Biodegradable Neuro-Spinal Scaffold Preserves Spinal Cord Architecture Following Spinal Contusion Injury in Rats

Richard T. Layer, Alex A. Aimetti, Pamela Podell, Simon W. Moore, Thomas R. Ulich
InVivo Therapeutics, One Kendall Square, Building 1400 East, 4th Floor, Cambridge, MA, USA 02139

BACKGROUND

Severe spinal cord injury (SCI) is accompanied by disruption of spinal cord architecture, including cystic cavitation and tissue loss. We hypothesized that implantation of a biodegradable, biomaterial scaffold (Figure 1) into the injured spinal cord could serve as a physical substrate for appositional healing and tissue remodeling that would preserve spinal cord architecture (Figure 2). We evaluated the effect of implantation of Neuro-Spinal Scaffolds composed of a block copolymer of poly(lactic-co-glycolic acid) and poly(L-lysine) (PLGA-PLL) on preservation of spinal architecture in a rat contusion model of severe SCI.

![Figure 1. Porous structure of the Neuro-Spinal Scaffold](image)

- PLGA is the inert biodegradable skeleton along which cells grow
- Poly-L-Lysine promotes cellular adhesion
- Neuro-Spinal Scaffold promotes 3D appositional healing, similar to a suture or butterfly bandage
- 2D Wound Healing
- Internal 3D Wound Healing

![Figure 2. Neuro-Spinal Scaffold implant promotes appositional healing](image)

HYPOTHESIS

Implantation of a biodegradable, biomaterial scaffold into the injured spinal cord can serve as a physical substrate for appositional healing and tissue remodeling that preserves spinal cord architecture.

MATERIALS AND METHODS

**Fabrication of Scaffolds.** Cylindrical Neuro-Spinal Scaffold implants (1.0 mm diameter, 2.0 mm length) were manufactured similar to previously published methods. Glucose pores of approximately 180 to 430 μm particle size were used, resulting in the formation of a highly interconnected porous structure of sufficient size to permit in-growth of endogenous cells and to facilitate nutrient and waste transport.

![Figure 3. Progression of Spinal Contusion Injury](image)

RESULTS

Most experts agree that the contusion injury model is the most clinically relevant model of human SCI. Spinal contusion injury results in tissue loss and spinal architecture disruption from the initial mechanical trauma as well as a second phase of tissue loss that persists for weeks to months. Damaged and necrotic tissue in the lesion site is cleared over the course of several weeks through the action of resident microglia and circulating leukocytes, leaving a fluid-filled cystic cavity surrounded by a rim of surviving tissue (Figure 3).

![Figure 4. Neuro-Spinal Scaffold implantation does not alter (A) functional recovery, (B) Von Frey withdrawal threshold, or (C) body weight gain (values are means ± standard deviation)](image)

CONCLUSIONS

- These results demonstrate that implantation of a Neuro-Spinal Scaffold in the acutely injured spinal cord can reduce cavitation, promote tissue sparing and remodeling, and act as a locus for appositional healing.
- Implantation of a Neuro-Spinal Scaffold preserves spinal cord architecture and may play an important role as a treatment for acute spinal cord injury.
- The Neuro-Spinal Scaffold is currently the subject of an ongoing human clinical trial.

REFERENCES