

A-1. Bone Regenerative Effects of Platelet Derived Growth Factor-BB Loaded Chitosan/Calcium Metaphosphate

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Chitosan is a biodegradable natural polymer that have been demonstrated its ability to improve wound healing, and calcium metaphosphate(CMP) is a unique class of phosphate minerals having a polymeric structure. In this study, chitosan/CMP and platelet derived growth factor(PDGF-BB) loaded chitosan/CMP sponges were developed, and the effect of the sponges on the bone regeneration and their possibility as scaffolds for bone formation by three-dimensional osteoblast culture were examined.

PDGF-BB loaded chitosan/CMP sponges were prepared by freeze-drying of a mixture of chitosan solution and CMP powder, and soaking in a PDGF-BB solution. Fabricated sponge retained its 3-dimensional porous structure with 100-200 μ m pores. The release kinetics PDGF-BB loaded onto the sponge were measured in vitro with ¹²⁵I-labeled PDGF-BB. In order to examine their possibility as scaffolds for bone formation, fetal rat calvarial osteoblastic cells were isolated, cultured, and seeded into the sponges. The cell-sponge constructs were cultured for 28 days. Cell proliferation, alkaline phosphatase(ALPase) activity were measured at 1, 7, 14, and 28 days, and histologic examination was performed. In order to examine the effect on the healing of bone defect, the sponges were implanted into rat calvarial defects. Rats were sacrificed 2 and 4 weeks after implantation and histologic and histomorphometrical examination were performed.

An effective therapeutic concentration of PDGF-BB following a high initial burst release was maintained throughout the examination period. PDGF-BB loaded chitosan/CMP sponges supported the proliferation of seeded osteoblastic cells as well as their differentiation as indicated by high alkaline phosphatase activities. Histologic findings indicated that seeded osteoblastic cells were well attached to sponge matrices and proliferated in a multi-layer fashion. In the experiments of implantation in rat calvarial defects, histologic and histomorphometric examination revealed that chitosan/CMP sponge promoted osseous healing as compared to controls. PDGF-BB loaded chitosan/CMP sponges further enhanced bone regeneration.

These results suggested that PDGF-BB loaded chitosan/CMP sponge was a feasible scaffolding material to grow osteoblast in a three-dimensional structure for transplantation into a site for bone regeneration.