Fabrication of interconnected porous carbonate apatite bone replacement by compositional transformation based on dissolution-precipitation reaction using calcite granules

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（炭酸カルシウム顆粒を前駆体とした溶解析出型組成変換による炭酸アパタイト連通多孔体の創製）

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論 文 内 容 の 要 旨

Carbonate apatite (CO_3Ap) has attracted much attention as an artificial bone substitute since it shows not only osteoconductivity but will be replaced to bone. Introduction of interconnected porous structure to the CO_3Ap is thought to accelerate the bone replacement because cells and tissues can penetrate into the pores. In this study, interconnected porous CO_3Ap was fabricated and its effectiveness was evaluated using experimental animals. First, interconnected porous calcite was made by bridging the calcium carbonate granules with dicalcium phosphate dihydrate (DCPD) crystals that could be precipitated by exposing the calcite granules to acidic calcium phosphate solution under loading condition. Then, the interconnected porous calcite was immersed into a solution containing carbonate and phosphate ions for compositional transformation to CO_3Ap maintaining interconnected porous structure. XRD analysis indicated that the calcite granules bridged by DCPD crystals was transformed into CO_3Ap. Porosity and mechanical strength of the obtained interconnected porous CO_3Ap were 55 ± 3.9 % and 1.7 ± 0.4 MPa, respectively. The interconnected porous CO_3Ap and the dense CO_3Ap were implanted in rabbit tibia for 1,3 and 6 months. The specimen with surrounding tissue was stained with Villanueva Goldner method. Both interconnected porous and dense CO_3Ap showed excellent tissue response and good osteoconductivity. Although no bone penetration was observed interior to the dense CO_3Ap, new bone was penetrated interior to the interconnected porous CO_3Ap one-month post implantation. Six-month post implantation, most of the porous CO_3Ap at cortical bone area was replaced to a new bone. In conclusion, the interconnected porous CO_3Ap fabricated in this study have a good potential value to be used in clinics as a bone replacement.