

# LESIONS OF THE HEEL

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Malignant and benign tumors of bone in the foot have traditionally been characterized as rare, or at least unusual. When these lesions do appear, however, they are frequently localized to the heel. They may be discovered on a routine radiographic evaluation for an unrelated condition. Only careful evaluation of good quality radiographs and a correlation with a thorough history will lead to an accurate diagnosis and appropriate treatment.

A review of a variety of lesions which may be seen in and around the calcaneus will be presented. Additionally, the typical patient population for each pathologic process will be outlined to help correlate the information gained from the history and physical with radiographic and imaging study information. For the purpose of discussion, the lesions of the heel have been divided into categories of benign and malignant tumors. Although this is somewhat artificial and not completely technically correct, it does correlate well with plain film radiographic findings.

Overall, the incidence of bone tumors in the foot accounts for only 1% to 2% of bone tumors in the body. Of these lesions, the benign lesions outnumber malignant lesions 4 to 1. The most common sites of occurrence are the calcaneus and metatarsals. The great majority of the lesions discussed have been seen by the author in the last several years. Case presentations will attempt to show the "real life" nature of these problems.

In addition to traditional neoplasms which may be seen in the heel, other non-neoplastic processes may include sequestered infection in the form of a Brodie's abscess, sclerotic changes from previous stress, or acute fracture and enthesiopathies which may be biomechanical or metabolic in origin.

The value of the history and physical examination cannot be overemphasized in evaluation of these lesions. Important information which may be gained is the quality, duration, course, and onset of pain as well as the response to daily activities and home therapies. Other key information, such as history of previous lesions at other sites in the body, may help discern primary and metastatic lesions.

Imaging of the calcaneus can easily be accomplished in the office with plain film radiographs. Views which may be helpful in evaluating lesions of the heel include the lateral, axial, medial, lateral oblique, and occasionally sunrise and Broden's views. More extensive evaluation may be obtained with special studies such as bone scans, magnetic resonance imaging (MRI), and computed tomography (CT). These studies may aid in fully evaluating the volume, density, and metabolic activity of the lesions. The higher sensitivity of these modalities may assist in detecting pathology such as cortical breaks not apparent on plain films. Despite the value of these studies, they should still be considered ancillary, and should be ordered under the appropriate circumstances.

Initial evaluation of any lesion on plain film radiographs should be fully characterized in a systematic fashion. This description should include the site (although this article is primarily concerned with the calcaneus), size, density compared with surrounding bone, margin characteristics, and effect on the natural cortical barrier of the bone. A system of description using five levels of evaluation has been described by Zulli, and has appeared on several occasions in recent literature.

## BENIGN LESIONS

### Unicameral Bone Cyst

Unicameral or solitary bone cysts are the most common bone lesion in the foot. They are found most frequently in the calcaneus (75% to 85% of all cases in the foot), but may also be seen in the talus and metatarsal. Unicameral bone cysts begin in children and teenagers, and generally do not enlarge once the patient has reached skeletal maturity. Often, these lesions are asymptomatic, and may be discovered on radiographs for an unrelated condition. If symptomatic, the possibility of pathologic fracture should be suspected.

Plain film radiographs show a radiolucent or cystic area 2 cm to 3 cm in size in the bone, surrounded by a sclerotic margin. These lesions

generally do not expand or violate natural cortical margins. They are generally found eccentrically located in the calcaneus, and in the shaft in long bones.

Treatment is indicated when there is the risk of pathologic fracture. Treatment most often includes curettage, irrigation, and packing of the lesions with autogenous or allogeneic bone. The author also routinely obtains cultures and biopsies for definitive diagnosis. For lesions of the calcaneus, the author recommends a lateral curvilinear incision, which avoids and protects the peroneal tendons and sural nerve.

### **Aneurysmal Bone Cyst**

Aneurysmal bone cysts are less common than unicameral bone cysts. When occurring in the foot, they are found in the tarsals and metatarsals. These lesions are usually found in patients in their 2nd or 3rd decade of life, and may present as a palpable tender mass.

Radiographically, these lesions are fairly distinct on plain films, showing bulging of the cortex, and trabeculation or "honeycombing" inside the lesion. The author finds it helpful to look for a bubbly-appearance inside the overall lesion.

Aspiration or opening of the aneurysmal bone cyst produces a hemorrhagic fluid. Treatment is debridement, irrigation, and packing with bone chips. There is limited case experience of a technique under evaluation where demineralized bone paste is introduced under CT or fluoroscopic guidance through a biopsy needle, following aspiration and irrigation. Early reports are promising, although there is some concern of the possible increased risk of recurrence

### **Osteoid Osteoma/Osteoblastoma**

Osteoid osteoma and osteoblastoma are essentially histologically identical, but differ in size. Convention dictates that lesions less than 2 cm are osteoid osteoma while lesions greater than 2 cm are osteoblastomas. The most common location in the foot is the tarsal bones. Typically the patients are 10- to 25-years-old and present with gradually worsening symptoms which are more pronounced in the evening. The pain is not improved with immobilization, but shows good, transient relief of symptoms with aspirin.

Radiographically, there is radiolucency in the periphery with radiolucency or calcification

centrally. Early in the development of these lesions they may not be apparent on radiographs despite significant clinical symptoms. Fortunately, the increased availability of CT and MRI have made detection of these and other lesions easier. Treatment of these lesions is *en bloc* resection where possible, however, curettage has also been described.

### **Chondroblastoma**

Chondroblastomas are rare, accounting for only 1% of primary bone tumors. Interestingly, however 10%, of these lesions in one study were found in the foot, and most commonly in the calcaneus or talus according to Walling. Kricun went on to evaluate the position of occurrence within the heel in 14 cases. This lesion typically arises from an active epiphyseal plate in a patient between 10 and 20 years of age. Patients present with pain and swelling due to the subchondral location. Radiographically, these lesions appear radiolucent with a sclerotic margin.

Treatment usually consists of curettage and grafting. However, in more aggressive lesions or in cases of recurrence, removal of the articular cartilage and primary arthrodesis may yield good results with decreased risk of recurrence and need for additional potentially debilitating procedures.

### **Giant Cell Tumor of Bone**

Giant Cell Tumors are rare in the foot, and account for 5% of all biopsied primary bone tumors. In a review of 1182 lesions, less than 2% occurred in the foot. When these lesions do arise in the foot, however, they are most often noted in the calcaneus and metatarsals.

Patients who present with giant cell tumors are usually in their third decade of life. When the malignant variety is encountered, men are affected three times as often as women. Radiographically, these lesions are radiolucent with a small zone of peripheral sclerosis.

Giant Cell Tumors are treated with curettage. However, due to their more aggressive nature, adjuvant treatments are also recommended including the use of intra-lesional cryotherapy, Phenol, polymethylmethacrylate, or cauterization. The recurrence rate of these lesions is between 10% and 30%. Higher stage lesions, and recurrent lesions may require wide excision and reconstructive arthrodesis, or even amputation.

### **Intraosseous Lipoma**

Intraosseous lipomas are rare, accounting for only 0.1% of all bone tumors. When present, they are usually located in the metaphyseal area of the host bone. This lesion occurs equally in males and females, and has no particular age predilection. Intraosseous lipomas are frequently asymptomatic, but risk of fracture is of specific concern.

The radiographic appearance is usually of a well-defined, but expansile lesion. The lesion may result in thinning of the cortex and also may not show any significant sclerosis of the margin. The treatment for the symptomatic lipoma or one at risk of pathologic fracture includes curettage and packing with bone chips.

### **Ganglion of Bone**

Reports of intraosseous ganglions in the calcaneus and cuboid have appeared several times in the recent literature. Despite these reports, the condition is extremely rare. The typical patient is young to middle-aged, and there is equal occurrence in both sexes. Presenting symptoms may include intermittent aching, which is aggravated by activity. Soft tissue swelling is rare, but has been noted with some cases.

Plain radiographs reveal an epiphyseal or metaphyseal location with a round or oval lytic area. The area may be unilocular or multilocular. Commonly, there is no periosteal reaction or bulging of the cortex. However, the author has experience with a case of a ganglion of bone which not only expanded but broke through the cortex of the metatarsal.

Treatment includes curettage and packing of the lesions with bone graft material. Intraoperatively, windowing of the cortex of the involved bone reveals the typical mucinous, straw-colored fluid of a ganglion. Also, a delicate capsule or lining may be seen and should be thoroughly removed with the curette.

### **Enchondroma**

An Enchondroma represents the second most common cartilaginous tumor of the skeletal system. The typical patient is between the 2nd and 6th decades of life. Presentation may include swelling and intermittent pain. Although the heel may be affected, the phalanges and metatarsals are far more common sites of presentation. Pathologic fracture is common, and may be the reason that

the patient seeks care. Radiographically, the enchondroma radiates from the medullary area, with varying degrees of cortical expansion and thinning.

Treatment includes curettage and packing with bone graft. Smaller digital lesions may also be effectively treated with phalangectomy. Care should be taken to completely remove all suspect areas, as the enchondroma does have potential for recurrence as a benign or malignant lesion.

### **Brodie's Abscess**

Although the Brodie's abscess is not a tumor, it is included for completeness sake. The chronic abscess of bone may also have a radiographic appearance of radiolucency with marginal sclerosis. The patient history and a careful clinical examination are paramount in obtaining an accurate clinical diagnosis and effective treatment. History of puncture wounds or pediatric hematogenous osteomyelitis are of particular interest.

Treatment of the abscess should include a thorough removal of all necrotic tissue back to healthy normal-appearing margins. The author favors the use of gentamicin-impregnated PMMA beads following debridement. This is in addition to appropriate systemic antibiotics. The antibiotics should be chosen based on a full set of intraoperative cultures including aerobic, anaerobic, fungal, and acid fast swabs.

## **MALIGNANT LESIONS**

### **Ewing's Sarcoma**

Ewing's sarcoma is the most common primary malignant tumor of bone in the foot, as reported by the IESS (Intergroup Ewing's Sarcoma Study). Despite it being the most common, it is uncommon in the foot, accounting for only 10 of 377 patients evaluated. In the IESS group of 10 lesions, 5 were located in the calcaneus, 1 in the talus, 2 in the metatarsal, and 1 in the distal phalanx of the hallux. The calcaneal lesions correlated with a higher mortality rate (4 of 5 patients deceased) as compared with metatarsal lesions.

The typical Ewing's patient is 5 to 15 years old, and presents with concerns of pain and swelling. Radiographically, the most common finding is permeation, although expansion is also frequently noted. Interestingly, however, periosteal reaction is less commonly found in the foot.

Further workup should include a bone scan, chest radiographs, and oncology consult before entertaining biopsy or other invasive treatments. Treatment commonly includes chemotherapy, radiation treatment, and amputation.

### **Osteogenic Sarcoma**

Osteogenic sarcoma is rarely seen in the foot. When cases are reviewed, the most common site is the metatarsals. Osteogenic sarcoma is divided into five types which include medullary, periosteal, mixed type, sclerosing, and chondrosarcoma type. Patients are typically between 10 and 20 years old. Radiographically, osteogenic sarcoma invades adjacent soft tissues and exhibits rapid bony destruction and proliferation. Metastasis is early and common, therefore, treatment includes excision or amputation and very close follow-up.

### **Chondrosarcoma**

Chondrosarcomas are also a rarely encountered malignant tumor in the foot. This lesion is most common in men over the age of 25. When present, they most frequently appear in the calcaneus, phalanges, and metatarsals. Most commonly, chondrosarcomas arise *de novo* but occasionally may arise from enchondromas or osteochondromas. Radiographically, the lesion is expansile with cortical destruction and expansion into the soft tissues. MRI may be very helpful in evaluating these lesions.

Treatment of this malignancy is dependent on the size and location of the lesion. However, the prognosis is much better with chondrosarcoma than with many other malignant bone tumors.

### **Synovial Sarcoma**

The synovial sarcoma, though not a lesion of bone, is included here due to the location of a tumor previously encountered by the author. Ten to twenty percent of synovial sarcomas occur around the foot and ankle. In Kirby's study this was noted to be the most common malignant lesion in the foot.

The synovial sarcoma is most often seen in patients between the third and fifth decades of life. There is a higher frequency in women than men (3:2). Frequently, patients may present with a concern of a gradually-enlarging "lump." The origin is most commonly from joint capsule, tendon sheath, or bursae. Radiographs may show

remodeling or invasion of adjacent osseous structures. Treatment may include local excision or amputation and radiation or chemotherapy.

### **Metastatic Lesions**

Metastatic lesions, although rare, do occur from time to time in the foot. The calcaneus is again a favored site of occurrence. Sites of primary disease which most frequently metastasize to the foot include breast, bladder, lung, kidney, and colorectal disease. One generalization that has been made is that metastasis to the foot is more likely to occur from sub-diaphragmatic sites of primary disease, while super-diaphragmatic primary tumors are more likely to metastasize to the hand and upper extremity.

## **CASE PRESENTATION**

The following case will show a surgical approach which the author has found helpful in approaching lesions of the heel. A 35-year-old female presented initially with a concern of atypical heel pain on the left foot. Radiographs showed no heel spur formation. A well-circumscribed lytic lesion was noted in the calcaneus, but it was initially felt only to be an incidental finding (Fig. 1).

After two months of conservative care which included NSAIDs, oral corticosteroids, injections, and biomechanical control, the patient remained symptomatic. An MRI was obtained to further evaluate the heel, and showed extensive cystic changes to the body of the calcaneus (Figs. 2A, 2B). Treatment options were discussed, and the patient decided on surgical intervention, due to the persistent pain.

Following appropriate medical evaluation and clearance, the patient was taken to the operating room and positioned in the lateral decubitus position on a bean bag. The left heel was then approached through a modified European calcaneal fracture incision (Fig. 3). The dissection plane was taken to periosteum prior to any undermining. The lateral flap was then elevated with the sural nerve undisturbed, and the periosteal flap was raised with the peroneal tendons.

After completion of the soft tissue dissection, the planned cortical window was marked with 4 safe-stop drill holes. The window was then cut and removed (Fig. 4). The fluid contents of the cyst were cultured prior to evacuation.

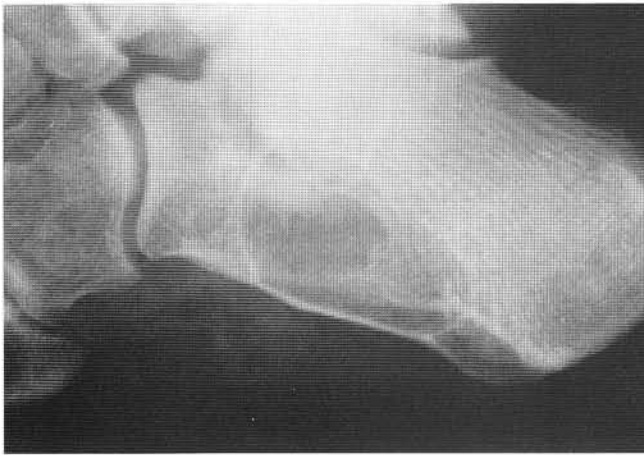


Figure 1. Lateral plain film showing lytic changes.

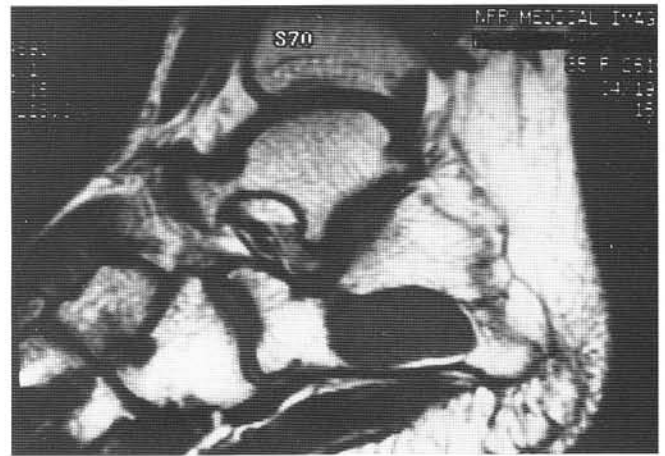


Figure 2A. Sagittal plane MRI.

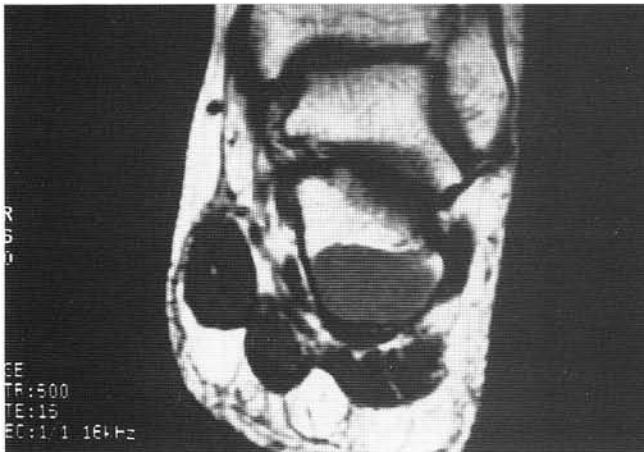


Figure 2B. Coronal MRI showing the significant extent of involvement of the calcaneal body and tuberosity.



Figure 3. Incisional plan showing the course of the peroneal tendons and sural nerve (dotted line).

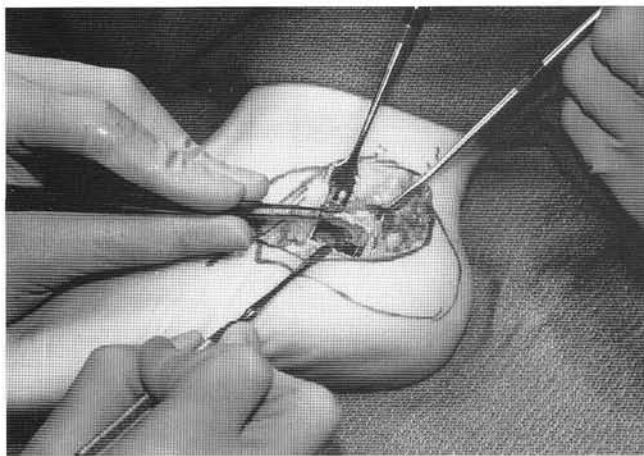


Figure 4. Windowing of the lateral wall of the calcaneus exposes the cyst.

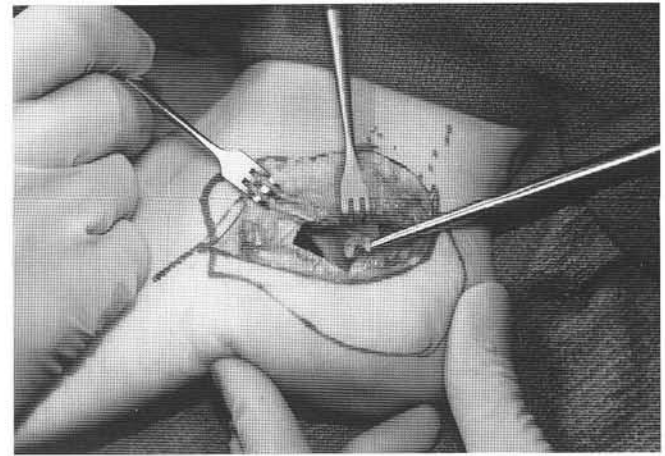


Figure 5. Aggressive curettage was undertaken removing the cyst lining and exposing raw cancellous surface where possible.

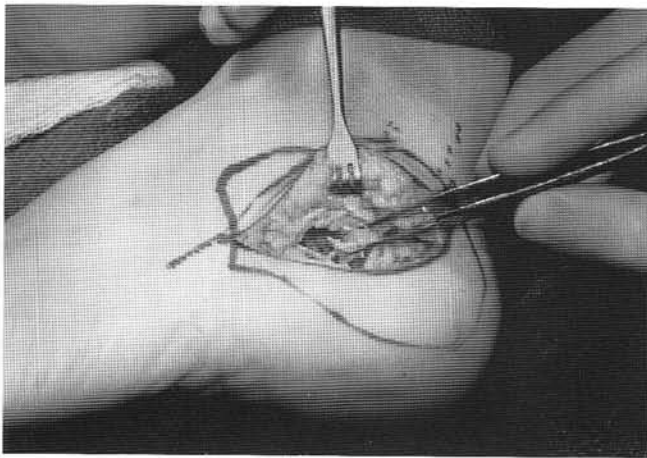


Figure 6. Following curettage and irrigation, the cyst was packed with cortico-cancellous chips.

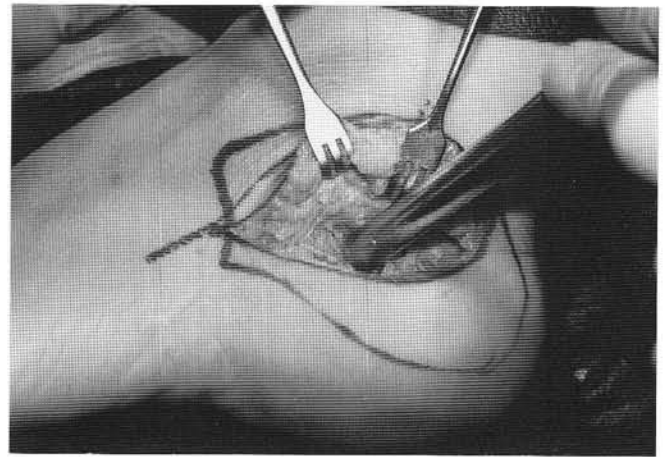


Figure 7. Chips were manually impacted with a bone tamp.

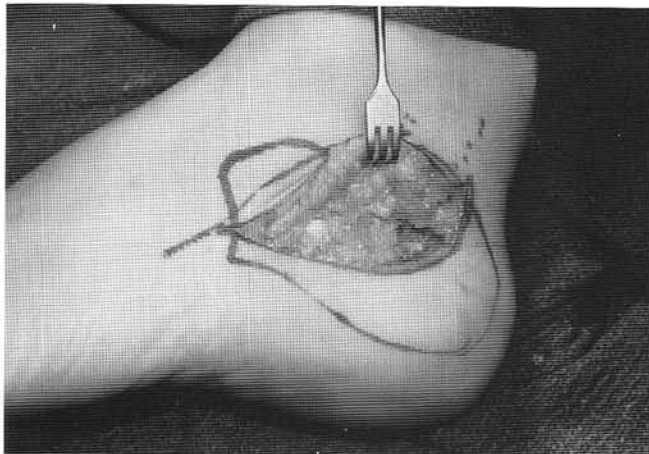


Figure 8. The cortical window was replaced and anchored with periosteal closure.

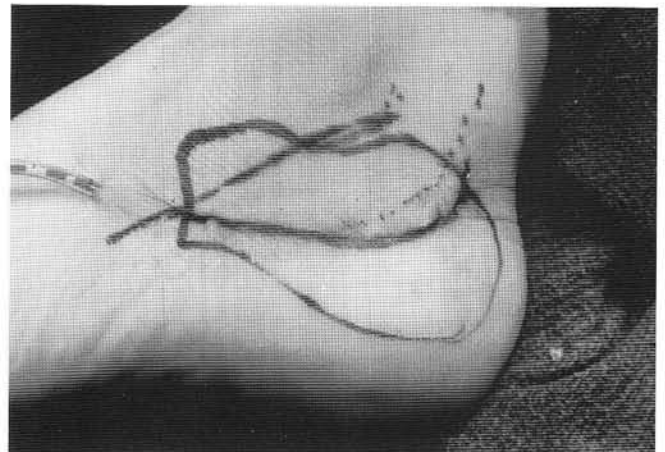


Figure 9. The completed closure prior to dressing and cast application.

The cyst was then curetted and irrigated, including the inner surface of the cortical window (Fig. 5). The wound was packed with a mixture of cortico-cancellous chips and demineralized bone paste (Fig. 6). Following impaction of the graft (Fig. 7) the cortical window was replaced, and the periosteum was sutured to hold the fragment in place (Fig. 8). Layered closure was then performed over a closed-suction drain (Fig. 9). A modified Jones compression dressing was then applied.

The patient's postoperative course was unremarkable. Range of motion exercises were instituted at four weeks, and partial-weight bearing at six weeks. Full-weight bearing was allowed in a removable cast-brace at eight weeks, and the patient was returned to shoes at ten weeks.

This case shows an example of a fairly large cystic lesion of the calcaneus. Differential diagnosis

included unicameral bone cyst, aneurysmal bone cyst, ganglion of bone, intraosseous lipoma, and Brodie's abscess. The MRI and preoperative laboratory studies effectively eliminated all possibilities, with the exception of unicameral bone cyst. The MRI also mapped the lesion and the surgical approach. No significant consideration was given to malignant tumors, due to the typical benign appearance on plain film radiograph, with a sclerotic, well-defined margin and surrounding normal appearing bone.

This article has presented a review of the more common lytic lesions commonly found in the heel, and may raise the readers index of suspicion in atypical lesions to insure that more aggressive lesions are diagnosed and treated in a timely fashion.

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