PHOENIX Wound Matrix: A *New* Building Block to Restore Wound Healing

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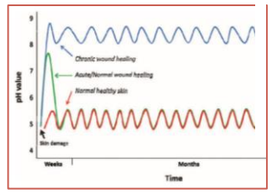
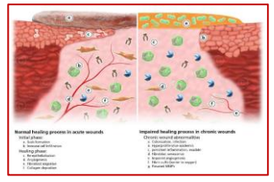
INTRODUCTION

The purpose of this quality case assurance series is to evaluate the positive effects of PHOENIX Wound Matrix, a new cost-effective, 3D nanofabricated polymer scaffold that aims to support and restore natural wound healing for both acute and chronic wounds. The following case series and documented photos highlights the rapid reestablishment and progression of healthy tissue regeneration and repair using PHOENIX Wound Matrix.

pH AND ADDRESSING CHRONIC ACTIVITY - VITAL TO HEALTHY WOUND HEALING

It is known that a homeostatic wound environment is vital in wound healing and that pH acts as a mediatory to regulate healthy cellular function. Acute wounds maintain an acidic physiologic environment or balanced wound milieu, with a pH of 5-7. Due to this balance and proper cellular function, acute wounds allow the body to naturally progress through the healing process for tissue regeneration and repair in a predictable and expected timeframe.



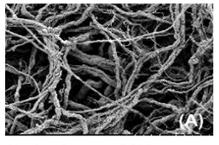


In contrast, chronic wounds have an altered physiologic environment and tend to have high pH in the range of 7.15–8.9. Elevated pH creates an alkaline wound environment which fuels a host of chronic endotoxic activity including excessive proteolytic and protease-inhibitor activity, increased microbial loads and decreased tissue oxygenation. [11-17] This endotoxic activity causes tissue dysbiosis and wounds to stall in the inflammatory phase making it an extremely complex process to manage as there is not just one deleterious factor that needs to be addressed. [1-11].

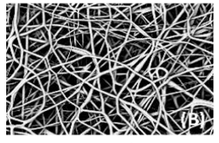
NEW THINKING IN WOUND HEALING: PHOENIX WOUND MATRIX

PHOENIX Wound Matrix is a novel, 3D nanofabricated scaffold scientifically engineered to inspire a pro-healing wound environment, allowing the body's natural wound healing process to function effectively and achieve definitive closure of acute and chronic wounds, and burns. The 3D morphology of PHOENIX is designed to mimic native ECM structure and function, supporting cellular adhesion, infiltration and proliferation. Due to is precise construct and manufacturing process, PHOENIX Wound Matrix offers a consistent scaffold structure for predictable performance and improved outcomes.

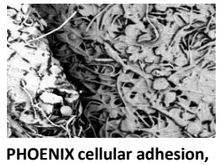
The electrospun nano polymers comprised of PHOENIX Wound Matrix have been strategically selected to support low wound pH and support lactate-mediated effects. Through hydrolysis, PHOENIX Wound Matrix naturally biodegrades into α-hydroxy acids and fatty acids, known to aid in wound healing, facilitate angiogenesis and oxygenation to restore the body's natural wound healing process for tissue regeneration and repair.



Native Dermal ECM



PHOENIX Wound Matrix



PHOENIX cellular adhesion, infiltration and proliferation

METHODOLOGY:

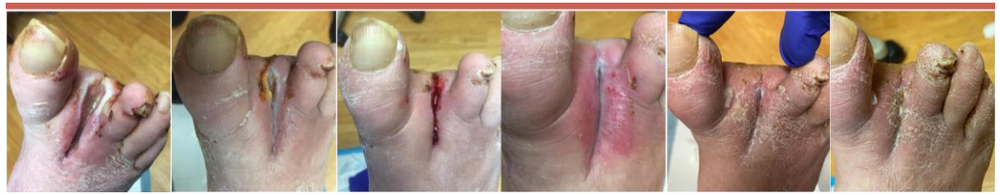
This particular case series used PHOENIX Wound Matrix, manufactured by RenovoDerm, a subsidiary of Nanofiber Solutions, which is designed to provide a synthetic extracellular matrix substitute for acute and chronic wound management. PHOENIX is a non-woven electrospun fibrous polymer matrices designed to mimic dermal ECM and provide a scaffold for cellular migration, infiltration and proliferation. The theory is that by incorporating a naturally biodegradable synthetic scaffold into the wound bed, endogenous cells can infiltrate the scaffold to stimulate the natural progression of new, living and functional tissue.

Natural scaffold formation is difficult to achieve in wounds that are in an active state of inflammation. PHOENIX Wound Matrix provides this scaffold support while naturally biodegrading into fatty acids over time which helps to lower the pH and reestablish a pro-healing wound environment.

CLINICAL OUTCOMES:

Utilizing a new cost-effective nanofabricated synthetic extracellular matrix demonstrated positive effects in wound healing. It was observed that PHOENIX Wound Matrix rapidly promoted healthy wound bed granulation with impressive wound healing outcomes on a variety of complex wound etiologies. As demonstrated in the highlighted cases, using PHOENIX Wound Matrix achieved consistent weekly measurement improvement and control over the wound environment in all subjects.

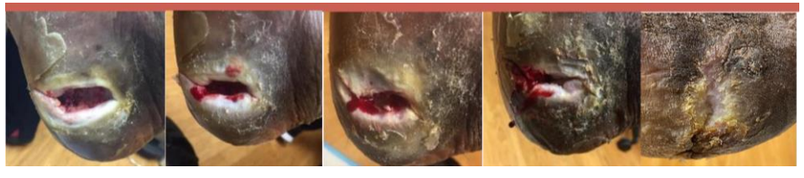
Case 1: Nonpalpable S/P Partial 2nd Ray Resection



Day 1	Day 21	Day 31	Day 45	Day 66	Day 80
5.2cm x 1.1cm x 0.8cm	3.9cm x 0.8cm x 0.6cm **59% wound closure** 3rd Phoenix Application	**Blood flow restored.** 4th Phoenix Application	0.9cm x 0.3cm x 0.2cm **98% wound closure** 5th Phoenix Application	Continued closure	**CLOSED**

Case Brief: 68 y/o male with DMII, HO neuropathy and PVD presented to Graft Clinic 2 weeks after surgery. His pic line is intact, wound measuring 5.2cm x 1.1cm x 0.8cm **with nonpalpable pedal pulses**. Patient had a long-standing plantar ulceration sub 2nd metatarsal that contributed to osteomyelitis of the second ray. PHOENIX Wound Matrix was selected for the treatment strategy to evaluate its performance and potential on this stalled, nonpalpable foot wound. By Day 21, after 2 applications of PHOENIX, a 59% reduction in wound size was achieved. By Day 31, restored blood flow was accomplished with continued progression of wound healing. By Day 45, 98% wound closure was achieved with complete wound closure of this nonpalpable 2nd ray resection foot wound by Day 80.

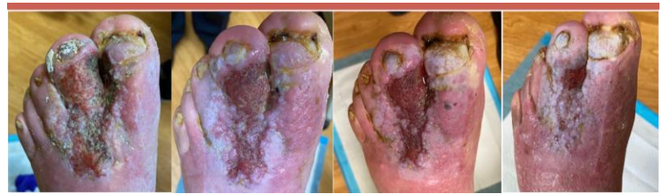
Case 3: Stalled Diabetic Foot Ulcer



Day 1	Day 7	Day 14	Day 21	Day 81
4.9cm x 1.3cm x 2.1cm	5.3cm x 0.9cm x 2.0cm **29% wound closure** 2nd Phoenix	2.5cm x 1.0cm x 1.0cm **83% wound closure** 3rd Phoenix	Continued closure **Transitioned to amniotic**	**Closed**

Case Brief: Patient is a 61y/o male with DM, lumbar radiculopathy, Hypertension, MRSA, Neuropathy, Osteomyelitis presented with a 4.9cm x 1.3cm x 2.1cm wound subsequent to an IND. Just removed from pic line, currently on Doxycycline. Positive drainage, negative probe to bone. Pulses 2/4 bilateral. **Would has been open for 2 months**. Initiation of Phoenix Wound Matrix jump started wound healing of this stalled ulcer. After three applications of PWM, by Day 14, 83% wound closure was achieved by day 14. Transitioned to an amniotic for closure.

Case 2: Two-year Complex Ulceration of the Left Foot



Day 1	Day 14	Day 28	Day 56
8.0cm x 3.0cm x 0.1cm	7.0cm x 3.0cm x 0.1cm **Healthy granulation tissue** **13% wound closure** 2nd Phoenix Application	6.5cm x 2.5cm x 0.1cm **Neovascularization** **33% wound closure** 3rd Phoenix Application	2.8cm x 1.2cm x 0.1cm **84% wound closure** 6th Phoenix Application

Case Brief: 66 year old male, DMII, morbidly obese with Lymphedema & drainage presented to the clinic with a left foot ulceration, **2 years in duration**. Profore and other forms of compression used daily. Prior treatment included a large variety of wound care products including amniotics. Patient can only make 1-2 visits a month. Treatment strategy switched to PHOENIX Wound Matrix. By Day 14 we achieved a 13% decrease in wound size in addition to an increase in healthy granulation tissue, a decrease in fibrotic tissue and improved wound edges. By Day 28 a 33% decrease in wound size and neovascularization along with a significant decrease in wound drainage. By Day 56 a dramatic 84% decrease in wound size with a decrease in odor and wound drainage.

Case 4: Diabetic Foot Ulcer – 7 months in duration

Day 1	Day 7	Day 14
0.3cm x 0.2cm x 0.2cm 1st PHOENIX	0.2cm x 0.1cm x 0.1cm **83% wound closure** 2nd PHOENIX	**CLOSED**

Case Brief: Case Brief: 51 y/o DM male with neuropathy. Pedal pulses were 2/4 bilateral with hair growth presented with a diabetic ulcer of left toe. **Ulcer was present for 7 months without resolution.** The area has been off-loaded in cam boot for over 6 months. Previous treatments include Iodosorb, Medihoney, amniotic membrane. Treatment strategy switched to utilize Phoenix Wound Matrix. Patient RTC after one week with 83% reduction in wound volume, Phoenix reapplied 1X. Complete closure in two weeks.

References: 1. NJ, T., et al., Analysis of the acute and chronic wound environments: the role of proteases and their inhibitors. Wound Repair Regen., 1999. 7(6): p. 442-52.; **2.** Grice, E.A. and J.A. Segre, The skin microbiome. Nat Rev Microbiol, 2011. 9(4): p. 244-53.; **3.** Weyrich, L.S., et al., The skin microbiome: Associations between altered microbial communities and disease. Australas J Dermatol, 2015. 56(4): p. 268-74.; **4.** Jones, E.M., C.A. Cochrane, and S.L. Percival, The Effect of pH on the Extracellular Matrix and Biofilms. Adv Wound Care (New Rochelle), 2015. 4(7): p. 431-439.; **5.** Schneider, L.A., et al., Influence of pH on wound-healing: a new perspective for wound-therapy? Arch Dermatol Res, 2007. 298(9): p. 413-20.; **6.** Gethin, G., The significance of surface pH in chronic wounds. Wounds UK, 2007. 3.; **7.** B, G., et al., Proteases and pH in chronic wounds. Journal of Wound Care, 2005. 14(2): p. 59-61.; **8.** TK, H. and B. S, Theoretical and Practical Aspects of Oxygen in Wound Healing, in The Wound Management Manual, L. B, Editor. 2005, McGraw-Hill: New York. p. 44-54.; **9.** Leveen, H.H., et al., Chemical acidification of wounds. An adjuvant to healing and the unfavorable action of alkalinity and ammonia. Annals of surgery, 1973. 178(6): p. 745-753.; **10.** Das, A., et al., Monocyte and macrophage plasticity in tissue repair and regeneration. Am J Pathol, 2015. 185(10): p. 2596-606.; **11.** McCarty, S.M. and S.L. Percival, Proteases and Delayed Wound Healing. Adv Wound Care (New Rochelle), 2013. 2(8): p. 438-447.