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Rare anterior nutrient foramen of the tibia in an adolescent with shin pain

Charles Rawson, MD, and Joseph Robinson, MD

Nutrient foramina are normal anatomic structures that typically appear linear on radiographs and can therefore mimic fractures. When seen *en face*, they may appear rounded or ovoid. The interpreting radiologist must be aware of the typical location and appearance of the various nutrient foramina to avoid misdiagnosing them as osseous pathology, such as fractures or lytic bone lesions. We present a case of a rare anterior tibial nutrient foramen in an adolescent patient with anterior shin pain. We also review the literature on location of tibial nutrient foramina, and discuss the potential for misdiagnosing these foramina as a pathologic finding.

Case report

A 13-year-old male presented to an outpatient pediatric clinic with pain in the anterior aspect of the proximal-to-mid-left tibia. He reported pain that began at night, but was present both during the day and night and was relieved by NSAIDs. He reported playing tennis for 2 hours a day, 3 days a week. He denied any trauma or constitutional symptoms. Radiographs of the tibia and fibula (Figs. 1A and B) showed a small, ovoid radiolucent focus in the anterior proximal third of the left tibia, centered within the cortex, with adjacent subtle cortical sclerosis along the anterior tibia.

Based on the clinical and radiographic findings, an osteoid osteoma was suspected, and CT of the tibia and fibula was ordered to confirm the diagnosis, targeted to the area of abnormality of the left proximal tibia. The CT showed a low attenuation focus at the anterior tibial cortex that appeared to communicate with the anterior subcutaneous tissue. There was subtle sclerosis along the anterior tibial cortex adjacent to this low attenuation focus (Fig. 2).

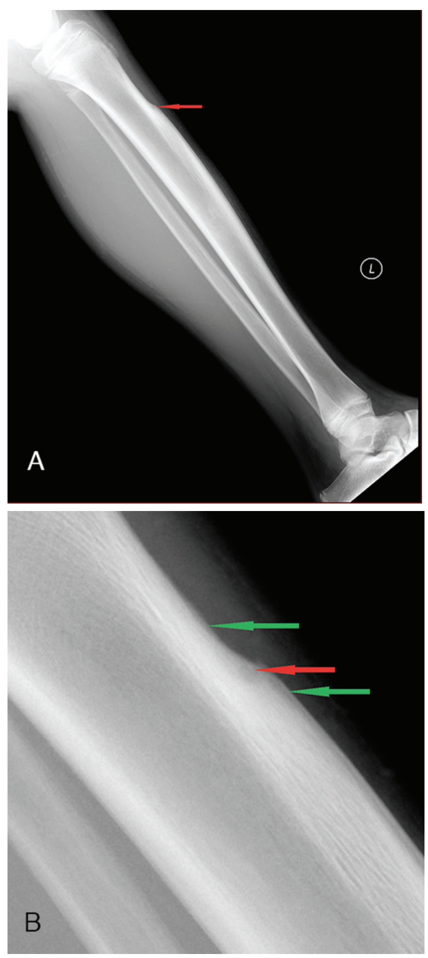

Fig. 1. A. Lateral radiograph of the left tibia and fibula showing a lucent lesion (arrow) of the anterior tibia with subtle adjacent sclerosis and smooth periosteal reaction. B. Magnified lateral radiograph of the left tibia and fibula showing a lucent lesion (red arrow) of the anterior tibia with subtle adjacent sclerosis and smooth periosteal reaction (green arrows).

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The authors are both in the Department of Imaging, Cedars-Sinai Medical Center, Los Angeles CA. Contact Dr. Rawson at charles.rawson@cshs.org.

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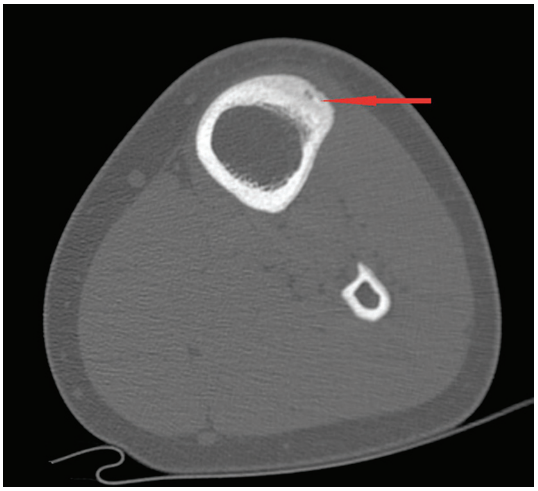

Fig. 2. Axial CT through the proximal third of the left tibia shows subtle sclerosis (arrow) and periosteal reaction adjacent to an anterolateral vascular channel.

The right tibia was compared to the left on CT; it also showed a low attenuation focus in the identical location—identical to that seen on the left, aside from the lack of adjacent cortical sclerosis (Figs. 3 and 4).

The patient was referred to an orthopedic surgeon; an MRI demonstrated bone marrow edema and heterogeneous signal in the proximal tibial shaft, but no fracture line (Fig. 5). A technetium bone scan showed diffuse uptake in the proximal left tibia (Fig. 6). Based on work up to that point, a differential diagnosis of bone tumor versus stress response was considered, and the patient underwent a percutaneous, CT-guided biopsy of the abnormal bone marrow (Fig. 7).

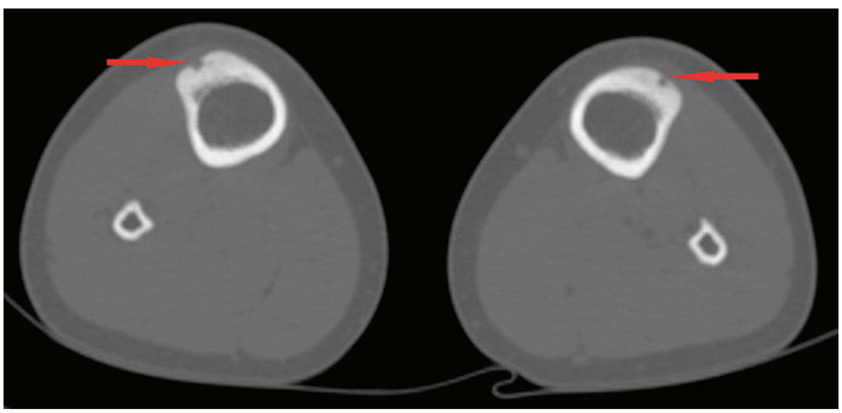

Fig. 3. Axial CT through the proximal third of the bilateral tibias shows symmetric prominent vascular channels of the anterolateral tibias (arrows).

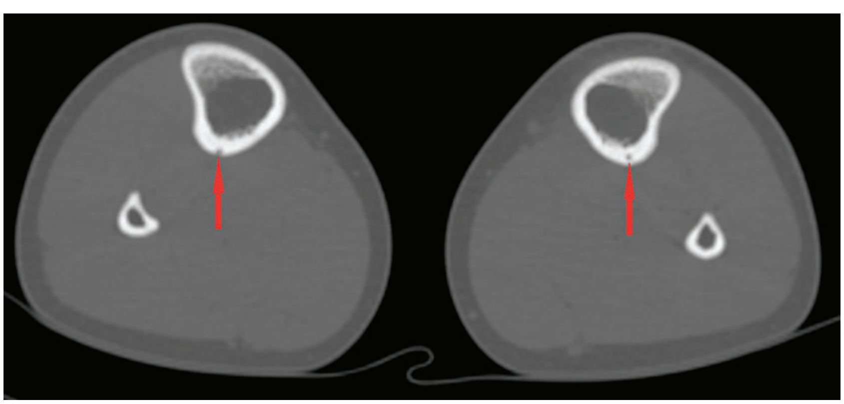

Fig. 4. Axial CT through the proximal third of the bilateral tibias showing the normal posterior nutrient formina of the tibia (arrows).

Fig. 5. Sagital T2, fat-saturated TSE MRI (TR 2170 ms, TE 75 ms) showing bone marrow edema and heterogeneous signal in the proximal left tibial shaft (arrow).

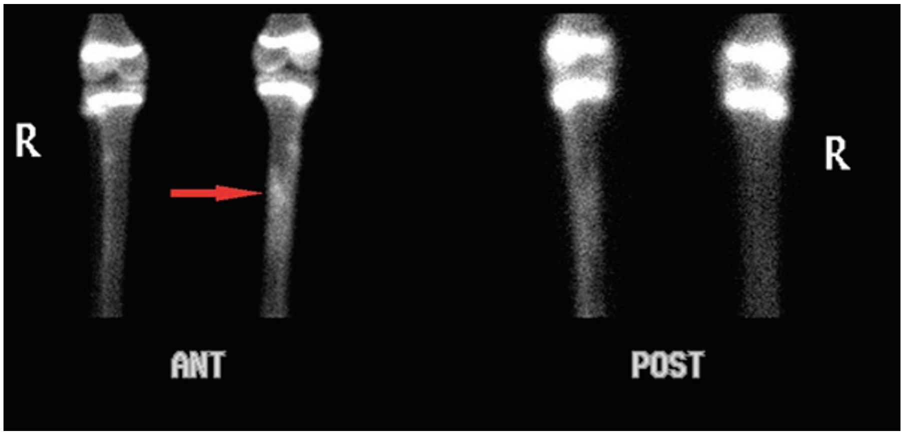

Fig. 6. Technetium 99-m bone scan showing diffuse uptake in the proximal left tibia (arrow).

Biopsy specimens showed predominantly peripheral blood elements and an organized blood clot with scattered, partially viable bone shards. No malignancy was identified. The organizing clot was thought to be consistent with an area near a fracture or hematoma site, and a presumptive

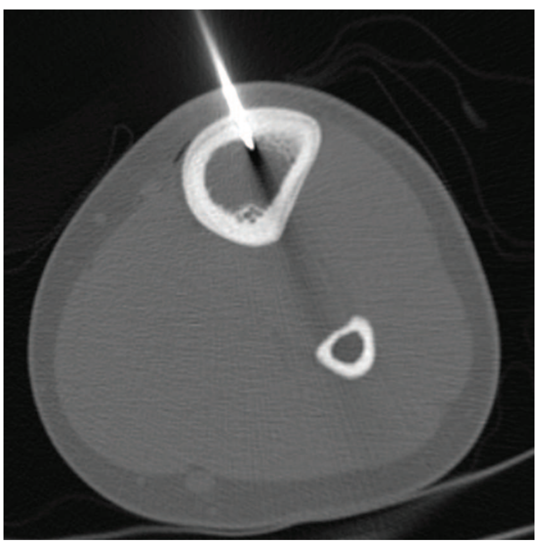

Fig. 7. CT-guided biopsy of the left tibia.

diagnosis of stress response or stress fracture was made. The patient was asymptomatic after biopsy was performed. Followup MRI was planned for 3 months after the biopsy.

Discussion

The blood supply of long bones is derived from nutrient arteries (usually 1 or 2) that pierce the shaft of the bone obliquely through nutrient foramina (1). These foramina usually angle away from the dominant growing end of the bone (1). The typical location of a linear lucency, which angles away from the knee, should lead to the correct assessment of a tibial nutrient foramen (1, 2). This can be remembered by the following rhyme: "to the elbow I go, and from the knee I flee."

In a review of 100 tibiae, Kizilkanat et al found that 99 had a nutrient foramen on the posterior surface, and 1 had a nutrient foramen on the medial surface (3). Only two of the tibiae had two nutrient foramina, and these occurred only on the posterior surface (3). We could find no literature reports of an anterior tibial nutrient foramen such as the one we report here.

As a nutrient foramen is a defect in cortical bone, it forms a potential site of weakness (1). When there is increased stress from increased physical activity (fatigue) or decreased quality of bone (insufficiency), longitudinal stress fractures may form either from the foramen itself, or close to it (1, 3). This is most common in the tibia, although these fractures may occur in the femur, patella, and fibula as well (3). As demonstrated by this case, the most common abnormality on conventional radiographs is reactive callus formation, with periosteal and endosteal reaction being universally present on CT and MRI (4). The classic finding of stress fracture on nuclear bone scan is focally intense, fusiform cortical uptake, as was seen in this patient (5). The definitive imaging diagnosis of a stress fracture is visualization of the fracture line, for which CT is more sensitive than MRI (82% vs. 73%) (4).

Nutrient foramina can be mistakenly diagnosed as nondisplaced fractures on conventional radiographs, as their appearance is typically linear. However, when they are seen *en face* on radiographs, as in this case, they may appear round or ovoid. The unusual anterior location of the tibial nutrient foramen reported in this case, appearing as an ovoid lucency in the cortex, led to an initial misdiagnosis as osteoid osteoma. Further imaging with CT revealed the true etiology of this ovoid lucency as a nutrient foramen. Opening the field of view of the CT and comparing the two tibiae was essential for diagnosis. This case demonstrates that when an osteoid osteoma is suspected on radiographs, a confirmatory diagnostic CT should be obtained before proceeding with radiofrequency ablation or surgical resection.

In summary, it is important for radiologists to know the common locations of nutrient foramina to avoid misdiagnosing them as pathology. Our case illustrates an unusual tibial nutrient foramen that is located anteriorly. To our knowledge, such a normal variant has not been previously reported in the medical literature. In this case, the combination of the unusual location of the nutrient foramen and adjacent tibial stress reaction mimicked an osteoid osteoma.

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