Antimicrobial-Peptide Biofunctionalized Titanium for Dental Implants

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Introduction: The clinical efficacy of dental titanium (Ti) implants is influenced by peri-implantitis, an inflammatory response to bacteria, resulting in bone loss and implant failure. Antimicrobial-peptide GL13K, derived from Parotid Secretory Protein, has been shown to have bactericidal and bacteriostatic properties. This work aims to fabricate a biofunctionalized Ti-surface by covalently-anchoring the potentially antimicrobial GL13K peptide.

Methods: Commercially-pure Ti discs were ultrasonically-cleaned, activated by etching or plasma-cleaning, silanized with 3-chloropropyltriethoxysilane (CPTES), and functionalized with GL13K. Thermochemical and mechanical stability were assessed by immersion in PBS (37°C, 5-8 days) and ultrasonication in DI-water for 2h, respectively. Surfaces were characterized by advancing-water contact-angle θ_c, diffuse-reflectance infrared fourier-transform spectroscopy (DRIFTS), and x-ray photoelectron spectroscopy (XPS). The cell number of *P. gingivalis* culture after 5-7 days was quantified by measuring ATP-content and CFUs. ANOVA ($p<0.05$) tables with post-hoc test were used to determine statistically significant differences.

Results: Ti discs were successfully biofunctionalized with antimicrobial-peptide GL13K. θ_c significantly increased from 15° to 125 after coating with GL13K. DRIFTS showed amide-I (1630 cm^{-1}) and amide-II (1540 cm^{-1}) vibrations on modified surfaces, and N1s-peak (400.0 eV) was present on coated samples from XPS, demonstrating the presence of the peptide. Coatings were thermochemically and mechanically stable. Etched GL13K-coated Ti-surfaces showed an antimicrobial effect compared to the control-etched surfaces.

Conclusions: We have demonstrated successful coating of GL13K on Ti via silanization and etching with mechanical and thermochemical stability, due to physisorption on etched-Ti and covalent conjugation to Ti-CPTES. The biofunctionalized Ti constitutes a promising candidate for anti-bacterial dental implants.