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## Fracture of the entire posterior process of the talus: A case report and review of the literature

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### Abstract

Although fractures of talus and talar neck are relatively common, fracture of entire posterior process of talus is very rare. Since this injury is rarely encountered, most of the available information comes from previously published case reports. Unfortunately there is no extensive review of these published cases in the relevant literature. We described a 28 year-old patient who had a fracture of entire process of talus that occurred while playing volleyball. The patient underwent open reduction and internal fixation through posteromedial surgical approach. At the final follow-up 18 months after the initial injury, the patient was free of pain and returned to his previous level of activity and work. Herein, all previously published cases were reviewed and its demographic and clinical characteristics, imaging findings and treatment options were discussed. This fracture is usually resulting from high energy trauma in young patients. The diagnosis may be missed. Open reduction and internal fixation is a good option for the treatment.

**Keywords:** Talus, posterior process fracture, open reduction

### 1. Introduction

Talus is an anatomically complex bone that consists of a body, a head and a neck. There are two bony processes that project from the body of talus, namely *lateral* and *posterior* processes. The posterior process is composed of medial and lateral tubercles and constitutes the 25% of the posterior subtalar joint [1, 2]. Fracture of posterior process of talus may involve medial tubercle (Cedell fracture) or lateral tubercle (Shepherd's fracture) as an isolated fracture [3, 4]. On the other hand, fracture of entire posterior process of talus is rare [5]. Since this injury is rarely encountered, most of the available information comes from previously published case reports. Unfortunately there is no extensive review of these published cases in the relevant literature. Herein, we describe a case with fracture of entire process of talus. We also reviewed all previously published cases and discussed its demographic and clinical characteristics, imaging findings and treatment options.

### 2. Case report

A 28-year-old male was admitted to the emergency department after sustaining an ankle sprain during a volleyball match. According to his descriptions, he sustained an inversion and plantar flexion injury to his right ankle during landing on his right foot after jumping. On presentation, he was unable to weight bear and there was slight edema over the ankle joint without ecchymosis or deformity. On physical examination, there was tenderness at the posterior aspect of medial malleolus. Ankle range of motion was painful, particularly with plantar flexion, and slightly restricted. Neurovascular examination revealed no abnormality.

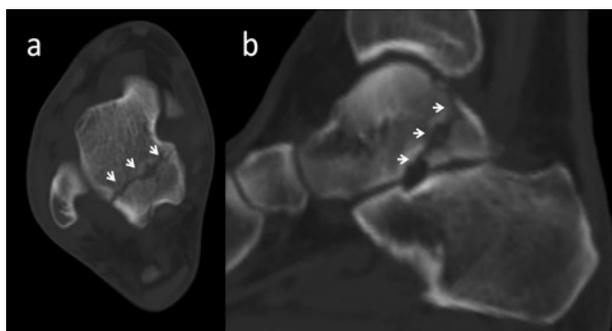
Plain radiographic examination of the ankle demonstrated a fragment of bone at the medial aspect of the body of the talus on the anteroposterior (AP) view and posterior to the body of the talus on the lateral view (Figure 1). Further CT imaging of the ankle revealed a fracture of the entire posterior process of the talus (Figure 2). As the fracture was involving the majority of the posterior subtalar facet open reduction and screw fixation was planned.

Under spinal anesthesia and tourniquet control, posteromedial approach was used to expose

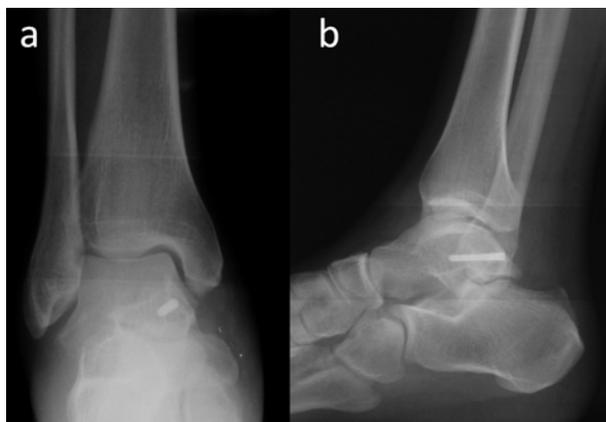
the fracture. During dissection the neurovascular bundle was protected. After reduction of the fragment, a cannulated headless compression screw was used for fixation (Figure 3 and 4). A below knee plaster cast was applied to the patient. Postoperative period was uneventful. At the end of 6<sup>th</sup> week, plaster cast was removed and active ankle range of motion exercises was started and gradually increased without weight bearing. At the end of 8<sup>th</sup> week weight bearing was allowed. At the final follow-up 18 months after the initial injury, the patient was free of pain and returned to his previous level of activity and work.



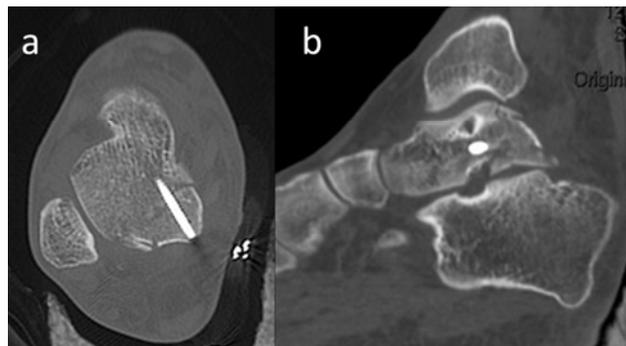
**Fig 1:** Plain radiographic examination of the ankle demonstrated a fragment of bone at the medial aspect of the body of the talus on the anteroposterior (AP) view, and posterior to the body of the talus on the lateral view



**Fig 2:** CT imaging of the ankle revealed a fracture of the entire posterior process of the talus



**Fig 3:** Plain radiographic examination of the ankle after reduction of the fragment, a cannulated headless compression screw was used for fixation



**Fig 4:** CT imaging of the patient postoperatively.

### 3. Discussion

Talus fractures constitute 0.32% of all fractures and usually involve talar head and neck [6]. Fracture of entire process of talus is very rare in the literature. To the best of our knowledge, 19 cases have been reported up to date (Table 1). There is no epidemiological data regarding this fracture type. According to our literature review, there were 5 female and 15 male patients and the mean age of the reported patients was 30.3±13.3 (range, 13-59). Most of the patients were young active males similar to our case.

These fractures commonly caused by high-energy trauma, like fall from a height or a motor vehicle accident (11 out of 20 reported cases) [7]. The exact mechanism of the fracture is not clear, but probably hyper-plantar flexion of the ankle that leads to entrapment of posterior part of the talus between tibia and calcaneus is responsible mechanism of injury. Nasser and Manoli reported a case with hyperplantar flexion of the ankle and compression of the posterior talus [8]. However, Heckman proposed forced inversion of the foot as the responsible mechanism of injury for this fracture pattern [9]. On the other hand, medial or lateral tubercle fractures have been frequently caused by avulsion injury secondary to a pronation-dorsiflexion force, which cause tension at the origo of the posterior talotibial ligament [10]. In contrast to entire process of talus fractures, tubercle fractures may be seen following low energy ankle sprains [11]. This type of injury may seen in athletes and dancers, especially those with frequent plantar flexed of the foot, as in soccer and ballet players [12, 13]. We thought the injury mechanism is inversion and hyper-plantar flexion in our case based on the history taken from the patient. Clinically, posterior talar process fracture can be suspected in patients with a history of hyperplantar flexion injury and pain on the posterior malleolus. Pain on palpation to the posterior triangle, and pain with active range of motion of the great toe also supports the diagnosis as the flexor hallucis longus passes between the two tubercles. However, the most reliable clinical indicator is the presence of a positive *nutcracker sign*, which presents as pain on the posterior aspect of ankle created with forced plantar flexion of the ankle [14, 15]. In our patient, there was tenderness at the posterior aspect of medial malleolus and also ankle range of motion was painful, particularly with plantar flexion.

The diagnosis of posterior process fractures may be missed due to detection of these fractures can be challenging on direct radiography. Undiagnosed or delayed diagnosis may result with several complications, thus CT should be ordered in case of suspicion [16]. CT provides cortical details to distinguish a posterior process fracture from the other type of fractures which may not be realized with standard radiographs. CT is also helpful in determination of fracture type and associated dislocations. Subtalar dislocation rarely occurs but it is

important to diagnose associated process or tubercle fractures with CT. Most commonly seen complication is neglecting this type of fractures as other fractures of talus [17]. Subtalar post-traumatic arthritis can be seen after neglecting these fractures. If there any suspicion about the soft tissues, MRI can be obtained to diagnose [18]. Nuclear medicine imaging can be used in order to diagnose occult fractures of the hindfoot. We evaluated the patient with CT preoperatively and indication of surgery was considered when we observe the fracture pattern.

The treatment methods are controversial in posterior talus fractures. Nonsurgical management may be considered for acute process and tubercle fractures with small (<1 cm), minimally displaced (<2 mm) fragments [19]. Posterior talar process fractures are treated with 4 to 6 weeks of non-weight bearing in a short leg cast, with early range of motion to protect flexor hallucis adhesion. Other conservative therapies are the use of non-steroidal anti-inflammatory drugs and corticosteroid injections.

Surgical management of talar tubercle fractures should be strongly considered for large (>1 cm), displaced (>2 mm) fragments with articular involvement. Surgery consists of open reduction and internal fixation (ORIF) for large fragments, primary excision in highly comminuted fractures, and delayed excision for chronic nonunions. If bony fragment is large, open reduction and internal fixation can be considered while excision can be necessary if they are smaller. Headless cannulated screws or bio-absorbable screws can be used. Cancellous grafting may be necessary for stable fixation. First six-week the treatment can be achieved by short-leg cast and range of motion exercises can be began after 8 weeks with weight-bearing [19]. We used posteromedial approach for fixation of the fracture and osteosynthesis was achieved by cannulated screw.

Complications of talar fractures are common and can vary.

The worst complication is avascular necrosis resulting from decreased blood supply to the talus. Posttraumatic arthritis is another common complication after talar fractures seen nearly %100 in some series [20, 21]. Arthritis seen in the talonavicular and ankle joints, but in general affects the subtalar joint. This condition may be caused by combination of compression and shearing forces between the talus and calcaneus during injury while in damage to cartilage [22]. Although arthritis is a common sequela of talus fractures, it may be asymptomatic. Symptomatic cases of posttraumatic arthritis can be treated by conservative treatments including bracing, orthoses, ankle-foot orthoses, and activity modification. When conservative treatments fail, other options can be applied, such as arthrodesis of the affected joint.

On review of the literature, first displaced posterior tubercle fracture reported in a 20 years-old woman whom had an inversion injury. This case was referenced in Heckmann's article [9]. But, there is no long-term follow up about this patient. The other literature about posterior process fractures of talus that we came across were only case reports. Within this, some of these case reports are only posterior process fractures while others had an additional injury like medial subtalar dislocation, medial malleol fracture, navicular fracture, subtalar fracture-dislocation and 5th metatarsal base avulsion fracture [8, 23-28]. Some of these fractures treated conservatively while others treated by surgery [17, 23, 29, 30]. Good results are reported in some conservative treatments but more satisfactory results reported from open reduction and internal fixation [8, 24-28, 31-34]. Our case has a history of injury by inversion and hyperplantar flexion as described in the literature. We followed-up our patient 18 months and patient returned to his daily activity pain free. We thought that open reduction and internal fixation is a good option while treating such injuries.

**Table 1:** Previously reported cases with fracture of entire process of talus in current English literature

Author	Year	Age	Sex	Mechanism of injury	Associated injuries	Treatment	Follow-up (duration)	Outcome
Nasser S	1990	31	M	Fall from height	Avulsion fracture of the base of the fifth metatarsal	ORIF Cancellous screw	32 months	Limitation of great toe dorsiflexion.
Stutz JM	1991	13	M	Not reported	Subtalar fracture-dislocations	Closed reduction, Conservative	Absent	Successful
Jimulia TR	1995	25	M	Fall from height	-	Conservative	3 months	Excellent
Chen YJ	1996	52	M	Motorcycle accident	Dislocation of the talonavicular and talocalcaneal joints	ORIF Mini-screw	32-months	Excellent
Nyska M	1998	30	M	Fall from height.	-	Conservative	24 months	Painful limitation in subtalar motion.
		40	F	Inversion injury	-	Conservative	36 months	Subtalar arthritis, mild limitation in ankle motion and pain
		20	F	Inversion injury	-	Conservative	36 months	Painful limitation in ankle and subtalar motion
		30	M	Fall from height	-	Conservative	24 months	Painfull limitation in ankle and subtalar motion
Nadim Y	1999	19	M	Fall from height	-	ORIF-cannulated Herbert screw and K-wires	18 months	Excellent
Iyakutty PP	2000	26	F	Fall from height	-	ORIF-cannulated cancellous screw	12 months	Minimal restriction of ankle joint and subtalar joint motion.

Bhanot A	2004	19	M	Scooter crash	No	ORIF cannulated screw	12 months	Excellent
		22	M	Fall from height	Fracture of medial malleolus	ORIF cannulated screws and K-wire	12 months	Minimal restriction of ankle ROM
Nakai T.	2005	14	M	Jumping during a football match	No	ORIF Cannulated screw	12 months	Excellent
Ahmad R	2007	50s	F	Slipped off decking and landed	No	Conservative	Not reported	Not reported
Liu Z	2013	17	M	Basketball game	Medial subtalar dislocation	Lateral tubercle was excised and ORIF with absorbable screws for medial tubercle	12 months	Excellent
Mehrpour SR	2012	31	M	Motorcycle accident	No	ORIF- headless compression screw	9-month	Excellent
		59	M	Motor vehicle accident	-	ORIF- headless compression screw	9-month	Excellent
Mao H	2015	31	F	-	Medial subtalar dislocation and navicular fracture	ORIF Cannulated screw and K-wires		Good
Park CH	2016	50	M	Fall from height	Medial subtalar dislocation	ORIF Headless compression screws	13 months	Excellent
Current case	2016	28	M	Volleyball	No	ORIF Headless compression screws	18 months	Excellent

#### 4. Conclusion

Fracture of the entire posterior process of the talus is a rare injury. This fracture is usually seen in young patients following high energy trauma. Inversion and hyperplantar flexion of the ankle is the responsible mechanism of injury. The diagnosis at initial admission with radiographs may be missed due to difficult interpretation. Further imaging modalities should be ordered in case of suspicion. Surgical management of talar tubercle fractures should be strongly considered for large (>1 cm), displaced (>2 mm) fragments with articular involvement. Open reduction and internal fixation with compression screws usually result with excellent outcome.

#### 5. Compliance with Ethical Standards

**5.1 Conflict of interest statement:** All authors have no conflict of interest

**5.2 Funding:** No funds have been received for this study.

**5.3 Ethical approval:** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**5.4 Informed consent:** Informed consent was obtained from the patient

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