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Fabrication and characterization of three-dimensional poly(lactic acid- co -glycolic acid), atelocollagen, and fibrin bioscaffold composite for intervertebral disk tissue engineering application (Article)

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Abstract

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The use of synthetically derived poly(lactic-co-glycolic acid) scaffold and naturally derived materials in regeneration of intervertebral disks has been reported in many previous studies. However, the potential effect of poly(lactic-co-glycolic acid) in combination with atelocollagen or fibrin or both atelocollagen and fibrin bioscaffold composite have not been mentioned so far. This study aims to fabricate and characterize three-dimensional poly(lactic-co-glycolic acid) scaffold incorporated with (1) atelocollagen, (2) fibrin, and (3) both atelocollagen and fibrin combination for intervertebral disk tissue engineering application. The poly(lactic-co-glycolic acid) without any natural, bioscaffold composites was used as control. The chemical conformation, morphology, cell-scaffold attachment, porosity, water uptake capacity, thermal properties, mechanical strength, and pH level were evaluated on all scaffolds using attenuated total reflectance Fourier transform infrared, scanning electron microscope, gravimetric analysis, swelling test, differential scanning calorimetry, and Instron E3000, respectively. Biocompatibility test was conducted to assess the intervertebral disk, annulus fibrosus cells viability using 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide assay. The attenuated total reflectance Fourier transform infrared results demonstrated notable peaks of amide bond suggesting interaction of atelocollagen, fibrin, and both atelocollagen and fibrin combination into the poly(lactic-co-glycolic acid) scaffold. Based on the scanning electron microscope observation, the pore size of the poly(lactic-co-glycolic acid) structure significantly reduced when it was incorporated with atelocollagen and fibrin. The poly(lactic-co-glycolic acid)-atelocollagen scaffolds demonstrated higher significant swelling ratios, mechanical strength, and thermal stability than the poly(lactic-co-glycolic acid) scaffold alone. All the three bioscaffold composite groups exhibited the ability to reduce the acidic poly(lactic-co-glycolic acid) by-product. In this study, the biocompatibility assessment using the 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide cells proliferation assay demonstrated a significantly higher annulus fibrosus cells viability in poly(lactic-co-glycolic acid)-atelocollagen-fibrin compared to poly(lactic-co-glycolic acid) alone. The cellular attachment is comparable in poly(lactic-co-glycolic acid)-atelocollagen-fibrin and poly(lactic-co-glycolic acid)-fibrin scaffolds. Overall, these results may suggest potential use of poly(lactic-co-glycolic acid) combined with atelocollagen and fibrin bioscaffold composite for intervertebral disk regeneration. © SAGE Publications.

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View Compounds

Author keywords

annulus fibrosus | atelocollagen | fibrin | intervertebral disk | Poly(lactic-co-glycolic acid)

Indexed keywords

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