

Comparing the Efficacy of Common Irrigation Solutions on Biofilm Formed on Titanium Orthopaedic Implant Surfaces

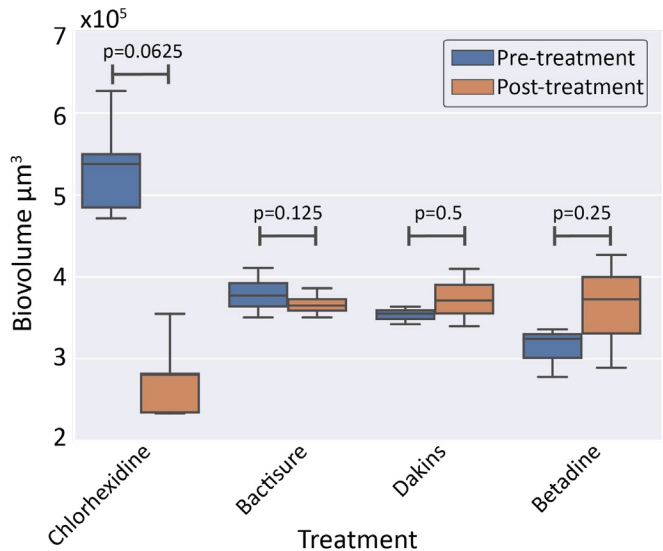
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Purpose: A diverse array of antibacterial solutions are used by orthopaedic surgeons in an attempt to eradicate bacterial biofilm from orthopaedic implants. However, few studies compare these agents against biofilm grown in high-fidelity models on clinically relevant orthopaedic biomaterials, such as titanium. The aim of this study was to evaluate the effect of commonly used irrigation solutions on biofilm using a high-fidelity biofilm model imaged using high-resolution confocal microscopy.

Methods: A dual species biofilm (*Escherichia coli* and *Enterococcus faecalis*) biofilm was cultivated in microfluidic chambers on a titanium orthopaedic implant under continuous flow. Antibacterial solutions were tested according to manufacturer guidance and included: 4% chlorhexidine solution, 7.5% povidone iodine, Bactisure, or Dakins solution. Biofilm was imaged using a scanning confocal microscope and biovolume was quantified post hoc pre-treatment and 2 hours post-treatment. During treatment the 1% tryptone broth was exchanged for the irrigation solution for 30 minutes. Experiments were performed in triplicate and a Wilcoxon signed rank test was used to compare pre- to post-treatment.

Results: None of the irrigation solutions removed more than 50% of the biofilm biovolume from pre- to post-treatment. Chlorhexidine demonstrated a 48.1% reduction in biovolume ($p = 0.0625$). Bactisure demonstrated a small 2.3% reduction in biovolume ($P = 0.125$). Betadine and Dakins solution demonstrated continued biofilm growth (16.1% larger biovolume, $P = 0.5$; and 5.6% larger biovolume, $P = 0.25$, respectively).

Conclusion: None of the commonly used irrigation solutions were very effective at eradicating established biofilm from titanium implants. However, of the 4, chlorhexidine-based irrigation was most effective, resulting in a 48.1% reduction in overall biovolume. The solutions that are more commonly used for intraoperative irrigation (Betadine and Bactisure) were ineffective at eradicating biofilm. More research is needed to improve and optimize irrigation strategies for eradication of biofilm.



The FDA has stated that it is the responsibility of the physician to determine the FDA clearance status of each drug or medical device they wish to use in clinical practice.