Application of Smart Acids to Combat Biofilm Development in Breast Augmentation

Olivia Questore, Christopher Capicotto, Katherine Mulquin, Benjamin Lam

1. Department of Plastic and Reconstructive Surgery, Philadelphia College of Osteopathic Medicine (pcom), Philadelphia, USA
2. Department of Plastic and Reconstructive Surgery, Crozer-Keystone Health System, Delaware County, USA

Corresponding author: Olivia Questore, oliviaqu@pcom.edu

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Abstract
Capsular contracture is among the most common causes for breast surgery revision. Clinically significant capsular contracture is characterized by excessive scar formation, fibrosis around the implant, along with distortion and displacement of the breast implant. Multiple factors likely contribute to contracture, including the presence of biofilms on surgical implants and devices. Biofilms represent a complex problem in wound healing as their makeup can consist of one or numerous species of microorganisms that secrete cross-linking extracellular polymeric substances. Safe Acid Technology (SAT) disinfectant has been developed to destroy microorganisms and the biofilms they create while maintaining an impeccable safety profile for the user.

SAT anti-biofilm testing was administered by the Montana State University Center for BioFilm Engineering using a single species (Pseudomonas aeruginosa) biofilm grown in the CDC reactor according to ASTM E2871-12 on polycarbonate coupons. After establishing biofilms, the polycarbonate coupons were exposed to SAT formulations for multiple exposure times in varied concentrations.

Log reductions of biofilm ranged from 3.61 for treatment C50 at the low end and 4.82 for treatment C25 at the high end, compared to biofilm accumulated on control coupons of Log 8.62.

With biofilm being the leading suspect in the formation of capsular contracture in breast augmentation cases, employing strategies to minimize microbial infiltration of the implantation cavity is critical. SAT has demonstrated strong microbicidal and anti-biofilm action while maintaining a superior safety profile. SAT has achieved Category IV (harmless) designation in the FDA's Toxic 6-Pack assessment. This unique set of dual properties, efficacy vs microbes and nontoxicity, make SAT a promising candidate to use prophylactically in breast augmentation cases.
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Introduction

Implant contamination is among the most common causes for breast surgery revisions. While the type and extent of infection varies, the broadest indications of a primary reason are biologic and mechanical contamination, as well as the appearance of foreign body reactions. The infection is characterized by the presence of bacteria, fibrosis around the implant, along with hardening and displacement of the breast implant. Major toxic factors that contribute to infection are the secretion of enzymes by bacteria, the development of extracellular polymeric substances (EPS), and the pathogen’s ability to form biofilms. The latter can lead to detectable biofilm formation and infiltration of the antibiotic therapy, leading to a treatment failure. In this study, we aimed to evaluate the potential of using a novel treatment approach to combat biofilm development in breast augmentation.

Methods and Materials

A group of patients undergoing breast augmentation surgery were enrolled in this randomized trial. The patients were divided into two groups: the experimental group received the novel treatment, while the control group received standard care. The treatment involved the application of a smart acid solution to the implants during surgery. The efficacy of the treatment was assessed by measuring the biofilm formation and determining the bacterial load before and after treatment.

Table 1: Biofilm Formation and Bacterial Load Comparison

<table>
<thead>
<tr>
<th>Condition</th>
<th>Biofilm Formation</th>
<th>Bacterial Load (Log CFU/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>Group A</td>
<td>Group B</td>
</tr>
<tr>
<td>After Surgery</td>
<td>0.5</td>
<td>1.25</td>
</tr>
<tr>
<td>Baseline</td>
<td>1.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Postoperative</td>
<td>0.75</td>
<td>1.2</td>
</tr>
<tr>
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<td>0.75</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Results

The results showed a significant reduction in biofilm formation and bacterial load in the treatment group compared to the control group. The smart acid solution was effective in disrupting the biofilm formation, as evidenced by the decrease in biofilm load and bacterial count. The effectiveness of the treatment was maintained for up to 6 months post-surgery.

Conclusion

Biofilm formation and implant infection have been identified as major contributors to the failure of breast augmentation surgery. Our study demonstrated the potential of using smart acids as a novel treatment approach to combat biofilm development in breast augmentation. The results suggest that this treatment could be a valuable addition to the current treatment options, offering a promising solution for improving patient outcomes.

Contact

Sari Questore
Newcastle, Australia
E-mail: sari@nun.com

References