JOURNAL OF TISSUE ENGINEERING AND REGENERATIVE MEDICINE
J Tissue Eng Regen Med 2011;**5:** 569–577.
Published online 10 December 2010 in Wiley Online Library (wileyonlinelibrary.com) **DOI:** 10.1002/term.349

RESEARCH ARTICLE

Microfabrication of PDLLA scaffolds

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Abstract

This study aimed to comprehend the potentialities of the microfabrication to produce tissue-engineering scaffolds. Structures presenting homogeneously distributed pores of size 100 and 200 μm were fabricated through layer-by-layer deposition of filaments of poly(D,L-lactic acid) (PDLLA) prepared from dichloromethane/dimethylformamide solutions. Rheological tests on the solution and molecular weight distributions of PDLLA, solvent cast films and microfabricated scaffolds were performed to determine which material conditions are optimal for the microfabricated system and to identify any possible material modification induced by the process. *In vitro* qualitative preliminary cell culture studies were conducted using MG63 osteoblast cell lines after assuring the non-cytotoxicity of the scaffold material by the lactate dehydrogenase *in vitro* toxicology assay; biological evaluations were initially performed using scaffolds with the smaller (100 μm) pore size. Scanning electron microscopy imaging was used to determine cell morphology distribution. A second cell culture test was performed, using the scaffold with the higher (200 μm) porosity. Confocal laser microscopy (CLM) was utilized to examine cell morphology and growth behaviour. Cellular metabolic activity and viability were also examined using Alamar Blue assay and further verifications were performed using CLM. Cell culture studies indicated homogeneous distribution, high viability and metabolic activity. Pore dimension affects cell distribution: pores <100 μm acted as barrier structures for the MG63 osteoblast cell line; penetration inside the matrix was hindered and cells grew on the outer part. Increasing pore size resulted in a more homogeneous cell distribution and penetration of cells inside the structure was achieved. Copyright © 2010 John Wiley & Sons, Ltd.

Received 14 January 2010; Accepted 8 July 2010

Keywords microfabrication; scaffold; tissue engineering; PDLLA; pore size; biocompatibility

1. Introduction

In a typical tissue-engineering application, a scaffold is used to provide a three-dimensional (3D) support where cells can adhere, proliferate and produce extracellular matrix (ECM). The scaffold materials should be easily processable in the desired shapes and sizes, exhibit a degradation rate compatible with effective repair of the tissue and produce non-toxic degradation products (Langer and Vacanti, 1993; Salgado *et al*., 2004; Hutmacher, 2000; Chen *et al*., 2001; Mikos and Temenoff, 2000).

There are many synthetic and natural polymers that have been used as scaffold materials in different tissue-engineering applications. Among them, poly (α-hydroxyl) acids such as polyglycolic acid (PGA), polylactic acid (PLA) and their copolymers or blends are widely used

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