A NEW ANTI-BIOFILM HYDROFIBER® DRESSING: *IN VIVO* INVESTIGATION

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Introduction

"A growing body of evidence suggests that in addition to hypoxia, ischemia-reperfusion injury, and intrinsic host factors, bacterial biofilms represent a fourth major pillar in chronic wound pathogenesis." [1]

To better understand the behaviour and clinical consequences of biofilm and how it may be effectively treated, controlled studies are required. Human studies are logistically and ethically prohibitive and they are also impossible to standardise. *In vitro* models have been developed but these are not always representative and are unable to provide concurrent information about wound healing. The research group at Northwestern University has adapted a rabbit dermal ulcer model (a well-characterised, validated, FDA-recognised model of wound healing in use for 20+ years) to give a reproducible biofilm-containing wound that is sub-infection (Figure 1)[1]. The following have been demonstrated:

- Consistency (healing observations, bacterial counts)
- Control wounds heal like human wounds
- The presence of wound biofilm (by scanning electron microscopy)
- Quantitative & qualitative analyses at multiple time-points

The aim of this study was to use this *in vivo* wound biofilm model to quantify the effect of a new anti-biofilm Hydrofiber® dressing (ABHF), **AQUACEL® Ag+**, on reducing bioburden and improving wound healing rates. The model chosen closely represents the dermal loss seen in human chronic wounds, and allows healing by granulation and epithelialisation, rather than by contracture as seen in other animal models.

Figure 1. Biofilm-colonised wounds do not exhibit the purulence and debris associated with actively-infected wounds; rather 'films' of bacteria are observed across the wound[1]

Method

Pseudomonas aeruginosa (wild-type strain PA01) biofilm-colonised wounds were created over a 6-day period. Wounds were treated for 6 days, with dressings changes every other day:

- Half the wounds on each animal were covered with **a non-adherent PHMB gauze dressing (Telfa™ AMD)**
- The other half were covered with either **ABHF** or a **non-antimicrobial vehicle dressing (HF; AQUACEL®)**

At each dressing change clinical observations were made and samples were taken for microbiological analysis. On the sixth treatment day: histological samples were taken to measure new (and missing) granulation tissue and epithelium.

Results & Discussion

ABHF significantly reduced bioburden of biofilm-colonised wounds compared to the HF and PHMB gauze dressings (Figure 2):

- ~57% reduction in biofilm bioburden per treatment day with ABHF dressing (p<0.05)
- Only ~17% reduction per treatment day with HF or PHMB gauze dressings

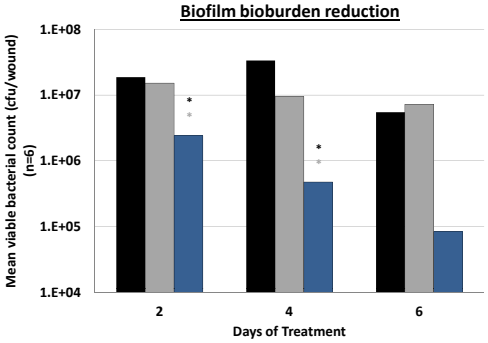

Figure 2. Biofilm bioburden reduction beneath PHMB gauze (■), HF (■) and ABHF (■) (* p<0.05)

REFERENCE:
1. Gurjala et al. Wound Repair Regen 2011; 19:400-410.

Results & Discussion (cont.)

ABHF significantly improved the rate of granulation tissue formation in biofilm-colonised wounds compared to the HF and PHMB gauze dressings:

- 10% smaller granulation gap with ABHF compared to PHMB gauze dressing (p<0.05; Figure 3A)
- 48% larger granulation area with ABHF compared to PHMB gauze dressing (p<0.05; Figure 3B)

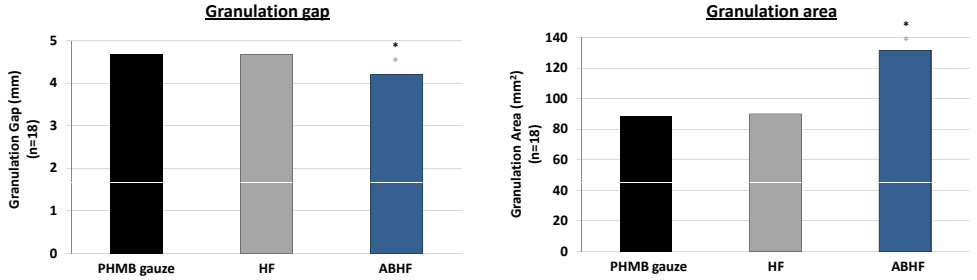

Figure 3. (A) Granulation tissue gap; (B) granulation tissue formation beneath PHMB gauze (■), HF (■) and ABHF (■) (* p<0.05)

ABHF significantly improved the rate of epithelialisation of biofilm-colonised wounds compared to the HF and PHMB gauze dressings:

- 19% smaller epithelial gap with ABHF compared to PHMB gauze dressing (p<0.05; Figure 4A)
- 24% larger epithelial area with ABHF compared to PHMB gauze dressing (p<0.05; Figure 4B)

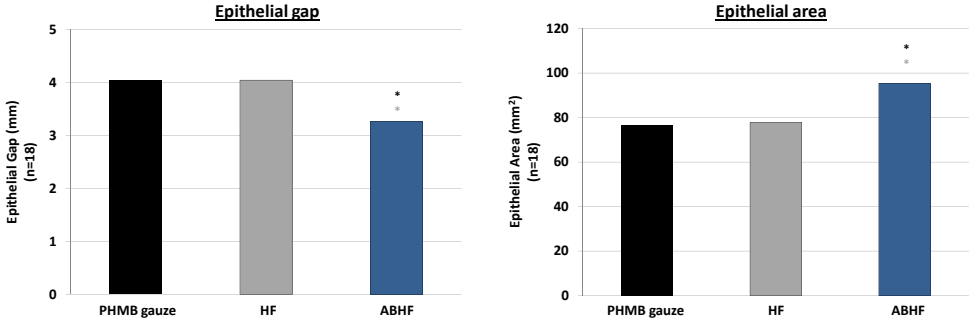

Figure 4. (A) Granulation tissue gap; (B) granulation tissue formation beneath PHMB gauze (■), HF (■) and ABHF (■) (* p<0.05)

Conclusion

Controlled animal models can be used to study the biological consequences of wound biofilm. Even in acute wounds in healthy animals, the presence of biofilm was shown to delay wound healing. In a model which closely represents the dermal loss and healing characteristics of human chronic wounds, ABHF was shown to be more effective in reducing biofilm, and thus restoring normal wound healing, compared to the base dressing (HF) or the PHMB gauze dressing. ABHF was shown to:

- **Significantly reduce wound bioburden (biofilm)**
- **Significantly improve the rate of granulation tissue formation**
- **Significantly improve the epithelialisation rate**

This suggests that a new anti-biofilm Hydrofiber® dressing, **AQUACEL Ag+**, will have an important role to play in reducing biofilm in human wounds and therefore improving healing rates.