Characterization of Electroactive Nanofibers for Nerve Regeneration

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Opportunity and Significance

In the event of peripheral nerve injury, loss of function may occur as the result of a severed nerve. Hollow nerve gap conduits are used to provide a protected environment for nerves to reconnect and regain function, although therapies for nerve gaps larger than 3 cm lack a stable environment for nerves to reconnect. Development of a nerve guide conduit filler has been proposed to mimic the cell’s microenvironment. This would lead to increased functional regeneration.

Technical Objectives

We are aiming to create a biomaterial to act as a filler for the hollow nerve gap conduits to promote functional regeneration of the severed nerves. We have hypothesized that cell behavior can be altered by providing electrical stimulation through electroactive nanofibers. Objectives include:

- Optimization of material recovery and testing
- Comprehensive material characterization
- Cell viability tests

Related Work and State of Practice

A wide range of biomaterials are used in tissue engineering. Environmental cues have been shown to alter cell behavior. This research provides topographical, mechanical, and electrical cues through hyaluronic acid (HA) and HA nanofibers containing multiwalled carbon nanotube (MWCNTs) further referred to as HA-CNT. Similar research techniques used in our lab provide chemical cues. HA and HA-CNT fibers are fabricated through a process called electrospinning and allows for biomaterial deposition on a surface.

Volume mV Duration min HA % Relative Neurite Outgrowth HA-CNT % Relative Neurite Outgrowth

Objective 1: Optimization

Optimization of electrospinning procedure allowed for increases in both fiber deposition and scaffold recovery. Improvements include:

- Humidity controlled chamber
- Improvement of scaffold adhesive system

Objective 2: Viability Tests

Custom electrical stimulation chambers were built to conduct viability test in a protected, stable, and reproducible environment. Improvements include:

- 14.3% greater functional recovery than comparable systems
- Near elimination of sample contamination and leaks

References