

# Insufficiency Fractures of the Calcaneus: A Diagnostic Pitfall for Ankle Arthritis

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**ABSTRACT.** *Objective.* To highlight the differential diagnosis between insufficiency fractures (IF) of the calcaneus and arthritis of the ankle.

*Methods.* We retrospectively reviewed clinical charts and imaging findings for 6 patients with 7 IF of the calcaneus who were referred with the diagnosis of ankle arthritis. The main predisposing factors, clinical features, therapy, and outcome were recorded. IF was considered when occurring spontaneously or with minimal trauma.

*Results.* All patients were women, with a mean age of  $73.8 \pm 6.3$  years. The median delay to diagnosis was 6 weeks (25th, 75th percentiles: 1, 12). Two had previous IF at other locations. Three patients had a history of chronic inflammatory conditions while receiving longterm steroid therapy. All complained of moderate to severe pain that interfered with daily activities and was relieved with rest. Physical examination revealed ankle inflammation in all cases. Radiographs were normal in 5 patients. Magnetic resonance imaging (MRI) was diagnostic. All received conservative treatment with complete resolution of symptoms without sequelae.

*Conclusion.* IF of the calcaneus are relatively rare but can be mistaken for ankle arthritis. MRI is recommended because this type of fracture is difficult to detect on plain films. Although IF have a good prognosis with conservative treatment, increased awareness is of importance for prompt diagnosis and proper management. (J Rheumatol 2006;33:1140–2)

## Key Indexing Terms:

INSUFFICIENCY FRACTURES      CALCANEUS      MAGNETIC RESONANCE IMAGING

Insufficiency fracture (IF) results from the application of normal force or minimal trauma on a bone weakened by underlying conditions<sup>1</sup>. The incidence of IF increases with age, and women are more frequently affected<sup>2</sup>. Osteoporosis, chronic inflammatory diseases, or corticosteroid therapy may weaken bone and predispose to IF<sup>2,3</sup>. Such fractures occur with a relatively high frequency in the ribs, vertebrae, sacrum, pelvis, and distal ulna<sup>3</sup>.

IF of the calcaneus are less common and often under-recognized and mistaken for other conditions. The insidious clinical presentation and the fact that radiographs are usually normal make diagnosis troublesome unless there is a high index of suspicion.

We describe the main clinical features, imaging findings, treatment, and outcome of 6 patients with 7 IF of the calcaneus referred to our rheumatology division with the suspicion of ankle arthritis.

## MATERIALS AND METHODS

We retrospectively studied 6 patients who attended in our unit and were diagnosed with IF of the calcaneus between January 1999 and September 2005. IF was considered when occurring spontaneously with daily activities or with minimal trauma<sup>4</sup>.

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All study patients attended the outpatient rheumatology clinic and were seen as routine referrals. Clinical data were obtained from a detailed review of medical records using a standardized form that included gender, age, location of fracture, risk factors for fracture, initial symptoms, physical examination, initial diagnostic suspicion, and diagnostic delay. Previous skeletal fractures, use of glucocorticoids, and disorders associated with bone loss and osteoporosis were also recorded, especially chronic inflammatory diseases.

Studies including plain radiographs, magnetic resonance imaging (MRI), and computed tomography (CT) scans were also reviewed. All MRI was performed on a 1.5 T unit using an extremity coil. The routine MRI protocol included axial, sagittal, and coronal T1-weighted and fat-suppressed T2-weighted imaging. An IF was diagnosed if a linear area of diminished signal intensity was seen within the bone with variable surrounding marrow edema, manifesting as ill-defined low signal intensity on T1-weighted images and high signal intensity on fat-suppressed T2-weighted images<sup>5,6</sup>. Location and orientation of fractures and the presence of concomitant osseous and soft-tissue injury were noted. Bone mineral density was measured in all patients with dual x-ray absorptiometry (DEXA) of the lumbar spine and/or femoral head. Based on bone densitometry, osteoporosis was defined as a T-score less than  $-2.5$  SD, and osteopenia as a T score between  $-1$  and  $-2.5$  SD<sup>7</sup>. Treatment and outcome were obtained from medical chart review or from direct interview on followup visits.

## RESULTS

During the study period, 6 patients were diagnosed with 7 IF of the calcaneus. All patients were women, with a mean age of  $73.8 \pm 6.3$  years and all were referred by their general practitioners with the clinical suspicion of ankle arthritis. Delay to diagnosis was variable, with a median delay of 6 weeks (25th, 75th percentile: 1, 12).

Predisposing conditions for IF were identified in 3 patients, 2 with history of seropositive rheumatoid arthritis (RA)<sup>8</sup> and the other with classic polyarteritis nodosa (PAN)<sup>9</sup>, all on

longterm steroid therapy. Two had previous multiple vertebral fractures. Patient 1 had a contralateral calcaneus fracture 7 months after the initial IF. Three were receiving treatment or prophylaxis for osteoporosis before the IF. Only one patient had no previous comorbidity.

No patient remembered previous trauma or overuse prior to onset of symptoms. All reported moderate to severe pain that interfered with daily activities and was relieved with rest. None had night pain. Physical examination revealed ankle inflammation in all cases, with mild periarticular edema in 5 patients, and severe local tenderness on the palpation of the calcaneus in all (Table 1).

Radiographs were normal in the 5 cases that were performed (Figure 1A). MRI were diagnostic in all cases and showed irregular bandlike areas of low signal intensity, continuous with the cortex, and surrounding areas of abnormal signal intensity in the marrow space (Figure 1B-C). In one patient, MRI was not done because of claustrophobia and diagnosis was made by CT. Densitometry study of the lumbar spine and/or proximal femur was available in all patients. Three had densitometric criteria compatible with osteoporosis, 2 with osteopenia, and in one case results were within the normal range.

Treatment was conservative in all cases, consisting mainly of immobilization, rest, and analgesics/nonsteroidal antiinflammatory drugs (NSAID). Complete recovery without sequelae was confirmed in all cases during followup.

## DISCUSSION

IF of the calcaneus are probably more common than is generally appreciated, especially in older individuals<sup>4</sup>. Patients with

RA<sup>10</sup> and other connective tissue diseases that required longterm corticosteroid treatment may also have this complication with an underrecognized frequency. However, in patients with arthritis the diagnostic problem increases when IF occurs in close proximity to a joint. The most frequent factor contributing to misdiagnosis could be the presence of other abnormalities of the ankle, especially arthritis of these joints.

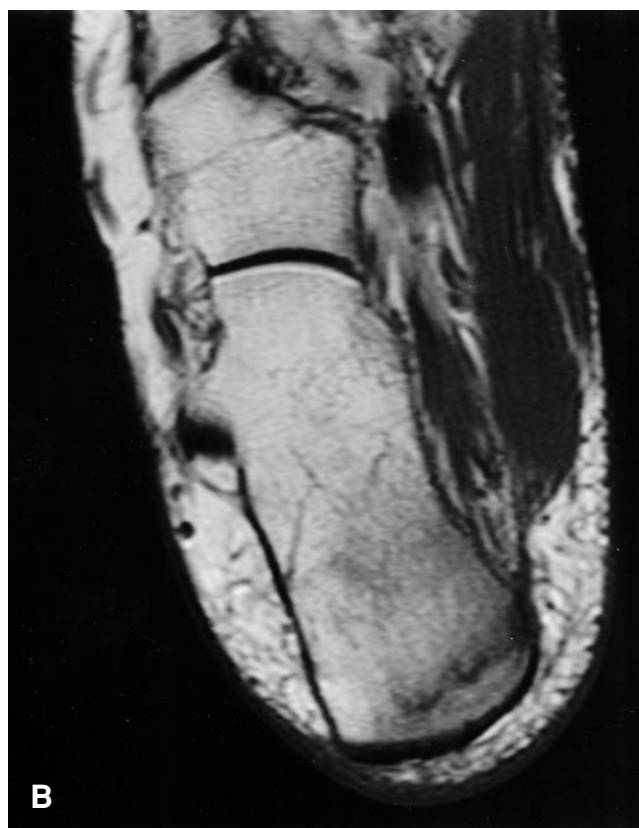
Clinically, spontaneous onset of severe pain in a lower extremity, with tenderness and swelling localized over the adjacent bone rather than the joint, as well as functional impairment, are the main symptoms<sup>11</sup>. The insidious onset, absence of a history of trauma, and physical findings suggesting an inflammatory/infectious process, in the setting of arthritis, make it somehow difficult to consider fracture as the primary diagnosis, especially in primary care<sup>12</sup>. Several risk factors for the development of osteoporosis in elderly patients usually occur in the same patient. In addition to age, gender, and race, the use of corticosteroids is of great importance<sup>13</sup>.

In contrast to other studies of IF where the diagnostic technique of choice for IF was based mainly on procedures such as CT and bone scan, we found MRI to be diagnostic in the majority of our patients. In the early stage, 5 patients had radiographs, and all were normal. In our review of patients, diagnosis was based on MRI in 6 cases, and CT in one. Typical MRI findings of IF consist of a linear zone of low signal intensity surrounded by a broader, poorly defined area of signal intensity alteration in the marrow space, with low signal intensity on T1-weighted and high signal intensity on T2-weighted and STIR images. Adjacent soft-tissue edema may also be present. Periosteal callus formation appears as a low signal rim running parallel to the cortex.

Table 1. Main demographic features, location, diagnosis, and treatment in 6 patients with IF of the calcaneus or talus.

Patient	1	2	3	4	5	6
Age, yrs	79	66	74	83	69	72
Fracture location	Calcaneus right & left	Calcaneus	Calcaneus	Calcaneus	Calcaneus	Calcaneus
Initial diagnosis	Arthritis/sprain	Arthritis	Arthritis	Arthritis	Arthritis	Arthritis
Diagnostic delay, wks	1, 0.5	6	4	20	7	12
Risk factors						
Underlying disease	Osteonecrosis /atherosclerosis	RA + steroids	Diabetes mellitus	No	PAN + steroids	RA + diabetes mellitus
Previous fractures	Vertebrae	No	No	No	Vertebrae	No
Clinical features						
Pain on weightbearing	Yes	Yes	Yes	Yes	Yes	Yes
Pain at night	No	No	No	No	No	No
Pain improving with rest	Yes	Yes	Yes	Yes	Yes	Yes
Selective tenderness	Yes	Yes	Yes	Yes	Yes	Yes
Local swelling	Yes	Yes	Yes	Yes	Yes	Yes
Imaging diagnosis						
Plain radiograph	Not done, negative	Negative	Negative	Not done	Negative	Negative
Definitive diagnosis	MRI	MRI	MRI	MRI	MRI	CT
Treatment	Rest, NSAID	Rest, NSAID	Rest, NSAID	Rest, NSAID	Rest, NSAID, splint	Rest, NSAID, splint

RA: rheumatoid arthritis; MT: metatarsal; PAN: classic polyarteritis nodosa; MRI: magnetic resonance imaging; CT: computed tomography; NSAID: non-steroidal antiinflammatory drugs.



**Figure 1.** Plain radiograph and magnetic resonance imaging (MRI) in a 69-year-old woman with an insufficiency fracture of the calcaneus. A. Lateral plain radiograph of the ankle: normal. B. Axial T1-weighted images show a linear fracture of low signal intensity surrounded by marrow edema. C. Sagittal T2-weighted fast SE MRI shows an irregular area of high signal intensity in the calcaneus.

Standard conservative treatment for IF consisted mainly of immobilization of the affected extremity, and analgesics. The disease course and outcome were favorable, with complete recovery in all patients.

IF of the calcaneus are relatively rare but can be frequently mistaken for ankle arthritis. A higher index of suspicion of this type of fracture may help avoid unnecessary diagnostic tests and treatment. IF should be considered in the differential diagnosis of unexplained persistent pain and swelling near a joint in patients with predisposing conditions. MRI is recommended because insufficiency fracture is difficult to detect on plain radiograph. Early diagnosis is important because the severe pain can be relieved by simple immobilization of the affected part.

## REFERENCES

1. Resnick D. Diagnosis of bone and joint disorders. Philadelphia: Saunders;1985:2580-96.
2. Alonso-Bartolome P, Martinez-Taboada VM, Blanco R, Rodriguez-Valverde V. Insufficiency fractures of the tibia and fibula. *Semin Arthritis Rheum* 1999;28:413-20.
3. Dafner RH, Pavlov H. Stress fractures: current concepts. *AJR Am J Roentgenol* 1992;159:245-52.
4. Kannus P, Pakkari J, Niemi S, Palvanen M. Epidemiology of osteoporotic ankle fractures in elderly persons in Finland. *Ann Intern Med* 1996;125:975-8.
5. Lee JK, Yao L. Stress fractures: MR imaging. *Radiology* 1988;169:217-20.
6. Umans H, Pavlov H. Insufficiency fracture of the talus: Diagnosis with MR imaging. *Radiology* 1995;197:439-42.
7. The WHO study group. Assessment of fracture risk and its application to screening for postmenopausal osteoporosis. Technical Report Series 843. Geneva: World Health Organization; 1994.
8. Arnet FC, Edworthy SM, Bloch DA, et al. The American Rheumatism Association 1987 revised criteria for the classification of rheumatoid arthritis. *Arthritis Rheum* 1988;31:315-24.
9. Lightfoot RW Jr, Michet BA, Bloch DA, et al. The American College of Rheumatology Criteria for the classification of polyarteritis nodosa. *Arthritis Rheum* 1990;33:1088-93.
10. Schneider R, Kaye JJ. Insufficiency and stress fractures of the long bones occurring in patients with rheumatoid arthritis. *Radiology* 1975;116:595-9.
11. Jones G, Jawad A. Another look at stress fractures in rheumatoid arthritis. *J Rheumatol* 1984;11:867-8.
12. Pease CT. Insufficiency fractures of the distal tibia. *Br J Rheumatol* 1994;33:1056-9.
13. Hoyman JR, Melton LJ, Nelson AM, O'Fallon WM, Riggs BL. Fractures after rheumatoid arthritis: a population-based study. *Arthritis Rheum* 1984;27:1353-61.