Pan Metatarsal Head Resection with Achilles Lengthening: The Practical Alternative to Transmetatarsal Amputation or Isolated Ray Resection

Brett Saltrick, Michael Savisky, Daniel Ryan, Tiffanie Liu, Jonathan Friedman, Mark Boissonneault
Dr. William M. Scholl College of Podiatric Medicine at Rosalind Franklin University of Medicine and Science

ROSALIND FRANKLIN UNIVERSITY of MEDICINE AND SCIENCE
DR. WILLIAM M. SCHOLL COLLEGE OF PODIATRIC MEDICINE

Statement of Purpose

Diabetic foot ulcerations (DFUs) account for a large portion of morbidities around the world, affecting those who have them with functional deficits and decreased quality of life. According to the American Diabetes Association, there were 30.3 million Americans with diabetes in 2015 with 1.5 million new cases each year.[1] Patients with Diabetes Mellitus and subsequent neuropathy commonly present with non-healing ulcers on the plantar aspect of the forefoot. These ulcers, even if treated can re-ulcerate and become infected leading to osteomyelitis causing further complications and the need for removal of the necrotic underlying structures. This case study presents a pan metatarsal head resection (PMHR) with Achilles lengthening as a practical alternative to transmetatarsal amputations (TMAs) or isolated ray resection (IRR) in order to preserve forefoot length and mechanics, cosmetic appearance, as well as prevent further ulceration.

Literature Review

Treatment of infectious non-healing diabetic ulcers with PMHR and Achilles tendon lengthening has been briefly discussed in literature with limited comparisons to TMA and isolated ray resections. Throughout the gait cycle forefoot mechanics are necessary to allow for propulsion and subsequent ground reactive force to dissipate over the surface area in contact. The PMHR procedure has been utilized to retain said propulsion and preserve forefoot mechanics successfully since being first published in 1911 as the Hoffman procedure.[2,3] The use of PMHR in patients versus TMA or isolated ray resections provides maintenance of foot length allowing the patient to retain a proper gait, preserve cosmetic appearance, reduce re-ulceration and infection rates, and return to bipedal ambulation with minimal functionality loss.[2,4,5,6,7] Preservation of foot length is vital in diabetic patients whose morbidity consistently affects micro vascularization and healing as well as implication of sensory neuropathy and high plantar pressures causing the forefoot to be one of the most common sites of ulceration leading to osteomyelitis.[3,5,6,8]

Literature states that limited ankle dorsiflexion has been implicated as a causative factor to forefoot plantar ulcerations during ambulation as well as re-ulceration in diabetics who have undergone previous forefoot surgery such as a TMA or IRR. Achilles tendon lengthening should be considered on diabetic patients at high risk for ulceration or who have undergone surgery for plantar ulcerations as an effective surgery to reduce plantar pressure and promote healing of the forefoot. Peak pressures on the forefoot have been substantially reduced 27% after Achilles tendon lengthening allowing decreased breakdown of the skin and increasing the efficacy of wound healing measures following forefoot surgery.[6,10,11]

Non-healing reoccurring diabetic foot ulcers have generally been treated with IRR or TMA's however both have the tendency to progress to more proximal amputations due to the subsequent change in pattern of force. While the reported rates of occurrence of re-amputation and operation for TMA's was very high within the first 6 months postoperatively, PMHR with accompanied Achilles lengthening provided adequate forefoot offloading resulting in improved healing and high patient satisfaction over the first 4 years of the postoperative period.[12,13.14.15]

Case Study

We present a case of a 28-year-old female with a history of uncontrolled Type I Diabetes Mellitus, severe anemia of chronic disease, chronic kidney disease, and diabetic ketoacidosis with a non-healing diabetic plantar ulceration of 2-3 weeks located sub 3rd and 4th metatarsal heads and to the medial aspect of the 4th digit (Fig 1).

Figure 1: Initial presentation of the wound on the right foot with non-healing ulceration sub 3rd-4th metatarsal heads and positive probe to bone.
Figure 2: Ulceration following second incision and drainage procedure, prior to PMHR.
Figure 3: AP radiograph following second incision and drainage procedure, prior to PMHR

Initially, the right foot presented with non-palpable pedal pulses secondary to edema and erythema from the level of the ankle to the digits. Through examination the Wagner grade 3 full thickness ulceration sub 3rd and 4th metatarsal heads displayed a positive probe to bone test transpiring to the dorsal aspect of the foot within the 3rd web-space and possible osteomyelitis. Tracking was displayed medially from the wound to the level of the midfoot with positive malodor and 20cc of purulent drainage expressed from the ulceration. The first successful treatment of the ulceration included excisional irrigation and debridement with removal of affected tissue, muscle, and bone followed by administration of accompanying intravenous antibiotic therapy. Bone biopsy displayed positive focal acute and chronic osteomyelitis and reactive changes of the 1st metatarsal bone and surrounding tissue. The right fourth metatarsal was identified and noted to be discolored yellow and soft. Attention was then directed to the wound dorsally where an incision had been healed from a previous surgery. This wound was inspected and probed and it was noted that the dorsal and plantar wounds were communicating. Pulse lavage with bacitracin was used to irrigate both wounds. Tissue was debrided one final time until healthy granular wound beds were present.

A second irrigation and debridement were performed 5 days later and patient refused any digital amputation. Patient was discharged with stable wounds, intact dressing, and was instructed to await wound VAC delivered to her home and continue IV antibiotics for 6 weeks (Fig 2-3). After wound care clinic visits for past 3 months due to worsening right foot, a PMHR with Achilles lengthening was agreed upon as an alternative to amputation. Utilizing a sagittal saw, metatarsal heads 1-5 and corresponding proximal phalanx were resected in a normal parabola arrangement (Fig 4). Correction of excess forefoot loading by Achilles lengthening was necessary to surgically offload the forefoot in order to prevent metatarsal head regrowth and re-ulceration. Complete healing of surgical wounds was achieved approximately one-month post pan metatarsal head resection and Achilles lengthening (Fig 6). The patient remained non-weight bearing with assist of a knee walker post-surgery and followed up with wound clinic once a week for a month until wounds had epithelialized and healed. Achilles lengthening successfully offloaded the forefoot, mitigating the risk of bone regrowth causing pressure areas and preventing re-ulceration. The patient is now able to ambulate with maintenance of gait due to retentive forefoot mechanics and has no reulcerations due to the PMHR during the 23 months of follow up.

Analysis and Discussion

Plantar ulcerations and deformities produced by a diabetic foot are becoming more common due to increasing prevalence of the disease and with this it is important to know which procedures provide the patient with the highest quality of life and long term outcome. While TMAs and IRRs are used in cases requiring more proximal treatment of

Figure 3: AP radiograph PMHR and Achilles lengthening immediately post-op
Figure 4: Wound healing progression 10 days post-operatively.
Figure 5: Wound healing progression 5 weeks post-operatively.

the affected area, it is vital to consider a PMHR as an alternative in order to retain residual forefoot length when dealing with common ulceration on the plantar aspect of the metatarsal heads.

This case provides a practical alternative to TMAs and IRRs by preventing the loss of forefoot mechanics. Due to the prevalence of chronic non-healing diabetic wounds, as well as their rates of re-ulceration once treated, it is important to consider the different options that give the patient quality outcomes such as retaining appropriate gait, healing time, and cosmetic appearance.[2,4,5,6,7] This alternative also eliminates the need for a rocker soled shoe with a toe filler that patients would require after returning to ambulating status post amputation. In consideration of the patient's factors for non-healing such as uncontrolled diabetes mellitus type I, neuropathy, and osteomyelitis of the right foot, it is imperative to acknowledge the successful outcome of this surgery. While different patient factors may contribute to healing and subsequent altered treatment pattern may follow, a PMHR with Achilles tendon lengthening should be a top consideration for forefoot wounds indicative of amputation or IRR.

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