CHAPTER 19
The Hip and Pelvis

KEY TERMS
- adductor muscles
- coccyx
- greater sciatic notch
- hamstring muscles
- hip flexors
- iliac crest
- iliac crest contusion
- iliac fossa
- ilium
- ischium
- obturator foramina
- pubis
- sacrum
- symphysis

OBJECTIVES
Upon completion of this chapter, the reader should be able to:

- Explain the importance of the hip and pelvis as a support structure for the human body
- Describe the skeletal structure of the hip and pelvis
- List the primary muscles of the hip and pelvis
- Describe common injuries associated with the hip and pelvis
THE HIP AND PELVIS

The hip is one of the most stable joints in the body, although it allows a great deal of motion. It is well protected and surrounded by muscle on all sides. The hip is a freely movable, ball-and-socket joint that lies between the head of the femur and the acetabulum of the pelvis (Figure 19–1).

The hip is where the muscles of the back, abdomen, hamstrings, quadriceps, abductors, adductors, and gluteals attach. These muscles are shorter than the leg muscles, allow rotation, and help in stabilization of the joint. Most hip injuries result from these small muscles being overused or pushed too hard. This arrangement of bones, ligaments, muscles, and tendons makes the hip the strongest joint in the body.

Figure 19–1 Anatomy of the hip joint.
The pelvis is made up of several flattened bones that form a ring and function as a support structure for the human skeleton. The function of the pelvis is to transmit weight from the axial skeleton to the lower limbs when standing, or to the ischial tuberosities when sitting. The pelvis:

- Provides attachments for various muscles that attach onto and control the lower limbs
- Houses parts of the digestive and urinary tracts
- Houses reproductive systems

Important differences exist in the size and structure of the hip and pelvis in men and women (Figure 19–2). A woman’s bone structure is slightly less dense than a man’s, and the pelvis is smaller, shorter, and wider. Additionally, the bony protrusions for muscle attachment are not as sharply defined.

**Skeletal Structure**

The ilium, sacrum, ischium, pubis, and coccyx are the structures of the pelvis.

The **ilium** is a broad, flared bone that constitutes the upper and lateral sections of the pelvis. The primary features of the ilium are:

- The **iliac crest**, which marks the upper ridge of the ilium
- The **greater sciatic notch**, which allows the sciatic nerve to pass to the legs below
- The **iliac fossa**, the broad, slightly concave inner surface of the ilium

The fossa, pubis, and ischium create a basin in which the lower abdominal organs rest.

The **sacrum** is the portion of the vertebral column between the lumbar vertebrae and the structures of the coccyx. It is composed of five vertebrae fused together to form a single bone structure.
The **ischium** bears the body weight when sitting, and is attached to the pubis in front and to the ilium laterally and to the back. The large openings in the ischium on either side of the pelvis, just below the pubis, are the **obturator foramina**. The obturator foramen is the large opening in each ischium. These openings admit blood vessels and nerves from the abdominal cavity to the inside of the upper legs.

The **pubis** is located just to the front and below the bladder. In the center of the pubis is the **symphysis**, which marks the line where the two sides of the pubis are fused.

The **coccyx** (tailbone) is composed of three to five rudimentary vertebrae. Often, the first of these coccygeal vertebrae is separate, while the remainder are fused together. The articulation between the coccygeal vertebrae and the sacrum allows some flexibility in the coccyx, which is particularly beneficial in taking the stresses of sitting and falling. The coccyx is extremely susceptible to shock fracture, as might be induced from a fall. Furthermore, because a number of nerve pathways...
pass near this area, damage to the coccyx threatens damage to the nerves of the lower body. The juncture of the first coccygeal vertebra with the sacrum occurs at the lower facet of the sacrum.

**Primary Muscles of the Pelvis, Hip, and Thigh**

Strong capsular ligaments surround and support the hip joint. Muscles from the lower back, pelvis, and thigh contribute to strength and stability. The head of the femur is covered with a smooth layer of cartilage, which helps to absorb shock and reduce friction during movement, while synovial fluid further cushions the joint and transports essential nutrients to joint structures.

Attached to the pelvis are groin and torso muscles that are involved in supporting and moving the trunk, as well as the upper and lower extremities. The bones of the hip and pelvis are supported by these ligaments: ligamentum teres, transverse acetabular, iliofemoral, pubofemoral, and inguinal (Figure 19–3).

A number of important muscle groups are located in the hip and pelvic region. The largest muscle group includes the gluteal muscles. The gluteus medius, gluteus minimus, and gluteus maximus assist in hip extension, internal and external rotation, and abduction. Muscles that assist in hip flexion (hip flexors) are the iliopsoas, sartorius, pectineus, and rectus femoris muscles.

**KEY CONCEPT**

The hip joint is where the spherical head of the femur fits into the deep socket of the pelvis. The ilium, sacrum, ischium, pubis, and coccyx are the structures that constitute the pelvis.

![Figure 19–3 Ligaments of the hip.](image-url)
that compose the bulk of the thigh (quadriceps and **hamstring muscles**) also assist in movement of the hip (Figure 19–4). Those movements are hip flexion and hip extension. Some of the muscles that move the femur are summarized in Table 19–1.

This area of the body is innervated by a number of different nerves. Additional anatomical structures frequently injured are fat pads and bursa. Fat pads are specialized soft-tissue structures for bearing weight and absorbing impact. The synovial sacs generally located over bony prominences throughout the body are called **bursae**.

**adductor muscles**
A muscle group that aids in adduction of the hip; consists of the adductor longus, adductor brevis, and adductor magnus muscles.

**hamstring muscles**
A muscle group that aids in hip movement; consists of the biceps femoris, semitendinosus, and semimembranosus muscles.

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**Figure 19–4** Primary muscles of the pelvis, hip, and thigh.
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M
uscles from the lower back, pelvis, and thigh contribute to strength and stability. The largest muscle group of the hip and pelvic region is the gluteals. The adductor muscles assist in hip adduction. The quadriceps and hamstring muscles also assist in hip movement.

<table>
<thead>
<tr>
<th>MUSCLE</th>
<th>ORIGIN</th>
<th>INSERTION</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psoas major</td>
<td>Transverse process of lumbar vertebrae</td>
<td>Femur</td>
<td>Flexes, rotates thigh medially</td>
</tr>
<tr>
<td>Psoas minor</td>
<td>Last thoracic and lumbar vertebrae</td>
<td>Junction of ilium and pubis</td>
<td>Flexes trunk</td>
</tr>
<tr>
<td>Iliacus</td>
<td>Last thoracic and lumbar vertebrae</td>
<td>Junction of ilium and pubis</td>
<td>Flexes, rotates thigh medially</td>
</tr>
<tr>
<td>Gluteus maximus</td>
<td>Ilium, sacrum, and coccyx</td>
<td>Fascia lata, gluteal ridge</td>
<td>Extends, rotates thigh laterally</td>
</tr>
<tr>
<td>Gluteus medius</td>
<td>Ilium</td>
<td>Tendon on femur</td>
<td>Abducts, rotates thigh medially</td>
</tr>
<tr>
<td>Gluteus minimus</td>
<td>Ilium</td>
<td>Femur</td>
<td>Abducts, rotates thigh medially</td>
</tr>
<tr>
<td>Tensor fascia lata</td>
<td>Ilium</td>
<td>Femur</td>
<td>Tenses fascia lata</td>
</tr>
<tr>
<td>Abductor brevis</td>
<td>Pubis</td>
<td>Femur</td>
<td>Abducts, rotates thigh</td>
</tr>
<tr>
<td>Adductor magnus</td>
<td>Ischium, ischiopubic ramus</td>
<td>Femur</td>
<td>Adducts, extends thigh</td>
</tr>
<tr>
<td>Obturator externus</td>
<td>Ischium, ischiopubic ramus</td>
<td>Femur</td>
<td>Rotates thigh laterally</td>
</tr>
<tr>
<td>Pectineus</td>
<td>Junction ilium and pubis</td>
<td>Femur</td>
<td>Flexes, adducts thigh</td>
</tr>
</tbody>
</table>
COMMON INJURIES AND CONDITIONS OF THE HIP AND THIGH

Injuries to the hip and thigh are very common in athletics. The major injuries and conditions are discussed in the following subsections.

**Bursitis**

The most frequent location for bursitis is over the outside of the hip. This is called greater trochanteric bursitis (refer to Figure 19–1). This condition is commonly seen in athletes who do not sufficiently stretch and warm up this area.

**Signs and Symptoms**

Tenderness over the outside of the hip, one of the symptoms of bursitis, can frequently be made worse by walking, running, or twisting the hip in certain directions.

**Treatment**

The initial treatment for bursitis is limiting activity, followed by stretching exercises and ice massage. Nonsteroidal anti-inflammatory medicines are also quite helpful.

**Fracture**

A hip fracture refers to a break of the top part of the femur where it connects to the pelvis. Hip fractures are classified into many types, the most common being femoral neck fractures, intertrochanteric fractures, and subtrochanteric fractures (Figure 19–5).

The most common cause of hip fractures is falling. The majority of these fractures occur in the elderly. Extreme trauma, such as motor
vehicle accidents and impact injuries from athletics, may cause hip fractures in younger patients.

**Signs and Symptoms**

Most hip fractures are diagnosed by a history of a fall or an accident followed by severe hip pain. The leg may appear abnormally rotated. Any attempt to move the hip will result in a significant increase in pain. X-rays are used to confirm the diagnosis. Occasionally, a bone scan or MRI is needed to prove that a fracture is present.

**Treatment**

Hip fracture treatment is highly individualized. Treatment choices must be discussed with the surgeon and made according to the patient’s fracture type and medical condition.

**Quadriceps and Hip Flexor Strains**

Strains of the quadriceps and hip flexors are common in sports requiring jumping, kicking, or repetitive sprinting. Most quadriceps strains involve the rectus femoris. Hip flexor strains may involve the rectus femoris and/or iliopsoas muscle. With grade I and II injuries, the major concern is preventing reinjury and complete disruption (grade III strain) (Figure 19–6).

**Treatment**

Initial treatment includes icing, compression with an elastic wrap, and anti-inflammatory medications. As with all medications, a physician should be consulted.

![Figure 19–6 Quadricep rupture in an athlete.](image)
Rehabilitation

Rehabilitation should be progressive and sport specific. For example, for quadriceps strains caused by running, range-of-motion exercises and stretching should commence early and progress to strengthening exercises, walking, pool-running, jogging, limited speed running, and full-speed sprints as soon as the athlete is free of pain. Figures 19–7 and 19–8 demonstrate stretching that is useful for the hip flexors.

Hamstring Strains

The hamstring muscles bend and flex the knee. Strong hamstring muscles are especially important for power and balance when sprinting and jumping. Counterparts to the quadriceps muscles in the front of the thigh, they are involved in almost every movement the leg makes.

![Figure 19–7](image1.png)

**Figure 19–7** The athlete stands with the leg to be stretched behind the other leg and rotated slightly outward. She then shifts weight forward to the opposite leg, putting the hip flexor muscles in a stretch. Posture should be erect, with hips thrust forward.

![Figure 19–8](image2.png)

**Figure 19–8** This stretch is similar to the one described in Figure 19–7, except that the athlete kneels on a towel (which serves as a cushion). The athlete then thrusts forward with the hips, still maintaining an erect posture. A stretch should be felt in the area of the hip flexors.
The hamstrings are actually composed of three separate muscles: the biceps femoris, semitendinosus, and semimembranosus (Figure 19–9). These muscles originate at the ischial tuberosity of the pelvis and attach behind the knee. These muscles span two joints and are prone to strain during athletic activity. Any of the three hamstring muscles may be injured, but the long head of the biceps femoris is most frequently affected.

A hamstring strain is commonly called a “pulled hamstring.” Pulling the hamstrings too far or too fast stretches the muscle fibers, which causes the strain. A hamstring strain can range from microtears in a small area of muscle to a complete tear in the muscle or the tendons that attach the muscle to bone.

In general, the term *hamstring strain* refers to mild or moderate damage in the muscle tissue. Completely tearing the muscles or separating them from connective tendons is usually a more serious injury, a *hamstring tear*.

Sudden, explosive starts and stops, and chronic overuse of the hamstring muscle-tendon unit, are the most common causes of pulled hamstrings. More severe hamstring pulls often result from sprinting or making a quick start or stop when the leg is extended. Chronic hamstring strains can also result from overtraining that puts stress on fatigued hamstring muscles.

When the quadriceps muscles are overdeveloped in relation to the hamstring muscles, the athlete may be able to straighten the leg with an imbalanced force that damages the hamstring muscles. Inflexibility
also can cause a hamstring strain. Certain athletic movements, like ballet dancing, tackling, or martial arts, may stretch the leg beyond the normal range of motion and strain tight hamstring muscles. Athletes of all abilities are equally at risk of pulling a hamstring. Insufficiently warming up the hamstring muscles before engaging in athletics can leave the muscles tight and at risk for pulls and strains. Competitive weekend athletes who do not properly stretch and condition during the week are particularly prone to straining inflexible hamstring muscles.

A direct blow to the back of the leg while the hamstring muscles are contracting, like being struck hit by a squash racquet or a hockey puck, can also strain the hamstring muscles.

**Signs and Symptoms**

Hamstring strains usually cause a sharp pain in the back of the thigh during or soon after sports or strenuous physical activity. The athlete may experience bruising, swelling, and loss of strength in the upper leg when trying to extend the hip or bend the knee. The athlete may feel or even hear a “pop” if he or she suffers a moderate or severe hamstring strain. The pain occurs most commonly in the middle of the thigh, but may be felt in the pelvis or the back of the knee if the tendons are damaged.

**Treatment**

Nonsurgical treatment usually can heal hamstring strains. Physicians typically prescribe a combination of RICE, medication, and physical therapy. Most patients receive adequate pain relief from nonprescription anti-inflammatories such as aspirin or ibuprofen.

Depending on the severity of the hamstring injury, the athlete's physician may prescribe crutches to keep weight off the injured leg for up to three weeks. Massage from a trained therapist can help relax and tone the hamstring muscles after an injury.

**Rehabilitation**

The athlete should begin a rehabilitation program as soon as possible after a hamstring strain. Rehabilitation progresses into a weight-training program focused on balancing strength between the hamstrings and quadriceps muscles. Rushing through the rehabilitation process and returning to sports before the athlete has completely recovered risks reinjury of the hamstring. Athletes can expect to return to sports at full strength after most hamstring strains. Mild strains can usually be rehabilitated in 2 to 10 days. Moderate strains may take between 10 days and 6 weeks to heal. Severe strains may require 6 to 10 weeks of rehabilitation before the athlete can return to competition.

To prevent reinjury, it is important to keep leg muscles strong and flexible. The athlete should make the exercises learned in rehabilitation part of an everyday exercise routine. The athlete should also maintain
cardiovascular fitness so that the legs are prepared for quick starts and stops during physical activities. Figures 19–10 through 19–15 demonstrate stretching techniques for the hamstring.

Adductor (Groin) Strains

Adductor strains are common in sports requiring sudden sideways changes in direction, such as skating, soccer, track and field, and tennis. Most involve the adductor longus. Typically, an adductor strain is
a grade I or II strain (mild or moderate) and is characterized by groin pain when running or kicking. The adductors originate on the pelvic bone and attach at intervals along the length of the femur (Figure 19–16). This interval attachment provides the most power and stability for the hip joint and the femur.

**Treatment**

Adductor strains are difficult to treat, and the risk of reinjury is high. As with hamstring strains, the athlete should be carefully monitored during rehabilitation. Treatment involves rest, ice, and anti-inflammatory medications, followed by adductor stretching and strengthening exercises. Figure 19–17 shows a stretching exercise for the adductor muscles.

**Iliotibial Band Syndrome**

Iliotibial band syndrome occurs when there is inflammation of the iliotibial band. The iliotibial band is a thick band of fibrous tissue that runs down the outside of the leg. It begins at the hip and extends to the outer side of the tibia just below the knee joint (Figure 19–18). The band functions in
coordination with several of the thigh muscles to provide stability to the outside of the knee joint.

**Signs and Symptoms**

Irritation usually occurs over the outside of the knee joint, at the lateral epicondyle end of the femur. The iliotibial band crosses bone and muscle at this point.

Between these structures is a bursa that should facilitate a smooth, gliding motion. However, when inflamed, the iliotibial band does not glide easily, and pain associated with movement of the knee joint is the result. Usually the pain worsens with continued movement and resolves with rest.
People who suddenly increase their level of activity, such as runners who add mileage, often develop iliotibial band syndrome. Others who are prone to iliotibial band syndrome are individuals with mechanical problems: people who overpronate, have leg-length discrepancies, or are bow-legged.

**Treatment**

Treatment of iliotibial band syndrome begins with analysis of the athlete's gait and training program, to rule out mechanical problems or training errors that may predispose the athlete to this condition. Proper footwear, icing the area of pain, and stretching help to treat iliotibial band syndrome. The athlete will need to reduce activity level until symptoms subside. Figures 19–19 and 19–20 demonstrate stretches for the iliotibial band. Iliotibial band syndrome is also discussed in Chapter 18.

**Quadriceps Contusions**

Quadriceps contusions are common in football, rugby, soccer, and basketball. In these sports, contusions are usually caused by a direct blow to the thigh from a helmet or knee. The injury may limit motion and affect gait. The severity of the contusion is usually graded by the range of motion in the hip at the time of evaluation.
Treatment

Treatment consists of immediate compression, ice (applied during the first 24 to 48 hours), and crutches to assist with weight bearing. Massage is contraindicated and may in fact cause further damage (bleeding and increased pain).

Complete recovery can be expected, but painless full range of motion should be achieved before the athlete returns to his or her sport. Recovery time may range from two days to six months, depending on the severity of the injury and the development of complications, such as myositis ossificans.

Myositis Ossificans

*Myositis ossificans* is a very painful condition in which an ossifying mass (calcium deposit) forms within the muscle. In many cases, myositis...
Ossificans is the result of recurrent trauma to a quadricep muscle that was not properly protected after an initial injury. A history of injury should always be investigated to rule out other causes.

**Signs and Symptoms**

A hard, painful mass in the soft tissue of the thigh and progressive loss of bending motion of the injured knee are indications of myositis ossificans. The definitive diagnosis of this condition is made by x-ray, but usually not until at least four weeks after the injury.

**Treatment**

In the early stages, treatment consists of heat, limitation of joint motion, and rehabilitative exercises within the limits of pain. Passive stretching and vigorous exercise during the first six months after injury are discouraged. The calcium mass usually is reabsorbed by the body; however, resorption may take three to six months. Surgical excision may be necessary if pain and limited motion persist beyond one year.

**Iliac Crest Contusions**

The *iliac crest contusion*, or “hip pointer,” is a very painful injury caused by a direct blow to the hip. Hip pointers are common in football players who wear improperly fitting hip pads.

**Signs and Symptoms**

Extreme tenderness, swelling, and ecchymosis over the iliac crest are classic signs and symptoms of a hip pointer (Figure 19–21).

**Treatment**

Treatment involves application of ice and compression.

**Rehabilitation**

Return to sport should be dictated by the athlete’s pain level. The injured area should be padded to protect it from further injury.

**Overuse Injuries**

Overuse injuries are common in athletes who have focused their efforts on one sport. These injuries are caused by the cumulative effect of very low levels of stress—such as that caused by the repetitive action of running. Chronic muscle strains, stress fractures, tendinitis (overuse/overload fatigue within the tendon),
In athletics, there are several common injuries to the hip and pelvic region:

- **Bursitis** is inflammation of bursae toward the outside of the hip. Treatment is to rest and ice the affected area. Anti-inflammatory medication is also helpful.
- **Fractures of the hip** usually result from a fall and result in severe hip pain. Treatment will depend on the fracture type.
- **Quadriceps and hip flexor strains** usually occur in athletes whose sports require repetitive sprinting, jumping, and kicking. Treatment consists of ice, compression, and anti-inflammatory medications.
- **Hamstring strains** result when these muscles are pulled too far too fast. Treatment is usually a combination of RICE, medication, and physical therapy.
- **Adductor strains** usually result from sudden sideways changes in direction. Typically, they are difficult to treat; rest, ice, anti-inflammatory medications, and stretching are recommended.
- **Iliotibial band syndrome** is an inflammation of the iliotibial band. Treatment includes analysis of gait and modification of the athlete's training regimen.
- **Quadriceps contusions** are the result of a direct blow to the thigh. Treatment consists of compression, ice, and protection from weight bearing.
- **Myositis ossificans** is a painful condition in which a calcium deposit forms within the muscle. Treatment involves heat, limitation of joint movement, and rehabilitative exercises.
- **Iliac crest contusions** are a result of a direct blow to the hip. Treatment involves ice and compression.
- **Overuse injuries** are the result of the cumulative effects of low-level stress on one particular area. Treatment may include developing a more well-rounded training routine.
- **Stress fractures of the pelvis** occur most often in runners and dancers. Treatment consists of rest and nonweight-bearing exercises.

snapping hip (iliopsoas tendon snapping over the head of the femur), and bursitis (inflammation and thickening of the bursal wall) are examples of overuse injuries.

An athlete with an overuse injury should rest from the sport that aggravated the injury and use cross-training techniques. Exercises that work different parts of the body to maintain cardiovascular conditioning will help the athlete to return to the sport sooner.


**Stress Fractures**

Stress fractures of the pelvis occur most often in runners and dancers. Stress fractures of the femur usually occur in runners.

**Signs and Symptoms**

The injured athlete may complain of chronic, ill-defined pain over the groin and thigh, and initially be diagnosed with a muscle strain. If there is no history of acute injury, though, a stress fracture should be considered. If the symptoms do not resolve with rest and rehabilitative exercise, the athlete should be examined by a sports medicine specialist. Diagnosis is performed by using x-rays and/or bone scans.

**Treatment**

Treatment of stress fractures consists of rest and nonweight-bearing endurance exercises, such as running in water or swimming.

**CONCLUSION**

The hip is a stable joint that is well protected and surrounded by muscle on all sides. It allows substantial range of motion. Because the hip is a freely movable, ball-and-socket joint, the muscles that protect it are prone to injuries. Injuries of the hip usually result from these muscles being overused or pushed too hard.

The pelvis is made up of several flattened bones that form a ring and function as a support structure for the human skeleton. The function of the pelvis is to transmit weight from the axial skeleton to the lower limbs, when standing, or to the ischial tuberosities, when sitting. The pelvis provides attachments for various muscles, which insert onto and control the lower limbs; it also houses parts of the digestive and urinary tracts. The pelvis also houses the reproductive system in both males and females.

Injuries to the hip and thigh are very common in athletics. They include muscle strains, ligament sprains, inflammation of bursae, contusions, and fractures. The iliotibial band, which provides stability to the knee and assists in flexion of the knee joint, can also become inflamed. When the IT band is irritated, movement of the knee joint becomes painful.

1. Describe the differences of the hip and pelvis between men and women.
2. List the adductors and abductors of the hip.
3. List the common injuries and conditions of the hip and thigh. Briefly describe each.
4. What is the difference between a hip flexor strain and a groin strain?
5. The hamstrings are made up of three different muscles. What are they?
6. Describe the causes of hamstring strains.
7. Explain the causes of iliotibial band syndrome.
8. How does myositis ossificans develop?
9. What is a “hip pointer”?
10. What can be done to avoid overuse injuries?

**StudyWARE Connection**
When you complete this chapter, go to your StudyWARE™ CD-ROM and take a practice quiz.

1. Using the library or the Internet, research the “core muscle group.” How does this pertain to the hip and pelvis? Explain.
2. Select one of the common injuries and conditions of the hip and thigh explained in this chapter. Research and write a paper on this topic.
3. Create a stretching chart using the stretching exercises explained in this chapter.

**PROJECTS AND ACTIVITIES**

**WORKBOOK PRACTICE**
Go to your Workbook for more practice, including a review of chapter concepts, vocabulary review, research activities, anatomical labeling and coloring exercises, a word search or crossword puzzle, and a critical thinking exercise to help you learn and apply the content in this chapter.

**LEARNING LINKS**
- Visit http://www.sportsknee.com; click on the patient education animation link to view the anatomy of the hip. (This site also has a nice animation of the knee and shoulder.)
- Visit http://www.kaganorthopedic.com; click on the patient education link for information on the hip.