Fabrication and Characterization of Anisotropic Silk Fibroin/Gelatin Scaffolds Using Unidirectional Freezing

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Abstract— Cells have been shown to respond to the topography of their environment through contact guidance, which can direct their migration, morphology and even gene expression. This is a particularly important phenomenon in tissue engineering, wherein the importance of recreating the native environment of cells is paramount to achieve a functional tissue-engineered construct which can readily integrate to the local environment upon implantation. In light of this, scaffolds with a certain alignment or anisotropy are being fabricated in order to recapitulate the natural anisotropy in certain tissue such as muscles. However, most common fabrication methods are usually tedious and involve harsh conditions during processing. Unidirectional freezing is a simpler method which offers biocompatibility, versatility, tunability and scalability in

achieving anisotropic scaffolds. In this study, different silk fibroin/gelatin solutions were unidirectionally-frozen and subsequently lyophilized in order to create anisotropic scaffolds. Morphological, mechanical and cell proliferation properties were then investigated to fully characterize the scaffolds and the effect of the addition of gelatin. Alignment was attained in these scaffolds, as well as anisotropy in terms of their mechanical properties. Furthermore, mesenchymal stem cells cultured on these scaffolds were shown to align themselves according to the direction of the fibers. Together, the results show a possibility of utilizing these scaffolds in engineering anisotropic tissues.

Keywords— silk, fibroin, gelatin, scaffold, anisotropic.

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