Physical Properties and Biocompatibility of 3D Hybrid PLGA Based Scaffolds

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Abstract

Biomaterial scaffolds play an important role in cartilage tissue engineering. They act as a temporary extracellular matrix substitute and template for cellular growth in vitro and support mechanical integrity in vivo. Several limitations have been reported when natural and synthetic biomaterials were used individually. They are unable to satisfactorily mimic the actual substrate for tissue regeneration both structurally and functionally. The formation of hybrid scaffolds consisting natural and synthetic biomaterials has been proposed to improve the outcomes. Therefore, this study aimed to form and evaluate threedimensional (3D) 65: 35 poly(lactic-co-glycolic acid) PLGA ("P") scaffold incorporated with and without atelocollagen ("A") and/or fibrin ("F"). The PLGA scaffold was formed using solvent casting and salt leaching method, freeze-dried, and crosslinked with the natural biomaterials. The hybrid scaffolds groups were "PAF", "PA" and "PF". The PLGA only scaffold was used as control. All scaffolds were evaluated using selected analytical techniques namely Attenuated Total Reflectance Fourier Transform Infrared (ATR-FTIR) spectroscopy analysis, scanning electron microscopy (SEM), porosity study, water uptake capacity, and cytocompatibility analysis in "chondrocyte-scaffold" constructs groups at week 1, 2 and 3 in vitro. The interaction of PLGA scaffold with fibrin and/or atelocollagen was evidenced based on the notable peaks of amide bonds. The microscopic pore structures appeared interconnected. Total porosity in all scaffolds were varied. All groups demonstrated porosity range from 56% to 61%. Proper swelling ratio of the scaffold is crucial to mimic the water uptake capacity in the living tissues. Despite its hydrophobicity, the PLGA only group demonstrated the highest swelling ratio when compared to other groups though, the difference is not significant. The cytocompatibility of all scaffolds except PA showed similar trends of cell proliferation. In this study, the incorporation of fibrin facilitates better microenvironment for cellular growth in terms of cell adherence to the scaffolds compared to the groups without fibrin. Based on the preliminary results, the 65: 35 PLGA based hybrid scaffolds may have the potential for cartilage tissue engineering application.

Keywords

Author Keywords: PLGA; fibrin; atelocollagen; chondrocytes
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