

# The Foot and Ankle: MR Imaging of Uniquely Pediatric Disorders

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## KEYWORDS

• MR imaging • Pediatric • Foot • Ankle • Musculoskeletal

Although the primary imaging modality for ankle- and foot-related problems in children is plain radiographs, MR imaging becomes useful for specific indications, such as evaluating osteochondral abnormalities, preoperative assessment of tumors and infection, evaluating occult osseous trauma and soft tissue injury, and less commonly evaluating the cartilaginous anlagen in clubfoot.

## TECHNICAL CONSIDERATIONS

The most important technical factor for consideration is coil selection. This depends on patient size. Although extremity, knee, or head coil are appropriate for most children, smaller surface coils are needed for evaluating babies and smaller children and for high-resolution imaging in older children. Rarely, torso coils are needed to evaluate more extensive abnormalities involving the calf and the foot. Almost all the studies are performed in supine position. On occasion, however, prone position is used to advantage in older patients for imaging the midfoot and forefoot for such indications as metatarsal and sesamoid stress fracture. Other considerations of sedation and immobilization are the same as in other MR imaging examinations.<sup>1,2</sup>

Selection of sequence is tailored to individual examination but routine imaging includes T1 fast spin echo proton density images with and without fat saturation and fluid-sensitive sequence (short tau inversion recovery or T2 fast spin echo with fat saturation) in at least one plane, usually sagittal. Intravenous gadolinium-based contrast is used in

cases of suspected infection, evaluation of mass, and differentiating solid from cystic abnormality.

## OSTEOCHONDRAL LESIONS

### *Osteochondritis Dissecans*

Osteochondritis dissecans most commonly involves the talar dome in the ankle and foot. The postulated mechanism is repetitive microtrauma. The common locations for this abnormality are the posterior one third of the medial margin and middle one third of the lateral margin and less commonly the central talar dome. MR imaging is useful in assessing stability of the lesions, which significantly influences management.<sup>3,4</sup> Features that indicate instability include loose body, focal cartilage defect greater than 5 mm, subchondral cyst, and linear high T2 signal abnormality tracking at the donor-fragment interface for at least 5 mm or circumferentially around the osteochondral fragment (**Fig. 1**).<sup>3,5–7</sup>

Routine imaging includes proton density spin echo and T2-weighted fat-suppressed fast spin echo sequences. Cartilage-sensitive sequences, however, such as three-dimensional T1-weighted fat-suppressed spoiled gradient recalled, have been found helpful in assessing cartilage integrity. Use of gadolinium to distinguish granulation tissue from fluid at the linear high T2 signal at the donor fragment interface has been reported. Intra-articular use of gadolinium has not been shown to improve accuracy of articular cartilage damage.<sup>8–11</sup>

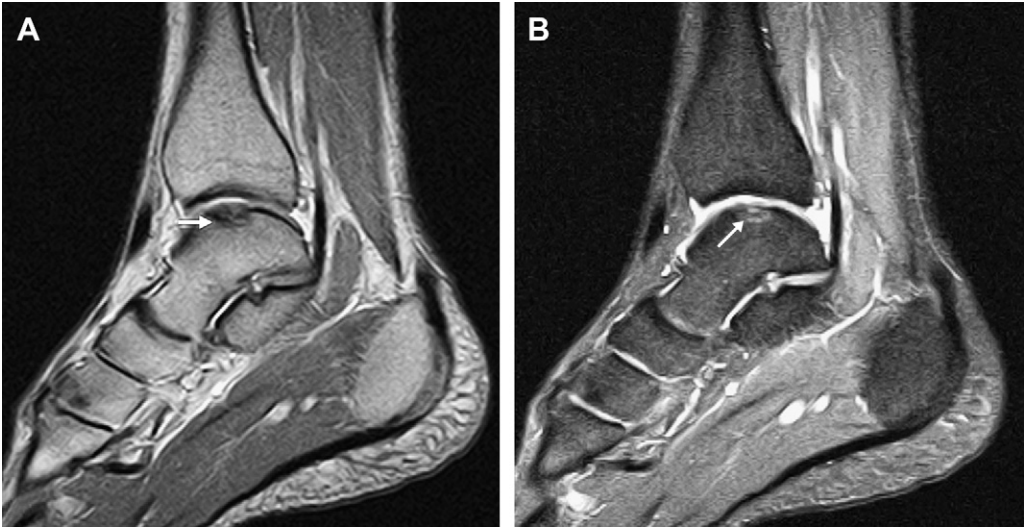
On occasions osteochondritis dissecans may be encountered incidentally in a child evaluated

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**Fig. 1.** Osteochondritis dissecans. (A) Sagittal T1-weighted image shows osteochondral defect in the central talar dome (arrow). (B) Sagittal T2 fat-suppressed image shows a rim of high signal (arrow) encircling the osteochondral fragment suggesting unstable osteochondritis dissecans.

for acute or subacute ankle injury. Osteochondritis dissecans can be differentiated from acute osteochondral fracture by the presence of adjacent focal marrow edema and kissing contusion in the tibial plafond. Both represent parts of a spectrum, however, and as such do not differ from management perspective.

Osteonecrosis of talar dome can mimic osteochondritis dissecans on MR imaging. The presence, however, of a predisposing condition, such as talar neck fracture, corticosteroids, or vasculitis, and the presence of characteristic double-rim sign on MR imaging with hyperintense inner rim and hypointense outer rim on T2-weighted images makes differentiation easier (Fig. 2).<sup>12</sup>

Focal subchondral edema is seen in both acute and chronic injury and following high-intensity exercise. They present as ill-defined areas of high signal on T2-weighted sequences. These findings may persist for months after resolution of symptoms. In contrast to lesions with ill-defined reticular margin, well-defined subchondral lesions have about 50% likelihood of progressing to focal cartilage loss.<sup>13,14</sup>

**OTHER OSTEOCHONDROSES AND OSTONECROSES**

Other common locations for osteochondroses and osteonecrosis in the foot include the tarsal navicular or Köhler disease and head of second or third metatarsal or Freiberg infraction.

Köhler disease is an abnormality of endochondral ossification. Clinical presentation includes swelling, erythema, and tenderness along the

medial foot. It is more commonly seen in boys between 3 and 10 years if age and may be bilateral in up to 25%. Diagnosis is based on clinical and radiographic findings, which shows sclerosis and fragmentation of the navicular ossification center.



**Fig. 2.** Multifocal osteonecrosis. (A) Coronal T1-weighted image in patient status posttherapy for leukemia, showing focal ill-defined loss of normal marrow signal in talus (arrow) and calcaneus (white arrow) adjacent to the posterior subtalar facet. Bone infarct is seen in the distal tibia (black arrow). (B) Coronal T2-weighted fat-suppressed image shows increased signal at those areas in talus (arrow) and calcaneus (long arrow) and infarct in the distal tibia (short arrow).

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