Drug release from gelatin-calcium titanate composite formed on Ti-6Al-4V alloy

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Background

Ti-6Al-4V alloy has been widely used for orthopedic and dental fields owing to its high mechanical strength and biocompatibility. The alloy, however, is insufficient in bone-bonding capacity and its implant often causes loosening. Osteoporosis increases with aging of the population, and drugs of bisphosphonate (BS) such as alendronate and minodronate (MA) are used for the medical treatment. Reliable and multifunctional implants showing both of bone bonding and drug releasing functions are desired.

Concept

Calcium titanate layer formed by Ca-heat treatment exhibits osteoconductivity owing to its apatite formation capability as well as high scratch resistance [1]. Meanwhile drug containing hydrogel exhibits osteoconductivity although its scratch resistance is usually poor. In this study, we developed novel organic-inorganic composite layer consisting of MA-containing gelatin and calcium titanate on Ti-6Al-4V alloy to provide osteoconductivity and osteoconductivity as well as high scratch resistance. Its apatite formation, scratch resistance and dissolution rate of gelatin are evaluated.

Materials and Methods

The composite of MA-containing gelatin and calcium titanate was produced on Ti-64Al-4V by Ca-heat treatment and subsequent dip coating. Vacuum heat treatment that promotes cross-link of gelatin [2] was examined after the dip coating to suppress the initial dissolution rate of the gelatin.

Results

Effect of gelatin concentration on the thickness of coating layer

Apatite formation: effect of additives in a coating layer

Degradation rate of gelatin layer

Scratch resistance

Summary

Novel organic-inorganic composite of MA-containing gelatin and calcium titanate was produced on Ti-64Al-4V alloy. The treated alloy exhibited high scratch resistance, apatite formation and MA releasing capacity, and thus will be useful for the treatment of osteoporosis bone.

References
