

Fabrication and in vivo evaluation of porous carbonate apatite by a new foam method

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論文題目 Fabrication and *in vivo* evaluation of porous carbonate apatite by a new foam method

(新しい炭酸アパタイトフォームの創製と動物実験の評価)

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論 文 内 容 の 要 旨

In this study, three - dimensional porous carbonate apatite (CO₃Ap) bone substitute was produced based on dissolution – precipitation type compositional transformation reaction using calcite foam as a precursor. Negative ceramic foam method was proposed to fabricate interconnecting porous calcite precursor with good mechanical strength. First, polyurethane foam was coated with polyurethane to increase thickness of struts to ensure cell and tissue penetration. Then the pores were filled with calcium hydroxide (Ca(OH)₂) slurry. It was heat-treated to burn out the polyurethane and carbonation of Ca(OH)₂ under CO₂ and O₂ gas stream. Composition of the calcite foam thus prepared was transformed based on dissolution- precipitation reaction in disodium hydrogen phosphate (Na₂HPO₄) aqueous solution. X-ray Diffraction (XRD) analysis revealed that calcite foam was completely transformed to CO₃Ap foam. CO₃Ap foam prepared in this study showed much higher compressive strength when compared to the CO₃Ap foam prepared by conventional ceramic foam method.

Bone defect made at rabbit tibia was reconstructed with CO₃Ap foam and hydroxyapatite (HAp) foam by the same method. Micro-x-ray computed tomography (μCT) and histological analysis revealed that both CO₃Ap and HAp foams showed excellent tissue response and good osteoconductivity. The amount of bone penetrated into the pore was much larger in the case of CO₃Ap foam when compared to HAp foam. After 12 months of implantation, CO₃Ap foam was replaced to bone whereas HAp foam remained its structure without being replaced by bone. It is concluded that CO₃Ap foam prepared by the present study could be ideal bone substitute due to its good mechanical strength and replacement to bone.