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Vertebral osteoid osteoma masquerading as a malignant bone or soft-tissue tumor on MRI

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Abstract *Purpose.* Four pediatric patients were sent to our institution with the diagnosis of soft-tissue/malignant bone tumor. In all cases an MRI was the initial study performed for neck or back pain. All were surgically proven to have an osteoid osteoma/osteoblastoma (OO) as a final diagnosis. The MRI findings are reviewed.
Methods. Four patients, three boys and one girl, ranging in age from 5 to 17 years, presented with symptoms of neck or back pain for 2 months to 2 years. Two had neurological findings. All patients underwent MRI.
Results. All MRIs demonstrated decreased T1 signal and increased T2 signal in the soft tissues and bone surrounding the lesions consistent with edema. Enhancement was observed in the adjacent soft tissues and in the lesion nidus retrospectively.
Conclusion. Investigating neck or back pain with an initial MRI may lead to misleading diagnoses unless the radiologist is aware of the typical MRI appearance of vertebral osteoid osteoma.

Introduction

Performing an MRI as the initial examination for back or neck pain has become common practice. This can lead to an incorrect diagnosis in the case of osteoid osteoma or osteoblastoma. Four pediatric patients are presented who were initially diagnosed as having a malignant bone or soft-tissue tumor on MRI, while the final surgical diagnosis was osteoid osteoma or osteoblastoma.

Four children with back or neck pain were sent to our institution with the diagnosis of a malignant bone or soft-tissue tumor involving the spine. In all cases MRI was the initial study. All four patients were surgically proven to have an osteoid osteoma/osteoblastoma (OO) as the final diagnosis. The lesions were readily diagnosed preoperatively after being demonstrated on CT. The MRI findings of these four patients are reviewed.

Materials and methods

Four patients, three boys and one girl, ranging in age from 5 to 17 years of age, presented with chief complaints of back or neck pain for 2 months to 2 years (Table 1). Three patients were evaluated with GE (General Electric Medical Systems, Milwaukee, Wis.) 1.5 T MRI, and one patient was evaluated with a Siemens (Siemens, Erlangen, Germany) 1.0 T MRI. All patients were evaluated with T1 weighted imaging, three patients were evaluated with T2 weighted imaging, and two patients were evaluated with gradient echo imaging. Two of the four patients received intravenous contrast. All four patients had CT scans performed following MRI and prior to surgery. Preoperative plain films were not obtained.

Results

All the lesions were resected (Table 1). Two patients had neurologic findings. All MRI examinations demonstrated decreased T1 signal intensity and extensive increased T2 and T2* signal in the soft tissues

Table 1 Patient information

	Age/ Sex	Symptoms	Signs	Initial diagnosis
Case 1 (Fig. 1)	17/F	Neck pain for 2 years	Hand grasp weakness	Soft-tissue mass neurofibroma
Case 2 (Fig. 2)	15/M	Left scapula pain for 3 months	Weakness/ atrophy biceps, triceps, intrinsic hand muscles	Tumor
Case 3 (Fig. 3)	11/M	Back pain for 6 months	None	Tumor
Case 4	5/M	Neck pain for 2 months	None	Tumor/ Ewing's

surrounding the lesion consistent with edema. There was also extensive bone-marrow edema adjacent to the lesion characterized by decreased T1 signal and increased T2 signal. The lesion itself, retrospectively evaluated after CT localization, demonstrated heterogeneous T1 signal and decreased T2 and T2* signal. The nidus of the lesions heterogeneously enhanced following contrast administration, as did the adjacent soft tissues. The adjacent bone-marrow edema did not enhance. The adjacent intervertebral disc spaces were not involved and no pathologic vascular flow voids were appreciated (Figs. 1–3).

Discussion

OO is more frequent in males (as in our four cases) and usually develops in the second to fourth decade. Our patients were all under the age of 18, reflecting selection bias, as we are a tertiary referral center for pediatric patients with spine lesions. The most common presenting sites (50 %) are the femur and tibia; however, the entire skeleton has proved fertile ground for this tumor.

The hallmark of OO histologically is the central nidus, which is primarily osteoid surrounded by fibrous stroma. This renders the nidus radiolucent on radiographs and low attenuation on CT, the diagnostic modality of choice. The nidus is in turn surrounded by sclerosis. Treatment includes nidal excision or thermal coagulation [1, 2].

The patients classically present with severe pain, which is worse at night, and was experienced by all our patients. Different theories have been proposed as the cause of pain [1, 3, 4]. The pain has been shown to abate if one waits long enough (4–8 years) as the osteoid tissue of the nidus matures into bone tissue.

The imaging features of vertebral OO have been documented. The articles have often been reported under a title that stressed the difficulty in making the diag-

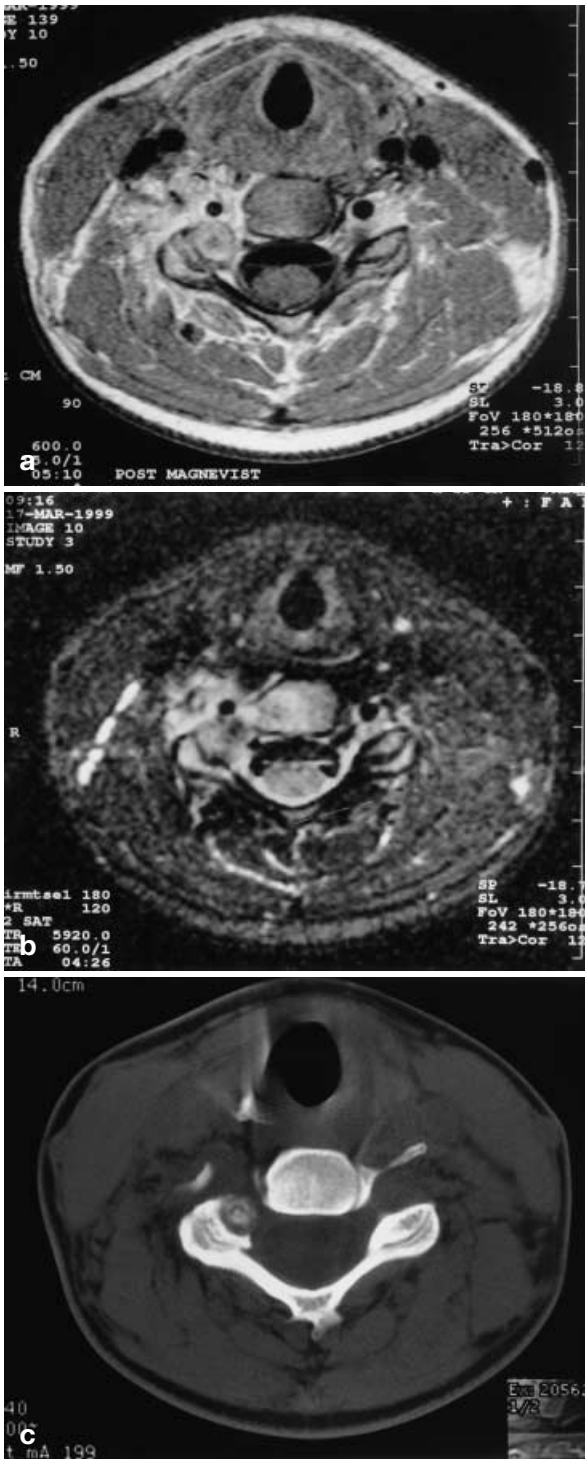

Fig. 1a–c Contrast-enhanced axial T1-weighted (**a**) (TR:600, TE:15) and T2-weighted inversion recovery (**b**) (TR:5920, TE:60) images of case 1 (17-year-old girl) demonstrate heterogeneous enhancement of the lesion and paraspinal soft tissues as well as marrow and paraspinal edema. The CT (**c**) examination demonstrates the characteristic osteoid osteoma nidus in the right C6 ascending facet and reactive sclerosis of the adjacent bone

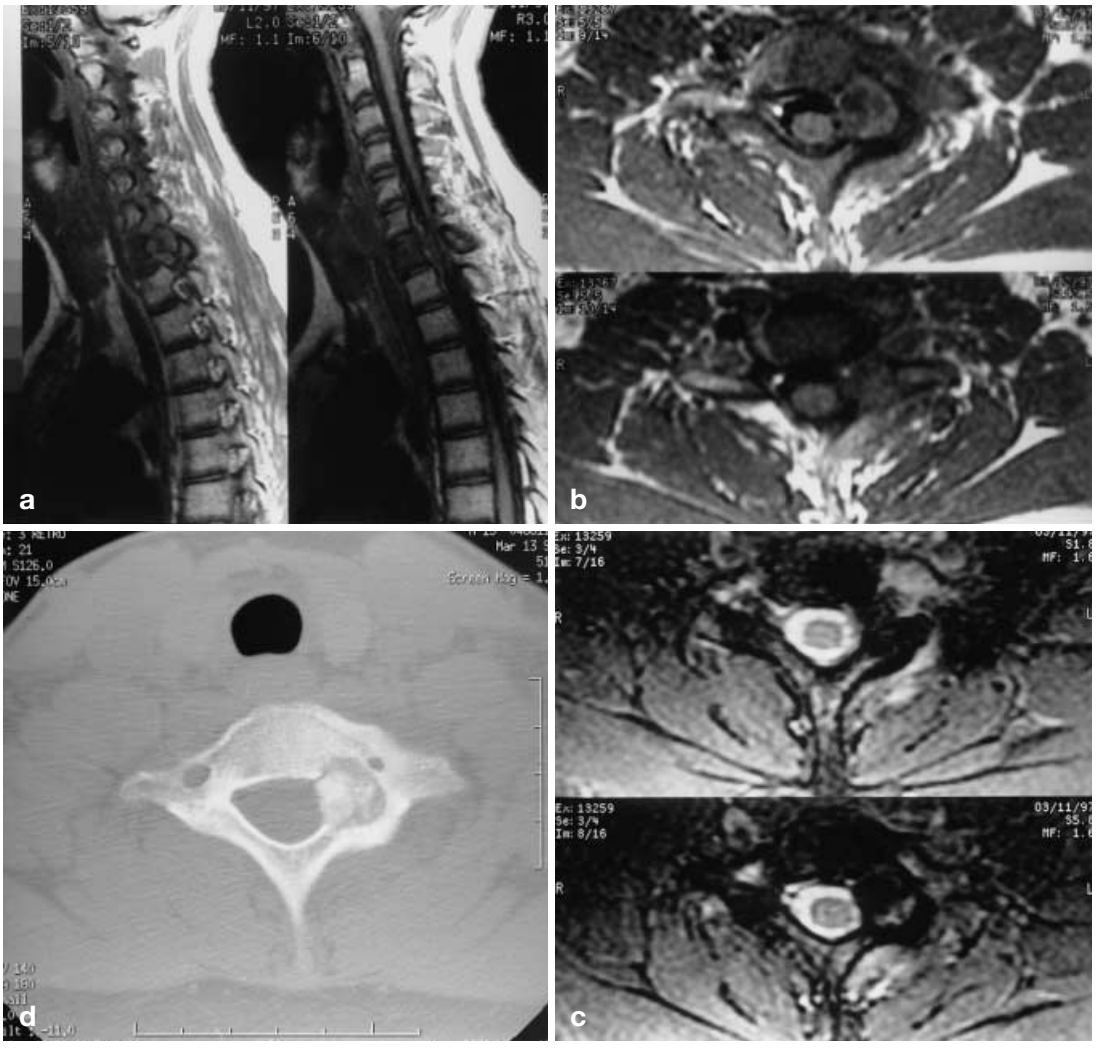

Fig. 2 a–d Sagittal (**a**) (TR:650, TE:15), and axial (**b**) (TR:600, TE:15) T1-weighted images of case 2 (15-year-old boy) male demonstrate replacement of the normal vertebral marrow with decreased T1 signal. The axial gradient echo image (**c**) (TR:550, TE:15) demonstrates increased marrow signal due to edema, as well as edema within the paraspinal soft tissues. The CT examination (**d**) demonstrates the characteristic nidus and perinidal lucency at the level of the C7 pedicle

nosis or localizing the lesion, especially with MRI [5–8]. Our cases illustrate the pitfalls inherent in interpreting MRI examinations obtained as the initial screening examination in pediatric patients with pain related to the spine.

Because there are no specific MRI features, pathognomonic signs or symptoms, patients often undergo multiple therapies for relief of pain, including unnecessary surgery. On MRI, one is made aware of a local inflammatory process with edema in the bone marrow and adjacent soft tissues [9]. The nidus is rarely appreciated in the midst of the edema and reactive sclerotic bone [5]. Even in long bones the nidus is not consistently identified on MRI, and the adjacent marrow edema/joint effusion often leads to the false diagnosis of Ewing's tumor, juvenile rheumatoid arthritis, osteonecrosis, stress fracture and Lyme arthritis [5, 6].

In conclusion, the presence of extensive soft tissue and bone-marrow edema on spinal MRI with sparing of the intervertebral disc space, in a patient presenting with back or neck pain, should prompt further evaluation with a CT examination in order to identify OO as the potential etiology. This practice would likely help to avoid misdiagnosis as a malignant bone or soft tissue tumor and avoid potentially hazardous and likely non-diagnostic biopsy.

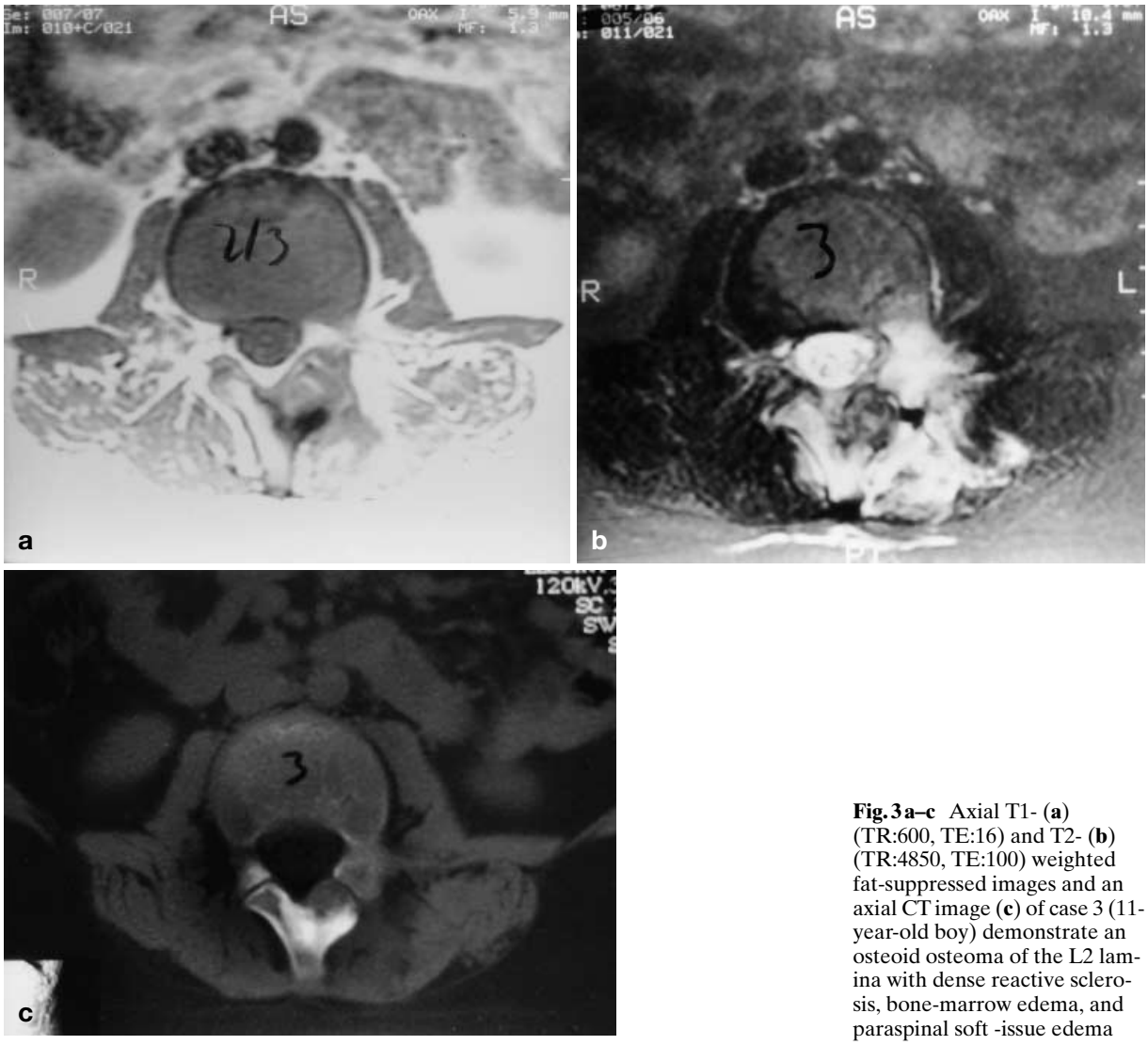

Fig. 3 a–c Axial T1- (**a**) (TR:600, TE:16) and T2- (**b**) (TR:4850, TE:100) weighted fat-suppressed images and an axial CT image (**c**) of case 3 (11-year-old boy) demonstrate an osteoid osteoma of the L2 lamina with dense reactive sclerosis, bone-marrow edema, and paraspinal soft -issue edema

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