

Tibiototalcalcaneal Arthrodesis with use of an Antibiotic Coated Intramedullary Nail for Limb Salvage

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STATEMENT OF PURPOSE & LITERATURE REVIEW

Severe limb deformity can create a major disability for a person which can ultimately lead to a non-ambulatory lifestyle. Limb deformities created by open fractures not only put the patient at risk for a non-functional lifestyle, the patient is also at risk for gross contamination and osteomyelitis of the osseous structures. At times, these deformities require amputation for better functionality. However, an attempt for limb salvage should always be pursued. Here we present a single stage technique which may be used as an attempt for major deformity limb salvage in the setting of chronic osteomyelitis. Most literature refers to a staged procedure in which two procedures need to be performed(1,2,5,6); this includes a temporary antibiotic nail followed by a permanent intramedullary nail after complete resolution of the infection. Staged procedures prolong the non-weightbearing status of the patient, decreasing their quality of life. The use of a single staged antibiotic coated nail has rarely been discussed in the literature(3,4).

Figures 1 & 2: Pre-operative Anteroposterior and Lateral ankle radiographs displaying severe valgus deformity and anterior ankle subluxation.



CASE STUDY & SURGICAL PROCEDURE

The procedure began with a 12-cm linear incision over the right fibula. Upon exposure of the fibula, there were multiple loose bony fragments noted at the distal fibula which corresponded with non-union. An osteotome was utilized to gain access to the ankle joint. No acute signs of infection were appreciated upon dissection of the ankle joint. With utilization of a sagittal saw, planar remodeling of the tibial plafond and talar dome was performed. The foot was still noted to be in a valgus position with the talus sitting lateral to the foot. The medial malleolus was noted to be blocking the reduction of the valgus deformity, the decision was then made to resect the medial malleolus. Once the medial malleolus was removed, the entire foot was translocated underneath the tibia. Next, the ankle joint was wedged in a more rectus position. The use of a 14 mm femoral head allograft was tamped into place from lateral to medial with the base sitting lateral allowed for resolution of the deformity. Once proper positioning was appreciated the ankle joint was copiously irrigated with 3 L of antibiotic solution. Next the axis guide and reaming system was used to create a canal for the intramedullary nail, reaming 2 mm over to allow for the cement nail insertion. Then, the intramedullary nail by was coated in 40 g of polymethyl methacrylate cement, 2 g of vancomycin powder, and 3.6 g of tobramycin powder as a permanent coating (Figures 5-11). After the nail was coated in antibiotic cement, it was inserted utilizing standard protocol. The medial malleolus was utilized as an autograft, it was crushed and packed on the medial and lateral aspects of the ankle joint, fortifying our construct.

Figures 3 & 4: Clinical photographs of the patient simulating weight-bearing pre-operatively, showing the presenting valgus deformity. 3D-CT recon image showing severe deformity



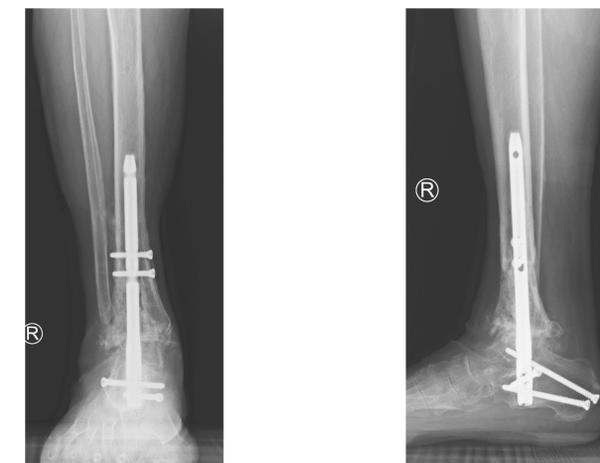
Figures 5-11: Surgical series showing lateral approach with fibular takedown, nonviable bone removal, and opening tibial osteotomy. The imaging sequence highlights the use of femoral allograft interposition to correct valgus and achieve rectus alignment of the ankle. The final images show drilling to the tibia and preparation of the antibiotic coated nail.



DISCUSSION

Open fractures must be managed diligently to prevent contamination and infection of the underlying osseous structures. Often, external fixation is applied until negative cultures are obtained, followed by permanent internal fixation. Instances where medullary bone becomes infected often require more creative means of fracture stabilization. Most literature refers to a staged procedure using a temporary antibiotic nail, which may be exchanged for a permanent nail after infection resolves. Downfalls to this technique include the necessity of multiple surgical procedures and a prolonged non-weight bearing period. Paley and Herzenberg described this staged procedure on 9 patients and exchanged their fixation at an average of 164 days, requiring an immense period of immobility for their patients (1). Miller and colleagues described a case of a failed total ankle arthroplasty complicated by infection. The patient was temporized with an Ilizarov antibiotic coated rod followed by permanent intramedullary nailing (2). This sequence of surgical management resulted in two separate procedures which delayed the patients functionality. To eliminate the downfalls of a staged procedure, antibiotic coated permanent fixation is an option. Use of antibiotic coated permanent nail fixation has been sparsely discussed in literature. Use of antibiotic coated nails was described by Thonse and colleagues in 2007. They reported 20 patients (4 ankle, 4 tibia, 5 knee, 7 femur) who received permanent antibiotic coated intramedullary nails. Infection control was achieved in 19/20 patients, with one patient receiving an above knee amputation. Bony union achieved in 17/20 patients. 2/20 patients achieved stable nonunion, with cement de-bonding where a nail exchange was necessary. Their average follow up was 16 months with no further complications (3). In 2012, Woods et al published a case report of a single tibiototalcalcaneal (TTC) arthrodesis using antibiotic coated nail and they concluded antibiotic coated TTC nail arthrodesis is a viable option for patients suffering from a severe deformity in the setting of chronic osteomyelitis (4). Our case study follows the course of a patient who suffered from chronic osteomyelitis after a severe injury to the lower extremity. We were successful in reconstructing her ankle with the use of a single, permanent procedure.

Figures 12 & 13: Post-operative AP and Lateral radiographs showing stable correction of the patients ankle with maintenance of a plantigrade foot.



CASE STUDY

A 60 year old female presented with a painful severe valgus deformity after sustaining an open pilon fracture to her right ankle 3 years prior. The patient had multiple procedures performed by an outside surgeon which include multiple attempts of external fixation and open reduction internal fixation. The patient developed a subsequent osteomyelitis which was treated with intravenous antibiotics. The patient was wheelchair bound for three years due to her painful deformity. The patient visited several different providers before visiting us, all offering her a below knee amputation. Once in our care x-rays (Figures 1 & 2) and CT scan (Figure 3) were performed for surgical planning. Both imaging modalities showed severe post-traumatic arthritis with collapse of the distal tibia and fibula resulting in 27 degrees of valgus and 1.5 cm anterior dislocation of the tibiotalar joint. Clinically the patient demonstrated only 3 degrees of ankle joint range of motion with painful crepitation. She had no subtalar joint range of motion and upon simulated weightbearing, she suffered from a severe rearfoot valgus (Figure 4). Initially, the patient was taken to the operating room for bone biopsy and culture. The biopsy was consistent with chronic osteomyelitis and the patient was treated with intravenous ceftaroline per infectious disease recommendations. Once the patient completed her antibiotic therapy, she was taken back to the operating room for a single staged tibiototalcalcaneal arthrodesis with use of an antibiotic coated nail.

RESULTS

The patient originally presented with 27 degrees of ankle valgus and a 1.5 centimeter anterior dislocation of the tibiotalar joint. Near rectus alignment of the ankle joint was achieved after total reconstruction with use of an antibiotic coated intramedullary nail was performed (Figures 12 & 13). Osseous union was achieved at 12 weeks and the patient no longer is dependent on a wheel chair. The patient is 15 months post-operative and is fully ambulatory with use of a cane, the patient also has complete resolution of pain.

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