Antimicrobial Ovine Foregut Matrix Prevents Biofilm Formation

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Introduction
Biofilm management continues to be a challenge in wound care. Clinical consensus indicates that biofilms are present in the majority of chronic wounds and contribute to delayed healing outcomes and infection risk.

Biofilms are typically polymicrobial and notoriously resilient to treatment by antibiotic and antiseptic agents, thus debridement is the primary approach to controlling biofilm in the wound. Sharp debridement is highly effective in removing biofilm, however biofilm can rapidly regrow from any remnants or form anew from contaminating microbes. Thus, adjunctive measures to debridement such as topical antiseptics and antimicrobials are often used to control biofilm regrowth and facilitate the progression of healing.

We have previously described the antimicrobial Ovine Foregut Matrix termed OFM-Ag™, a native extracellular matrix scaffold functionalized with ionic silver. The present study sought to quantify biofilm prevention of OFM-Ag using an in vitro model of polymicrobial biofilm compared with Collagen/ORC/Ag®, Collagen/Ag® and gauze.

Conclusions
- Quantifiable biofilm formation occurs in vitro as rapidly as 1 h following microbial exposure.
- OFM-Ag™ demonstrated significant prevention of polymicrobial biofilm formation in vitro.
- Further studies are required to evaluate the potential for OFM-Ag™ to prevent wound biofilm when used as an adjunct to debridement.

Methods
Figure 1. Biofilm Formation Assay

Figure 2. Biofilm Prevention Model

Results
Crystal violet stain was used to quantify biofilm due to its affinity towards staining viable and dead microbes in addition to extracellular polymeric biofilm matrixes (Figures 1 – 4).

The biofilm formation kinetics of the model demonstrated dependency on surface adhesion time (Figure 5 and 6). Biofilm increased as a linear function of adhesion time (0.5 – 4 h). Interestingly, there was no significant difference in biofilm formation over adhesion times of 0–30 minutes (Student t-test, p = 0.586).

As expected, the non-antimicrobial gauze™ dressing exhibited high biofilm formation (Figure 7). In contrast, OFM-Ag™ was significantly more effective in preventing biofilm formation (p < 0.05) compared to all other treatment groups. Collagen/ORC/Ag® was also more effective in biofilm prevention compared to gauze and Collagen/Ag® (p < 0.05) but less effective compared to OFM-Ag™. Collagen/Ag® was the least effective antimicrobial dressing in preventing biofilm formation, exhibiting less biofilm formation than gauze however, this result was not statistically significant (p = 0.05).

Interestingly, Collagen/Ag® has the highest silver concentration (1.2% w/w AgCl) or 0.9% Ag w/w® compared to Collagen/ORC/Ag® (0.25% w/w®) and OFM-Ag™ (0.33% w/w®) as portrayed in Figure 8. Therefore it is surprising that Collagen/Ag® was the least effective in preventing biofilm formation. This may be due to the dressing design which utilizes AgCl rather than ionic silver.

Figure 3. Crystal Violet

Figure 4. Biofilm Sample Contact

Figure 5. Linearity of Polymicrobial Growth vs. Surface Adhesion Time

Figure 6. Polymicrobial Biofilm Growth vs. Surface Adhesion Time

Figure 7. Polymicrobial Biofilm Prevention Screening

Figure 8. Device Silver Concentration

Reference and Disclosures