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Gingival Keratinocyte Adhesion on Atomic Layer-Deposited Hydroxyapatite Coated Titanium

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Objectives The aim of this study was to evaluate the effects of the atomic layer deposited hydroxyapatite (ALD-HA) coating on human gingival keratinocyte (HGK) adhesion, spreading, growth, and hemidesmosome formation on the titanium surface.

Methods Grade 2 square-shaped titanium substrates were prepared (n=62). The HA coating was done by first depositing with ALD CaCO3, which was hydrothermally converted to HA. Half the substrates were ALD-HA coated, while the other half was used as non-coated control (NC). The ALD-HA coating underwent surface characterization through scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDS) analysis. The initial cell adhesion and hemidesmosome formation of HGKs were evaluated after a 24-hour cultivation period. The cell proliferation was detected by cultivating cells for 1, 3 and 7 days. In addition, the levels of adhesion proteins integrin α6 and β4 were detected with the Western Blot method. Furthermore, high resolution imaging of cell areas and adhesion protein signals was established using a confocal microscope.

Results SEM-EDS analysis demonstrated the formation of HA crystals on the ALD-HA surfaces. The relative cell attachment was significantly higher ($p < 0.05$) on the ALD-HA surface compared to NC after 1 and 3 days of cell culture. No significant difference was found in integrin α6 or β4 expression. The microscope evaluation showed significantly wider cells with peripheral hemidesmosome expression on ALD-HA surfaces compared to the NC ($p = 0.0001$). The signal of laminin γ2 on the cell bottom layer was significantly higher on ALD-HA-coated surfaces compared to NC ($p < 0.001$).

Conclusions Based on the findings of this in vitro study, the ALD-HA coating enhances the attachment of HGKs and promotes the expression of adhesion proteins on coated titanium surfaces. The results of this study indicate that ALD-HA coating has good potential for improving mucosal attachment on implant surfaces.