



Long-term follow up of talus fractures; the surgical treatment outcome of 30 cases after 5 years

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Abstract

Talus fractures are rare and usually the result of high-energy trauma. These fractures compromise motion of the foot and ankle and result in severe disability. Therefore a satisfactory clinical outcome remains a challenge in the treatment of talus fractures. Complications like posttraumatic arthritis, avascular necrosis, malunion, and nonunion invariably occur in talus fractures. Follow-up periods in most studies are too short to analyze precisely these complications. The aim of our study was to evaluate the clinical and radiological outcome of 30 displaced talus fractures who were treated operatively with a long follow-up of 5 years. Patient records and radiographs were reviewed to determine the mechanism of injury, fracture type, associated injuries and surgical intervention. The fracture had occurred in the neck of the talus in 15 feet, the body of the talus in 8 feet, the head in 2, lateral process in 4 and the posterior process in 1. Six patients (20%) presented an osteonecrosis of the talus. At five year follow-up, 18 (60%) patients presented post-traumatic osteoarthritis in at least one ankle joint and only ten patients (45%) had a normal hindfoot alignment at 5 year follow-up (8 cases of arthodesis excluded). Clinical outcome based on ankle-hindfoot scoring was rated as excellent in 5 feet, good in 12, fair in 9, and poor in 4 at the end of 5 years.

Keywords: talus, trauma, surgery, long term results, complications.

Introduction

Talar fractures are rare and represent 3% of foot fractures^[8]. Talar neck fractures account for almost 50% of all talus fractures. Talus fractures compromise motion of the foot and ankle and result in severe disability. Talar neck or body fractures usually follow high-energy injuries and arise from an excessive dorsiflexion of the foot with an axial compression^[12,13, 21]. As the axial-loaded dorsiflexed foot becomes externally rotated and/or everted, fracture of the lateral process of the talus occurs. The outcome after fracture of the lateral process of the talus in snowboarders is favorable provided an early diagnosis is made and

adequate treatment undertaken. Fractures of the posterior process of talus can involve either medial or lateral tubercle depending upon the mechanism of injury. An inversion injury of ankle may avulse lateral tubercle by force transmitted through posterior talo fibular ligament. Talar head fractures are very rare and result from compressive force of talonavicular joint with a plantar flexed foot and hence may be associated with subluxation or dislocation of the joint.

Fractures of the talar body are highly uncommon (13–23% of talus fractures) and present a greater risk for avascular necrosis than talar neck

fractures^[3, 13]. Sometimes, non displaced talar body fractures can be difficult to visualize adequately because of the shape of the tibiotalar articulation and the overhang of the anterior and posterior tibial plafond. Boyd and Knight have classified talar body fractures according to the plane of the fracture line. A type I fracture is a coronal or sagittal shear fracture, compared to a type II fracture which occurs in the horizontal plane^[4]. The most common mechanism of injury resulting in a shearing-type talar body fracture is a fall from a height resulting in axial loading. Most authors favour conservative treatment for undisplaced talar fractures, but displaced fractures require stable fixation and early physiotherapy to achieve the best results^[9, 15, 20]. The treatment of type I and type II talar neck fractures is not uniform in the orthopedic community. The option of closed reduction versus ORIF is dependent upon the degree of injury, surgeon experience, and preference. Avascular necrosis, malunion and osteoarthritis are the most frequent complications of talus fractures with variable incidences in the literature.

Materials and Methods

This retrospective study was done to assess the long-term outcome of all operated talus fractures who presented to us between between April 2011 and May 2013. They were followed regularly for two years and recalled again after 5 years of trauma (between 2016 and 2018) for assessment of functional outcome. A total of 34 patients met the inclusion criteria but 4 patients lost to follow up at 6 months and were excluded. Hence 30 patients who were available after 5 years were

reviewed by an independent observer. The study excluded undisplaced talar fractures and all those fractures who were managed conservatively due to one or the other reason. Among the reviewed patients, there were 22 men and eight women with an average age of 34.17 years (range 19–57 years). High-energy injury occurred in 27 (90%) of the cases (16 road traffic accidents and 11 falls from height).

Preoperatively, X-rays and CT-scans were used to locate the talus fractures and define the fracture pattern and morphology. Talar neck fractures were defined as fractures anterior to the lateral process, whereas talar body fractures were defined as fractures extending to the lateral process or posterior to it^[14]. Talar neck fractures were classified according to the Hawkins classification^[12] modified by Canale and Kelly^[5]. For talar body fractures, we distinguished coronal and sagittal fractures on CT scan. There were 15 talar neck fractures and 8 talar body fractures. Six fractures were open (20%) and classified according to Gustilo and Anderson Classification (two type I, three type II and one type IIIa)^[11]. Three patients who had open fracture had fracture in neck of talus, and of which two were associated with fracture of ankle mortise. Other open injuries included two patients with isolated talar body fracture in coronal plane with medial malleolus fracture while one patient had crush injury of body along with talar neck and lateral malleolus fracture. There were no preoperative nerve or vascular injuries. Nine patients presented an associated injury of the ipsilateral ankle including six distal tibia fractures and three lateral malleolar fractures. Patient data can be found in Table 1.

Table 1

	No of cases	Male : Female	Mean age(yrs)	Closed/ Open	Associated injuries
Neck	15	11:4	35.43	12/3	4 (6%)
Body	8	5:3	34.38	5/3	4 (50%)
Head	2	2:0	31.28	2/0	—
Lateral Process	4	3:1	32.78	4/0	1(25%)
Posterior Process	1	1:0	37.00	1/0	—
Total	30	22:8	34.17	24:6	8 (24%)

Surgical Procedure

All patients were operated under spinal anesthesia on a radiolucent table and a tourniquet control. The goal of operative treatment was to obtain a near anatomic reduction of the fracture. Any of the standard anterolateral, posterolateral, posteromedial or anteromedial approach was used. The surgical approach depended upon the fracture pattern and hence a single or combined approach was used. Medial malleolus osteotomy was also performed if a better exposure was needed. Three such osteotomies were performed via a posteromedial approach for three talar body fractures in order to increase the visualisation of the talus. Out of 30 patients, 21 had been operated within 12 hours of trauma and included all open injuries and the rest 9 patients were operated after 24 hours of trauma. All the patients had been operated within 10 days of trauma. The delay in surgery was related to late presentation, severe soft tissue injury and associated injuries. Cancellous screws (4 mm) and small Herbert screws were used according to the fracture pattern. Bone grafting was not performed in any cases. Patients were kept non-weight-bearing by wearing an off-the-shelf fracture boot with early foot and ankle motion for 10–12 weeks, until radiographs and clinical examination revealed evidence of union. Anteroposterior, lateral and mortise radiographs were routinely made at 2 weeks, 6 weeks, 10–12 weeks and 6 months post-operatively. Additional radiography, computed tomography scans and magnetic resonance imaging were performed as often as needed. Post-traumatic arthritis was defined as a decreased joint space, juxta-articular osteophytes, subchondral sclerosis and/or subchondral cysts seen either on plain radiographs or on computed tomography scans. Osteonecrosis was documented as present or absent as seen on standard radiographs.

Results

The total of 30 patients were followed regularly for a period of 24 months and all patients were available for clinical and radiological assessment

after 5 years of trauma. We lost follow up of 4 before 6 months of treatment and were excluded from the study. These included 2 body and 2 neck fractures.

Early complications included three superficial wound infections and two deep infection required surgical irrigation and debridement and appropriate antibiotic treatment. All of these infections occurred in open fractures. The other complication noted was delayed union in 2 patients and was related to persistent infection, however one had full consolidation after 9 months and the other had persistent infection, sinus drainage and non union of talar neck at 5 years. Two of our patients developed reflex sympathetic dystrophies in the postoperative period.

Six patients (20%) presented an osteonecrosis of the talus; four (66.67%) of them occurred after a talar neck fracture and two after body fracture. The radiographic finding of osteonecrosis was made within the first 12 months after injury in 4 cases and within 24 months in all cases (mean of 9.4 months and range 6–17 months). No signs of revascularisation were seen despite the non-weight-bearing cast for three to six months. By the end of 5 years four patients (3 neck of talus, 1 body of talus) had undergone secondary surgery. Three patients who developed a major collapse of the talar dome underwent tibiotalar arthrodesis between 14 and 24 months. One patient who had avascular necrosis and persistent subtalar pain underwent tibiotalar calcaneal arthrodesis at 36 months.

At five year follow-up, 18 (60%) patients presented post-traumatic osteoarthritis in at least one ankle joint. Subtalar arthritis affected 8 (44.4%) patients, tibiotalar arthritis in 6 (33.3%) and talonavicular arthritis affected 1 (5.55%) patients. Two patients developed arthritis of both ankle and subtalar joints. One patient each of talar neck, body and head has undergone arthrodesis of one joint before 36 months of trauma.

Postoperative radiographic analysis confirmed the difficulty of obtaining an anatomical reduction for talus fractures. Reduction was anatomical in 14

cases (46.7%), nearly anatomical in 10 cases (33.3%) and poor in 6 cases (20%). Ten patients (45%) had a normal hindfoot alignment at 5 year follow-up. In nine cases (41%) there was a varus malunion (from 10° of varus to 0° of valgus) and in three cases there was a valgus malunion (10° to 15° valgus). One patient with a serious valgus malunion of 15° has been advised corrective osteotomy and subtalar arthrodesis at five years. Hindfoot alignment was not measured in eight cases who had undergone tibiotalar or tibiotalarcalcaneal arthrodesis at any point of time. The fracture type (neck or body) significantly influenced the malunion rate. Out of nine cases with Varus malunion, six (67%) were found in those having talar neck fractures and three cases(33%) had talar body fracture ($p < 0.04$). we believe that quality of the initial reduction and osteosynthesis material type also influence the malunion rate.

Clinical outcome based on ankle-hind foot scoring was rated as excellent in 5 feet, good in 12, fair in 9, and poor in 4. Among the various talar fractures, 2 patients with open talar neck fractures and one patient with talar body fracture had a poor outcome. One patient with crush fracture of talar

body and grade IIIA wound also had poor outcome The cause of poor outcome in the late stage was posttraumatic osteoarthritis secondary to avascular necrosis and incongruity of the joint surface. Symptomatic cases are treated by arthrodesis even more than 5 years after the injury because the outcome is greatly improved by arthrodesis.

The clinical and radiological evaluation of the operated cases of fractures of lateral process of the talus was done at 5 years. One patient had evidence of subtalar arthritis where one had been operated for subtalar arthritis at 36 months. Fractures of posterior process of talus are very rare. Operative fixation of the lateral tubercle of posterior process was done, and showed excellent result based on AFHS score.

The AOFAS score was not significantly different in relation to the fractures of neck and body (62.6 for the talar neck fractures and 68.4 for the talar body fractures and $p = 0.39$), but was statistically significant when compared to that of operatively treated posterior process fracture ($p < 0.005$). Complications and final score can be found in table 2. Some radiographs displayed as Fig. 1 and 2.

Table 2:

		AVN	Malunion	Nonunion	Osteoarthritis	Secondary surgery	AHFS
Neck	15	4	8	1	9	4	62.6
Body	8	2	4	0	5	3	68.4
Head	2	0	0	0	2	1	72.1
Lateral process	4	0	0	0	2	1	70.2
Posterior process	1	0	0	0	0	0	85.0
Total	30	6	12	1	18	9	Mean 71.66



1. Preop and post op radiographs of one of our patients with talar neck and medial malleolus fracture



1. Preop radiograph of one of our patients with talar neck and medial malleolus fracture. United fractures of both talus and malleolus at 24 months also displayed.

Discussion

In 1919, Anderson described for the first time a series of fracture dislocations of the talus after aircraft crashes and described the mechanism of injury. He called this injury *aviator's astragalus*. In 1952, Coltart collected a larger series after World War II and attempted to classify these fractures and to track their outcomes^[7]. These fractures result from high-energy trauma to the lower extremities such as that which occurs in airplane crashes, motor vehicle accidents or falls from a height^[17]. The most commonly proposed mechanisms are an excessive ankle dorsiflexion with a cantilever effect for the talar neck fracture and an axial compressive load for the talar body fractures^[15, 17, 18].

Undisplaced talar neck or body fractures are treated conservatively in most cases with very good results. However, for displaced fractures, open reduction and internal fixation is the rule for most authors^[6, 20]. Talar body fractures have been associated with a high incidence of complications including osteonecrosis, malunion, nonunion, secondary osteoarthritis, subtalar bony ankylosis, skin infection and skin necrosis. The incidence and severity of these complications appear to relate to several factors including the intrinsic talar vascular supply, the initial extent of displacement, the presence of associated dislocation and the adequacy of reduction^[11].

For a better initial reduction, some authors recommend a dual anteromedial and anterolateral

approach. This dual approach is sometimes associated with a medial malleolar osteotomy^[15, 23]. This technique permits good visualisation of the talus but increases the risk of skin necrosis or infection (10–20% depending on authors) and increases the duration of surgery^[10, 22].

Avascular necrosis is a common complication after talar fractures. In recent papers, the osteonecrosis rate was variable from 11–50%^[2, 14, 17, 22]. The surgical delay seems important and most authors recommend urgent reduction and stabilisation of displaced talar fractures^[15]. In 2004, Vallier et al. presented a study where 91% of the talar neck fractures underwent a dual anteromedial and anterolateral approach. At final follow-up, 49% developed avascular necrosis of the talus. Risk of malunion is a classical complication in this fracture type and is mostly a varus malunion. This risk is mainly influenced by the initial quality of reduction or the fracture type but also by the osteosynthesis technique. For talar neck fractures, Juliano et al. insist on the restoration of the talar length and particularly the medial side; they recommend avoiding compression screwing across an area of comminution at the origin of a talar neck shortening^[15]. For talar body fractures, Thordarson recommends the use of neutralisation (non compression) screws for cases with comminution at the fracture site^[21]. Some authors prefer plate fixation on the side with the most severe comminution in order to restore the neck

length which permits control of the compression in the fracture site^[19]. Vallier et al., reporting on radiographic findings of 26 talar body fractures with a minimum follow-up of 1 year, noted a 38% incidence of AVN, 65% incidence of post-traumatic tibiotalar arthritis and 34% incidence of post-traumatic subtalar arthritis. Worse outcomes were noted in association with comminuted fractures, associated talar neck fractures and open fractures^[22].

In this study, we used slightly aggressive operative treatment, and hence obtained fair initial radiological results in comparison with the literature^[9, 19]. The lack of good or excellent results may be explained by the exclusion in this study of the undisplaced fractures because such fractures have an excellent prognosis^[9, 13, 15]. Lindvall et al., in 2004, reported on 26 isolated talar neck and body fractures with a minimum follow-up of 48 months and found a 50% incidence of AVN and 100% incidence of post-traumatic arthritis. Timing of fixation did not appear to affect the outcome, union or prevalence of AVN in the later study because the fractures that were stabilised within 6 h did not have a lower incidence of AVN than those stabilised after 6 h^[16]. Both of these studies concluded that patients with these injuries should be counselled on the long-term complications and that arthritis is an expected outcome in displaced talar body fractures despite accurate reduction with stable fixation.

The risk of osteoarthritis is high after a talar fracture as majority of the talus has articular cartilage^[15]. Arthritis of the ankle and subtalar joint can occur in the absence of osteonecrosis or joint incongruity. Chondral damage can result only from the initial injury or from prolonged immobilisation^[21]. At long-term follow-up, we observed a very high rate of post-traumatic osteoarthritis (all joints taken together). This arthritis mainly affected the tibiotalar joint and the subtalar joint. Our results may be explained by the high rate of malunion and also by the long follow-up of this study.

Conclusion

The complication rate for talar fractures was high, mostly due to osteonecrosis and osteoarthritis; these conditions had an impact on the final outcome. The outcome could be improved by better evaluating these fractures with a CT scan, developing dual surgical approaches to best preserve the bone vascular supply and achieve better reduction, and improving the internal fixation hardware, especially the use of plates for comminuted fractures.

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