Abstract

A limp is a common reason for a child to present to the orthopaedist. Because of the long list of potential diagnoses, some of which demand urgent treatment, an organized approach to evaluation is required. With an understanding of normal and abnormal gait, a directed history and physical examination, and the development of a differential diagnosis based on the type of limp, the patient’s age, and the anatomic site that is most likely affected, the orthopaedist can take a selective approach to diagnostic testing. Laboratory tests are indicated when infection, inflammatory arthritis, or a malignant condition is in the differential diagnosis. The C-reactive protein assay is the most sensitive early test for musculoskeletal infections; an abnormal value rapidly returns to normal with effective treatment. Imaging should begin with plain radiography. Ultrasoundography is particularly valuable in assessing the irritable hip and guiding aspiration, if necessary.

Normal Gait

Normal gait is a smooth, rhythmic, mechanical process that advances the center of gravity with a minimum expenditure of energy. Many aspects of gait change with age. When children begin to walk (typically between 12 and 16 months of age), they have a short stride length, a relatively fast cadence and slow velocity, and a widened base of support in double stance. Their hips, knees, and ankles move through a small arc of motion. Until 30 to 36 months of age, children have neither the balance nor the abductor strength to maintain single-limb stance for very long. By 7 years of age, children exhibit a mature gait.

The mature gait cycle is composed of the stance phase (initial contact, loading response, midstance, terminal stance, preswing) and the swing phase, during which the limb is advanced in space to position the foot for the next heelstrike. The abductors stabilize the pelvis during stance phase, preventing significant side-to-side motion as the opposite limb swings...
through. During normal walking motion, one foot is always on the ground. The kinematics of normal gait has been studied in detail,2,3 establishing normal ranges of joint motion during different phases of the gait cycle. The ankle dorsiflexes at heel-strike, then plantar-flexes to foot-flat, and then dorsiflexes again as the tibia moves forward. The knee is flexed at heel-strike, extends until toe-off, and then flexes during swing, allowing clearance of the foot as it positions for the next heel-strike. The hip follows a similar pattern, with slight flexion at heel-strike, extension through stance, and then flexion in swing.

Abnormal Gait

Normal gait can be altered by pain, a mechanical problem, or a neuromuscular problem. A child will adopt an antalgic gait in an effort to prevent pain in the affected limb. The single-limb-support phase of stance is shortened on the painful extremity, as is the stride length of the normal opposite limb (to get back to bearing weight on the well leg as quickly as possible). A variant of the classic antalgic gait is the “cautious” gait of a child with back pain.4 For example, a child with diskitis will lose the normal rhythmic flexion and extension of the lumbar spine, as demonstrated when bending to pick up objects off the floor.5 Another variant of the antalgic gait is the complete refusal to walk. This pattern is seen most often in toddlers and may indicate a condition causing pain that cannot be avoided by any of the possible gait alterations.

Circumduction—excessive hip abduction, pelvic rotation, and hiking—functionally shortens a limb, thus enhancing foot clearance during swing when there is joint stiffness, particularly in the ankle.5 Children with a significant limb-length inequality may “vault” with the short leg (or toe-walk) to clear

| Table 1 | Differential Diagnosis of Antalgic Gait |
|---|---|---|
| <4 yr | 4 to 10 yr | >10 yr |
| Toddler’s fracture (tibia or foot) Osteomyelitis, septic arthritis, diskitis Arthritis (juvenile rheumatoid arthritis, Lyme disease) Discoid lateral meniscus Foreign body in the foot Benign or malignant tumor | Fracture (especially physeal) Osteomyelitis, septic arthritis, diskitis Legg-Calvé-Perthes disease Transient synovitis Osteochondritis dissecans (knee or ankle) Discoid lateral meniscus Sever’s apophysitis Accessory tarsal navicular Foreign body in the foot Arthritis (juvenile rheumatoid arthritis, Lyme disease) Benign or malignant tumor | Stress fracture (femur, tibia, foot, pars intra-articularis) Osteomyelitis, septic arthritis, diskitis Slipped capital femoral epiphysis Osgood-Schlatter disease or Sindig-Larsen-Johansen syndrome Osteochondritis dissecans (knee or ankle) Chondromalacia patellae Arthritis (Lyme disease, gonococcal) Accessory tarsal navicular Tarsal coalition Benign or malignant tumor |

| Table 2 | Differential Diagnosis of a Nonantalgic Limp |
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| Equinus Gait (Toe-Walking) | Trendelenburg Gait | Circumduction Gait / Vaulting Gait | Steppage Gait |
| Idiopathic tight Achilles tendon Clubfoot (residual or untreated) Cerebral palsy Limb-length discrepancy | Legg-Calvé-Perthes disease Developmental dysplasia of the hip Slipped capital femoral epiphysis Muscular dystrophy Hemiplegic cerebral palsy | Limb-length discrepancy Cerebral palsy Any cause of ankle or knee stiffness | Cerebral palsy Myelodysplasia Charcot-Marie-Tooth disease Friedreich’s ataxia |
the long leg, rather than circumduct it. An equinus gait (toe-walking) occurs when ankle dorsiflexion is limited. This may result from gastrocnemius-soleus spasticity, shortening of the Achilles tendon, or both. Thus, stance phase will be initiated with toe-strike rather than heel-strike.

Several abnormal gait patterns result from muscle weakness or a neurologic abnormality. A Trendelenburg gait results from altered hip mechanics, particularly abductor weakness. During stance on the involved side, the contralateral side of the pelvis drops. To preserve balance, the child may lean the trunk toward the affected side. A variation of the Trendelenburg gait is the waddling gait of a child with bilateral hip dislocation. A “step-page gait” develops when the ankle dorsiflexors are weak (e.g., as in Charcot-Marie-Tooth disease). To compensate for the weakness, the child increases knee flexion in the swing phase to clear the foot. The foot will slap to the ground because the ankle dorsiflexors are unable to decelerate the foot between heel-strike and foot-flat. An unsteady gait may result from conditions that affect balance, such as Friedreich’s ataxia. Careful initial analysis of the gait can enhance the specificity of the remainder of the physical examination and facilitate localization of the origin of the limp.

**History**

An accurate history may be difficult to obtain from a young child, and some or all of the history must be obtained from the parents or primary caregivers. A brief discussion with the child, followed by a parental description of pain complaints and changes in gait pattern, is invaluable in guiding the subsequent physician-directed evaluation. In certain circumstances, adolescents and some children should be questioned privately, as they may provide important details regarding exposure to sexually transmitted diseases, such as gonococcal infection, which may not be obtained in the presence of parents. Once the parent and patient have had an opportunity to describe the pain and/or limp in their own terms, the physician is best prepared to complete the history.

The history should focus on the character of the limp: the presence or absence of pain or other localizing symptoms, the frequency and duration of symptoms, and the mechanism of injury, when appropriate. A history of ceasing athletic participation or social play with friends should raise concern. The absence of pain suggests either neuromuscular or metabolic disease or a congenital or developmental abnormality, such as hip dysplasia or limb-length discrepancy. In a toddler, the absence of pain complaints may not be particularly helpful, and the physical examination takes on greater importance.

The pattern, onset, and duration of pain may suggest the origin. Acute onset of severe pain over a few days focuses the evaluation on trauma, infection, or malignancy, whereas gradual worsening over months suggests inflammatory or mechanical symptoms. It is helpful to characterize the quality of the pain as constant, intermittent, or transient. Constant pain is of particular concern, suggesting an intramedullary process, such as expanding tumor or infection. A history of trauma is readily established in most circumstances, with some notable exceptions: pathologic fracture and child abuse.

It is important to characterize the timing of pain (e.g., morning pain, pain after activity, or pain that wakes the child from sleep). Morning pain or pain and stiffness after inactivity are more characteristic of inflammatory joint disorders. Pain after activity may suggest an overuse injury, such as a stress fracture, or an internal articular derangement, such as an osteochondral lesion, a meniscal tear, or an anterior cruciate ligament tear. Night pain that wakes a child from sleep may represent benign “growing pains,” but the concern is that it may derive from osteoid osteoma or a malignant condition.

Pain relief with nonsteroidal anti-inflammatory medications may be characteristic of osteoid osteoma but is not diagnostic. Referred pain must also be considered, particularly thigh or medial knee pain referred from painful conditions of the hip (e.g., slipped capital femoral epiphysis). Buttock or lateral thigh pain may be referred from the back. Pain in multiple joints suggests an arthritic process.

A past medical history including recent trauma or exposure to infectious diseases and use of antibiotics is helpful in diagnosis. Recent varicella infection may lower systemic immunity, rendering the child susceptible to opportunistic bone or joint infections. Failure to achieve appropriate developmental milestones or, more ominously, deterioration of motor ability warrants further neuromuscular or metabolic evaluation. The review of systems should seek a history of recent fever, weight loss, or malaise suggestive of infection or malignancy. A history of prior medical evaluation for the same problem should be sought, and the pertinent records should be obtained when possible. A complete history should include questioning about the family history of neuromuscular disease, metabolic disease, inflammatory arthritis, or infectious disease exposure.

**Physical Examination**

The physical examination of the limping child has three essential components: the gait exam, the
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standing/floor exam, and the tabletop exam. The child should be dressed in as little clothing as is practical; gym shorts and bare feet are ideal. Much can be missed watching a small child walk in an oversized gown that extends to the floor.

Gait Examination

The examination area should offer sufficient space to see multiple gait cycles. It is important not to be fooled by an artificial “doctor walk”; the best chance to see the true limp is by observing gait when the child does not know she is being watched, such as when the child is walking to the examination room. Running may accentuate the limp or abnormal gait. Subtle weakness or the upper-extremity posturing of cerebral palsy might not be seen until the child runs. Shoes may provide valuable clues to gait problems; for example, a child having trouble clearing his foot in swing phase may have excessive toe wear.

It is best to adopt a systematic approach to the gait examination, working from the ground up and watching each limb segment and joint through several gait cycles. Trying to simultaneously analyze every facet of gait is difficult for even the most experienced clinician, considering that a typical toddler takes 180 steps per minute. Note how the foot strikes the floor—is there heel-strike, foot-flat, or toe-strike? A child may walk on the medial or lateral border of the foot to protect a sore bone or the site of a puncture wound or foreign body. Abnormal limb rotation may be observed. Metatarsus adductus, internal tibial torsion, or femoral anteversion will result in an internal foot-progression angle. An adolescent with a slipped capital femoral epiphysis or a young child with an occult fracture may walk with an external foot-progression angle.

The next feature to consider is the symmetry of the stance phase. A unilateral shortened stance phase is characteristic of an antalgic gait. The range of motion of each joint should also be evaluated. Limited ankle dorsiflexion is seen in children with a short Achilles tendon or a spastic gastrocnemius-soleus. At the knee, motion should be observed through several gait cycles. Contracture or spasticity in the quadriceps or hamstrings or intra-articular derangement will limit knee motion. Any frontal-plane abnormalities should be noted as well (e.g., a varus thrust of the proximal tibia in Blount’s disease). Hip motion may be abnormal, exhibiting circumduction, persistent flexion, or excessive pelvic or trunk motion. Upper-extremity posturing as well as difficulty with balance and coordination may suggest a neurovascular origin of the limp.

Standing/Floor Examination

After the history and vital signs have been taken and the physician has thoroughly studied the child’s gait, there are several tests to consider before the tabletop examination. The spine should be examined with the child standing, taking care to note balance in the coronal and sagittal planes, scoliosis, lumbar-sacral step-off, pelvic obliquity, and any cutaneous findings (e.g., café-au-lait spots, hairy patches, or sacral dimples). On the forward bend, the examiner should note a thoracic or lumbar prominence due to scoliosis.

The Trendelenburg test is performed by having the child stand on the affected leg with the knee flexed and the hip extended. The child may need to rest his hands against the wall for balance. If the Trendelenburg test is performed with hip flexion, the hip flexors can elevate the pelvis and mask a mild deficiency of the gluteus medius. It may take 20 seconds or more of continuous testing on the affected limb before abductor weakness causes the opposite pelvis to drop.

If muscular dystrophy is a possibility, a Gower test is performed by having the child sit on the floor and then rise quickly, observing to see if he uses his hands to substitute for weak hip extensor muscles. Repetitive single-leg heel raises and toe raises can be utilized to accentuate subtle weakness in the foot plantarflexors or dorsiflexors.

Tabletop Examination

With the child on the examining table, one should thoroughly inspect for asymmetry, deformity, erythema, rashes, and swelling. Puncture wounds or foreign bodies should be sought on the planter surface of the foot in walkers and on the anterior aspect of the knee in crawlers. The resting position of the limb should be noted; for example, a child with septic arthritis of the hip will hold the hip flexed and externally rotated. Note also any muscle hypertrophy (e.g., calf hypertrophy in muscular dystrophy) or atrophy (e.g., global unilateral atrophy in hemiplegia or quadriiceps atrophy in a child with a painful hip or knee).

Palpation of the lower extremity to find the point of maximum tenderness is often the most valuable part of the physical examination of a limping child. Knowing the exact site of pain dramatically limits the differential diagnosis and may eliminate the need for a bone scan or other diagnostic test (Fig. 1). Every joint of the lower extremity should be taken through its range of motion, noting pain, contractures, or muscle spasticity. The patellofemoral joint, a common source of pain in adolescents, should be tested for signs of apprehension or pain with patellar compression during flexion and extension. The sacroiliac joint is tested by direct percussion posteriorly and by stressing the joint with the hip positioned in flexion, abduction, and external rotation (FABER test). The rotational profile should
be documented in children with in-toeing or out-toeing. Appropriate neurologic testing should also be performed.

Limb lengths should be assessed. If an inequality is noted, the difference is most accurately determined by leveling the pelvis with blocks under the short leg. Although a significant limb-length inequality may itself alter gait, it also suggests other potential causes of limping, such as hemiplegia and developmental dislocation of the hip.

Radiographic Evaluation

Although the various imaging modalities may each have a role in the assessment of the child with a limp, plain radiography should always be performed first, because radiographs are inexpensive, can be easily obtained at any hour, and are both sensitive and specific for a wide variety of disorders. In children who can localize tenderness, initial plain radiographs should include orthogonal images of the affected limb that visualize the joint both above and below the point of maximum tenderness. A third oblique view is included when imaging the ankle or foot if an area of suspected pathologic change may be obscured by bone overlap, minimal displacement of fracture fragments, or minimal physeal widening. If the patient can localize pain but the initial radiographs of the long bones are negative, additional oblique views may reveal more subtle osseous changes, such as a minimally displaced tibial fracture (toddler’s fracture) or the periosteal elevation of a stress fracture. In children who present with a limp or refusal to bear weight but are too young to localize pain, plain radiographs of the entire lower extremity should be obtained (Fig. 2).

Plain radiographs are not particularly helpful in identifying early bone or joint infections. The early radiographic findings of acute hematogenous osteomyelitis include a normal osseous appearance with subtle displacement and swelling of the soft tissues. Comparison views may depict subtle soft-tissue swelling, but radiographic sensitivity for the early changes of osteomyelitis is less than 50%. The radiographic appearance of early soft-tissue changes due to septic arthritis is difficult to interpret and unreliable. Early bone or joint changes are not typically seen radiographically until 10 to 12 days after the onset of bone or joint infection and the presence of these changes suggests a significant delay in diagnosis.

The triphasic technetium-99m bone scan is an excellent test for evaluating a limping child when the history and physical examination fail to localize the anatomic site of pathologic changes (Fig. 3). Bone scanning has been demonstrated to be superior to the other standard screening tests for infection (temperature, white blood cell count, erythrocyte sedimentation rate, and plain radiography) in the limping toddler. The technetium accumulates at the site of increased blood flow and osteoblastic activity in osteomyelitis, stress fractures, occult fractures, neoplasm, and metastases. In suspected early bone infection, bone scans have high sensitivity (84% to 100%) and specificity (70% to 96%).

Although the diagnosis of many long-bone infections can be made.
without scintigraphy, bone scans are particularly helpful in localizing sepsis around the pelvis and the spine—areas that are difficult to examine and where soft-tissue changes are difficult to identify. Bone drilling and periosteal elevation have been demonstrated experimentally to have no effect on a subsequent bone scan performed within 24 hours, and prior aspiration has not interfered with results in clinical practice. Other advantages of bone scanning over cross-sectional imaging modalities include decreased expense, less need for sedation, and the ability to image the whole body.

Limitations of bone scintigraphy include difficulty in distinguishing between bone infarct and osteomyelitis in hemoglobinopathies and the occurrence of false-negative bone scans in cases of Langerhans cell histiocytosis and some other aggressive tumors in children. Bone scanning has low sensitivity for septic arthritis, especially when there is adjacent osteomyelitis, and is therefore not indicated in this circumstance. Leukemia may result in increased, decreased, or no change in technetium uptake. A “cold” scan (i.e., one showing low uptake) in the setting of suspected osteomyelitis is not necessarily negative; instead, it may represent bone rendered avascular due to a subperiosteal or endosteal abscess. A study of cold bone scans in pediatric patients with osteomyelitis revealed that they had more severe bone infections requiring more aggressive medical and surgical treatment compared with control children with “hot” bone scans and osteomyelitis.

Figure 2  A, Anteroposterior (AP) radiograph of the hips and pelvis of a 2-year-old girl with a 2-week history of limping, fever, malaise, and difficulty sleeping through the night. Periosteal changes (arrow) were noted in the right femur. B, A full-length AP radiograph of the femur demonstrates the extent of periosteal elevation and geographic medullary canal erosion of the lesion, which on biopsy proved to be eosinophilic granuloma.

Figure 3  A, AP radiograph of an 8-year-old girl who presented with a limp and the sudden, nontraumatic onset of severe left groin and thigh pain. The film was read as normal. B, The history, physical examination, and plain radiographs did not allow precise localization of the process. A bone scan showed decreased uptake in the left femoral head, suggesting Legg-Calvé-Perthes disease.
Ultrasonography is a valuable diagnostic tool in the evaluation of a limping child with an irritable hip (Fig. 4). Ultrasonography is noninvasive, requires no sedation, and is typically more accessible and less expensive than other secondary radiologic tests. However, if infection is highly probable, ultrasonography should not delay urgent operative irrigation and debridement. If a hip effusion is noted, the ultrasonographer can assist with a guided aspiration and can document the intra-articular positioning of the needle. If ultrasonography is not available, a possibly infected hip can be aspirated with fluoroscopic guidance.

In one series of 44 patients with a limp or hip pain and negative plain radiographs, ultrasonography was 100% accurate in predicting the presence of aspiration-documented hip effusion. Another larger prospective study of 111 children with irritable hips confirmed that the plain radiograph was of little value in the detection of early hip effusion; in that study, there was radiographic evidence of effusion in 15% of hips, compared with sonographic evidence of effusion in 71% of hips. Furthermore, Zawin et al. showed that ultrasound-guided hip aspiration in the radiology suite decreased the subsequent operative time for septic hips by 50%. However, a large prospective study of 500 painful hips in children demonstrated that ultrasound cannot effectively differentiate among sterile, purulent, and hemorrhagic effusions. The authors of that study concluded that ultrasonography of the hip should be reserved for select cases in which sepsis is suspected.

Ultrasound evaluation of the irritable hip is performed with the transducer oriented in an oblique sagittal plane parallel to the long axis of the femoral neck with the hip in extension. An effusion causes bulging of the iliofemoral ligament, so that the joint capsule appears convex; the normal opposite capsule will be concave.

Ultrasonography can help confirm the diagnosis of osteomyelitis on the basis of characteristic early and late ultrasonographic clinical features. Early changes, such as deep soft-tissue swelling, are followed by periosteal thickening. Subperiosteal fluid or abscess is seen as a later finding 1 to 2 weeks after the onset of symptoms. The main value of ultrasound imaging of the extremity in cases of suspected infection is to rule out subperiosteal abscess.

Cross-sectional imaging, including computed tomography (CT) and magnetic resonance (MR) imaging, is rarely necessary as an initial study in the evaluation of a limping child. Computed tomography is indicated specifically for imaging of suspected localized abnormalities of cortical bone (Fig. 5). It may also confirm the presence of either a central nidus in cases of osteoid osteoma or the occurrence of a tarsal coalition. Magnetic resonance imaging has proved to be the most effective imaging modality for bone marrow, joints, cartilage, and soft tissues (Fig. 6, C). It is extremely useful in cases of suspected tumor and stress fractures.

**Laboratory Testing**

Infection, inflammatory disease, and malignancy all demand rapid diagnosis and treatment, and laboratory testing may assist both in making the appropriate diagnosis and in monitoring the efficacy of treatment. Laboratory testing is indicated when a child presents with an acute non-traumatic limp and signs and symptoms of fever, malaise, night pain, or localized complaints. Appropriate tests include a complete blood cell count with differential and determination of the ESR, the C-reactive protein (CRP) and antinuclear antibody levels, and the rheumatoid factor and Lyme titers.

In the setting of bone or joint infection, the WBC count is neither sensitive nor specific. Although the WBC count is elevated in 25% to
31% of children with osteomyelitis, normal values for the WBC count are seen frequently in osteomyelitis. The differential is more sensitive and may be abnormal in as many as 65% of children with osteomyelitis and 70% with septic arthritis. The complete blood cell count may reveal moderate to severe anemia in cases of systemic juvenile rheumatoid arthritis (JRA), as well as leukocytosis with active disease. Patients with systemic-onset JRA may present with WBC counts in the range of 30,000 to 50,000/mm³. The platelet count may rise considerably as well.

The ESR is a sensitive indicator of inflammation and is elevated in 90% of patients with osteomyelitis. However, early in the course of infection, the ESR may be normal. Extreme elevation of ESR in what appears to be isolated osteomyelitis should raise the question of associated septic arthritis.

C-reactive protein is an acute-phase protein synthesized by the liver in response to inflammation. Unlike the ESR, the CRP level rises within 6 hours of onset of symptoms and returns to normal within 6 to 10 days with appropriate treatment. The CRP level is more sensitive than the WBC count or the ESR in assessing the effectiveness of therapy and predicting recovery from osteomyelitis and septic arthritis. The CRP value is not influenced by prior aspiration or drilling of the cortex, and a secondary rise suggests relapse. The CRP level should be determined on the initial screening examination if musculoskeletal infection is in the differential diagnosis.

Aspiration and evaluation of joint fluid should be performed when joint sepsis is considered in the differential diagnosis. Of the large joints, the hip is the most technically difficult to aspirate. Sedation and local anesthesia are helpful, and aspiration under fluoroscopic guidance with arthrography at the completion of the procedure is recommended to confirm appropriate spinal needle placement within the joint. Ultrasound-guided aspiration provides similar confirmation of needle placement. Culture and cell counts should be obtained in all cases. A WBC count greater than 80,000/mm³ with a percentage of polymorphonuclear cells greater than 75% is highly suggestive of joint sepsis, although early sepsis may present with a much lower cell count.

The rheumatoid factor and antinuclear antibody levels are determined when inflammatory arthritis is a possibility. In practice, JRA is the most frequently diagnosed pediatric arthritis. It must be noted that the rheumatoid factor test is positive in only 15% to 20% of children with JRA, and is more frequently positive in older children and children in a poor functional class. The finding of a positive antinuclear antibody test is important in the identification of children most at risk for the development of chronic uveitis, which may result in blindness if untreated.

Testing for Lyme disease should be performed on any patient who presents with acute arthritis and who lives in or has recently traveled to an endemic area. The presentation of acute Lyme arthritis may have considerable overlap with that of septic arthritis, including fever, local swelling, pain with range of joint motion, and an elevated WBC count in joint aspirate. Serologic confirmation of Lyme disease is based on a two-test approach consisting of a preliminary enzyme-linked immunosorbent assay and a confirmatory Western immunoblot assay, which specifically examines the reactivity of antibodies.

Figure 5  A, A 10-year-old soccer player presented with a limp and thigh pain of 4 weeks’ duration. AP radiograph shows a radiodense area in the medial subtrochanteric region. B, CT scan obtained to better characterize the sclerotic area shows a pattern typical of a femoral-neck stress fracture. A biopsy was avoided. The pain and limp resolved after 2 months of protected weight bearing.
Making the Diagnosis

When a limping child is brought for musculoskeletal evaluation, some potential diagnoses require urgent treatment to ensure the best possible outcome. Some conditions affect all age groups, but many conditions have a peak age of onset. Although there is increasing interest in practice standardization with use of algorithms for many musculoskeletal conditions, there are so many exceptions in the evaluation of the limping child that any single algorithm will be unreliable for all presentations. Despite this complexity, there are five essential questions that the orthopaedist must answer to direct the evaluation of a limping child: (1) Is the limp due to pain? (2) Did the limp develop suddenly or gradually, or has it always been there? (3) Is the child systemically ill? (4) What type of limp does the child exhibit? (5) Can the problem be localized (specifically, is there a point of maximum tenderness)? The answers to these questions will narrow the differential diagnosis and establish the pace of evaluation. Determining whether the gait is antalgic is the first step in developing a differential diagnosis (Tables 1 and 2).

The answers to these five essential questions direct the evaluation of different clinical scenarios. For example, a healthy 4-year-old presents with the gradual onset of a painless Trendelenburg gait. Examination shows that there is unilateral limitation of hip motion. The work-up of this limp requires only a plain radiograph to establish the diagnosis of Legg-Calvé-Perthes disease or developmental dysplasia of the hip.

In a very different scenario, an ill child presents with the sudden onset of an antalgic gait. Samples for screening laboratory studies should be drawn, and plain radiographs should be obtained for anatomic localization. If the site cannot be localized, a bone scan is valuable. An MR imaging study may add important information, especially if a malignant condition is suspected. If septic arthritis of the hip is a possibility, ultrasound-guided aspiration may be indicated.

Unfortunately, the presentations are usually not this straightforward. The most common challenge is determining whether an acute limp is due to trauma. A typical case is illustrated in Figure 6. The 11-year-old patient had ankle pain after falling. Her pain persisted after casting of a suspected fibular physeal fracture. The plain-radiographic appearance remained normal. Her limp was clearly due to pain, which was worsening with time. Because this was uncharacteristic for trauma, laboratory tests were obtained, which revealed an ESR of 35 mm/hr. Because the process could be localized by pain and swelling around the distal fibula, a bone scan was not needed. An MR imaging study obtained to simultaneously evaluate the soft tissues, the bone, and the ankle joint revealed osteomyelitis with a soft-tissue abscess. The patient was successfully treated with surgical drainage and antibiotic therapy.

Figure 6  An 11-year-old girl sustained a suspected distal fibular physeal fracture. AP (A) and lateral (B) plain radiographs of the ankle taken 10 days after the injury. C, Because of persistent pain and an ESR of 35 mm/hr, an MR imaging study of the distal portion of the leg was obtained. The appearance of this transverse section at the distal fibula is consistent with fibular osteomyelitis and soft-tissue swelling with an abscess, which were successfully treated with surgical drainage and antibiotics. Cultures grew *Staphylococcus aureus*.
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Summary

Limping children commonly present to the orthopaedic surgeon, who is expected to recognize the gait abnormality, determine the probable anatomic origin, and develop a good working diagnosis on which to base a cost-effective strategy for ordering diagnostic tests. Armed with the results of an appropriate history and physical examination and an understanding of normal and abnormal gait, the orthopaedist can use the child’s age and the answers to five essential questions to develop a differential diagnosis and plan a selective approach to diagnostic testing.

References