The Child Who Has A Limp
Thomas S. Renshaw
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The Child Who Has A Limp
Thomas S. Renshaw, MD*

FOCUS QUESTIONS
1. What are the typical findings in the history, physical examination, and radiologic examination of a child who has Legg-Calvé-Perthes disease? Is it ever bilateral? What is the long-term course of this illness?
2. Why is the early diagnosis of infections of bones or joints critical? What is the treatment of choice and what is the prognosis for infections of joints and for osteomyelitis?
3. What are the specific points to be observed in the physical examination of a child who has a limp? What are the specific reasons for limping in children?
4. What are the findings in unilateral developmental dysplasia of the hip? What are the findings in bilateral developmental dysplasia of the hip? Should readily diagnosed cases of either unilateral or bilateral dysplasia be managed by the pediatrician with the use of spints following an orthopaedic consultation?
5. Repetitive microtrauma is a common problem in children. Is any evaluation or management beyond observation and the treatment of pain warranted?

A limp is defined generically as any deviation of a child’s walking pattern from the expected normal pattern for the child’s age. Limping more commonly is unilateral than bilateral, and its many causes range in severity from malfitting shoes to highly malignant bone tumors.

Specific reasons for limping fall into one or more of three categories: pain, weakness, and structural abnormalities. An antalgic gait may be caused by such painful conditions as synovitis of a major weight-bearing joint; infection of bone, joint, or soft tissue; neoplasia; or trauma from such things as repetitive microtrauma, a torn knee cartilage, or a chronic stress fracture. Muscle weakness can result from disuse atrophy or from a neurologic or a primary muscle disease. The structural or mechanical causes include limb length inequality, joint stiffing, and articular surface deformity.

The anatomic origin of the limp may be the foot, ankle, leg, knee, thigh, hip, spine, or even the abdomen. It follows, therefore, that a careful and thorough history and physical examination are mandatory for the child who has a limp and that all of these anatomic areas be evaluated carefully.

The history should include the duration of the limp, the child’s or parents’ perception of its site of origin, if possible, and whether pain is associated. Any recent trauma, infections, or general symptoms such as fever, malaise, or weakness should be investigated. The history also should include questions regarding any past infections, trauma, neoplasia, congenital anomalies, or metabolic problems.

The physical examination of the limping child begins with observing the gait pattern, with the child walking barefoot in as long a hallway as possible and wearing as little as possible. Particularly important factors are the length of stance phase (because a child will get off of a painful lower extremity as fast as possible); stride length; hip abductor muscle insufficiency, which produces a waddle (shifting the upper body over the stance phase limb to maintain balance); abnormal in-toeing or out-toeing; and restricted or excessive motion of the ankle, knee, or hip.

Following observation of gait, the lower limb lengths should be measured. This can be done by assessing whether the pelvis is level, with the patient standing barefoot on a smooth floor, or by using a tape measure to document the distance between the anterior superior iliac spine and the tip of the medial malleolus or sole of the heel bilaterally, making sure there is no knee flexion contracture. Each segment can be assessed by having the supine patient flex the hips to 90 degrees, with the knees fully flexed to assess femoral lengths and extend the hips in the prone position with the knees flexed to 90 degrees to evaluate tibial lengths. Limb lengths may be documented precisely by radiographic studies such as scannograms or digital computed tomographic images.

Muscle strength can be tested by having the child walk on his or her toes, heels, and medial and lateral borders of the feet; perform a deep knee bend; and stand first on one leg and then the other so that hip abductor muscle strength (the Trendelenberg test) can be assessed. This also is an excellent time to do a 30-second test for scoliosis and assess range of motion of the spine as well as whether paraspinal muscle spasm exists. Excessive joint laxity or instability is assessed best with the child recumbent; in this position, joint range of motion, tenderness, and swelling also can be evaluated. The examination may be concluded by evaluating the abdomen for reflexes, tenderness, “guarding,” organ enlargement, or masses.

The most common causes of limping are listed in Table 1.

Limb Length Inequality
A difference in lower limb lengths may be caused by idiopathic hypoplasia (“hemiatrophy”); hemihyper trophy; trauma to the tibia or femur with subsequent shortening, overgrowth, or growth plate damage; prior infection of the growth plates or joints; neoplasms; asymmetric bowing from metabolic bone diseases; and congenital anomalies of the limbs.

It is important to establish the precise cause of limb length inequality because some cases are minimal and static, while others may progress to substantial deformity. Periodic documentation of limb length inequality throughout the child’s growth is important (Figure 1). Generally, less than 2 centimeters of inequality is acceptable for an average-size adult, but a predicted adult discrepancy of more than 2 centimeters requires orthopedic management. Commonly, 2 to 4 centimeters of discrepancy are corrected by epiphysodesis or shortening of the longer limb; limb lengthening often is recommended for discrepancies that exceed 4 centimeters.

*Professor of Orthopaedic Surgery and Pediatrics, Yale University School of Medicine, New Haven, CT.
Neoplasms

Both benign and malignant neoplasms may produce limping, usually by causing pain that may be due to the lesion itself or to a pathologic stress fracture in the surrounding bone. Although neoplasms can occur virtually anywhere in the body, skeletal lesions in children have a predilection for the metaphyseal areas of long bones, particularly the knee and proximal femur. Tumors near growth plates may interfere with normal growth, whereas other tumors, such as hemangiomatous lesions, may accelerate growth.

Bony neoplasms usually are detected by plain radiographs or technetium bone scans, but soft-tissue lesions are noted most often by palpation or localized tenderness, with magnetic resonance imaging used for localization and characterization. Many benign lesions simply are followed, although biopsy and/or excision or other treatment is necessary if the lesion weakens the bone and increases the risk of fracture, if the lesion is painful, or if the diagnosis is uncertain. Malignant tumors always require specialized management.

Infection

SEPTIC ARTHRITIS

Joint infections occur most often among infants and young children. They present with joint pain, involuntary guarding, and muscle spasm (pseudoparalysis); in severe cases, palpable or visible erythema and edema surround the joint. The child often is toxic and febrile and has little appetite. A very high index of suspicion is necessary on the part of the physician because an infected joint is a surgical emergency. If treatment is not prompt and proper, bone and articular surfaces are likely to be destroyed permanently. Joint aspirations do not affect bone scans and should not be superceded or delayed by planned imaging studies.

Septic arthritis of the hip requires prompt open surgical drainage via arthrotomy performed under general anesthesia in the operating room to save the joint. Repeated aspiration is inadequate treatment for septic arthritis of the hip. The child should be taken to the operating room, anesthetized, and the hip joint aspirated with a large-bore needle, with or without arthrography, to document placement of the needle within the hip joint. Upon confirmation of septic arthritis, open drainage, by either an anterior or posterior approach, with appropriate cultures, irrigation, and insertion of a soft drain (for at least 48 hours) is necessary.

Septic arthritis of the knee, ankle, or foot may be treated appropriately by open arthrotomy, by arthroscopic irrigation of the joint, or by repeated needle aspirations, but again this is an emergency. Septic arthritis also can occur in the sacroiliac joint. In this location it is drained easily through a relatively small incision. Appropriate cultures should be obtained as soon as possible. Regardless of the joint involved, antibiotic therapy is begun after cultures are obtained. The length and route of administration of antibiotics sometimes is controversial, but most physicians begin with the intravenous route and maintain the appropriate therapy for at least 6 weeks or until the erythrocyte sedimentation rate returns to normal, whichever is longer.

Following appropriate drainage, the joint should be rested during its acutely painful phase, but motion should begin as soon as tolerated by the child. The prognosis for a septic joint is reasonably good if adequate treatment is provided within 24 hours of the onset of symptoms; thereafter, it deteriorates proportionally to the length of delay in diagnosis.

OSTEOMYELITIS*

Osteomyelitis in children usually arises from hematogenous seeding, with the organisms settling in the metaphyseal regions of the bones and producing periartricular pain, tenderness, and often, edema and erythema. A careful and gentle physical examination may reveal that the adjacent bone rather than the joint itself is tender. Established infection may erode into the joint and/or destroy the growth plate (Figure 2) or epiphysis, or it may erode through the bony cortex and dissect along the periosteum, sometimes producing necrosis of the shaft of the bone. Although less common than in the long bones, osteomyelitis also can occur in the bony pelvis; the patella; and the talus, calcaneus, and the smaller bones of the foot. The patient may appear quite toxic or may have very little outward evidence of infection.

Early plain radiographic signs include loss of the soft-tissue planes, followed by mottling of the bone.

*See October 1995 Pediatrics in Review for expanded discussion.
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ting may demonstrate the inl'ection with technetium. gallium. or low with technetium bone scan or magnetic resonance image. Other sites for repetitive microtrauma include the tibial tubercle, where the condition is known as Osgood-Schlatter disease; the tibia and anterior tibial muscles (shin splints); the calcaneal insertion of the Achilles tendon (known as Sever disease); and the plantar calcaneal tuberosity attachment of the intrinsic foot muscles and plantar ligaments.

Pain in a distal metatarsal head, usually the second or third, may be the result of avascular necrosis, which many believe may be caused by repetitive microtrauma. This condition is known as Freiberg infraction (Figure 3). Painful osteonecrosis involving only the tarsal navicular bone is known as Kohler disease.

An extremely common form of repetitive microtrauma, seen in active adolescents and preadolescents, is the patellofemoral arthralgia syndrome. This condition results from excessive repeated force applied to the posterior surface of the patella and usually

Trauma

Whereas major fractures with displacement are apparent clinically and prevent walking, trauma of lesser magnitude can produce nondisplaced fractures and require a high index of suspicion and appropriate radiographs to establish the diagnosis of fracture. Following recognition, acute fractures are treated by reduction (if necessary), restitution of bone strength (by appropriate immobilization), and rehabilitation (usually carried out by the child pursuing ordinary activities). These are the four “Rs” of pediatric fracture management. Trauma also may cause lesions such as torn muscles, ligaments, and cartilaginous structures, particularly about the ankle and knee.

Repetitive Microtrauma

Pain that usually is much more subtle than that experienced in acute fractures is produced by repetitive microtrauma or overuse of a limb. These problems often are seen after sedentary periods or after a person begins a new sport or other physical activity. A history of repetitive physical activity is a constant finding. Repetitive microtrauma can produce stress fractures of the femoral neck, the femoral shaft, the tibial shaft, and the metatarsal or, less commonly, other foot bones. These fractures may be so subtle as to elude detection by ordinary radiographs, but almost always will produce a positive technetium bone scan or magnetic resonance image. Other sites for repetitive microtrauma include the tibial tubercle, where the condition is known as Osgood-Schlatter disease; the tibia and anterior tibial muscles (shin splints); the calcaneal insertion of the Achilles tendon (known as Sever disease); and the plantar calcaneal tuberosity attachment of the intrinsic foot muscles and plantar ligaments.

Arthritis

Many types of arthritis can produce joint pain, swelling, erythema, skin rash, fever, limping, and systemic symptoms. These include juvenile rheumatoid arthritis, acute rheumatic fever, Lyme disease, lupus, and others. One should not overlook the possibility of gonococcal arthritis. The diagnosis of these types of arthritis usually is confirmed by laboratory methods. Appropriate treatment is based on the specific diagnosis.
Foot Deformities

In addition to repetitive microtrauma, avascular necrosis, infection, neoplasia, and arthritis, foot deformities may cause limping. Most of these are apparent clinically, such as clubfoot, metatarsus varus (adductus), and congenital limb deficiencies, but some are more subtle. Examples of the latter are congenital vertical talus and tarsal coalition. Congenital vertical talus presents with fixed hindfoot equinus, dorsal dislocation of the forefoot, and a rocker bottom sole. Tarsal coalition, which usually is detected initially early in the second decade of life, presents with a painful rigid flatfoot, often with peroneal muscle spasm. The most common tarsal coalitions are talocalcaneal (Figure 4) and calcaneonavicular. They usually are treated by resection of the bony bar, mostly with good results. Most foot deformities that are corrected have a good prognosis and are unlikely to become painful or develop osteoarthritis until late in life, if at all.

Hip Problems

Hip problems that cause limping are listed in Table 2.

**TRANSIENT SYNOVITIS OF THE HIP**

The cause of this condition is not known; it is a diagnosis of exclusion. It is most common between ages 3 and 10 years and occurs more often in boys (up to 80% in some series). Transient synovitis presents with pain related to the hip joint (anterior groin, lateral trochanteric, anterolateral thigh, and knee regions), guarding and/or spasm of the muscles crossing the hip joint as demonstrated by the log roll test, and limitation of active and passive hip joint motion. Often the child lies with the involved hip in flexion, abduction, and external rotation in an effort to reduce the discomfort caused by an irritable, fluid-filled hip joint. The signs usually are of lesser intensity than those found in patients who have septic arthritis. The patient who has transient synovitis usually has sick systemic, and laboratory values are normal, with the exception of mild-to-moderate elevation of the erythrocyte sedimentation rate. Imaging studies may show some bulging of the pericapsular fat lines on plain radiographs and mild effusion in the hip joint by ultrasonography or magnetic resonance imaging, but usually these studies are normal.

Severe transient synovitis may be very difficult to distinguish from septic arthritis of the hip. It is better to err on the aggressive side and aspirate the hip joint. If no fluid is obtained, arthrography should be performed to confirm the position of the needle in the joint, and a saline wash of the joint will provide fluid for culture.

Transient synovitis of the hip is a self-limited condition, but may require bedrest (usually not requiring skin traction), crutches, or the limitation of activities to accelerate its res-
olution. The symptoms usually resolve within a few days, during which time it is wise to reassess the patient daily or discuss his or her status by telephone with a parent to minimize the risk of not detecting septic arthritis. The amount of hip rotation is probably the most sensitive physical finding in hip pathology. Transient synovitis sometimes may be recurrent. If so, it is followed by Legg-Calvé-Perthes disease in 2% to 3% of patients. Otherwise, the prognosis is benign.

DEVELOPMENTAL DYSPLASIA OF THE HIP

This diagnosis includes the spectrum of acetabular dysplasia, hip subluxation, or hip dislocation among infants and children. It is a more accurate, but general, term than the one used previously—the "congenital dislocation of the hip"—which is a very specific diagnosis, both temporally and pathologically, and has been applied injudiciously in the past to other conditions. The prevalence of clinically detectable hip instability at birth is about 1 in 100; the likelihood of complete dislocation is 1 in 1000.

An in-depth discussion of this subject is far beyond the scope of this article (see August 1995 Pediatrics in Review for expanded discussion), but it is important to realize that a child whose hip is significantly subluxed or frankly dislocated will have shortening of that limb and insufficiency of the hip muscles caused by alteration in their lengths (Figure 5). When unilateral, a painless short-leg limp with associated abductor insufficiency is noted, the thighs are of unequal length, and the adductor muscles on the involved side are tighter than on the normal side. Out-toeing may occur from external rotation of a dislocated hip. Unilateral cases diagnosed after walking age may have been present since early infancy and were missed because the hips were not examined during infant well-baby check-ups or may have resulted from undetectable insidious subluxation caused by progressive acetabular dysplasia. This latter is thought to occur in about 8% of late diagnosed hip dysplasias.

Bilateral cases may be difficult to detect and are characterized by a bilateral waddling abductor insufficiency gait, hyperlordosis of the lumbar spine, widening of the perineum, and usually out-toeing, caused by external rotation of the dislocated hips.

The treatment of developmental dysplasia of the hip can be quite complex. It is wise to refer such patients to orthopedic surgeons experienced in its management.

The prognosis depends to a major extent upon the residual dysplasia at skeletal maturity, but recent disturbing findings suggest that a small percentage of "normal result" hips, particularly in females, are destined to develop premature osteoarthritis.

Legg-Calvé-Perthes Disease

This condition is the result of avascular necrosis of the capital femoral epiphysis and is a common cause of limping in children ages 2 to 10 years old. The peak incidence occurs at age 6 years, and the condition is more common in boys by a factor
of about 5:1, occurring in about 1 in 750 boys and 1 in 3700 girls. The condition is bilateral in 15%, but almost never concomitantly.

Although some cases may be completely silent and be diagnosed as incidental findings, the typical patient presents with a limp, which may or may not be painful, that is associated with very mild hip abductor weakness, thigh and buttock muscle atrophy, decreased internal and, to a lesser extent, external rotation of the extended hip, and often signs of synovitis, including muscle guarding or spasm, joint tenderness to palpation, and a mild flexion contracture.

The early radiographic signs of Legg-Calvé-Perthes disease are failure of the epiphysis to grow, apparent widening of the medial joint space, and occasionally, bulging of the pericapsular fat line. Irregularities in the epiphysis, flattening and widening of the femoral head, and shortening of the femoral neck soon follow (Figure 6). Prior to obvious radiographic signs, magnetic resonance imaging or a technetium bone scan probably would reveal the avascularity.

The disease process runs a variable course, usually lasting from 18 to 24 months, with initial radiographic avascularity, then apparent epiphyseal fragmentation, then reossification and reconstitution, and finally, remodeling of the femoral head. The result, however, almost never is normal radiographically.

Intermittent pain and synovitis are not uncommon throughout the disease process and are treated by restriction of activities through crutches, bedrest with or without skin traction, or temporary cast immobilization for the 2 to 5 days usually required to clear the symptoms of synovitis.

Definitive treatment consists of maintaining hip motion by clearing synovitis. The value of containing the femoral head, either by abduction bracing or surgical bony realignment, is an issue of debate among pediatric orthopedic surgeons.

The prognosis in healed Legg-Calvé-Perthes disease is painless, good-to-excellent function for several decades. The more nearly spherical the hip is at maturity, the longer the function likely will last. Nevertheless, most patients eventually will develop osteoarthritis, although often not until their fifth or sixth decades.

**Slipped Capital Femoral Epiphysis**

This lesion occurs as the result of acute or repetitive microtrauma to what is probably an abnormal proximal femoral growth plate. It occurs during or just prior to the adolescent growth spurt, with a peak age range of 10 to 13 years (mean, 12.0 years) in girls and 12 to 15 years (mean, 13.5 years) in boys. The male-to-female ratio is 3:2. It occurs with an overall incidence of about 1 per 1000 and most often is seen in very obese and/or very tall adolescents, with 63% of patients exceeding the 90th percentile for weight. Unilateral involvement is seen in about 40% to 80% of cases, with 20% to 60% being bilateral. Most bilateral cases do not occur concurrently. In 80% to 90% of cases, symptoms have been present for more than 2 weeks. When seen in children younger than 10 years, one should be alert for an endocrine problem, such as hypothyroidism, growth or sex hormone imbalances, renal disease, and metabolic bone diseases.

The clinical presentation is a limp with pain related to the hip joint. There may be some shortening of the involved limb, and internal rotation of the hip is limited. The classic patient is a large, very obese adolescent who has a unilateral, externally rotated limp. Biplanar radiographs, taken in the anteroposterior and true lateral positions, and/or computed tomographic scans will establish the diagnosis. In a condition known as "pre-slip," the patient has mild symptoms, usually mild loss of internal hip rotation with radiographic documentation of some widening of the physis on the involved side compared with the normal hip (Figure 7). Mild demineralization of the metaphysis on the involved side often is associated as well.

Because a slipped epiphysis is at significant risk for further slipping, which could lead to disastrous avascular necrosis of the femoral head, this problem is an extremely urgent situation. A patient seen in the office...
should lie down, be transported to the hospital in recumbency, and be maintained in bed in traction until definitive surgical management, with internal fixation of the slip, has been accomplished.

The majority of slipped epiphyses are treated by percutaneous or limited exposure in situ pin fixation with one or two pins. The patients then are mobilized rapidly on crutches and discharged, pain-free, within 1 to 2 days. With unilateral slips, prophylactic pin fixation of the normal side is a matter of debate. Severe chronic slips may require complex reconstructive surgery.

Like many other hip problems in children, the prognosis depends on the residual proximal femoral deformity. The majority of hips that have significant deformity will degenerate by the fifth or sixth decade.

**Spine Problems**

Certain conditions in the lumbar and lumbosacral regions of the spine can produce unilateral or bilateral lower extremity pain, weakness, and limp (Table 3).

**SPONDYLOLYSIS AND SPONDYLOLISTHESIS**

Spondylolysis is a stress fracture of the pars interarticularis portion of the posterior vertebral arch, most commonly seen at L5, less commonly at L4, and rarely above that level. It usually is bilateral and occurs in about 5% of the population in the United States. Less than 50% of the children who have spondylolysis will develop spondylolisthesis. This is the forward displacement of the vertebral column through the disc space directly below the vertebra with the spondolytic lesions. Both lesions occur with about equal frequency in boys and girls.

Spondylolysis and spondylolisthesis rarely are seen prior to age 5 years and occur most commonly between ages 10 and 15 years. They usually present with low back pain, often associated with unilateral or bilateral buttock or posterior thigh or leg pain. A limp often is seen. Plain radiographs almost always will establish the diagnosis of spondylolysis. About 80% of the lesions are visible on a lateral view; most of the rest are seen on oblique views. Although not often necessary, a technetium bone scan or a computed tomographic scan will display the defect when plain radiographs fail to do so. Spondylolisthesis is detected on a lateral view. A thorough neurologic examination is essential to rule out nerve root compression or cauda equina signs.

Although a majority of patients who have spondylolysis or spondylolisthesis will respond to conservative treatment, up to 40% will require surgical stabilization of the involved level because of substantial (>50%) or progressive slipping of the spondylolisthesis or because of intractable pain. The prognosis for adequately treated spondylolysis or spondylolisthesis is excellent for return to lifelong normal activities with little or no discomfort or restrictions.

**VERTEBRAL OSTEOMYELITIS AND DISCITIS**

These lesions are caused by bacterial or, less commonly, other infectious agents. Whether confined to the disc space, involving the adjacent vertebral body metaphysis, or both, the patient who has an acute spinal infection presents with severe back pain, often asymmetric leg pain, muscle spasm, and limping. These patients may be unable to walk after their initial symptoms and have rigid, painful spines. A careful neurologic examination is mandatory. The straight leg-raising test usually is strongly positive.

Early radiographs may be normal, at which time magnetic resonance imaging will demonstrate the pathology. Later radiographic findings are disc space narrowing and erosion or irregularity of the vertebral end plates, sometimes with some collapse of the vertebral body. Blood cultures should be obtained, but are only positive in slightly more than 50% of the patients.

In discitis, empiric antibiotic treatment, rest, and, if necessary, immobilization of the spine usually are quite successful. With documented bony destruction, one is much more likely to consider either needle biopsy or open biopsy for diagnostic confirmation or stabilization of an unstable destructive lesion. Following successful treatment, the prognosis is excellent for no pain or recurrence.

**HERNIATED NUCLEUS PULPOSIS**

This lesion is rare in young children, but less so in adolescents and presents much like the adult type with back pain and/or unilateral sciatic pain and a limp. Unilateral neurologic signs often are seen, including reflex asymmetry, sensory deficit, weakness, and a positive straight leg-raising test. Bilateral involvement is not as common. Plain radiographs may be normal, and the diagnosis most often is confirmed by magnetic resonance imaging.

The majority of patients respond to such conservative measures as limited activity or bedrest and analgesics. The indications for surgical disc excision are progressive neurologic deficit, cauda equina involvement, or failure to improve after adequate conservative treatment for about 1 month. Long-term results of conservative or surgical treatment are good in most patients, although a small percentage will develop degenerative low back changes.

**SPINAL NEOPLASMS**

Neoplasms of the bony spine, spinal cord, or other neural structures can produce lower extremity pain, weakness, and limping. The history, physical and neurologic examinations, and especially imaging studies confirm the diagnosis of a tumor. With the exception of eosinophilic granuloma, most benign and all malignant spinal tumors will require biopsy and/or definitive surgical treatment. The prognosis depends to a large extent on the type of lesion and its treatment.
Intra-abdominal Problems

Although not commonly considered to be a potential site for the cause of limping in children, the abdomen should be considered by the thorough physician, particularly when the cause for limping has not been found in the lower extremity or the spine (Table 4). Appendicitis can irritate the right iliopsoas muscle group, producing hip or thigh pain, muscle spasm, hip flexion deformity, and unilateral limping. A ruptured appendix or other cause of a pelvic abscess, such as erosive pelvic osteomyelitis, can irritate the obturator internus muscle and produce pelvic and/or hip pain. A psoas abscess usually will cause substantial pain in the groin and thigh. Unilateral renal disease, infection, or urolithiasis can produce back pain and spasm and, occasionally, limping. Retroperitoneal tumors may involve motor and/or sensory nerve fibers, resulting in unilateral weakness, leg pain, and limping. Even painful hernias in the inguinal or femoral canals can be an occult cause of a limp.

Conclusion

The child who has a limp may have a very serious problem until proven otherwise and the cause sometimes will be difficult to determine, but early diagnosis may avoid considerable morbidity.

SUGGESTED READING

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