The hip is a vitally important anatomic structure. Among joints, it is structurally and functionally unique in many ways. The other articles in this issue discuss pitfalls in diagnosing diseases of, or injuries to, the musculoskeletal system as a whole. Upon reading those articles, one is impressed with the frequency, severity, and consequences of pathologic involvement of the hip joint. The final common result of many of these diagnoses is osteoarthritis. The best way to avoid or delay its onset is with early diagnosis and early definitive treatment.

In this article, the unique features of the hip joint will be discussed as they relate to the pathophysiology and diagnosis of musculoskeletal disorders. Pitfalls in diagnosing hip problems will also be considered. The diagnoses of most interest are listed in Table 1.

UNIQUE FEATURES OF THE HIP

The hip, like all joints, begins as a block of cartilage which undergoes autolysis in its central portion at 7 to 8 weeks of gestation to form the two articulating components of the joint. The proximal femur and acetabulum then undergo many changes in position and shape during the remaining weeks of gestation. These changes continue into early adolescence and are more extensive and complex than at any other joint in the body.

The best way to avoid or delay the onset of osteoarthritis is with early diagnosis and definitive treatment.

The hip is the only true ball-and-socket joint in the body, although it is not a universal joint. There are limitations to range of motion which change with growth. Neonates and infants have flexion and external rotation contractures that spontaneously resolve with time. Once the contractures have resolved, the underlying anatomic bony configuration can be appreciated. A broad spectrum of age related normal configurations accounts for the wide range of rotational hip profiles and torsional variations seen clinically. Those normal values change spontaneously with growth. It is important to recognize these normal variations before attempting to diagnose an abnormality.

The vascular anatomy of the hip joint is complex, precarious, and changes with growth. Once ossification begins in the femoral head, the growth plate acts as a barrier to prevent the rich intraosseous blood supply in the femoral metaphysis from penetrating into the epiphysis. In addition, the proximal femoral epiphysis, like the radial head but unlike most other epiphyses, is entirely intraarticular and cartilage-covered. The blood vessels to the epiphysis cannot enter directly from the adjacent soft tissues as they do in...
most epiphyses. Instead, they must travel for some distance in the relatively unprotected intraarticular space. They penetrate the hip capsule and travel on the surface of the femoral neck (metaphysis), cross the perichondrial ring of the growth plate, and then penetrate the epiphysis of the femoral head (Figure 1). Increases in intraarticular pressure from inflammation, hemorrhage, or infection may obstruct blood flow and cause avascular necrosis. Because the vessels are closely adherent to the growth plate and cross it at right angles, injury to the growth plate is frequently associated with injury to the vascular supply. The relationship between this unusual blood supply and Legg-Calvé-Perthes disease (LCPD) is under study in many centers.

The hip is also unique in that the growth plate and epiphysis of the proximal femur are within the joint capsule. Infections of, or injuries to, these anatomic parts can have consequences for the joint as well. Only the proximal humerus in the shoulder and the distal tibia in the ankle share this anatomic arrangement. In other joints, only a part or all of the epiphysis is intraarticular.

Innervation of the hip joint is by the obturator and femoral nerves, which also innervate the knee joint and provide sensory innervation to the anterior and medial thigh. Referred pain to these more distant areas is a frequent cause of delayed diagnosis of hip problems. Pain may also be referred to the “hip” from more proximal anatomic areas, such as the spine and ilium. For most children and adults, the “hip” refers to any or all structures between the low back and upper thigh. There are many other anatomic structures in that interval that could account for the symptoms.

From a biomechanical standpoint, the hip is the only major weightbearing joint in which a growth plate is loaded with a component of shear force. Other joints are loaded in compression, a more stable configuration. The exact relationship of this anatomic finding to slipped capital femoral epiphysis (SCFE) is uncertain but suspect.

The hip is situated deep in the soft tissues, which makes clinical evaluation difficult. Swelling, warmth, and redness in the hip area are delayed compared with these findings in more superficial joints. Tenderness is often nonspecific as many anatomic structures are, of necessity, palpated simultaneously. Deformity is likewise obscured by the large soft tissue envelope. The muscles that cross the hip are quite powerful. Pain in the hip area can cause so much guarding that evaluation of range of motion, even in neonates, may be unrewarding for the casual examiner.

Radiographic evaluation of the hip is more difficult than for most joints, except perhaps the elbow. Ossification of the femoral head is rare at birth. Only approximately 20% of femoral heads are ossified at age 3 months, 80% at 6 months, 96% at 9 months, and 100% at 12 months. In infants, mild asymmetry or asynchronous appearance of ossification from right to left may be normal. Normal ossification of the acetabulum is difficult to evaluate with certainty until about age 2 months. At all ages, it is difficult to obtain two x-ray views of the hip at 90° to each other because of the orientation and depth of the joint within the body. Rotating the femur gives a different projection of the femoral head but not the acetabulum, which for most conditions of the hip is sufficient. Occasionally, however, three dimensional analysis is necessary and may not be possible with planar x-rays alone.

### PITFALLS

Failure to Consider Other Diagnoses When There is a History of Trauma

*Trauma is always a consideration in the evaluation of a child with musculoskeletal complaints, limp, or refusal to walk, but a presenting history of trauma may be a red herring. Children play for a living. They are constantly subjected to minor, and occasionally major, injury. Certainly from a statistical standpoint, most mild and transient musculoskeletal complaints are due to bumps and bruises.*

One must constantly ask what else could account for the symptoms. Could the history of trauma merely be coincidental? It takes fairly major trauma to fracture the pelvis or hip, so the history should be highly suggestive. Less energy is required to avulse the anterior superior or anterior inferior iliac spine, or the ischial tuberosity. These injuries usually occur in adolescents during athletics. They are diagnosed by a history of sudden, forceful contraction by the muscle of origin at that site, point tenderness on examination, and apophyseal bony displacement seen radiographically. A history of sudden, forceful resistance to passive abduction of the hip, as during an unexpected split, suggests adductor muscle strain. There is point tenderness over the origin of the adductor muscles in the groin. Passive abduction (spread) and active adduction are painful. Adductor tenderness and pain with movement may, however, be seen as a consequence of other painful conditions of the hip such as

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**TABLE 1**

<table>
<thead>
<tr>
<th>Common Diagnoses of the Hip</th>
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</thead>
<tbody>
<tr>
<td>Congenital dislocation of the hip (CDH)</td>
</tr>
<tr>
<td>Infection—sepsis, osteomyelitis</td>
</tr>
<tr>
<td>Juvenile rheumatoid arthritis (JRA)</td>
</tr>
<tr>
<td>Legg-Calvé-Perthes disease (LCPD)</td>
</tr>
<tr>
<td>Slipped capital femoral epiphysis (SCFE)</td>
</tr>
<tr>
<td>Stress fracture</td>
</tr>
<tr>
<td>Transient synovitis</td>
</tr>
<tr>
<td>Trauma</td>
</tr>
<tr>
<td>Tumors—osteoid osteoma</td>
</tr>
</tbody>
</table>

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LCPD or SCFE. The symptoms in these cases are due to adductor spasm, the body’s protective mechanism for hip pain. The differentiation is obviously important.

Other diagnoses in the trauma category must also be considered. Hip sprain is not a reasonable diagnosis. As a rule, children do not sprain joint ligaments. They injure growth plates (which are weaker than the ligaments) or they strain muscles. This is definitely the case with the hip. Therefore, although a history of trauma is frequently obtained when a child presents with hip pain, other potentially more serious diagnoses should be considered, especially if the initial trauma workup is negative.

Failure to Consider Age and Sex Related Diagnoses

Some of the common pathologic conditions of the hip have a characteristic narrow age range of onset and a sex predilection (Table 2). Knowing these can improve accuracy of diagnosis by including them in the differential diagnosis.

Failure to Consider Hip Problems with Complaints of Knee Pain

As discussed previously, because of common innervation patterns, some conditions of the hip may present as medial knee or thigh pain even though there are no focal knee findings. This is frequently the case with LCPD and SCFE. It is, therefore, essential to continued on page 17
TABLE 2

<table>
<thead>
<tr>
<th></th>
<th>Transient Synovitis</th>
<th>LCPD</th>
<th>SCFE</th>
<th>Stress Fracture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak age</td>
<td>3-10</td>
<td>3-10</td>
<td>10-15</td>
<td>Late adolescence</td>
</tr>
<tr>
<td>Sex (M:F)</td>
<td>2:1</td>
<td>4:1</td>
<td>2:1</td>
<td>male</td>
</tr>
</tbody>
</table>

**Figure 2.** Patient with slipped capital femoral epiphysis of right hip. A. Slightly greater external rotation seen at rest.

B. Marked external rotation seen with passive hip flexion.

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examine the hip carefully in a child with “knee pain.” A limitation of hip rotation (tested prone) and hip abduction (tested supine) will confirm suspicions and redirect the evaluation to the hip.

**Failure to Consider Spine and Pelvis Problems with Complaints of Hip Pain**

Discitis, lumbar vertebral osteomyelitis, herniated lumbar disc, spondylolysis, sacroiliac joint infection or spondyloarthropathy, iliac osteomyelitis, iliac abscess or intramuscular hemorrhage from hemophilia, and retrocecal appendicitis are among a long list of conditions that may present as “hip pain” in children. The spine and pelvis should always be examined in cases of hip pain especially if the hip exam is relatively unremarkable.

**Failure to Appreciate Hip Idiosyncracies**

Hip involvement as the first or only joint in pauciarticular juvenile rheumatoid arthritis is rare. There is no good explanation for this phenomenon, but being aware of this fact may prevent complacency in attributing the signs and symptoms of a serious condition to a fairly benign disease for which diagnosis is by exclusion only.

Another idiosyncracy is the painless limp occasionally seen with LCPD. One may elicit a history of pain which has subsided, only to be left with a painless limp.
Failure to Appreciate Subtleties of the Hip Exam

For most painful conditions of the child's hip joint, a posture of flexion, abduction, and external rotation is assumed. Pseudoparalysis — lack of spontaneous movement due to pain rather than true paralysis — is also seen. Neonatal congenital dysplasia of the hip and traumatic separation of the proximal femoral epiphysis may appear to be similar on x-ray, but the former is painless whereas the latter is painful. Acute hip sepsis at any age is exquisitely painful with attempted active or passive movement. Move the hip and move the child. Transient synovitis is less painful. Significant hip motion is often possible with slow, gentle, passive examination.

The child with LCPD is typically a 4- to 9-year-old male who is small for his age, has an abductor lurch, and has painful limitation of hip abduction and rotation. The typical young adolescent with SCFE walks with an out-toed, antalgic gait. With passive hip flexion, the extremity rotates externally (Figure 2). Internal hip rotation is most limited and painful, but abduction is also painfully limited.16

Failure to Obtain Adequate X-Rays

Hip examination is difficult and often nonspecific. Therefore, x-ray evaluation is often more helpful in

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evaluating the hip than it is for evaluating other joints, given the limitations noted earlier. An x-ray of the pelvis rather than just the symptomatic hip should be obtained. Because many early x-ray findings are subtle, an x-ray of the entire pelvis permits comparison with the normal hip. This evaluation is useful in determining soft tissue shadow changes with joint effusion, joint space widening with early LCPD or late sepsis, rarefaction of the metaphysis in osteomyelitis, and apparent changes in shape of the epiphysis in SCFE (Figure 3A).

Just as no one would order a single x-ray view of the knee or ankle in evaluating those joints, no one should forget the second view of the hip. In addition to the anterior-posterior pelvis view, a bilateral frog leg lateral pelvis x-ray should be obtained to show the 90° view of the proximal femur. For most conditions of the hip, the lateral view of the acetabulum is not necessary. If the hip is too painful to position for the frog lateral view, a true lateral of the hip can be taken. The earlier x-ray changes in LCPD and SCFE are often seen best on the lateral view (Figure 3B).

Failure to Use Bone Scan Appropriately

The technetium bone scan can be very helpful in localizing hip pathology when the physical exam is nonspecific and x-rays are nondiagnostic. This is certainly the case with neonatal multifocal osteomyelitis, early osteomyelitis of the hip area or pelvis (focal increased uptake), osteoid osteoma (marked focal increased uptake) or stress fracture of the femoral neck (focal, linear increased uptake), and early LCPD (decreased uptake).

The bone scan may be normal in the first 2 days of osteomyelitis or joint sepsis and may warrant repeating if further workup is unrewarding and the diagnosis is still suspected. The bone scan may appear normal or may not adequately localize the pathology unless pinhole collimation and oblique or rotated views are requested. Needle aspiration of the bones or joint will not affect a subsequent scan.

SUMMARY

The hip joint is unique anatomically, physiologically, and developmentally. Because of these features, diagnosis of pathologic conditions is more difficult than for most joints. Because delay in diagnosis and treatment may result in crippling osteoarthrosis, it is imperative that diagnostic pitfalls be avoided.

REFERENCES