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Salvage of Failed Total Ankle Replacement Using a Custom Titanium Truss

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ABSTRACT

Subsidence of the talar component results in significant morbidity after total ankle replacement. When recognized, prompt revision could be needed to preserve the function of the implant; however, this is not always the case. In situations in which the implant cannot be revised, tibiotalocalcaneal arthrodesis might be necessary to salvage the extremity. The purpose of the present report is to describe the use of a custom titanium alloy truss to fill a bony void created by explantation of the implant components. Total ankle replacement was performed as the initial surgery to address end-stage osteoarthritis. Two years after the index procedure, the patient underwent revision of the polyethylene and talar components with subtalar arthrodesis secondary to progressive subtalar osteoarthritis and talar subsidence. The implant subsequently became infected and was removed. The patient underwent re-implantation after the infection had resolved, but significant talar subsidence required conversion to a tibiotalocalcaneal arthrodesis with a custom titanium alloy truss and retrograde intramedullary nail. At the most recent follow-up appointment, the patient was weightbearing on a stable extremity and pain free. Radiographic examination confirmed appropriate implant alignment and evidence of bone formation throughout the titanium truss. Although our results are restricted to a single case with initial, limited follow-up data, combining sound structural mechanics with an open architecture and unique texture, the custom titanium truss appears to maintain the limb length and promote healing across a large void.

In recent years, total ankle replacement (TAR) has increased in popularity for the treatment of end-stage ankle arthritis. By replacing the deteriorated articular surfaces of the ankle joint, mobility is restored, and patients are able to return to pain-free activity (1). Since its initial introduction, the prosthetic design and techniques have dramatically advanced, with improved implant survivorship (1,2). A recent review by Easley et al (2) demonstrated an implant survivorship of 80% to 95% at 8 to 12 years. Despite improved implant longevity and durability, TAR failure has not been eliminated (3,4).

Subsidence and aseptic mechanical loosening of the prosthesis remain the most common causes of failure (3,5–7). Subsidence is defined as the progressive, longitudinal migration of the implant into the bone in which it is embedded (8). Although "settling of the component" is acceptable and should be expected, progressive motion threatens not only the stability of the implant itself but also the adjacent subtalar joint (Table 1) (5).

Failure of TAR is a devastating complication and a considerable challenge for both patients and surgeons (9). The complex task of revision surgery is burdened by critical bone loss, poor bone quality, deformity, and disrupted soft tissues (10). These challenges are further confounded by the limited surgical treatment options. Salvage scenarios include revision of the components, replacement of the polyethylene bearing, arthrodesis, and, in extreme cases, below-the-knee amputation (11–13).

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Table 1
Talar subsidence

Grade	Description
1	Minimal migration of the talar component
2	Talar component has migrated into the talar body but has not yet violated the subtalar joint
3	Talar component has migrated into the subtalar joint

Data from Ellington JK, Gupta S, Myerson MS. Management of failures of total ankle replacement with the agility total ankle arthroplasty. J Bone Joint Surg Am 95:2112-2118, 2013.

Tibiotalar arthrodesis and tibiotalocalcaneal arthrodesis have proven to be acceptable surgical treatment options for salvage of failed TAR (11,14,15). Given the bony void that remains after removal of the implant, autografts and allografts are often used to fill the defect space, promoting joint congruency and successful consolidation (5,16). Although positive outcomes have been achieved (15), these techniques have been associated with a relatively high rate of nonunion (14), donor site morbidity, graft infection, graft collapse, and limb length discrepancies (17), promoting the search for alternative treatment options. The purpose of the present case report is to describe the use of a custom titanium alloy truss (Osteotomy Truss System™; 4WEB Medical, Inc., Frisco, TX) to fill a bony void created by explantation of the implant components owing to subsidence.

Case Report

A 56-year-old male presented with a chief complaint of left ankle pain. On physical examination, the ankle demonstrated a limited range of motion with crepitus, and advanced imaging demonstrated degenerative arthritis of the ankle joint (Fig. 1). After extensive discussion of the conservative and surgical treatment options, the patient elected to undergo TAR with the INBONE® I total ankle system (Wright Medical Technologies, Memphis, TN) in February 2011 (Fig. 2).

In January 2013, approximately 2 years after the index procedure, the patient underwent subtalar joint arthrodesis and TAR revision (INBONE® II total ankle system; Wright Medical Technologies). The polyethylene and talar components were replaced with bone cement owing to progressive subtalar osteoarthritis and talar subsidence. Removal of the subtalar joint screw was performed in October 2013. The patient subsequently developed a deep complex abscess of the left foot, necessitating an incision and drainage procedure in December 2013. Cultures from the abscess revealed *Staphylococcus aureus* as the infective agent; bone cultures were not taken at that time. Nuclear medicine imaging after the incision and drainage confirmed infection of the prosthesis. In March 2014, approximately 3 years after the initial TAR, the implant was explanted, and an antibiotic cement spacer of polymethylmethacrylate mixed with 0.5 g gentamicin was placed into the bony void. Cultures take at explantation revealed the same infective agent as in the abscess evacuated 4 months earlier. The infectious disease department was consulted to determine the appropriate intravenous antibiotic management to treat the *S. aureus* infection. In May 2014, once the infection had resolved, the spacer was removed, and a new ankle prosthesis was implanted.

After this most recent revision, the patient continued to have pain and demonstrated continued talar subsidence on serial radiographs. Tibiotalocalcaneal arthrodesis was discussed as a salvage option for the patient. Fully informed, the patient elected to proceed. A complete surgical timeline is provided in Table 2.

Preoperatively, the patient underwent computed tomography scanning. These images were used to measure the anticipated bony void and create a customized titanium implant that would allow insertion of the intramedullary (IM) nail through the implant (Fig. 3). Various trial and final implant trusses were available to the surgeon for the procedure (Fig. 4). In March 2015, approximately 4 years after the index TAR, the patient underwent explantation of the TAR and tibiotalocalcaneal arthrodesis with custom titanium truss and retrograde hindfoot IM nailing. General anesthesia and a lower extremity block were administered. The previous surgical incision was used to gain exposure to the ankle joint. The tibial modular stem and talar components were removed, leaving a trapezoidal bone void. All interposed fibrotic tissue, interposed bone, and nonviable tissue was removed from the ankle joint. A sagittal saw was used to freshen the edges on all surfaces of the trapezoidal void to increase the probability of postoperative bony union of native bone to the titanium truss.

In accordance with the technique guide for the IM nail (T2™ ankle arthrodesis nailing system; Stryker®, Kalamazoo, MI), the extremity was prepared for insertion. As the guidewire and reamer were transmitted across the bone void, they were guided carefully to ensure central placement within the tibia. Additionally, the template for the titanium truss was placed into the defect to ensure the final truss would align appropriately. Fluoroscopic imaging was used throughout the procedure. After preparation of the extremity, copious irrigation was performed, the titanium truss was placed into the defect, and the nail was placed from the calcaneus through the talus and into the tibial canal, threading through the truss and secured into position. Appropriate placement was confirmed by intraoperative fluoroscopy. Next, the IM nail was secured with talar, tibial, and calcaneal screws in accordance with the technique guide in a static fashion. Proper positioning was confirmed by intraoperative fluoroscopy. The titanium truss was confirmed to be within the joint and in appropriate alignment with the tibial axis. The foot was also translated slightly posterior on the leg for appropriate postoperative function. Then, approximately 20 mL of bone graft substitute (Vitoss® bone graft substitute; Stryker®) mixed with 5 mL of allogeneic

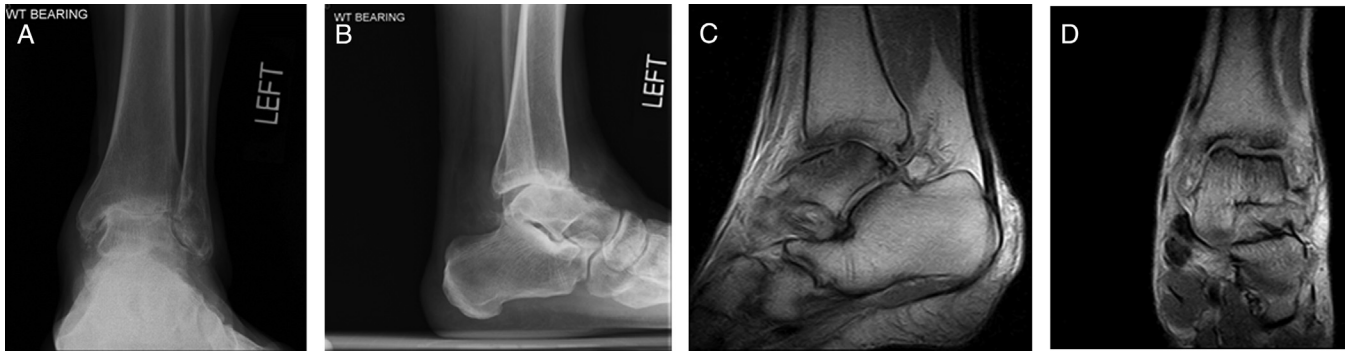

Fig. 1. Preoperative imaging. (*A*) Anteroposterior and (*B*) lateral radiographs and (*C*) sagittal and (*D*) coronal computed tomography scans of the left ankle demonstrating end-stage ankle osteoarthritis with anterior translation of the talus.