Novel polymer/nano-bioceramic composite scaffold for bone tissue engineering

Sang-Soo Kim, Min Sun Park[1], Cha Yong Choi, Byung-Soo Kim[2]
Interdisciplinary Program for Biochemical Engineering and Biotechnology, Seoul National University, [1]Department of Chemical Engineering, Hanyang University, [2]Department of Bioengineering, Hanyang University.
TEL: +82-2-2297-0838, FAX: +82-2-2291-0838

Biodegradable polymer/bioceramic composite scaffolds for bone tissue engineering can overcome the limitations of conventional ceramic bone substitutes. However, conventional methods (e.g., solvent casting and particulate leaching (SC/PL)) to fabricate polymer/bioceramic composite scaffold use organic solvents, which might be harmful to cells or tissues and hinder the exposure of the ceramics to the scaffold surface. In this study, a novel polymer/nano-bioceramic composite scaffold with highly exposed bioceramics to the scaffold surface was developed for efficient bone tissue engineering. Poly(lactic-co-glycolic acid)/nano-hydroxyapatite (PLGA/HA) composite scaffolds were fabricated by gas foaming and particulate leaching (GF/PL) method without the use of organic solvent.[1)] Both scaffolds were seeded with rat calvarial osteoblasts and cultured in vitro or subcutaneously implanted into athymic mice for 8 weeks. The GF/PL method exposed HA nanoparticles to scaffold surface at significantly higher extent than conventional SC/PL method. The GF/PL scaffolds showed interconnected porous structures without skin layer, and exhibited enhanced mechanical properties in comparison with SC/PL scaffolds. The GF/PL scaffolds exhibited significantly higher cell growth, alkaline phosphatase activity, and mineralization compared to the SC/PL scaffolds in vitro. Histological analyses and calcium content quantification of the retrieved tissues showed more extensive bone formation on the GF/PL scaffolds than SC/PL scaffolds. Compared to the SC/PL scaffolds, the enhanced bone formation on the GF/PL scaffolds may result from the higher exposure of HA nanoparticles to the scaffold surface, which allows for direct contact with transplanted

cells and would stimulate the cell proliferation and osteogenic differentiation. The polymer/bioceramic composite scaffolds fabricated with the novel GF/PL method could enhance bone regeneration compared with conventional SC/PL scaffold.

References

1. Kim SS, Park MS, Jeon O, Choi CY, Kim BS. Poly(lactide-co-glycolide)/hydroxy apatite composite scaffolds for bone tissue engineering (2005), Biomaterials, (Epub ahead of print).