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Enhancement of 3D electrospun polycaprolactone/collagen constructs to facilitate the integration of nanofiber/cell mats in skin graft

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Layer-by-layer electrospinning with the capability of producing fibers in the range of nanometers represents an optimistic method to produce versatile nanofibrous matrices to recapture the key characteristics of extracellular matrix of native tissues. In recognition of the limited cell infiltration into such electrospun nanofiber matrices, it becomes highly desirable to generate large interstitial space. In this regard, the aim of this study was to differentially modulate the spatial organization of nanofibers within the mats to achieve large inter fiber distances for their efficiency in forming the integrated 3D skin-like constructs. Polycaprolactone (PCL)/collagen nanofibers were collected onto various grounded conductive surfaces to obtain the nanofiber mats composed of random, aligned and meshed fibers. The fiber diameter, morphology, and pore size were characterized by Micromaster™ inverted digital microscopes and scanning electron microscopy (SEM). Rat fibroblasts or keratinocytes were seeded onto various electrospun fiber mats. Totally, 15 layers of cell-seeded nanofiber mats were assembled either with only fibroblasts or with mixture of both cells. Various tests performed including tensile test, histological analysis, methylene blue and immunofluorescence staining. Nanofiber mats with the spinning time range of 10 to 40 seconds were used. Result for spinning within the range of 20 and 25 seconds showed more reasonable mechanical strength. Due to the presence of large pore size, cell infiltration through the nanofiber mats was significantly improved and led to a better integration between layers. The meshed nanofiber mats show their advantages in promoting cell infiltration for better formation of 3D tissues.

Biography

Seyed Babak Mahjour has completed his MD (Doctor of Medicine) from Shiraz University of Medical Sciences, Iran and received his ME (Master of Engineering) from Stevens Institute of Technology in 2012. He is PhD Candidate in Biomedical Engineering department at Stevens Institute of Technology. His work has been published in 4 peer-reviewed journal articles, a book chapter, patent and numerous conference paper and posters.

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