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Anomalies of ossification in the posterolateral femoral condyle: assessment by MRI

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Abstract *Background.* Anomalies of ossification in the lower femoral epiphysis are often radiographically indistinguishable from juvenile osteochondritis dissecans.
Objective. To clarify the MRI characteristics of the anomalies of ossification in the posterolateral femoral condyle that distinguish it from juvenile osteochondritis dissecans.
Materials and methods. We retrospectively examined the medical records, plain radiographs ($n = 4$), MRI ($n = 4$) and follow-up MRI ($n = 2$) of four boys (age 8–11 years) with anomalies of ossification in the posterolateral femoral condyle.
Results. Plain radiography showed symmetrical marginal irregularity of the posterolateral femoral condyles of both knees. These lesions were asymptomatic, and the areas of irregular radiographic appearances reduced in size or disappeared without treatment within a mean observation period of 3.5 months. MRI showed a clearly demarcated low-intensity islet with the same signal intensity as subchondral bone (which was considered to be an accessory ossification nucleus) in a high-signal area in which the signal intensity was equal to that of normal articular cartilage. The areas observed as radiolucent zones on plain radiography were visualised at the same signal intensity as articular cartilage, and were continuous with articular cartilage on MRI; thus they were regarded as uncalcified cartilage. These MR findings are different from MR images of osteochondritis dissecans.
Conclusions. MRI is considered to be the most effective non-invasive diagnostic method for these two conditions.

Introduction

It is well known that anomalies of ossification in the lower femoral epiphysis are frequently observed in children. These anomalies of ossification usually disappear spontaneously but are often radiographically indistinguishable from juvenile osteochondritis dissecans [1, 2]. However, less information is available regarding the differential diagnosis and the aetiologies of anomalies of ossification and osteochondritis dissecans.

The objectives of this study were to analyse anomalies of ossification in the posterolateral femoral condyles using MRI and to clarify their differentiation from osteochondritis dissecans.

Materials and methods

The subjects were four boys treated at the Department of Orthopaedic Surgery, Tottori University Hospital, between December 1994 and August 1997 and diagnosed as having anomalies of ossification of the posterolateral femoral condyles. The ages of the patients at the initial examinations were 8–11 years (mean 10.0 years).

Radiographs were obtained in AP, lateral and tunnel projections at the initial examination and, with consent of patients and their parents, at monthly intervals until the lesion showed resolution. The radiographic findings were classified into three groups according to the method of Caffey et al. [3]:

Group 1: Varying degrees of roughening of the margins and occasionally small foci of calcification immediately beyond the roughened edge of the main centre.
Group 2: Larger localised marginal irregularities in the form of indentations.

Table 1 Clinical diagnosis and radiographic evaluation in patients with anomalies of ossification (*M* male, *MCL* medial collateral ligament)

Patient	Age and sex	Clinical diagnosis	Group[a]	
			Left	Right
1	8 years, M	Left MCL injury	1	1
2	10 years, M	Right knee discomfort	2	2
3	11 years, M	Bilateral Osgood-Schlatter disease	3	1
4	11 years, M	Left knee discomfort	3	3

[a] According to Caffey et al. [3]

Group 3: Irregularities of the same kind as those of group 2, except that there is an independent island of bone in the marginal crater.

MRI was performed in all patients at the initial examination. Follow-up MRI was performed on three knees of two patients in group 3 when the lesions were found to have been reduced on plain radiography. All MR examinations were performed on a 0.5-T system using a transmit-receive coil. Slice thickness was 5 mm with an interslice gap of 1.5 mm. Spin-echo imaging was used. Proton-density (PD) weighted sequences (TR/TE, 2500/25) and T2-weighted (T2-W) sequences (TR/TE, 2500/110) were used. Coronal and sagittal images were obtained in all patients.

Each MR scan was evaluated by one observer without knowledge of the plain radiographic findings.

Results

The clinical diagnoses were medial collateral ligament injury of the knee in one patient, Osgood-Schlatter disease in one patient and occasional, mild non-specific discomfort in two patients. All patients showed bilateral anomalies of ossification in the posterolateral femoral condyles but reported no clinical symptoms at the sites of anomalies of ossification (Table 1). The anomalies of ossification reduced or disappeared radiographically without treatment in all patients during a mean observation period of 3.5 months (3–4 months).

On MRI, the lesions were separated by a depressed low-signal band continuous with the subchondral bone of the normal area. A clearly demarcated low-intensity islet with signal intensity equal to that of subchondral bone was observed in a high-signal area, in which the signal intensity was equal to that of normal articular cartilage. On MRI, these low-intensity islets were in contact with the depressed low-signal band continuous with subchondral bone in group 1 and group 2, but were only partially continuous with, and mostly separated from, this depressed low-signal band in group 3. Furthermore, the articular cartilage in the lesions appeared to be continuous with that in the normal area and to be thicker than in the normal area (Figs. 1, 2 a,b).

On follow-up MRI the margins of the low-signal band continuous with subchondral bone became obscure, and the entire lesions appeared as homogeneously pale low-signal areas. Moreover, the articular cartilage covering the lesions was visualised as having the same thickness as in other areas (Fig. 2 c,d).

Discussion

Sontag and Pyle [4] were the first to note roughening or complete loss of the regular epiphyseal outline of the distal femoral epiphyses as normal after reviewing radiographs from 220 children. They were able to corre-

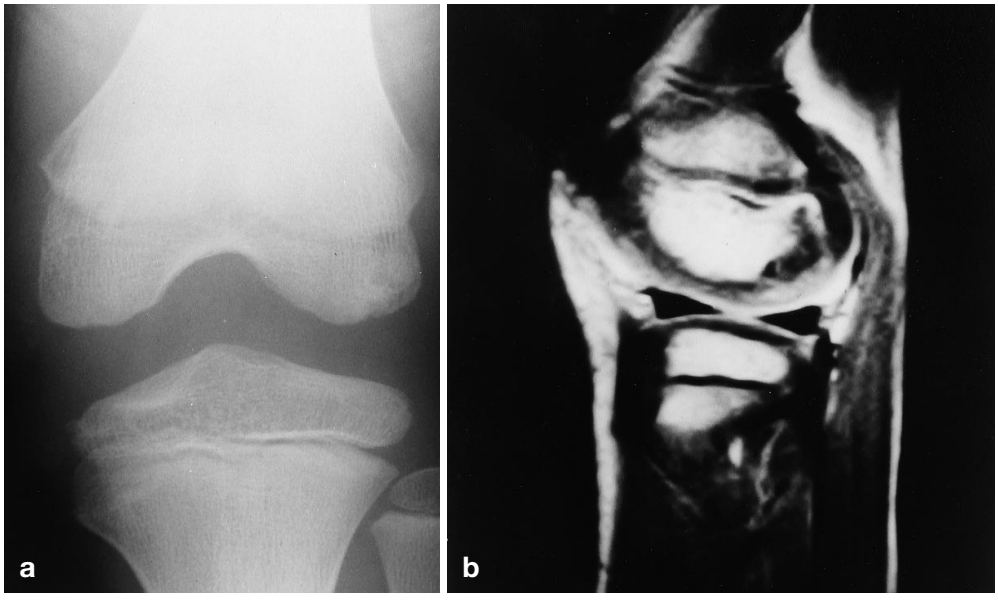

Fig. 1 a,b The left knee of an 8-year-old boy (patient 1 in Table 1). **a** Tunnel view and **b** sagittal PD MRI show group 1 type of irregularity in the posterolateral femoral condyle

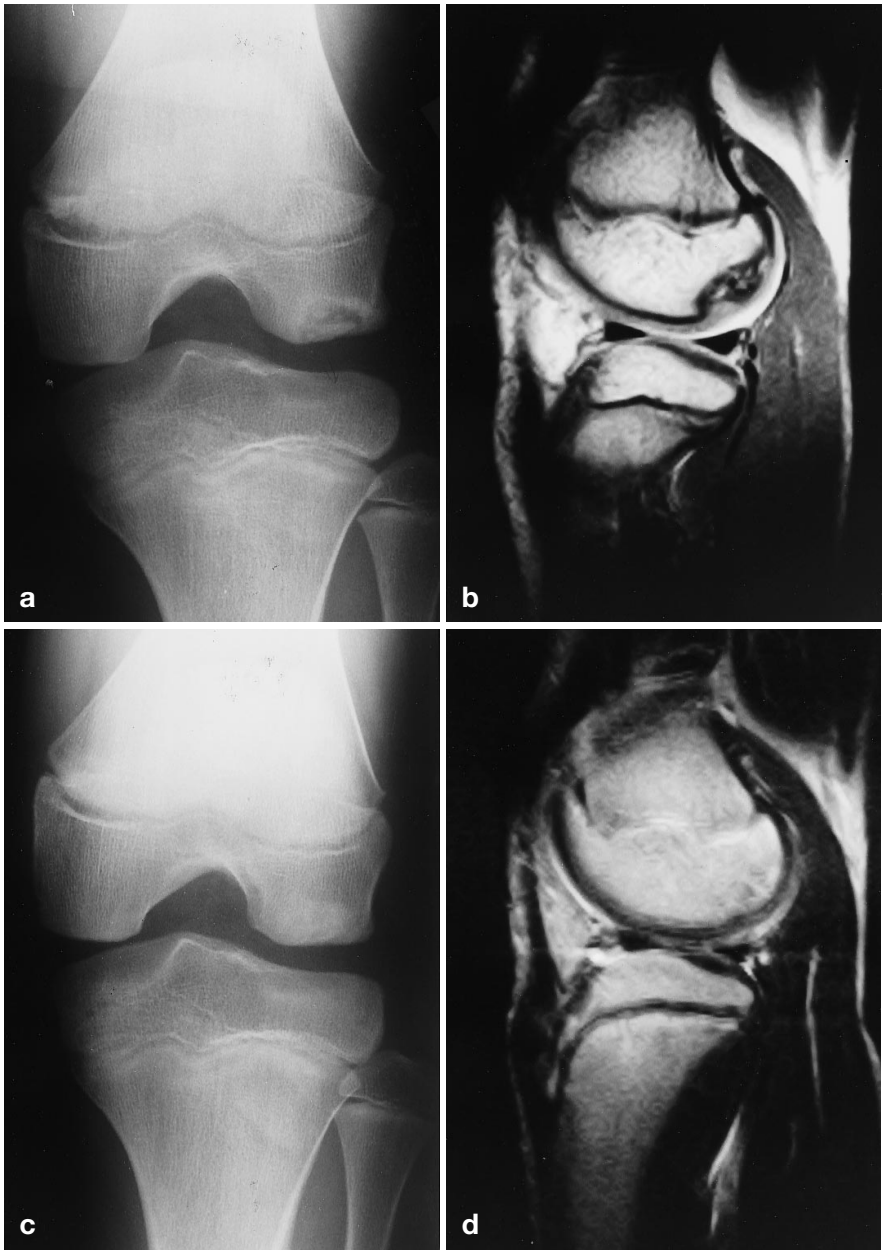

Fig. 2a–d The left knee of an 11-year-old boy (patient 3 in Table 1). **a** Tunnel view and **b** sagittal PD MRI show group 3 type of irregularity in the postero-lateral femoral condyle. Three months later the tunnel view **(c)** and MRI (**d**) show resolution of the lesion

late the changes with periods of rapid growth. Caffey et al. [3] examined the frequency and form of the irregular ossification by reviewing knee radiographs of 147 children between the ages of 3 and 13 years, all known to be free of clinical abnormality in the knee joints. Irregularity was present in 66% of the boys and 44% of the girls. The lateral condyle only was involved in 44% and the medial condyle only in 12%. The changes were frequently bilateral but were not always symmetrical.

We diagnosed the irregular radiographic appearance of the posterolateral femoral condyle of four patients as anomalies of ossification. Our four patients, aged 8–11 years, were boys in their period of rapid growth who exhibited symmetrical marginal irregularity of the posterolateral femoral condyles of both knees. These lesions were asymptomatic, and the irregular radiographic appearances reduced or disappeared without treatment during a mean observation period of 3.5 months. For these reasons, the diagnoses of anomalies of ossification are considered to have been valid.

Caffey et al. [3] examined the radiographic appearances of irregularities of ossification and found that provisional calcification can be retarded in a localised segment of the epiphysis, producing a radiolucent de-

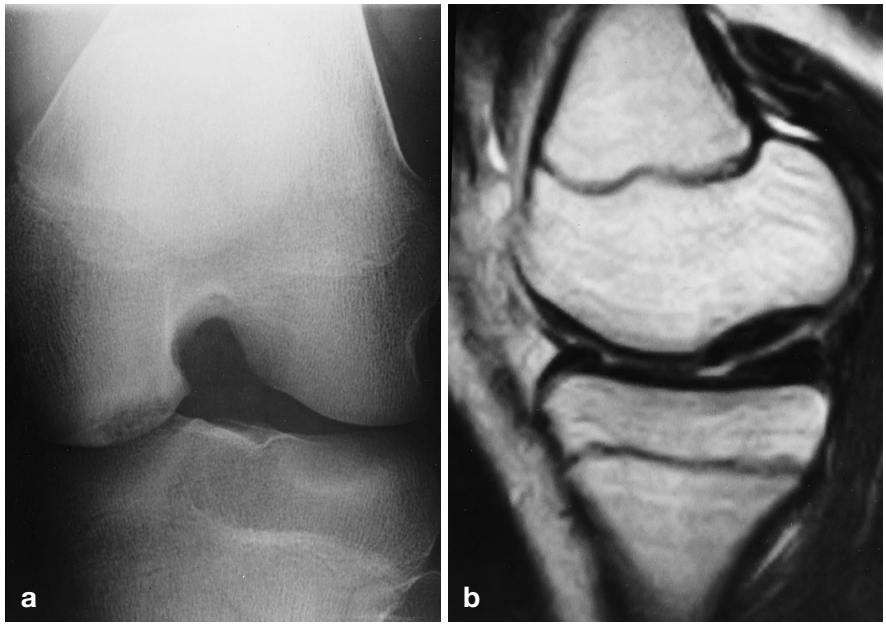

Fig. 3 a,b The left knee of a 12-year-old girl with intermittent knee pain. **a** Tunnel view and **b** sagittal PD MRI show the extended classic type [5] of osteochondritis dissecans

fect. Within the area of the defect, a focus of calcification can occur, distant from the main calcified mass. As both the focus of calcification and the main cartilaginous mass enlarge, a radiographic appearance, similar to osteochondritis dissecans, can occur. However, the nature of this radiolucent zone of an osteochondritis dissecans-like lesion has remained unclear because uncalcified cartilage, fibrous tissue, rarefaction of bone and a true space all have a similar appearance by conventional radiography.

The low-intensity islets observed on MRI in our patients are considered to be accessory ossification nuclei because of the similarity of their signal intensity to that of subchondral bone. The areas that appeared as radiolucent zones on plain radiography appear to be uncalcified cartilage, because they were visualised with the same signal intensity as articular cartilage and were continuous with articular cartilage in MR images.

On the other hand, osteochondritis dissecans is reported to be visualised as homogeneously low-to-moderate signal intensity on T1-W MRI (Fig. 3), and a line of increased signal intensity separates the lesion from the adjacent articular cartilage and/or subchondral bone [6–8]. Therefore, MR images of osteochondritis dissecans may be clearly differentiated from those of anomalies of ossification.

The site of anomalies of ossification in posterolateral femoral condyle is in the weight-bearing area, but osteochondritis dissecans has been reported at the same site [9, 10]. We believe that the differential diagnosis of these two disorders is clinically very important in order to avoid unnecessary treatment of anomalies of ossification. MRI is considered to be the most effective non-invasive diagnostic method for these two disorders.

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