

# Limb Salvage in Charcot Deformity Correction: A Case Series of 20 Limbs



Jordan Ernst, DPM, MS<sup>2</sup>; Dalton Ryba, DPM<sup>2</sup>; Alan Garrett, DPM, FACFAS<sup>1</sup>  
<sup>1</sup>Attending Foot and Ankle Surgeon, John Peter Smith Hospital, Fort Worth, TX  
<sup>2</sup>Resident Foot and Ankle Surgeon, John Peter Smith Hospital, Fort Worth, TX



## STATEMENT OF PURPOSE

Charcot arthropathy, a potentially disabling complication of neuropathy, often demands surgical intervention due to the progressive nature of osseous destruction, which, when left unabated, may lead to ulceration, infection and ultimately amputation. While a host of procedures and techniques for Charcot reconstruction have been enumerated in the literature, no clear consensus had been reached on a superior method or modality, nor has a deformity specific algorithm been established.<sup>1</sup> As each case of Charcot deformity is unique, largely due to patient physiology and pattern of destruction, direct comparison of fixation techniques may not be feasible. Given this lack of equipoise, we present a case series of 20 limbs in 18 patients, demonstrating an 80% success rate at 3 years follow up, utilizing varied operative approaches. This piece provides vivid examples of how Charcot deformity is amenable to, and even mandates a diverse surgical repertoire for the most effectual outcomes in this high risk population. No patient was reconstructed who would have clearly been better served with a proximal amputation, and all reconstructions with appropriate follow up were included.

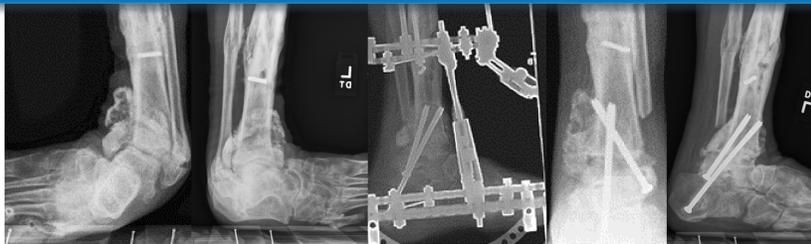
## LITERATURE REVIEW

Dayton and Feilmeier,<sup>2</sup> in their systematic review comparing internal and external fixation for Charcot deformity, uncovered several trends in fixation choice. They noted internal fixation tended to be the method of choice when ulceration or osteomyelitis did not complicate the deformity. Specifically, screws were most often used with deformities confined to the foot, whereas surgeons were more likely to employ nails when the ankle joint was compromised. With regards to external fixation, this was most often employed when osteomyelitis or wounds were present. In many cases, this method was staged to afford limb salvage and allowed for earlier weight bearing. Overall, the odds of success with internal fixation was 0.52 times as likely than with external fixation, despite the higher usage of external fixation in more complicated cases.

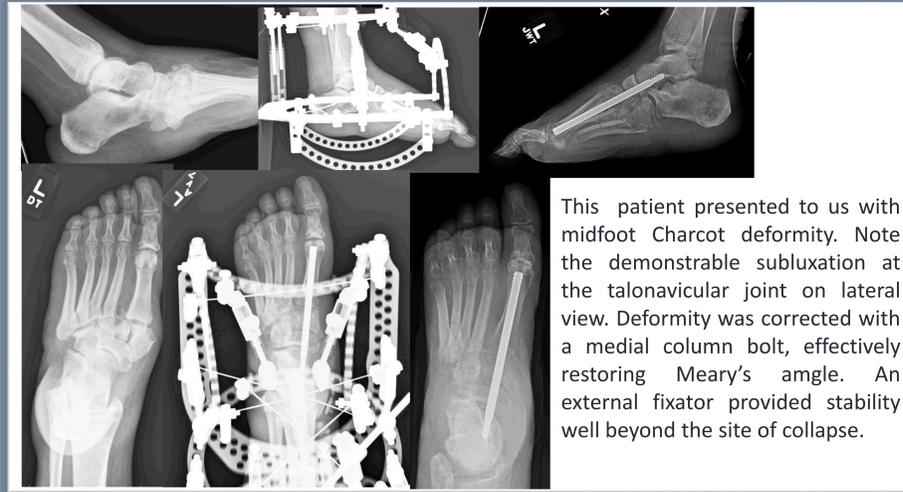
While internal and external fixation each have merits of their own, combining the two methods may provide a favorable outcome in certain patients. Hegewald et al<sup>3</sup>, in a series of 22 patients with Charcot deformity without osteomyelitis, were able to attain a 91% incidence of short term (58 weeks) limb-salvage utilizing a combined approach.

Lamm and colleagues<sup>4</sup> obtained impressive results with a novel two-stage approach to midfoot Charcot deformity correction. Their protocol first obtains correction through gradual distraction and realignment with a Taylor Spatial Frame. Prior to application, a percutaneous Gigli saw osteotomy is performed across the coalesced midfoot to allow for manipulation of the forefoot on a fixed hindfoot, utilizing wires affixed to the frame on either side of the osteotomized segment. This correction is successively maintained with a minimally invasive arthrodesis technique consisting of percutaneously inserted partially threaded, cannulated, intramedullary metatarsal screws after frame removal. The guidewires are used to stabilize the foot before the frame is removed.

## CASE EXAMPLES



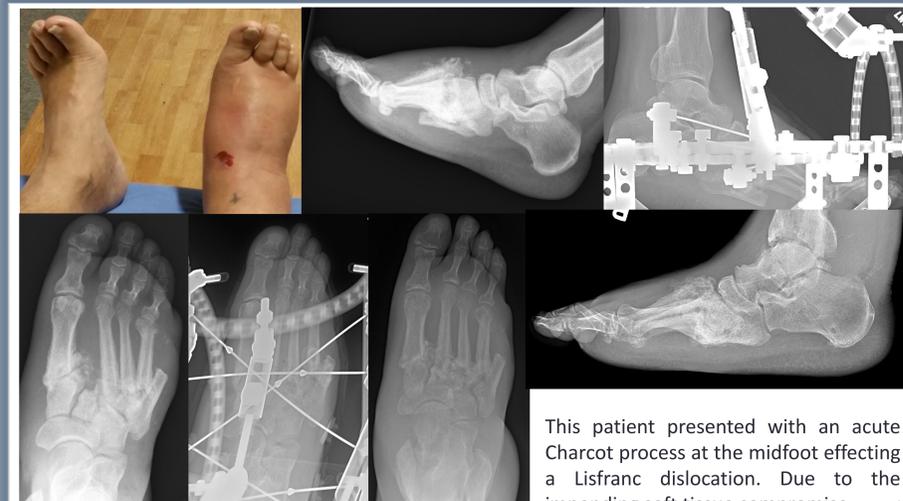
This patient presented with a pathologic bimalleolar fracture secondary to Charcot disease at the ankle. The egregious varus deformity was remediated with corrective cuts of the tibia and talus. A combination of internal and external fixation was used to maintain reduction and impart stability.



This patient presented to us with midfoot Charcot deformity. Note the demonstrable subluxation at the talonavicular joint on lateral view. Deformity was corrected with a medial column bolt, effectively restoring Meary's angle. An external fixator provided stability well beyond the site of collapse.



This patient presented with gross deformity at the ankle with obvious Charcot destruction. He was treated with TTC nailing which was compromised by late infection and non-union. After temporization with an antibiotic nail, his fusion was revised with a titanium cage and external fixator. He is clinically stable despite a pseudoarthrosis, and has maintained a plantigrade, ulceration-free foot.



This patient presented with an acute Charcot process at the midfoot effecting a Lisfranc dislocation. Due to the impending soft tissue compromise,



correction was obtained by way of an external fixator with olive wires. He ambulated successfully for 4 months after coalescence, but later presented to the ED in a septic state. No open wounds were present but there was an obvious ankle abscess with soft tissue emphysema on x-ray. A concurrent Charcot process is evident at the ankle. An emergent bedside I&D was performed before he was taken to the OR for a guillotine BKA. The relationship between the abscess and Charcot process without open wound is unclear. This is our only patient who underwent major amputation.

## RESULTS

Descriptive Characteristics of Study Population by Outcome and in Total	Ulcer Free Limbs (80%) 16 Limbs, 15 pts	Limbs with Ulceration/BKA 4 Limbs, 4 pts	Total Study Population: 20 Limbs, 18 pts
Age (years)	56.8	51.5	55.7
Follow-up (months)	37.2	32.3	36.4
BMI (Kg/m <sup>2</sup> )	35.2	32.3	34.6
Diabetes-related Neuropathy (limbs)	12	3	15
A1C	9.7%	8.3%	9.3%
PVD	0	1	1
Tobacco Use	60%	50%	55.6%
Number of Pre-operative wounds and Duration (Per Limb)	10 Limbs 10.6 months	2 Limbs 14 months	12 Limbs 11.2 months
Time in External Fixator (Months)	2.8	2.9	2.8
Repeat Charcot Events (Same Limb)	3	2	5 (25% of Limbs)
Prior Forefoot Amputations (Limbs)	2 1 ipsilateral	2 2 ipsilateral	4 3 ipsilateral
Location of Deformity			
Ankle/Hindfoot	5	1	6
Midfoot/Hindfoot	13	4	17
Procedures			
TTC/TC/Ankle Fusions	5	1	6
Midfoot/Rearfoot Fusions	7	3	10
Ex-fix alone	1	1	2
Planing with Ex-Fix	5	0	5
Calcaneal Avulsion Repair	1	0	1

## ANALYSIS AND DISCUSSION

In summary, 80% of our limbs have obtained successful outcomes at a follow up of 3 years, longer than most comparable cohorts, and without undue sequelae. Additionally, only 1 patient (5%) has undergone major amputation, less than the 9% reported in the literature,<sup>1</sup> and despite an average A1C of 9.3% and high incidence of pre-operative wounds (60%). We feel the tailoring of operative correction to each individual patient may ultimately prove to be the most decisive factor in imparting successful outcomes. Further research may provide the surgeon with greater knowledge with which to temper their decisions<sup>5</sup> rather than to develop an accepted protocol or gold standard of treatment. Increased understanding of the risk for a secondary Charcot event after reconstruction may be a pivotal factor as well. In our study, 25% of limbs sustained a repeat Charcot event after reconstruction on the same extremity, equal to the reported rate of contralateral Charcot.<sup>6</sup> To what extent this is true in a larger population, and the relationship between various anatomical zones remains to be seen, as this has not been investigated in previous works. Given these methods and findings, we hope to better arm the reconstructive surgeon for this formidable task amongst a host of surgical options.

References:  
 1. Schneekloth BJ, Lowery NJ, Wukich DK. Charcot Neuroarthropathy in Patients With Diabetes: An Updated Systematic Review of Surgical Management. *J Foot Ankle Surg.* 2016;55(3):586-90.  
 2. Dayton P, Feilmeier M, Thompson M, Whitehouse P, Reimer RA. Comparison of Complications for Internal and External Fixation for Charcot Reconstruction: A Systematic Review. *J Foot Ankle Surg.* 2015 Nov-Dec;54(10):1072-5.  
 3. Hegewald KM, Wilder ML, Chappell TM, Hutchinson BL. Combined Internal and External Fixation for Diabetic Charcot Reconstruction: A Retrospective Case Series. *J Foot Ankle Surg.* 2015 Jul 15. pii: S1067-2516(15)00179-9.  
 4. Lamm BM, Gottlieb HD, Paley D. A two-stage percutaneous approach to charcot diabetic foot reconstruction. *J Foot Ankle Surg.* 2010 Nov-Dec;49(6):517-22.  
 5. Shazadeh Safavi P, Jupiter DC, Panchbhavi V. A Systematic Review of Current Surgical Interventions for Charcot Neuroarthropathy of the Midfoot. *J Foot Ankle Surg.* 2017;56(6):1249-1252.  
 6. Caputo GM, Ulbrecht J, Cavanagh PR, Juliano P. The Charcot foot in diabetes: six key points. *Am Fam Physician.* 1998;57:2705-10.