The limping child: a systematic approach to assessment and management

Parents and carers often describe their child as 'limping' when they notice that the child has an abnormal gait. The abnormal gait can be caused by weakness, pain or deformity (Perry and Bruce, 2010).

An acute limp in a child can be caused by a wide host of conditions ranging from mild and self-limiting causes such as transient synovitis to more sinister and life-threatening diagnoses such as malignancy and septic arthritis (Herman and Martinek, 2015). The National Institute for Health and Care Excellence (2015) guidance classifies diagnoses for acute limp in children according to the patient's age, although specific pathologies can occur at any age.

This article focuses on non-traumatic causes of the limping child. However, non-accidental injury and traumatic causes are equally as significant and should be considered within the differential diagnosis. In cases where non-accidental injury is suspected, medical records must be checked rigorously and safeguarding procedures for children followed effectively. The incidence of non-accidental injury is difficult to estimate because of the hidden nature of the abuse, but it is estimated that 4–16% of children in industrialized countries are abused (Gilbert et al, 2009).

Mr Daniel J Rossiter, Orthopaedic Registrar, Department of Trauma and Orthopaedics, Royal Surrey County Hospital NHS Foundation Trust, Guildford, Surrey GU2 7XX

Dr Aashish Ahluwalia, Core Surgical Trainee 1, Department of Trauma and Orthopaedics, University College London Hospital, London

Dr Phien Vo, Senior House Officer, Department of Paediatrics, Kingston Hospital, London

Dr Rahee Mapara, Core Surgical Trainee 1, Department of General Surgery, NHS Greater Glasgow and Clyde, Glasgow

Correspondence to: Mr DJ Rossiter (danielrossiter@doctors.org.uk)

Table 1. Red flags for serious pathology

Red flag	Potential cause
Pain waking child at night	Most commonly this is growing pains but in <1% of cases it can be caused by malignancy
Redness, swelling or stiffness of joint or limb	Infection or inflammatory joint disease are the most common causes
Weight loss, anorexia, fever, night sweats or fatigue	Malignancy, infection or inflammation can be potential causes of these symptoms
Unexplained rash or bruising	Non-accidental injury must be excluded in these cases; haematological or inflammatory joint disease should be considered as a rarer diagnosis
Limp and stiffness worse in the morning	Inflammatory joint disease, although rare in this age group, is still possible
Severe pain, anxiety and agitation after a traumatic injury	Compartment syndrome is very rare in this age group. Its incidence in non-trauma centres is <0.01% (secondary to infection) and 0.02% in trauma centres (Erdös et al, 2011)

From Perry and Bruce (2010)

Assessment

History

Communication with children can be challenging but clinicians must tease out red flag symptoms from even the least cooperative children. A collateral history from an adult accompanying the child is always necessary (Fischer and Beattie, 1999). The primary aim of this is to exclude any red flag symptoms (*Table 1*).

Duration of the limp, precipitating illness and a thorough pain history are key elements to elicit. Another essential component is a thorough birth and developmental history. This will highlight any delay in milestones, indicating a potential neuromuscular cause.

Children may also frequently present with pain referred to the knees or alongside the lateral border of the leg and clinicians must be alert to the potential for a hip pathology (Kane and McMorrow, 2014).

Examination

The National Institute for Health and Care Excellence (2015) recommends that clinicians perform the paediatric gait, arms, legs and spine (pGALS) examination to effectively assess a limping child (www.arthritisresearchuk.org/health-professionals-and-students/video-resources/pgals.aspx).

The pGALS examination begins with a general inspection of the child from the front, back and side. The inspection should include looking for joint swellings, muscle bulk, scoliosis, fixed flexion deformity of the hip or knee, rashes and bruising. As part of the general inspection, it is essential to review observation charts, which may give the clinician clues to a potential infective cause of the child's limp. Clinicians should be aware that sepsis may present with pyrexia and tachycardia but can often present as pallor, lethargy or irritability (Leet and Skaggs, 2010).

When examining all joints, a 'look, feel, move' approach should be adopted. It is also recommended to examine the range of movement in other joints, especially the knee, for example, to elicit any referred pain from the hip.

Clinicians must also be wary, as both abdominal and testicular pathology can present with an acute limp secondary to pain. Clinicians should therefore perform a thorough abdominal and testicular examination when clinical suspicion is high (Perry and Bruce, 2010).

Table 2. Differential diagnosis for the child with a limp, by age

Age group	Likely diagnosis	Other possible diagnosis
Under 3 years	Septic arthritis, osteomyelitis	Developmental dysplasia of the hip, transient synovitis
3–10 years	Transient synovitis, septic arthritis, osteomyelitis, Perthes disease	
10–18 years	Slipped upper femoral epiphysis, osteomyelitis, septic arthritis, Perthes disease	Osgood–Schlatter disease, Sever's disease (calcaneal apophysitis), osteochondritis dissecans, chondromalacia patellae

Differential diagnosis: children under 3 years of age

The differential diagnosis in this age group includes septic arthritis, osteomyelitis, developmental dysplasia of the hip and transient synovitis (*Table 2*).

In children in whom a fracture or soft tissue injury has been excluded, the two most important and time-critical pathologies to exclude in this age group are osteomyelitis and septic arthritis of the hip.

Osteomyelitis

Osteomyelitis is an infection of the bone. It should be suspected in infants who present with fever, unexplained limp and reluctance to use the limb. There may be local bone or joint tenderness, swelling and erythema. *Staphylococcus aureus* is the principal causative organism in the UK. Seeding into the bone via the haematogenous route is the commonest method (Sawyer and Kapoor, 2009).

Investigations

Blood tests demonstrate neutrophilia and increased levels of acute phase reactants, such as erythrocyte sedimentation rate and C-reactive protein, in 92–98% of cases. Blood cultures are crucial before starting antibiotic therapy, although they are only positive in 40–60% of cases (Yeo and Ramachandran, 2014).

Magnetic resonance imaging detects changes early in the disease and technetium bone scan is positive within 24–48 hours of infection. While plain X-rays should be obtained to exclude other bony lesions, changes demonstrating periosteal elevation and radiolucent metaphyseal lesions do not occur until after 10 days (Pineda et al, 2006).

Management

Targeted intravenous antibiotic therapy should be started promptly, but there is no consensus regarding the duration of treatment. Debridement is indicated if necrotic bone and pus are present.

Septic arthritis

Septic arthritis is an infection of the synovium and joint space. Left untreated it can lead to joint destruction and irreversible loss of function. Septic arthritis is most commonly caused by *S. aureus* and is classically monoarticular. It is characterized by fever and a swollen, tender joint, severely restricting joint movement (Pääkkönen, 2017).

Investigations

Blood tests typically show neutrophilia, and elevated C-reactive protein levels and erythrocyte sedimentation rate. However, the definitive investigation for septic arthritis is joint aspiration. Although plain radiographs help exclude trauma or other bony lesions and an ultrasound scan is helpful to identify joint effusion, joint aspiration allows urgent Gram staining and microscopy, culture and sensitivity, thus guiding management.

Management

Immediate initiation of intravenous antibiotics and surgical drainage (open or arthroscopic) with washout of the affected joint (Pääkkönen, 2017).

Other differentials

Children in this age group can also present with developmental dysplasia of the hip (formerly known as congenital dislocation of the hip). Risk factors include a family history of developmental dysplasia of the hip, female sex, being a first-born child, breech presentation at birth, oligohydramnios and a high birth weight (Noordin et al, 2010). High risk groups are normally screened at birth; however, if they are not detected early, a limp later in life is a common presentation.

Transient synovitis is another differential to consider in this age range, but it is far more commonly seen slightly later in life and is therefore described below.

Differential diagnosis: children aged 3–10 years

In this age group, the differential diagnosis includes transient synovitis, septic arthritis, osteomyelitis and Perthes disease.

As with children of any age, it is most important to first consider and exclude both osteomyelitis and septic arthritis, along with fractures and soft tissue injuries.

Transient synovitis

Transient synovitis is a common differential diagnosis in this age group with a 3% risk of occurrence throughout childhood (Harrison et al, 2014). Inflammation of the hip synovium is self-limiting, commonly lasting from 3 to 10 days, and is generally preceded by a viral illness. Transient synovitis most commonly affects the hip then the knee. Clinicians should be aware of Kocher's criteria, which help to differentiate between septic arthritis and transient synovitis (*Table 3*).

Children with a diagnosis of transient synovitis can be managed in the community provided that they have been symptomatic for <48 hours, are generally well, mobilizing with the limp and afebrile (National Institute for Health and Care Excellence, 2015). Analgesia should be prescribed and a follow-up appointment scheduled for 48 hours' time. A further review 7 days after the onset of symptoms should be arranged and an urgent referral to orthopaedics made if symptoms have not resolved at this point (National Institute for Health and Care Excellence, 2015).

Table 3. Differentiating septic arthritis of the hip from transient synovitis using Kocher's criteria

Temperature >38.5°C
White cell count >12x10^9/litre
Erythrocyte sedimentation rate >40 mm/hr
Weight bearing: yes or no

One point is scored for each parameter. A score of 4 gives a 99% chance of the patient having septic arthritis, 3 gives a 93% chance of septic arthritis, 2 gives a 43% chance of septic arthritis, and a score of 1 gives a 3% chance of septic arthritis.

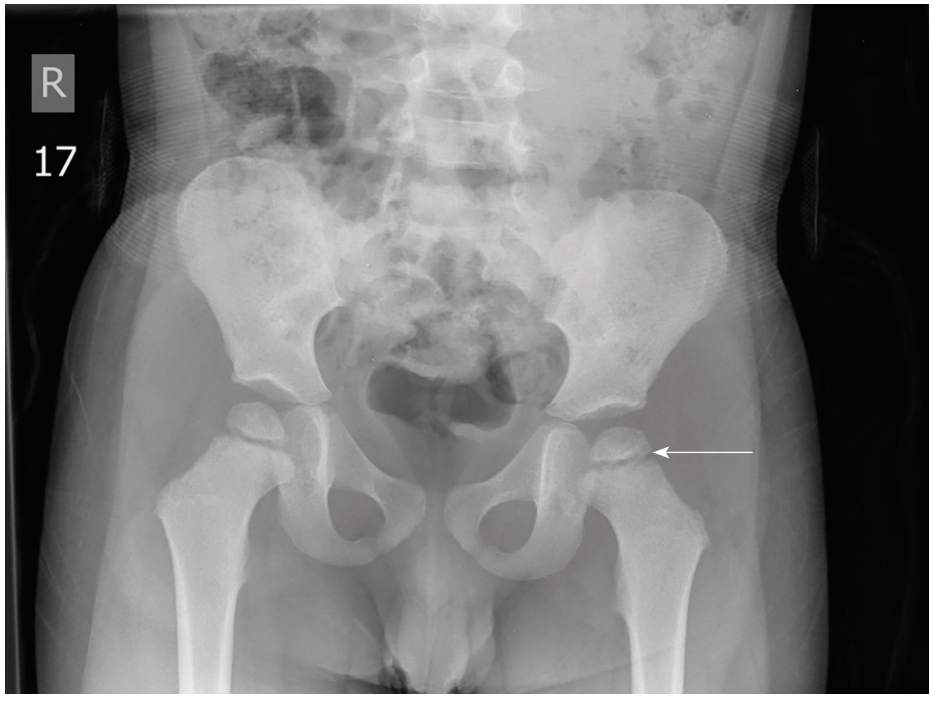

Figure 1. Perthes disease (left hip). Early stages: asymmetrical femoral epiphyseal size and blurring of the physeal plate on the left (arrow).

Perthes disease

Perthes disease is another important differential most common in boys aged 4–8 years. It tends to present as a sub-acute limp in this age group, and is caused by idiopathic necrosis of the developing femoral head. It can also present with referred pain to the groin, thigh or knee. If managed appropriately, these children tend to have good outcomes but they can develop chronic pain or osteoarthritis (Larson et al, 2012), so an orthopaedic referral should be arranged promptly.

Investigations

Unlike septic arthritis and osteomyelitis, blood tests in children with Perthes disease are typically normal. Anteroposterior and frog leg lateral X-rays are the gold standard in the diagnosis of Perthes disease in later stages; typical radiographic findings demonstrate collapse and flattening of the femoral head. In the early stages, X-rays may be normal or show an increased density, or subtle subchondral collapse. Plain radiographs are also useful for assessing the stage of disease and prognosis (*Figure 1*).

Magnetic resonance imaging and bone scanning should be considered if there are persistent symptoms or doubtful diagnosis.

Treatment aims to maintain the range of movement and to contain the femoral head in the acetabulum. Conservative management consists of physiotherapy and simple analgesics and is indicated in younger children and milder cases. Surgical management via corrective osteotomy is considered in more advanced cases or when conservative treatment is unsuccessful.

Differential diagnosis: children aged 10–18 years

The differential diagnosis for older children includes slipped upper femoral epiphysis, osteomyelitis, septic arthritis, Perthes disease, Osgood–Schlatter disease, Sever's disease (calcaneal apophysitis), osteochondritis dissecans and chondromalacia patellae.

Slipped upper femoral epiphysis

Over the age of 10 years, an important differential to consider is slipped upper femoral epiphysis – displacement of the proximal femoral epiphysis relative to the metaphysis. Although children do present with an acute limp, they can also have hip, thigh or knee pain. On clinical examination, there is a progressive loss of abduction and internal rotation, and the affected leg is shortened and externally rotated. The incidence is higher in boys over the age of 10 years, particularly in those who are overweight. An association has been noted with slipped upper femoral epiphysis and endocrine disorders such as hypothyroidism and those being treated for growth hormone deficiency (Novais and Millis, 2012).

Slipped upper femoral epiphysis is classified as stable or unstable, depending on the ability to weight-bear. Plain anteroposterior X-rays of the hip and pelvis are used to diagnose unstable presentations, with the addition of frog leg lateral views in stable slipped upper femoral epiphysis. A characteristic feature on the X-ray of an adolescent with slipped upper femoral epiphysis is the presence of Trethowan's sign, where Klein's line does not intersect the lateral part of the superior femoral epiphysis (Peck, 2010) (*Figure 2*).

Patients with a slipped upper femoral epiphysis should be referred urgently to orthopaedics with advice to refrain from weight bearing. Slipped upper femoral epiphysis is always definitively managed surgically, with the method of surgery dependent upon the degree of displacement. Mild to moderate displacement is treated by screw fixation of the epiphysis, while corrective osteotomy is required in more severe displacement.

Although typically unilateral, bilateral slipped upper femoral epiphysis occurs in 25% of children. Prophylactic pinning of the contralateral epiphysis remains controversial (Peck, 2010).

Again fractures, soft tissue injuries, osteomyelitis and septic arthritis must be included in the differential diagnoses.

There are also a number of more chronic pathologies around the knee that can cause a child in this age range to limp including Osgood–Schlatter disease, osteochondritis dissecans and chondromalacia patellae. These diagnoses will not be discussed in this article.

Other important diagnoses to consider in all age groups

Malignancies (sarcoma, leukaemia and lymphoma) can present at any age and must always be considered, as well as non-malignant haematological causes including sickle cell disease and inflammatory joint disease. Limping can also occur in neuromuscular diseases such as muscular dystrophy, cerebral palsy or spina bifida.

Conclusions

A limping child could represent a number of pathologies. It is essential to take a history, examine the patient and conduct the necessary

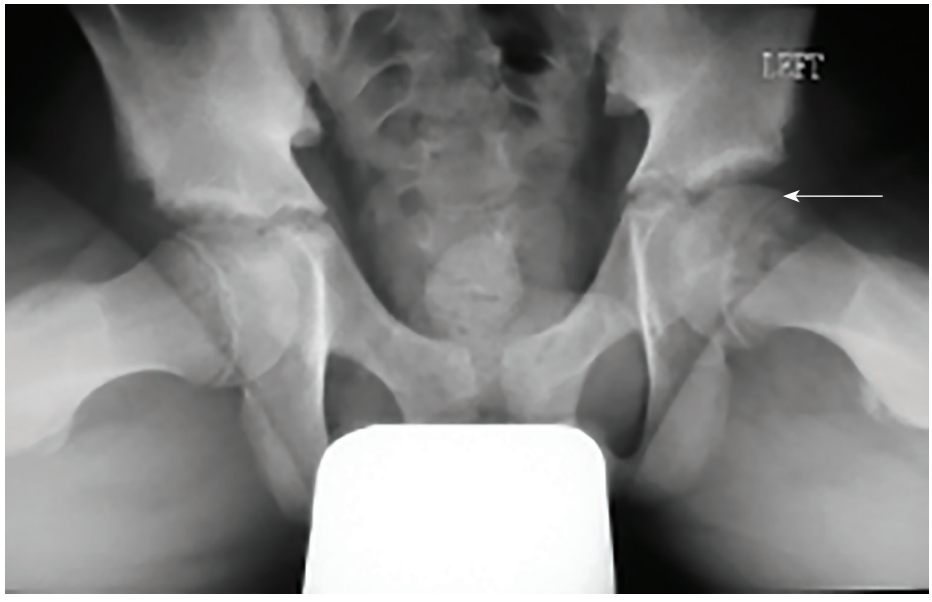

Figure 2. Frog leg lateral views showing a slipped upper femoral epiphysis on the left (arrow).

KEY POINTS

- An acutely limping child is a common presentation with a range of causes from mild to life threatening.
- Establishing the underlying pathology requires a thorough and formal assessment, including history taking, examination and imaging if required.
- Always rule out septic arthritis and osteomyelitis in a child of any age.
- Urgent referral to orthopaedics is required if any of the following are suspected: septic arthritis, osteomyelitis, slipped upper femoral epiphysis, compartment syndrome, malignancy or non-accidental injury. If non-accidental injury is suspected local safeguarding pathways for children should be promptly adhered to.

investigations in order to narrow down the differential diagnoses. Any red flag sign or symptom should prompt urgent referral and management in a limping child. **BJHM**

Conflict of interest: none.

Erdös J, Dlaska C, Szatmary P, Humenberger M, Vécsei V, Hajdu S. Acute compartment syndrome in children: a case series in 24 patients and review of the literature. Int Orthop. 2011 Apr;35(4):569–575. https://doi.org/10.1007/s00264-010-1016-6

Fischer SU, Beattie TF. The limping child: epidemiology, assessment and outcome. J Bone Joint Surg Br. 1999 Nov;81(6):1029–1034.

Gilbert R, Widom CS, Browne K, Fergusson D, Webb E, Janson S. Burden and consequences of child maltreatment in high-income countries. Lancet. 2009 Jan 3;373(9657):68–81. https://doi.org/10.1016/S0140-6736(08)61706-7

Harrison WD, Vooght AK, Singhal R, Bruce CE, Perry DC. The epidemiology of transient synovitis in Liverpool, UK. J Child Orthop. 2014 Feb;8(1):23–28. https://doi.org/10.1007/s11832-014-0556-5

Herman MJ, Martinek M. The limping child. Pediatr Rev. 2015 May;36(5):184–195, quiz 196–197. https://doi.org/10.1542/pir.36-5-184

Kane I, McMorrow S. Approach to the limping child. Emerg Med. 2014;46(9):409–415.

Larson AN, Sucato DJ, Herring JA et al. A prospective multicenter study of Legg-Calve-Perthes disease: functional and radiographic outcomes of nonoperative treatment at a mean follow-up of twenty years. J Bone Joint Surg Am. 2012 Apr 4;94(7):584–592. https://doi.org/10.2106/JBJS.J.01073

Leet AI, Skaggs DL. Evaluation of the acutely limping child. Am Fam Physician. 2000 Feb 15;61(4):1011–1018.

National Institute for Health and Care Excellence. 2015. Acute childhood limp. (accessed 19 September 2018) https://cks.nice.org.uk/acute-childhood-limp

Noordin S, Umer M, Hafeez K, Nawaz H. Developmental dysplasia of the hip. Orthop Rev (Pavia). 2010 Sep 23;2(2):e19. https://doi.org/10.4081/or.2010.e19

Novais EN, Millis MB. Slipped capital femoral epiphysis: prevalence, pathogenesis, and natural history. Clin Orthop Relat Res. 2012 Dec;470(12):3432–3438. https://doi.org/10.1007/s11999-012-2452-y

Pääkkönen M. Septic arthritis in children: diagnosis and treatment. Pediatric Health Med Ther. 2017 May 18;8:65–68. https://doi.org/10.2147/PHMT.S115429

Peck D. Slipped capital femoral epiphysis: diagnosis and management. Am Fam Physician. 2010 Aug 1;82(3):258–262.

Perry DC, Bruce C. Evaluating the child who presents with an acute limp. BMJ. 2010 Aug 20;341:c4250. https://doi.org/10.1136/bmj.c4250

Pineda C, Vargas A, Rodríguez AV. Imaging of osteomyelitis: current concepts. Infect Dis Clin North Am. 2006 Dec;20(4):789-825. https://doi.org/10.1016/j.idc.2006.09.009

Sawyer JR, Kapoor M. The limping child: a systematic approach to diagnosis. Am Fam Physician. 2009 Feb 1;79(3):215–24.

Yeo A, Ramachandran M. Acute haematogenous osteomyelitis in children. BMJ. 2014 Jan 20;348:g66. https://doi.org/10.1136/bmj.g66