Role of Fibronectin in mediating topographical guidance of peripheral nerve cells on electrospun fibers

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Introduction

The clinical “gold standard” for bridging peripheral nerve gaps is autografts. However, their usefulness is limited by several issues including the requirement for multiple nerve segments, mismatch between injured nerve and nerve grafts, and the loss at the donor site [1]. Empty hollow conduits created from natural and synthetic materials have been used to bridge nerve gaps. These scaffolds have shown promising outcomes in small gaps but fail when the nerve gap is longer than 10 mm in rats or more than 30 mm in humans. Tissue engineering strategies that involve the use of luminal fillers have been used to augment the rate as well as efficacy of nerve regeneration across long gaps. But the mechanisms by which they affect nerve regeneration are not completely understood.

In this study, we design an oriented fiber based scaffolds to understand how protein adsorption as well as cell behaviour are altered based on the underlying topography.

Materials and Methods

Ten micron thick oriented nanofiber films were fabricated by electrospinning poly(acrylonitrile-co-methylacrylate) (PAN-MA) on a high-speed rotating metal drum. Polymer film was casted by solvent evaporation. The morphology of these fibers and the film were evaluated using scanning electron microscope.

Dorsal Root ganglion (DRG) were incubated on these scaffolds and the extent of Schwann cell migration and neurite outgrowth were quantified. To further understand how the underlying topography affects protein adsorption, Fibronectin adsorption was quantified using a modified Elisa based assay. Extra cellular matrix organization (ECM) was also observed to determine how the underlying topography affects the formation of the ECM.

Results

Fig 1. Demonstrates that aligned electrospun fibers enhance both Schwann cell migration and Neurite Outgrowth from DRGs. We observe that fiber based topographies stimulate the absorption of FN from serum compared to smooth films of the same chemistry Fig 2. In figure 3 we show that the underlying topography influences the organization of FN laid down by Schwann cells.

Discussion and Conclusions

Several strategies to enhance peripheral nerve regeneration have been proposed. In order to develop scaffolds that augment PNS repair, it is vital to understand how they interplay with microenvironment at the injury site and alter the function of supporting cells.

References


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