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Electrospun silk fibroin nanofibers in different diameters support neurite outgrowth and promote astrocyte migration

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Abstract

Nerve tissue engineering has been one of the promising strategies for regenerative treatment in patients suffering from neural tissue loss, but considerable challenges remain before it is able to progress toward clinical application. It has been demonstrated that transplantation of cells in combination with physically or chemically modified biomaterials provides better environments for neurite outgrowth and further promotes axonal regeneration in animal models of spinal cord injury. In this study, neurons and astrocytes were incorporated into 400-nm, 800-nm, and 1200-nm electrospun *Bombyx mori* silk fibroin (SF) materials to investigate the effects of scaffold-diameter in regulating and directing cell behaviors. β-III-tubulin immunofluorescence analyses reveal that SF nanofibers with smaller diameters are more favorable to the development and maturation of subventricular zone derived neurons than 1200-nm SF scaffolds. In addition, astrocytes exhibited well-arranged glial fibrillary acidic protein (GFAP) expression on SF scaffolds, and a significant increase in cell-spreading area was observed on 400-nm but not 1200-nm SF scaffolds. Moreover, a significantly enhanced migration efficiency of astrocytes grown on SF scaffolds was verified, which highlights the guiding roles of SF nanofibers to the migratory cells. Overall, our results may provide valuable information to develop effective tissue remodeling substrates and to optimize existing biomaterials for neural tissue engineering applications.

Biography

Huanxiang Zhang has completed his Ph.D at the age of 28 years from Beijing Normal University, China and postdoctoral studies from Geneva University School of Medicine, Switzerland. He is now working in the Department of Cell Biology, Medical College of Soochow University, China. His research focuses on the control of the directed migration and differentiation of stem cells, including neural stem cells, mesenchymal stem cells and embryonic stem cells, and tissue engineering, especially the interaction between stem cells and the silk fibroin scaffolds with a variety of physical and chemical properties. He has published more than 50 papers in reputed journals. Recently, his group demonstrated the close relationship between the chemoattractant-stimulated chemotaxis of stem cells and their differentiation states.