



Electrospun Nanofibers as Neural Guidance Scaffolds

Motivation – Over 11,000 SCI/year with loss of function and life-long disability

- *M.E. Mullins, Department of Chemical Engineering*

Strategies for repair

Remove inhibitory scar tissue.

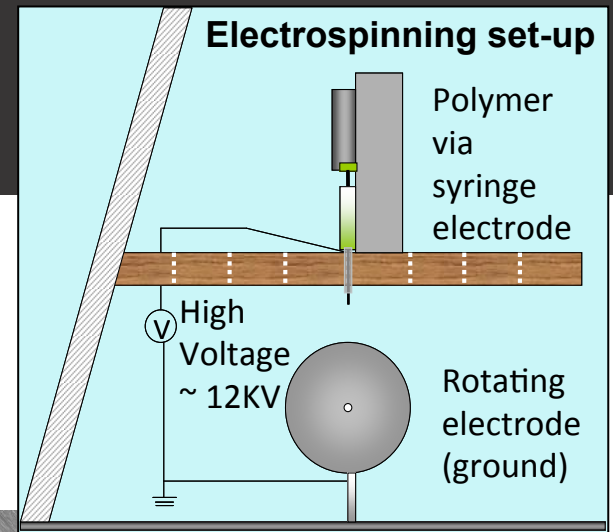
A growth permissive bridge (across scar)

Increase intrinsic growth capacity (stem cells)

Combined strategies may be necessary

Hypothesis - Aligned fiber scaffolds may guide neuronal outgrowth in a directed manner.

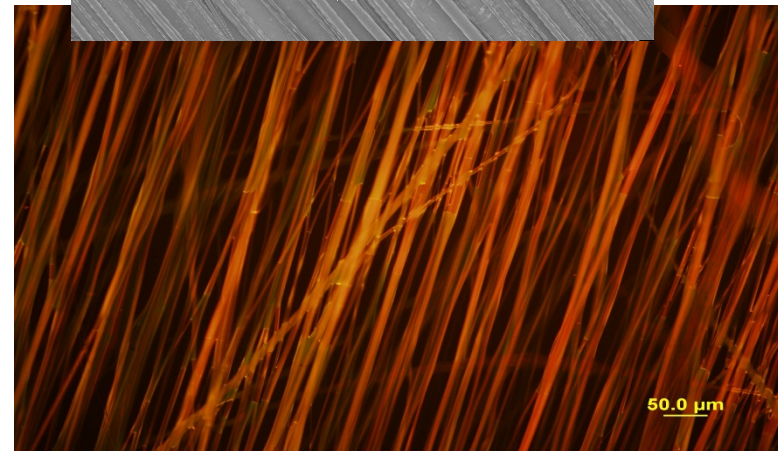
Approach – Electrospin PLLA fibers onto rotating collection stages for *in vitro* studies, then implantable conduits for *in vivo* studies.



SEM of aligned PLLA fibers

S4700 1.0kV 12.5mm x600 SE(U)

50.0um

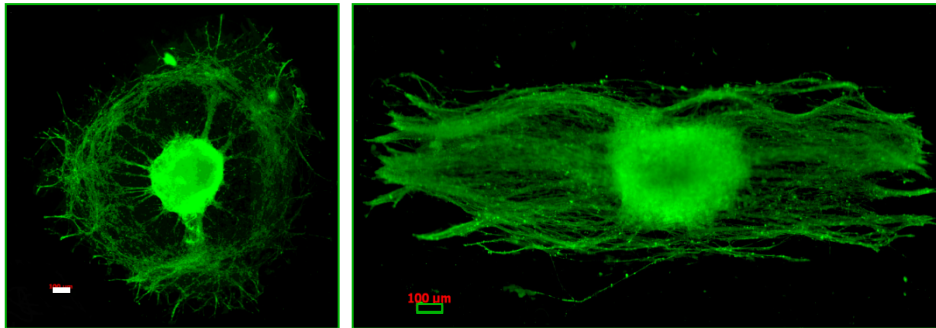




In vitro studies – Culture embryonic stage nine chick dorsal root ganglia directly on fibers.

Plain cover slip (no fibers)

Aligned PLLA fibers



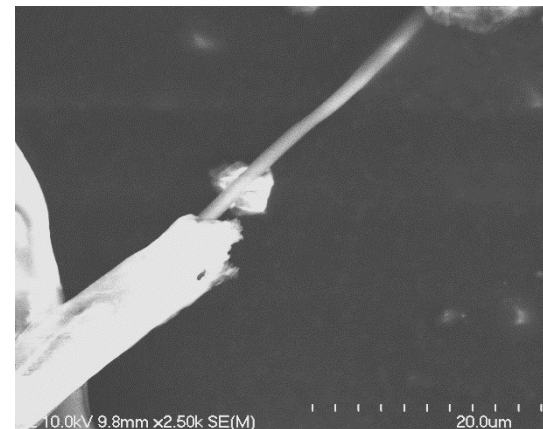
In vivo studies - Complete transection at the thoracic level, with implantation of cylindrical PLLA scaffolds containing highly aligned fibers. Fitted for length, luminal diameter and shapes and fiber orientation.



In vivo studies (~180 sample) done at Johns Hopkins Medical School

Results and path forward

- Significant regeneration of transected spinal cords (~90%), but disappointing Hind Limb Motor Function scores.
- Extend studies to provide chemical or electrical stimulus cues for growing axons.
- Design of new co-axial electrospinning technique for core-shell fiber structures.
- Artificial axons?



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“Artificial axon” with insulating PLLA sheath and conducting PEDOT core.