The Challenging Consequences of Charcot Arthropathy: A Case Report

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Statement of Purpose

The purpose of this case study is to highlight the use of a custom 3D-printed titanium talar implant in combination with a tibiotalocalcaneal (TTC) arthrodesis nail as an innovative surgical solution for extensive joint destruction and deformity encountered in Charcot arthropathy.

Procedures

The patient, in their early 70s, underwent a two-stage surgical intervention to address Charcot arthropathy with severe talar bone loss and deformity.

Initial Procedure:

- Open arthroplasty of ankle.
- External fixation with an Ilizarov frame to stabilize the right ankle.
- Antibiotic spacer placement to manage infection and joint space loss.

Definitive Procedure (Pantalar Arthrodesis):

- Removal of the external fixation device and antibiotic spacer.
- Resection of damaged bone to prepare for fusion.
- Insertion of a custom 3D-printed titanium talar implant to replace the lost talus.
- Tibiotalocalcaneal (TTC) fusion nail placement for structural support.
- Application of AlloMatrix and Augment (bioengineered PDGF-BB) to promote bone healing.
- Postoperative imaging confirmed proper alignment and implant positioning.

Case Study

Introduction

Charcot arthropathy is a progressive and debilitating condition affecting neuropathic patients, particularly those with diabetes mellitus. This case study presents a 70s-year-old patient with severe Charcot-related talar bone loss, highlighting the role of custom 3D-printed titanium implants in limb salvage.

Case Presentation

The patient presented with chronic right ankle pain and deformity due to advanced Charcot arthropathy. Past medical history included diabetes mellitus, rheumatoid arthritis, and multiple joint surgeries. Imaging revealed complete talar collapse, pseudoarthrosis, and significant osseous destruction. Initial treatment with external fixation and an antibiotic spacer failed to restore stability, necessitating surgical intervention.

Surgical Management

A pantalar arthrodesis was performed, including:

- •Removal of the external fixation device and antibiotic spacer
- •Resection of damaged bone for optimal fusion
- •Implantation of a custom 3D-printed titanium talar replacement
- •Tibiotalocalcaneal (TTC) fusion nail placement for structural support
- •Use of AlloMatrix and Augment (bioengineered PDGF-BB) to enhance bone healing

Outcome & Rehabilitation

Postoperative imaging confirmed proper implant positioning and alignment. The patient followed a non-weight-bearing rehabilitation protocol, incorporating physical and occupational therapy for mobility and daily function adaptation. Early follow-ups indicated successful limb salvage with ongoing monitoring for fusion progression.

Conclusion

This case highlights the effectiveness of custom 3D-printed titanium implants in addressing severe Charcot deformities, offering a promising alternative to traditional reconstruction methods. A multidisciplinary approach is crucial in optimizing patient outcomes and functional recovery.

Fig. 1: Initial presentation of R ankle

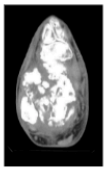
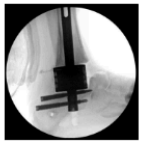
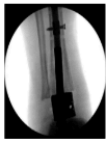
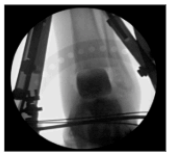


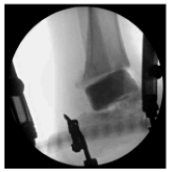
Fig. 2: CT confirming destruction of the talus





Figs. 5 and 6: Intra-operative R Ankle AP/Lateral – Final s/p talar implant and TTC nail





Figs. 3 and 4: Intra-operative R Ankle AP/Lateral – final s/p External fixation, using Ilizarov frame, Open arthroplasty of ankle

Literature Review

Dekker et al. (2018): Reported an 87% success rate in Charcot patients treated with custom 3D-printed titanium implants, showing improved pain relief and function.

Bejarano-Pineda et al. (2021): Evaluated retrograde intramedullary nails combined with 3D implants, finding an 85% fusion rate and reduced surgical complications.

Raikin et al. (2022): Compared outcomes of tibiotalocalcaneal (TTC) fusion using custom cages versus traditional techniques, concluding that patient-specific implants led to higher satisfaction and better fusion rates.

Zhang et al. (2019): Demonstrated the benefits of 3D preoperative modeling in reducing operative time and complications in ankle reconstruction surgeries.

Analysis and Discussion

Traditional interventions, including total contact casting (TCC) and external fixation, remain essential for early-stage disease, but severe bone loss and joint destruction require advanced surgical solutions. The introduction of 3D-printed titanium implants marks a significant shift in Charcot management, offering personalized anatomical reconstruction, improved osseointegration, and enhanced stability. Studies confirm that custom 3D-printed implants improve fusion rates (85%-95%) and reduce complications compared to traditional TTC fusion alone. Our case study aligns with recent research, demonstrating the clinical benefits of custom implants in managing severe Charcot deformities. The 3D-printed talar implant provided structural integrity, allowing for functional limb salvage in a patient with extensive joint destruction. This suggests that patient-specific implants may surpass traditional fusion methods, reducing the need for amputation in advanced cases.

References

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