Evaluation of the growth and adhesion of osteoblast cells on surface-modified dental implants of titanium dioxide nanotubes with electrochemical anodizing method

Abstract

INTRODUCTION. A goal of current dental biomaterials research is to design implants that induce controlled, guided, and rapid healing. Titania (TiO_2) nanotube or TNTs is gaining prominence as an implantation material due to its unique properties such as high specific surface area and the ability to exhibit positive cellular response. To achieve these goals, however, a better understanding of events at the bone–material interface is needed, as well as the development of new materials and approaches that promote osseointegration. Using anodization, titania interfaces can be fabricated with controlled nanoarchitecture.

MATERIALS AND METHODS. TiO_2 nanotube arrays were successfully synthesized by the anodization method of Ti6Al4V disc in electrolyte containing the mixtures of ethylene glycol (EG), ammonium fluoride (0.3 wt % NH_4F) and deionized water (2 Vol % H_2O). A constant dc power supply at 80 V was used anodization process with different anodizing times. The resultant samples were annealed at 550 °C for 3 h. TiO_2 nanotube arrays were studied by field emission scanning electron Microscope (FESEM), Atomic Force Microscopy (AFM) and contact Angle (CA). The prepared TiO_2 NTs has diameter in 30-130 nm. The minimum of diameter TiO_2 nanotube arrays was approximately 30 nm for 10 h of anodization process. Human osteosarcoma bone cells (MG-63) were prepared and planted on these surfaces along with control surfaces. The cell proliferation, osteocalcin (OC) and alkaline phosphatase (ALP) activity of MG-63 cells on samples were calculated and compared in vitro experiments.

RESULTS. FE-SEM images of TiO_2 NTs exhibited the presence of elongated tubular structures. Our results indicate that the nanotubular titania surfaces provide a favorable template for the growth and maintainence of bone cells. The results of the MTT assays showed the viability of MG-63 cells. The cells cultured on nanotubular surfaces showed higher adhesion, proliferation, OC and ALP activity on titanium alloys surfaces. In vitro biocompatibility results suggest that nanotubular titania does not Cytotoxicity.

CONCLUSION. The fabrication routes of titania nano-architectures are flexible and cost-effective, enabling realization of desired platform topologies on existing non-planar dental implants.

Keywords: Dental Implant, Titania Nanotubes, Electrochemical Anodizing, Osteoblast Cells