Skeletal Radiol (1989) 18:70–74

Skeletal Radiology

Case report 523

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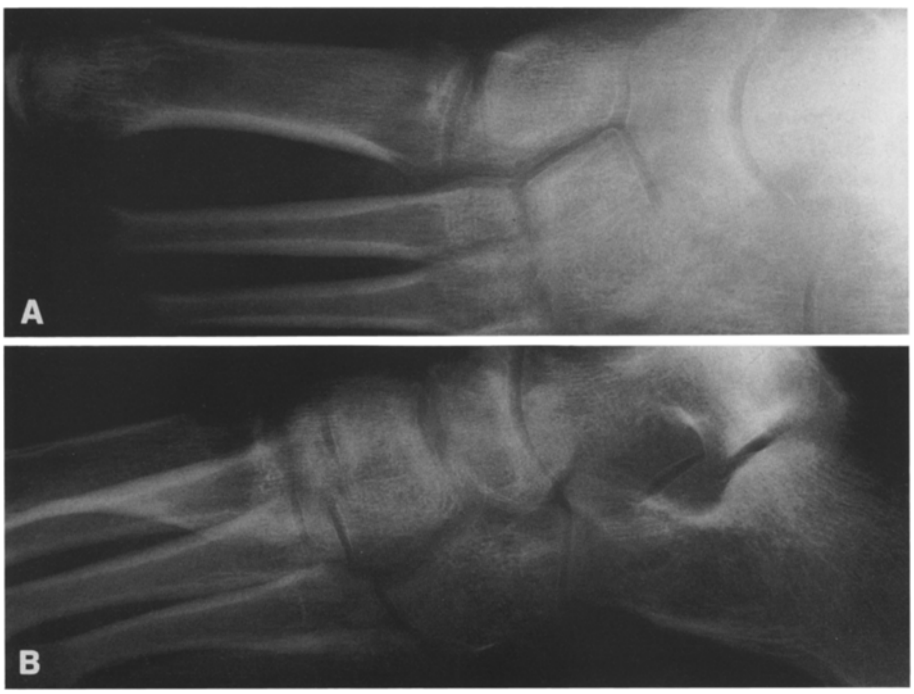

Fig. 1 A, B. AP and lateral radiographs of left foot (4-17-87) show spotty osteopenia without a well defined lesion

Clinical information

A 21-year-old, black man presented to Henry Ford Hospital in April, 1987, complaining of pain and swelling over the dorsum of his left foot for approximately two years, aggravated by excessive activity. He had been treated by an outside physician, in February 1987, for tendonitis of the left foot. Physical examination revealed swelling and tenderness over the dorsum of the left foot with normal strength and reflexes. Range of motion was limited, secondary to pain. Noted was bilateral pes planus. Initial radiographs of 4-17-87 (Fig. 1) showed soft tissue swelling and substantial osteopenia involving the midfoot. At this time, the patient was treated for peroneal spastic flat foot and it was recommended that he use a cane for decreased weight-bearing. A follow-up visit in June showed an essentially unchanged condition on clinical examination with no relief from either Motrin or decreased weight-bearing.

Subsequent radiographs demonstrated severe diffuse osteopenia throughout the left foot as well as sclerotic changes of the dorsal portion of the

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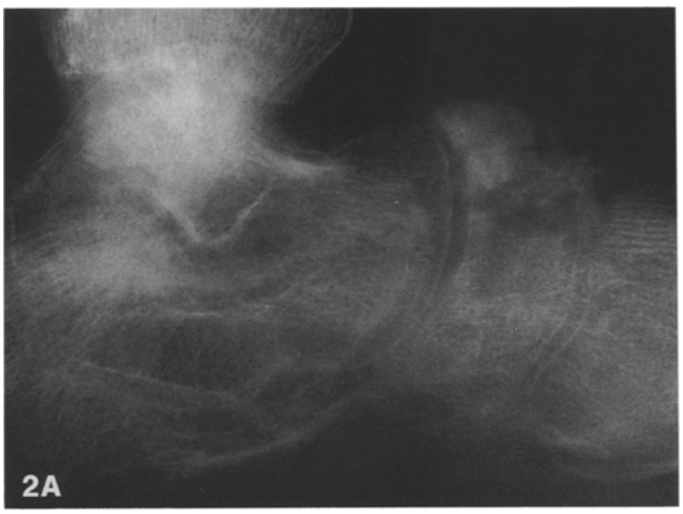
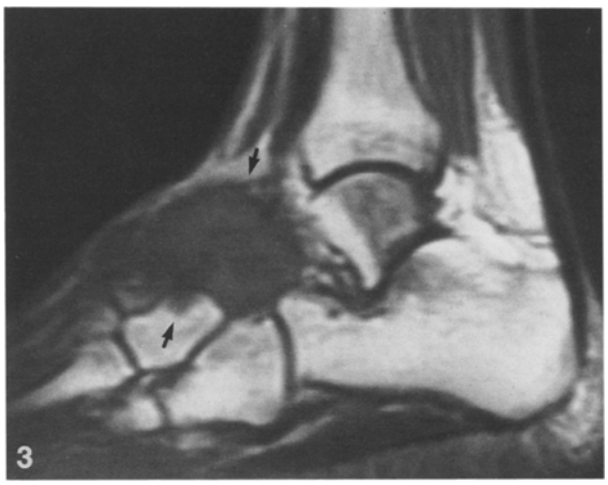




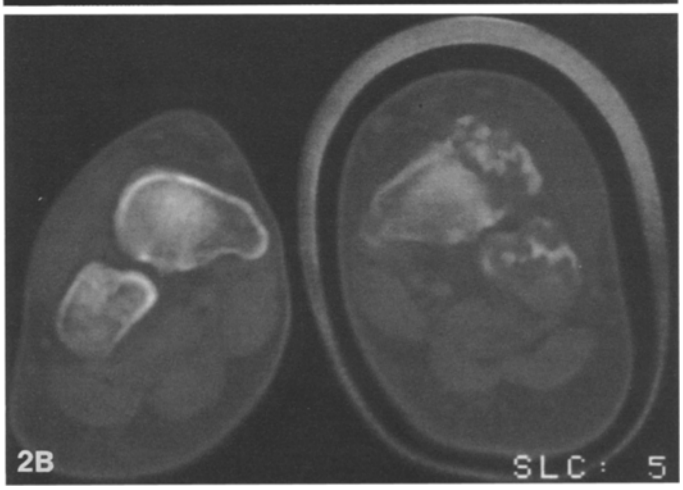


Fig. 2. A A lateral view of the foot (7-14-87) shows localized lytic and sclerotic change of the navicular bone on its dorsal surface **B** Coronal CT shows irregular destruction of the lateral aspect of the navicular bone with calcific densities within the confines of the lesion

Fig. 3. A sagittal T1 weighted MRI (TR = 600, TE = 25) demonstrates an extensive, low signal, soft tissue mass arising from the navicular bone (*arrows*)

navicular (Fig. 2A). Computed tomography (CT) of the left navicular showed deformity and lytic changes within the lateral aspect, with multiple calcific or ossific densities suggesting matrix mineralization (Fig. 2B).

Magnetic resonance imaging (MRI) demonstrated a low signal mass with extensive involvement of the navicular, as well as invasion of the second and third cuneiforms and talus (Fig. 3). Abnormal signal changes were suspicious for involvement of the calcaneus and cuboid bones.

A biopsy was performed.

Diagnosis: Osteoblastic osteosarcoma of the navicular

The biopsy specimen demonstrated osteoblastic osteosarcoma of the navicular with substantial necrosis.

The major differential diagnosis include aggressive or malignant osteoblastoma and chondrosarcoma. An infective process is unlikely.

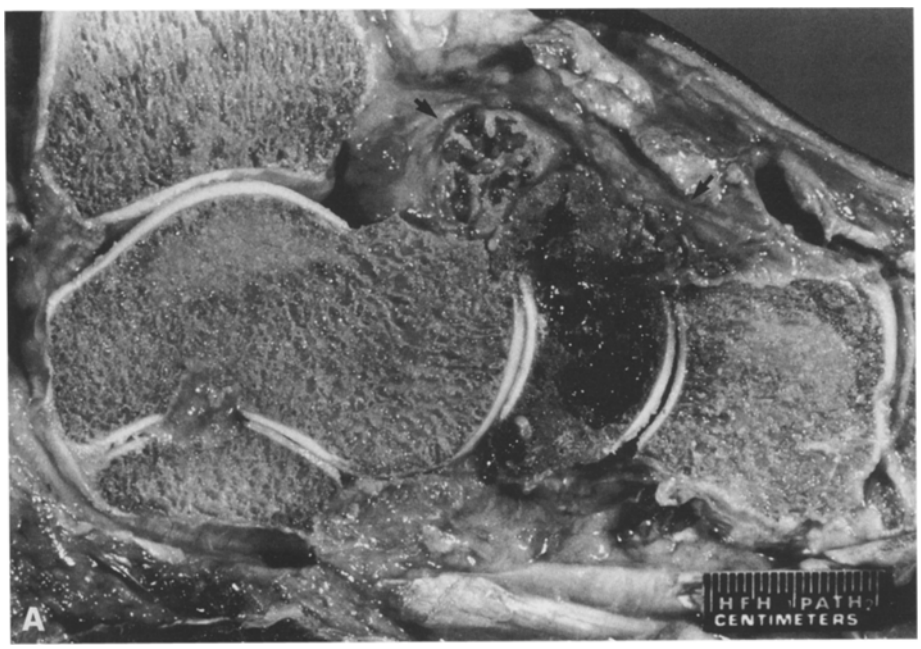
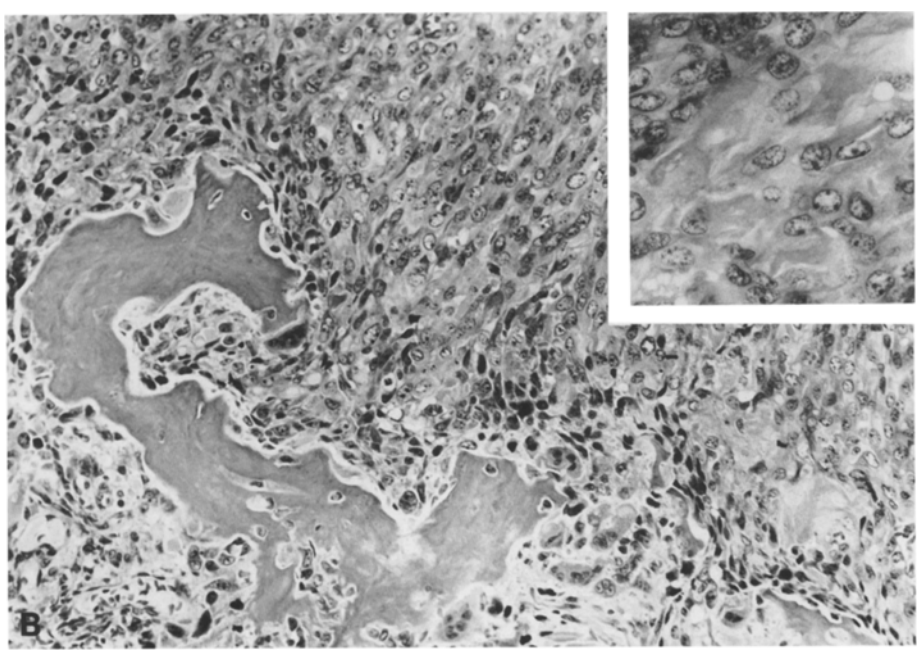


Fig. 4. A A sagittal section through the foot demonstrates tumor of the navicular bone (*arrows*).



B The features of osteoblastic osteogenic sarcoma are noted within the navicular bone (HE, × 36). *Inset* shows abnormal osteoid formation associated with the malignant cells (HE, × 70)

Pathologic studies

A biopsy specimen from the left navicular showed a high-grade osteoblastic osteosarcoma. After four courses of chemotherapy with high-dose Methotrexate in October, the patient underwent amputation. Gross pathological findings demonstrated tumor throughout the entire lateral dimension of the navicular with some central necrosis (Fig. 4A). The tumor growth extended dorsally beyond the normal cortex and extended anteriorly over the first cuneiform, correlating well with the MRI findings (Fig. 3). Microscopic findings revealed osteoblastic osteosarcoma with approximately 50% necrosis (Fig. 4B). Invasion the talus, calcaneous, cuboid and second and third cuneiforms was confirmed.

Discussion

Osteosarcoma is the most common primary malignancy of bone except for plasmacytoma. The peak incidence is in the second decade, with a predilection for the metaphysis of long bones and, less commonly, the central skeleton. Occurrence in the epiphyseal and diaphyseal regions is uncommon. Dahlin's series of primary osteosarcomas (the largest study available: $n=962$) showed that over half the osteosarcomas arose in the area of the knee, with less than 1% in the tarsal region [2]. To our knowledge, no individual report of osteosarcoma arising in the navicular has appeared in the literature.

The classical radiographic picture of primary osteosarcoma demonstrates cortical destruction in the metaphysis of a long bone with areas of lysis and irregular new bone formation, often extending into an extraosseous mass containing calcified-osteoid matrix. In our case, the initial radiographic presentation was nonspecific. As the destructive nature and matrix mineralization of the lesion became manifest, the differential diagnostic considerations were limited to osteosarcoma, aggressive or malignant osteoblastoma, and chondrosarcoma.

Osteoblastoma is an uncommon tumor in which the presentation, age, distribution and sites of predilection are similar to that of osteosarcoma, though occurring more frequently in the feet. It resembles osteoid osteoma histologically, but is larger and generally less painful. The majority of the lesions are seen in the vertebrae, femora, tibiae and mandible; however, 10% occur in the feet and hands [6]. Osteoblastoma is an expansile lesion with varying degress of cortical destruction or thickening and may be difficult to differentiate from osteosarcoma radiographically. Microscopically, the lesion demonstrates osteoid trabeculae with adjacent osteoblasts, osteoclasts and capillary vessels. Osteoblastoma lacks the streams of osteoid, sheets of cells without intervening bone formation and mitotic atypia of osteosarcoma.

Also included in the differential diagnosis is the entity of aggressive or malignant osteoblastoma. This is a rare form of osteoblastoma which shows slow growth and is locally invasive. Although malignant osteoblastoma resembles the benign form histologically, with immature, woven bony trabeculae and abundant osteoid, the lesion may demonstrate more atypical hyperchromatic nuclei and numerous osteoclastic giant cells. In Schajowicz's series of eight such cases, the lesion appeared more often in long bones with variable and noncharacteristic radiographic appearances [7]. None of the lesions in Schajowic's series had the classic radiographic appearance of osteosarcoma. Generally, a well-defined area of osteolysis with cortical expansion and thinning exists. More advanced lesions showed cortical destruction with extensive local invasion. However, Mitchell and Ackerman recently described a case of osteoblastoma which apparently progressed to frank metastatic osteosarcoma [4]. Controversy exists over the separation between aggressive osteoblastoma, malignant osteoblastoma, and osteosarcoma resembling osteoblastoma [1].

Chondrosarcoma in its classical form, if frankly malignant and aggressive, may be radiographically indistinguishable from osteosarcoma. However, classical chondrosarcoma generally occurs in a much older age group, with more than 40% of patients over the age of 40 years, and less than 3% found in the second decade. Chondrosarcoma rarely occurs in the feet. An aggressive chondrosarcoma may be entirely lytic and lack calcifications, and usually there is less of a periosteal reaction than in osteosarcoma. In our case, the suggestion of cartilaginous tumor matrix (Fig. 2B) merits the inclusion of chondrosarcoma in the differential diagnosis.

The MR images (Fig. 3), in this case, demonstrated the extent of tumor and showed excellent correlation with the pathological findings. MRI has been shown to be highly sensitive in the depiction of local extension and staging of a malignant lesion for limb-salvage procedures. Conventional radiographs remain the most useful study for predicting the histological diagnosis of a bone lesion and, along with CT, are better for displaying ossification and calcification, periosteal and endosteal reaction and cortical destruction. Sundaram et al.

examined 14 osteosarcomas with MRI [8]. They found all lesions to be low intensity on T1 weighted images with both high and low intensity signals seen on T2 weighted images. These authors stressed the appearance of T2 weighted images for the identification of extra-compartmental disease and noted that extra-osseous tumor tended to be a high signal intensity on T2 weighted images. MRI was extremely accurate in estimating the extent of disease. MRI's primary advantages over CT in evaluation of primary bone tumors are capability of pluri-directional imaging, increased contrast resolution and demonstration of soft tissue for depiction of extraosseous extent of malignancy [5].

Osteosarcoma arising in the navicular bone is rare. Recognition of destructive changes and matrix mineralization warrants its consideration in the differential diagnosis of painful swelling of the foot. CT and MRI are helpful in the early recognition, characterization, and staging of such tumors, as was demonstrated in this case.

In *summary*, a case of osteosarcoma of the navicular is presented with discussion of the incidence of such involvement and the differential diagnosis. Findings on CT and MRI are considered and their contribution to the evaluation of such lesions is emphasized. The importance of imaging with MR in instances of malignant skeletal neoplasms is stressed. Of particular importance is the value of MR in determining extension of a skeletal lesion into the adjacent soft tissues and the identification of possible spread of a skeletal neoplasm in the bone involved. Limb salvaging procedures are thereby enhanced.

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