

Drawtex Effects on VLU Healing And Biofilm

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Introduction

Clinicians have, since the very beginning of wound care, ascribed at least some role to bacteria for the nonhealing of wounds. The wound care practitioner's behavior has usually included cleansing and biocides — even to the current day — as evidenced by our use of silver, iodine and other antibacterial agents. Yet our understanding of the wound bioburden remains incomplete.

Individual bacteria, planktonic bacteria, express proteins that let them compete with different microbial species as well as attack and kill host cells. This behavior of single cells creates a very easy-to-identify clinical scenario that practitioners have termed acute infection. However chronic wounds act much more like chronic infections. We now know that the microbes residing on the surface of a wound choose to organize as a biofilm community.¹ This community is not just a bunch of single-cell microbes crammed together underneath a protective coating but, rather, a complex community.²

Biofilm communities are characterized by cooperation and, more importantly, synergies between the different species including bacteria, yeast and fungus. This cooperation yields polymicrobial biofilms with infinite variability, making each wound biofilm unique. Although the variability and the potential synergies between the species are unlimited, each biofilm community must possess certain specific functions to maintain a chronic infection in a host environment.³ These functions include the ability to attach to host epitopes, to prevent the sloughing or shedding of their attachment site by usurping the functions of host cells (making these cells senescent), and to produce hyper-inflammation. Inflammation is necessary for a biofilm community to provide a source of nutrition. Whereas individual bacteria kill and digest host tissue for nutrition, biofilm is restricted from such a strategy because it would sacrifice its attachment site. Biofilm must maintain (not destroy) the host surface to which it is attached. Therefore, bacteria/fungus utilize inflammation to produce plasma exudate that percolates through the biofilm, thus providing sustainable nutrition for the entire community.

The use of inflammation to provide nutrition is an important characteristic shared by most pathogenic biofilms producing chronic infections in almost every tissue found in the human body. Wound biofilms' reliance on chronic inflammatory exudate may be an exploitable vulnerability. It seems reasonable, that if inflammatory exudate is rapidly removed, pathogenic activities of biofilm may be suppressed. That is, by decreasing the dwell time of this nutrient-rich source, the individual members of the community may be impacted negatively. Therefore, if rapid removal of exudate diminishes wound biofilms' pathogenic activity, then wound healing may improve.

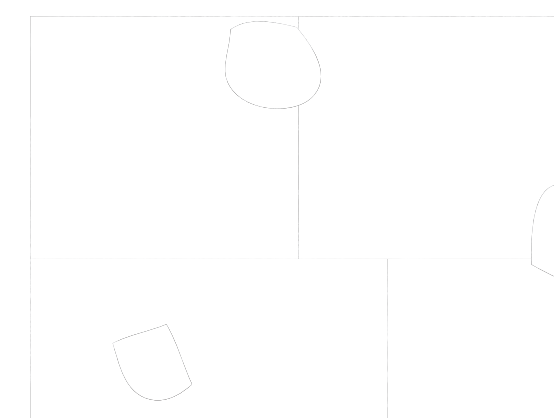
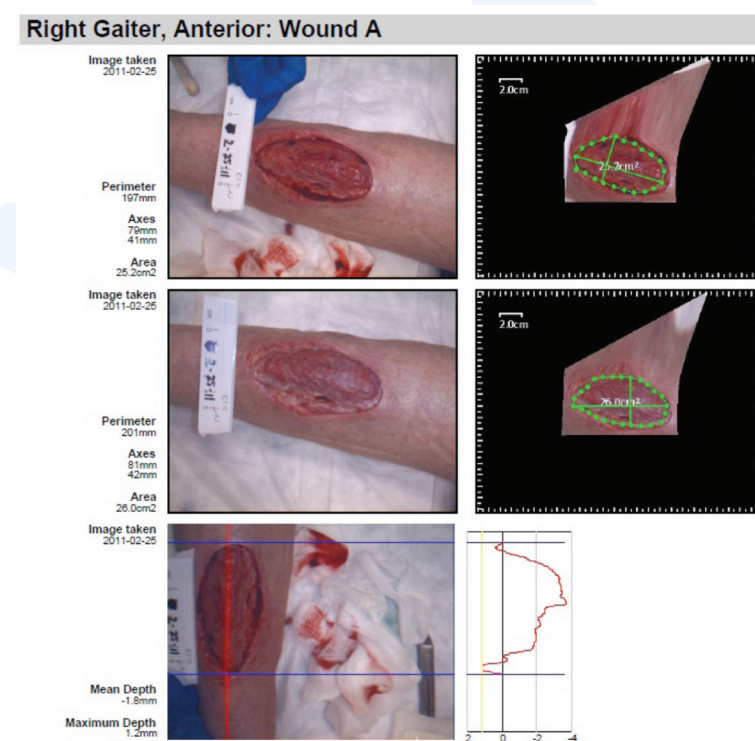
Objective

- Demonstrate that Drawtex by the rapid removal of wound exudate improves wound healing
- Demonstrate that rapidly removing wound exudate suppresses wound biofilm by reducing the activity and number of bacteria

Materials and Methods

Ten patients with non-healing venous leg ulcers for over 30 days were identified and consented to participate in a small cohort study (Western IRB #20101569).

Each patient was subjected to evaluation at each visit (weeks 0, 1, 2, 3, and 4) for a total of 5 visits over a 4-week period. At visits 0 and 4, the patient had all wound metrics and included 5 mm punch biopsies and comprehensive molecular evaluation (PCR and sequencing) evaluation. The molecular diagnostics were conducted by PathoGenius laboratories. The biopsies were sent for scanning electron microscopy evaluation at the Center for Biofilm Engineering.



The Aranz Silhouette was utilized to obtain measurements for each study wound on each visit.

Biopsies were taken at the first and final visits in an effort to qualitatively assess the wound bed surface in particular wound biofilm pre- and post-dressing. However, fibers and particulate matter from the dressing confounded this comparison. It is interesting to note that the biofilm and white blood cells are nestled in the residual dressing fibers.

Results

Acct#	Initial Vol	Final Vol	%
23008			
22517	0.07	0.00	100.0%
22632	1.10	0.09	91.7%
9510	2.18	2.14	1.7%
23008	0.48	0.28	41.6%
23262	9.43	4.75	49.6%
16358	5.58	3.01	46.1%
13711	0.08	0.00	100.0%
3035	1.82	1.11	39.0%
15623	1.18	0.23	80.5%
22822	2.94	0.89	69.7%
	Avg		62.0%

Table 1 demonstrates a significant reduction in wound volume for 9 of the 10 patients in the study. Two patients actually went onto full wound healing within the 4 weeks of the study.

Table 2 demonstrates the beginning cycle threshold (CT) number versus the final CT number for the 10 patients that were evaluable. The CT number indicates how many times the sample had to be doubled before a signal could be obtained. The more doublings required to obtain a signal is directly related to how

much of the target DNA is in the original sample. The more bacteria present, the smaller the CT number. Four patients showed an increase in bacteria over the 4 weeks of the study.

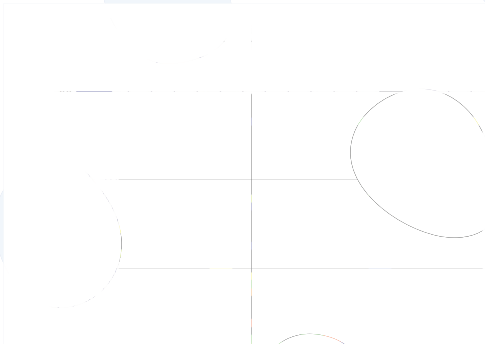


Figure 1: The first 4 subjects represented in this heat map did not have any final sample to compare against because of complete healing or very little bacterial DNA, which was used for the PCR testing. Of the remaining 6 subjects, 4 showed less bacteria and less diversity after treatment. There is a tendency but not statistical significance for the reduction of diversity after treatment with Drawtex dressings.

Patient ID	Initial CT	Final CT	Amount Bacteria
23262	25.73	26.10	less
15623	28.50	28.31	more
23008	16.81	27.05	less
3035	18.75	26.99	less
16358	19.95	18.28	more
9510	28.85	19.78	more
22822	22.85	24.51	less
22632	27.63	22.24	more
13711	27.11	0	less
22517	27.41	0	less

Discussion

Drawtex dressings possess the physical property of a very strong and, therefore, rapid capillary force upon fluids. This property can be utilized in wound care to decrease dwell time of nutrient-rich plasma exudate within the wound bioburden. It seems reasonable to assume that decreasing the contact of plasma exudate with wound biofilm may suppress biofilm activity and improve wound healing as a result. The data shows that, for 9 of the 10 study subjects, Drawtex had a positive effect on wound healing by reducing wound volume. Yet only 6 of the 10 patients also showed reduction in bacteria present (Table 1) and only 4 of 6 wounds showed reduction in diversity of organisms (Figure 1).

The data clearly shows an improvement in wound healing for 90% of the study subjects with 2 completely healed in the 4 weeks. Yet the dependence of this healing is not a 1:1 correlation with reduction of wound biofilm. This may mean Drawtex also impacts wound healing by mechanisms unrelated to biofilm. Confounding factors may include increasing the density of the wound biofilm through the dehydration caused by the dressing itself. By drying out the wound biofilm, this may spuriously yield smaller cycle threshold numbers, which suggest more bacteria. A second caveat is that regardless of the quantity of bacteria present, the rapid removal of nutrient source may suppress the activity of the remaining bacteria, thus the positive healing effect may not depend on reduction of bacterial numbers but rather on suppressing their activity. Further studies to assess the activities and interactions of individual bacteria will be necessary.

References

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3. Wolcott RD, Rhoads DD, Dowd SE. Biofilms and chronic wound inflammation. *J Wound Care.* 2008;17(8):333-341.

Acknowledgments

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