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Case Report

Tibiotalocalcaneal Hindfoot Fusion for Acute Phase Severe Charcot Osteoarthropathy: A Case Report

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Abstract: Charcot osteoarthropathy is a debilitating disease associated with uncontrolled diabetes mellitus that has multiple orthopedic complications. Severe degenerative foot and ankle changes have been cited in the literature and remain a challenging pathology for treatment. A 61 year old female with severe Charcot osteoarthropathy to the left tibiotalar and subtalar joints treated successfully with a minimally invasive tibiotalocalcaneal hindfoot fusion nail construct. While multiple stabilization techniques exist to include cross screws, plates, and intramedullary devices, hindfoot nailing systems offer a technique with minimal periosteal stripping and soft tissue dissection. Tibiotalocalcaneal hindfoot fusion nails show promise to fast post-operative return to activities of daily living.
Keywords: ankle, Charcot arthropathy, hindfoot fusion, osteoarthropathy, tibiotalocalcaneal.

INTRODUCTION

Charcot osteoarthropathy (COA) of the hindfoot and ankle is an infrequent neuromusculoskeletal pathology often concomitant with diabetes mellitus which progresses into destruction and deformity of the foot and ankle. COA presents a challenge for orthopedic surgeons as functional limb salvage is a high priority due to the extensive risk for joint subluxation, dislocation, chronic deformity, and even amputation. Early diagnosis and correction are recommended as COA involving the tibiotalar, subtalar, and Chopart's joints is most likely to lead to progressive deformity and unresponsiveness to nonoperative management (Richman, J. *et al.*, 2017). Pedal neuropathy may also be accelerated by diabetes along with associated metabolic abnormalities causing insensibility and deformities in the foot (Gonzalez-Martin, C. *et al.*, 2019). Charcot arthropathy typically presents clinically with erythema, edema, break-through pain, or soreness, local rise in temperature, variable pedal pulse, loss of sensation in the foot, instability of joints, and foot deformity upon musculoskeletal exam or radiographic imaging (Rajbhandari, S. M. *et al.*, 2002). Variable pain manifestations are common, as patients are typically superficially insensate but complain of deep gnawing pain with motion of involved joints. If diagnosed in acute Charcot phase, conservative management with total contact casting and Charcot Restraint Orthotic Walker (CROW) may be utilized. More recent literature suggests the possible benefits of acute stabilization in early inflammatory phase of Charcot and even as a primary surgical measure in irreparable tibiotalar trauma (Tarkin, I. S., & Fourman, M. S. 2018).

To treat COA foot and ankle deformaties that could progress into more severe debilitation or possible risk of amputation for the patient, tibiotalocalcaneal (TTC) fusion using an intramedullary (IM) nail and ring external fixators have been shown as effective salvage options (Lee, M. *et al.*, 2018). Due to the extent of destruction and lack of bone stock in the talus, cross threaded screws tend to theoretically be a weaker biomechanical construct. The surgical technique used is largely up to the managing team; however, the retrograde intramedullary nail has been shown to be largely advocated for due to its load sharing ability leading to less secondary operations for hardware failure. The intramedullary nail technique also is preferred due to the higher risk of pin tract infections and tibia fracture with the ring external fixator technique (Santy, J. *et al.*, 2009). The main purpose of the reconstruction technique is to obtain plantigrade alignment of the foot and ankle as well as arthrodesis to significantly reduce the risk of ulceration and further irreparable damage (Chraim, M. *et al.*, 2018). Many surgical techniques for achieving a stable fusion are made difficult with conventional plates, screws, and pins due to the associated poor bone quality and extensive soft tissue compromise and bone loss accompanying COA associated tibiotalar destruction (Lee, D. J. *et al.*, 2016).

The intramedullary nail was developed from simple straight nails to specially modified nails with appropriate curvatures and internal compression capabilities (Dominic Marley, W. *et al.*, 2014). The IM nail has shown to have higher bending stiffness, increased rotational stability, and higher dynamic compression capability than crossed lag screws, external fixators, or blade plates (Alfahd, U. *et al.*, 2005). Greater compression is achieved and maintained with an ankle arthrodesis nail-mounted compression device compared with external fixation (Berson, L. *et al.*, 2002). In this case study, we aim to present the etiology, presentation, and diagnostic workup of tibiotalar joint associated COA and its subsequent successful treatment using an intramedullary tibiotalocalcaneal arthrodesis nail in an adult patient with multiple comorbidities.

CASE REPORT

A 61-year old female presented in the clinic as a new patient for evaluation of chronic left ankle pain. The patient had a long-standing history of uncontrolled type II diabetes (T2D), cardiovascular pathology, and tobacco use. Approximately 2 weeks prior to the clinic visit, the patient was seen in the emergency room due to a sudden increase in her chronic left ankle pain. The patient stated that she had sharp, stabbing, and throbbing pain to the left ankle radiating up to the knee with dramatic swelling that responds to compression sleeves. Patient had no history of malignancy and no accompanying infectious signs to include constitutional symptoms.

On physical exam, her left foot and ankle were markedly limited to range of motion secondary to pain. She was able to demonstrate motor function in all myotome distributions and severely diminished sensory to the foot and ankle to the level of about 10 cm proximal to the tibiotalar joint. Her legs were darkly discolored with 3+ pretibial pitting edema consistent with chronic vasculopathy. Plain radiograph films of the left foot and ankle were obtained which showed extensive destructive changes at the level of the tibiotalar, subtalar joints. Talar collapse, obliteration of the tibiotalar joint, and persistent soft tissue swelling were noted with no acute obvious fractures of the left foot. The conclusion upon physical examination and radiographic analysis was consistent with type II diabetic Charcot osteoarthropathy with acute destruction to the tibiotalar and subtalar joints (Figure 1).

Figure 1: (a) anterior to posterior, (b) mortise, and (c) lateral plain radiographic films demonstrating severe destruction of tibiotalar joint and subtalar arthrosis

Due to the patient's extreme risk for continued degradation and collapse with malalignment of the ankle joint, the treatment plan was formed with the best interest for longevity of her left lower extremity. This included seeking a procedure that diminished her chances of amputation while stabilizing the osseous structures so that at completion of the coalescence phase of COA, the patient will be left with a functional extremity for balance and pain free independent ambulation. After thorough discussion of post-operative outcomes and rehabilitation goals, a tibiotalocalcaneal hindfoot arthrodesis was scheduled. The patient obtained cardiac and medical clearances, and then informed consent was obtained by the patient for the procedure scheduled for 20 days after the initial day of visit. On the day of the procedure, the patient received a preoperative popliteal and saphenous nerve block by anesthesia and was brought into the operating room. The left lower extremity was prepped and draped in usual sterile fashion, and pneumatic thigh tourniquet set to 300 mm of mercury to be kept for the duration of the procedure. Due to the near previous complete destruction of the tibiotalar and subtalar joints, direct denution of the cartilage via a two incision ankle approach was unnecessary. A 1.6 mm wire was used to enter the plantar surface of the calcaneus in the subtalar space with several passes into the talus to induce subchondral bleeding at multiple points to further promote subtalar fusion. Next, an incision was made longitudinally on the plantar foot allowing passage of a guidewire for a Synthes 13 mm entry reamer from center of plantar calcaneus to the center of talar dome. Next, a reaming guide and reamers were inserted from 8-11 mm in 1 mm increments until it was determined that a 10 mm x 240 mm tibiotalocalaneal fusion nail could be inserted with adequate purchase and stability. Once the tibia had been reamed, a Synthes hindfoot fusion nail was inserted in traditional technique with two 6.0 locking screws in the calcaneus, one 5.0 screw in the talus, and two 5.0 screws in the tibia, all engaging the nail and securing in multiple planes. All screws were inserted through 1 cm percutaneous incisions, with placement visualized and verified under low dose fluoroscopy. The wound construct was then thoroughly irrigated and closed in sterile fashion. A short leg plaster splint was then placed. Discharge plan included remaining non-weight bearing on operative limb with use of assistive walking devices. Upon first post-op visit, patient was elated and noticed an immediate reduction in pain from her preoperative symptoms. Incisions were healing uneventfully, and she was placed in a walking cast and followed up two weeks later for suture removal and cast replacement. At the second post-op visit, patient continued to deny constitutional symptoms and major concerns. Three x-ray views were obtained, demonstrating intact hardware without failure (Figure 2). The patient was instructed to follow up in 3-4 weeks for cast removal, x rays, and transition to a walking boot.

Figure 2: (a) anterior to posterior, (b) mortise, and (c) lateral plain radiographic films demonstrating intact tibiotalocalcaneal hindfoot fusion nail without hardware failure.

DISCUSSION

This case demonstrates the powerful effect of internal stabilization in acute phase of advanced destructive changes associated with COA. Tibiotalocalcaneal fusion via intramedullary nail was the best choice to reconstruct the foot and ankle to a plantigrade alignment. Due to compromised soft tissue envelope, active acute Charcot status, uncontrolled diabetes, and other comorbidities, this minimally invasive approach was deemed the most utile. The Synthes hindfoot system has an intrinsic neutral plantigrade fixed angle and 5 degrees hindfoot valgus. There are many hindfoot fusion nails currently on the market that range from straight to valgus positions. While the ultimate goal of either system is functional alignment, the operator must be mindful to ream in the recommended valgus position if inserting a straight nail without intrinsic valgus. The use of retrograde intramedullary nail has been shown to also result in high rates of successful limb salvage when used specifically for tibiotalocalcaneal arthrodesis in patients with Charcot arthropathy similar to this case (Richman, J. *et al.*, 2017). Typically, the rate of success in cases outside of Charcot arthropathy vary between 50% and 90% due to infection, hardware failure, pseudoarthrosis, or malunion (Caravaggi, C. *et al.*, 2006).

Figure 3: (a) Pre and (b) post-operative lateral plain radiographic films demonstrating recovering soft tissue contours, muscle striations, and soft tissue planes.

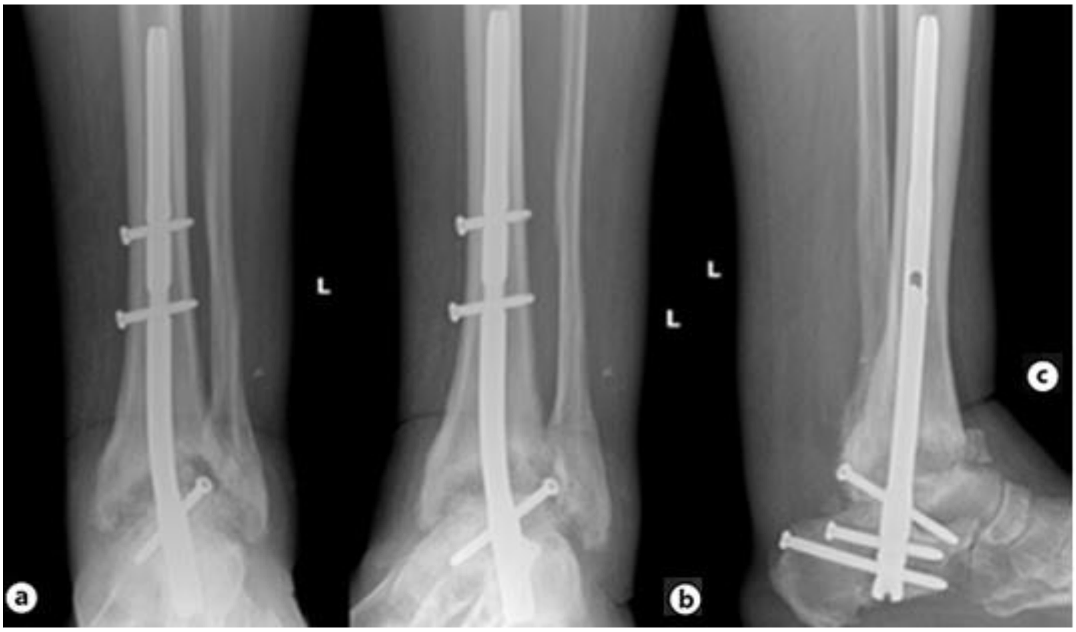

Figure 4: (a) anterior to posterior, (b) mortise, and (c) lateral plain radiographic films interval consolidation of fusion mass three months post-operative.

The 61-year-old female patient was observed to have no post-operative complications. Radiographic analysis confirmed no hardware complications and the patient underwent physician recommended recovery protocol with no further left ankle associated pain. Surgical correction led to limb salvage, relief of left ankle associated pain, and restoration of both functional mobility and soft tissue contour of the left lower extremity. With less soft tissue dissection and risk of de-vascularization, patient had a return of soft tissue planes / muscular striations on radiographs and concave contours circumferentially at level of ankle (Figure 3). Patient has noticed dramatic improvement in soft tissue edema and discoloration since pre-operative evaluation. Due to multiple comorbidities, the treatment team will continue to monitor for ulcerations and secondary infections, as both could lead to necessary amputation of the limb. Final follow up radiographs show impressive interval consolidation of fusion mass at the level of the tibiotalar joint (Figure 4).

CONCLUSION

Tibiotalocalcaneal fusion via intramedullary hindfoot nail is an effective and preferable orthopaedic surgical treatment option for Charcot osteoarthropathy associated with tibiotalar and subtalar joint destruction and foot deformity. Indications for this type of device are expanding and currently include severe osteoarthritis to hindfoot, COA, severe equinovarus deformity, and most recently being considered for acute tibiotalar trauma (Lee, B. H. *et al.*, 2018). Post-operative outcomes are promising with no observable complications but should be followed up with continual maintenance of patient comorbidities and risk factors to prevent further injury.

Statement of Ethics

Informed consent was obtained by patient for publication of this case and all related images.

Disclosure Statement

The authors have no conflicts of interest to declare.

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Author Contributions

Vamsi Reddy and Benjamin Sookhoo participated in the production of the manuscript literature. Andy Nguyen assisted with grammatical corrections and final production. Edward Szabo is the attending physician that performed the final review of completed document.

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Nothing to declare

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