DentiPhage

Next-Generation Care for Dental Implants

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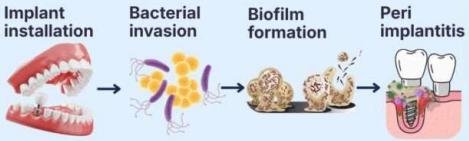
Abstract

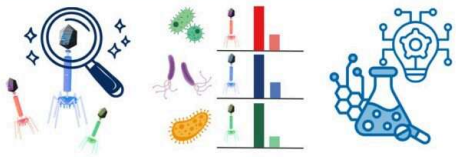
The anti-microbial resistance (AMR) crisis is one of the greatest threats facing humanity today.[1] Misuse of antibiotics has accelerated the emergence of superbugs, while the discovery of new antibiotics has stagnated. Dental implants are a particularly vulnerable yet often overlooked element of this problem. **Peri-implant diseases are mainly driven by biofilm formation,** which makes bacteria up to 1,000-fold more antibiotic-resistant than their planktonic counterparts.[2]

Peri-implantitis can result in **bone loss** and is the **leading cause of implant failure**, often necessitating surgical removal when antibiotics fail.[3] Periodontal pathogens are linked to aspiration pneumonia, prostate disease, colon cancer, and even Alzheimer's.[2] There are **~500,000 dental implants** placed annually in the United States, with **~5-10% developing peri-implantitis**. As the world's population becomes older and dental implant popularity rises, such infections and their systemic consequences are increasing.

Bacteriophages, viruses that infect and destroy bacteria, **offer a promising therapeutic alternative to antibiotics**. They are highly selective, free to evolve, non-toxic, self-amplifying, and capable of clearing mature biofilms by up to 99%.[5, 6] These properties make them strong candidates for controlling biofilm formation on dental implants. By harnessing phage's natural anti-bacterial properties, our team has developed a prototype phage-based dental implant cleaning gel, ***Dentiphage***. This is the first product of its kind, offering precisely targeted biofilm intervention and oral microbiome balancing.



Workflow



Phages and Anti-Biofilm Activity

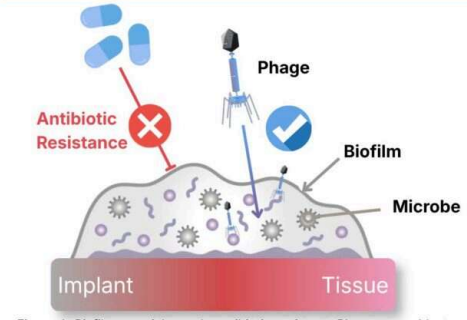
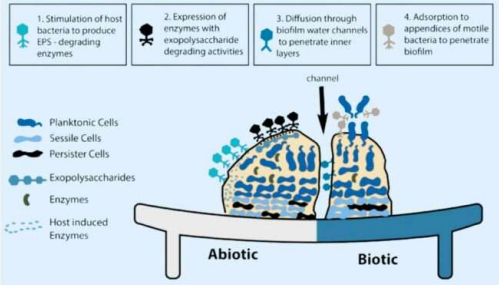
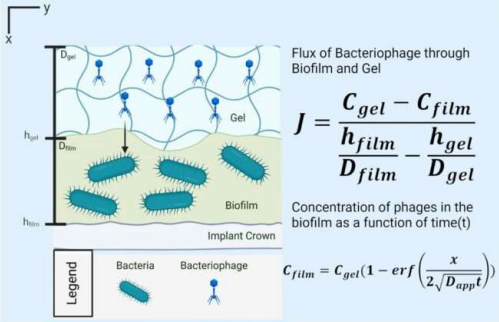


Figure 1. Biofilms are inherently antibiotic resistant. Phages are able to penetrate biofilms and eradicate them from within.





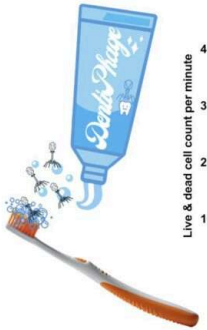
Flux of Bacteriophage through Biofilm and Gel

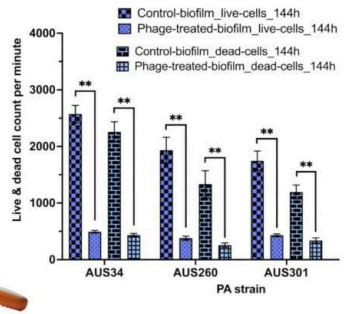
$$J = \frac{C_{gel} - C_{film}}{\frac{h_{film}}{D_{film}} - \frac{h_{gel}}{D_{gel}}}$$

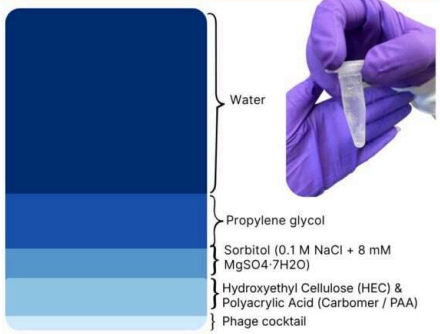
Concentration of phages in the biofilm as a function of time(t)

$$C_{film} = C_{gel}\left(1 - erf\left(\frac{x}{2\sqrt{D_{app}t}}\right)\right)$$

Product and Formulation







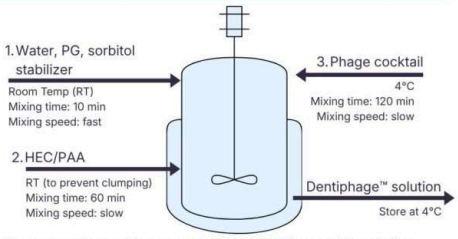


Figure 2: Continuous bioreactor model for DentiPhage gel formulation.

Market Validation

Clinical need verified by multiple dentists in the DMV area.

"A product that could help reduce implant failure would be extremely useful for both dentists and periodontists."

Periodontist at Wilmington Periodontics and Implants

Conclusion

By capitalizing on the proven selectivity, safety, and efficacy of bacteriophages, **DentiPhage** will serve as a **solution to biofilm formation surrounding dental implants**. If and when antibiotics fail, DentiPhage will offer a second treatment option besides surgical intervention.

Next steps

- Phage discovery, multi-biofilm expansion.
- Scientific trials for safety and efficacy of product, to presentat for FDA and American Dental Association validation.
- File ROI to JHU to get patent subsidized.

Citations

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[4] Romandini, Mario, et al. "Incidence and Risk Factors of Peri-Implantitis Over Time—A Prospective Cohort Study." Journal of Periodontal Research, 13 Jan. 2025, https://doi.org/10.1111/jre.13367.
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