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Engineered Protein Coatings to Improve the Osseointegration of Dental and Orthopaedic Implants

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Abstract

Here we present the design of an engineered, elastin-like protein (ELP) that is chemically modified to enable stable coatings on the surfaces of titanium-based dental and orthopaedic implants by novel photocrosslinking and solution processing steps. The ELP includes an extended RGD sequence to confer bio-signaling and an elastin-like sequence for mechanical stability. ELP thin films were fabricated on cp-Ti and Ti6Al4V surfaces using scalable spin and dip coating processes with photoactive covalent crosslinking through a carbene insertion mechanism. The coatings withstood procedures mimicking dental screw and hip replacement stem implantations, a key metric for clinical translation. They promoted rapid adhesion of MG63 osteoblast-like cells, with over 80% adhesion after 24 hours, compared to 38% adhesion on uncoated Ti6Al4V. MG63 cells produced significantly more mineralization on ELP coatings compared to uncoated Ti6Al4V. Human bone marrow mesenchymal stem cells (hMSCs) had an earlier increase in alkaline phosphatase activity, indicating more rapid osteogenic differentiation and mineral deposition on