PR-II-1. Surface calcium chemistry improves the biocompatibility of Ti6Al4V alloy implants

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Background

Recently reported in vitro and in vivo studies have demonstrated the potential effectiveness of a calcium ion (Ca)-incorporated Ti oxide layer in enhancing osseointegration, Ca-incoporation enhanced attachment and proliferation of osteoblastic cells and bone formation of Ti implants. In this study, we evaluated the biocompatibility of Ca-incorporated Ti6Al4V (Ti64) alloy implants produced by hydrothermal treatment for future biomedical use.

Materials and methods

The surface characteristics of Ca-incorporated Ti64 implants were evaluated by scanning electron microscopy, thin-film X-ray diffractometry, Auger electron microscopy, and stylus profilometry. The viability of MC3T3-E1 cells on Ca-incorporated machined Ti64 surfaces with different oxide thickness was compared with that of on untreated machined Ti64 surfaces with MTT assay. The osteoconductivity of the Ca-incorporated Ti64 implants (2.4 mm in diameter, 8 mm in length) was evaluated by removal torque testing and histomorphometric analysis after 6 weeks of implantation in rabbit tibiae.

Results

Surface treatment produced a crystalline CaTiO3 layer on Ti64 surfaces, and calcium ions were gradually incorporated throughout the oxide layer. After immersion in Hank's balanced salt solution, a considerable apatite deposition was observed on all surfaces of the Ca-incorporated samples. Significant increases in cell viability (P

< 0.001), removal torque forces ($P < 0.05$), and BIC% ($P < 0.05$) were observed for Ca-incorporated Ti64 implants compared with those for untreated Ti64 implants.

Conclusion

Our results show that this Ca-incorporated surface offers a cytocompatible surface for osteoblasts and enhances the osteoconductivity of machined Ti64 implants in rabbit tibiae.