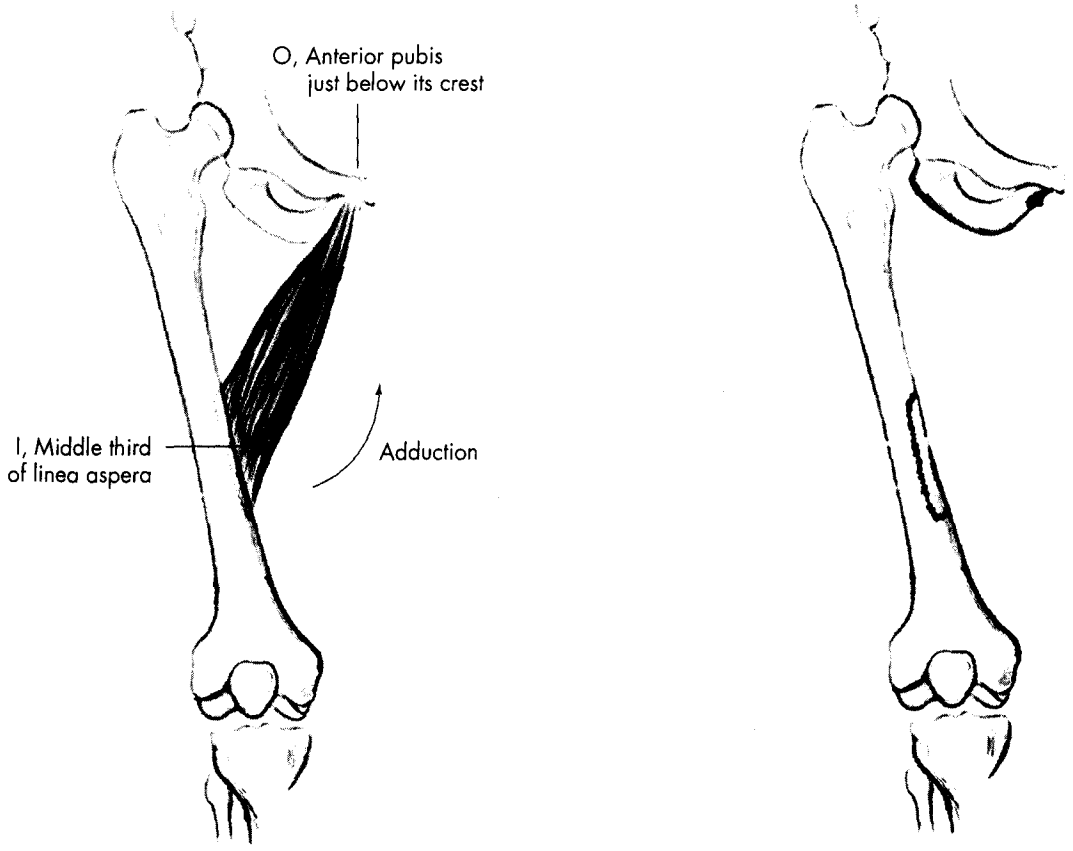
Obturator nerve (L3-4).

Application, strengthening, and flexibility

The muscle may be strengthened by using the scissors exercise, which requires the subject to sit on the floor with the legs spread wide while a partner puts his or her legs or arms inside each lower leg to provide resistance. As the subject attempts to adduct his or her legs together, the partner provides manual resistance throughout the range of motion. This exercise may be used for either one or both legs. The adductor longus is stretched in the same manner as the adductor brevis.

FIG. 7.20 • Adductor longus muscle. *O*, Origin; *I*, insertion.

Modified from Anthony CP, Kolthoff NJ: *Textbook of anatomy and physiology*, ed 9, St. Louis, 1975, Mosby.



Adductor magnus muscle FIG. 7.21

(ad-duk'tor mag'nus)

Origin

Edge of the entire ramus of the pubis and the ischium and ischial tuberosity.

Insertion

Whole length of the linea aspera, inner condyloid ridge, and adductor tubercle.

Action

Adduction of the hip.
External rotation as the hip adducts.

Palpation

Posteromedial surface of the thigh.

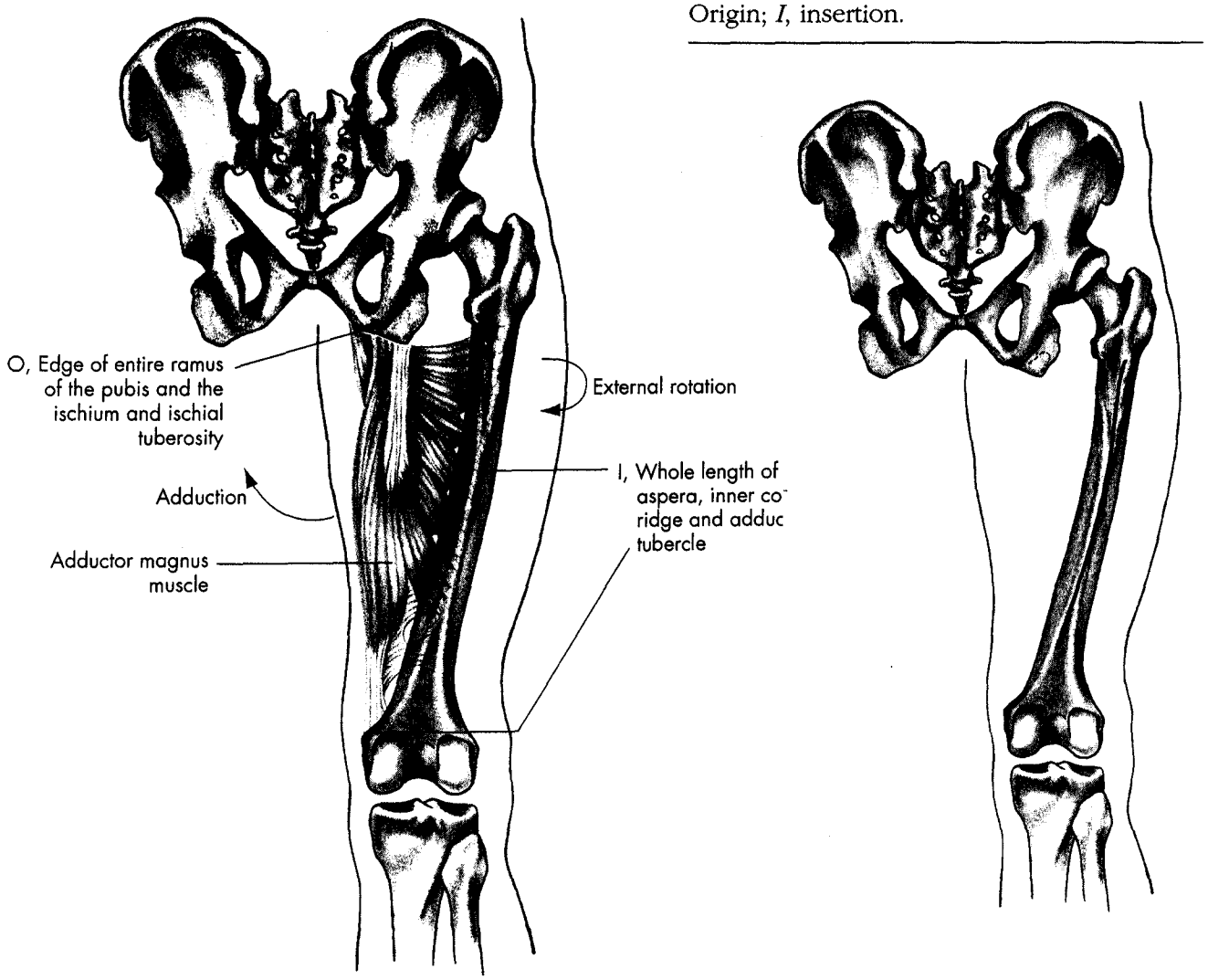
Innervation

Anterior: obturator nerve (L2-4).
Posterior: sciatic nerve (L4-5, S1-3).

Application, strengthening, and flexibility

The adductor magnus muscle is used in the breaststroke kick in swimming or in horseback riding. Since the adductor muscles (adductor magnus, adductor longus, adductor brevis, and gracilis muscles) are not heavily used in ordinary movement, some prescribed activity for them should be provided. Some modern exercise equipment are engineered to provide resistance for hip adduction movement. Hip adduction exercises such as those described for the adductor brevis and the adductor longus may be used for strengthening the adductor magnus as well. The adductor magnus is stretched in the same manner as the adductor brevis and adductor longus.

FIG. 7.21 • Adductor magnus muscle. *O*, Origin; *I*, insertion.



Gracilis muscle FIG. 7.22

(gras'-il-is)

Origin

Anteromedial edge of the descending ramus of the pubis.

Insertion

Anterior medial surface of the tibia below the condyle.

Action

Adduction of the hip.
Flexion of the knee.
Internal rotation of the hip.

Palpation

Medial side of the thigh 2 to 3 inches below the pubic bone.

Innervation

Obturator nerve (L2-4).

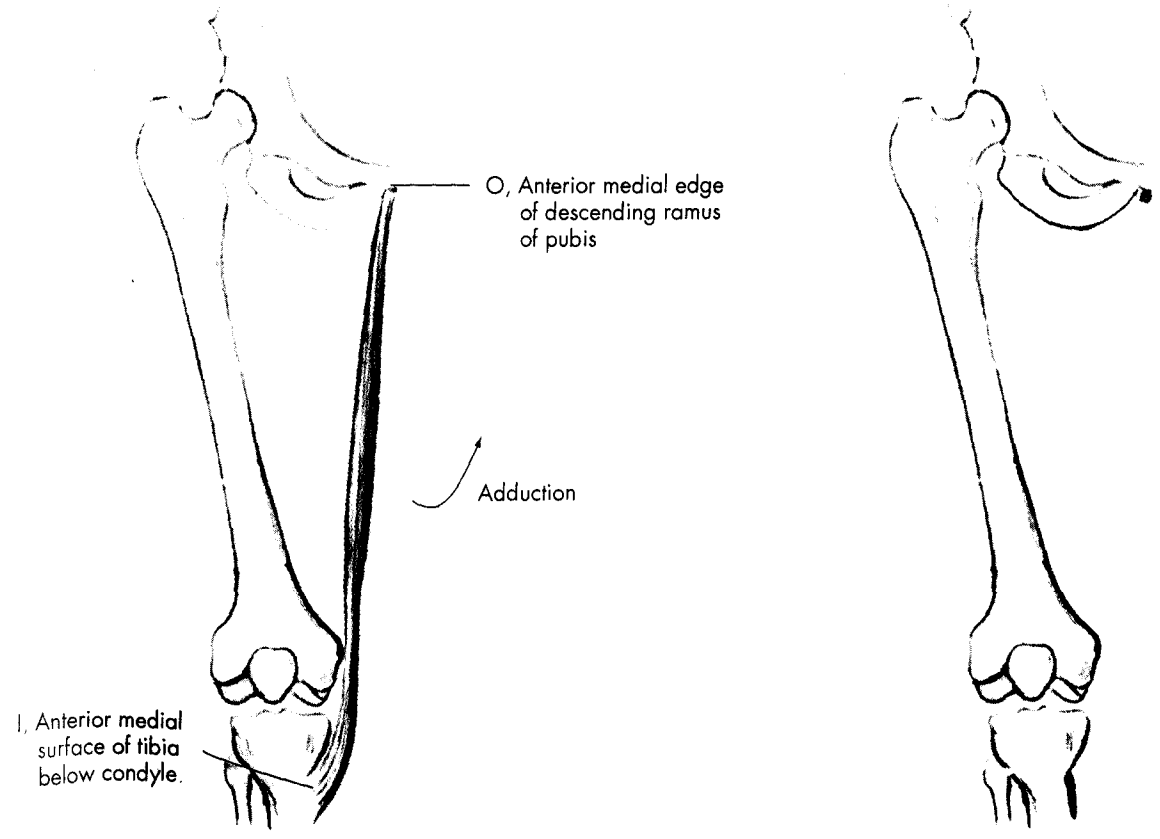
Application, strengthening, and flexibility

The gracilis muscle performs the same function as the other adductors but adds some weak assistance to knee flexion.

The adductor muscles as a group (adductor magnus, adductor longus, adductor brevis, and gracilis) are called into action in horseback riding and in doing the breaststroke kick in swimming. Proper development of the adductor group prevents soreness after participation in these sports. The gracilis is strengthened with the same exercises as described for the other hip adductors. The gracilis may be stretched in a manner similar to the adductors except that the knee must be extended.

FIG. 7.22 • Gracilis muscle. *O*, Origin; *I*, insertion.

Modified from Anthony CP, Kolthoff NJ: *Textbook of anatomy and physiology*, ed 9, St. Louis, 1975, Mosby.



Muscle identification

In developing a thorough and practical knowledge of the muscular system, it is essential that individual muscles be understood. Figs. 7.23 and 7.24 illustrate groups of muscles that work together to produce joint movement.

FIG. 7.23 • Cross-section of the left thigh at the midsection.

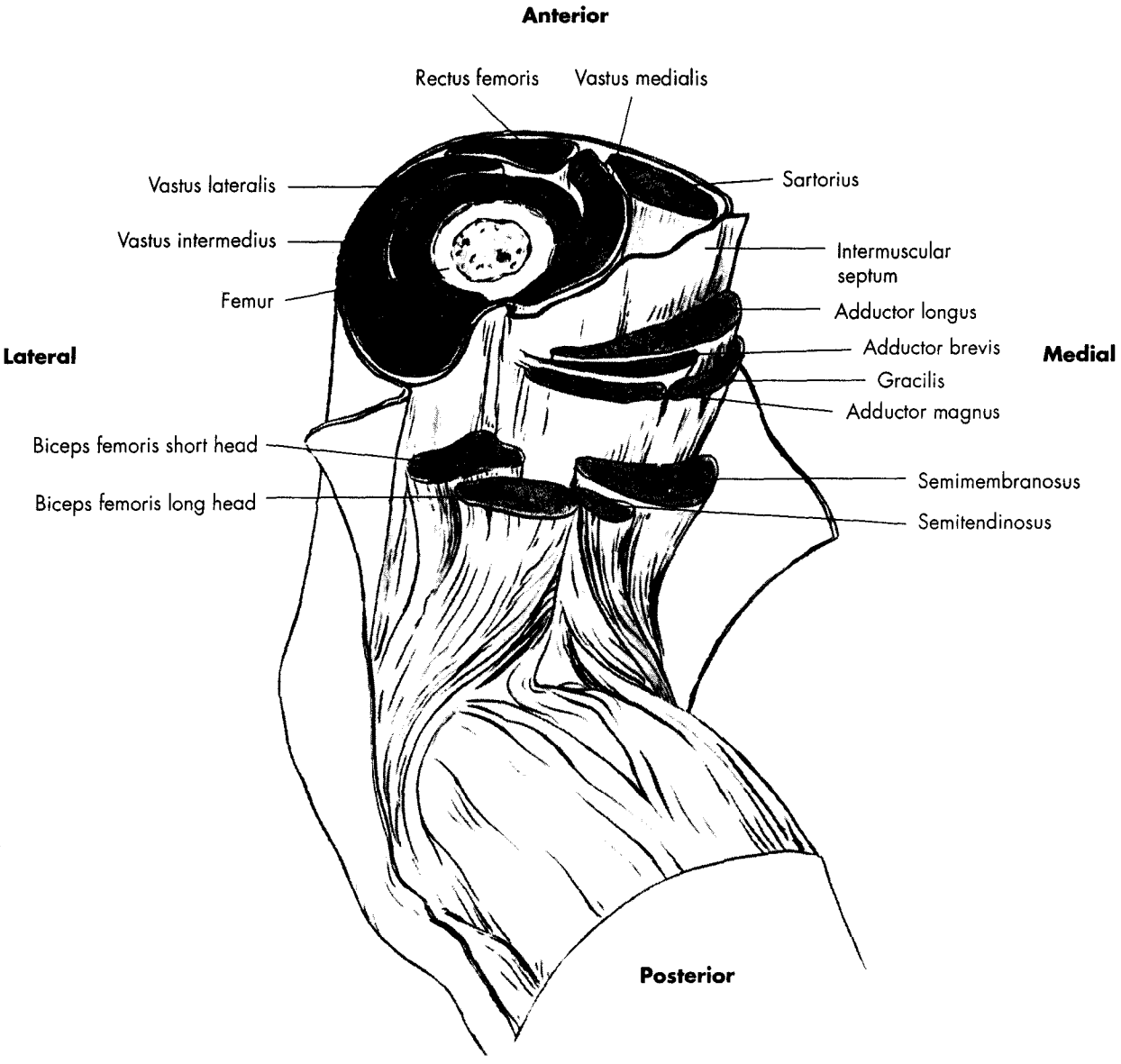
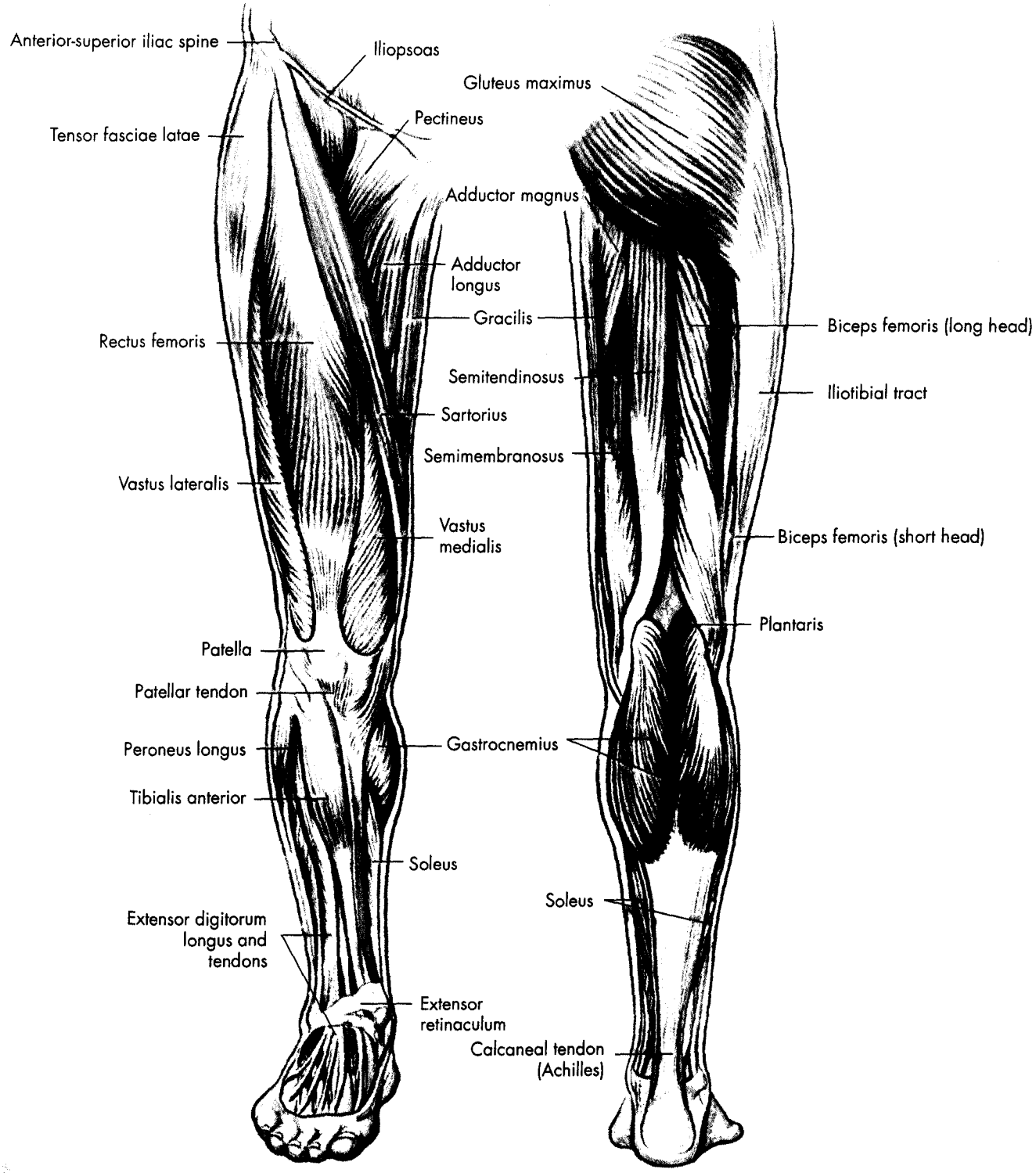


FIG. 7.24 • **Left**, Superficial muscles of the right upper leg, anterior surface; **Right**, superficial muscles of the right upper leg, posterior surface.

Modified from Anthony CP, Kolthoff NJ: *Textbook of anatomy and physiology*, ed 9, St. Louis, 1975, Mosby.



Worksheet exercises

As an aid to learning, for in-class or out-of-class assignments, or for testing, tear-out worksheets are found at the end of the text (pp. 254 and 255).

Laboratory and review exercises

1. Locate the following parts of the pelvic girdle and hip joint on a human skeleton and on a subject.
   a. **Skeleton**
      (1) Ilium
      (2) Ischium
      (3) Pubis
      (4) Symphysis pubis
      (5) Acetabulum
      (6) Rami (ascending and descending)
      (7) Obturator foramen
      (8) Ischial tuberosity
      (9) Anterior superior iliac spine
      (10) Greater trochanter
      (11) Lesser trochanter
   b. **Subject**
      (1) Crest of ilium
      (2) Anterior superior iliac spine
      (3) Ischial tuberosity
      (4) Greater trochanter
2. How and where can the following muscles be palpated on a human subject?
   a. Gracilis
   b. Sartorius
   c. Gluteus maximus
   d. Gluteus medius
   e. Gluteus minimus
   f. Biceps femoris
   g. Rectus femoris
   h. Semimembranosus
   i. Semitendinosus
   j. Adductor magnus
   k. Adductor longus
   l. Adductor brevis
3. Be prepared to indicate on a human skeleton, using a long rubber band, where each muscle has its origin and insertion.
4. Distinguish between hip flexion and trunk flexion.
5. Demonstrate the movement and list the muscles primarily responsible for the following hip movements:
   a. Flexion
   b. Extension
   c. Adduction
   d. Abduction
   e. External rotation
   f. Internal rotation
6. List the planes in which each of the following hip joint movements occur. List the respective axis of rotation for each movement in each plane.
   a. Flexion
   b. Extension
   c. Adduction
   d. Abduction
   e. External rotation
   f. Internal rotation
7. How is walking different from running in relation to the use of the hip joint muscle actions and the range of motion?
8. How may the walking gait be affected by a weakness in the gluteus medius muscle? Have a laboratory partner demonstrate the gait pattern associated with gluteus medius weakness. What is the name of this dysfunctional gait?
9. How might bilateral iliopsoas tightness affect the posture and movement of the lumbar spine in the standing position? Demonstrate and discuss this effect with a laboratory partner.
10. How might bilateral hamstring tightness affect the posture and movement of the lumbar spine in the standing position? Demonstrate and discuss this effect with a laboratory partner.
11. The hip joint and pelvic girdle muscles are listed at the left of the chart on the next page. Place a check in the column for each action of the muscle. Add a "P" for primary action.
12. Fill in the antagonistic muscle action chart by listing the muscle(s) or parts of muscles that are antagonistic in their actions to the muscles in the left column.

Muscle analysis chart • Hip joint and pelvic girdle

Muscles	Flexion	Extension	Abduction	Adduction	External rotation	Internal rotation
Gluteus maximus						
Gluteus medius						
Gluteus minimus						
Biceps femoris						
Semimembranosus						
Semitendinosus						
Adductor magnus						
Adductor longus						
Adductor brevis						
Gracilis						
Lateral rotators						
Rectus femoris						
Sartorius						
Pectineus						
Iliopsoas						
Tensor fasciae latae						

Antagonistic muscle action chart • Hip joint and pelvic girdle

Agonist	Antagonist
Gluteus maximus	
Gluteus medius	
Gluteus minimus	
Biceps femoris	
Semimembranosus/ Semitendinosus	
Adductor magnus/ Adductor brevis	
Adductor longus	
Gracilis	
Lateral rotators	
Rectus femoris	
Sartorius	
Pectineus	
Iliopsoas	
Tensor fasciae latae	

References

Hislop HJ, Montgomery J: *Daniels and Worthingham's muscle testing: techniques of manual examination*, ed 6, Philadelphia, 1995, Saunders.

Kendall HO, Kendall FP, Wadsworth GE: *Muscles: testing and function*, ed 2, Baltimore, 1971, Williams & Wilkins.

Lindsay DT: *Functional human anatomy*, St. Louis, 1996, Mosby.

Luttgens K, Hamilton N: *Kinesiology: scientific basis of human motion*, ed 9, Dubuque, IA, 1997, Brown & Benchmark.

Lysholm J, Wikland J: Injuries in runners, *American Journal of Sports Medicine* 15:168, September-October 1986.

Noahes TD, et al: Pelvic stress fractures in long distance runners, *American Journal of Sports Medicine* 13:120, March-April 1985.

Perreira J: Treating the quadriceps contusion, *Scholastic Coach* 57:38, October 1987.

Seeley RR, Stephens TD, Tate P: *Anatomy & physiology*, ed 2, St. Louis, 1992, Mosby-Year Book.

Sieg KW, Adams SP: *Illustrated essentials of musculoskeletal anatomy*, ed 2, Gainesville, FL, 1985, Megabooks.

Stone RJ, Stone JA: *Atlas of the skeletal muscles*, Dubuque, IA, 1990, Brown.

Thibodeau GA, Patton KT: *Anatomy & physiology*, ed 9, St. Louis, 1993, Mosby.