The limping child: a clinical approach to diagnosis

Acute limp in childhood is associated with considerable anxiety for parents and clinicians alike. It can be a diagnostic challenge in the uncooperative child and any delay in diagnosis can result in significant morbidity and even mortality. A thorough clinical evaluation is of utmost importance. This review revisits the clinical assessment of a limping child and explores the relevant literature.

Limp is defined as any deviation from the normal rhythmical pattern of walking. Parents are usually good at detecting any abnormality in their child's gait. Limping in childhood is relatively common and in a large proportion of cases a cause may not be found. It is therefore not surprising that in a study by Fischer and Beattie (1999) the incidence of limp was found to be 1.8 per thousand and the main diagnosis was 'irritable hip' in a large proportion (39.5%).

Limp can be antalgic or the result of mechanical or neuromuscular disorders. Although children have begun to walk when led or by holding on to furniture by 12 months, walking with a normal gait develops only by 18–24 months.

Table 1. Common causes of painful limp in childhood according to age

Less than 3 years	Toddler's fracture
	Septic arthritis
	Osteomyelitis
	Foreign body
	Transient synovitis
	Tumours
3–10 years of age	Trauma (physeal fractures)
	Septic arthritis
	Osteomyelitis
	Perthe's disease
	Transient synovitis
	Tumours
Over 10 years of age	Trauma (physeal fractures)
	Septic arthritis
	Slipped upper femoral epiphysis
	Juvenile arthritis
	Tumours

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The differential diagnosis is extensive and daunting at first glance; however, after a careful history and clinical examination it can quickly be narrowed to only a few possibilities. *Table 1* summarizes some of the more common causes of an antalgic limp according to age and *Table 2* lists other possible causes of this condition in childhood.

As discussed earlier, it may be difficult to establish the exact cause of a limp on the first visit or in the emergency room; however, it is prudent to rule out the common and more serious causes. This can be done with relative ease and certainty by a simple and logical clinical assessment. In this review such an assessment in a child with an acute (often antalgic) limp is discussed and an algorithm for the clinical evaluation of this presentation is suggested (*Figure 1*).

History

As with any other condition a careful history is crucial. The history should concentrate on the pattern of the limp and any associated pain. Painless limp is likely to be the result of mechanical or neuromuscular disorders and seldom presents acutely. Onset of the pain should be enquired about. Acute pain over a few days is more in keeping with an infective, malignant or traumatic

Table 2. Other causes of painful limp in childhood

Chondromalacia patella
Kohler's avascular necrosis
Lyme's disease
Freiberg's avascular necrosis
Developmental dysplasia of hip
Tarsal coalition
Discitis
Osgood Schlatter
Ankylosing spondylitis
Osteochondritis dissecans
Spondylosis
Pars defect

process as opposed to developmental or mechanical causes. There may be a history of pain in the hip before the onset of the limp in conditions such as Perthe's disease or in a slipped upper femoral epiphysis. Knee pain is a common presentation when the primary pathology is in the hip.

Trauma is a common cause of limping in children and a history of trauma or involvement in sporting activities should alert the clinician to the presence of a fracture or soft tissue injury. In the context of trauma it is important to assess the child and the parents for the potential for a non-accidental injury. In toddlers trauma can often go unnoticed and cannot be ruled out even in the absence of a history from the parents.

Sepsis can cause a loss of appetite and can result in the child being withdrawn and disinterested. A history of fever, rigors or sweats suggests a possible septic focus. A recent history of a viral infection, however, makes transient synovitis a possibility.

A full developmental and prenatal history must be taken and details of any relevant vaccinations noted. *Haemophilus influenzae* type b, for example, can cause both septic arthritis and osteomyelitis in children who have not been immunized during infancy (Peltola et al, 1998).

Past medical history can also be helpful in making the diagnosis – some endocrine conditions such as hypothyroidism or a delay in sexual development have been linked to slipped upper femoral epiphysis.

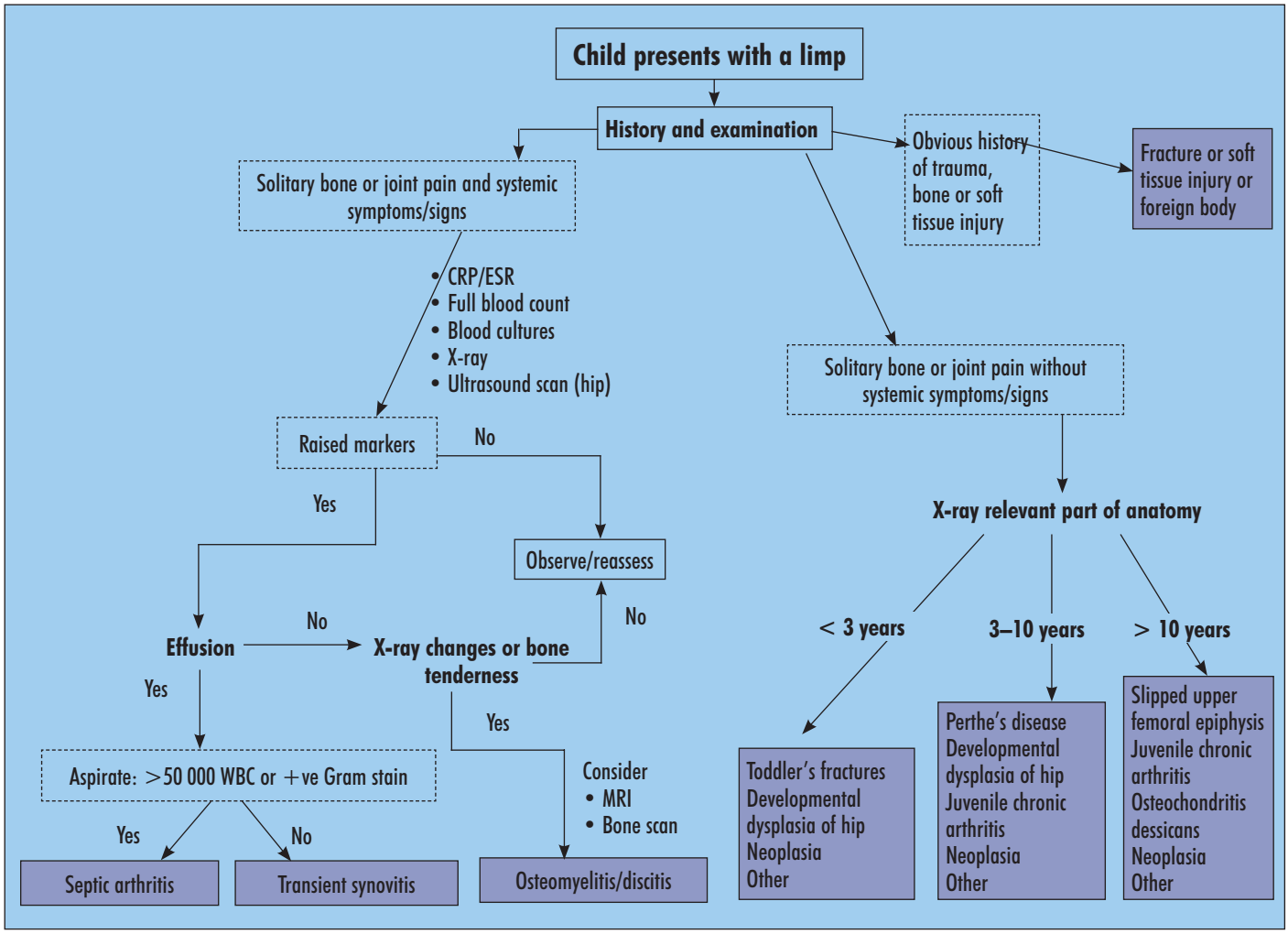
Systemic review should identify any recent weight loss or malaise suggesting a generalized process. Abdominal pain, diarrhoea or urinary symptoms may suggest a non-orthopaedic cause such as orchitis, testicular torsion, appendicitis or a psoas abscess.

Clinical examination

Start by observing the child's gait pattern. A short stance phase on one side is typical of an antalgic gait. A child with a foreign body in his or her foot may avoid heel strike or may walk on the side of the foot to avoid the painful area.

External rotation deformity caused by a slip of the upper femoral epiphysis can lead to an externally rotated foot progression angle. It can also lead to a limb length

Figure 1. Algorithm for the diagnosis of antalgic limp. CRP = C-reactive protein; ESR = erythrocyte sedimentation rate; MRI= magnetic resonance imaging; WBC = white blood cell count.



discrepancy that may be apparent when standing. Blocks can be used under the short limb to estimate this discrepancy.

The child's temperature and vital signs can help identify a systemic process and in particular infection. General observation of the child is also important. A child with a septic arthritis, for example, may be quiet, pale, tearful or disinterested.

The resting position of the hip in slight flexion and external rotation should alert the examiner to a painful effusion of the hip joint, as seen in septic arthritis. This position is comfortable because the joint capsule is under the least tension.

Both limbs and the spine should then be examined for skin changes, swellings, erythema, abrasions, discolouration and naevi, and palpated for any local tenderness or heat. In particular the sole of the foot should be carefully inspected, as often a limp may be caused by a foreign body in the foot.

All the joints of the lower extremity are then examined and their range of movement documented. Pain on passive movement of the joint, which results in a severe restriction of motion, is a feature of septic arthritis. Patients with a slipped upper femoral epiphysis will have limitation of hip movements, especially internal rotation.

Finally it is important to examine the neurovascular supply to the limbs as well as examining the genitals and the abdomen. A urinary sample for dipstick and microbiological evaluations must also be obtained.

Investigations

After a through history and examination the potential differential diagnoses or at least the offending part of the anatomy should be easily identified. Further investigations will then help in identifying the true diagnosis.

Laboratory tests

A full blood count, C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) should be considered in the assessment of the limping child. An elevated white blood cell count and inflammatory markers can be helpful in identifying those with septic arthritis or osteomyelitis.

In comparison to ESR, CRP is a better independent predictor of disease. CRP is a better negative predictor than a positive predictor. Indeed, if the CRP is <1.0 mg/dl, the probability that the patient does not have septic arthritis is 87% (Levine et al, 2003).

In another study by Kocher et al (1999), four independent clinical predictors were identified to differentiate between septic arthritis and transient synovitis:

1. History of fever
2. Non-weight-bearing
3. ESR of at least 40 mm/hr
4. Serum white blood cell count of more than 12.0 x 10^9 cells/litre.

The predicted probability of septic arthritis was 99.6% for all four positive predictors.

Imaging

Plain radiographs of the abnormal or painful parts of the limb should be obtained in two views. A foreign body may be visible in the soft tissue shadows and soft tissue films should be obtained if this is suspected.

Plain films are of particular value in the diagnosis of fractures. Toddler's fractures may be difficult to see on plain films and a high index of suspicion is required (*Figure 2*). Unusual fractures, such as avulsion fractures about the pelvis which most often occur in adolescents after athletic activity, can be missed and again a high index of suspicion is required. *Figure 3* demonstrates an avulsion fracture of the anterior inferior iliac spine in a 14-year-old boy.

Anterior-posterior and frog-leg lateral views of the hip should be obtained in all those with hip pain and considered in those with knee pain. It is said, however, that if an acute slip of the upper femoral epiphysis is suspected the frog-leg lateral view should be avoided as it may cause further slipping.

Klein's line is used to help interpret the radiographs. This is a line drawn as a continuation of the superior cortex of the femoral neck on the anteroposterior view and will intersect the capital femoral epiphysis in a normal hip. In the presence of a slip Klein's line will 'miss' the femoral head altogether (*Figure 4*). In Perthe's disease

Figure 2. Arrow showing a minimally displaced fracture of the distal tibia in a child (toddler's fracture).

changes can be subtle at first with joint space widening and sclerosis of the femoral head but can become quite gross with fragmentation and collapse in the late stages (*Figure 5*).

Joint effusions can be suspected on plain radiographs. This is seen in the knee as a lucent pre-patellar shadowing. In the hip, on the anteroposterior view of the pelvis the distance between the femoral head and the teardrop may be increased in the presence of an effusion.

A radioisotope bone scan is particularly of value in cases where diagnosis is in doubt and a specific focus has not been established. In osteomyelitis there can be an increase (or a decrease) uptake extending beyond the confines of the joint capsule; in septic arthritis there is increased (or decreased) uptake on either side of the joint line, but limited to the joint capsule. In one study (Tuson et al, 1994) the overall accuracy of the bone scans was 81%. The predictive value for a positive scan to be correct was 100% for a cold scan and 82% for a hot scan.

Ultrasound can be helpful in assessing the hip for the presence of effusions. It has been found to be 100% sensitive as well as specific for effusions of the hip joint in children (Alexander et al, 1989); it can also be used to obtain joint fluid by guided aspiration at the same time.

Other imaging modalities such as magnetic resonance imaging or computed tomography are usually not routine in the assessment of an acute limp. They may, however, help in difficult cases. They are of particular value in the diagnosis of tumours, stress fractures and in confirming the presence of infection.

Figure 3. Avulsion fracture of the anterior inferior iliac spine (arrows), seen in an adolescent boy with a history of a painful limp after kicking a ball.

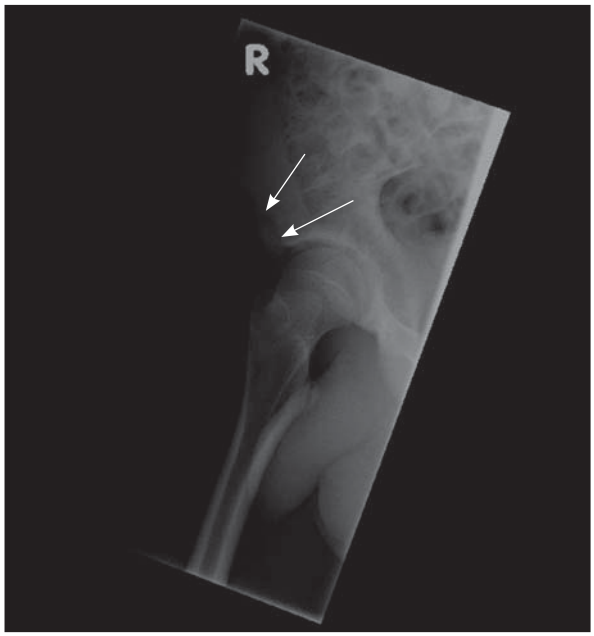
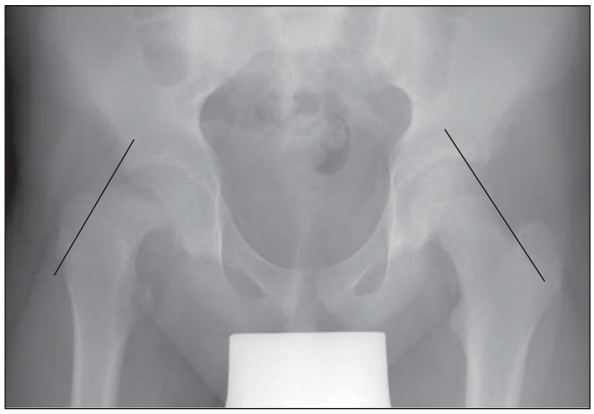


Figure 4. View of the pelvis showing a slip of the right upper femoral epiphysis. Note how the Klein's line misses the capital femoral epiphysis on the right but not the left.

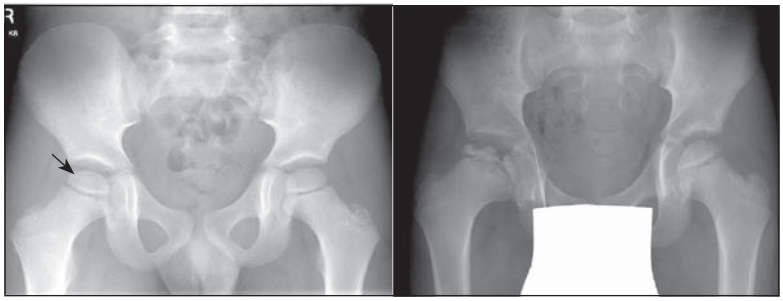


Microbiology

Microscopy of the joint fluid is important in making the diagnosis of septic arthritis but cannot be used to exclude septic arthritis. In one study (Faraj et al, 2002) Gram staining was 100% specific but only 45% sensitive for septic arthritis. The authors concluded that Gram staining is an unreliable tool in early decision making in patients requiring urgent surgical drainage and washout.

Parenteral antibiotics should be given only after fluid has been obtained for microscopy and culture.

Figure 5. Views of the pelvis in two children with Perthe's disease. a. Changes can be subtle at first, with joint space widening and crescent sclerosis (arrow). b. In later stages, collapse and fragmentation can become gross.



KEY POINTS

- History, examination and simple laboratory tests alone can identify most serious causes of limp in childhood.
- Toddler's fractures should be suspected even in the absence of a clear history of trauma from the parents.
- The presence of raised inflammatory markers, fever and a history of non-weight bearing makes septic arthritis the most likely diagnosis.
- Gram staining has a low sensitivity for septic arthritis and should not reduce clinical suspicion.

Conclusions

This review has highlighted the importance of a full history and clinical examination in the diagnosis and management of limp in childhood. Bedside parameters such as temperature and simple laboratory tests are essential in screening for septic causes of limp. Special investigations will help in confirming the final diagnosis but a careful interpretation of their findings is required. **BJHM**

Conflict of interest: none.

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