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Bioactivity response to TiO_2-ZrO_2 nanocomposite coating on commercially pure titanium

A Thesis

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Abstract

Background: Development of dental implant in recent years allows to occupy notable status in dentistry, it is regarded better choice for replacing missing teeth in comparison with removable prostheses for all indicated patients. Clinically, the technologies for success dental implants is not only achieved by excellent mechanical strength and biocompatibility of implant material but it also based on the other characteristics such as surface properties.

Aim of study: To evaluate the biological effect of nanocomposite mixture of titanium oxide and zirconium oxide coating of commercially pure titanium by electrophotic deposition (EPD) and dip coating technique.

Materials and methods: Grade (II) commercial pure titanium rod was machined into disc shaped samples . Discs were divided into 3 groups according to the types of coating used: First group (25 discs) were coated by nanocomposite mixture of 70% nano titanium and 30% nano zirconium using electrophoretic deposition, the second group also include (25 discs) were coated by the same mixture using dip technique while the third group include (25 discs) was uncoated commercially pure titanium discs.

The crystallinity, microstructure, surface morphology, surface roughness and microhardnrss were investigated and compared among three groups.

For bioactivity assessment, simulated body fluid (SBF) were prepared. Thirty discs (10 for each group) were soaked in SBF for 14 days. Then samples were evaluated by using optical microscope, x-ray diffraction analysis, atomic force microscope, scanning electron microscope and energy-dispersive x-ray investigations.

For cell culture, isolation of osteoblast cells from calvaria and long limbs of 3-4 days neonatal rate in order to evaluate attachment and proliferation assay in 4 and 8 days incubation periods for each group.

Results: By comparing among three groups (EPD, dip and uncoated samples), the EPD coated sample technique was significantly higher in microhardnes. *In vitro* investigation for simulated body fluid recorded that more hydroxyapatite formation on EPD & dip coated samples in comparison to uncoated samples. In cell culture tests shows highly significant difference of **attachment assay (P≤0.01)** and **proliferation (P≤0.01)** at 4 and 8 days incubation and control group the least attached and proliferation cells in uncoated samples while EPD coated sample were the highest.

Conclusion:

Coating of commercially pure titanium with 70% TiO_2 and 30% ZrO_2 nano composite exhibit a favorable bioactive surface that enhanced for osteoblast cells attachment and proliferation, which regarded as a key issue for increase bone formation at bone implant interface.