HYDROXYAPATITE-REINFORCED COLLAGEN TISSUE ENGINEERING SCAFFOLDS

Abstract

by

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Scaffolds have been fabricated from a wide variety of materials and most have showed some success, either as bone graft substitutes or as tissue engineering scaffolds. However, all current scaffold compositions and architectures suffer from one or more flaws including poor mechanical properties, lack of biological response, non-degradability, or a scaffold architecture not conducive to osteointegration. Biomimetic approaches to scaffold design using the two main components of bone tissue, collagen and hydroxyapatite, resulted in scaffolds with superior biological properties but relatively poor mechanical properties and scaffold architecture. It was hypothesized that by optimizing scaffold composition and architecture, HA-collagen bone tissue engineering scaffolds could provide both an excellent biological response along with improved structural properties.

The mechanical properties of freeze-dried HA-collagen scaffolds, the most common type of porous HA-collagen material, were first shown to be increased by the addition of HA reinforcements, but scaffold stiffness still fell far short of the desired

range. Based on limitations inherent in the freeze-dried process, a new type of leached-porogen scaffold fabrication process was developed. Proof-of-concept scaffolds demonstrated the feasibility of producing leached-porogen HA-collagen materials, and the scaffold architecture was optimized though careful selection of porogen particle size and shape along with an improved crosslinking technique. The final scaffolds exhibited substantially increased compressive modulus compared to previous types HA-collagen scaffolds, while the porosity, pore size, and scaffold permeability were tailored to be suitable for bone tissue ingrowth. An *in vitro* study demonstrated the capacity of the leached-porogen scaffolds to serve as a substrate for the differentiation of osteoblasts and subsequent production of new bone tissue. The new leached-porogen scaffold HA-collagen scaffolds were shown to have potential as a highly tailorable bone tissue engineering scaffold with a unique combination of biological, mechanical, and structural properties.