Biocompatibility of Precipitation-Enhancing Anodic Oxidation on Titianium as Implant Mateiral

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INTRODUCTION : Anodic oxidation is an effective method to modify the thickness, crystal structure, composition, and topography of titanium oxide films to promote an osseointegration. The degree of roughness, the type of crystalline, and the composition of the oxide film are dependent on the voltage, current density, and the composition of the electrolyte. Precipitation-enhancing anodic oxidation (PREOX) has been developed by modifying the composition of electrolyte that used in anodic oxidation. The aim of present study was to evaluate biocompatibility of TiO2 surface by novel anodic oxidation, PREOX, compared with those by simple machining and anodic oxidation.

MATERIALS AND METHODS : For the first group as control, specimens (5×5×1mm) were polished with 600-grit silicone carbide paper and cleansed in distilled water by using an ultrasonic cleaner. For the second group, the electrolytes consisted of 0.04 M beta-glycerol phosphate disodium salt n-hydrate and 0.4 M calcium acetate n-hydrate was used. Specimens placed at anode were oxidized at 250 V for 3 min by a DC power supply. For the third group as the experiment (PREOX), the composition of the electrolytes was modified from the second group condition. XRD, SEM, cell (ST2, multipotential stem cell) proliferation, bioactivity, and MTT test (MG-63, osteoblast) were performed to evaluate the physical properties and biocompatibility of the oxide films.

RESULTS : XRD results exhibited that anatase form of TiO2 had grown on the second and third group, and was not able to observe on the first group specimens. SEM observation of the second and third group revealed that crater/pore structure arranged irregularly and the periphery of the crater erupted slightly over the surface. The size of pore ranged from 0.2 to 3 ㎛ and most of them in between 1-2 ㎛. On the third group specimens, granular precipitates evenly distributed all over the surface of the crater/pore with their diameter around 50 to 100 nm. The thickness of oxide layers was around 7-10 ㎛. In the bioactivity evaluation, precipitate layer was observed after 2 days in SBF only on the third group specimens and on all of the groups after 8 and 16 days. Cell proliferation, bioactivity, and MTT test revealed that there were no significant differences among groups tested at longer observation period such as 48 h-cell proliferation, 32-day-immersion in SBF, and MTT test after 48h.

DISCUSSION & CONCLUSION : Nano-sized particles distributed all over the surface of craters/pores of the third group specimens. Cell proliferation, bioactivity test, and MTT tests confirmed that PREOX is non-toxic to cell attachment nor interfere the growth of cells in vitro, and may be possible surface treatment for the titanium dental implant.

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