Does Three-Dimensional Elastic Compression Therapy Deliver Positive Pressure Wound Therapy: Bedside Observations of Refractory Wound Responses to Compression with a Third Dimension

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Fuzzy Wale Compression Stockinet* as Contact Layer of Compression **Dressing delivers Positive Pressure Wound Therapy (PPWT)**



Rx day #0: 55yo female with aortic occlusion below renal arteries, no doppler signals below R knee, and profound R leg ischemia. Pt. refused R BKA amputation. Failed 3 days of NPWT due to maceration beneath polyethylene drape.

Compression as a contact layer used at first visit on painful, inflamed, mixed arterial ulcer that did not tolerate NPWT. Maceration was from polyethylene adhesive film.



Fuzzy wale textile compression enhances arterial perfusion via NO-- observe scarless healing in face of profound ischemia (no doppler signals in R foot).

Rx day# ~45: Observe robust peri wound skin without scar in a profoundly ischemic R leg--no audible doppler signals below the knee. Why has this ischemic wound been able to heal? Fuzzy wale elastic compression stockinet: (1) improves skin perfusion almost certainly Nitric Oxide is involved, (2) moves water out of the subcutaneous fat to control swelling, and (3) creates cell micro distortion in tissues adjacent to cornrow furrows. Micro distortion signals cell DNA to upregulate gene expression to make the myriad proteins required for cell division to heal the wound.

Rx Day~ #3: EdemaWear used as the wound contact layer on Rx Day #0 above photo.

Rx Day #193: patient discharged. This 'miraculous' photo documents profoundly ischemic wound healing without scar-- a clinical sign of regenerative healing which occurs when stem cells are recruited to the wound. Regenerative healing is commonly seen with NPWT. Suzie Ehmann (2022) makes the case that results of EdemaWear[®] in this case and others represent Positive Pressure Wound Therapy (PPWT). Delivering elastic textile compression via fuzzy wales* that create furrow in 20% of the wound surface mimics what is seen with NPWT. PPWT from fuzzy wale compression delivers three unique physiologic therapies:

1) enhanced skin perfusion (probable upregulation of Nitric Oxide?) 2) rapid edema control wales forming skin furrows in 20 percent of skin surface, 80% of the lymphatic collecting ducts arising at the skin dermis are wide open to act as a low pressure run off sink down which lymphatic and venous effluent moves, and

3) fuzzy wales deliver: compression to tissue beneath wales, tension to skin & subcutaneous fat between furrows generating cell micro distortion which signals DNA to upregulate gene expression to make the myriad proteins required for to heal the wound.

Aristotle reported textile compression healed leg ulcers in 400 BCE at the temple of Asclepius by priest practitioners. Fuzzy wale elastic compression* introduces a third dimension, furrows in skin that appears to dramatically increase three physiologic functions of textile compression therapy.

We used Fuzzy Wale Compression stockinet as a wound contact layer first in 2006. 16 years and hundreds of patients later, Ehmann coined the term Positive Pressure Wound rapy (PPWT).

Scarless regenerative healing in this ischemic full thickness wound frequently is seen with NPWT. Fuzzy wale compression stockinet* appears to have delivered Positive Pressure Wound Therapy C**

Physiology of Cell Micro Distortion & Upregulation of Gene **Expression with Force Delivered to Wound Surface by Open Cell** Foam with Sub Atmospheric Pressure Delivering Static Force.

Rx Day # 0: Painful weeping nonhealing refractory VLU, present >3 years, compression therapy not tolerated. (Photo© Marta Ostler)

Rx Day ~# 8: 2nd or 3rd Clinic Visit, observe dramatic wound bed preparation - granulation tissue is responding to fuzzy wale compression. Corn row furrows in the subcutaneous fat and granulation tissue are therapeutic. Tissue beneath wales experiences compression while islands of skin and subcutaneous fat between furrows are on "stretch". These conditions are also seen in NPWT, and are termed "micro distortion," which is the mechanism of NPWT and the mechanism of fuzzy wale compression. (Photo© Marta Ostler)

Illustration shows the forces delivered by a single cell of NPWT open cell foam under sub atmospheric air pressure. The open cell foam wall is sucked down to compress the wound surface that it touches. Simultaneously, tissue in the center of the foam cell is sucked up, creating tenson, illustrated by artist with black arrows.

Photo micrograph shows lab animal wound granulation histology at a single open foam cell tissue interface. Simultaneous compression and tension (blue arrows) create cell micro distortion, a term coined by Orgill (2007), to describe tissue conditions that upregulate local wound tissue gene expression, protein synthesis, and cell division that occur during NPWT, which is arguably the most important advance in wound care this century.

(Ehmann 2022) coined the term Positive Pressure Wound Therapy to describe wound surface and stasis dermatitis results of fuzzy wale elastic compression stockinet that she observed. We posit that PPWT is in part, a mechanism of traditional limb swaddling introduced by Greek healers of antiquity. We Nebraskans posit that the term "corn row furrow" is right to describe where cell micro distortion is maximized to up regulate gene expression, protein synthesis, cell division, stem cell recruitment and wound closure.

uzzy wale elastic npression stockinet* delivers static compressive force to tissue under the wales in subcutaneous fat with simultaneous tension on the skin and subcutaneous fat between the furrows.

(Photo© Marta Ostler)

RX Day~ #40: The healing VLU surface illustrates how fuzzy wale elastic compression stockinet* delivers static compressive force:

(1) to tissue under the wales, creating furrows in subcutaneous fat, (2) while simultaneously creating tension on the tissue between fuzzy wales that compress just 20% of the skin surface.

As in NPWT, simultaneous compression and tension creates cell micro distortion, a term coined by Orgill (2007), to describe the mechanism of upregulation of gene expression, protein synthesis, and cell division that occurs in Negative Pressure Wound Therapy (NPWT) which is, arguably, the most important advance in wound care this century.

The term Positive Pressure Wound Therapy (Ehmann 2022) explains the results of existing textile swaddling introduced by priest healers at the Temple of Asclepius 400 BCE. Delivering force with fuzzy wales, bad sci-fi pun ahead, 'theraforms' the skin creating skin furrows where conditions are optimal for cell micro distortion to upregulate local cell DNA gene expression to make the myriad proteins required to heal the wound.

Introduction

Open cell foam intimate with wound surface under sub atmospheric pressure creates tissue under compression by oval foam cell walls, and tissue under stretch (tension) in the center of the foam ovals. This cell micro distortion turns on gene expression via mechano transduction pathways to synthesize myriad proteins required to close wounds and is arguably the key physiologic mechanism of Negative Pressure Wound Therapy (NPWT). (Saxena 2004) (Orgill 2008) Clinical experience with lumps of foam rubber under torso compression garments and with fuzzy wale elastic compression stockinet in intimate contact with VLU surface suggests that static force delivered to skin is dramatically more effective if it creates a third dimension, depth, think valleys in subcutaneous fat creating useful tissue micro deformation, versus flat textile compression first reported by Aristotle 400 BCE. (Ehmann 2022) (Fazzari 2022) (Melin 2021)

Methods

Clear photos of chronic leg wounds create a visual library of the physical findings of three-dimensional elastic compression. Additionally, we document wound edge and peri wound skin changes.

Results

We document wound edge epiboly clears rapidly, robust granulation replaces friable weeping friable tissue, peri wound stasis dermatitis resolves, and rapid migration of neo epithelial cells at wound edge. These bedside findings suggest that fuzzy wale elastic compression textile* upregulates gene expression via mechano transduction pathways in the manner of NPWT.

Conclusion

Textile compression with a third dimension appears to increase gene expression, improve lymphatic function, and increase subcutaneous perfusion. Positive Pressure Wound Therapy** with more clinical research, may prove to be an appropriate term.

References

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** Positive Pressure Wound Therapy© Suzanne Ehmann