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RESEARCH ARTICLE

Collagen scaffolds with *in situ*-grown calcium phosphate for osteogenic differentiation of Wharton's jelly and menstrual blood stem cells

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Abstract

The aim of this research was to investigate the osteogenic differentiation potential of non-invasively obtained human stem cells on collagen nanocomposite scaffolds with *in situ*-grown calcium phosphate crystals. The foams had 70% porosity and pore sizes varying in the range 50–200 μm. The elastic modulus and compressive strength of the calcium phosphate containing collagen scaffolds were determined to be 234.5 kPa and 127.1 kPa, respectively, prior to *in vitro* studies. Mesenchymal stem cells (MSCs) obtained from Wharton's jelly and menstrual blood were seeded on the collagen scaffolds and proliferation and osteogenic differentiation capacities of these cells from two different sources were compared. The cells on the composite scaffold showed the highest alkaline phosphatase activity compared to the controls, cells on tissue culture polystyrene and cells on collagen scaffolds without *in situ*-formed calcium phosphate. MSCs isolated from both Wharton's jelly and menstrual blood showed a significant level of osteogenic activity, but those from Wharton's jelly performed better. In this study it was shown that collagen nanocomposite scaffolds seeded with cells obtained non-invasively from human tissues could represent a potential construct to be used in bone tissue engineering. Copyright © 2012 John Wiley & Sons, Ltd.

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1. Introduction

The need for better techniques, materials and cell sources for the treatment of bone and joint diseases is increasing along with the increase in human population and the average life expectancy. For example, bone fractures due to osteoporosis are more frequently observed in people over 50 years old. The costs of bone and joint disease surgeries are high and the recuperation period is quite long, and gets longer as the patient becomes older. In recognition of the seriousness of the issue, the World Health Organization, the United Nations and 37 countries declared the period 2000–2010 as the Decade of Bone and Joints (Lidgren, 2003).

Bone formation and resorption is a continuous process in healthy bone tissue and during this some minor defects are repaired. However, accidents, surgical procedures (e.g. resection of tumours), fractures (due to osteoporosis) or bone tissue loss for other reasons may lead to non-union defects. Such defects with sizes that cannot be healed by the tissue during normal bone formation and resorption are called the 'critical-sized defects' (Cacchioli *et al*., 2006; Barrére *et al*., 2006; Wahl and Czernuszka, 2006). Today, in the treatment of most of the orthopaedic and craniofacial critical-sized defects, acellular grafts or implants are used. Tissue engineering appears to be a better alternative to

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