Acute right ankle pain in a 9-year-old boy without history of trauma

V. Appiah¹ · G. Boitsios¹ · O. Vander Elst¹ · Paolo Simoni¹

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Diagnosis

Normal variant of distal tibial epiphysis.

Discussion

Before growth plate closure, distal tibial physis is visible on MRI as a trilaminar structure including a high signal epiphyseal layer (physeal hyaline cartilage); an interposed hyposignal layer corresponding to the mineralized provisional calcification zone; a high signal metaphyseal layer (metaphyseal spongiosa) (Fig. 2a) [1, 2]. As the tibia matures, the growth plate evolves from a flat to an undulated tridimensional structure [3]. Four main undulations (humps and valleys) are almost constantly observed in the distal tibial physis [4]. A hump is defined as a peak of the growth plate toward the metaphysis, whereas a valley is defined as a peak of the growth plate toward the epiphysis.

The most known and prominent undulation is known as “Kump’s hump” (also known as Poland’s hump). “Kump’s hump” is typically located anteriorly just above and anterior to the medial malleolus. It appears during the first 2 years of life [3, 4]. The second constant hump is located posteriorly and laterally [4]. In addition, two anatomically, and relatively constant, valleys have also been described in between the above-mentioned humps [4]. The anterior valley extends centrally into the epiphysis and it is located just lateral to “Kump’s hump,” whereas the posterior valley is visible just behind Kump’s hump. Unlike Kump’s hump,

the other humps and valleys are inconstant and smaller in size.

This complex anatomical appearance has recently been described by Nguyen et al. based on the 3D modelling of computed tomography images [4]. Moreover, the distal tibial growth plate presents a peculiar pattern of physeal closure, which simulates bone bridge formation: unlike the typical pattern of closure starting centrally and extending peripherally in many larger physes, closure in the distal tibial physis starts medially from Kump’s hump and progresses posteriorly and laterally [1, 5]. This should be considered to distinguish pathological findings from normal variants in young individuals to avoid overcalling fractures and other pathological conditions. The awareness of the characteristics of the growth plate is also essential in cases of distal tibial trauma to guide the orthopedic surgeon to safe areas for metaphyseal screw placement without hampering the growth plate [4].

In our case, radiographs show an irregular growth plate with a metaphyseal extension protruding downward, confirmed by MRI. The prominent medial extension of the metaphysis toward the epiphysis corresponds to a “deep anterior valley.” However, our case was particularly tricky because MRI also revealed the presence of a bone bridge located posteriorly. A bone bridge is a physeal bar formation that develops between the epiphysis and metaphysis, and restricts bone growth. The most common causes are trauma and infection. However, in some cases, physeal bar formation can be of unknown etiology [6]. Most often these bone bridges are seen on imaging as protrusions from the physis into the metaphysis and not the other way round, as in our case. The nontraumatic context and the knowledge of the developmental anatomy of the physis clarify this bone-bridge as being idiopathic.

Another confounding finding was a hyperintense focus overlying the anterior valley on the fluid-sensitive sequence, corresponding to residual red marrow. The latter is not an uncommon finding in the pediatric population. It is described in literature as “flame-shaped” areas in the

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✉ Paolo Simoni
paoloemiliosimoni@gmail.com

¹ Queen Fabiola Children’s University Hospital, Université Libre de Bruxelles, Brussels, Belgium

metaphysis of young children and normally disappears by early adulthood. Differentials include red marrow hyperplasia in stress situations and neoplastic replacement. However, a higher signal intensity compared with muscle on T1-weighted imaging, feathered margins, red marrow with a central focus of yellow marrow (“bull’s eye”), bilateral occurrence, and a lack of mass effect are often criteria of benignity [7, 8].

Taking together the nontraumatic history, the metaphysis peaking toward the epiphysis, and the normal surrounding soft tissue, the above MR images have no pathological significance and should not be overcalled as a fracture.

Compliance with ethical standards

Conflicts of interest The authors declare that they have no conflicts of interest.

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