Advancing the science of wound bed preparation and wound healing in chronic wounds

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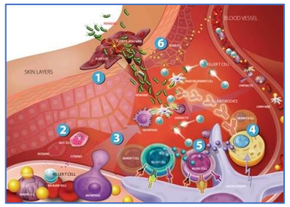
INTRODUCTION

Non-healing wounds, burns and ulcers affect approximately 8 million Americans annually with a total cost of care to the health system of approximately $25B[1]. Alarmingly, chronic non-healing wounds such as, DFUs, VLUs, pressure injuries and ulcers of mixed etiology, are responsible for the greatest number of skin disease deaths (~30%) after skin cancer[1]. The statistics are staggering, and furthermore, as a result of the aging population and patients living with diabetes, the mortality rates associated with chronic non-healing wounds is being considered, a silent epidemic[2].

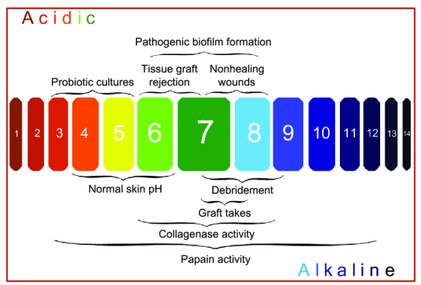
The focus of this case series is to evaluate the role and efficacy of a new bioresorbable 3D electrospun synthetic polymer matrix (3DESPM) as a catalyst to establish healthy wound tissue and accelerate the healing trajectory of chronic non-healing ulcers.

DISRUPTING CHRONICITY DURING WOUND BED PREPARATION IS PARAMOUNT IN THE WOUND HEALING PROCESS

Cutaneous wound healing involves complex independent and dependent pathways which employ numerous cell lineages, tissues, and intrinsic and extrinsic mediators.[3,4] Any interruption or interference to these pathways results in a nonhealing or "stalled" wound, rendering the wound chronic. [3-8]



Many healing processes are affected by changes in pH including angiogenesis, collagen formation, and macrophage activity. [7-9] A change in pH has also been shown to influence the toxicity of bacterial end products and affect enzyme activity. [11]



In particular, the matrix metalloproteinases (MMPs), which are important for wound healing and extracellular matrix remodeling. [11-14] Studies have also reported that variations in pH may affect wound closure, graft take, microbial infection rates, bacterial virulence, and biofilm formation.[15-16]

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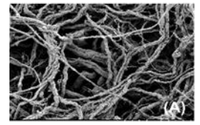
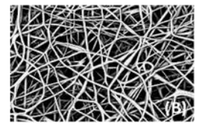
AN INNOVATIVE 3D ELECTROSPUN SYNTHETIC POLYMER MATRIX

A novel 3-D electrospun synthetic polymer matrix (3DESPM, PHOENIX™ Wound Matrix, RenovoDerm®, Dublin, OH) is scientifically engineered to mimic native ECM to provide a multidimensional solution to wound healing. The 3DESPM microporous scaffold has fibers ranging 600–1,000 nm in diameter (Fig. 1) and acts as a stimulus to facilitate pro-regenerative cellular adhesion, infiltration, and proliferation for the tissue regeneration and repair of acute/chronic wounds and burns.

Comprised of two bioresorbable synthetic polymers, **Polyglycolide** or poly(glycolic acid (PGA) and **poly(L-lactide-co-caprolactone)** (PLCL), 3DESPM naturally degrades into α-hydroxy acids and fatty acids, known to stimulate pro-regenerative cellular activity for wound healing. 3DESPM supports a pro-healing wound environment, by enacting low pH and lactate mediated effects that address chronicity and sustained inflammation. 3DESPM demonstrated a reduction in pH from 7.4 to 4.75 within a 1-week period during an in vitro degradation test in isotonic PBS solution (unpublished).



Native Dermal ECM

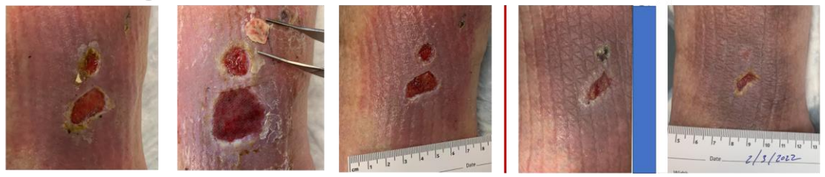


I3DESPM SEM Image

I3DESPM cellular adhesion, infiltration and proliferation

CLINICAL OBSERVATIONS & OUTCOMES:

Venous Leg Ulcer



8/14/2021
Wound bed preparation; HOCL, debridement
1st application

8/21/2021
Healthy granulation tissue within 7 days
2nd application

9/9/2021
Accelerated healing trajectory
3rd application

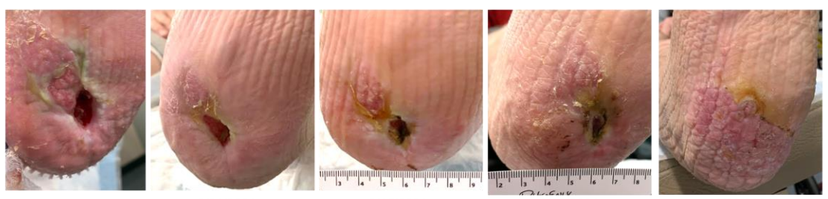
12/22/2021
Ulcer #1 closed

2/3/2021
Ulcer #1 remained closed.
Ulcer #2 continued closure

Patient History: 35 yo male, loss of hearing at young age, CVI with **6 month history of venous ulcer** and associated lymphedema/chronic interstitial edema. No h/o DVT, non diabetic, non smoker. Right leg venous DUS; multi level deep venous insufficiency, R GSV incomp, incomp venous perforator. ABIs normal.

During treatment, 9/9/2021 – 9/16/2021 Incompetent Perforating vein, CVI; MPFF, FWC, 2 layer wrap, awaiting insurance approval MTHFR Heterozygote (SNP); B12, B6, folate.

Diabetic Foot Ulcer



8/4/2021
Wound bed preparation
1st application

8/21/2021
Healthy granulation tissue. Reduction in wound depth
2nd application

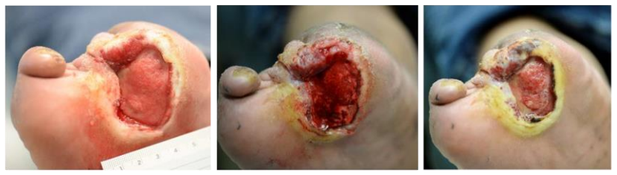
9/15/2021
Continued healing trajectory
3rd application

9/22/2021
4th application

10/20/2021
Wound closure in 9.5 weeks

Patient History: 56 yo male, Schizophrenic, h/o AODM, no tobacco, ABIs normal, h/o calcaneal osteo, s/p resection 2 years prior.

Diabetic Foot Ulcer



10.26.21
4.2 cm x 6.8 cm x 1.5 cm

11.09.21
4.0 cm x 6.5 cm x 1.3 cm

11.30.21
3.6 cm x 5.0 cm x 0.6 cm

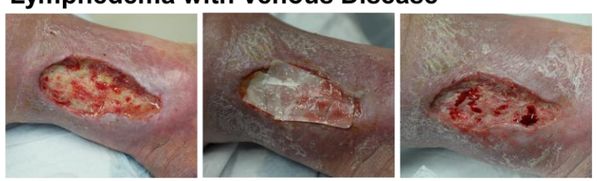
1st application of Phoenix

% Reduction pre application of Phoenix: 0.80% in 3 weeks

% Reduction post application of Phoenix: 32% in 3 weeks

Patient History: 68 y.o. Native American male with chronic **DFU of 5 months duration**. History of type 2 DM, PN (sensory and motor), CHF, HT, and ESRD. Patient was noncompliant to offloading. No reoccurring infection noted post application of Phoenix.

Lymphedema with Venous Disease



10/26/21
8.2x3.4x0.7

11/15/21
8.0x3.4x0.6

12/7/21
6.2x2.4x0.4

1st application of Phoenix

% Reduction pre application of Phoenix: 8% in 3 weeks

% Reduction post application of Phoenix: 37% in 3 weeks

Patient History: 74 y.o. Caucasian female with a chronic medial leg ulcer secondary to lymphedema and venous insufficiency. The **duration of the ulcer is 4 years.** Venous testing demonstrates GSV insufficiency without perforator involvement. Phoenix was used in conjunction with standard of care and compression.

Study highlights:
3DESPM accelerated the wound healing process of these complex stalled wounds.

A DFU 5 months in duration achieved a 32% reduction in wound size in 3 weeks.

A VLU 4 years in duration achieved a 37% reduction in wound size in 3 weeks.

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