



## Isolated "Nutcracker" Fracture of the Anterior Calcaneal Process: Do We Need a More Comprehensive Classification for this Injury Spectrum? A Case Report

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### Abstract

Fractures of the anterior calcaneal process are relatively rare accounting for 3% to 15% of all calcaneal fractures and can occur due to high or low energy trauma. Avulsion fractures are generally due to forced inversion and plantar flexion of the foot and are associated with ligament tears. More rare impaction fractures, i.e. nutcracker fractures, are commonly described as due to a forced eversion and abduction of the foot with compression forcing the anterior process of the calcaneus against the cuboid. Clinical features are subtle and X-ray examination for the diagnosis of anterior calcaneal process fracture is challenging. A CT examination can reveal the fracture and should be performed whenever a doubt exists for correct diagnosis. Here we present the unique clinical case of a 44ys old female patient who suffered an isolated compression fracture of the anterior calcaneal process due to a fall from a stair with forced foot eversion and low energy trauma mechanism. The patient healed uneventfully with a conservative treatment. A more comprehensive classification of this spectrum injury is sought as many different fracture or combined bone-ligamentous lesions exist requiring different surgical or non surgical management. Actually, no clear guidelines exist in literature assisting the treating physician in the management of such challenging lesions.

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**Keywords:** Isolated anterior calcaneal process fracture; Nutcracker fracture; Midtarsal sprain; Chopart fracture-dislocation

### Introduction

Anterior calcaneal process fractures are rare, accounting for 15% of all calcaneal fractures [1-3]. Compression, i.e. "nutcracker" fractures of the anterior calcaneal process are described as caused by a forceful eversion of the foot and are often associated with other fractures or dislocations of the midfoot [1-3]. They can be due to low energymidtarsal sprain or high energy trauma mechanism and involve the calcaneo-cuboid articular surface differently from inversion mechanism, where an intact articular surface is left [4-6]. Isolated nutcracker fractures of the anterior calcaneal process due to low energy mechanism are exceedingly rare [7,8]. Subtle clinical presentation and difficult X-ray interpretation due to bone overlap make a high suspicion index necessary for a correct diagnosis and appropriate management as such fractures are often misdiagnosed in the emergency setting as ankle sprain [7-9].

Here we present the unique clinical case of a 44ys old female patient who suffered an isolated compression fracture of the anterior calcaneal process due to a fall from a stair with forced foot eversion and low energy trauma mechanism.

### Case Presentation

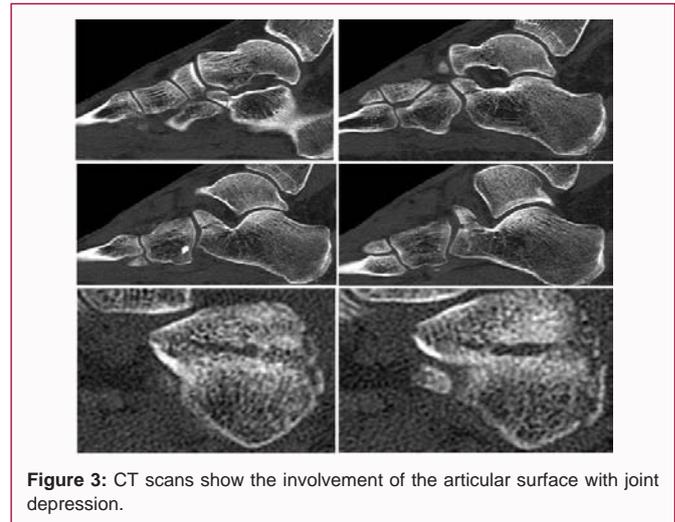
A 44ys old female nurse with no sensitive medical history presented to the Emergency Ward of Our Department due to a fall from stairs at home. The patient referred she had suffered few hours earlier an ankle sprain; she described an eversion/abduction trauma mechanism of the foot. The patient revealed that she heard at the moment of the trauma a sudden "clunk" along her lateral foot side, followed by impossibility to walk. The physical exam revealed ankle swelling and ecchymosis along the lateral calcaneal side. An elective pain was present over the calcaneo-cuboid joint and along the course of the fibulotalar ligament. Stress tests did not reveal instability of the subtalar ormidtarsal joint.



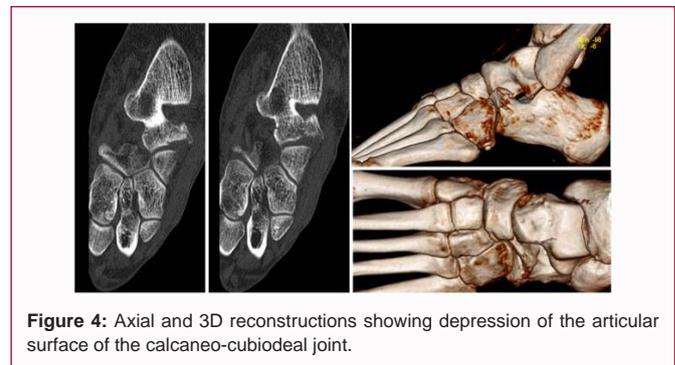
**Figure 1:** a) Antero-posterior and b) lateral X-ray imaging of the left foot. Fracture rim is not visible in conventional views.



**Figure 2:** a) Dorso-ventral and b) 20° oblique X-ray imaging of the left foot demonstrate fracture rim involving the anterior process of the calcaneus.



**Figure 3:** CT scans show the involvement of the articular surface with joint depression.



**Figure 4:** Axial and 3D reconstructions showing depression of the articular surface of the calcaneo-cuboidal joint.

The X-ray examination in the lateral view and AP view was unremarkable for fractures (Figure 1). However the lateral 20° view of the foot revealed a fracture rim along the anterior calcaneal process (Figure 2). A CT scan was performed and confirmed the diagnosis of compressive anterior calcaneal process fracture (Figure 3 and 4) no further bony lesions were assessed at the CT examination. Due to the preserved length of the lateral column of the foot and the absence of marked instability or displacement, the patient was managed with a conservative treatment consisting of below the knee paris plast without weight bearing for 6 weeks and then progressive weight bearing assisted with cans for further 4 weeks and range of motion exercises of the ankle. The patient healed uneventfully without complaining of foot instability or chronic pain.

### Discussion

The anterior portion of the calcaneus body is a distinct, well recognized and clinically important part of this bone; despite the lack of an official anatomic term, it is reported in literature as the anterior process of the calcaneus [10]. It is a saddle shaped osseous process that participates to the calcaneo-cuboid joint and forms the anterior subtalar joint superiorly. A ligamentous network consisting of the bifurcate ligament and interosseous ligament joins the anterior calcaneal process with both the navicular and cuboid. Fractures of the anterior calaneal process are relatively rare accounting for 3-15% of all calcaneal fractures [1-3] and can occur due to high or low energy trauma. Avulsion fractures are generally due to forced inversion and plantarflexion of the foot and are associated with ligamentous tear of dorsal talonavicular, dorsal calcaneocuboid and bifurcate ligaments

[1-3,7-9]. More rare impaction fractures, i.e. nutcracker fractures, are commonly described as due to a forced eversion and abduction of the foot with concomitant axial compression forcing the anterior process of the calcaneus against the cuboid [7]. The impaction force propagates through the medial side of the foot generally involving the navicular bone or other bones and midtarsal ligaments, presenting mainly as an associated fracture [11-12]. Degan et al. [13] classified the anterior calcaneal process into three types according to the fragment extension and dislocation and this classification is often cited to decide whether a conservative (type I and II) or surgical (type III) management has to be considered.

Due to similar causative mechanisms and comparable clinical symptoms with ankle sprain, anterior calcaneus process fracture with midtarsal sprains are often missed at diagnosis in the emergency setting. Besides, anterior calcaneal fractures are particularly challenging to diagnose on plain radiographs [14-15] due to bone overlap obscuring the midfoot bones. The reported incidence of missed fractures at the Chopart joint on radiographs ranges from 6% to 41% in the literature [16-18]. However, the distinction between the two conditions is of paramount importance because of the different biomechanics of the joints and an improper management of midtarsal sprain with associated anterior calcaneal process fractures could lead to persistent pain and chronic instability with the development of the cuboid syndrome [19-21].

Clue elements for an appropriate diagnosis, apart a high suspicious index due to injury pattern, are an elective tenderness over the calcaneocuboid joint located 1 cm inferior and 3 cm to 4 cm anterior to the lateral malleolus and a plantar or lateral ecchymosis.

X-ray examination for the diagnosis of anterior calcaneal process fracture is challenging: oblique X-ray of the foot or a lateral foot view can reveal the fracture although directing the beam 20 degrees superior and posterior to the mid portion of the foot can project the APC away from the talar neck, thus improving fracture visualization [1-3,7,19-21]. A CT examination can reveal the fracture and should be performed whenever a doubt exists for correct diagnosis [1-3,7,19-21].

The unicity of our case is that a "nutcracker" fracture of the anterior process of the calcaneus occurred with no associated lesions of other midtarsal bones and with a low energy mechanism, differently from other cases reported in literature [18]. The lack of the navicular avulsion fracture, described as a fracture pattern associated with calcaneal "nutcracker" fractures, reveals a wide spectrum of different patterns of lesions involving the anterior calcaneal process during forced abduction and eversion of the foot according to the magnitude of involved forces. A more comprehensive classification of such lesions should be sought as a deeper knowledge of the different existing fracture pattern may affect the clinical management and final outcome of such lesions.

The low energy trauma (fall from stairs), supports the hypothesis that an insufficient trauma force is unable to cause additional fractures or ligament fracture avulsions through a medial propagation towards the navicular bone. Medial or capsular lesions could be expected. According to Hirschmann et al. [7], a MRI in the acute setting seems to be inappropriate when an accurate diagnosis based on X-ray and CT is done. Such exam should be performed when unclear clinical symptoms or non conclusive previous imaging are present.

Although no clear guidelines exist in literature for the treatment of midtarsal sprain and associated fractures, Open Reduction And Internal Fixation (ORIF) is usually reserved for displaced (>2 mm) large fragments (>1 cm) involving the calcaneo-cuboid joint [22] or in cases of associated non reducible midtarsal dislocation. A conservative treatment consisting in a below the knee cast immobilization with no weight bearing for 6 to 8 weeks and then a progressive weight bearing and range of motion exercises seems to afford good clinical results [22-23] in the treatment of non displaced or minimally displaced fractures. Failure to diagnose and properly treat calcaneal fractures caused by lateral column compression in a timely manner can lead to severe chronic disability due to lateral column shortening, valgus deformity, and malalignment of the foot.

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