The Thigh, Hip, Groin, and Pelvis

When you finish this chapter, you should be able to
- Describe the major anatomical features of the thigh, hip, and pelvis as they relate to sports injuries.
- Identify and evaluate the major sports injuries to the thigh, hip, and pelvis.
- Establish a management plan for a sports injury to the thigh, hip, or pelvis.

Although the thigh, hip, and pelvis have relatively lower incidences of injury than the knee and lower limb, they do receive considerable trauma from a variety of sports activities. Of major concern are thigh strains and contusions and chronic and overuse stresses affecting the thigh and hip.

THE THIGH REGION

Anatomy

The thigh is generally considered that part of the leg between the hip and the knee. Several important anatomical units must be considered in terms of their relationship to sports injuries: the shaft of the femur, musculature, nerves and blood vessels, and the fascia that envelops the thigh.

The Femur

The femur (Figure 20-1) is the longest and strongest bone in the body and is designed to permit maximum mobility and support during locomotion. The cylindrical shaft is bowed forward and outward to accommodate the stresses placed on it during bending of the hip and knee and during weight bearing.

Musculation

The muscles of the thigh may be categorized according to their location: anterior, posterior, and medial.

Anterior Thigh Muscles

The anterior thigh muscles consist of the sartorius and the quadriceps femoris group.

Sartorius The sartorius muscle (Figure 20-2) consists of a narrow band that is superficial throughout its whole length. It stems from the anterosuperior iliac spine and crosses obliquely downward and medially across the anterior aspect of the thigh where it attaches to the anteromedial aspect of the tibial head. It helps flex the thigh at the hip joint, abducts and outwardly rotates the thigh at the hip joint, and inwardly rotates the flexed knee. When the legs are stabilized, both muscles act to flex the pelvis on the thigh. When the sartorius muscle contracts, the pelvis is rotated.

Quadriceps femoris Normally the strongest of the thigh muscles, the quadriceps femoris muscle group (Figure 20-3) consists of four muscles: rectus femoris, vastus medialis, vastus lateralis, and vastus intermedius. These four muscles form a common tendon that attaches distally at the superior border of the patella and indirectly into the patellar ligament, which attaches to the tibial tuberosity.

Rectus femoris The rectus femoris muscle is attached superiorly to the anterior inferior iliac spine and the ilium above the acetabulum and inferiorly to the patella and patellar ligament.

Vastus muscles The vastus medialis and vastus lateralis muscles originate from the lateral and medial linea aspera of the femur. The vastus intermedius muscle originates mainly from the anterior and lateral portion of the femur. Inferiorly, the three
vastus muscles are attached to the rectus femoris muscle and to the lateral and proximal aspects of the patella. Of particular importance is the vastus medialis muscle, which serves as a major stabilizer for patellar tracking.

Functional Anatomy

The function of the quadriceps femoris muscle group is extension of the lower leg or the thigh on the lower leg. The rectus femoris muscle, with its pelvic attachment of the quadriceps muscles, is the only flexor of the thigh at the hip joint. The common peroneal nerve innervates the short head of the rectus femoris muscle, and the tibial portion of the sciatic nerve innervates the long head. This muscle group is innervated by the femoral nerve.

Posterior Thigh Muscles

The posterior thigh muscles include the popliteus and the hamstring muscles.

Hamstring Muscles

Located posteriorly, the hamstring muscle group (Figure 20-4) consists of three muscles: the biceps femoris, semimembranosus, and semitendinosus muscles.

Biceps Femoris

The biceps femoris muscle, as its name implies, has two heads. Its long head originates with the semitendinosus at the medial aspect of the ischial tuberosity. Its short head is attached to the linea aspera below the gluteus maximus attachment on the femur and medial to the attachment of the vastus lateralis. Both muscle heads attach with a common tendon to the head of the fibula.

Semitendinosus

The semitendinosus muscle originates at the medial aspect of the ischial tuberosity along with the biceps femoris muscle. Together with the semimembranosus muscle, the semitendinosus muscle attaches to the medial aspect of the proximal tibia. This attachment is just behind those of the sartorius and gracilis muscles, which all together form the pes anserinus tendon. The tibial branch of the sciatic nerve supplies this muscle.

Semimembranosus

The semimembranosus muscle originates from the lateral aspect of the upper half of the ischial tuberosity. Moving downward, it attaches into the medial femoral con-
dyle. It also attaches to the medial side of the tibia, the popliteus muscle fascia, and the posterior capsule of the knee joint. The tibial branch of the sciatic nerve supplies this muscle.

FUNCTIONAL ANATOMY

The hamstring muscles are biarticular, acting as extensors at the hip and flexors at the knee joint. Assisting the hamstrings in knee flexion are the sartorius, gracilis, popliteus, and gastrocnemius muscles. At the hip, hamstrings work in cooperation with the gluteus maximus to extend the hip. Lateral rotation of the leg at the knee is conducted by the biceps femoris muscle. Medial rotation is caused by both the semitendinosus and semimembranosus muscles.

Medial Thigh Muscles

The medial thigh muscles include the gracilis, pectineus, and three adductor muscles.

Gracilis; Pectineus; Adductor Longus, Brevis, and Magnus

Five muscles make up the medial bulk of the thigh: the sartorius; gracilis; and adductor longus, brevis, and magnus muscles. All act as adductors and lateral rotators of the thigh at the hip joint (Figure 20-5).

Gracilis The gracilis muscle is attached superiorly to the body of the inferior ramus of the pubis and inferiorly to the medial aspect of the proximal tibia. It is a relatively narrow-appearing muscle that adducts the thigh at the hip and flexes and me-
dially rotates the leg at the knee joint. The anterior branch of the obturator nerve serves this muscle.

**Pectineus** The pectineus muscle arises from the pectineal crest of the pubis and attaches distally on the pectineal line of the femur. As one of the adductors, it also flexes and outwardly rotates the thigh.

**Adductor longus, brevis, and magnus** The adductor longus, brevis, and magnus muscles originate at the ramus of the pubis and attach inferiorty on the linea aspera of the femur. The muscles adduct the thigh at the hip and outwardly rotate the thigh. All of these muscles assist in the flexion of the thigh.

**Nerve Supply**
Among nerves that emerge from the sacral plexus are the tibial and common peroneal nerves, which in the thigh form the largest nerve in the body, the greater sciatic nerve. The sciatic nerve supplies the muscles of the thigh and lower leg (see Figure 20-18).

**Blood Supply**
The main arteries that supply the thigh are the deep medial circumflex femoral, deep femoral, and femoral artery. The two main veins are the superficial great saphenous and the femoral vein (see Figure 20-18).

**Fascia**
The fascia lata femoris is that part of the deep fascia which invests the thigh musculature. It is relatively thick anteriorly, laterally, and posteriorly but thin on the medial side where it covers the adductors. On its most lateral part, the iliobibial tract, an attachment is provided for the tensor fascia lateral and greater aspect of the gluteus maximus.

**ASSESSMENT**
Thigh injury evaluation is concerned with the femur and the soft tissue that surrounds it.

**History**
The athletic trainer should ask the following questions:
- Was the onset sudden or slow?
- Has this injury occurred before?
- How was the thigh injured?
- Can the athlete describe the intensity or duration of the pain?
TABLE 20-2 Management of Muscle-Tendon Injuries of the Hip, Groin and Pelvis

<table>
<thead>
<tr>
<th>Management</th>
<th>Phase I Acute, 1 to 72 hr</th>
<th>Phase II Healing and Repair</th>
<th>Phase III Maturation and Remodeling</th>
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<td>Ice</td>
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<tr>
<td>Return to sport</td>
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<td>X</td>
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<tr>
<td>Strength and flexibility maintenance</td>
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</tbody>
</table>

**Femoral stress fracture** Femoral overuse fractures represent 10% to 25% of all stress fractures.11

**Etiology** It often stems from excessive downhill or mountain running or in jumping activities. In a compression fracture the fracture occurs more horizontal to the trabeculae. In a distraction type fracture the fracture line occurs perpendicular to the trabeculae of the femoral neck.10 Stress fractures of the femur are being diagnosed more often than in the past.

**Symptoms and signs** The athlete complains of a persistent pain in the thigh. X-ray or bone scan reveals the stress fracture. The most common site is in the area of the femoral neck.

**Management** Analgesics, RICE, and NSAIDs, are given as needed. Range-of-motion exercises and PRE are carried out within pain-free limits. For incomplete fractures rest and limited weight bearing constitute the usual treatment of choice.2 Complete stress fractures may have to be surgically pinned.

**THE HIP, GROIN, AND PELVIC REGION**

Normal function of the hip and pelvis is necessary for sports performance. Normal body movement is highly important for sports that predominantly use the lower extremities or the upper extremities. It must be remembered that the hip and pelvis are part of the kinetic chain that transmits a load from the foot to the spine and vice versa in all three planes of movement.
Anatomy

Bones
The pelvis is a bony ring formed by the two innominate bones, the sacrum and the coccyx (Figure 20-13). Each innominate bone is composed of an ilium, ischium, and pubis. The functions of the pelvis are to support the spine and trunk and to transfer their weight to the lower limbs. In addition to providing skeletal support, the pelvis serves as a place of attachment for the trunk and thigh muscles and as protection for the pelvic viscera. The basin formed by the pelvis is separated into a false and a true pelvis. The false pelvis is composed of the wings of the ilium. The true pelvis is composed of the coccyx, the ischium, and the pubis.

The innominate bones are three bones that ossify and fuse early in life. They include the ilium, which is positioned superiorly and posteriorly; the pubis, which forms the anterior part; and the ischium, which is located inferiorly. Lodged between the innominate bones is the wedge-shaped sacrum, composed of five fused vertebrae.

Articulations

Sacroiliac joint and coccyx The sacrum is joined to other parts of the pelvis by strong ligaments, forming the sacroiliac joint. A small backward-forward movement is present at the sacroiliac junction. The coccyx is composed of four or five small fused vertebral bodies that articulate with the sacrum.

Hip joint The hip joint is formed by articulation of the femur with the innominate, or hip, bone. The spherical head of the femur fits into a deep socket, the acetabulum, which is padded at its center by a mass of fatty tissue, ligaments, and capsule. The acetabulum, a deep socket in the innominate bone, receives the articulating head of the femur. It forms an incomplete bony ring that is interrupted by a notch on the lower aspect of the socket. The ring is completed by the transverse ligament that crosses the notch. The socket faces forward, downward, and laterally. The femoral head is a sphere fitting into the acetabulum in a medial, upward, and slightly forward direction.

Ligament, joint capsule, and synovial membrane Surrounding its rim is a fibrocartilage known as the glenoid labrum. A loose sleeve of articular tissue is attached to the circumference of the acetabulum above and to the neck of the femur below. The capsule is lined by an extensive synovial membrane, and the iliofemoral, pubo-capsular, and ischiocapsular ligaments give it strong reinforcement. Hyaline cartilage completely covers the head of the femur, with the exception of the fovea capitis, a small area in the center to which the ligamentum teres is attached. The ligamentum
Rteres gives little support to the hip joint—having as its main function the transport of
nutrient vessels to the head of the femur. Because of its bony, ligamentous, and mu-
cular arrangements, this joint is considered by many to be the strongest articulation
in the body.

The synovial membrane is a vascular tissue enclosing the hip joint in a tubular
sleeve, with the upper portion surrounding the acetabulum. The lower portion is fas-
tened to the circumference of the neck of the femur. Except for the ligamentum teres,
which lies outside the synovial cavity, the membrane lines the acetabular socket.

The articular capsule is a fibrous, sleeve-like structure covering the synovial mem-
brane, its upper end attaching to the glenoid labrum and its lower end to the neck of
the femur. The fibers surrounding the femoral neck consist of circular fibers that serve
as a tight collar. This area is called the zona orbicularis and acts in holding the femoral
head in the acetabulum. Many strong ligaments—the iliofemoral, the pubofemoral,
and the ischiofemoral—reinforce the hip joint (Figure 20-14).

The iliofemoral ligament (Y ligament of Bigelow) is the strongest ligament of the
body. It prevents hyperextension, controls external rotation and adduction of the
thigh, and limits the pelvis during any backward rolling of the femoral head during
weight bearing. It reinforces the anterior aspect of the capsule and is attached to the
anterior iliac spine and the intertrochanteric line on the anterior aspect of the femur.

The pubofemoral ligament prevents excessive abduction of the thigh and is positioned
anterior and inferior to the pelvis and femur.

The ischiofemoral ligament prevents excessive internal rotation and adduction of the
thigh and is located posterior and superior to the articular capsule.

**Hip Musculature**

The muscles of the hip can be divided into anterior and posterior groups. The ante-
rior group includes the iliacus and psoas muscles. The posterior group’s muscles in-
clude the tensor fasciae latae, gluteus maximus, glutueus medius, gluteus minimus,
and the six deep outward rotators—the piriformis, superior gemellus, inferior gemel-
lus, obturator internus, obturator externus, and quadratus femoris.

**Anterior hip** The iliacus and psoas muscles are the anterior hip muscles. The
triangular-shaped iliacus is contained within the iliac fossa within the abdomen. Its
tendon merges with the psoas major muscles, forming a common tendon that is called
the iliopsoas. The iliopsoas attaches on the iliac fossa and part of the inner surface of
the sacrum proximally, and it attaches distally on the lesser trochanter of the femur.
The psoas muscle attaches proximally on the transverse processes and bodies of the
lumbar vertebrae. Its distal attachment is on the lesser trochanter. The iliopsoas
muscle flexes the thigh at the hip joint and tends to rotate the thigh outwardly and
to adduct the thigh when free to move. When fixed, the iliopsoas assists in flexing
the trunk and hip.

**Posterior hip muscles** The posterior muscles of the hip consist of the tensor fasci-
cae latae, the three gluteal muscles, and the six deep outward rotators.

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**Figure 20-14**

Ligaments of the hip.

- Iliofoemoral ligament
- Pubofemoral ligament
**Tensor fasciae latae** The tensor fasciae latae muscle is located on the upper anterior aspect of the lateral thigh (Figure 20-15). It is attached superiorly to the iliac crest just behind the anterior superior iliac spine and is inserted inferiorly into the iliotibial tract. Its primary action is flexion and medial rotation of the thigh. It is innervated by the superior gluteal nerve.

**The gluteal region** The gluteus maximus muscle forms the buttocks in the hip region. Lateral to and underneath the gluteus maximus are the gluteus medius and the gluteus minimus muscles (Figure 20-16). Underneath these larger muscles are much smaller muscles—the piriformis, the obturator internus, and the gemelli (Figure 20-16).

**Gluteus maximus** The gluteus maximus muscle is attached above to the posterior aspect of the iliac crest, the sacrum, and the coccyx, as well as to the fascia in the area. Inferiorly, this muscle attaches to the iliotibial tract and into the gluteal tuberosity of the femur between the linea aspera and greater trochanter. It acts as a lateral rotator of the thigh at the hip joint and allows the body to rise from a sitting to a standing position. Through the attachment to the iliotibial tract, it helps extend the flexed knee. The inferior gluteal nerve supplies this muscle.

**Gluteus medius** The gluteus medius muscle is located lateral to the hip. It is attached superiorly to the lateral aspect of the ilium and inferiorly to the lateral aspect of the trochanter. The gluteus maximus muscle covers this muscle posteriorly, and it is covered anteriorly by the tensor fasciae latae. It acts primarily as a thigh abductor at the hip, with some flexion and medial rotation occurring from its anterior aspect and some extension and lateral rotation occurring from its posterior aspect. It is innervated by the superior gluteal nerve.

**Gluteus minimus** The gluteus minimus muscle originates above the lateral aspect of the ilium and attaches inferiorly to the anterior aspect of the greater trochanter of the femur. Its main action is to cause medial rotation at the hip joint; its secondary action is abduction of the thigh at the hip joint. It is innervated by the superior gluteus nerve.

**Deep outward rotators** The six deep outward rotator muscles are positioned behind the hip joint (Figure 20-17). They hold the head of the femur in the acetabulum.

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![Tensor fasciae lata](image1)

Tensor fasciae lata

![Iliotibial tract](image2)

Iliotibial tract

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![Gluteus maximus](image3)

Gluteus maximus

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![Deep outward rotators](image4)

Deep outward rotators
**Figure 20-17**
The six deep, outward rotators of the hip.

**Figures 20-17 and 20-18**

**Bursae** The hip joint has many bursae. Clinically, the most important of them are the iliopsoas bursa and the deep trochanteric bursa. The iliopsoas bursa is located between the articular capsule and the iliopsoas muscle on the anterior aspect of the joint. The deep trochanteric bursa lies between the greater trochanter and the deep fibers of the gluteus maximus muscle.

**Nerve Supply**
The lumbar plexus is created by the intertwining of the fibers stemming from the first four lumbar nerves. The femoral nerve, a major nerve emerging from this plexus, later divides into many branches to supply the thigh and lower leg. Nerve fibers from the fourth and fifth lumbar nerves and the first, second, and third sacral nerves form the sacral plexus within the pelvic cavity, anterior to the piriformis muscle. Along with other nerves, the tibial and common peroneal nerves emerge from the sacral plexus and form the large sciatic nerve in the thigh (see Figure 20-18).

**Blood Supply**
**Arteries**
Opposite the fourth lumbar vertebra, the aorta divides to become the two common iliac arteries (Figure 20-18). They in turn pass downward to divide, opposite the sacroiliac joint, into the internal and external iliac arteries. Most of the branches of the internal iliac artery supply blood to the pelvic viscera. The external iliac artery is the primary artery to the lower limb.
Veins

The major veins in the region of hips, groin, and pelvis include the common iliac vein, which stems from the inferior vena cava on both sides draining the lower body. Next is the internal iliac vein, which ascends behind its iliac artery to the brim of the true pelvis, where it joins the external vein to form the common iliac vein. Its tributaries drain the pelvis and adjoining area. Third is the external iliac vein, which passes upward from the femoral vein behind the inguinal ligament and follows the brim of the true pelvis joining the opposite to the sacroiliac joint and the internal iliac vein.

FUNCTIONAL ANATOMY

The hip joint is a ball-and-socket joint that has maximum stability because of deep insertion into the acetabulum. The acetabulum faces outward, forward, and downward. The capsular pattern of the hip is flexion, abduction, and medial rotation. The forces involved in the hip are as follows: standing—one third of the body weight; standing on one foot—2.4 to 2.6 times the body weight; walking—1.3 to 5.8 times the body weight; and running—4.5 times the body weight.\(^\text{12}\)

The sacroiliac joints and symphysis pubis do not have direct control of their movements. They are influenced by the muscles that influence the lumbar spine and hip. Many of these muscles attach to the sacrum and pelvis. Movement occurring in the sacroiliac and symphysis pubis joints is slight when compared with the hip and spinal joints.\(^\text{11}\)

ASSESSMENT OF THE HIP AND EXTERNAL PELVIS

The hip and pelvis form the body’s major power source for movement. The body’s center of gravity is located just in front of the upper part of the sacrum. Injuries to the hip or pelvis cause the athlete major disability in the lower limb, trunk, or both. Because of the close proximity of the hip and pelvis to the low back region, many evaluative procedures overlap.

History

The following information is determined from the athlete:

- What are your symptoms (e.g., weakness, disability, pain)?
- When did you first notice a problem with the hip or pelvis?
- Describe types of pain (hip pain is felt mainly in the groin and medial or frontal side of thigh; hip pain may also be referred to the knee).
- Describe the sacroiliac pain; does it radiate in the posterior thigh, iliac fossa, or buttock on the affected side?
- When does the pain occur (e.g., during activity, while turning in bed)?
- Age and gender of the athlete (e.g., boys 3 to 12 years old can have Legg-Calvé-Perthes disease; distance-running amenorrheic girls may develop a hip stress fracture).

Observation

The athlete should be observed for postural asymmetry while standing on one leg and during ambulation.

Postural Asymmetry

- From the front view, do the hips look even? A laterally tilted hip could mean a leg-length discrepancy or abnormal muscle contraction on one side of the hip or low back region.
- From the side view, is the pelvis abnormally tilted anteriorly or posteriorly? This tilting may indicate lordosis or flat back, respectively.
- In lower-limb alignment, is there indication of genu valgum, genu varum, foot pronation, or genu recurvatum? The patella should also be noted for relative position and alignment.