

Statement of Purpose

This case explores treatment options for patients with severe lower extremity disease that would traditionally require a major lower extremity amputation (MLEA). The goal of this study is to explore innovative techniques which can be utilized for lower extremity limb salvage in appropriate candidates.

Case Study

67-year-old female was transported to the emergency department after being found unconscious in her motel room. She presented with sepsis, adult failure to thrive, and multiple body site ulcerations - one including a maggot infestation to the left plantar heel with osseous exposure. Labs were significant for leukocytosis, hypokalemia, hyperglycemia, and hypoalbuminemia. Pertinent history included T2DM, with non-compliance due to unmanaged depression, previous left lower extremity (LE) ulcerations, and a failed foot charcot reconstruction. She was medically stabilized and a limb salvage surgical plan was discussed.

Antibiotic IM Nail

An antibiotic IM nail was employed as adjunctive temporary stability for the tibio-talo-calcaneal (TCC) joints. It was created using polymethyl methacrylate (PMMA), with tobramycin/vancomycin. An intubation tube/stylet was manually shaped for the procedure. The antibiotic mix was inserted into the adapted tube, allowed to harden, and casting removed - resulting in cement cylindrically encasing the stylet. The TCC joints were pre-drilled, and IM nail placed. The nail placement resulted in deficit filling, temporary tri-joint stability, and infection mitigation.

References:

Wukich, D. K., et al. (2022). Limb Salvage in Severe Diabetic Foot Infection. *Foot and ankle clinics*, 27(3), 655-670.
Kwaadu K. Y., (2020). Charcot Reconstruction: Understanding and Treating the Deformed Charcot Neuropathic Arthropathic Foot. *Clinics in podiatric medicine and surgery*, 37(2), 247-261.
Greco, T., et al. (2023). RANKL-RANK-OPG Pathway in Charcot Diabetic Foot: Pathophysiology and Clinical-Therapeutic Implications. *International journal of molecular sciences*, 24(3), 3014
Burnstock G., et al. New insights into the local regulation of blood flow by perivascular nerves and endothelium. *Br J Plast Surg*. 1994 Dec;47(8):527-43

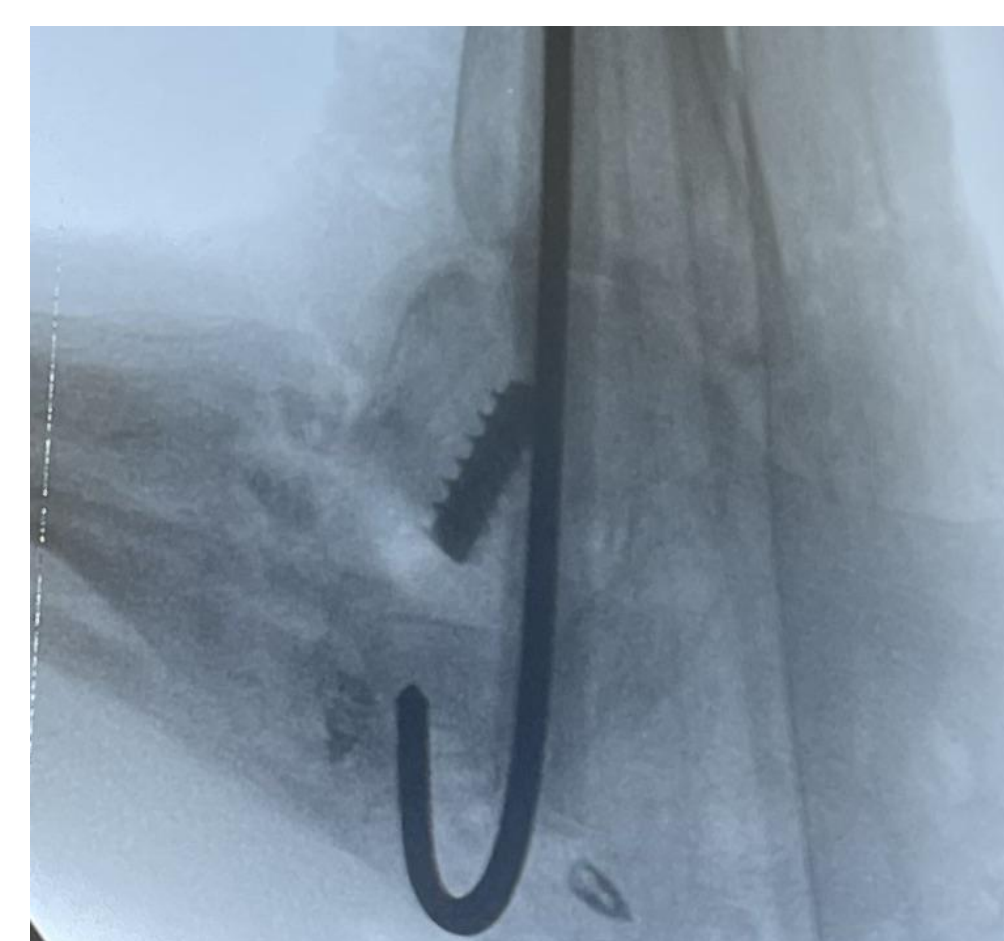
Literature

Two theories predominate literature regarding the etiology of charcot-arthropathy. The neurotraumatic theory involves repetitive microtrauma to an insensate extremity, and subsequent poor healing in equino-favoring positions - due to glycosylation of collagen based LE tissues. Ambulation during this process leads to collapse/subluxation of the medial longitudinal arch subsequent to biomechanical demand on vulnerable structures. The neurovascular theory, is predicated on the RANK-L (Receptor Activator of NF-κB ligand)/Osteoprotegerin (OPG) pathway - a focal point in the inflammatory/acute process of the disease. RANK-L is a protein and cytokine produced by osteoblasts, involved in regulation of osseous resorption. The etiology behind diabetic induced RANKL:OPG mismatch is not well establish in literature, but many theories have been proposed. One suggests injury induced edema increases peripheral flow to the LE. Another suggests tissue glycosylation leads to damage of local trophic nerve structures resulting in poor control of endothelial cell management of vasodilatory mechanisms, thereby distorting dilatory commands and increasing peripheral arterial flow. Both aforementioned theories result in increased RANKL to osseous structures, causing increased resorption and subsequent weakening. Most clinicians accept an interposition of these theories, and regard both as a sequela of the damaging nature of peripheral neuropathy. Therefore, chronic hyperglycemic conditions on nervous tissues, in conjunction with repetitive microtraumas, leads to the destruction noted in a charcot limb.

Discussion

At postoperative week one, the patient showed significant improvement with no signs of infection. Two month follow-up demonstrated maintained rearfoot alignment and a plantigrade foot, allowing for temporary fixation removal. At one year, imaging demonstrated TCC pseudoarthrosis with stability - allowing ambulation in regular shoe gear with an orthotic to fill the calcaneal deficit. Utilization of antibiotic cement is well documented; however, the molding and utilization of the cement as highlighted in this case, is relatively novel. The use of a removable rod within the cement acts as additional temporary fixation that is removed after adequate healing and is a design that could potentially be integrated into standard of care. Current literature shows a 50-80% five year mortality rate for a MLEA in diabetic populations, and an approximate 30% five year mortality rate for charcot and diabetic foot ulcer diagnosis/management. The etiology behind MLEA mortality is complex, but the major factor is notably related to hemostatic shift, due to the physical removal of extensive tissues, as such, it is post-procedurally difficult to prevent. Therefore, avoidance of MLEA in diabetic lower extremity disease significantly improves the mortality rate in patients. In this case, surgical management of the infection and charcot deformity was successful in salvaging the limb and creating a stable, ambulatory foot. This patient was given a significantly higher chance at long-term survival and her success is an indication that multimodal and ingenuitive limb salvage can be successful at reducing MLEA rates, and should be an industry priority.

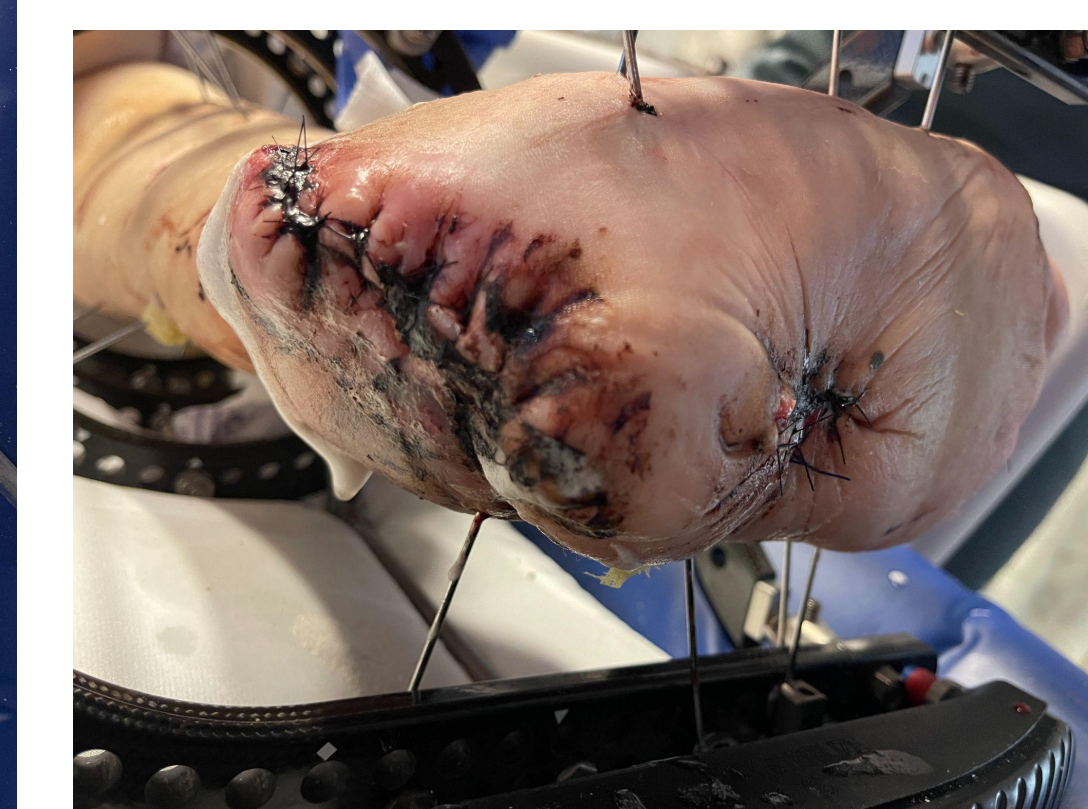
IM Nail



Operative



S/P 1 Week



S/P 1 Year



S/P 2 Months

