

STATEMENT OF PURPOSE

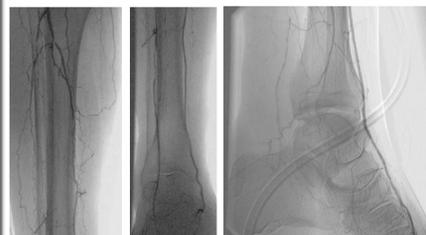
The purpose of this study is to evaluate the risk peripheral arterial disease (PAD) poses on major osseous reconstruction in diabetic Charcot neuroarthropathy (DM-CN). In addition to this primary purpose we endeavor to highlight the concurrence of PAD and DM-CN. With the results, guidelines can be acquired about the proper vascular work-up needed for Charcot osseous reconstruction, and in which subset Charcot osseous reconstruction is contra-indicated.

METHODOLOGY & HYPOTHESIS

A retrospective review was conducted from a single center and 282 patients were include with DM-CN who underwent foot and ankle osseous reconstruction over a 7-year period (1997-2013). The criteria for inclusion in the study were as follows (1) Diabetic Charcot neuroarthropathy (2) foot and ankle osseous reconstruction secondary to ulceration or acute infection (3) >18 years of age (4) greater than one year post-operative follow-up (5) vascular assessment via clinical assess or angiography.

The patients were stratified into diagnosis of PAD via angiography (defined as less than 3 vessel run off after potential intervention) and diagnosis of peripheral arterial disease by clinical examinations. The two groups outcomes were evaluated for rates of major lower extremity amputation, delayed healing, lack of wound healing and dehiscence. The results were used to determine the necessity for proper vascular work. Multivariate logistic regression and Fischer Test were used for analysis. Statistical significance was set at 5% ($p < 0.05$).

The hypothesis was in DM-CN cohort with major osseous reconstruction, patients diagnosed with PAD via angiography would have worse outcomes than patients with PAD diagnosis clinically. Thus demonstrating the need for angiography vascular workup, due to its higher reliability of results.

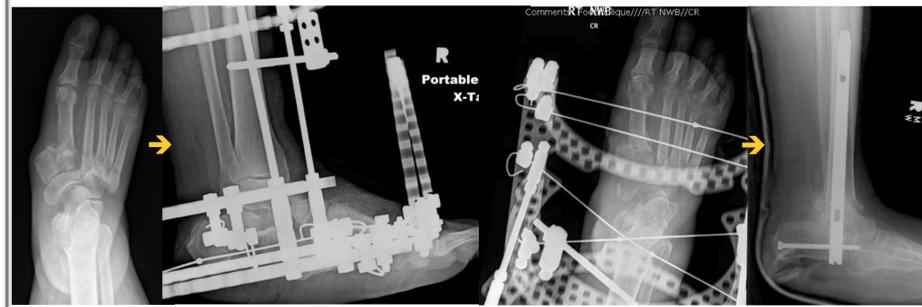


Figures 1-3: Angiography with Peripheral Arterial Disease, 1 vessel run off



Figures 4-6: Angiography with no Peripheral Arterial Disease, 3 vessel run off

PROCEDURES



Figures 7-10: (7) pre-op AP midfoot Charcot (8,9) Post op external fixator application for realignment of charcot deformity. (10) Status post tibio-talo-calcaneal arthrodesis with intramedullary nail

LITERATURE REVIEW

Although the exact mechanism of Charcot neuroarthropathy is unknown, the commonly accepted theory is hyperemia resulting in periarticular osteopenia from autonomically stimulated vascular reflex (1-Renner). However, both peripheral neuropathy and PAD occur in the natural history of diabetes (Palena). Chevtchouk found a positive correlation between PAD (abnormal ABI) and progression of diabetes; when comparing DMT2 for less than 10 years vs greater than 10 years, abnormal ABI's increased from 52.3% to 73.4%. The concurrence of peripheral neuropathy and PAD were demonstrated by higher rates of neuropathic pain (64.2% assessed in the DN4 questionnaire) in abnormal ABI (<1.3) (Chevtchouk). Additionally the rate of peripheral neuropathy was higher in the presence of PAD; 13.6% PAD in the peripheral neuropathy cohort compared to 4% PAD in the general population.

Jeffcoate et al theorized neuropathy as a potential pathogenesis of arterial calcification, with radiographic findings of medial artery calcification (MAC) in 80% of DM-CN patients. Patients with DM-CN had a higher percentage of MAC than non DM-CN groups. Wukich et al found a high correlation between PAD and MAC, with MAC associated with increased rate of mortality and lower extremity amputation. The connection between PAD and neuropathy can be difficult to assess due to the sensory loss masking intermittent claudication pain and ischemic pain (Chevtchouk), leading clinicians to miss the need for a vascular workup.

RESULTS

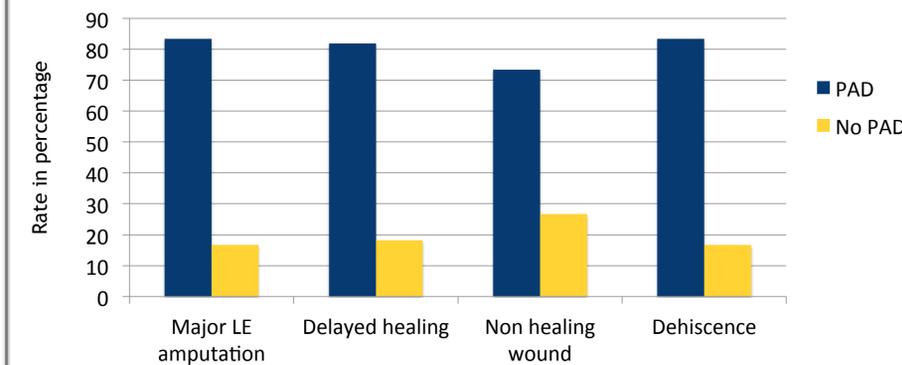


Figure 11. Comparison of outcomes between angiography diagnosed PAD after vascular intervention

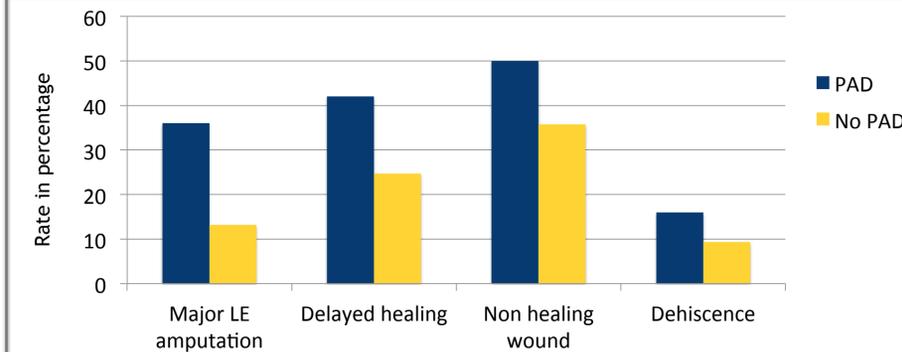


Figure 12. Comparison of outcomes between clinically diagnosed PAD vs no-PAD

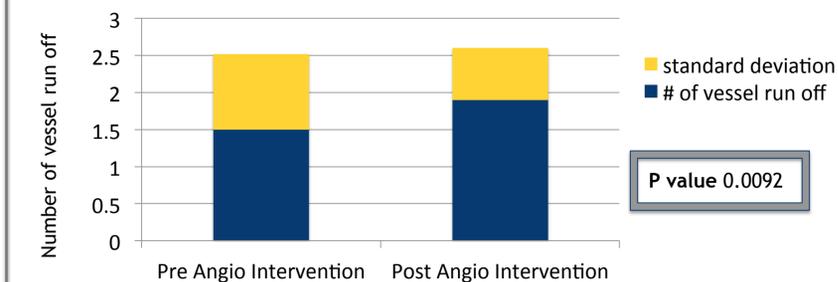


Figure 13. Pre and post intervention number of vessel run off

ANALYSIS & DISCUSSION

The connection between Charcot neuroarthropathy and peripheral arterial disease contra-indicates this accepted dogma that CN is correlated to increased peripheral perfusion. Due to clinicians misconception, the extent of the peripheral arterial disease may be under-estimated.

The PAD cohorts in both angiography diagnosed and clinically diagnosed cohorts showed higher rates of major amputation and wound healing complications. However, the difference in rates were larger in the angiography diagnosed cohort than the clinically diagnosed cohort. This could be due to the more definitive results of angiography, thus highlighting the unreliability in clinical vascular examinations.

The results demonstrate the higher rates of major amputation and wound complications in the angiography diagnosed PAD cohort than non-PAD cohort (Figure 1). However, angiography intervention resulted in a statistically significant increase in number of vessel run off (figure 3). Therefore, patients with PAD should not be excluded from major osseous reconstruction until attempt of vascular intervention is performed. After angiography intervention is performed, in patients with less than three vessel run off, major Charcot reconstruction should not be performed.

Further understanding the relationship between Charcot neuroarthropathy and peripheral arterial disease in patients is essential to decreasing amputation and wound complication rates. This study helps alert clinicians to the potentially detrimental effects of PAD in CN patients. Additionally, the study demonstrate the need for proper vascular evaluation to help dictate surgical intervention treatment course.

REFERENCES

- 1) Renner, N et al. "Outcome after protected full weightbearing treatment in an orthopedic device in diabetic neuropathic arthropathy (Charcot arthropathy): a comparison of unilaterally and bilaterally affected patients." BMC Musculoskelet Disord. 2016, 17(504).
- 2) Palena, L.M. and Brocco, E. "Critical Limb Ischemia in Association with Charcot Neuroarthropathy: Complex Endovascular Therapy for Limb Salvage." Cardiovasc Intervent Radiol 2014, 37: 257-261.
- 3) Chevtchouk, L. et al. "Ankle-brachial index and diabetic neuropathy: study of 225 patients." Arq. Neuro-Psiquiatr. 2017, 75(8).
- 4) Jeffcoate, W.J. et al. "Medial arterial calcification in diabetes and its relationship to neuropathy." Diabetologia 2009, 52: 2478-2488.
- 5) Wukich, D.K. et al. "Prevalence of Peripheral Arterial Disease in Patients With Diabetic Charcot Neuroarthropathy." J Bone Joint Surg Am. 2016 55: 727-731.