

First Metatarsal Phalangeal Joint Arthroplasty, a Cure for the Chronic First Metatarsal Head Ulceration: A Retrospective Study

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Introduction

According to the World Health Organization (WHO), worldwide approximately 422 million adults were living with diabetes in 2014, compared to 108 million in 1980. The universal prevalence of diabetes has almost doubled since 1980; climbing from 4.7% to 8.5% in the adult population.¹ Patients with diabetes are faced with various complications including peripheral neuropathy, nephropathy, and retinopathy. The high-risk diabetic foot is thought of as a syndrome because of several characteristics of the diabetic disease state; for example peripheral arterial disease, both microangiopathy and macroangiopathy, and peripheral neuropathy leading to foot ulcerations that affect one in ten diabetic patients during their lifetime. Additionally, recent studies show that patients with diabetic foot ulcerations treated with a distal amputation have a 50% mortality rate within 5 years with cardiovascular disease being the major cause of death.^{2, 6}

The risk for plantar ulceration increases when an anatomic abnormality such as joint rigidity pairs together with an insensate foot causing a localized area of pressure³⁻⁵. The forefoot is the most common area of the foot for plantar ulcerations to occur in diabetic patients, especially the plantar aspect of the hallux and first metatarsal head⁸⁻¹⁰. Chronic plantar ulcerations of the first MTP joint are typically very difficult to treat conservatively. Depending on severity of infection or degree of osteomyelitis, partial or total first ray amputation is often the treatment of choice to address these ulcerations. Following first ray amputation, the weightbearing pattern of the foot can significantly change, leading to imbalances within the forefoot intrinsic musculature causing lesser digital deformity.¹¹

Objective

This retrospective study is to demonstrate that the first metatarsal phalangeal joint (MTP) arthroplasty (resection) is, indeed, an effective curative surgical procedure for chronic plantar first metatarsal head ulcerations. It will be expected that a decrease in first metatarsal head plantar pressure with the first MTP joint arthroplasty will result in healing of plantar first metatarsal head ulcers with minimal complications. Post-surgical complications of the first MTP joint arthroplasty also will be evaluated.

Methods

All patients who had a first MTP joint arthroplasty for chronic plantar first metatarsal head ulceration in the period 2003 through 2016 will be included in this retrospective medical record chart review. Non-diabetic patients undergoing the same procedure will be analyzed separately for outcomes related to healing and complications but otherwise will be pooled with diabetic patients for analyses as appropriate.

Inclusion criteria included patients with peripheral neuropathy from diabetes mellitus or other causes with ulceration under the first metatarsal head with and without osteomyelitis. The diagnosis of peripheral neuropathy was based on the inability of the patient to feel the Semmes-Weinstein 5.07 monofilament. Diagnosis of osteomyelitis was made based on radiographs and either MRI, bone scan, indium-111 leukocyte scan, or positron emission tomography (PET) CT or MRI; as well as clinical observation of a chronic open wound with exposed and palpable bone (Figures 1-3). The exclusion criteria were as follows: patients who had a first MTP joint procedure other than a first MTP joint arthroplasty, i.e. Keller arthroplasty or other bunionectomy procedures.

References

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Methods (continued)

From 2003 through 2016, 40 feet (37 patients) underwent first MTP joint arthroplasty for treatment of chronic plantar first metatarsal head ulceration with or without osteomyelitis. At the time of surgery, the average age of the patient was 67.8 (range, 51 to 91) years. Each patient's medical record was reviewed for follow-up data from the date of surgery to 2016. Ten out of 40 feet (25%) subsequently required a secondary procedure due to post-operative complications, infection, or ulcer recurrence. Three of 10 feet (30%) required a revision of the initial procedure, three feet (30%) underwent a first ray amputation, two (20%) had a transmetatarsal amputation and two (20%) had a below knee amputation.

Characteristic	Value	(%)
Sex		
Male	36	(97.30)
Female	1	(2.70)
Age (years)		
Mean	67.8	
Range	51 to 91	
Diabetes Mellitus		
Mean Duration of DM (years)	16.03	
Type 1	0	(0.00)
Type 2	28	(100.00)
Non-DM		
Peripheral neuropathy present	8	(88.89)
Peripheral neuropathy absent	1	(11.11)
CAD	17	(45.95)
Serum Creatinine >1.2mg/dL	16	(43.24)
Known PAD	14	(37.84)
*Study population characteristics (N=37 patients; 40 feet)		

Results

Primary healing rates and complications following first MTP joint arthroplasty were also analyzed during this study. Of the total 40 patients, 35 completely healed primarily as indicated by macroscopically complete epithelialization. The average time to heal among the patients that continued on to complete healing was 12 weeks. Of note, 16 of the 40 patients died during the follow-up period. As well, 11 of the 40 patients continued on to an amputation during the follow-up period. Of the 11 patients that had an amputation performed in the follow-up period, 4 patients died at a later date. Of all the patients that were analyzed and died, the average time to death was 13 months. In another comparison, it was seen that of 11 patients that continued on to an amputation, 8 of them were positive for diabetes mellitus. There were a total of 10 post-operative infections among the 40 patients analyzed. Of these 10 patients that encountered post-operative infection, 7 had a confirmed diagnosis of diabetes mellitus.

Hemoglobin A1c (HbA1c) was also analyzed as a complicating factor. It was noted that the mean HbA1c among the patients observed was 7.34. The HbA1c among those patients with reported post-operative complications was 7.46. Upon completing a Spearman analysis between the time to heal and HbA1c levels, a positive correlation was noted, showing that as HbA1c increases, so does the time it takes to heal.

The average white blood cell count was seen to be 11.96 in patients that did not heal their wound post-operatively. On the other hand, the white blood cell count was seen to be 8.56 in patients that did primarily heal their wound post-operatively. The probability ratio was 0.0437. The white blood cell count in patients that progressed towards an amputation was seen to be 9.95.

Limitations

There are several limitations to this study that would allow it to be a stronger analysis. First, a larger data set would increase the validity of the findings. In addition, it would be useful to further analyze specific white blood cell count ranges pre-operatively to draw a more accurate conclusion on at what point does pre-operative white blood cell affect post-operative healing rates.

Conclusion

We conclude that the first MTP joint arthroplasty is an effective curative surgical procedure for the chronic plantar first metatarsal head ulceration. We have found that this procedure has a high success rate, specifically an 87% healing rate post-operatively in chronic ulcers, as well as preventing future ulcer recurrence in that area. We have also found a statistical significance between an elevated white blood cell count and decreased post-operative healing. Therefore, we conclude that given a stable, non-infected and non-ischemic chronic ulcer on the plantar aspect of the first metatarsal head, a first MTP joint arthroplasty is a crucial surgical procedure to consider.

Figures

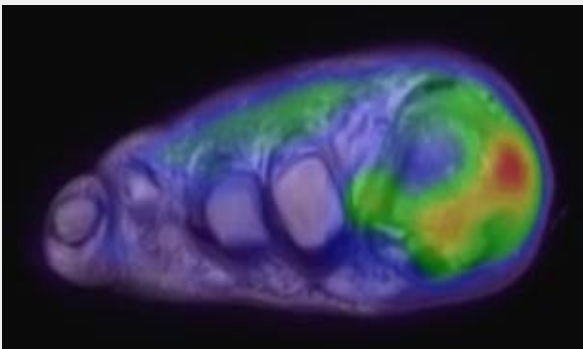
Figure 1

DP Preoperative Radiograph

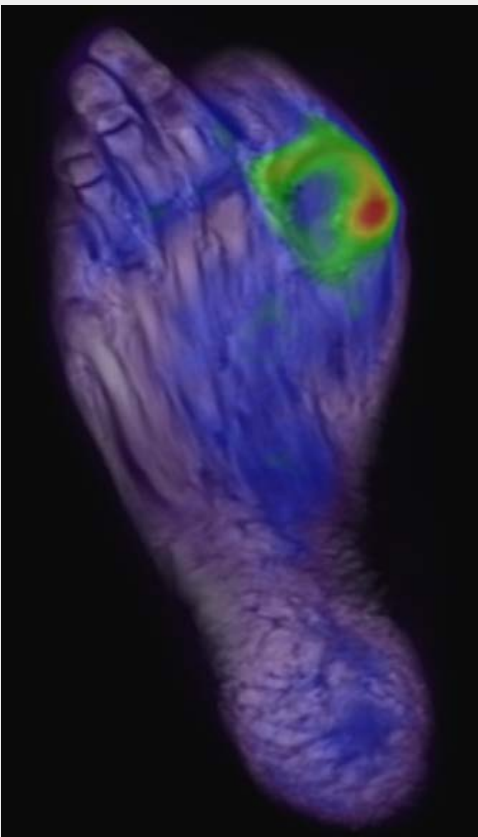


Figure 2

PET MRI;(a) Coronal and (b) Axial Views



(a)



(b)

Figure 3

DP Postoperative Radiographs;
(a) Immediate Post-op and (b) 6 Months Post-op



(a)



(b)