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PII: S2667-3967(23)00020-4

DOI: <https://doi.org/10.1016/j.fastrc.2023.100282>

Reference: FASTRC 100282

To appear in: *Foot & Ankle Surgery: Techniques, Reports & Cases*

Received date: 18 February 2023

Accepted date: 11 March 2023

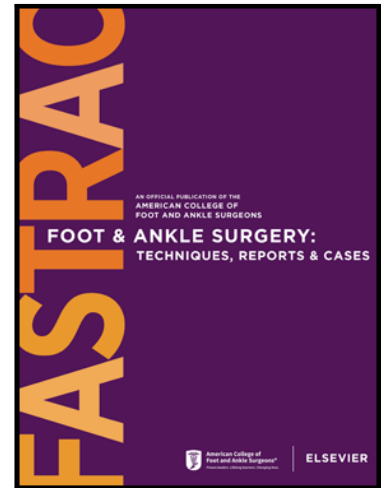
Please cite this article as: Kyleigh Pierson , Gabriel Hamawi , Zach Pierson , Andrew Cohen , Insufficiency Fracture of the Body of the Calcaneus: A Case Study, *Foot & Ankle Surgery: Techniques, Reports & Cases* (2023), doi: <https://doi.org/10.1016/j.fastrc.2023.100282>

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Insufficiency Fracture of the Body of the Calcaneus: A Case Study

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The authors have no conflicts of interest to declare and no financial gain. We would like to dedicate this work to patients with insufficiency fractures of the body of the calcaneus.

Abstract:

Insufficiency fractures of the body of the calcaneus are a rare pathology, typically seen in women with osteoporosis. Our patient was seen by multiple physicians over the course of the year with no symptomatic relief. Her previous treatments included serial heel injections, physical therapy and non-weight bearing in a short leg synthetic cast. Initial radiographs revealed no osseous pathology that correlated with the area of pain and swelling. Magnetic resonance imaging (MRI) was obtained which suggested findings for an insufficiency fracture with increased signal intensity on T2 and decreased signal intensity on T1 in the calcaneus. The patient opted for surgical management and underwent subchondroplasty and repair with microfracture of the left calcaneus. At the first post-operative appointment she had significant pain relief, and she was later able to resume her previous activities pain free. This case demonstrates the importance of maintaining insufficiency fractures as a differential diagnosis and the success of using microfracture and subchondroplasty when non-surgical measures have failed.

Introduction

Stress fractures are categorized into two subtypes, fatigue fractures and insufficiency fractures. A fatigue fracture happens when abnormal stress is applied to a bone with normal elastic resistance. An insufficiency fracture happens when physiologic stress is applied to a bone with abnormal elastic resistance.² Common risk factors include, but are not limited to, women, long-term corticosteroid use, geriatric population, those with connective tissue disorders, and other conditions which lead to osteoporosis, such as rheumatoid arthritis, diabetes mellitus, hyperparathyroidism, etc^{1-3,6,9}. Insufficiency fractures of the calcaneus are often overlooked and misdiagnosed due to absent or subtle radiographic evidence which leads to delayed treatment.¹⁻

^{4,6,7} Insufficiency fractures of the calcaneus are typically caused by trauma and/or repetitive activity ^{1-4,6,7}. Patients taking bisphosphonates for osteoporosis are at an increased risk of stress fractures.^{2,4} Conservative treatment should be used as first line therapy.⁷⁻⁹ However, surgical intervention may be required if conservative measures fail, as seen in our patient.

Subchondroplasty is a relatively new procedure, first described in 2007, for treatment of bone marrow lesions in the knees.^{3,5} Literature has provided evidence for the use of subchondroplasty for osteochondral defects (OCD) of the ankle, talus, and avascular necrosis of the talus.¹⁻⁵ Microfracturing has also been utilized for treatment of OCD for ankles and knees where it provides the body's own natural bone for remodeling.³ There has been well documented literature for conservative management for non-operative calcaneal insufficiency fractures.^{6,7,10} To the best of our knowledge, however, there is minimal published literature that has discussed the management of non-union insufficiency fractures of the calcaneus when conservative treatment has failed and is treated with subchondroplasty and microfracturing. Our case demonstrates a patient with non-union insufficiency fracture who was able to resume her previous activities of daily living after being treated with subchondroplasty and microfracturing.

Case Report:

A 47-year-old female with a past medical history of rheumatoid arthritis, osteoporosis, cutaneous Lupus, and Raynaud's phenomenon presented with chronic left heel pain for over one year. She denies any history of trauma to the area. She had previously been treated by other physicians in the area with immobilization, steroid injections, physical therapy and laser therapy. Her past surgical history was unremarkable in regards to the left foot. She had no known drug allergies and was taking Fosamax, calcium carbonate, Enbrel and Procardia XL. Her family history was not significant for cancer. She smokes approximately one pack per week, drinks socially, and denies using any illicit drugs.

On physical examination, her left foot revealed normal, full, pain-free range of motion at the metatarsophalangeal, ankle, and subtalar joints. No crepitus was noted at the subtalar or ankle joints. Tenderness was noted on direct palpation of the calcaneus. No edema, erythema, and ecchymosis was noted to the left foot. Tenderness was noted on palpation to the calcaneus near insertion of Achilles tendon and extending to the plantar calcaneus. Calcaneal squeeze sign was negative. There was also tenderness on palpation to the ankle joint. Calcaneal tenderness was noted with ankle dorsiflexion and weight bearing. Neurovascular examination was unremarkable. Radiographic examination consisted of multiple views of the left foot and ankle, which revealed no osseous pathology that correlated with the area of pain and swelling. Three months prior a bone scan was performed, ordered by her primary care physician, which showed increased radiotracer uptake in the body of the left calcaneus, she was then referred to our clinic.

Radiographs of foot and ankle in the office were unremarkable apart from an infra-calcaneal heel spur. Future imaging was acquired: MRI was positive for insufficiency fracture

with hyperintense signal on T2 and hypointense signal on T1 overlying the calcaneal tuberosity posterior superiorly and involves cortical bone as seen in figure 1 and figure 2. At this time the patient elected to proceed with surgical management to alleviate pain.

Surgical Technique: Subchondroplasty with Microfracturing

The patient, who had received a popliteal block from anesthesia, was brought into the operating room and placed on the operating room table in the supine position. Left thigh tourniquet was applied accordingly. Anesthesia was administered and the left lower extremity was prepped and draped in the usual aseptic manner and tourniquet inflated. Approximately a 4-cm longitudinal incision was made just proximal to the insertion of the Achilles tendon and diagonally near the insertion of the plantar fascia and the plantar calcaneus. The incision was deepened down to the level of the subcutaneous tissue then further advanced to the level of the calcaneus. Soft tissue was freed from the area of the incision off the calcaneus to allow for drilling into the calcaneus. An 11-gauge drill was utilized to drill converging holes through the calcaneus to allow back fill to spill into multiple holes and treat the insufficiency fracture. After the holes had been created, the drill was left in place in the central most hole, which would allow for backfilling into all of the drilled holes. The mineral phosphate compound was then filled into the predrilled holes and all backfilled holes. This can be appreciated in figure 3. Any excess was then wiped and removed from the bone surface. It was allowed approximately 15 minutes to dry and an additional image was taken to confirm that all holes had been backfilled (this can be appreciated in figure 4 intraoperatively). After this was confirmed, attention was then directed towards closure where 3-0 Vicryl was utilized to reapproximate the deep tissue and then 4-0 nylon was utilized in a horizontal mattress fashion to reapproximate the skin. The foot was then dressed with 4 x 4's, fluffs, and Kling wrap, and a short-leg synthetic cast with the left ankle in flexion 90 degrees to the leg. The tourniquet was deflated and good digital perfusion was noted to return to all toes. Patient was then followed for six months in the post-operative course, and we utilized the visual analog scale (VAS) to assess her pain.

Post-operative course: patient was seen three days post-op and noted a significant decrease in her pain, reporting 1/10 pain. Non-weight bearing with short leg synthetic cast was continued until her five week follow up visit. At her five week follow up visit she reported 0 for pain and was made full weight bearing as tolerated in a tall CAM boot and was encouraged to perform active and passive ROM. Patient continued to progress and returned to full activity without pain by postoperative week 14 with no pain. At week 26, the patient reported a full return to activity with no pain and ambulating in tennis shoes. Radiographs at each post op visit showed complete consolidation of the bone graft as seen in figure 3.

Discussion:

An insufficiency fracture of the body of the calcaneus tends to be forgotten in the differential diagnosis unless it is suspected.⁹ The clinical features of our patients were useful in

directing our attention toward this fracture. The patient's pain was elicited with mechanical forces and upon ambulation. There was no history of trauma or repetitive activity. She was previously treated for plantar fasciitis by receiving corticosteroid injections and NWB in a short leg synthetic cast with no relief of her symptoms. Our patient was diagnosed with osteoporosis and Rheumatoid arthritis, and a smoker which increased her risk for an insufficiency fracture as documented in literature.¹⁻⁴ She was also taking Fosamax for osteoporosis which can lead to weakening of bone integrity.¹⁻⁴ On physical examination, the patient had edema and tenderness to the left calcaneus and ankle. Radiographs of the left foot and ankle were unremarkable for any acute osseous process. MRI was diagnostic and determined the location of the fracture by bone marrow edema remarkable for a fracture which has not healed. Despite the delay in proper diagnosis of the calcaneal insufficiency fracture, the patient's outcome with surgical intervention was successful. In this case report the patient had reported significant pain relief in post op day three and no pain for the remainder of her post op visits. Godvairne et al. discussed a case study of an 82 year old male with osteoporosis and Rheumatoid arthritis with an insufficiency fracture of the right calcaneus. The patient had right heel tenderness for over 18 months and had failed three months of non-surgical management. Godvairne et al. performed a percutaneous cement calcaneoplasty with significant pain relief at the 12 week postoperative appointment. Their goal was very similar to ours in which to surgically handle the defects doing so will mimic the body's own natural bone to remodel.

Conclusion:

Insufficiency fractures may be difficult to diagnose due to the nonspecific presentation of symptoms without history of inciting incidents. Physicians should include insufficiency fractures in their differential diagnoses for patients who present with localized pain without a history of trauma. This case shows that subchondroplasty with microfracturing is a viable treatment option for those patients who fail non-surgical treatment. Whenever a patient has a significant history of osteoporosis or any other pathology which reduces bone density, especially female patients that have pain in the calcaneus and or ankle region with no significant trauma. The possibility of insufficiency fracture of the body of the calcaneus should be considered. MRI should be utilized to help diagnose insufficiency fractures when the patient is not improving with non-surgical treatment. Proper surgical technique with subchondroplasty with microfracturing is a viable treatment option for those patients who fail non-surgical treatment with relief of pain in the postoperative course.

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