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Multimodality Imaging of a Patient with Intra-Articular Osteoid Osteoma: A Case Report

Lin J, MD[1] | Salibian R, MD[1]

Author Affiliation: [1]Department of Radiological Sciences, David Geffen School of Medicine at UCLA

Corresponding Authors: J.L. (jolin@mednet.ucla.edu)

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Abstract: Osteoid osteoma is a benign bone-forming tumor with characteristic clinical and imaging features. Clinically, patients present with pain at the site of the tumor, worsening at night and relieved by nonsteroidal anti-inflammatory drugs. The typical imaging features of osteoid osteoma include a round or oval intracortical radiolucent lesion with surrounding cortical thickening and reactive sclerosis. However, intra-articular osteoid osteoma often has imaging and clinical features that deviate from those of osteoid osteoma, which may result in delayed diagnosis. We report a case of intra-articular osteoid osteoma in a 20-year-old woman with a history of ankle pain. The variant clinical and imaging characteristics of intra-articular osteoid osteoma and the important considerations for the treatment of patients with this condition are briefly discussed.

Keywords: *osteoid osteoma, osteomyelitis, osteonecrosis, stress fracture*

Key Points

- Intra-articular osteoid osteoma is a benign bone-forming tumor that occurs within or near a joint and manifests itself in nonspecific joint-related symptoms.
- On imaging, intra-articular osteoid osteoma shows a lesser degree of or no cortical thickening and reactive sclerosis than the extra-articular forms of the tumor.
- Knowledge of the characteristic clinical and imaging features of intra-articular osteoid osteoma can prevent both diagnostic errors and delay in diagnosis and management.

Case Presentation

A 20-year-old woman with a history of ankle sprain presented with progressively worsening right ankle pain and difficulty weight-bearing for 6 months. Initial radiography of the ankle did not show fracture, arthritic change, or an obvious bone or soft tissue mass (Figure 1). Subsequent magnetic resonance imaging (MRI) of the ankle showed a region in the dorsal talar neck with an irregular low-intensity signal and surrounding bone marrow edema-like signal intensity on both fat-sensitive and fluid-sensitive sequences (Figure 2). The proposed diagnoses at this time included a healing stress fracture and osteomyelitis of the talus secondary to avascular necrosis. Consultation with a podiatric surgeon prompted additional ankle imaging, including three-phase bone scintigraphy with technetium Tc 99m medronate and a noncontrast computed tomography (CT) study of the ankle. All three phases of bone scintigraphy showed intense focal and faint peripheral increase in radiotracer uptake (double-density sign) (Figure 3) in the region of the talus. The diagnoses healing stress fracture and osteomyelitis of the talus remained unchanged based on the results of imaging studies at the time. Subsequent noncontrast CT showed a small radiolucent lesion with minimal adjacent, irregular osseous sclerosis in the dorsal talar neck (Figure 4). Osteoid osteoma was finally suggested as the most likely diagnosis. During re-examination, the patient confirmed that the pain in the region of the tumor definitely worsened at night and was significantly relieved by

nonsteroidal anti-inflammatory drugs (NSAIDs). Simultaneous CT-guided bone biopsy and radiofrequency ablation (RFA) of the tumor were performed, with complete resolution of pain in the patient's ankle. Histopathologic analysis confirmed the diagnosis of osteoid osteoma.

Figure 1. Initial Radiography of the Ankle of a 20-Year-Old Woman with a 6-Month Experience of Progressively Worsening Pain in the Right Ankle.

The radiograph shows a lateral view of the right ankle. No fracture, arthritic change, or obvious bone or soft tissue mass are seen.

Discussion

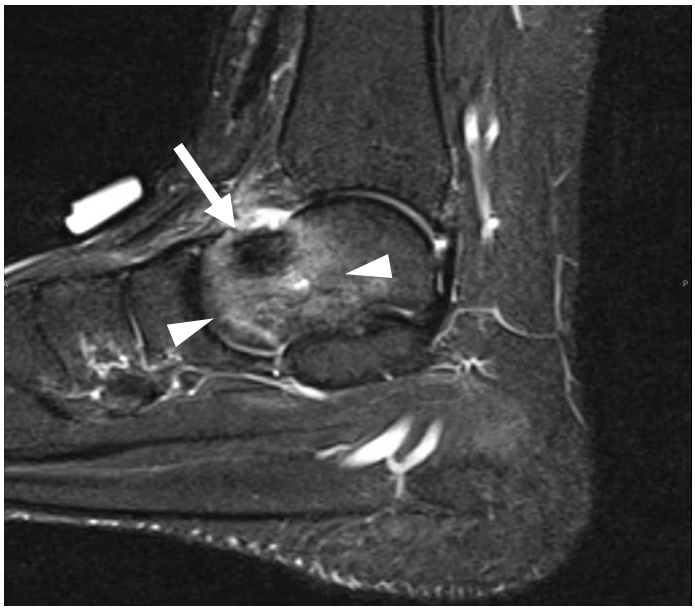
Osteoid osteoma is a relatively common (10%-14% of all benign tumors), benign, bone-forming tumor that usually affects people (mostly males) aged 5 to 30 years.[1] Typically, these tumors are located in the cortex of a long bone, such as the femur or the tibia, and are associated with the classic clinical presentation of pain that worsens at night and is relieved by NSAIDs.[1,2] Radiographic imaging usually shows a small (< 2 cm) round or oval cortically-based radiolucent lesion or nidus that represents the tumor and may have variable degrees of internal osteoid mineralization.[1,2] Surrounding cortical thickening and sclerosis are also characteristic features of this form of benign bone tumor.[1,2]

Computed tomography, MRI, and bone scintigraphy are commonly used for the evaluation of patients with bone pain to assist in making an accurate diagnosis of osteoid osteoma.[1] Computed tomography is the best imaging modality to identify the radiolucent nidus of an osteoid osteoma.[1,2] The surrounding cortical thickening, reactive sclerosis, and specific for osteoid osteoma "vascular groove" sign are well demonstrated by CT.[1-3] On standard MRI sequences, small nidi of intracortical lesions often have signal intensity similar to that of the adjacent cortical bones and are therefore less conspicuous and extremely difficult to identify.[2] On T1-weighted images, the nidus has a low-to-intermediate signal intensity; however, on T2-weighted images the nidus shows variability in signal intensity that increases with a lesser degree of nidus matrix mineralization.[2,4] Yet, according to Tepelenis et al,[1] MRI is an excellent modality for viewing nidus of intra-articular tumors. In addition, dynamic contrast-enhanced MR sequences and chemical shift MRI are exceptionally helpful in making an accurate diagnosis of osteoid osteoma.[4] In particular, in the arterial phase, dynamic contrast-enhanced MRI shows characteristic enhancement of a highly vascularized tissue within the nidus, more intense than that of the adjacent bone marrow.[4] On chemical shift MRI, the nidus area shows a characteristic preservation of signal intensity in both phases.[4] Furthermore, MR imaging is efficient in showing the surrounding cortical thickening and reactive sclerosis and in evaluating both preprocedural and postprocedural conditions of the associated bone marrow and soft tissue edema.[2,4,5] On bone scintigraphy, the nidus shows increased radiotracer uptake that manifests as the "double-density" sign, explained by the presence of an area of intense focal radiotracer uptake surrounded by an area with a less dense uptake.[1,3] This characteristic feature of osteoid osteoma can help distinguish this entity from osteomyelitis.[3] Although radiographic examination of our patient did not show specific signs of osteoid osteoma, the use of other imaging modalities, MRI, CT, and bone scintigraphy, provided us with findings similar to those described above, typical of osteoid osteoma.

Figure 2. Magnetic Resonance Imaging of the Ankle of a 20-Year-Old Woman with Intra-articular Osteoid Osteoma.

A T1-weighted image, sagittal view

B Short tau inversion recovery (STIR) image, sagittal view



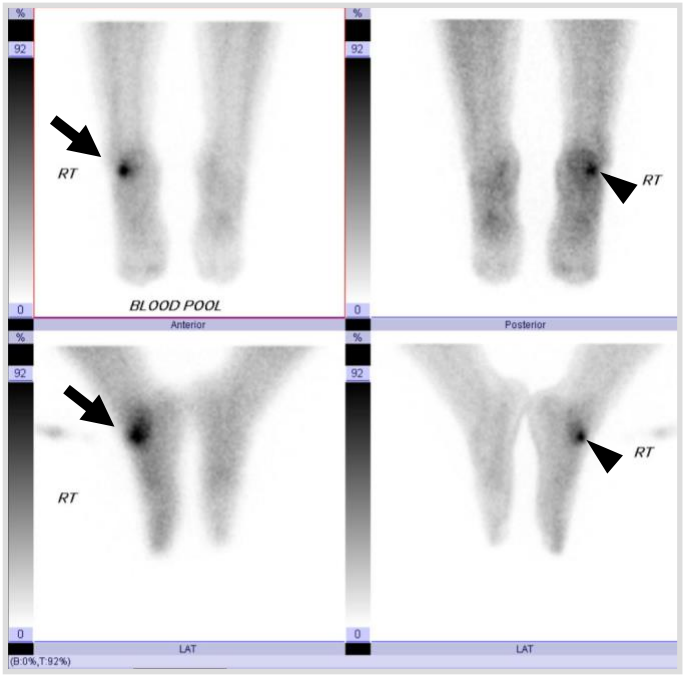
(A) T1-weighted image, sagittal view and (B) short tau inversion recovery (STIR) image, sagittal view, show an irregular hypointense focus (A and B, arrows) in the dorsal talar neck. This corresponds with the area of irregular sclerosis seen on a subsequently performed ankle CT (Figure 4) at this site. Bone marrow edema-like signal intensity (B, arrowheads) is seen around the area of sclerosis.

Accurate diagnosis of intra-articular osteoid osteoma may be delayed because the lesion often does not show the typical clinical and imaging features of osteoid osteoma.[2,5,6] Intra-articular osteoid osteomas occur within or near the joints[5-7] and most commonly affect the hip joint, but have also been reported in the ankle, the elbow, the knee and the wrist.[2,6,7] Clinically, this tumor manifests itself in nonspecific joint-related symptoms, such as pain, swelling, joint effusion, and limited range of motion.[2,6,7] These clinical findings, also seen in patients with different forms of inflammatory arthritis, can lead to diagnostic errors and delayed diagnosis.[5-7] Patients with intra-articular osteoid osteomas less commonly describe the characteristic for extra-articular osteoid osteoma pain that worsens at night and is relieved by NSAIDs.[2,5,6]

On imaging, intra-articular osteoid osteoma typically shows a lesser degree of or no cortical thickening and reactive sclerosis, and thus deviates from the imaging appearance of the extra-articular forms of the tumor.[2,5] The sagittal view of our patient's affected ankle on CT (Figure 4) shows some reactive sclerosis surrounding the radiolucent nidus in the talus, but no cortical thickening. This atypical appearance of osteoid osteoma, coupled with nonspecific joint pain, can also lead to diagnostic errors and delayed diagnosis and management.

Although in some histologically unconfirmed cases osteoid osteoma was observed regressing spontaneously while being managed conservatively, in most cases, interventional treatment is warranted to prevent patients' continuous experience of pain, harmful effects of the prolonged use of NSAIDs, and a potential development of a deformity of the affected bone or synovitis of the affected joint and/or impaired mobility.[1,8] Surgical treatment includes en bloc resection and curettage; however, more recently, minimally invasive approaches have become accepted alternative options.[1,8] CT-guided radiofrequency ablation (RFA) of osteoid osteoma is safe and effective,[9] with faster recovery time and lesser bone loss than those associated with an open surgery.[8,10] In particular, RFA has been shown to be effective in treating intra-articular lesions.[9] However, because image-guided RFA of these lesions has a success rate lower than that of

Figure 3. Technetium-Tc 99m-Medronate Bone Scintigraphy of the Ankle of a 20-Year-Old Woman with Intra-articular Osteoid Osteoma.



The scintigram shows intense focal radiotracer uptake (arrows) in the region of the right talus. A double-density sign (arrowheads) is seen as a focal region of intense radiotracer uptake surrounded by the region of more wide-spread increased tracer uptake, typical for an osteoid osteoma.

Figure 4. Computed Tomography (CT) of the Ankle of a 20-Year-Old Woman with Intra-articular Osteoid Osteoma.

CT image, sagittal view, shows a small oval radiolucent nidus (arrow) in the subperiosteal region of the dorsal talar neck. Irregular surrounding reactive sclerosis is seen, corresponding to the hypointense signal seen on MRI (Figure 2). Note the lack of significant cortical thickening that is typically associated with extra-articular but not with intra-articular osteoid osteoma.

an open surgical or arthroscopic excision and may be associated with a substantial radiation load, perioperative or delayed articular damage, and sizeable recurrence and complication rates, the arthroscopic excision may be considered a safer and more effective treatment option.[10]

Conclusion

Intra-articular osteoid osteomas characteristically deviate from the typical imaging and clinical manifestations of extra-articular lesions. This deviation can often lead to diagnostic errors and delayed diagnosis and treatment. In the case reported here, the absence of classic reactive sclerosis along with a less common location of the tumor and nonspecific presentation of joint pain, led to an extensive imaging workup. Both a healing stress fracture and avascular necrosis were suggested based on the nonspecific MRI findings. Osteomyelitis was also considered based on the bone scan. It was not until the CT was performed and a history of the patient experiencing pain relieved with NSAIDs was confirmed that the diagnosis was finally established. In our patient with intra-articular osteoid osteoma, CT played a critical role in assisting to make the accurate diagnosis.

Author Contributions

Conceptualization, R.S.; Acquisition, analysis, and interpretation of data, J.L. and R.S.; Writing – original draft preparation, J.L.; Review and editing, R.S.; Supervision, R.S. All authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Disclosures

None to report.

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