Multimodal Approach to Healing a Large Wound and Preventing Reulceration in a Patient with Multiple Medical Comorbidities

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INTRODUCTION

Diabetes mellitus and end-stage renal disease (ESRD) have both long been known to impede wound healing. Patients with both of these comorbidities have over 2X the frequency of foot complications and over 6X the rate of amputation compared to the general diabetic population[1]. Research also suggests that wound healing in patients with both diabetes mellitus and ESRD is further impaired[2] and a strong correlation between ESRD and failure of transmetatarsal amputations to heal has been reported[3].

Our case details the processes and modalities used in treating a 75 year-old male patient with Type II diabetes, ESRD on hemodialysis, HLD, HTN, and CAD who presented to the Southern Arizona VA Emergency Department with a wet gangrene infection. Patient was placed on long-term IV antibiotics upon presentation. Patient underwent an initial incision and drainage procedure with subsequent open transmetatarsal amputation.

Once the acute infection had resolved, a variety of advanced wound care modalities and products were used to facilitate wound healing, including negative-pressure wound therapy, placental products (Grafix®), and an acellular dermal matrix (ADM) (Dermacell®). Over the course of approximately 6 months, complete healing of the wound occurred despite the significant size of the wound and the patient's multiple comorbidities.

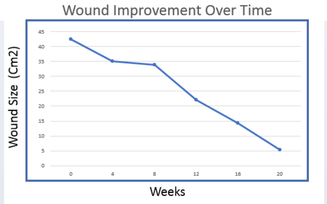
Following complete healing of the wound, additional advanced treatment modalities were used to prevent and closely monitor the patient's risk of reulceration. These modalities included custom shoe gear, infrared skin thermography, and LUNA fluorescence angiography system. The patient currently remains ambulatory and wound-free.

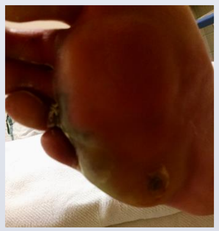
MATERIALS & METHODS

Patient presented to the Emergency Department with a severe soft tissue infection and plantar forefoot abscess. Podiatry was immediately consulted and an initial incision and drainage procedure, along with partial 4th and 5th ray resection, was performed. Due to non-viability of the 2nd and 3rd digits, an open TMA was performed 5 days later. Dehiscence of the medial aspect of the incision increased the wound size. Following resolution of the initial infection, the patient was treated with SNaP® negative-pressure wound therapy and weekly Grafix Core® viable cryopreserved human placental membrane (vCHPM) applications for 6 weeks. Dressing changes were performed using manufacturer recommended instructions (twice weekly for SNaP) and wound debridement was performed weekly prior to Grafix Core® application. Once adequate granulation tissue was noted to the wound bed, a 5x9cm Dermacell® acellular dermal matrix was sutured to the wound bed using chromic gut suture. Dermacell® was allowed to fully incorporate into the wound bed for 8 weeks with a moist, bolster dressing, changed every-other day, overlying the wound. Grafix Core® was then applied weekly for an additional 3 months until complete wound healing occurred. Weekly wound measurements were performed throughout the treatment course and weight-bearing was limited to transfer only for the first 3 months until the Dermacell® graft had firmly incorporated. Patient ambulation was then allowed in a surgical shoe with a walker for balance

RESULTS

The open amputation site steadily decreased in size throughout the treatment course. In spite of the significant size of the wound and the patient's medical comorbidities, complete wound closure was achieved after a total of 18 weeks of weekly human-derived placental membrane application and one acellular dermal matrix graft left in place for 8 weeks.





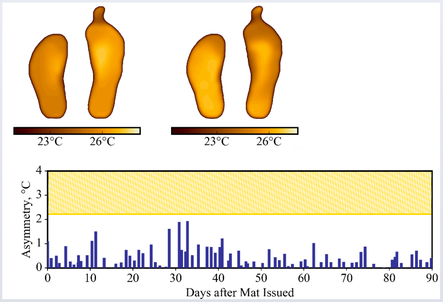
RESULTS

Following complete healing of the wound, our focus shifted towards preventing reulceration secondary to the altered shape and function of the foot. Podiatry worked closely with the Prosthetics department to develop a custom shoe with a custom plastizote insert that minimized pressure to the bony prominences of the remaining metatarsal stumps

RESULTS

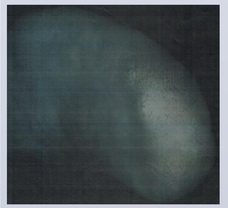
Infrared skin thermography is a viable, yet underutilized tool in detecting potential skin breakdown and ulceration. Infrared skin thermography has been proven to detect areas at high risk for reulceration up to 5 weeks beforehand[4]. This allows the provider the opportunity to alert and examine the patient prior to reulceration and make any necessary modifications to the patient's activity level or shoe gear.

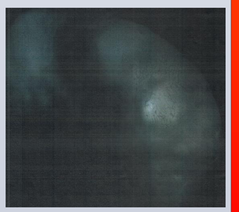
Following complete healing of the wound, the patient was dispensed a Remote Temperature Monitoring System® (RTMS) (Podimetrics Inc.) The RTMS monitors for temperature asymmetry between both feet over time. This patient did not deviate outside of the accepted range of 2°C asymmetry throughout his use of the RTMS, indicating that he had little risk of reulceration.



Standard non-invasive vascular imaging consists of Ankle-Brachial Index (ABI) and toe pressures. While helpful in evaluating healing potential, these modalities are oftentimes inaccurate when a patient has significant arterial calcification. This results in falsely-elevated ABI values. As such, our patient had right ABIs of 1.38, but exhibited significant vascular calcification on x-ray.

The LUNA® fluorescence angiography system (Novadaq) allows for real-time visualization of perfusion to wound beds, providing a more accurate evaluation of healing potential[5]. The imaging process utilizes indocyanine green dye, which is non-nephrotoxic. LUNA angiography revealed that our patient exhibited adequate tissue perfusion to the amputation site





CONCLUSIONS

Patients with multiple medical comorbidities present unique challenges in wound healing. Our case highlights complete closure of a large surgical wound in one such patient. Once the acute infection has resolved and all necrotic tissue has been debrided, the importance of exploring all available methods to both heal the wound and prevent reulceration cannot be overstated

The SNaP® negative pressure wound therapy system has been shown to optimize the wound bed environment and promote angiogenesis within the wound bed[6]. This modality effectively decreased the wound depth and promoted granulation tissue in our patient.

vCHPM products, such as Grafix®, provide wound beds with a structural matrix, native growth factors, and viable mesenchymal skin cells[7]. With weekly use, the wound size steadily decreased in our patient.

Dermacell© is an ADM that has shown increased cell infiltration, host tissue integration, and vascularization in comparison to other ADMs[8]. After 8 weeks of incorporation, our patient's wound had significantly decreased in size.

Following complete healing of the wound, our attention turned to utilizing all possible modalities prevent reulceration. Custom shoe gear was developed to accommodate all bony prominences of the foot.

The RTMS was used daily by the patient to allow remote monitoring of the patient's feet to detect any risk of reulceration. Through these modalities, the patient has remained wound-free and ambulatory.

Our case demonstrates that even large wounds in patients with multiple comorbidities can heal and remain healed with appropriate use of the many advanced treatment modalities available.

REFERENCES

1. Papanas, N. et al. The Diabetic Foot in End Stage Renal Disease, *Renal Failure* (2007) 29:5, 519-528
2. Maroz, N and Simman, R. Wound Healing in Patients With Impaired KidneyFunction. *Journal of the American College of Clinical Wound Specialists* (2014) 5, 2–7
3. Pollard J et al. Mortality and morbidity after transmetatarsal amputation: retrospective review of 101 cases. *JFAS*. 2006; 45: 91-97
4. Frykberg RG et al. Abstract 141-OR/141. An automated home monitor for the early detection of diabetic foot ulcers. Presented at: ADA 76th Scientific Sessions; June 10-14, 2016; New Orleans, LA.
5. Joh JH et al. Intraoperative indocyanine green angiography for the objective measurement of blood flow. *Ann Surg Treat Res*. 2016 May;90(5):279-86.
6. Huang, C et al. Effect of negative pressure wound therapy on wound healing. *Curr Probl Surg*. 2014 Jul;51(7):301-31.
7. Frykberg, RG et al. A prospective, multicentre, open-label, single-arm clinical trial for treatment of chronic complex diabetic foot wounds with exposed tendon and/or bone: positive clinical outcomes of viable cryopreserved human placental membrane. *Int Wound J*. 2016 Aug 3.
8. Yonehiro L et al. Use of a new acellular dermal matrix for treatment of non-healing wounds in the lower extremities of the diabetic patient. *Wounds* **25:** 340, December 2013.

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