

Talectomy (astragalectomy) and tibiocalcaneal arthrodesis following traumatic talus fracture-dislocation

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Talus fractures occur rarely but are often associated with complications and functional limitations. Urgent reduction of associated dislocations is recommended with open-reduction and internal fixation of displaced fractures when adjacent soft tissue injury permits [1]. However, it is important to remember that there is a high incidence of long term complications, along with a significant impact on activities of daily living and quality of life. This case report describes the successful treatment of a severely comminuted talar fracture dislocation with primary talectomy and tibio-calcaneal arthrodesis. A reminder that in selected cases that the talectomy (astragalectomy) may be a viable alternative.

Keywords: talus, comminuted, tibiocalcaneal arthrodesis, fusion, talectomy, astragalectomy, trauma, avascular-necrosis, AVN

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Talus fractures account for less than 1% of all fractures, they may be caused by high-energy trauma, and any other form of forced dorsiflexion injury to the ankle and foot [1]. Talar fractures may be classified anatomically as head, neck, body, lateral or posterior processes, displaced or non-displaced. A range of classifications have been established such as the original Hawkins, then modified by Canale & Kelly and then the Sneppe classification [2]. These sub-classifications help to guide treatment options[3]. Non-displaced fractures may be treated conservatively with a non-weight-bearing short-leg cast, whereas displaced fractures require open-reduction and internal fixation. Reconstruction after a talus fracture poses the greater surgical challenge if restoration of the articular

surfaces is precluded secondary to comminution [4]. The talus is the second largest of the tarsal bones, with more than half of its surface being covered with articular cartilage, with no muscular attachments[1]. Therefore, the vascular supply of the talus is well-known to be tenuous, therefore predisposing the talus to significant ischemic injury after fractures [5]. Risk of post-traumatic avascular necrosis (AVN) increases with the magnitude of injury [6]. Extensive intraosseous anastomoses are present throughout the talus and are responsible for its survival during severe injuries. At least one of the three main anastomoses preserved may potentially allow adequate circulation via anastomotic channels [1].

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Using the Hawkins's classification system; 0-13% for grade I, 20-50% for grade II, 83-100% for grade III, and 100% for grade IV fracture dislocations result in AVN [1,6].

Clinical experience of talar fracture assessment and management is limited by their infrequent incidence, which is further exacerbated by the numerous sub-classifications of fracture, as previously alluded to. Case reports, although regarded as level V evidence can aid and develop an understanding of the risks and benefits of treatment options to achieve optimal patient outcomes [7]. Clinicians should maintain a high index of suspicion for AVN, which can only be diagnosed radiographically six to eight weeks following injury [8]. Furthermore, the potential for long term issues, such as hind-foot arthrosis and further revisionary surgery must be considered, alongside risks of repeated anesthetics for multiple procedures after complications. Approximately 25% of talus dislocations treated with internal reduction require additional surgery, including secondary arthrodesis [9].

Operative treatment measures for this area may be broadly split into two categories; joint sparing procedures - such as protected weight bearing, patella loading splints and bone graft or joint sacrifice procedures - such as talectomy and arthrodesis. Total talectomy and tibiocalcaneal arthrodesis may be viewed as a salvage procedure in this case report due to the case of severe comminuted fracture, where it may be impossible to anatomically reduce the talus and allow for adequate stable fixation.

A literature search was performed using the keywords 'talectomy', 'astragalectomy', 'fracture', 'tibiocalcaneal arthrodesis' and Boolean search terms. Ovid SP databases (including embase & medline) was used with no exclusion dates to allow for a search of all historical literature. It appears that there was only one other reference in 1955 to such a procedure following a traumatic fracture to the talus body [10]. Historically, this case involved a Royal Navy soldier, where following a dislocated fracture a primary talectomy and tibiocalcaneal arthrodesis was performed.

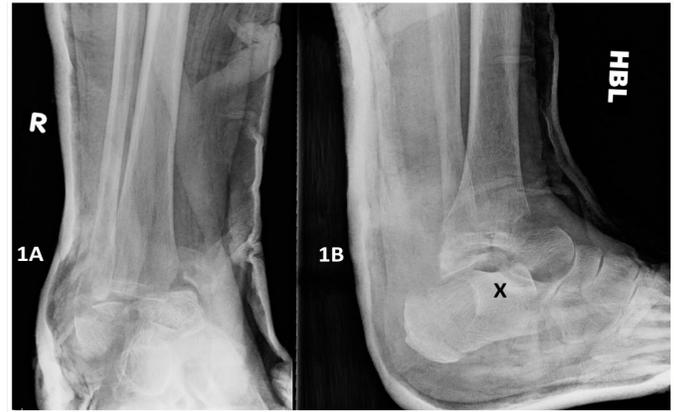


Figure 1 Preoperative radiographs lateral and AP views.

Case Report

A sixty eight-year-old lady with no significant past medical history presented to Accident and Emergency. She had been a seat-belted, front-seat passenger of a car that suffered a high-speed head-on road traffic collision. She sustained a grade I (Gustilo-Anderson) open, comminuted fracture dislocation of the talus (Figure 1) with puncture wounds on the lateral aspect of the talus. The foot was neurovascularly intact initially. The ankle was manipulated and back-slab applied. Apart from body ache and multiple minor abrasions and bruises there were no other injuries. Whilst she was waiting on the ward to have a CT scan performed she developed increasing pain in foot, numbness of toes and sluggish capillary refill in the toes, which were not relieved even after removing the plaster slab. She was counselled that she would need to be rushed to the operating room to attempt to reestablish circulation to her foot with a plan to open reduce the fracture and stabilize it. She was also made aware of the possibility of having to excise the fragments if it was not possible to operatively stabilize the fracture.

Procedure

Under spinal anaesthesia, antibiotic cover and usual sterile draping, the lateral puncture wounds were thoroughly debrided and lavaged with saline. The fracture was exposed using an anterior approach between tibialis anterior and extensor hallucis longus, carefully protecting the neuro-vascular bundle throughout the procedure. The displaced fracture fragments of the talus, the medial malleolus and the medial hematoma all appeared to have caused pressure on the posterior tibial neurovascular bundle.



Figure 2 One year follow-up radiographs.

This was relieved after opening the fracture and the toes regained their color. Intra-operatively, it became apparent that the fracture could not be anatomically reduced and fixated adequately due to the severe degree of comminution, and lack of any soft tissue attachments to the majority of the fragments. Hence, the original plan of anatomical reduction and internal fixation of the fracture was abandoned. All loose fragments were excised, which involved removing all of the posterior process and body of the talus. Using the cancellous bone from the excised fragments as autogenous graft, the calcaneal and tibial articular surfaces were fused using three 7.5 mm cannulated AO screws (Figure 2). A small lateral malleolar avulsion fragment was excised. The medial malleolus fragment was reduced and fixed with a cancellous 4mm AO screw (Figure 2). Post-operatively, the foot was observed to be well-vascularised. The lateral wounds were allowed to heal with regular dressings and a plaster of Paris splint was applied.

Postoperative care protocol

Postoperatively, the patient received intravenous antibiotics for 24 hours, limb elevation for 48 hours and prophylactic anticoagulation for six weeks. Mobilization started with physiotherapy, consisting of non-weight bearing for six weeks, partial-weight bearing in air cast boot for two weeks and then allowed to fully-weight bear with an air cast boot. The patient was advised to stop using the air cast boot at three months. The wounds healed well and there were no other complications.

Outcomes

Due to the urgency of care required and history of trauma it was not deemed appropriate to use any

form of patient reported outcome measure at the time of incident. However, the patient was reviewed frequently for eight weeks until the wounds healed. Then, accordingly, when she was allowed to weight bear, again at six months, one year and two years post-injury. At six months, the patient had no pain or tenderness, with some dorsiflexion and plantar flexion possible at the mid-tarsal level. One-year follow-up showed that the tibio-calcaneal fusion was solid via plain x-ray (Figure 2). Final follow up at two years, she had a 2 cm shortening of her right leg measured in a weight bearing manner (measured blocks) and appropriate footwear adaptations were incorporated on the right side. She is very happy with the outcome, has no pain and is fully mobile and weight bearing without support.

Discussion

Talus fractures occur rarely and are commonly associated with complications and functional limitations [11]. The main complication being osteonecrosis, Vallier et al reviewed 100 talus fractures and reported osteonecrosis with collapse (31%), ankle arthritis (18%), subtalar arthritis (15%). Operative intervention was complicated by superficial (3.3%) and deep infection (5%), wound dehiscence (3.3%), delayed union (1.7%) and non-union (3.3%) [11]. Restoration of the axial alignment has been recommended to ensure optimisation of ankle and hindfoot function. It has been reported that tibiotalar and subtalar ranges of motion are reduced by up to 50% and arthrosis occurs in roughly 50% of fractures classified as Hawkins type III and IV [4]. The original paper proposing Hawkins classification even stated that comminuted fractures or those involving the body of the talus, were believed to be more problematic injuries and outside the scope of his original article [12].

A range of classifications for talus fractures exist, the most famous being the original Hawkins classification [2].

Historically, cases of talus injuries date as far back to as 1608. Interestingly, a term was coined known as 'aviator's astragalus' due to its high frequency of injury in aircraft accidents [12]. The first case of talectomy for compound fracture was reported in 1609 by Hildanus [13]. The patient had jumped over a ditch and turned his ankle on landing, causing the

talus to dislocate completely out of the skin. The talus was removed completely, following which the man was seen walking without apparent discomfort. In 1931, Whitman reported use of astragalectomy in correction of a calcaneus deformity of the foot [14]. Although these accounts are reported anecdotally, they demonstrate that the procedures used then are used in a similar fashion to case descriptions today. Talectomy has been used as a salvage procedure in correction of pathological deformity in conditions like Charcot-Marie-Tooth, neglected idiopathic clubfoot, neurogenic clubfoot, cerebral palsy, gunshot wound, hemiplegia secondary to head trauma, Volkmann ischaemic contracture, poliomyelitis, arthrogryposis, myelomeningocele, and Charcot arthropathy [15-18]. Talectomy has been used for patients with osteomyelitis or osteonecrosis of the talus [19,20]. We found only one study which reported 4 cases of total talectomy for Hawkins Type III fractures dislocations of talus in 1993 [21]. However, tibio-calcaneal arthrodesis was formally not carried out in the patients in this series.

Detenbeck and Kelley (1969) reported dire results following total dislocation of the talus in nine cases, of which seven were open [22]. Eight of the nine developed sepsis; seven required secondary talectomy, five with tibio-calcaneal fusion. This report highlights the serious consequences of this kind of injury. Their recommendations were to apply a more aggressive approach to initial treatment using talectomy and some form of tibio-calcaneal arthrodesis as the primary treatment for fracture-dislocation of the talus.

Predominantly, cases of tibio-calcaneal (TC) arthrodesis are described for treatment of post-traumatic AVN of the talus or for treatment of rheumatoid arthritis [23-25]. Authors have reported TC arthrodesis of nine ankles in eight patients; seven were for post-traumatic talar AVN and one for rheumatoid arthritis [25]. Fixation was achieved using 6.5 or 7mm cannulated screws or multiple staples, with autologous cancellous bone graft. Fusion was achieved in all patients between 12 and 40 weeks with a 2cm leg length discrepancy. Complications included local infection, malunion, wound dehiscence, prominent fibula and two patients required supplemental external fixation.

In 1972, Reckling reported early TC fusion after displaced talus fractures in eight feet; Steinmann pins

were used to achieve fixation without the use of bone grafting [26]. No wound complications were reported and bone union was achieved within 17 weeks.

The main draw-back of TC fusion is the shortening of 2 to 3 cm that is produced in the limb. It is also possible that secondary arthrosis of other joints of the foot may occur over time after TC fusion.

Using the technique of tibio-calcaneal fusion there is a potential to increase the calcaneal pitch angle. Intra-operatively, the surgeon must be careful to keep this in mind and achieve a well-aligned position of the foot. 7.5 mm cannulated AO screws were utilised providing stable compression across the fusion surfaces and encouraged rapid fusion of the inferior tibial surface to calcaneal articular surface. There are other modes of fixation discussed within the literature such as intramedullary nail, pre-contoured plates or an external fixator. This would depend not only the surgeon's experience and preference but in this case the setting (trauma) and clinical scenario due to the compromised blood supply.

Dennison et al treated six patients who had previous failed surgery and suffered post-traumatic AVN of the talus [27]. The necrotic body of the talus was excised and TC fusion achieved using an Ilizarov frame, combined with corticotomy and a lengthening procedure. Patients were aged between 27 and 67 years. Shortening was corrected in four patients, and bony fusion achieved in all. Four out of six patients reported good or excellent results.

Thomas and Daniels in 2003 reported using talonavicular and subtalar arthrodesis as a primary fusion to treat a three week old Hawkins type IV traumatic comminuted neck of talus fracture in a 29-year-old man [28]. Their case had similarities to ours, in that open reduction internal fixation had been planned, however, this was not possible anatomically due to the degree of comminution. The patient underwent 16 months of follow-up and despite successful fusion without avascular necrosis, he was unable to return to his job as a roofer.

Hantira et al reported treating a comminuted open fracture of the body of the talus on the same day of injury by tibio-talar fusion using the Blair technique [29]. Küntscher nails and cancellous screws remained *in situ* while the graft healed and they were removed at

four and eight weeks post-surgery, respectively. The patient started active and assisted foot exercises 14 weeks following surgery, with partial-weight bearing on crutches 20 weeks after the injury. Fusion was complete at 10 months after injury and the patient was reportedly almost pain free.

Conclusion

The severity of talus fractures has increased over the last 3 decades due to modern safety equipment resulting in higher survival rates from serious accidents [2]. Due to recent advances in surgical and fixation techniques, the tendency is to reduce the talar fractures as anatomically as possible and stabilize them with screws.

It is worthwhile considering the option of a talectomy in conjunction with a primary tibiocalcaneal arthrodesis. although cases of talus fractures with comminuted dislocations are rare. In this particular case study, to attempt to perform an open reduction and internal fixation procedure may have increased the potential risk and complications associated with these procedures, mainly AVN, traumatic hind foot arthrosis both potentially requiring further surgery. Ultimately, increasing the potential for a high rate of long-term complications and a significant impact on activities of daily living and quality of life after such treatment [30].

In summary, surgeons should be flexible in their approach in regards to consideration of treatment options in order to maximise patient outcomes. This case highlights that the procedure choice of a primary talectomy and tibio-calcaneal arthrodesis is a viable treatment option for traumatic dislocated comminuted talar fractures, which intra-operatively was unable to be anatomically reduced and fixated.

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