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The emergency and delay management in total talus extrusion: Case report and review of literature after 24 months of follow up

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ABSTRACT

Total talus extrusion is a rare and severe injury. It is burdened by many complications as avascular necrosis and osteomyelitis even if a proper debridement of extruded talus is performed. Few case reports or case series were published, and because of the rarity of this event, there are no guidelines for treatment. We report the first case on an octogenarian man providing a long-term follow-up performing contrast enhanced magnetic resonances. The authors report the case of an octogenarian man who fell from an olive tree reporting a total talus extrusion associated with the fracture of the medial malleolus. After an accurate debridement and washing of the wound, the talus was anatomically repositioned and the fracture was treated with an external fixator. The wound healed with difficulty after 12 months and the patient developed a chronic osteomyelitis of the talar dome and avascular necrosis of talar head. We followed the patient for 24 months performing contrast enhanced magnetic resonances and evaluating the development of the avascular necrosis. Even if we encountered these complications, the treatment allowed the patient to walk without pain, using a talus type shoe and one crutch. Although the literature suggests that an anatomic replacement of talus allows avoiding main complications, we deem that the patient's age is an important biological feature to consider in the prognostic stratification. Moreover, primary talectomy and tibio-calcaneal fusion should be reserved as a salvage procedure. Talus replacement allows an overall good outcome for the patients, retaining height, and allowing a good quality of life.

1. Introduction

Total talus extrusion is a rare but severe injury. It is often associated with fractures and damage of adjacent soft tissues. There are few cases reported in literature and the incidence is about 0.6% of all talus fractures[1,2]. Talus dislocation is open in the 70% of cases[1], and is usually caused by a high energy trauma. Talar extrusion is the result of a combined movement of tibio-talar dorsiflexion and excessive subtalar supination or pronation[2–4]. The extrusion is often associated with loss of vascular supply and contamination of the wound that can lead to severe complications. The most common complications are osteomyelitis and avascular necrosis (AVN) even if the talus is replaced after a proper debridement of both the wound and the extruded talus[1,5]. Because of the rareness of this lesion, there are no guidelines for the treatment and the follow-up[2,3]. We present the case of an 80-year-old man referred to our Emergency Department with a total talus extrusion, associated with the fracture of the medial malleolus, treated with an external fixator and screws and with a long-term follow-up.

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2. Case report

An 80-year-old male patient referred to our Emergency Department because of an accidental fall from an olive tree. He reported a trauma, describing a tibiotalar dorsiflexion and subtalar supination. The physical examination showed a 7 cm wound of the medial region of the ankle, with total talus extrusion (Figure 1). The mobility of the toes was preserved and

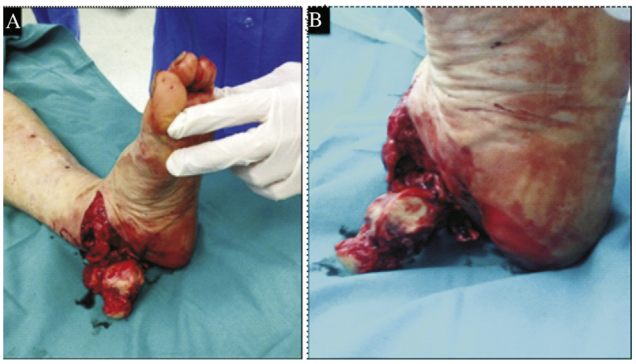

Figure 1. Clinical appearance at the time of presentation to the emergency department.
A: Note the wide wound of the medial region of the ankle, with open total talus extrusion; B: Zoomed image showing the subtalar joint surface.

the sensory examination was normal. The pulse of the pedis arteria was weak while posterior tibial artery was present. X-rays of the ankle showed the fracture of the medial malleolus (Figure 2).

Figure 2. Radiographs of the left ankle.
A: Loss of articular mortar between the tibial-fibular joint with talus; B: Extruded talus and the fracture of the tibial medial malleolus.

The patient received tetanus prophylaxis prior to surgery in the General Emergency Department, then he was immediately transferred to the operating room, where he received broad-spectrum antibiotic prophylaxis. After the spinal block, we washed the wound and the talus using 10000 mL of saline solution, and an accurate debridement of the bone were performed[6]. Then the talus was anatomically repositioned. The procedure also revealed a tendon lesion few millimeters distally to the myotendinous junction of longus flexor digitorum, in which we attempted to suture. Thereafter, we performed the reduction of the medial malleolus, its osteosynthesis with two screws (4 × 40 mm Asnis III Cannulated Screws, Stryker®, Kalamazoo, MI, USA) and the reconstruction of medial flexor, deltoid ligament and flexor retinaculum, that were all torn. We completed the procedure suturing the subcutaneous tissue and the skin that were strained due to the tissues loss during the injury. Stabilization of the ankle was performed with a spanning ankle external fixator in the neutral position (Figure 3). We scheduled a

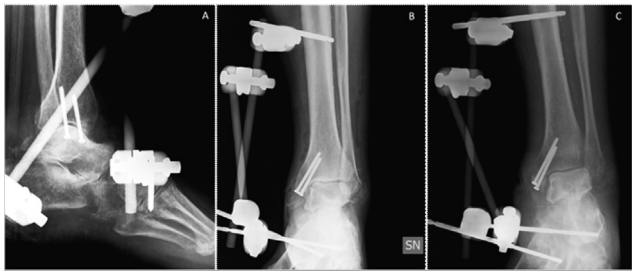

Figure 3. Lateral (A), anterior posterior (B) and oblique (C) postoperative radiographs after stabilization of the ankle with a spanning ankle external fixator.
Medial malleolar reduction and osteosynthesis with two screws.

broad-spectrum antibiotic therapy, with gentamicin and teicoplanin for 3 days, to cover the wide range of bacteria that could involve an open fracture, preventing the infection of the joint[7].

During the hospitalization the patient has undergone consulting by infectious disease specialists who recommended two broad-spectrum antibiotic therapy, given the high rate of contamination of the injury. Three days after surgery, the patient was discharged, providing a therapy with amoxicillin–clavulanic acid (875 mg + 125 mg bid *per os*) and levofloxacin (500 mg/day *per os*) for 10 days and recommending wound medication every 2 days.

Eight weeks after surgery, the external fixator was removed and X-ray of the left ankle was performed showing no signs of avascular necrosis of the talus (but Hawkins sign was not evident) (Figure 4)[8]. Patient started walking using Lofstrand

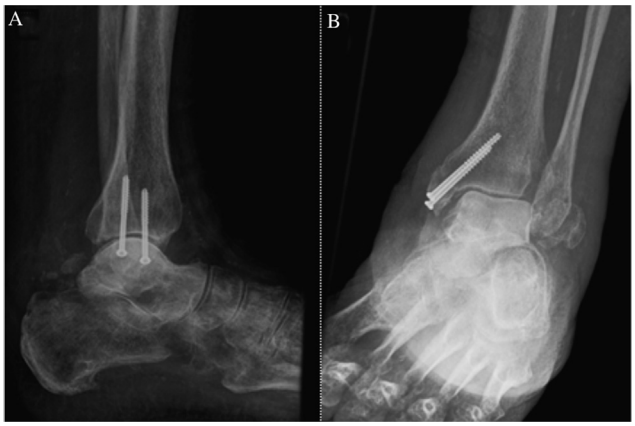

Figure 4. Lateral (A) and anterior posterior (B) radiographs of the ankle after removing the spanning ankle external fixator.

crutches and a talus type shoe. Five months after surgery the wound was not yet completely healed (Figure 5), so a

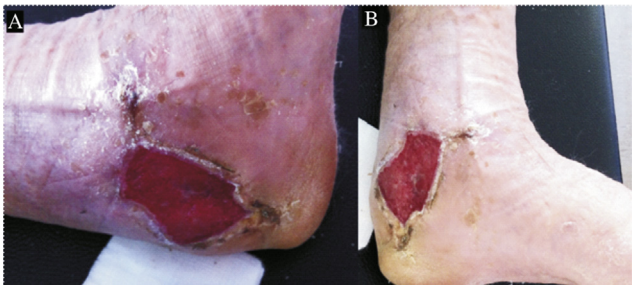

Figure 5. Medial views of the wound 5 months after the procedure (A, B), showing the wound was not completely healed.

biological sample through a wound swab was taken and analyzed revealing a skin infection by *Staphylococcus epidermidis*; the antibiogram was performed to optimize the antibiotic treatment.

The skin lesion was treated with topic antibiotic therapy and healed after 12 months (Figure 6). Even so, the patient referred

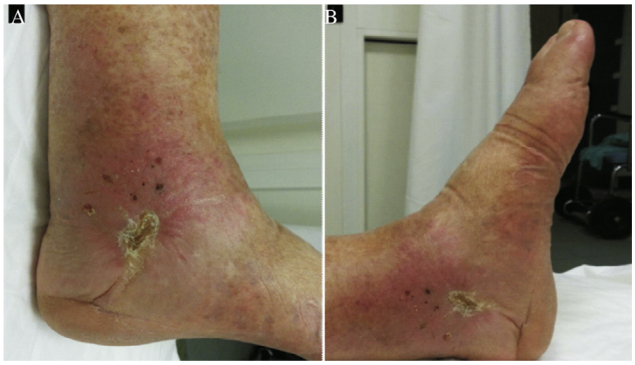

Figure 6. Medial view of the wound 12 months after the procedure (A, B), showing the wound was completely healed.

persisting pain, even if he was able to walk using a talus type shoe without two crutches, but symptoms were getting worse in the following 2 weeks. Perimalleolar edema, but a good mobility (range of motion 45°) of the ankle was seen at the physical examination, with no clear signs of infection. Since the suspect of infection was high, a LeukoScan exam was performed and the infection was detected (Figure 7). So the patient was hospital-

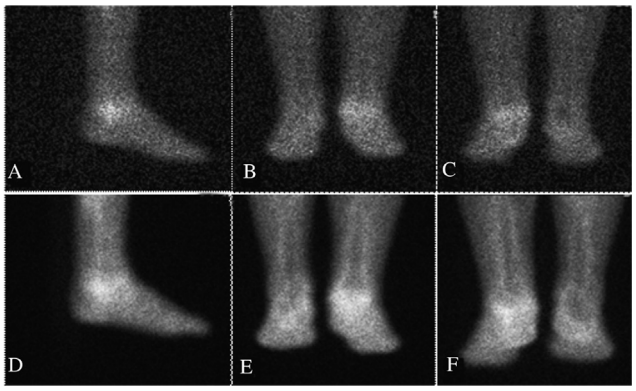

Figure 7. LeukoScan performed about 12 months after the talus replacement showing radionuclide accumulation in the left ankle, providing high suspect for infection.
A–F: Various uptake's phases of LeuKoScan.

ized, and the infection was treated with intravenous broad-spectrum antibiotics and removal of the malleolar screws. The biological material adhered at the screws was examined, but no confirmation of infection was obtained.

Two months later (about 14 months after surgery) a contrast enhancement magnetic resonance (MR) was performed, demonstrating chronic osteomyelitis (Figure 8), which was treated again with intravenous injection broad-spectrum antibiotics.

At 14 months from trauma, the patient was still able to walk with the use of one crutch, experiencing a moderate pain. At the physical examination, the ankle mobility was reduced (range of motion 30°). A new contrast enhancement MR was performed together with a CT scan (without contrast medium). MR revealed a mixed pattern showing high contrast enhancement areas close to completely no contrast enhancement ones,

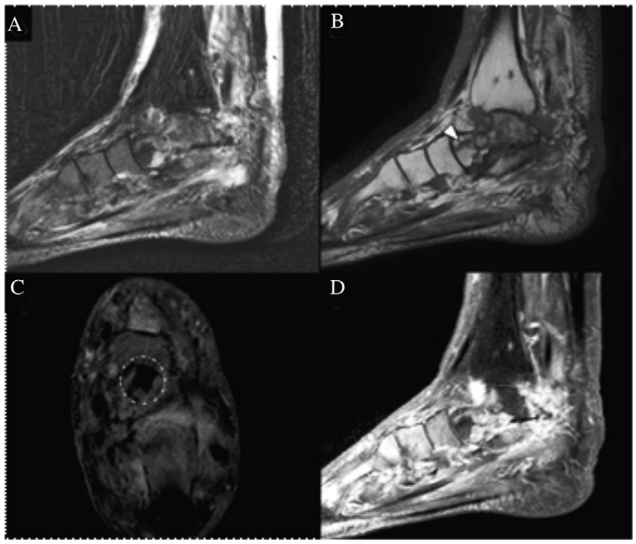

Figure 8. Contrast enhanced MRI performed 14 months after surgery.
(A): Sagittal T2 spectral inversion recovery (STIR) MRI shows increased and inhomogeneous T2 signal in the talar dome suspected for localized osteomyelitis and more diffuse reactive bone marrow edema. (B): Sagittal unenhanced T1-weighted image shows decreased T1 signal of the talar dome consistent with the suspect of osteomyelitis and bone marrow edema. It also demonstrates a serpiginous low-signal-intensity line in the talar head (white arrowhead) that outlines the beginning of avascular necrosis of that segment corresponding to the decreased signal in (C) Axial T1 SPIR images (circle). (D): Sagittal enhanced T1-weighted spin-echo image showing avid enhancement of the talar dome that matches distribution of T2 signal abnormality, supporting the hypothesis of osteomyelitis.

indicating the presence of both AVN and osteomyelitis (Figure 9). CT scan showed the presence of inhomogeneous

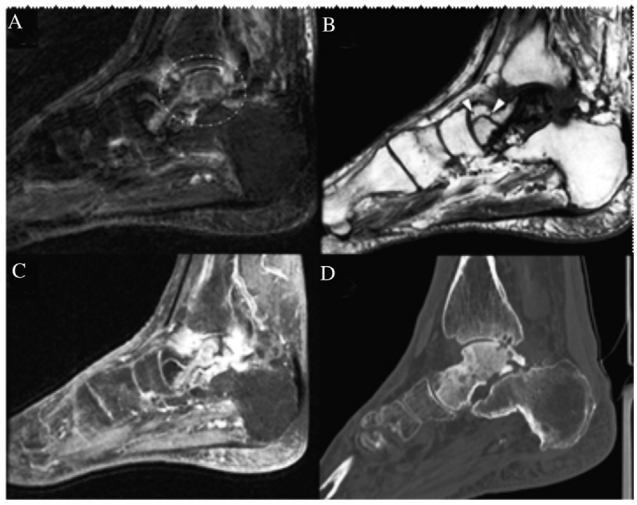

Figure 9. Contrast enhanced MRI performed 18 months after surgery.
A: Sagittal T2 STIR shows increased and inhomogeneous T2 signal in the talar dome confirming persistent osteomyelitis (white circle). B: Sagittal unenhanced T1-weighted image shows decreased T1 signal of the talar dome consistent with the osteomyelitis and bone marrow edema. The serpiginous low-signal-intensity line (white arrowheads) in the talar head confirms the avascular necrosis of that area. C: Sagittal enhanced T1-weighted spin-echo image showing enhancement of the talar dome confirming the persisting osteomyelitis. The line delimiting the avascular necrotic area shows high enhancement in the talar head. D: Corresponding sagittal reconstructed image of the ankle from CT data shows multiple cortical defects with a diffuse sclerosis of the talar dome, due to chronic osteomyelitis. Note the poorly evident hypoattenuating area delimiting the necrotic bone in the head of talus that did not collapse. Arthritic changes can be noted also in the subtalar joint.

sclerosis and erosions of the articular face of the body of astragalus consistent with the MR diagnosis. We scheduled a new cycle of antibiotic therapy.

On February 2015 (about 2 years after surgery), the patient referred relief of symptoms and the reduction of the erythrocyte sedimentation rate (leucocytes were within the normal range since 3 months after surgery). Hence, patient underwent a new contrast enhanced MRI (Figure 10), showing a complete outlined avascular segment on the neck of the talus and a poor reduction of the high contrast enhanced area of the talar dome (persistent chronic osteomyelitis). In addition, an area of AVN was evident in the talar dome.

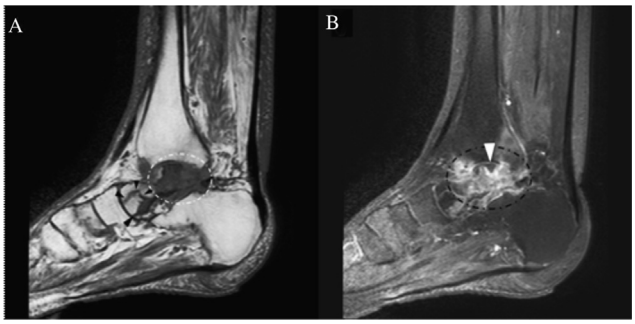

Figure 10. Contrast enhanced MRI performed about 24 months after surgery.
A: Sagittal unenhanced T1-weighted image shows decreased T1 signal of the talar dome (white circle) consistent with osteomyelitis and bone marrow edema. The serpiginous (black arrowheads) low-signal-intensity line in the talar head outlines a well-defined square area of avascular necrosis of that segment. B: Sagittal enhanced T1-weighted spin-echo image showing the reduction of the enhancement (compared to previous MRI) of the talar dome (black circle) suggesting the start of osteomyelitis resolution. A small area of avascular necrosis starts to be evident in the talar dome; it does not show contrast enhancement and it defined by an irregular iperenhanced line (white arrowhead).

At present, the patient is able to walk without talus shoe but using one crutch when walking on uneven ground; moreover, he continues experiencing perimalleolar edema in the evening. We used both a subjective (the foot & ankle disability index score)[9] and an objective scale (clinical rating system for the ankle and hindfoot)[10] to evaluate the ankle function. The scores assessed were of 42.3 and 45.0 respectively, suggesting a moderate disability.

3. Discussion

Total talus extrusion is a severe injury, burdened by a serious damage to the ankle, but it is fortunately a rare event[1–5,11–15]. There are no guidelines for the treatment of total talus extrusion, and only few case reports and a couple of case series were published[2–5,11–15]. Recently, talar reimplantation after thorough debridement was suggested[2,3].

Approximately 60% of talus surface is covered with articular cartilage, and there are no muscular or tendons attachments to this bone, but only ligaments[2,3], therefore talus could easily dislocate. Moreover, only a limited area of penetrable bone is available for vascular feeding. The above mentioned features, combined with small nutrient vessels, variations in intraosseous anastomoses, and a lack of collateral circulation (the posterior tibial artery, the dorsalis pedis arteria and the perforating peroneal artery), predispose the talus to osteonecrosis when its vascular supply is disturbed. Talar reimplantation gives the advantage of retained height and bone stock, despite the high risk of infection or post-AVN talar collapse[3,10–12].

Despite the patient's age, the high risk of talus contamination and the delay to reach the Emergency Department, we decided to perform a careful debridement and the repositioning of the extruded talus to preserve a good ankle mobility.

Even though, regular orthopedic and infectious disease follow-up were performed, our patient developed a small area of AVN in the talar dome only at 24 months even if no fracture was noticed; moreover, he developed an AVN in the neck of the talus. No collapse was noticed in our case, probably because AVN developed mostly in the talar head and not in the dome, where there is no direct load.

The wound healed with difficultly and this could be a promoting factor of the osteomyelitis. Hyperbaric therapy and a skin graft could be helpful in healing the wound, but was not available in our trust, and the patient preferred not to go outside the region for further therapies. Osteomyelitis developed in the talar dome, where, after about 18 months, cortical defects developed causing arthritic changes.

The patient started relatively early walking with a talus type shoe, thus to avoid immobilization syndrome. Some authors suggest immobilizing the ankle and avoiding loading it for a long time[12], but in such case complication would probably be worse, due to the immobilization syndrome. Some of the clinical decisions in our case might be criticized, however we are convinced that the attempt to reposition the talus was justified. Although the outcome of the present case was not optimal, the possibility to recover the function of the ankle joint justifies the risk of AVN and osteomyelitis. Considering the old age of the patient, it is questionable whether the best option was the removal of the talus, with the following arthrodesis, avoiding the risk of osteomyelitis, or reposition the talus with the procedure we used. We informed the patient about the two options, and he declared to prefer the second one. At present, the patient refers that he is experiencing a good quality of life in spite of age and the severe injury occurred.

Although the literature suggests that an anatomic replacement of talus allows avoiding main complications, we deem that the patient's age is an important biological feature to consider in the prognostic stratification. Moreover, we feel that primary talectomy and tibio-calcaneal fusion should be reserved as a salvage procedure. Talus replacement allowed an overall good outcome for the patient, retaining height, and allowing a good quality of life despite the complication encountered.

Conflict of interest statement

The authors report no conflict of interest.

References

[1] Morales-Suárez CJ, Reyes-Gallardo A, López-Gavito E. [Total talar dislocation. Case report, 15-month follow-up and literature review]. *Acta Ortop Mex* 2012; **26**(1): 39-44. Spanish.
[2] Ramesh P, Avadhani A, Dheenadhayalan J, Rajasekaran S. Reimplantation of total talar extrusions. *Inj Extra* 2010; **41**(5): 53-7.
[3] Breccia M, Peruzzi M, Cerbarano L, Galli M. Treatment and outcome of open dislocation of the ankle with complete talar extrusion: a case report. *Foot (Edinb)* 2014; **24**(2): 89-93.
[4] Smrke DM, Rožman P, Gubina B, Frangež I, Rejec Smrke B, Arnež ZM. An uncommon treatment of totally extruded and lost talus: a case report. *J Med Case Rep* 2014; **8**: 322.

[5] Karampinas PK, Kavroudakis E, Polyzois V, Vlamis J, Pneumaticos S. Open talar dislocations without associated fractures. *Foot Ankle Surg* 2014; **20**(2): 100-4.
[6] Cross WW 3rd, Swiontkowski MF. Treatment principles in the management of open fractures. *Indian J Orthop* 2008; **42**(4): 377-86.
[7] Rodriguez L, Jung HS, Goulet JA, Cicalo A, Machado-Aranda DA, Napolitano LM. Evidence-based protocol for prophylactic antibiotics in open fractures: improved antibiotic stewardship with no increase in infection rates. *J Trauma Acute Care Surg* 2014; **77**(3): 400-7.
[8] Pearce DH, Mongiardi CN, Fornasier VL, Daniels TR. Avascular necrosis of the talus: a pictorial essay. *Radiographics* 2005; **25**(2): 399-410.
[9] Martin RL, Burdett RG, Irrgang JJ. Development of the Foot and Ankle Disability Index (FADI) [abstract]. *J Orthop Sports Phys Ther* 1999; **29**: A32-3.
[10] Kitaoka HB, Alexander IJ, Adelaar RS, Nunley JA, Myerson MS, Sanders M. Clinical rating systems for the ankle-hindfoot, midfoot, hallux, and lesser toes. *Foot Ankle Int* 1994; **15**(7): 349-53.
[11] Mohindra M, Gogna P, Thora A, Tiwari A, Singla R, Mahindra P. Early reimplantation for open total talar extrusion. *J Orthop Surg (Hong Kong)* 2014; **22**(3): 304-8.
[12] Burston JL, Isenegger P, Zellweger R. Open total talus dislocation: clinical and functional outcomes: a case series. *J Trauma* 2010; **68**(6): 1453-8.
[13] Vallier HA, Reichard SG, Boyd AJ, Moore TA. A new look at the Hawkins classification for talar neck fractures: which features of injury and treatment are predictive of osteonecrosis? *J Bone Joint Surg Am* 2014; **96**(3): 192-7.
[14] Dumbre Patil SS, Abane SR, Dumbre Patil VS, Nande PN. Open fracture dislocation of the talus with total extrusion: a case report. *Foot Ankle Spec* 2014; **7**(5): 427-31.
[15] Lee HS, Chung HW, Suh JS. Total talar extrusion without soft tissue attachments. *Clin Orthop Surg* 2014; **6**(2): 236-41.