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Research paper

Incorporation of PLGA nanoparticles into porous chitosan–gelatin scaffolds: Influence on the physical properties and cell behavior

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ABSTRACT

Bone regeneration can be accelerated by localized delivery of appropriate growth factors/biomolecules. Localized delivery can be achieved by a 2-level system: (i) incorporation of biomolecules within biodegradable particulate carriers (nanoparticles), and (ii) inclusion of such particulate carriers (nanoparticles) into suitable porous scaffolds. In this study, freeze-dried porous chitosan–gelatin scaffolds (CH–G: 1:2 ratio by weight) were embedded with various amounts of poly(lactide-co-glycolide) (PLGA) nanoparticles, precisely 16.6%, 33.3% and 66.6% (respect to CH–G weight). Scaffolds loaded with PLGA nanoparticles were subjected to physico-mechanical and biological characterizations including morphological analysis, swelling and dissolution tests, mechanical compression tests and cell viability tests. Results showed that incorporation of PLGA nanoparticles into porous crosslinked CH–G scaffolds: (i) changed the micro-architecture of the scaffolds in terms of mean pore diameter and pore size distribution, (ii) reduced the dissolution degree of the scaffolds, and (iii) increased the compressive modulus. On the other hand, the water uptake behavior of CH–G scaffolds containing PLGA nanoparticles significantly decreased. The incorporation of PLGA nanoparticles did not affect the biocompatibility of CH–G scaffolds.

1. Introduction

Bone regeneration is a complex cascade of biological events controlled by numerous bioactive molecules that provide signals at local injury sites allowing progenitors and inflammatory cells to migrate and trigger healing processes. Conventional tissue engineering strategies utilize combination of cells, biodegradable scaffolds and systemic administration of bioactive molecules to promote natural processes of tissue regeneration and development (Borenstein et al., 2007). However, systemic administration of biomolecules such as growth factors often produces poor results, probably due

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