CHAPTER 4

The Orthopaedic Examination: Clinical Application

It is important for orthopaedic surgeons to be familiar with the numerous musculoskeletal and neuromuscular examinations detailed in Chapter 3, The Orthopaedic Examination: A Comprehensive Overview. Over time, the orthopaedist will most likely perform many of these examinations on different patients presenting with a variety of complaints. If the nature of the patient's medical condition is unclear, the physician may have to perform a comprehensive examination to arrive at a differential diagnosis.

In most cases, though, the orthopaedic surgeon does not have the time or the need to perform an all-encompassing examination on every patient seen in the clinical setting. In the real world, the pediatric orthopaedic examination must be tailored to the child's age, level of cooperation, and chief complaint. The two most common types of examinations performed are the *screening* examination and the *focused* examination.

Screening examinations are performed as part of comprehensive or abbreviated examinations to detect disorders that may be asymptomatic but could cause significant morbidity or mortality if undiagnosed and untreated. *Focused* examinations concentrate on specific abnormalities for which the patient has been referred or on the chief presenting complaint. With these factors in mind, the examiner should make the clinical assessment as orderly and organized as possible to avoid neglecting any essential parts of the examination. However, the examination also needs to be performed as expeditiously as possible, before the examiner loses the child's initial cooperation because of patient apprehension, fatigue, or boredom.

The final section of this chapter addresses the art of examining the pediatric patient. Although it is not difficult to outline the recommended principles for conducting the pediatric examination, rarely does the physician have the luxury of the ideal environment when seeing patients in the clinic. An uncooperative child, the presence of multiple family members, and limited time all provide an impetus to perform the examination as expeditiously as possible, while still maintaining good rapport with both patient and parents. To assist physicians inexperienced in examining children, we offer a number of suggestions based on years of personal experiences that should help the physician conduct an examination that is both efficient and enjoyable.

Screening Examinations

Screening examinations are conducted to determine whether the patient has any undiagnosed disorders that may be potentially harmful or deleterious if left unmanaged. In pediatric orthopaedics, two primary disorders of this sort are undetected developmental dysplasia of the hip (DDH) and scoliosis.

THE HIP EXAMINATION

All children are at risk for DDH, which, if not treated appropriately, can result in a limp and early degenerative arthritis. Because the condition is asymptomatic, all newborns and infants should be screened regularly for the condition until they have developed a mature normal gait. The most common clinical methods of detecting DDH are the tests for *Barlow's sign*[2] and *Ortolani's sign*.[20]

First, the test for Barlow's sign is performed to determine whether the hip is dislocatable (i.e., can the femoral head be pushed out of the acetabulum on examination?) (Fig. 4–1). The examiner attempts to subluxate or dislocate the femoral head from within the acetabulum by gently pushing the relaxed baby's hips laterally and posteriorly, with the leg in 90 degrees of flexion and neutral abduction. If there is instability, the femoral head will dislocate from the acetabulum and then spontaneously reduce, with a distinct "clunk" when pressure on the leg is relaxed. This may be the only physical finding on examination. Next, the examiner should determine whether the femoral head is dislocated out of the acetabulum by testing for Ortolani's sign (Fig. 4–2). In neonates, it is usually possible to temporarily reduce the dislocated femoral head by gently abducting the hip and lifting the upper leg forward. A distinct "clunk" will be felt as the head is reduced. When pressure on the leg is released, the femoral head will dislocate again. If the hip is dislocated, physical findings may include limited abduction (normal

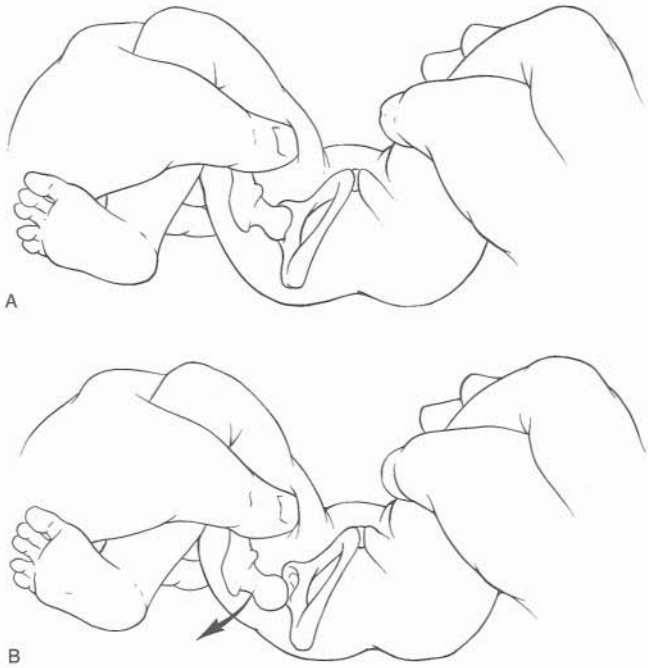


FIGURE 4–1 Test for Barlow's sign to determine whether the femoral head is dislocatable. **A,** With the infant relaxed and the hip and knee flexed, the examiner gently adducts the hip while attempting to displace the femoral head posteriorly. **B,** With a positive test, the femoral head will be felt to dislocate posteriorly.

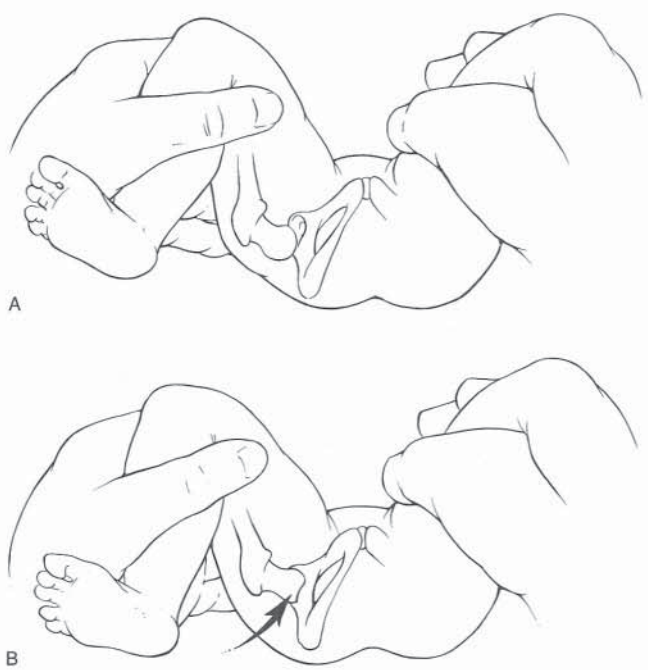


FIGURE 4–2 Test for Ortolani's sign to determine whether the femoral head is dislocated but reducible. **A,** The examiner attempts to reduce the dislocated femoral head by gentle traction, abduction, and anterior translation of the thigh. **B,** With a positive test, the femoral head will be felt to reduce into the acetabulum.

abduction is about 90 degrees), asymmetric thigh folds (excess on the affected side), and shortening of the leg compared with the opposite side.

One point to emphasize regarding these two maneuvers is that the examiner *cannot* elicit both Barlow's sign and Ortolani's sign from the same hip. *Either* the femoral head is sitting in the acetabulum and can be temporally dislocated on examination (Barlow's sign) *or* the head is dislocated and can be temporarily reduced on examination (Ortolani's sign). If the physical examination findings are equivocal and the patient is considered to be at high risk for DDH, ultrasound studies should be ordered.

OTHER NEWBORN SCREENING EXAMINATIONS

Newborns should also be screened for spinal deformities and malformations (e.g., torticollis, spinal dysraphism), digital anomalies (e.g., syndactyly or absence), long-bone deformities, and foot deformities (e.g., intoeing, rigid metatarsus adductus, clubfoot, calcaneovalgus foot). All children should be evaluated for normal lower extremity alignment, limb length inequality, kyphosis, and gross motor skills as well. In addition, the child's height, weight, and head circumference should be measured and charted to determine whether (1) weight or height is excessively high or low, (2) weight or height is disproportionate, (3) head circumference is disproportionate for height and weight, and (4) the weight, height, or head circumference deviates from the percentile line that has been maintained thus far.

THE SCOLIOSIS EXAMINATION

Scoliosis can result in severe cosmetic deformity and pulmonary compromise. The forward-bending test is a reliable means of screening for scoliosis. The examiner views the patient from the back during the test. The patient stands evenly on both legs with the knees straight, and then bends forward at the waist with the arms hanging free. The examiner evaluates the back for elevation of one hemithorax or flank relative to the other to determine the presence of a rotational deformity due to scoliosis.

GENERAL CHILDHOOD SCREENING EXAMINATION

An initial screening examination to help detect other potential deformities or disorders can be done by simply observing the child during certain maneuvers. Observing the patient standing upright with feet together will identify any bowlegs or knock-knees, foot deformities, or limb length inequality. The child's gross motor skills can be assessed in a number of ways. Having the patient heel-walk, toe-walk, and hop on either foot allows the examiner to evaluate gross strength in the legs and balance. When the child walks and runs, the examiner should look for limping or other gait abnormalities that may be due to muscle weakness or spasticity. Many neuromuscular disorders will disrupt this normal motion and function. How easily the patient rises from a supine position on the floor is a general indication of neurologic integrity, or it may indicate the presence of proximal leg muscle weakness, as seen in muscular dystrophy. Having the child bend over to pick up an object tests eye-hand

coordination and muscle balance, and also helps determine the severity of back pain if that is the chief complaint.

Screening examinations should be cost-effective, reliable, and specific in identifying the disorder in question. Ideally, there should also be a cost-effective treatment available that can significantly alter the natural history of the disorder if it is applied early. Such is the case with DDH, in which early use of the Pavlik harness usually corrects the condition and prevents the need for more costly treatment later on. Scoliosis screening is more controversial, however. Although the forward-bending test is a reliable means of screening for scoliosis, it may be too sensitive, since many false positive results occur with this maneuver. Radiography is highly specific for identifying scoliosis but is not a cost-effective means of screening the population at risk. In addition, whether treatment can effectively change the natural history of the deformity is under debate. The benefits of early detection of other commonly encountered orthopaedic conditions are detailed in the chapters dealing with the specific entities.

The Focused Examination

The focused clinical examination provides an expedient, organized approach to the assessment of commonly encountered pediatric orthopaedic complaints. The topics discussed here are intoeing, flatfoot, leg length discrepancy, and spinal deformity. These entities collectively account for a large proportion of presenting complaints of pediatric patients and referrals by their pediatricians when children are seen by orthopaedic surgeons in a nonemergency or office setting. Detailed differential diagnoses and the management of the disorders are discussed in the respective chapters on the various conditions.

INTOEING

One of the most common parental concerns prompting an orthopaedic evaluation is *intoeing*, or walking with an excessively inward foot-progression angle.[5,8,11] Typically the parent is concerned that the child will have a permanent disability or that the condition will interfere with the child's physical performance. In most cases, however, the problem is minor and self-limiting, and no treatment is necessary.

The most common benign causes of intoeing are metatarsus adductus, increased or persistent internal tibial torsion, and increased or persistent femoral anteversion.[8,11] Other benign causes include structural anomalies of the legs or feet. Most of these conditions do not need to be treated. Instead, the parents simply need to be reassured that the condition usually resolves on its own, and the patient should be observed on a regular basis to ensure that the foot-progression angle gradually returns to normal.

Occasionally, however, intoeing can be a manifestation of a more significant problem that necessitates further evaluation and may require treatment. Examples include static encephalopathy, other neurologic disorders, some mild tibial deficiencies, infantile Blount's disease, metabolic bone diseases, and skeletal dysplasias. Patients with these conditions are sometimes referred with an initial complaint of "intoeing."

Thus, the focused examination of the child with intoeing is concerned with ruling out one of the aforementioned serious causes, making sure the child has normal neurologic function, and confirming that the etiology of the problem is benign. The physician should ascertain whether there is a family history of DDH, neuromuscular disease (especially muscular dystrophies), or other, relatively rare, hereditary neurologic conditions such as Charcot-Marie-Tooth disease or familial spastic paraparesis. The examiner should be familiar with the child's neonatal history and developmental history when assessing the patient's neurologic status.

In addition, the age of the child can be of help in determining the cause of the intoeing. Typically, metatarsus adductus becomes evident after birth and before walking, increased internal tibial torsion is seen in toddlers to preschoolers, and increased femoral anteversion is most commonly found in school-age children to adolescents.

During the history taking, the younger child should be allowed to play or move about the room freely. From this free movement the physician can gain some idea of the nature and severity of the problem, which can be especially helpful if the patient becomes resistive or uncooperative during the formal physical examination. If it is not possible to observe the child walking or running while taking the history, the examiner should do so afterward, but from a "safe" distance. The child should be undressed from at least the knees down during the physical examination.

While the patient is ambulating, the examiner should first look for evidence of impaired mobility, significant balance problems, lethargy, or weakness in movement. Barring any of these problems, the physician should then try to discern the source of the intoed gait and its approximate severity (Fig. 4–3). Important observations to make while the patient

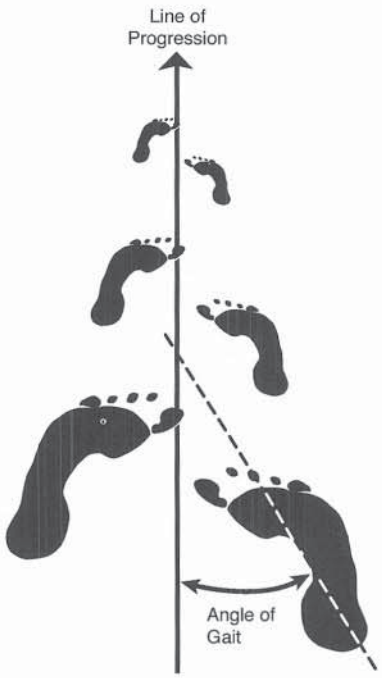


FIGURE 4–3 Assessment of the patient with an intoed gait. The foot-progression angle is estimated as the angle between the axis of the foot and the line of direction of gait.

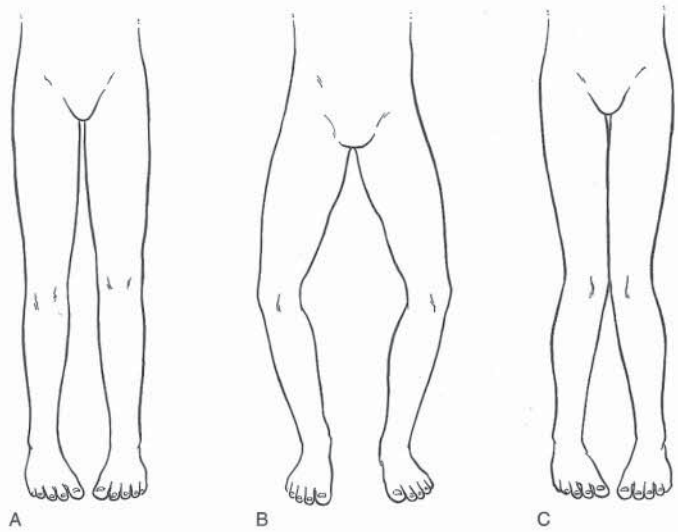


FIGURE 4–4 Evaluation of the etiology of intoed gait in healthy children. **A,** When the cause of the intoed gait is increased internal tibial torsion, the foot-progression angle will be negative and the patellae will point forward. **B,** Alternatively, the child may externally rotate the entire lower limb through the hip, resulting in a neutral foot-progression angle, externally rotated patellae, and apparent tibia vara. **C,** When the cause is increased femoral anteversion, the foot-progression angle is negative and the patellae are rotated medially.

is walking or running include (1) noting whether the lateral border of the foot is turned in, as occurs with metatarsus adductus; (2) observing whether the feet turn in relation to the knee, as occurs with increased tibial torsion; and (3) noting whether the entire leg rotates inward with "squinting" patellae, as is seen with increased femoral anteversion (Fig. 4–4). Older children may try to mask an intoed gait during the physical examination. To counter this attempt, the examiner should have the patient heel-walk, toe-walk, and hop across the room on either leg. This will make the intoeing gait more evident to the examiner, as it is to the parent who sees it on a day-to-day basis.

Having the child perform these maneuvers will also provide the physician with valuable initial information regarding the neurologic status of the patient. Although neurologic conditions are not the most common cause of intoeing, it is important for the examiner to rule them out as the cause of the problem.

The torsional profile can be expediently assessed with the patient prone on the examining table, as described by Staheli.[25] With the patient in this position, the examiner can determine the amount of internal and external rotation of the hip as an indication of the amount of femoral anteversion, assess the thigh-foot axis in order to estimate tibial torsion, and examine the shape of the lateral border of the foot (Fig. 4–5). If, however, a younger child is uncomfortable or feels threatened in this position, the examination can be conducted with the child in the comfort and safety of the parent's lap (making for a calmer patient). With the patient in this position, the lateral aspect of the foot can be assessed, the bimalleolar axis of the ankle relative to the knee can be estimated, and the amount of internal and external rotation of the hip in the flexed position can be assessed. The examiner should also feel the patient's muscle tone to determine whether there is hypertonia (suggesting spasticity) or hypotonia (suggesting muscle weakness).

Particular clinical manifestations are associated with the three most common causes of intoeing. Typically, metatarsus adductus is characterized by an inward deviation of the lateral border of the foot from the base of the fifth metatarsal. This deviation may or may not be flexible. With increased internal tibial torsion, there is excessive inward (or negative) thigh-foot angle or bimalleolar axis. Excessive femoral ante-

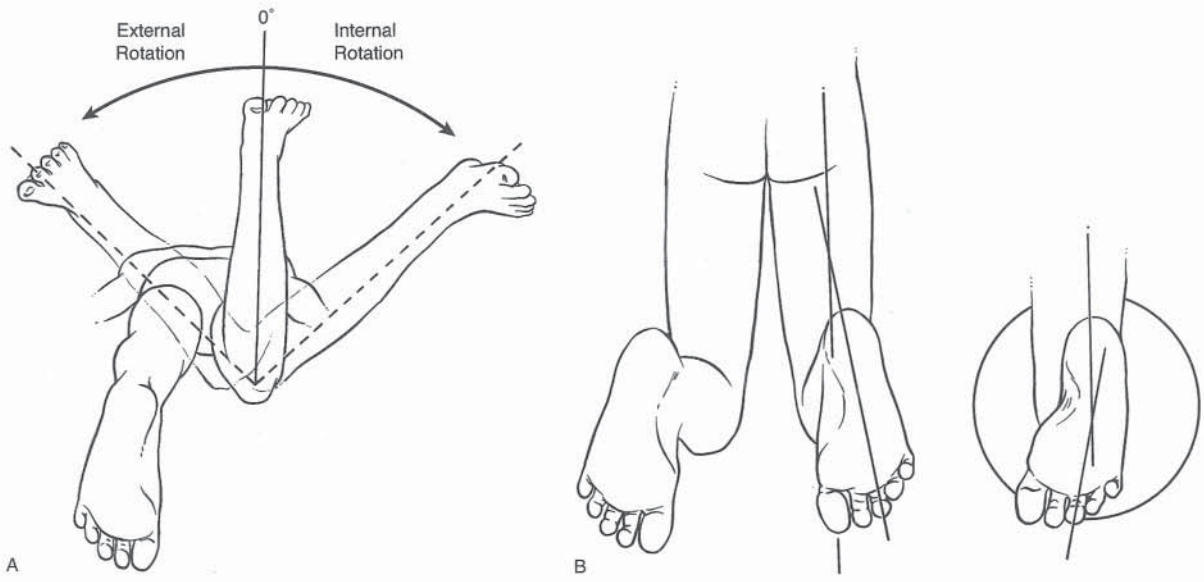


FIGURE 4–5 Torsional profile examination with the patient prone. The examiner can expediently (**A**) assess the thigh–foot axis in order to estimate tibial torsion and can examine the shape of the lateral border of the foot to assess the presence of metatarsus adductus and to (**B**) determine the amount of internal and external rotation of the hip as an indication of the amount of femoral anteversion. (Adapted from Staheli LT: Torsional deformity. Pediatr Clin North Am 1977; 24:799.)

version is typified by increased internal rotation and decreased external rotation of the hip in either flexion or extension.

FLATFOOT

When assessing children with flatfoot deformity, the examiner should first consider the patient's age, as certain underlying conditions tend to be age-specific. An *infant* may have simple positional deformity, a medial arch fat pad obscuring visual evidence of the underlying arch, a calcaneovalgus foot, or—least likely but most significant—congenital rocker-bottom foot (vertical talus).[10] The *young child* most likely has a flexible flatfoot deformity.[17,27] An *adolescent* may have a tight heel cord with secondary midfoot breakdown, or a peroneal spastic flatfoot due to tarsal coalition[1,13] or other cause.[15]

While taking the history, the examiner should determine whether there is associated pain, where it is located, and when it occurs. Pain that is not related to exercise may be due to inflammatory arthritis (the tarsal joints are a common location for juvenile arthritis), infection, or, rarely, a bone lesion. Nonspecific foot, ankle, or lower leg pain in the adolescent or preadolescent patient may be caused by tarsal coalition.

Examination of the feet starts by having the patient walk and observing whether the gait pattern is normal, antalgic, or indicative of neuromuscular dysfunction (e.g., hemiparesis). The child should then be asked to heel-walk, toe-walk, and hop on either foot if possible. This allows further assessment of neurologic and musculoskeletal functions, as well as a "stress" examination if pain is present. If the longitudinal arch is absent when the patient is standing still, the examiner should look for reconstitution of the arch when the patient is walking on the toes.

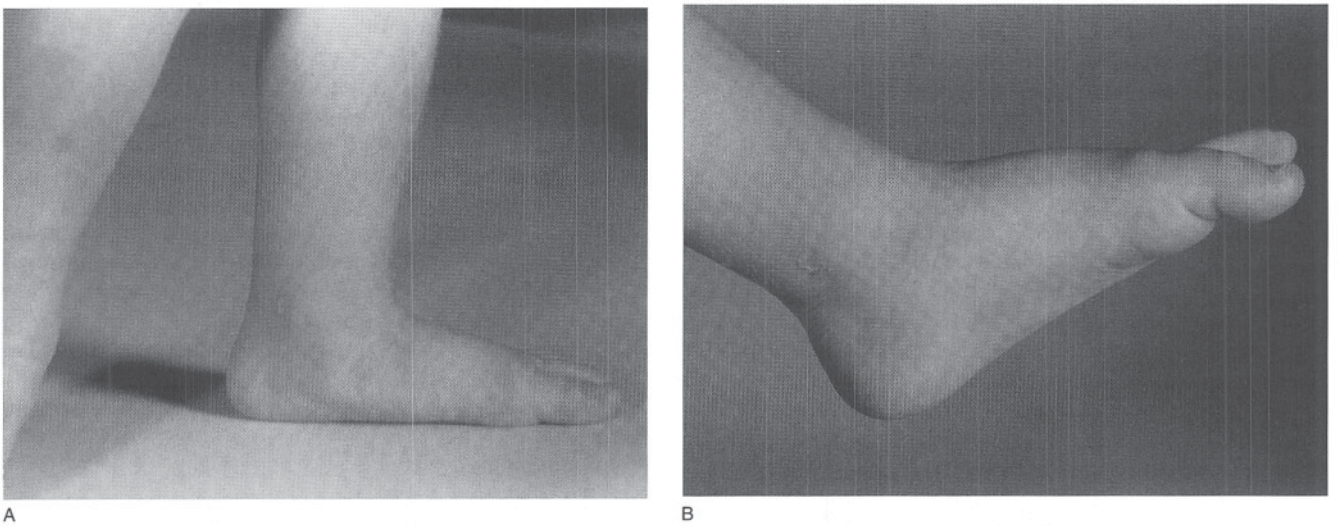
With the patient standing facing forward, the examiner should look for evidence of muscle atrophy, swelling, erythema, or deformity of the lower leg. The lower extremity alignment should be checked to determine if there is femoral-tibial valgus. Next, the patient's foot should be examined from behind, since it is easier to assess hindfoot valgus from this position. Reconstitution of the longitudinal arch can also be assessed at this point by having the patient stand on the toes. The examiner should also note whether the hindfoot swings from valgus to varus. If the hindfoot stays in valgus, tarsal coalition may be present.

Next, the examiner should have the patient sit with the feet hanging freely over the edge of the examination table (younger children can sit in their parents' laps). Passive range of motion should be checked, specifically to rule out the presence of a tight heel cord. A tight heel cord, regardless of its cause, can lead to flatfoot because of compensatory midfoot breakdown. The examiner should then rock the subtalar joint into inversion and eversion. Any stiffness (with or without discomfort) or peroneal muscle spasm during this maneuver suggests the presence of tarsal coalition or possibly inflammatory arthritis. If the physician has not yet checked for reconstitution of the longitudinal arch, it should be done at this point.

The examination concludes with a neurologic assessment of the lower extremities. The extent of this evaluation is based on the findings from the history and preceding physical examination and the examiner's degree of suspicion at this point regarding the cause of the deformity.

The most common type of flatfoot that the pediatric orthopaedist will see is the so-called *flexible* flatfoot deformity of childhood. There is no pain associated with this condition. Typically, the child is between 18 months and 6 years of age (when physiologic genu valgum is the norm and may not be noticed by the parents). The foot will have supple range of motion on examination, and the longitudinal arch will readily reconstitute during toe-walking or when the foot is in a nonweightbearing position (Fig. 4–6). Most flexible flatfeet resolve spontaneously with no residual adverse effects as the child ages, and surgery is rarely indicated to treat the condition.[7,27]

Congenital vertical talus is characterized by fixed flattening of the longitudinal arch, a tight heel cord, a variable



A B

FIGURE 4–6 Clinical photographs of a child with a flexible flatfoot deformity. **A,** When the child is weightbearing on the foot, the medial longitudinal arch is flattened. **B,** During nonweightbearing, the longitudinal arch is restored.

degree of pain, and usually a palpable dorsolateral dislocation of the navicular on the talus.[10] Because of the severity of this deformity, the patient usually is referred during infancy, or shortly after walking age at the latest.

Classic, symptomatic tarsal coalition is characterized by fixed flattening of the longitudinal arch, fixed hindfoot valgus, and nonspecific or exercise-induced pain.[14] During rapid, passive inversion of the subtalar joint by the examiner, the patient may experience peroneal muscle spasm. During gait, the patient will have an externally rotated, inflexible foot (as if the patient was wearing or had just come out of a short-leg walking cast). Patients with tarsal coalition typically are between 8 years of age and adolescence.

Patients with midfoot breakdown secondary to a tight heel cord may present at any age after walking. The longitudinal arch may or may not reconstitute when the foot is in the nonweightbearing position. The cause of the tight heel cord itself should be sought (e.g., static encephalopathy, tethered cord or other intrathecal anomaly, or idiopathic) by further examination as dictated by the clinical setting.

LEG LENGTH DISCREPANCY

Actual or apparent leg length discrepancy is a commonly encountered pediatric orthopaedic disorder that may be congenital or acquired. Actual limb length discrepancy is due to a true structural difference between the two lower limbs. In apparent limb length discrepancy, joint position or contracture decreases the functional length of the affected limb; however, the structural components of the limb may in fact not be shorter than the opposite extremity. In addition, unilateral weakness of the abductor muscle of the lower extremity may produce a Trendelenburg gait, giving the impression of a short-leg gait.

When taking the patient's history, the examiner should determine how long the shortening has been present, whether the patient has any neuromuscular disorders, and whether the limb has sustained a preceding noxious event (e.g., fracture, infection, surgery).

During the physical examination, the patient should be undressed as much as possible (taking modesty into account) so that an adequate assessment can be conducted. The examination starts with the patient walking toward and away from the examiner. The examiner looks for asymmetric gait and compensatory toe-walking on the shorter limb, or excessive knee flexion of the longer limb.[12,24] Evidence of muscle wasting or weakness in the power of the gait should also be noted. With the patient standing erect and facing forward, the physician notes the position of the joints and looks for evidence of angular deformity of the lower extremities. Particular attention should be paid to the relative height of the knees and to whether or not the patient has a tendency to stand on the toes of the shorter leg. The examiner then assesses these same features from behind the patient. Viewing the patient from behind, the physician can evaluate the relationship of the dimples over the posterior iliac spine, or place his or her hands on the iliac crests, to gain an appreciation of the magnitude of the limb length inequality.

An excellent method of assessing and quantifying limb length discrepancy while the patient is standing is to use graduated blocks. The patient should be standing evenly on both legs, with the feet flat on the floor and the knees straight. Then, blocks are placed under the shorter limb until the pelvis is level. The height of the blocks represents the patient's true limb length discrepancy if there is no joint deformity. If there is associated joint postural deformity, the height of the blocks provides the functional limb length discrepancy.

With the patient supine, the examiner checks the range of motion of the hips, knees, and ankles, looking specifically for flexion adduction or abduction contracture of the hips and flexion contracture of the knees. Subtle angular or rotational deformities of the shorter limb should again be assessed. These deformities include mild valgus of the knee with increased external rotation of the hip (as seen with congenital femoral deficiency or partial fibular deficiency) and tibial diaphyseal valgus deformity (which may be the result of posteromedial bowing of the tibia).

The actual and apparent limb lengths can be determined using a tape measure with the patient supine (Fig. 4–7). During the measurement, it is important that the joints be in a neutral position with respect to flexion of the hips and knees, and abduction and adduction at the hips. Otherwise the measurement will incorrectly create the impression that limb length discrepancy exists when in reality it is not present. The relative lengths of the femora are determined by measuring from the anterior iliac spine to the medial joint line, while the relative lengths of the tibiae are measured from the medial joint line to the medial malleolus. Another useful measurement that can be performed at this time to assess apparent or functional limb length discrepancy is the distance from the umbilicus to the medial malleolus for each limb.

With the patient still supine, the examiner performs manual muscle testing, a sensory examination, and a reflex assessment, as needed.

Based on the physical findings from the clinical examination, imaging studies may be necessary to more precisely determine the degree and nature of the patient's limb length inequality so that appropriate management can be initiated.

SPINAL DEFORMITY

Orthopaedists are often asked to evaluate patients who have apparent spinal deformity, usually because the parents or referring physician are concerned about the possibility of scoliosis (of any etiology) or kyphosis.[4]

If the patient complains of pain, the examiner needs to determine its location, nature, onset, and whether there is a history of antecedent trauma. Other important information to be obtained from the history includes (1) the patient's normal activity level, (2) whether there has been any change in that normal level, (3) how much the spinal deformity is interfering with physical activities, and (4) whether there are any neurologic symptoms, such as radiating pain or loss of bowel or bladder control. The physician should also determine whether there is a family history of scoliosis, connective tissue disease (e.g., Marfan's syndrome, neurofibromatosis[9,23]), or neuromuscular disease (particularly muscular dystrophy).[6,7,16,18]

The physician starts the examination by checking the patient's neck range of motion and, while doing so, looking for evidence of facial, neckline, or scapular asymmetry. The mouth is checked for a high-arched palate, which may be

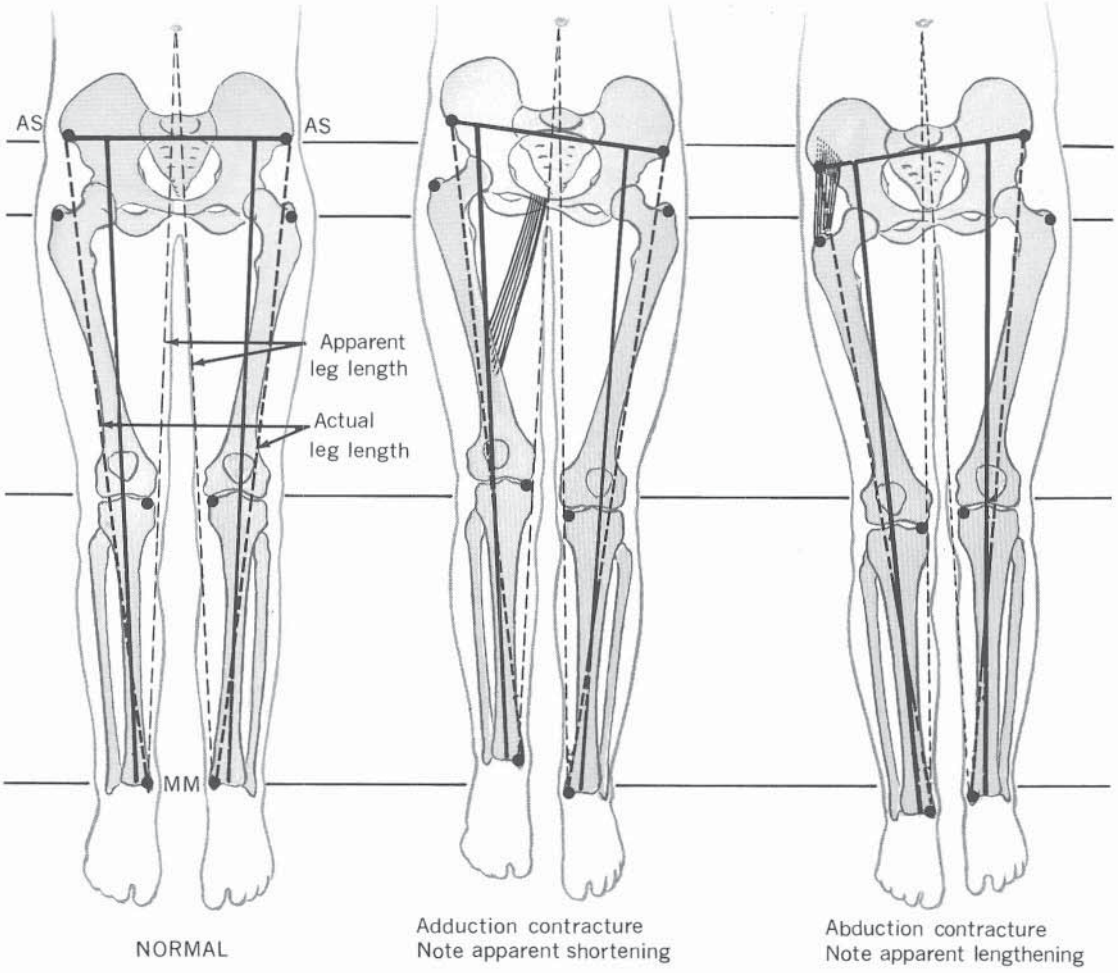


FIGURE 4–7 Measurement of actual and apparent limb length inequality. In these examples, apparent limb length inequality is produced by pelvic obliquity. Hip and knee flexion deformities will also produce apparent limb length inequality. (Adapted from von Lanz T, Wachsmuth W: Praktische Anatomie, pp 24–25. Berlin, Julius Springer, 1938.)

seen in patients with Marfan's syndrome.[22] A cranial nerve examination can be performed at this time, if deemed necessary. The upper extremities should be examined for evidence of restricted range of motion and muscle wasting. The latter may be an indication of peripheral neuropathy or atrophy due to syringomyelia. The patient's finger lengths should be checked for signs of arachnodactyly, another indication of Marfan's syndrome.

The clinician then examines the patient from behind with the patient standing evenly on both feet with the knees straight. The examiner looks for waistline, scapular, or paraspinal asymmetry.[21] The level of the posterior sacral dimples is checked to ensure that leg length inequality is not creating an apparent scoliosis. The relative position of the scapulae on the posterior chest wall is determined to rule out an associated or isolated Sprengel's deformity.[3,19] The physician should also look for a shift of the trunk to the right or left of the pelvis (Fig. 4–8A). A plumb line held over the base of the occiput or the C7 spinous process can aid in this clinical assessment.

The skin over the spine is inspected for pigmented spots, hairy pathches, and deep pits that might overlie external openings of sinus tracts extending to the spinal cord. The presence of café-au-lait spots and neurofibromata should be noted. Flattening of the buttocks with apparent loss of lumbar lordosis may indicate the presence of spondylolisthesis.

Defects of the vertebral bodies may be palpated by running the fingers along the spine and by palpating for stiff curvature or defects in the spinous process. If the patient complains of pain, the examiner should percuss the spine for areas of tenderness.

The examiner next stands behind the child while the child bends forward (as if touching the toes) with the arms hanging freely, to evaluate spinal flexion and hamstring tightness. The examiner should observe how smoothly the patient bends forward. A child with full flexibility should be able to touch the toes with the knees straight. While the patient is in the forward-bending position, the spine is first examined for evidence of rotational deformity secondary to scoliosis (Fig. 4–8B), which, if present, can be measured with a scoliometer, as described in Chapter 11, Scoliosis. The examiner should then view the patient's spine from the side to rule out excessive thoracic kyphosis (Fig. 4–8C).

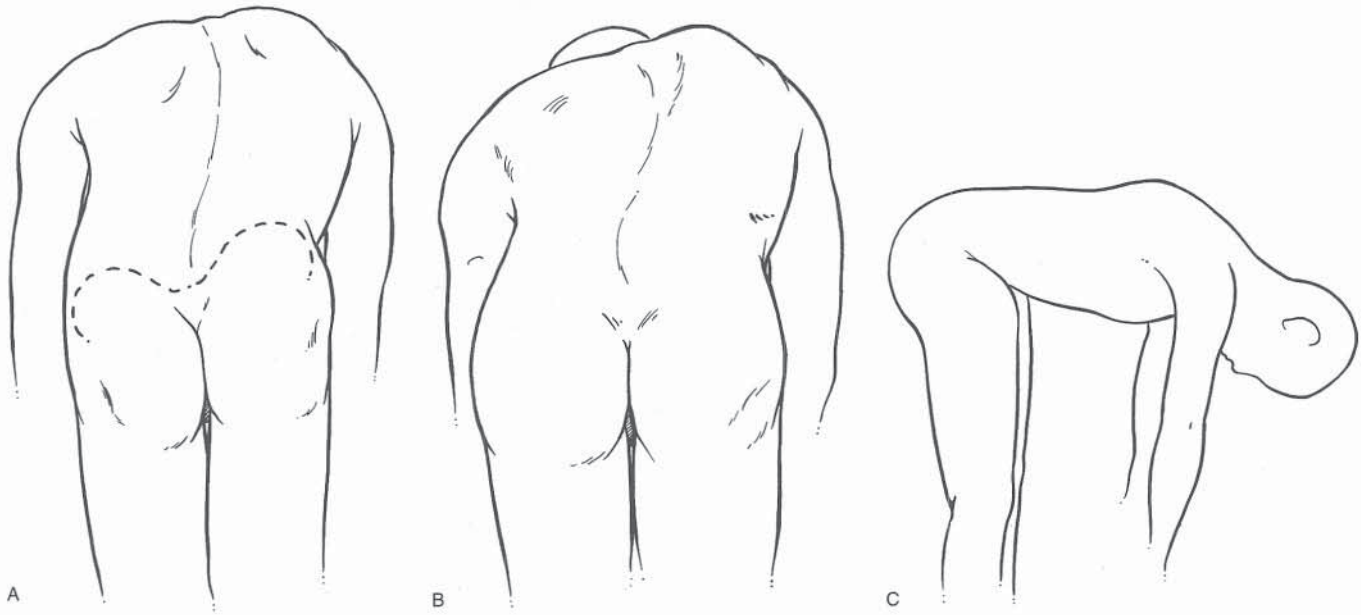


FIGURE 4–8 Assessing spinal deformity. **A,** A patient with limb length inequality will exhibit prominence of the entire length of the long side of the trunk during forward bending because of pelvic obliquity. **B,** A patient with true scoliosis will have truncal prominence localized to the convexity of the curve(s)—in this example, a right thoracic deformity. **C,** When viewed from the side, a patient with a kyphotic deformity will have an increased or sharply localized kyphosis when in the forward-bending position.

After the back has been thoroughly examined, the patient should be asked to walk on his or her heels and toes, and to hop on either foot. These maneuvers provide a good indication of the patient's general strength, muscle tone, and coordination.

Finally, formal testing of joint range of motion, muscle strength, and reflexes is performed with the patient on the examination table. The straight-leg-raising test is also performed at this time. If the patient has scoliosis and there also is a possibility of syringomyelia, the abdominal reflexes should be checked for asymmetry and for hypesthesia to light touch in the concavity of the deformity.[26]

This examination allows an observant examiner to rapidly assess patients for scoliosis, kyphosis, and other possible causes of spinal deformity (e.g., neuromuscular disease, spinal dysraphism, Marfan's syndrome,[22] neurofibromamatosis).[9,23] Appropriate imaging studies can then be ordered based on findings from the clinical examination.

The Art of Examining the Pediatric Patient

This discussion is intended to provide guidance to those orthopaedists who are new to or inexperienced in the examination of the child. In the real world, it is rarely possible to conduct the pediatric examination in the orderly, comprehensive sequence in which it is taught. Reality more often is a harried physician chasing an uncooperative child around the examining room, occasionally to the accompaniment of fundamentally undermining comments from the child's parent or caretaker, such as the intolerable "Do you want the doctor to give you a needle?" which only serves to guarantee a continued lack of cooperation from the child. What follows here are a number of suggestions that we have found to be helpful in the expedient acquisition of a good history and in performing a proper physical examination (Table 4–1). Over time, as the examiner becomes more comfortable examining children, the experience should be both informative and enjoyable.

• **Never wear a white coat.** The typical image of the physician is a person in a white laboratory coat, an accouterment that lends professional authority to its wearer and plays an introductory and role-assumption role. This symbol may be appropriate when dealing with adults, but it can be self-defeating when treating pediatric patients. Based on past personal experience or on what they have heard from others, children often perceive a person in a white coat as a threatening figure, and its presence can thwart any opportunity of cooperation from the patient. Doing without a white coat avoids this visible reminder that you are the ominous doctor. The best way to physically identify yourself to the parents and patient as a physician is with an identification badge. Minimizing your identity in this manner, though, should never be used to ambush a child. If an uncomfortable or painful examination must be performed, you should carefully explain at an appropriate time to the child and the parents why, how, and when there will be discomfort. To do otherwise would only reinforce any negative attitudes the child may have regarding physicians.

• **Treat your patients and their parents with dignity.** Introduce yourself to all who are present and inquire as to their relationship to the child. When introducing yourself, shake the child's hand. To show that you are interested in the child not only as a patient but as a person, ask about school, friends, and extracurricular activities that are of interest to the child. Be aware of and respect children's concerns, their modesty, and their apprehensions.

TABLE 4–1 **The Art of Examining the Pediatric Patient**

- Never wear a white coat.
- Treat your patients and their parents with dignity.
- Maintain your own professional dignity.
- Try to obtain the chief complaint and other information from the patient.
- Find out who is concerned about the patient's presenting complaint and why.
- Avoid threatening words.
- Respect the patient's modesty as much as possible while still performing an adequate examination.
- Never miss an opportunity to examine children without touching them.
- Make the first touch an innocuous, nonthreatening one in an area that doesn't hurt.
- Perform the examination without appearing to do so.
- Examine infants and young children while they are sitting in a parent's lap.
- Examine the normal, asymptomatic limb first.
- Minimize the discomfort of the examination without compromising its purpose.
- If you are unable to perform an adequate examination, ask the parent to do it while you observe.
- Always have a parent witness the examination.
- When discussing your findings, agree as much as possible with the parents with respect to their observations.
- Recognize and acknowledge when you have been unable to elicit a good history or perform an adequate examination.
- Always appear calm and unhurried.
- When faced with a complex problem that demands more time than you have at that particular moment, tell the family that you need to spend more time considering the child's problem before a definitive answer can be provided.
- When the family is unable to understand a complex orthopaedic problem, write them a letter explaining your assessment and the treatment alternatives.
- Always communicate with the referring physician and, when appropriate, any previous treating physicians.

• **Maintain your own professional dignity.** This begins by dressing appropriately. Do not participate in or, worse, initiate pejorative commentary about another physician's care. If you are confronted by an argumentative, accusatory parent, maintain a calm demeanor and quietly but firmly outline your assessment and recommendations. When you treat the patient and parents with dignity, you can and should expect to be treated with the same dignity.

• **As much as possible, try to obtain the chief complaint and other information from the child or adolescent.** Experienced physicians know they must tolerate and assimilate interjections from the parents when talking to the pediatric patient. However, by talking directly with the child or adolescent and asking them about their problem, the clinician establishes a rapport that will help when performing the physical examination. Be sure to check with the parent, though, that the information provided by the patient is essentially correct as the parent perceives it.

• **When taking the history, first find out who is concerned with the patient's presenting complaint and why.** With conditions such as intoeing, the primary caretaker may not have been troubled initially by the deformity, but was prompted (or cajoled) by other family members, teachers, or even complete strangers to bringing the child in for an evaluation. You should also find out whether the child has been previously treated for the condition; if so, by whom, and what the qualifications of the individual were; how the condition was treated and the results of the treatment; whether older family members were treated for similar complaints; and if so, when and how they were managed. Answers to these questions may not establish the specific diagnosis, but you will be in a better position to know who is most concerned about the condition and why.

• **Try to avoid threatening words like "hurt."** Saying "This won't hurt!" has two immediate negative effects. First, it introduces the subject of pain to the child, who promptly forgets the preface, "This won't. . . ." Second, it suggests to the child that something else later in the examination *will* hurt. It is important, however, not to minimize or trivialize a procedure that will be traumatic. Doing so will cause the patient to distrust you once he or she has discovered the true nature of the procedure.

• **Respect the modesty of children and adolescents as much as possible while still performing an adequate examination.** Be mindful of siblings or friends in the room who should be excused from the examining area if either the physician or the patient wishes it.

• **Never miss an opportunity to examine children without touching them.** Observe the child wandering around the room while you are quietly soliciting the history from the parents. Have the child walk or, better yet, run in a corridor. Look for fluid, coordinated gait. Also check for normal arm swing to rule out upper extremity posturing that may indicate spasticity. Ask the older child to heel-walk, toe-walk, and hop on either foot. The child's ability to execute these tasks well strongly suggests normal neurologic and musculoskeletal functions. These evaluations should be the first part of the examination in case subsequent direct, more formal examination results in loss of cooperation from the child.

• **Make your first touch of the child an innocuous, nonthreatening one in an area that you know doesn't hurt.** If you first touch an area that doesn't hurt, the child becomes aware that not everything you do will be painful, and you will quickly gain a sense of how cooperative the child will be. If it is clear from this initial maneuver that the child intends to fight off any examination, you may be able to modify your approach and the examining atmosphere to gain the child's cooperation. This reaction should make an astute parent aware of the challenge to your ability to obtain a cooperative examination. Thus, if the child exhibits any negative reactions, the parent cannot wrongly ascribe it to a noxious event committed by the physician or medical staff.

• **Perform the examination without appearing to do so.** One clear way to accomplish this is to observe the child playing, walking, running, or climbing, as previously mentioned. When examining a child in the parent's lap, do not formally examine the legs. Instead, check the toenail polish, look for other bruises or insect bites that are invariably present on the legs, and examine the soles of the feet for dust picked up in your examining room. By approaching the child in this manner, you will be able to gain an excellent impression of muscle tone, hip flexion, extension, and rotation, knee range of motion, and ankle flexibility without the child realizing that an examination has taken place. Occasionally, you may need to explain to the parent the purpose of your method.

• **Examine infants and younger children in a parent's lap.** Infants and younger children are often frightened and uncomfortable when placed on an examination table. As a result, an examination can become a wrestling match between you and the uncooperative, combative child pinned prone to the table. The result is frustration on the part of the examiner and, in most cases, and inadequate examination. With the patient in the comfort and safety of the parent's lap, you will have a more cooperative child and will still be able to obtain valuable information. For example, being able to appreciate that the child's hip range of motion is fluid without guarding, with an approximation of the arc of motion, as determined by examination of the hip while the child is in the parent's lap is more informative than a failed, formal examination of the hips with the child on an examining table.

• **When examining the extremities, examine the normal, asymptomatic limb first.** Again, this will allow you to see how the child will react to your touch as you continue the examination and will provide the child with some idea of what to expect during the examination. Don't be offended by the inevitable comment from either the patient or the parent, "Doctor, it's the other one." The simple response, "That's why there are two, to compare," should suffice.

• **Minimize the discomfort of the examination as much as possible without compromising its purpose.** Keep symptomatic limbs supported in some way. For example, when performing the Thomas test on an uncomfortable hip, flex the symptomatic hip to a comfortable degree and support it before flexing the asymptomatic hip maximally. Then extend the symptomatic hip gently while supporting the leg. This avoids flexing the symptomatic hip against its contracture with the whole weight of the leg levering against the tender area, which occurs when the Thomas test is performed as formally described (Fig. 4–9).

• **If you are unable to perform an adequate examination, ask the parent to do the examination while you observe.** This strategy works best in cases of ill or limping children who whimper and shy away every time you try to touch them. Quietly instruct the parent to gently palpate the child's limbs and take them through a range of motion. Be sure that the parent starts with the normal, asymptomatic extremity. If the child is being seen for possible diskitis, be sure to have the parent percuss the spine for tenderness.

• **Always have a parent witness the examination.** If the relationship is adversarial in any manner, also have a neutral health care professional observe the examination. This is important for both medical and legal reasons.

• **When discussing your findings, agree as much as possible with the parents with respect to their observations.** This is not meant to be a placating or condescending comment. Parents are able to observe the child's behavior in the child's normal environment, which often provides a better picture of the child's condition than that elicited in a strange examination room. In addition, complete offhanded dismissal of the parent's concerns will only erode your relationship with the parent. For example, if the complaint is intoeing and it is indeed present, agree with the parent that the child does have the condition. However, if the deformity is benign and does not require treatment, patiently explain to the parent why the condition is not medically significant.

• **Recognize and acknowledge when you have been unable to elicit a good history or perform an adequate examination.** If you believe that the patient's complaint or condition mandates a good examination, you should seek an opportunity to try again after an appropriate interval. For example, if you have tried to examine an infant's hips for DDH but the baby would not relax and allow you to conduct a proper examination, try after or while the baby is being fed, or have the patient return later that day or another day in the next week or two. Continue until you are able to perform a satisfactory examination. Don't presume your findings or give up simply out of frustration.

• **Always appear calm and unhurried, even when that is not the case.** A rushed manner tends to disorganize your thinking. Furthermore, the parents will feel as though inadequate attention has been paid to their concerns, and they may not appreciate the amount of time and energy that you have put into the history taking and examination. If possible, sit down when you are speaking to the parents, so that you

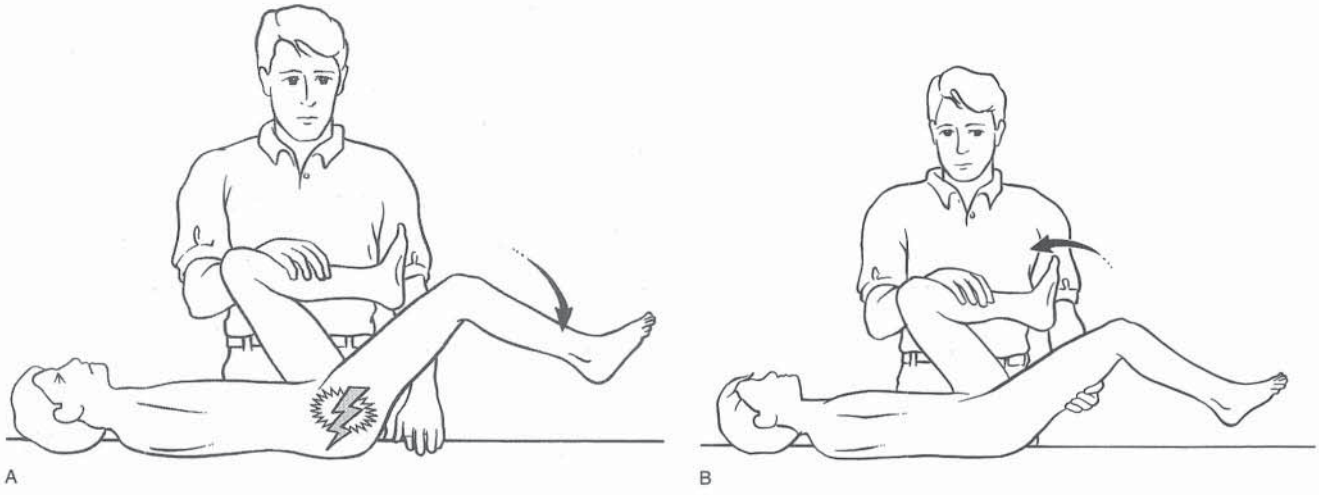


FIGURE 4–9 Examination of the patient with a painful hip. **A,** Flex both hips gently; then extend the symptomatic one while supporting the limb. **B,** If only the asymptomatic hip is actively flexed, the unsupported symptomatic hip will begin to passively flex, resulting in avoidable discomfort to the patient.

appear to have the time to listen to and respect their concerns. Also, provide explanations to the parents regarding their concerns as best as you are able.

• **When faced with a complex problem that demands more time than you have at that particular moment, tell the family that you need to spend more time considering the child's problem before a definitive answer can be provided.** Tell the family if you need to study your findings from the history and examination, confer with physicians who have previously treated the child, or study previous imaging studies and other diagnostic tests. Set a specific date and manner in which you will communicate further with them. Most families will appreciate that you are in fact spending extra time and effort on behalf of the child's problem in a concerned but unhurried manner, and will gladly agree to your request.

• **When faced with a complex orthopaedic problem that the family is having trouble comprehending, take the time to write them a letter explaining your assessment and treatment alternatives.** Your letter should outline the problem as you see it, describe the treatment alternatives and their respective advantages and disadvantages, and explain your personal recommendation and how you believe management of their child should proceed.

• **Always communicate with the referring physician and, when appropriate, any previous treating physicians, even when you will be assuming care of the patient.** The referring physician will want to know what you think, and should be guided by your advice regarding further follow-up or clinical manifestations that may require additional orthopaedic evaluation. Any previous physician should be contacted even if there is an unsatisfactory relationship between the parents and that physician. Discussing the case with a previous surgeon implies respect for that surgeon's care of the patient. Assume that prior treating physicians knew what they were doing and that they had made a genuine effort to treat the patient appropriately. Frequently the prior surgeon will be able to provide insight into the history and previous care the patient received, which the patient or parents may not be able to recount or remember differently.

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