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Osteoid osteoma masquerading tubercular arthritis or osteomyelitis on MRI: Case series and review of literature

Jatinder Pal Singh, Smita Srivastava, Dharmendra Singh[1]

Departments of Radiology, and [1]Orthopaedic Surgery, Medanta-The Medicity, Gurgaon, Haryana, India

Correspondence: Dr. Jatinder Pal Singh, 201, Tower-10, The Close South, Nirvana Country, Sector-50, Gurgaon, Haryana, India.
E-mail: jpsingh@doctors.org.uk

Abstract

Magnetic resonance imaging (MRI) scans for osteoid osteoma could be misleading and can be misinterpreted as tuberculosis, especially when used as the principal modality of investigation. We retrospectively reviewed cases presenting to our institute for second opinion and selected six cases that were referred to our institute with a provisional diagnosis of tubercular arthritis or osteomyelitis and were identified to have osteoid osteoma. We reviewed the literature on typical and atypical clinical and radiological presentations of osteoid osteoma depending upon their location and present radiological features on MRI that should alert the radiologists toward a correct diagnosis.

Key words: Bone tumor; computed tomography; magnetic resonance imaging; osteoid osteoma; tuberculosis

Introduction

Osteoid osteoma is a common benign osteoblastic lesion comprising 10-12% of all benign bone tumors,[1] most commonly seen in the second and third decades of life. Magnetic resonance imaging (MRI) scans for osteoid osteoma could be misleading and can be misinterpreted as tuberculosis (TB), especially when used as the principal modality of investigation.

MRI has become the investigation of choice for the clinicians in larger centers in India, principally due to improved access with the recent economic growth and also due to the impression that MRI is a "superior investigation." TB, being highly prevalent in India, is a common radiological diagnosis in cases where MRI reveals juxta-articular marrow edema and soft tissue high signal. It is important for the clinicians and radiologists to be aware of the similarity in the radiological features of TB and osteoid osteoma on MRI scans to prevent misinterpretation. This could prevent unnecessary biopsy or anti-tubercular treatment (ATT) in patients.

We retrospectively reviewed cases presenting to our institute for second opinion and selected six cases that were referred to our institute with a provisional diagnosis of tubercular arthritis or osteomyelitis, and had been prescribed or had completed a course of ATT for a variable length of time before referral and were identified to have intra- or juxta-articular osteoid osteoma. We reviewed the literature on typical and atypical clinical and radiological presentations of osteoid osteoma depending upon their location and present the features on MRI that should alert the radiologists toward a correct diagnosis.

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Cases

The first patient (patient 1) was a 14-year-old male who presented with a history of night pain in the left hip. He was diagnosed as tubercular osteomyelitis on the basis of MRI findings and had taken a 6 weeks course of ATT before referral to our hospital. The MRI of the patient [Figure 1] showed bone marrow edema in the proximal femur

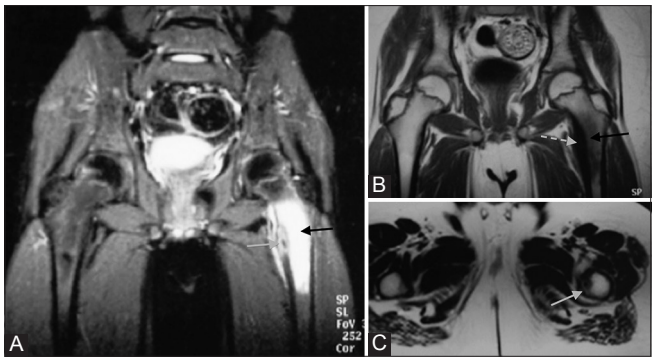

Figure 1: A 14-year-old male referred with a diagnosis of tubercular osteomyelitis of left femur - patient 1 (A-C). (A) Selected coronal STIR, (B) coronal T1 and (C) axial T2-weighted MR images show bone marrow edema within the left femoral neck and proximal shaft (black arrow). Note the thickening of the medial femoral cortex (broken white arrow in B) with edema in the soft tissue adjacent to the femoral neck and a suspicious intracortical osteoid osteoma nidus (solid white arrows in A and C). No significant effusion was identified within the hip joint

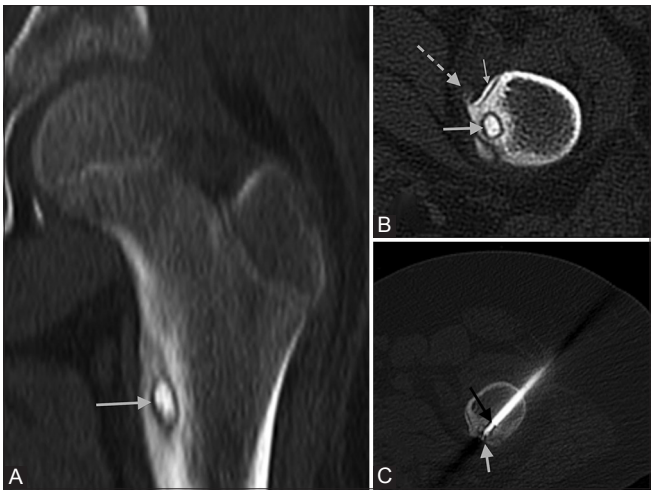

Figure 2: A 14 years old male with osteoid osteoma of left femur - patient 1 (A-C). (A) Reconstructed coronal and (B) axial high-resolution (1 mm). CT images show a nidus (white arrow) within the medial cortex of proximal shaft of left femur with a large central area of calcification and surrounding sclerosis. Note the minimal periostitis (thin white arrow in B) and a small area of linear calcification at the attachment site of iliopsoas tendon (broken arrow in B). (C) Axial CT image shows a Starburst radiofrequency electrode (black arrow) with end-deploying tines (white arrow) within the nidus of osteoid osteoma

on the left side with thickening of the medial femoral cortex. Although no definite nidus could be appreciated, patient history, failure to respond to therapy, and cortical thickening raised the suspicion of an osteoid osteoma. The patient underwent a computed tomogram (CT) [Figure 2] of his left hip joint, which revealed a 6 × 8 × 14 mm nidus with central calcification and associated cortical sclerosis and periostitis. The patient underwent CT-guided biopsy and radiofrequency ablation. The biopsy confirmed osteoid osteoma and the patient has been symptom-free at the recent follow-up after 10 months.

The second case (patient 2) was a 21-year-old male patient who suffered from upper back pain and presented to our hospital with a diagnosis of Pott's spine, and had no response from 8 months of ATT. Examination showed tenderness at T8-T9 level with a C-reactive protein (CRP) of 5.0 mg/l and erythrocyte sedimentation rate (ESR) of 4 mm/h. MRI examination [Figure 3] revealed extensive bone marrow edema in the left T9 transverse process, pedicle, posterior aspect of left T9 vertebral body, and left 9th costotransverse joint. Patient was sent for a CT of thoracic spine [Figure 4], which showed sclerosis and expansion of left T9 transverse process with an intraosseous nidus, highly suggestive of an osteoid osteoma. Patient underwent open surgical excision and biopsy that confirmed the diagnosis of an osteoid osteoma.

The third case (patient 3) was a 14-year-old male who presented with upper back pain persistent throughout the day and was referred to our hospital for a biopsy of an abnormal area of bone marrow edema within T3 lamina, with a diagnosis of TB of spine. The patient had received treatment with ATT for over a week. Review of the external MR images [Figure 5] showed a small nidus that could be appreciated within the lamina of T3 vertebra, along with bony expansion surrounding the bone marrow edema and high signal within the soft tissues around erector spinae muscles. A thin section CT of the dorsal spine [Figure 6] was performed and it revealed a 6-mm intraosseous nidus, with a 2-mm central area of calcification, within the lamina of T3 with bone expansion and surrounding sclerosis. Patient underwent laminectomy in another hospital and the histopathology report confirmed the diagnosis of an osteoid osteoma.

The fourth case (patient 4) was a 24-year-old male who presented with neck pain for the last 2-3 years and an external MRI (not available), which raised the suspicion of tubercular infection with non-specific marrow edema within lamina of C6 and mild syringomyelia. Patient was referred to our hospital for a second opinion, before starting ATT. A repeat MRI was performed as the previous images were not available, and it showed [Figure 7] periarticular bone marrow edema around right C6-C7 facet joint with surrounding soft tissue high signal. On careful review, a subtle 3 mm nidus with a tiny central signal void was suspected in the right C6 inferior articular process. A further CT scan [Figure 8] confirmed the presence of a small subarticular nidus within the right C6 inferior articular process with minimal surrounding sclerosis, consistent with an osteoid osteoma. The patient has opted for non-operative management and is currently on non-steroidal anti-inflammatory drugs (NSAIDs).

The fifth case (patient 5) was a 15-year-old male with right hip pain for 2 months, responding to NSAIDs. He had undergone MRI outside our hospital, which reported the diagnosis as tubercular arthritis. The patient had been

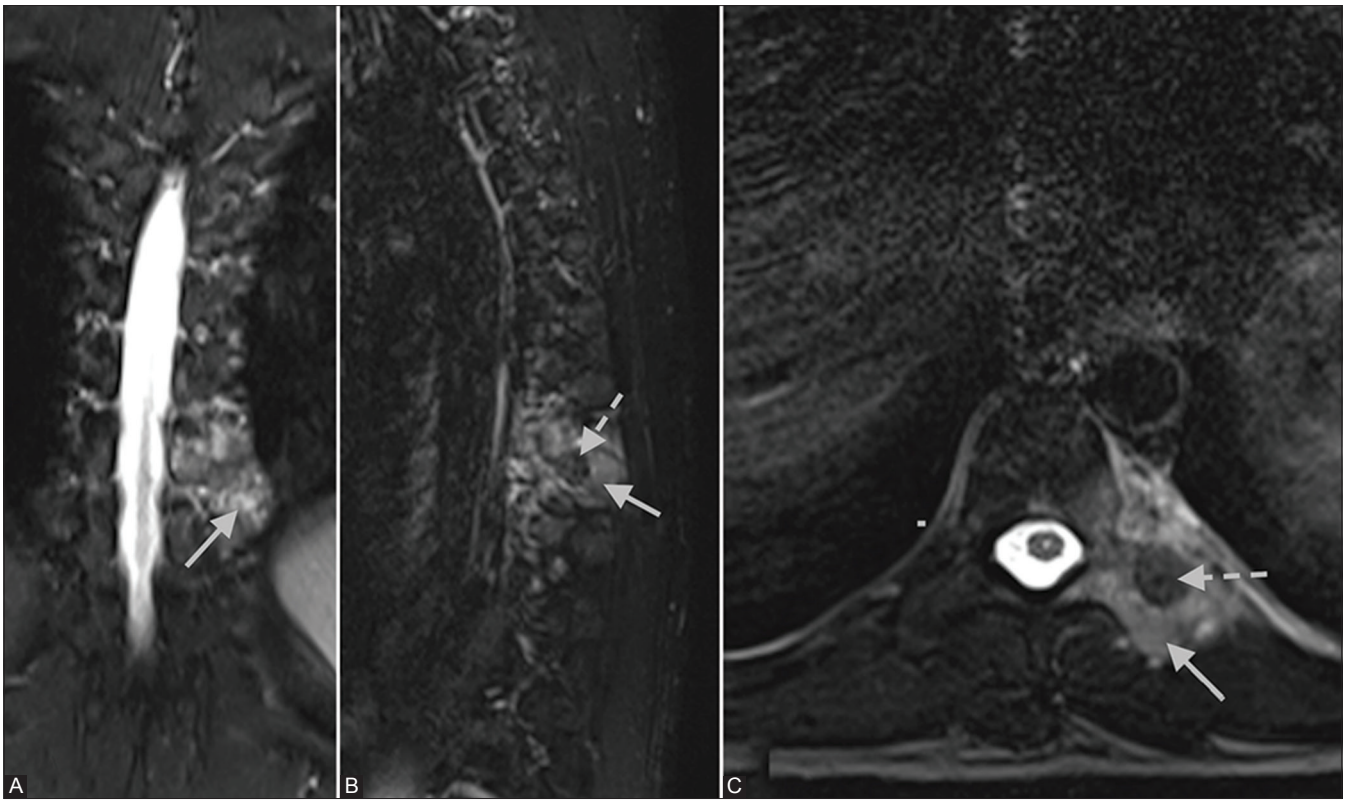

Figure 3: A 21-year-old male with a left D9 transverse process osteoid osteoma - patient 2 (A-C). (A) Coronal STIR (B) sagittal STIR and (C) axial T2 fat-saturated images show bone marrow edema in the left D9 transverse process and costotransverse joint (white arrow). On careful review, an oval hypointense intraosseus lesion (broken white arrow) was identified, which raised the suspicion of an osteoid osteoma nidus

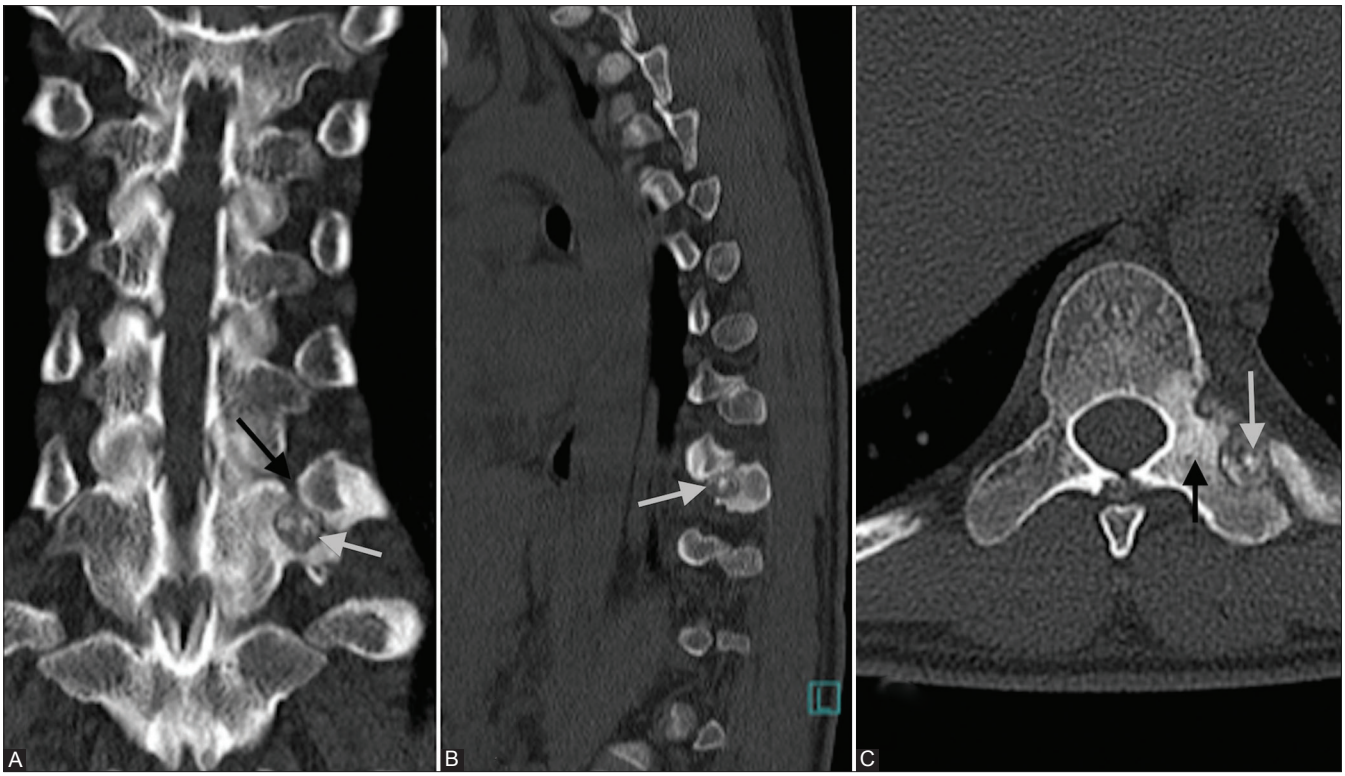

Figure 4: A 21-year-old male with a left D9 transverse process osteoid osteoma - patient 2 (A-C). (A) Coronal, (B) sagittal and (C) axial thin section. CT images show sclerosis and expansion of left D9 transverse process (black arrow in C), pedicle, and the posterior aspect of adjacent vertebrae with a subarticular osteoid osteoma nidus (white arrow) near the costotransverse joint (black arrow in A). The nidus shows heterogeneous areas of calcification with a thin rim of surrounding halo

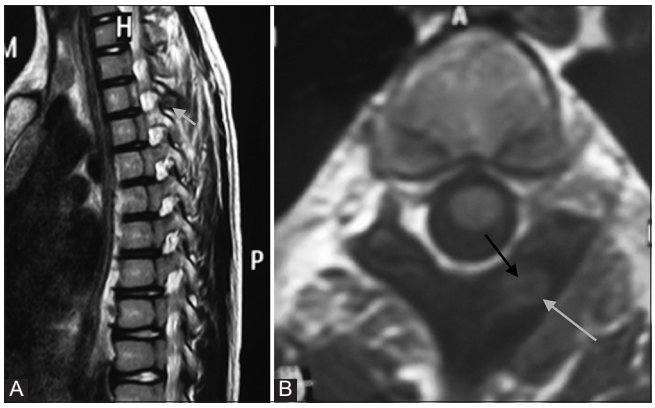

Figure 5: A 14-year-old male referred with a diagnosis of tuberculosis of dorsal spine - patient 3 (A and B). (A) Selected sagittal T2-weighted MR image of dorsal spine and (B) an axial T1-weighted. MR image at the level of D3 vertebra, show an intraosseous T1- and T2-isointense lesion (white arrow) with a central area of low signal intensity (black arrow) within the lamina of D3 vertebra, along with bony expansion and surrounding sclerosis. These MRI findings suggested that this could be an osteoid osteoma nidus, and therefore, the patient was sent for a high-resolution CT scan of the dorsal spine

Figure 6: A 14-year-old male with osteoid osteoma within the lamina of D3 - patient 3 (A and B). (A) Axial and (B) reformatted sagittal, high-resolution (1 mm) CT images show a 6 mm osteoid osteoma nidus (white arrow) with a 2 mm central area of calcification (black arrow) within the lamina of D3, with bone expansion and surrounding sclerosis

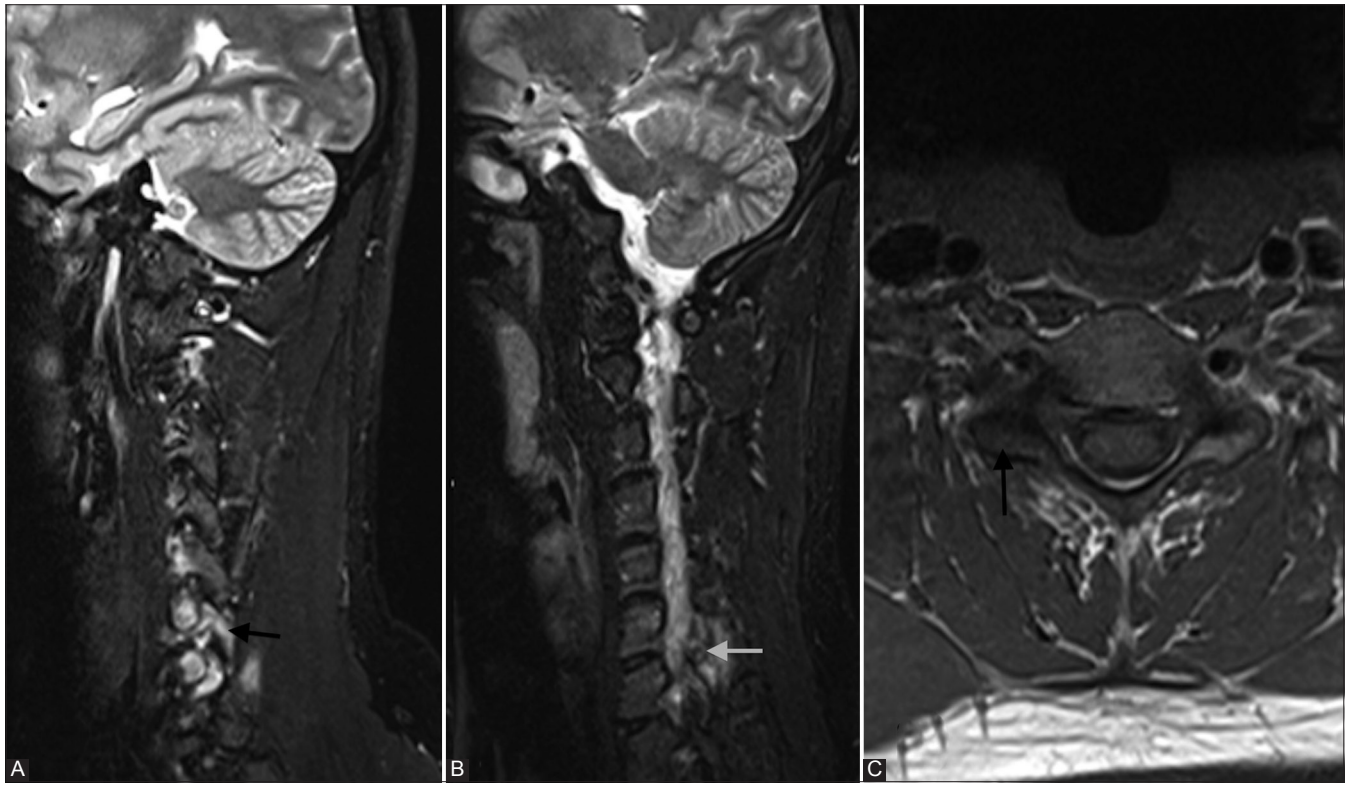

Figure 7: A 24-year-old male with osteoid osteoma lesion within the lamina of C6 vertebra - patient 4 (A-C). (A and B) Selected sagittal STIR and (C) axial T1-weighted MR image, shows periarticular bone marrow edema (black arrow) around right C6-C7 facet joint with surrounding soft tissue high signal. On careful review, a subtle 3 mm nidus (white arrow in B) with a tiny central signal void was identified

taking ATT for 15-20 days before referral. On review of external MRI [Figure 9], an osteoid osteoma was suspected and a CT [Figure 10A and B] was performed, which showed a 6 × 6 × 12 mm juxtacortical nidus in the right femoral neck with associated sclerosis and mild joint effusion. A CT-guided radiofrequency ablation (RFA) [Figure 10C] was performed and the patient remained symptom-free at 20 months follow-up.

The final case (patient 6) was a 20-year-old male who presented with a history of pain in the right elbow with reduced joint movements for 3-4 months. Pain was present

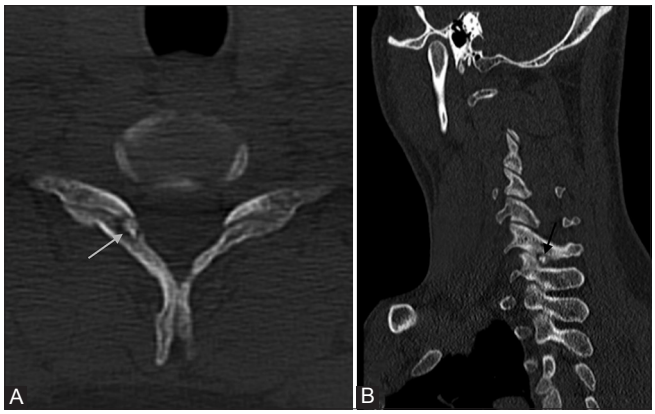

Figure 8: A 24-year-old male with osteoid osteoma lesion within the lamina of C6 vertebra - patient 4 (A and B). (A) Axial and (B) reformatted sagittal oblique, thin section (1 mm) CT images confirm the presence of a small subarticular nidus (white arrow) with central calcification within the right C6 inferior articular process, with minimal surrounding sclerosis, consistent with an osteoid osteoma

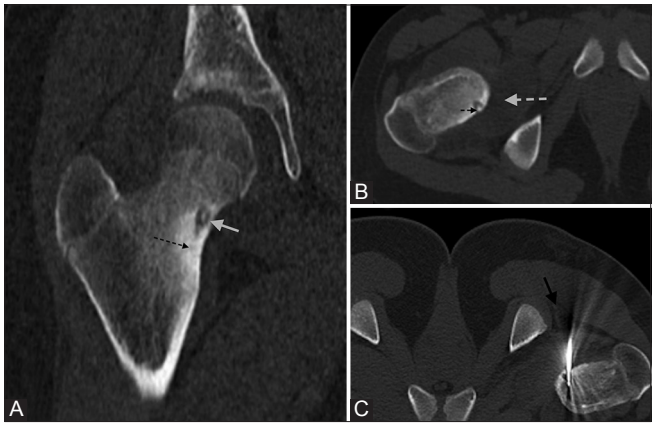

Figure 10: A 15-year-old male with right femoral neck osteoid osteoma - patient 5 (A-C). (A) Reconstructed coronal and (B) axial. CT images show a juxtacortical nidus (white arrow in A) in the right femoral neck with a small eccentric area of calcification and surrounding sclerosis (broken black arrow). Note the associated hypodensity in the adjacent soft tissue (broken white arrow in B) and joint effusion. (C) Axial CT image shows Starburst side-deploying electrode within the nidus with the patient in prone position. Sciatic nerve (solid black arrow in C) was carefully avoided

only at night and was relieved with NSAIDs. Outside MRI suggested an infective lesion, possibly tubercular, within the proximal ulna. The patient presented to our hospital for a biopsy before starting ATT. Review of the external MR images [Figure 11] revealed bone marrow edema within proximal ulna with surrounding soft tissue high signal and joint effusion; however, there remained a suspicion of an osteoid osteoma due to the clinical history. A CT [Figure 12A and B] was performed and it showed a subarticular nidus in the inferior portion of radial notch of ulna, with an eccentric area of calcification and surrounding reactive sclerosis, suggestive of an osteoid osteoma. A CT-guided RFA [Figure 12C] was carried out and the patient has been symptom-free 12 months after the procedure.

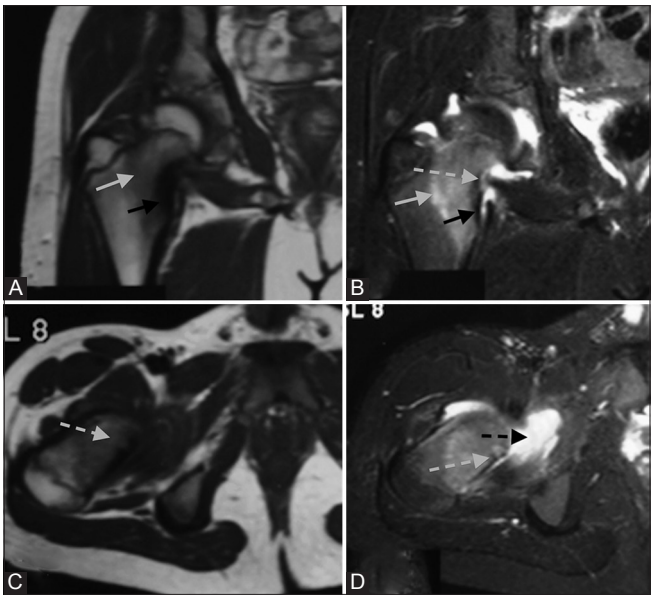

Figure 9: A 15-year-old male with right femoral neck osteoid osteoma - patient 5 (A-D). (A) Coronal T1, (B) coronal STIR, (C) axial T1 and (D) axial STIR. MR images of the right hip joint show bone marrow edema with the femoral neck (solid white arrows in A and B), interpreted as TB osteomyelitis. On careful review, thickening of the medial femoral neck cortex was noted (solid black arrows in A and B) suggesting an intracortical lesion (broken white arrows in B, C, and D), and was suspected to be an osteoid osteoma nidus. Note the synovial effusion within the hip joint (broken black arrow in D)

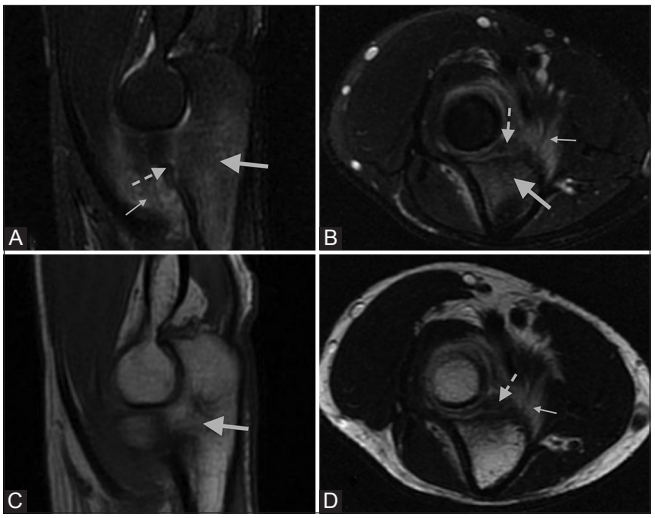

Figure 11: A 20-year-old male with an osteoid osteoma within the radial notch of ulna - patient 6 (A-D). (A) Sagittal STIR, (B) sagittal T1, (C) axial STIR and (D) axial T2-weighted MR images of the right elbow show bone marrow edema within proximal ulna (thick arrows in A, B, and C). This is associated with edema within the adjacent soft tissue (thin arrows in A, C, and D). Note a small focal area of reduced signal intensity on T2 and STIR images (broken arrows in A, C, and D) which raised the suspicion of an osteoid osteoma nidus

Discussion

Osteoid osteoma is a benign osteogenic tumor, usually < 1 cm in size, that accounts for approximately 13.5% of benign

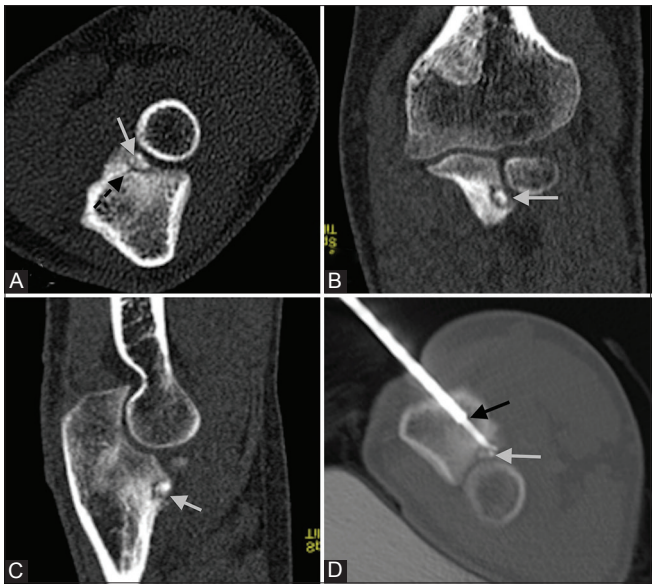

Figure 12: A 20-year-old male with an osteoid osteoma within the radial notch of ulna - patient 6 (A-D). (A) Axial, (B) reconstructed coronal and (C) sagittal. CT images of right elbow with a subarticular osteoid osteoma nidus (white arrow) in the radial notch of ulna, with eccentric calcification, vascular groove (broken black arrow in A), and reactive sclerosis. (D) Axial CT image shows an end-deploying Starburst radiofrequency electrode with its tip (white arrow in D) within the nidus. Note the distal end (black arrow) of the shielded introducer located slightly proximal to the tip of the RF electrode

bone tumors and 2-3% of all primary bone tumors.[2,3] It consists of a central nidus of atypical woven bone[1] enclosed within a well-vascularized stroma. A peripheral sclerotic reactive zone composed of osteoblastic cells, osteoclasts, and dilated capillaries surround the central nidus.

TB is a major cause of skeletal infection in many parts of the world,[4] with involvement of bone and joints accounting for approximately 10-15% of all extrapulmonary forms.[5] There is similarity in the clinical presentation of the patients with osteoid osteoma and musculoskeletal TB, which could lead to confusion. History of nocturnally aggravating and salicylate-responding pain is characteristic of osteoid osteoma.[6] However, less than 2% of patients present with no pain.[7] Spinal lesions may cause painful scoliosis in osteoid osteoma[8] as well as TB.[9] Intra-articular osteoid osteoma produces non-specific clinical symptoms that may mimic inflammatory mono-arthritis[10,11] and confuses diagnosis.[12,13] The effect of anti-inflammatory drugs does not constitute a proof for diagnosis, since they only demonstrate a low efficiency in intra-articular osteoid osteoma.[12] Mean delay between the onset of symptoms and diagnosis of intra-articular osteoma varies from 1.5 to 3.5 years,[10,14,15] and hence, there is a lot of scope for confusion.

On plain radiographs, the nidus is a small (1 cm or less), oval or round, radiolucent area surrounded by dense cortical bone or periosteal reaction,[16] and is demonstrated in up to 85% of the cases.[17] The amount of reactive bone may vary from minimal, particularly with intramedullary and intra-articular lesions, to extensive sclerosis. Standard radiographs only provide subtle findings in the intra-articular lesion due to the absence of any perilesional sclerosis or periosteal reaction.[12] Radiographic changes in joint TB are absent or non-specific in the early stages of the disease[18] and, hence, are not of much use in differentiating these two pathologies.

MRI remains the modality of choice for bone tumor exploration.[19-21] Some[22,23] believe that MRI has limited value for diagnosis of osteoid osteoma, which may have been due to the relatively low-resolution MRI techniques employed in these studies. Typically, osteoid osteoma shows low signal intensity on T1- and T2-weighted images,[24] with bone marrow edema around the nidus and high contrast enhancement after gadolinium administration. The increased signal intensity of the lesion on T2-weighted or enhanced T1-weighted images has been pathologically correlated with the degree of vascularity of the fibrovascular nidal stroma and the amount of osteoid substance within the nidus.[25,26] Calcified osteoid within the nidus is typically represented as a central area of signal void.[27] Intra-articular lesions may demonstrate synovial thickening apparent on MRI, with the diagnosis confirmed after gadolinium injection. However, precise localization of the nidus may not be easy. The nidus may not be visualized in 35% of the cases because of the associated surrounding perilesional edema, and in 50% of the cases, atypical presentation of the nidus may lead to misdiagnosis.[28] Osteoid osteoma may be mistaken for inflammatory or infectious arthritis, aseptic osteonecrosis of the femoral head, fatigue fracture, radicular syndrome, pigmented villonodular synovitis, or even tubercular arthritis.[10,11,13,14,29,30] Five out of six cases presented in our series had intra- or juxta-articular osteoid osteoma, which explains the cause of confusion.

CT remains the examination of choice when using high-resolution contiguous millimetric thin slices, thus providing accurate data regarding the size and location of the lesion.[21,31] The typical appearance of an intra-articular osteoid osteoma on CT images is that of a round or oval low-attenuation nidus surrounded by varying degrees of sclerosis. Calcification within the nidus is variable, occurring in 50% of cases reported by Kransdorf *et al*.[1] Patterns of calcification include "punctate, amorphous, or ring-like, due to dense central mineralization." The density of the tumor increases with age, and thereby provides an indication of the lesion's maturity.[21] The vascular groove sign, defined as serpiginous or linear grooves extending from the periosteal surface of the cortical bone down to the nidus, is a moderately sensitive but highly specific sign of osteoid osteoma that helps in differentiation and improves confidence in atypical indeterminate cases.[32] These radiating grooves represent prominent enlarged feeding

Table 1: Specific findings on MRI that should alert one to the possibility of an osteoid osteoma over TB

Marrow edema associated with sclerosis, cortical thickening, or bone expansion
A small hypointense round or oval intracortical, sub-periosteal or subcortical lesion
Lesion with central or eccentric signal void (representing calcification within the nidus)
Posterior element involvement with bone marrow and surrounding soft tissue edema, in the absence of abscess formation
Small lesion associated with extensive bone marrow edema
Absence of joint space narrowing or articular surface erosion in juxta-articular lesion

MRI: Magnetic resonance imaging

arterioles that have become encased by the hyperostotic reaction incited by the osteoid osteoma nidus. Additional CT findings include "changes often seen on both sides of the joint," described as osteophyte formation at the joint margins, muscle wasting, a localized soft tissue mass, and reduced bone density.

TB can occur almost at any site within the body and has three different patterns of involvement in the spine, depending upon the stage of the disease: Osteitis, osteitis with an abscess, and osteitis with or without an abscess plus discitis.[33] Abscess formation and collection of granulation tissue adjacent to the vertebral body is highly suggestive of spinal TB. The involvement of posterior spinal element is generally not a characteristic feature of spinal TB. Joint TB is monoarticular with the initial presentation involving soft tissue swelling and joint effusion. Later, a classic triad of radiological findings, known as the Phemister triad,[34] is seen, which includes juxta-articular osteopenia, joint space narrowing, and erosions. If a sclerotic rim is present around the nidus that is sub-periosteal or subchondral in location and lacks central calcification, differentiation from tubercular osteomyelitis or a small Brodie's abscess can be difficult. MRI features of a Brodie's abscess, i.e. high signal intensity on fat-suppressed T2W images, lack of central contrast enhancement, and target appearance with "penumbra sign," are characteristic.[35,36] A biopsy is always recommended and it may be considered obligatory in every case presenting as osteitis or osteitis with periarticular soft tissue edema (before abscess formation) in countries where TB is not common. However, since TB is quite common in India, ATT is sometimes started without a biopsy in patients presenting with marrow edema and surrounding soft tissue high signal on MRI and suspected to be suffering from bone or joint TB.

The cases presented above were diagnosed as tubercular arthritis or osteomyelitis and came to our institute for a second opinion. It is important to understand that the nidus can be less conspicuous and is not consistently visualized on MRI than with CT. MRI is more sensitive than CT in detecting bone marrow and soft tissue changes adjacent to the nidus, and should be interpreted with caution in order to avoid erroneous diagnosis. Diagnosis only on the basis of MR images may be very difficult, since they may demonstrate a more aggressive appearance than that suggested by a plain radiograph and CT imaging. Both volume averaging and decreased MR spatial resolution may make the nidus less conspicuous. Therefore, it is important that state-of-the-art MRI techniques with fast-spin echo, 512-image-matrix acquisition are obtained. CT is more accurate than MRI in demonstration of the nidus, and is the diagnostic modality of choice for osteoid osteoma. Thin-section CT (1 mm slices) reconstructed in bone algorithm with multi-planar reformat is optimal and should be obtained whenever osteoid osteoma is suspected.

Bone marrow edema in posterior elements of spine, with surrounding soft tissue edema should be interpreted with caution. All the cases of spinal osteoid osteoma involved only posterior elements, which is not typical in TB. TB of the posterior elements is usually associated with bone destruction, more marked adjacent soft tissue changes, and abscesses formation. Table 1 lists the findings on MRI one should specifically take note of to alert one to the possibility of an osteoid osteoma over TB.

Conclusion

We believe that both high-resolution CT and state-of-the-art high-spatial resolution MRI have the capability to significantly improve the detection of nidus for diagnosis of osteoid osteoma, if we remain aware of their relative common occurrence at juxta- or intra-articular sites, along with being familiar with their specific MRI findings. We would like to emphasize that when a diagnosis of tubercular arthritis or osteomyelitis is being considered on the basis of juxta-articular soft tissue and bone marrow changes or while reviewing external MRI, it is important that (1) images are interpreted with caution, making sure not to miss an inconspicuous nidus; (2) we make sure that state-of-the-art MRI techniques have been used; and (3) a low threshold is kept for performing high-resolution CT imaging, which is the modality of choice for detection of osteoid osteoma lesion.

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