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In vitro and *in vivo* evaluation of PEO-modified titanium for bone implant applications

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Abstract

This work investigated the capacity of plasma electrolytic oxidation coatings on titanium for biological regulation via controlled surface composition and morphology in order to improve osseointegration and implant fixation. PEO coatings with relatively high Ca/P ratios of ~2.0 and ~4.0 were designed, characterized and evaluated *in vitro*, focusing on murine osteoblast and osteoclast activities in order to reflect the equilibrium between bone synthesis and resorption. The coating with elevated anatase content and surface Ca/P ratio of ~2.0 disclosed a diminished osteoclast activity and adequate osteoblast differentiation, favoring an augmented bone matrix synthesis over resorption processes. The coating with Ca/P ratio of 4.0 and reduced pore population density enabled greater osteoclastic resorptive activity. Additionally, commercial mechanised dental implants were PEO-coated and placed in an adult pig for 8 weeks in order to test their biocompatibility and implant integration in a preliminary *in vivo* approach. Both coatings revealed positive behaviour, strong bone matrix deposition at the implant-tissue interface and higher mean BIC values than Ti CP, with no appreciable differences between the two coatings.

Keywords: Titanium; Dental implant; Plasma electrolytic oxidation; Osteoblast; Osteoclast