Development of Polymeric Nerve Guidance Conduits That Contain Anisotropic Cues Including Aligned Microfibers and Gradients of Adsorbed Laminin-1

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Structures that direct neurite extension are important for regeneration following spinal cord injury and peripheral nerve injury. Within the spinal cord, neurons encounter a glial scar environment that impedes regeneration. In the peripheral nervous system, endogenous regeneration cannot occur across nerve gaps greater than 2 mm. Current repair strategies use guidance conduits to channel axonal growth towards distal targets. While showing promise, conduit walls do not provide a suitable environment for neuronal attachment or extension, and axonal growth within conduits remains tortuous. Hence, there is a need for development of three-dimensional (3D) structures that use contact guidance—rather than confinement—as a means of guided regeneration. Our laboratory has developed aligned, electrospun fiber matrices that have been shown to direct neurite extension *in vitro*. In addition, a gradient of the glycoprotein laminin-1 has been adsorbed onto aligned microfiber matrices to stimulate directional growth. These matrices were then manipulated into 3D conduit structures. Novel polymeric conduits that utilize contact guidance and contain gradients of molecules that stimulate directional growth have the potential to foster fast, directed regeneration into and through conduit structures.