Collagen Microfiber Scaffolding for Nerve Repair Applications

Shah, Rishi

Current tissue engineering scaffolds for repair of damaged or diseased neural tissue has yet to allow for precise, guided re-innervation while incorporating functional extracellular matrix components to promote regeneration potential. This study proposes the use of an optimized scaffold for nerve regeneration and guidance, a nerve growth factor (NGF)-tethered collagen microfiber conduit. The purpose of this study was to solve the limitations involved with the development of this optimized scaffold: (1) optimize culturing media of dorsal root ganglion (PNS) and retinal ganglion (CNS) neurons, (2) discern between the bioactivities of NGF precursor protein and the β-NGF subunit when tethered, and (3) asses CNS growth on collagen microfiber conduits. Cells were isolated from stage E7 Gallus gallus, and axonal growth was quantified using the NeuronJ software. Results showed the β-NGF subunit retained almost two times the bioactivity of the NGF precursor protein after covalent tethering ($p < 0.05$), definitively showing the efficacy of tethered NGF as a guidance mechanism. Additionally, CNS neurons exhibited more than twice the growth on microfibers compared to two dimensional culture ($p < 0.01$), opening a wide array of previously discounted applications in the CNS. For example, growth factor tethered conduits would complete a possible treatment for blindness caused by optic nerve atrophy via guidance of CNS nerve regeneration post-neurotmesis. In addition, the conduits would allow for enhanced regeneration of PNS neurons post-open wound, specifically in the long term rehabilitation of wounded soldiers, and the incorporation of sensory signaling into prosthetics.