Open-fracture dislocation of the talus

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Purpose
The aim was to evaluate the incidence of infection and functional outcome of these injuries.
Patients and methods
A total of 14 patients with open-talar fracture dislocations or total dislocations of the talus were managed and the functional results evaluated between November 2012 and December 2016. Eleven of these patients were males and three were females. The injuries were sustained between the 20- and 50-year age group . The right side was affected in 10 and the left side was injured in four patients. Road traffic accident was the cause in nine patients and fall from the height was the cause in five patients. The principles of management were debridement and minimal fixation of fractures.
Results
The mean follow-up period was 33 months (range: 16–50 months). Two of 14 cases (14.2%) developed infection. One patient had resolved clinically with antibiotics alone. One patient had persistent drainage 4 months after injury and required late ankle and subtalar arthrodesis. The functional outcome according to Boston Children's Hospital ankle grading system was excellent in six (42.85%), good in five (35.71%), fair in two (14.28%), and failure in one (7.14%). There was no evidence of osteonecrosis or collapse of the talar dome.
Conclusion
In conclusion, patients with major open-fracture dislocation of the talus have a significant incidence of the best results with modern orthopedic techniques that dramatically decreased the rates of infection, avascular necrosis (AVN), and poor functional results although continued work is required to improve patient care and outcomes. Open-talar fractures should be managed as emergently including administration of broad-spectrum antibiotics, irrigation of the wound, operative debridement, reduction, and minimal fixation.

Keywords:
clinical outcomes, open-talar fracture dislocations or total dislocations of the talus, prognostic factors

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Introduction

One of the first reports of talar injury is by Herodot (490–420 B.C.). King Darius (522–486 B.C.) is said to have fallen from his horse sustaining an open-fracture dislocation while hunting a lion. The most important phrase in the original Greek is "the talus dislocated out of the joint." Treatment by an Egyptian surgeon was successful and the king was able to walk without difficulty [1].

Talus integrity is critical for normal function of the ankle, subtalar, and transverse tarsal joints. Talar head, neck, or body injuries can interfere with normal coupled motion of these joints resulting in deformity, permanent pain, and loss of motion [1].

Open fractures or dislocations of the talus or peritalar joints are uncommon. However, talar fractures grade second in frequency (after calcaneal fractures) of all tarsal bone injuries [1].

The incidence of talar fractures is relatively low (about 0.3%) of all fractures affecting usually young adult patients. Epidemiological studies have shown that fractures of talar body range widely from 13 to 60% and fractures of talar neck represent about 5% of the total number of talar fractures [2,3]. The combination of a bimalleolar and talus fracture is very rare with only two reports in the published literature [4,5]. Most injuries that involve both ankle and talus include a talar body fracture and a single malleolar fracture [6,7]. A combined bimalleolar ankle fracture with talar neck fracture has been reported [4].

Open-fracture dislocation of the talus usually results from high-energy traumas and talar body and neck fracture is often combinated. The mechanism of talus

fractures most commonly occurs when a person falls from a height or sustains forced dorsiflexion injury to the foot or ankle [8,9]. Open wounds have been reported to occur in about 20–25% of major injuries of the talus [10–14].

It is a rare injury associated with marked fracture displacement, severe soft-tissue damage, contamination, and disruption of the talar blood supply. Ankle and subtalar joint involvement can cause both instability and deep dead space, despite secure fracture fixation and soft-tissue closure [15]. According to the nature of the injury, infection, post-traumatic arthritis, and avascular necrosis are the most common major complications [15]. At present, there are no recommended treatment protocols for the management of such injuries. Early debridement, wound care, anatomic reduction, and adequate fixation are the key in the management of open injuries of the talus [6].

Revascularization of the lateral part of the talar body needs accurate reduction and stable fixation is obligatory to provide the best biomechanical environment [9,15,16]. In sagittal talar body fractures, devascularization of the lateral part of the dome is due to cutting of the main blood supply of the body, which comes from the medial side through the deltoid branches, which arises from the artery of tarsal canal [17]. Union in such a case is extremely slow as it depends on revascularization of the avascular bone by new blood supply [6]; therefore, the fracture needs protection for a long time and non-weight-bearing until union has occurred [16].

Talar body fractures have very high incidence of osteonecrosis [8,9,14,18,19]. Talar body with talar neck fractures has a very higher incidence of osteonecrosis [9], while talar body with malleolar fractures has a lower incidence of osteonecrosis, probably because the soft-tissue attachments remain intact to the body fragments [4].

The goal of this study was to avoid infection because infection can lead to prolonged morbidity and poor outcomes. A review of the literature showed few studies on various open-hindfoot injuries of which talar fracture dislocations were one subset [20], but we could find only one study that specifically evaluated patients with major open-talar fractures and dislocations [21]. We undertook the present study with two specific goals: first, to determine the incidence of infection and treatment factors that predispose to this complication of major open-talar injuries; and second, to determine whether infection affects long-term outcome.

Patients and methods

Patients

Between November 2012 and December 2016, a total of 14 patients with open wounds associated with either a talar neck/body fracture dislocation or total talus dislocations were managed at Mansoura Emergency Hospital and the functional results were evaluated. The study was approved by the institutional ethics committee in the Orthopedic Department of Orthopaedic Surgery, Mansoura University, Egypt. We excluded, first, an isolated ankle or subtalar dislocations; and second, multiple injuries for which the talus fracture was only one component of complex foot injuries.

Basic patient data are listed in Table 1. There were 11 males and three females. The injuries were sustained

Table 1 Details of our study

Patient	Age	Sex	Side	Trauma	Wound type	Treatment	FU (M)	Classification	BCHAEGS	Functional outcome
1	28	M	R	RTA	II	S	20	FD	72	G
2	25	M	L	RTA	III A	K.W	36	TD	96	E
3	40	M	R	FFH	II	S	24	FD	79	G
4	35	M	L	RTA	III A	S	48	FD	90	E
5	50	M	R	RTA	II	S	16	FD	76	G
6	20	F	R	FFH	II	S	50	FD	95	E
7	42	F	R	RTA	III A	S	38	FD	82	E
8	36	M	R	FFH	III A	S	40	FD	68	Fa
9	45	M	L	RTA	III A	K.W	28	TD	90	E
10	38	M	R	RTA	III B	S	36	FD	55	Failure
11	30	M	R	FFH	III A	S	30	FD	74	G
12	40	M	R	RTA	III A	S	28	FD	85	E
13	43	M	L	RTA	III A	S	42	FD	78	G
14	24	M	R	FFH	III A	S	26	FD	65	Fa

BCHAEGS, Boston children hospital ankle evaluation grading system; E, excellent; F, female; Fa, fair; FD, fracture dislocation; FFH, fall from a height; G, good; K.W, Kirschnner wire; L, left; M, male; R, right; RTA, road traffic accident; S, screw; TD, total dislocation.

between the 20- and 50-year age group . The right side was affected in 10 and the left side was injured in four patients. Road traffic accident was the cause in nine patients and fall from the height was the cause in five patients. The principles of management were debridement and minimal fixation of fractures.

Fracture dislocations were classified according to modified Hawkins classification [10,11]. There were 12 patients of type 3 (fracture dislocations) where talar head or the body was totally or partially extruded through the wound and two patients of type 4 (total dislocation) where the talus was completely extruded through the wound. Two patients sustained total dislocations of the talus. Wounds were classified according to Gustilo and Anderson classification [22,23]. There were four type 2, nine type 3 A, and one type 3B wounds.

Surgical management

Administration of broad-spectrum antibiotics and irrigation of the wound on arrival to the Emergency Hospital; further debridement of the wound and washout of the joint were performed under spinal or general anesthesia as emergently in the operating room. The average time from injury to operative debridement was 4 h (range: 1–6). Internal fixation was performed in all cases; screws were used for fracture-dislocation cases and Kirschner (K.w) wires were used for totally extruded cases. Eleven wounds were primarily closed, two were closed by secondary intention and one case required a split-thickness skin graft.

Totally extruded talus was merely attached by a single strand of the remaining ligament and all other talar soft-tissue attachments were torn. The talus was reduced and K-wire fixation was performed from the medial malleolus to the talus.

All patients were evaluated for development of infection. Infection was defined by a positive wound culture in the presence of one or more associated physical findings. Physical findings included wound drainage, fever, erythema, leukocytosis, or increased C-reactive protein .

Patients were asked to assess their level of pain and function according to the Boston Childrens' Hospital ankle evaluation grading system [24]. The overall outcome of these patients was quantitated according to a weighted point system. This system allocates a total of 90 possible points according to the amount of pain (50 points) and function (40 points). A final result of greater than 80 was considered an excellent result; 70–79, a good result; 60–69, a fair result; and less than 60 was a failure. In the present study, we considered any case requiring salvage procedure to be a failure (Table 1).

Results

Infection

Initial treatment consisted of preoperative irrigation and intravenous antibiotics, then operative irrigation, and debridement in all cases. Two of the 14 cases (14.2%) developed infection. Infections involved bone and/or joints and were treated with intravenous antibiotics. These infections were caused by Staphylococcus aureus organisms and developed early after injury (range: 4–10 days).

One patient had resolved clinically with antibiotics alone. One patient had persistent drainage 4 months after injury and required late ankle and subtalar arthrodesis. This patient stopped draining 6 weeks after arthrodesis.

Functional outcome

The mean follow-up period was 33 months (range: 16–50 months). According to the Boston Children's Hospital ankle grading system [24], the overall results were considered excellent in six (Figs 1 and 2), good in 5, fair in 2, and failure in 1.

Osteonecrosis

No evidence of osteonecrosis or collapse of the talar dome is seen in our noninfected cases.

Discussion

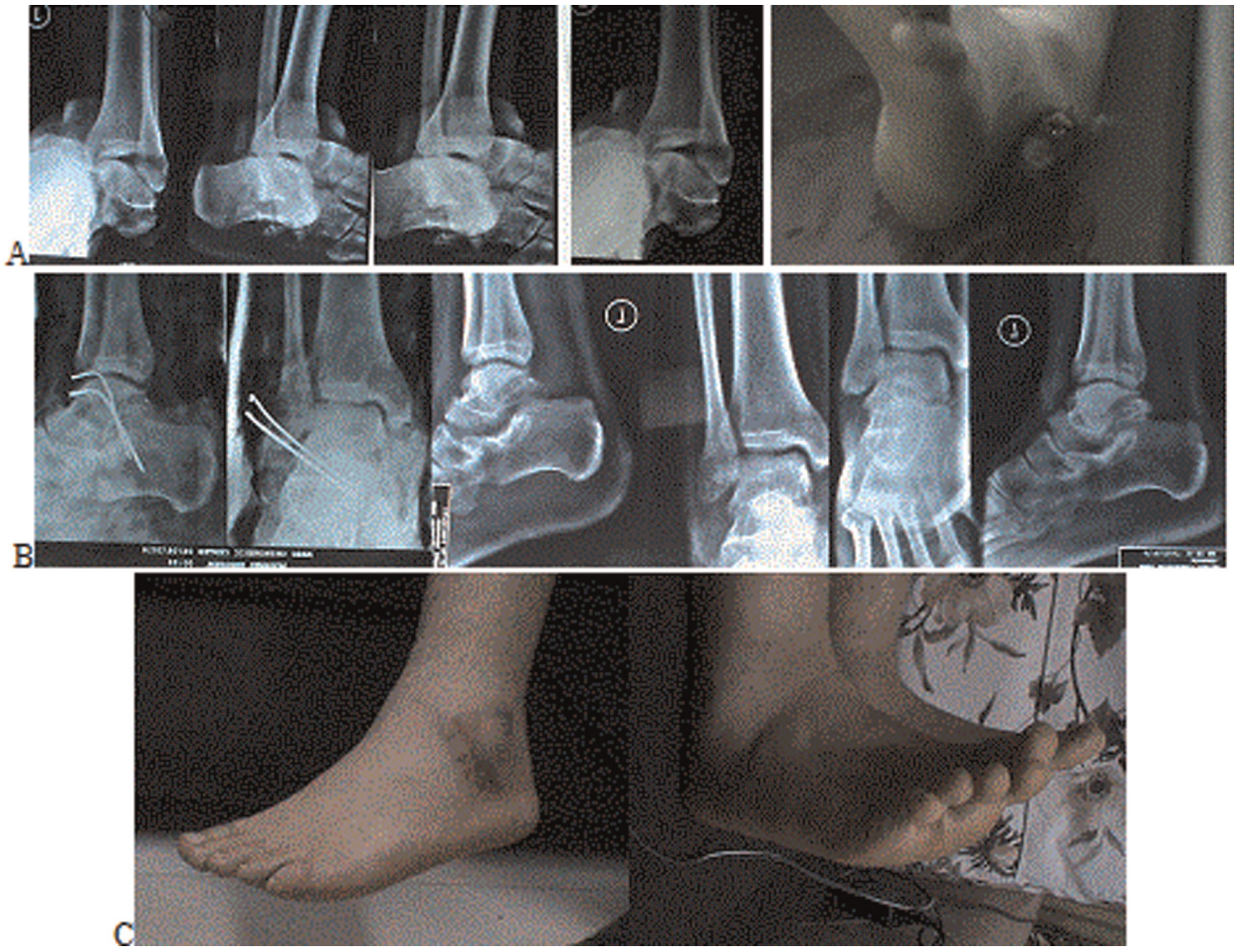
The functional outcome of the patients with open injuries of the talus in this study, was correlated with the occurrence of infection and osteonecrosis. We achieved the final follow-up on 14 feet. Of the 12 noninfected cases, no cases were rated as a failure, whereas of the two infected cases, one case (7.1%) was rated as a failure.

The infection rate in this series (14.28%) was lower than previously published. Hiraizumi *et al* [25]. reviewed the literature on total talar dislocation. They described six infections among 24 reported cases (17 open dislocations) (35%). Canale and Kelly [10] reported four infections among 17 open-talar neck fractures (24%). Kenwright and Taylor [12] reported two infections among 13 open injuries (15%) as part of a larger series of various talar injuries.

Figure 1

Fracture dislocation of the talus. (a) Preoperative, (b) 2 and 3 years postoperative, and (c) clinical movements.

Figure 2



Total dislocation of the talus. (a) Preoperative, (b) early and 2 years postoperative, and (c) clinical movements.

There are two explanations for the lower rate of infection in the present study: first, the average time from injury to operative debridement was 4 h (range 1–6). Second, irrigation of the wound on arrival to the Emergency Hospital; further debridement of the wound and washout of the joint were performed under anesthesia as emergently in the operating room.

The two cases that involved talar extrusion were treated with replacement in the ankle through the open wound. Replacement of a partially or totally extruded talar body is controversial [26]. Coltart [27] reviewed 288 talar injuries sustained in the Royal Air Force during the Second World War. He concluded that the talar body should be discarded in open-fracture dislocations and total dislocations of the talus.

Penny and Davis [28] agreed with Coltart's assessment because in their series of 40 talar neck fractures, they found it extremely difficult to obtain fusion to the avascular talar body when this was required late. Therefore, if an open wound was present, they recommended primary excision and Blair-type fusion. Detenbeck and Kelly [29] reported infection in eight of nine cases of talar body dislocation or fracture dislocation . They recommended excision to decrease the infection rate. However, recent series recommended reduction of the talus primary in open injuries. Szyszkowitz *et al.* [14] recommended primary excision only in the severely comminuted cases. Hiraizumi *et al.* [25] felt that the talar body should be replaced even when totally extruded with no soft-tissue attachments if this could be accomplished "within an appropriate time after injury". Kusakabe *et al.* [30] salvaged the talar body to maintain the foot height for a tibiocalcaneal fusion. Mindell *et al.* [13], Kenwright and Taylor [12], and Canale and Kelly [10] do not describe excision as an option in the primary treatment of the open-talar injuries in their large series. Total talus dislocation typically results from high-energy trauma but is rare and an unusual injury. Only a small series have been published with few case reports, and there is no established treatment protocol for such total dislocation injuries. There were only two total talus dislocations reported by Kenwright and Taylor [12] out of 58 talar injuries (3%). Treatment has progressed over the years from amputation to talectomy with tibiocalcaneal fusion to wound debridement, early reduction, and fixation now recent to yield good functional and clinical results [15]. Relocation of the talus is recommended, provided that the wound is relatively clean and the talus still attached, even the attachment by a small strand of soft-tissue [15]. Reduction and fixation of the talus in combination with complete wound debridement preserves the normal ankle anatomy, provides early revascularization, and avoids infection. Further extensive surgical intervention such as talectomy and tibiocalcaneal fusion should be reserved as a salvage procedure [15]. In our series, extruded talar bodies had no incidence of infection or osteonecrosis, so we recommended reduction after irrigation and debridement.

No functional outcome measure was universally used across all studies. According to the Boston Children's Hospital ankle grading system [24], Marsh *et al.* [21] achieved overall results for 14 of 18 feet, which were considered excellent in one, good in five, fair in two, and failure in six. In our series, the overall results were considered excellent in six, good in five, fair in two, and failure in one.

Conclusion

Patients with an open wound associated with a major fracture dislocation of the talus have a significant incidence of good results with modern orthopedic techniques that dramatically decreased the overall rates of infection, avascular necrosis (AVN), and potentially poor functional results although continued work is required to help improve patient care and outcomes.

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Conflicts of interest

There are no conflicts of interest.

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