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Review Article

Imaging findings of various talus bone tumors—clinico–radiologic features of talus bone tumors☆

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ABSTRACT

Osseous neoplasms of the foot are uncommon, accounting for only 3.3% of all primary bone tumors. Bone tumors of the talus are even rarer, and there are not many publications that comprehensively evaluate the imaging findings of talus tumors. The purpose of this article is to review the benign and malignant bone tumors affecting this uncommon site and to describe the clinical and radiologic features of each tumor.

1. Introduction

Bone tumors of the feet account for approximately 3% of all osseous tumors, and the incidence of bone tumors of the talus has been reported between 8% and 23% in tumors of the feet [1]. The rarity of these lesions can make it difficult for radiologists to limit the number of possible diagnoses. Although some bone tumors of the talus demonstrate characteristic imaging features, many have nonspecific characteristics, therefore making them difficult to diagnose. Familiarity with the imaging features and clinical presentations of bone tumors that are found in the talus helps to narrow the differential. Several talar lesions may present with atypical clinical findings compared to the same lesion in other parts of the skeleton. For example, osteoid osteoma (OO) in the talus is typically intraarticular or periarticular in location and may present as an inflammatory arthropathy or ankle impingement [2–6]. Computed tomography [CT] and MRI may be helpful in tumor characterization. Both are accurate at depicting intralesional fat and fluid, but CT is more accurate at detecting mineralization. The detection of fluid levels in an expansile talar bone lesion is highly suggestive of an aneurysmal bone cyst (ABC), although fluid levels may also be seen in other lesions including giant cell tumor and chondroblastoma. Perilesional marrow edema might suggest a sarcoma, but this is not uncommon with several benign lesions including OO, osteoblastoma, and chondroblastoma [7].

1.1. Benign bone tumors of the talus

1.1.1. Osteoid osteoma

OO is a common benign bone tumor most frequently located in the lower extremity in the meta-diaphyseal region of long bones in younger individuals. OO comprised 35% of all biopsied benign tumors of the foot, and the talus is the most commonly affected site [1,8,9]. Long-bone OO occurs most often in an extraarticular, intracortical location, usually associated with a prominently solid periosteal reaction. However, juxta-articular, subperiosteal, OOs arising around the talar neck tend to have minimal or absent periosteal reaction due to the lack of functional periosteum within the joint and have an atypical presentation such as joint stiffness, synovitis, or other intraarticular abnormality because of their proximity to the joint [4–6]. Occasionally, OO in the neck of the talus can mimic anterior ankle impingement presenting with restriction of ankle movement and pain [10]. The typical night

Abbreviations: MRI, Magnetic resonance imaging; CT, Computed tomography; T1WI, T1-weighted image; T2WI, T2-weighted image; PDWI, Proton density-weighted image; Gd, Gadolinium; DTPA, Diethylenetriaminepentaacetic acid; 3D, Three-dimensional; STIR, Short tau inversion recovery; SPAIR, SPectral Attenuated Inversion Recovery; ^{99m}Tc DPD, ^{99m}Technetium-dicarboxypropane diphosphonate; FDG-PET, Fluorodeoxyglucose-Positron Emission Tomography.

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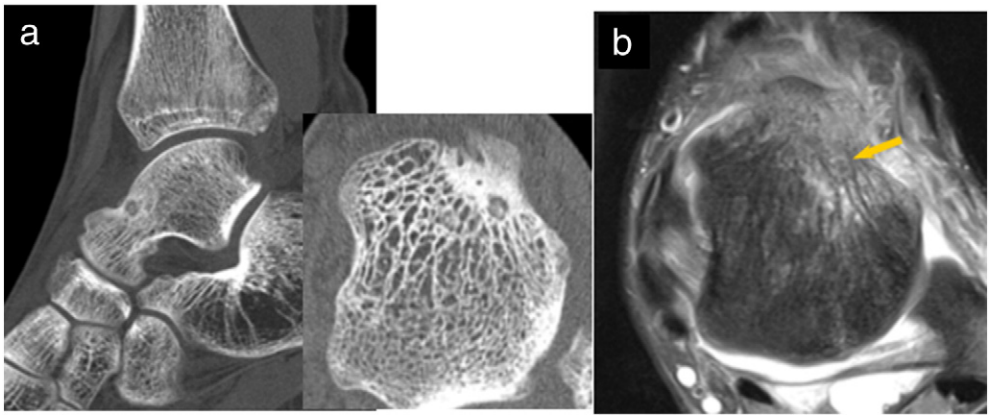

Fig. 1. A 23-year-old man with OO. (**a**) Sagittal CT image typically shows a focally lucent nidus within surrounding sclerotic reactive bone. A tiny, central focus of calcification is seen also. (**b**) Axial proton density image with fat suppression (3650/27) image shows a nidus of intermediate signal intensity (arrows) with associated medullary edema.

pain and response to nonsteroidal antiinflammatory drugs may be absent. The pathognomonic findings of OO on CT are considered as the gold standard and with the classic appearances of a low-attenuated, nonmineralized portion of the nidus with focal central calcification and peri-nidal sclerosis having been well-described. Although MRI is certainly sensitive, it is nonspecific, often unable to identify the nidus. The hyperemia and resultant extensive bone marrow edema pattern may result in the scans being misinterpreted as other pathology. The signal intensity of the nidus is variable on all sequences as is the degree of contrast enhancement (Fig. 1) [2,3,11].

Fig. 2. A 30-year-old man with chondroblastoma. (**a**) CT images show a well-marginated, osteolytic mass in the talus. Cortical thinning at the talar dome and punctate chondroid calcifications are seen. (**b**) Coronal spectral attenuated inversion recovery, T2-weighted (2373/60) image demonstrates a well-defined margin and a dark-signal-intensity sclerotic rim. The mass is mainly solid but contains some multiseptated cystic portion. (**c**) On a fat-suppressed gadolinium-enhanced coronal T1-weighted (523/23) image, the solid portion of the mass shows relatively homogeneous hyper-enhancement, and the cystic portion shows thin septal enhancement. Reactive bone marrow edema in the talus is also noted.

1.1.2. Chondroblastoma

Chondroblastoma favors an epiphyseal or subarticular location, which accounts for the high incidence in the subarticular regions of the talus and calcaneus and calcaneal apophysis in foot [7]. It is reported that only 4% of chondroblastomas arise in the talus [12–14]. In talus, it tends to be affect in the third decade rather than the second decade with more proximal lesions [7]. Radiographically, lesions are typically radiolucent, oval to round, with well-defined, often sclerotic margins, and mineralization can be present in up to 54% (Fig. 2). On MRI, lesions are typically inhomogeneous, and surrounding marrow edema is common. Chondroblastoma is frequently associated with an ABC. In this case, imaging analysis suggests that the lesion is either a primary ABC or chondroblastoma with secondary ABC, the latter of which should contain a solid component that shows low signal on T2-weighted magnetic resonance [MR] images or presence of mineralization on CT, although the definite differentiation is dependent on histopathological examination (Fig. 3) [12,15–17].

1.1.3. Intraosseous ganglion cyst

Intraosseous ganglion cyst is a benign, nonneoplastic bone lesion which contains mucoid viscous material but no epithelial or synovial lining. Pollandt et al. reported that intraosseous ganglion cysts are the most common tumors and tumor-like lesions in the talus [18]. On imaging, the intraosseous ganglion appears as a well-defined osteolytic lesion located near a joint. Most intraosseous ganglia are small, between 1 and 2 cm in maximum diameter (Fig. 4) [19].

1.1.4. Fibrous dysplasia (FD)

FD is a developmental anomaly in which osteoblasts fail to undergo normal morphologic differentiation and maturation and, thus, leading to the replacement of normal marrow and cancellous bone by immature bone and fibrous stroma [20]. It may affect a single bone (monostotic) (Fig. 5) or multiple bones (polyostotic) (Fig. 6), with the majority being monostotic. FD usually affects the long bones with the majority found in the femur, tibia, rib, and facial bone, and it is uncommon in the tarsal bones, including the talus [7,21]. On radiograph or CT, the lytic lesion in the metaphysis or diaphysis may appear the typical ground-glass appearance which results from the poorly oriented trabecular bone. On T2-weighted MR images showed variations of signal intensity, while TI-weighted MR images showed a homogeneously hypointense signal. The signal intensity [SI] and the degree of contrast enhancement depend on the amount and degree of bony trabeculae, cellularity, collagen, and cystic and hemorrhagic changes [22]. FD typically