Primary subacute epiphyseal and metaepiphyseal osteomyelitis in children

DIAGNOSIS AND TREATMENT GUIDED BY MRI

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We present three children with primary subacute epiphyseal and metaepiphyseal osteomyelitis. The diagnosis was delayed because of subtle radiological findings and mild general symptoms. Primary epiphyseal osteomyelitis is extremely rare. We believe that this is the first time that the MRI findings have been presented. In the first case they revealed a perforation into the knee and therefore an intra-articular epiphyseal approach was used for debridement. In the second and third cases the metaepiphyseal lesions showed considerable physical involvement and a metaphyseal approach was chosen. We believe that in this condition MRI is essential both for diagnosis and in the planning of surgical treatment.

Primary subacute osteomyelitis in children is rare, but has become more common in recent years. The diagnosis is often delayed because of slow onset, intermittent pain, absence of general malaise and subtle radiological changes. The advent of MRI has led to earlier detection and more precise localisation of the infection. Involvement of the epiphysis is extremely rare and we believe that this is the first time that MR scans of primary subacute epiphyseal osteomyelitis have been reported.

Methods

For MRI we used 0.5 Tesla scanners (Gyroscan T5 II and Gyroscan ACS-NT; Philips Medical Systems, Eindhoven, The Netherlands) with knee coils for two patients (cases 1 and 3) and a surface coil for one patient (case 2). Spin-echo (SE) images with T1-weighting (TR 406-420/TE 15-20) were obtained before and after the intravenous injection of contrast medium (gadolinium-DTPA, 0.1 mmol/kg Magnevist; Schering, Berlin, Germany) in all patients. T2-weighted imaging was performed in cases 1 and 3. STIR (Short T1 Inversion Recovery – TR 1.500/TE 30/TI 120 ms) images were also acquired. Two readers, a radiologist (TG) with extensive experience in musculoskeletal MRI and the senior author (ALM), who operated on all the patients, reviewed all the images.

Illustrative case reports

Case 1. A two-year-old boy presented with pain and swelling of his right knee two weeks after a chest infection with fever up to 40°C. Physical examination showed increased heat, considerable effusion and painful restriction of movement of the joint. Plain radiographs were normal. Laboratory tests showed an elevated ESR of 69 mm/hour, a normal white blood cell count (WCC) and a normal level of C-reactive protein (CRP). We aspirated 10 ml of cloudy fluid, which was sterile on culture (WCC 20.700/mm³, 83% neutrophils). A monoarticular juvenile rheumatoid arthritis was suspected and treated by an intra-articular injection of 15 mg of triamcinolone and oral naproxen. The pain subsided, but recurred two weeks later when a new lateral radiograph showed a lytic area in the epiphysis of the lateral condyle (Fig. 1a). He was referred to our department and underwent MRI with contrast medium. T1-/T2-weighted and STIR sequences showed a large effusion and marrow oedema of the lateral epiphysis with complete suppression of the fat marrow signal in T1 (Fig. 1b). In the contrast-enhanced T1-weighted images there was a suspicion of an abscess and penetration of the joint through the medial wall of the lateral condyle (Fig. 1c). The metaphysis showed slight oedema (Figs 1b and 1c). A primary subacute epiphyseal osteomyelitis was diagnosed (type V according to the classification of Roberts et al7). In view of the suspicion of penetration we undertook urgent surgical exploration. A medial arthrotomy gave good access to the medial wall of the lateral femoral condyle. There was an effusion of more than 10 ml and after debridement of hypertrophic synovial
tissue a small cartilage defect leading into a cavity in the epiphysis was identified. Granulation tissue was obtained, but no pus. There was perifocal sclerosis which prevented the introduction of a curette into intact cancellous bone or the growth plate. After copious irrigation, we closed the joint with a Penrose-type drain, which was retained for one week. Cultures of the curetted tissue were positive for *Streptococcus pneumoniae*. He was given intravenous penicillin and clindamycin ($4 \times 10^6$ IU and 450 mg daily, respectively). Histological examination revealed chronic fibrous osteomyelitis. We allowed free active movements from the first postoperative day, but advised non-weight-bearing for eight weeks. He was discharged after two weeks. Oral antibiotics were continued for two months. At follow-up two years later, he was asymptomatic with a full range of movement of the knee. Radiologically, the lytic defect had decreased in size and there were no signs of abnormality of growth. Our diagnosis was primary subacute epiphyseal osteomyelitis of the distal femur (Roberts type V).

**Case 2.** Six months after a febrile common cold a two-year-old German girl was referred to an orthopaedic department in New Zealand with a two-week history of a left-sided antalgic limp. She had a full range of movement of the left hip and knee (WCC 6,800/mm$^3$, CRP <1 mg/l, ESR 27 mm/hour). A pelvic radiograph was considered to be normal, although, in retrospect, a faint metaphyseal radiolucency was suspected in the proximal femur. Transient synovitis of the hip was diagnosed. The parents were told to restrict her activities and paracetamol was prescribed. The symptoms improved initially, but the painful limp recurred three weeks later.

**Fig. 1a** – Lateral radiograph of the right knee four weeks after the onset of symptoms showing a large radiolucency in the distal femoral epiphysis (arrows). MRI of the right knee. **Figure 1b** – The coronal T1-weighted image shows an area of low signal intensity in the lateral epiphysis. The primary epiphyseal process has no connection with the metaphysis, but slight reactive oedema can be seen. **Figure 1c** – The coronal T1-weighted contrast-enhanced image indicates a suspicion of an abscess (spot of persistent low signal intensity with a rim of massive enhancement, arrow). There is also uptake of contrast medium in the hyaline cartilage in the medial wall of the lateral condyle indicating substitution of cartilage by granulation tissue (asterisk). Penetration of the abscess into the joint was assumed and confirmed at operation. The metaphysis shows only a slight physiological enhancement.
later. Six weeks after the onset of symptoms further radiographs and a bone scan were performed. A lytic lesion occupying approximately half the metaphysis and involving the physis was seen (Fig. 2a). The bone scan was hot in this area. Her parents decided to return to Germany and when first seen in our unit she appeared well, but unwilling to walk. The left hip had a full range of movement with slight pain on full internal rotation and flexion. She had no fever, the WCC count was normal and the CRP moderately elevated (21 mg/l). After admission MRI showed evidence of a metaphyseal abscess extending beyond the growth plate (Roberts' type II/V lesion). Coronal, sagittal and transverse sequences allowed the precise localisation of the focus in the upper anterolateral neck and head (Figs 2b and 2c).
Arthrotomy was carried out through an anterior approach. There was a little clear synovial fluid which was sterile on culture. The articular cartilage looked normal except for a circumscribed greyish discolouration adjacent to the rim of the head, which the MR finding suggested as the site of the lesion. A cortical window, made in the anterolateral femoral neck, gave access to a large metaepiphyseal cavity, which contained much granulation tissue, but no pus. After careful curettage the wound was closed with a modified Penrose drain which was retained for six days. To avoid the risk of physeal bridging we did not insert any cancellous bone graft. The histopathological diagnosis was a purulent, abscess-forming infection of the left hip. Bacteriological cultures were initially negative. Antibiotic treatment was started with cefazolin intravenously (600 mg daily) for ten days and then changed to piperacillin (3 g daily) for a fur-

Case 3. Figure 3a – An AP plain radiograph showing a radiolucency in the midline of the distal femur which crosses the growth plate. Figure 3b – A T2-weighted gradient echo image in the sagittal plane showing a large metaepiphyseal signal-intense lesion with oedema in the adjacent muscles. The posterior cortex is involved leading to a subperiostal abscess (small arrows). The process affects approximately half of the physis with formation of a physeal sequestrum (large arrow). Figure 3c – In the transverse T1-weighted contrast-enhanced image in a plane proximal to the physis there is a metaphyseal abscess characterised by a central low signal intensity and an enhancing rim (arrow). In addition, there is a diffuse subperiostal uptake of contrast medium dorsally indicating subperiostal extension of the infection.
ther ten days when a wound culture revealed *Pseudomonas aeruginosa*. Four weeks after the operation she was allowed home with a dry wound and a painless fully mobile hip. We instructed the parents to avoid weight-bearing for eight weeks after the operation by using a buggy. MRI at four months showed no evidence of persistent osteomyelitis. The left femoral epiphysial showed a normal fat marrow signal. The physes was slightly broadened without bony bridging. The former metaphyseal defect showed an increased signal in T1-weighted sequences corresponding to fat and in T2-weighting indicating slight oedema. We allowed her to resume all activities. Clinical examination at six months was normal. A pelvic radiograph, however, still showed a metaphyseal abnormality and slight widening of the physes, but a normal neck length. Our diagnosis was primary subacute metaphyseal osteomyelitis of the proximal femur (Roberts type II/V).

**Case 3.** A seven-year-old girl complained of pain in the right popliteal fossa following ten days of fever up to 40°C of unknown cause. Three weeks after the onset of symptoms, an orthopaedic surgeon considered the radiographs to be normal and treated the knee with a bandage and restriction of activity. New radiographs, taken two weeks later, showed a radiolucency in the right distal femur (Fig. 3a). On admission she was apyrexial and well except for painful limitation of knee flexion and tenderness in the popliteal fossa. The ESR was 20 mm/hour, the WCC was normal and the haemoglobin was 108 g/l because of heterozygotic β-thalassaemia which was diagnosed later. Blood cultures showed no bacterial growth. MRI revealed metaphyseal osteomyelitis of the distal femur (Roberts type II/V) with a perforation into the popliteal fossa (Figs 3b and 3c). During surgical exploration, using a dorsal approach based on the proximal femoral epiphysis as has been reported previously, and there may be a connection with the joint.

The main difficulty in the management of subacute osteomyelitis is in making the diagnosis. Patients present with mild pain, little functional impairment and no systemic reaction. A number of benign and malignant conditions must be considered in the differential diagnosis, including eosinophilic granuloma, osteoid osteoma, chondroblastoma, tuberculosis, fungal infection, osteosarcoma, Ewing’s sarcoma, leukemia and round-cell tumours. Several studies have shown the value of MRI in diagnosing osteomyelitis in children and gadolinium-enhanced imaging is the most sensitive. MRI can give precise information about the localisation and extent of the infection. By contrast, plain radiographs may underestimate the destruction of bone and remain normal until irreversible progression of the infection has occurred. The three patients presented here demonstrate that MRI can determine the best approach for surgical exploration.

Primary subacute osteomyelitis in children follows a benign course and the routine management is early antibiotic treatment. In contrast to other authors, in our opinion MRI is essential, not only for early diagnosis, but to determine which patients require surgical exploration.

The initial focus of haematogenous osteomyelitis in childhood is most commonly located in the metaphysis. Primary epiphyseal infections are extremely rare. Only 44 cases have been reported. To our knowledge, case 1 represents the first report of the use of MRI in primary subacute osteomyelitis confined to the epiphysis. It showed massive contrast enhancement in the distal femoral epiphysis and evidence of perforation of the lateral condyle (Figs 1b and 1c), which was confirmed at operation. Thus, not all cases of epiphyseal osteomyelitis are confined to the epiphysis as has been reported previously, and there may be a connection with the joint.

**References**


