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PEER REVIEWED FEATURE
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The limping child: an approach to diagnosis and management

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Investigating a child with a limp requires careful consideration because the differential diagnoses are broad. The condition is rarely an emergency but it can be serious and debilitating.

Key points

- History, examination and simple laboratory tests can identify most serious causes of limp in children.
- The presence of acute pain, raised inflammatory markers, fever and nonweightbearing makes septic arthritis the most likely diagnosis.
- It is important to remember that muscle weakness and malignancy can be causes of limp.
- Referred pain may be present and the pathology may not be at the site of the pain.

The child with a limp is a common problem with broad differential diagnoses, of which few are true emergencies. This review focuses on the clinical evaluation of children presenting with a limp including key elements of the history and examination and appropriate diagnostic tests and management. It also focuses on the more common and important causes of limp in children.

A limp is defined as a deviation from the normal gait pattern expected for a child's age.[1] It is a common complaint in childhood, and was reported to account for four in every 100 visits to one paediatric emergency department in the USA.[2] The conditions to consider in the differential diagnosis will depend in part on the patient's age. Common conditions leading to a limping child include: soft tissue or bone injuries; infection of the bone, soft tissues or joints; and neuromuscular, congenital, developmental, ischaemic and neoplastic processes.

A prospective study that evaluated 243 children younger than 14 years of age who presented to a paediatric emergency department with limp and no history of trauma showed that:[3]

- the median age of affected children was 4 years
- limp was more common in boys (2:1)
- limp was painful in 80% of cases, and pain

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IMPORTANT ASPECTS OF THE HISTORY OF A LIMPING CHILD

- Age
- Onset of pain and limp: sudden or insidious, time of day
- Any history of trauma, including nonaccidental injury
- Association with pain and its location, including referred pain
- Preceding viral illness, which can precede transient synovitis
- Aggravating factors
- Functional limitations
- Constitutional symptoms, such as fever, weight loss or malaise

was localised to the hip in 34% and the knee in 19% of cases
- transient synovitis or irritable hip was the most common cause of limp, accounting for 40% of all cases.

Although the majority of affected children will have benign, self-limiting causes for limp, a significant proportion of children will require additional diagnostic studies and subspecialty care to diagnose and manage more serious underlying conditions.

HISTORY

History taking in children can be a challenge, especially in children who are unable to talk or adequately localise the site of pain (see the box on this page). The parents should be asked what their concerns are and what problems they have noticed. The age of the child is important because different diagnoses are entertained dependent on the child's age.

Is the limp associated with pain? Painless limp is often the result of mechanical or neuromuscular disorders and is less likely to present acutely. Pain that is worse in the morning and associated with stiffness is suggestive of an inflammatory process, whereas pain that is worse at the end of the day is more likely to be mechanical in nature.

Patients or their parents should be asked about the presence of constitutional symptoms. Fever and chills may suggest an infectious process such as osteomyelitis or septic arthritis. Patients with juvenile arthritis or malignancy may present with fever and loss of weight.

CLINICAL EXAMINATION

The clinical examination should begin by observing the child's gait pattern or posture if able. Three major factors will cause a child to limp – pain, weakness, or mechanical or structural abnormalities. Any asymmetry of the legs, rotation of a foot or other compensatory postures should be noted (see the box on this page). A general examination is also important to evaluate for signs of systemic disease or rule out causes of referred pain.

A more focused examination of the lower extremities should then be performed. Any erythema, rashes, swelling or other deformities should be noted and the bones and joints should be palpated to identify areas of tenderness, masses, effusion or warmth. All lower extremity joints, that is, hips, knees and ankles, should be examined for range of movement; the spine should also be included in this examination. This will help in the identification of any painful or stiff joints or any muscle weakness. A neurological examination including sensation, tone and power reflexes should also be performed because many neuromuscular problems can present with limp.

INVESTIGATIONS

After a thorough history and clinical examination have been conducted, potential differential diagnoses should be identified. Further investigations can then help to make the diagnosis (see the box on page 33). A full blood count and measurement of C-reactive protein levels and erythrocyte sedimentation rate should be considered in the assessment of the limping child. If an effusion is present and infection is suspected, then a joint aspiration should be performed. If the joint is septic, white cell counts will usually be greater than 50,000 cells/mm^3 and will be predominantly neutrophils.

Imaging may also be useful in determining a diagnosis. Plain x-ray is usually of low yield but can be useful in identifying slipped upper femoral epiphyses or Perthes disease. Ultrasound is useful for assessing joint effusion in hips or localising a collection, for example, an abscess. A bone scan is very sensitive but not highly specific. It will highlight areas of increased or decreased metabolic activity, which may be due to infection, inflammation, trauma, neoplasm or avascular disease.

CLINICAL EXAMINATION OF A LIMPING CHILD

- Carry out a general examination, including temperature and skin rashes
- Observe the child's gait and posture looking for pelvic tilting or asymmetry
- Test muscle strength with a squat, Trendelenburg test and heel and toe walk
- Inspect extremities looking for erythema, swelling or rashes
- Palpate bones and joints noting any tenderness, masses, effusion or warmth
- Observe passive and active range of motion in the spine and lower extremities
- Measure leg length and calf and thigh circumferences
- Carry out a neurological examination checking sensation and reflexes

CAUSES OF LIMPING

The common causes of limp in children are listed in the box on page 33.

INVESTIGATIONS OF A LIMPING CHILD

- Full blood count, including a differential white cell count
- Erythrocyte sedimentation rate: can be elevated in infective inflammatory or malignant conditions
- C-reactive protein: more sensitive for early infection or inflammation
- Joint aspiration, if effusion present: followed by a full blood count and differential white cell count, Gram stain and culture
- Blood cultures: for causative organism in osteomyelitis or septic arthritis
- Imaging: plain x-ray, ultrasound, bone scan, MRI or CT
- Surgical: arthroscopy

Transient synovitis

Transient synovitis or 'irritable hip' is the most common cause of limp in preschool aged children. It can occur between 18 months and 12 years of age and is a diagnosis of exclusion. The typical presentation is of a preschool aged child, who is otherwise well, limping or refusing to walk and it is often preceded by a mild viral infection.

The child will be mostly afebrile or have a low-grade fever with a mild to moderate decrease in range of movement in the affected hip. Inflammatory markers are usually normal or only slightly elevated. An ultrasound, if performed, should show a small effusion. Transient synovitis is a self-limited inflammatory condition that usually resolves within seven to 10 days. Treatment is rest and analgesia, usually with an NSAID such as ibuprofen or naproxen, based on the severity of the symptoms.

Septic arthritis and osteomyelitis

Differentiating transient synovitis from septic arthritis can be difficult because both conditions can present with a decreased range of movement in the hip. The presence of raised inflammatory markers, fever and a history of non-weightbearing makes septic arthritis the most likely diagnosis. If a septic process is suspected, the joint should be aspirated and the fluid sent for cell count, Gram stain and culture and sensitivities. There is overlap between synovial cell counts in infection and inflammatory conditions but if the white blood cell count is more than 50,000 cells/mm^3 and predominantly neutrophils, infection should be presumed. Treatment of patients with septic arthritis is surgical drainage and use of antibiotics (usually flucloxacillin) to cover infection with *Staphylococcus aureus*.

The presentation of osteomyelitis overlaps with that of septic arthritis and treatment is similar with empirical antibiotic therapy, usually with flucloxacillin. Open surgical drainage and washout may be required if there is evidence of joint involvement or abscess. Discitis, infection of the disc space, can also present with limp and should be suspected in younger children who are refusing to walk and cry when picked up. They may be tender in the region of the affected disc, usually L1 to L5.

COMMON CAUSES OF LIMP IN CHILDREN

Aged 1 to 5 years

- Trauma
- Transient synovitis
- Osteomyelitis and/or septic arthritis
- Discitis
- Juvenile idiopathic arthritis
- Malignancy

Aged 5 to 10 years

- Trauma
- Transient synovitis
- Osteomyelitis and/or septic arthritis
- Perthes disease
- Juvenile idiopathic arthritis
- Malignancy

Aged 10 to 15 years

- Trauma
- Septic arthritis
- Slipped upper femoral epiphyses
- Juvenile idiopathic arthritis
- Malignancy

Perthes disease

Perthes disease is an avascular necrosis of the femoral head and is seen commonly between the ages of 4 and 9 years and more often occurs in boys (Figure 1). The onset is often insidious with a painless limp and then the development of hip, groin, lateral thigh or knee pain. On examination, the patient may have a leg length discrepancy with decreased abduction and internal rotation of the hip. X-ray changes vary depending on the stage of the disease but there is usually flattening and fragmenting of the femoral head. A bone scan may pick up earlier changes. Treatment of patients with Perthes disease may vary from close observation to bracing or surgery with the goal being to maintain range of movement and

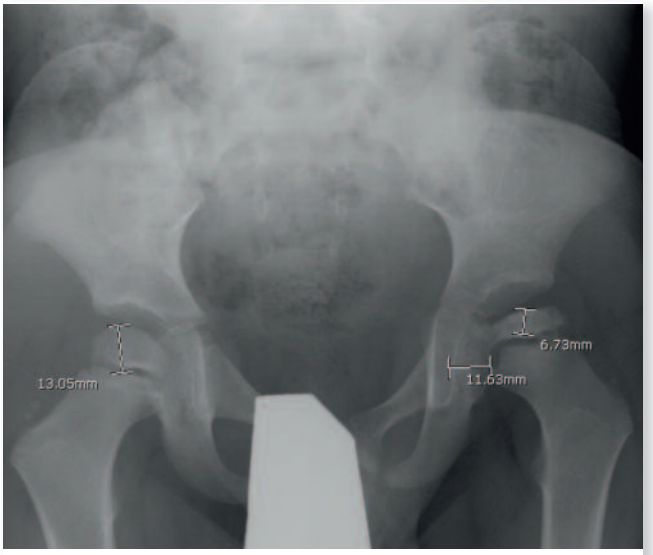

Figure 1. Perthes disease in a 4-year-old boy. Note the flattening of the left femoral head and sclerosis.

Figure 2. Slipped upper femoral epiphysis in the left hip of a 9-year-old girl.

containment of the femoral head within the acetabulum.

Slipped upper femoral epiphysis

Slipped upper femoral epiphysis is a fracture of the growth plate leading to slippage of the femoral epiphyses off the femoral neck (Figure 2). It more commonly affects teenage boys, particularly those who are overweight and skeletally immature. There is also an association with hypothyroidism. The presentation can be acute or chronic with a limp and often pain referred to the knee or thigh.

On examination, the leg may be externally rotated and shortened. Surgical treatment is often needed with fixation of the femoral epiphyses by pinning.

Juvenile idiopathic arthritis

Juvenile idiopathic arthritis is the most common chronic paediatric rheumatological disease. It is an inflammatory arthritis that affects one or more joints and presents in children younger than 16 years of age. Symptoms can last for more than six weeks and the condition is classified on the basis of disease pattern over the first six months.

On initial presentation, particularly in patients with the oligo-articular subtype of the disease, monoarticular swelling can be present. This is more likely to involve the knee or ankle and isolated hip arthritis is an uncommon presentation of juvenile idiopathic arthritis. During history taking, it is important to ask about early morning stiffness or any fevers, rashes and other systemic features. Examination should include examination of all joints including asymptomatic ones and checking for complications of disease, for example, leg length discrepancy, muscle wasting or growth failure.

There is no one diagnostic test for juvenile idiopathic arthritis and the diagnosis is made on clinical grounds and by excluding other conditions. Most, but not all, patients will have raised inflammatory markers and some will have associated anaemia and/or thrombocytosis. Depending on the severity of the condition, patients can be treated with a range of medications from NSAIDs, oral and intra-articular corticosteroids to disease-modifying anti-rheumatic drugs such as methotrexate and the new biologic therapies, such as the TNF antagonists etanercept and adalimumab.

MALIGNANCY

Neoplasms are some of the most concerning causes of limp or limb pain in children. Children may have pain or limp caused by a tumour, for example, osteosarcoma, nonspecific pain from leukaemia or gait deterioration from a tumour of the central nervous system.

Pain from leukaemia is often out of proportion to the findings on examination. There may also be pallor, lymphadenopathy and hepatosplenomegaly and the white cell count is usually abnormally high or low with abnormal cells, lymphoblasts, seen on film. A bone marrow aspirate will confirm the diagnosis.

Osteosarcomas are the most common type of bone tumour seen in children and commonly present in older children in the distal femur or proximal tibia. The pain will often be reported as being worse at night and a radiolucent defect will be

visible on x-ray. Benign bone tumours can also present with pain that is worse at night. Osteoid osteomas are benign tumours of bone that characteristically respond very well to NSAIDs and usually have typical x-ray findings of a radiolucent nidus surrounded by sclerotic bone and are hot on bone scan.

WHO TO REFER

Specialist referral is required for children with:

- suspected slipped upper femoral epiphyses
- suspected Perthes disease
- suspected bone or joint infection
- suspected juvenile idiopathic arthritis
- any persistent musculoskeletal symptom.

CONCLUSION

The limping child is a common clinical presentation in the primary healthcare setting. The causes are diverse from benign self-resolving conditions to infections, malignancy and inflammatory disorders.

Many conditions causing limp can be managed by the primary care physician. Immediate referral should be made if septic arthritis is suspected and advice should be sought for any musculoskeletal complaint that is persistent or worrisome. MT

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FURTHER READING

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COMPETING INTERESTS: Dr Cox: None. Dr Allen has been on paediatric advisory committees for Novartis and Roche and has been a principal or associate investigator in various drug trials sponsored by Merck, Amgen, Wyeth and Roche.