

Spatial control of drug delivery in multilayered poly(vinyl alcohol) scaffold for tissue regeneration

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Statement of Purpose:

Multilayered scaffolds exhibit optimal mechanical properties and functionality for complex tissue regeneration. One major challenge for the application of multilayered scaffolds is the spatial control of drug release. To address this challenge, a poly (vinyl alcohol) (PVA) scaffold consisting of three layers was fabricated, with two layers containing fluorescent salt (FITC) encapsulated alginate-graft-poly(ethylene glycol) (AA-g-PEG) microspheres. AA-g-PEG microspheres exhibit mechanical integrity, a neutral charge, and can be further chemically modified. In this preliminary study, we examine microsphere containment and FITC release within the PVA scaffold. Our long term goal is to develop the multilayered scaffold for tissue regeneration and wound healing.

Results:

The AA-g-PEG microspheres were successfully formed as verified by scanning electron microscopy (image not shown) with a nominal diameter of 1 μ m. AA-g-PEG microspheres were not only retained but spatially controlled within a multilayered PVA scaffold (**Figure 1**). A FITC gradient was achieved for the different layers of the scaffold. The top layer was the layer with less AA-g-PEG microspheres; the middle layer was the layer with more AA-g-PEG microspheres; the bottom layer was pure PVA scaffold layer. The high concentration of AA-g-PEG microspheres in the middle layer did not appear to migrate into the bottom layer.

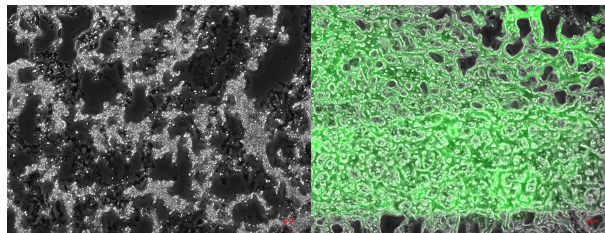


Figure 1. The bright-field micrograph (left image) for PVA scaffold top layer with AA-g-PEG microspheres; the bright white dots are FITC-encapsulated microspheres. Multilayered PVA scaffold (right image) showing spatial control of FITC-encapsulated microspheres of varying concentrations (top = low concentration, middle = high concentration, bottom = no microspheres).

Conclusions:

The study demonstrates the efficacy of using a multilayered PVA scaffold for the spatial control of drug delivery through the incorporation of drug-encapsulated microspheres. Future experiments will include encapsulating various growth factors in AA-g-PEG microspheres and measuring the spatial and temporal release in multilayered PVA scaffolds. Cytotoxicity experiments are currently underway using primary human Mesenchymal stem cells; differentiation experiments will be performed in the near future.