

# Using polycaprolactone scaffolds to treat spinal cord injuries

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## Introduction

In 2010, there were 1785 cases of spinal cord injuries (SCI) in Canada, and about 85 556 people currently live with SCI (Noonan, *et al.*, 2012). There are few modern therapies available to SCI patients, and current therapies do not focus on healing the damaged neurons.

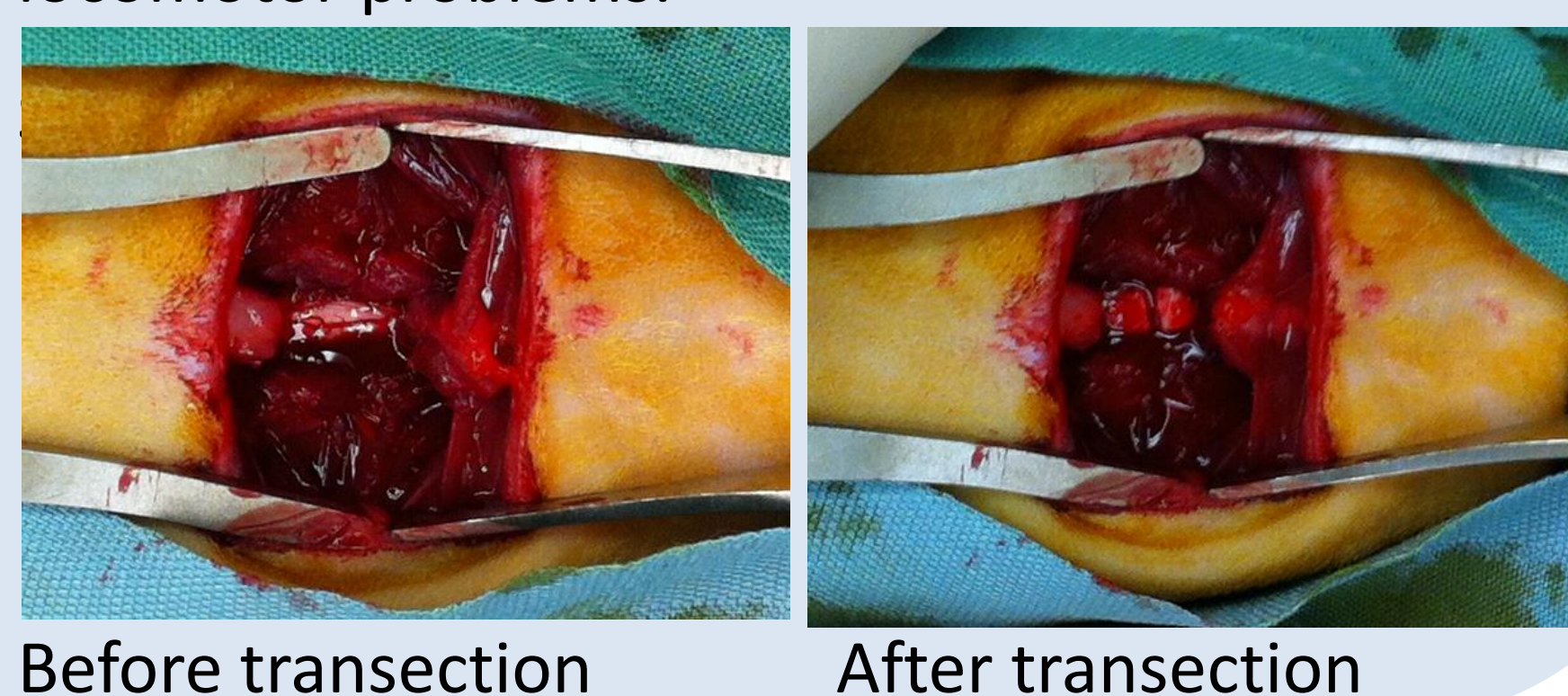
However, a biodegradable polycaprolactone (PCL) scaffold containing growth factors and neurotrophic factors can be surgically implanted at the injury site (Woodruff, Hutchmacher, 2010). As the PCL degrades, these growth factors and neurotrophic factors would be released, promoting neurogenesis and axonal regeneration (McLenachan, S., *et al.*, 2009).

Neurogenesis begins with neural progenitor cells (cells that can differentiate into neurons) and glial cells. Recent *in vitro* studies conducted in the Tsai lab have shown that PCL does not significantly affect neural progenitor cell proliferation and differentiation. Extrapolating from *in vitro* results, it follows that the use of PCL biomaterials to treat spinal cord injuries should not be detrimental to the cord itself.

## Methods

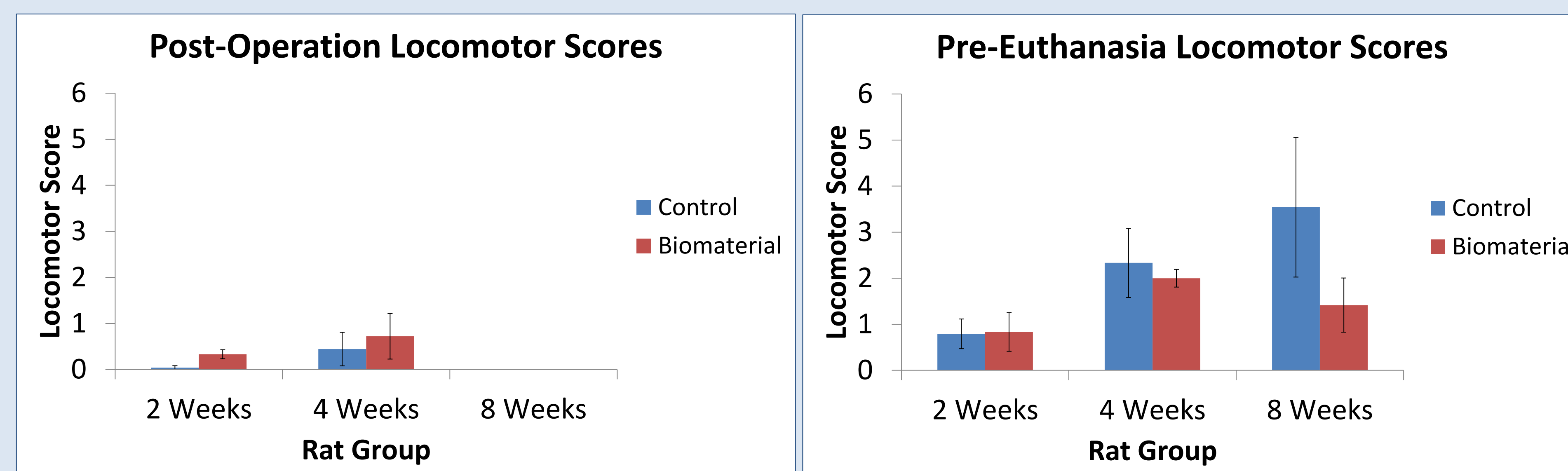
Experimental (PCL Biomaterial)	Control
10 rats successfully undergo spinal cord transection	11 rats successfully undergo spinal cord transection
Implantation of PCL biomaterial to transection site	No implantation of PCL biomaterial to transection site
Evaluate hind limb movement using Basso, Beattie and Bresnahan Locomotor Rating Scale	Evaluate hind limb movement using Basso, Beattie and Bresnahan Locomotor Rating Scale
3 rats euthanized after 2 weeks, 3 after 4 weeks, and 4 after 8 weeks.	4 rats euthanized after 2 weeks, 3 after 4 weeks, and 4 after 8 weeks.
Sectioned spinal cord transection sites	Sectioned spinal cord transection sites
Stained sections with Hoechst LFB, H&E, and ED1	Stained sections with Hoechst LFB, H&E, and ED1

The Basso, Beattie, Bresnahan (BBB) Locomotor Rating Scale is a reliable method of evaluating recovery after spinal cord injury (Basso, D.M., *et al.*, 1995). Before surgery, rats were evaluated using this method to ensure that they had no prior locomotor problems.



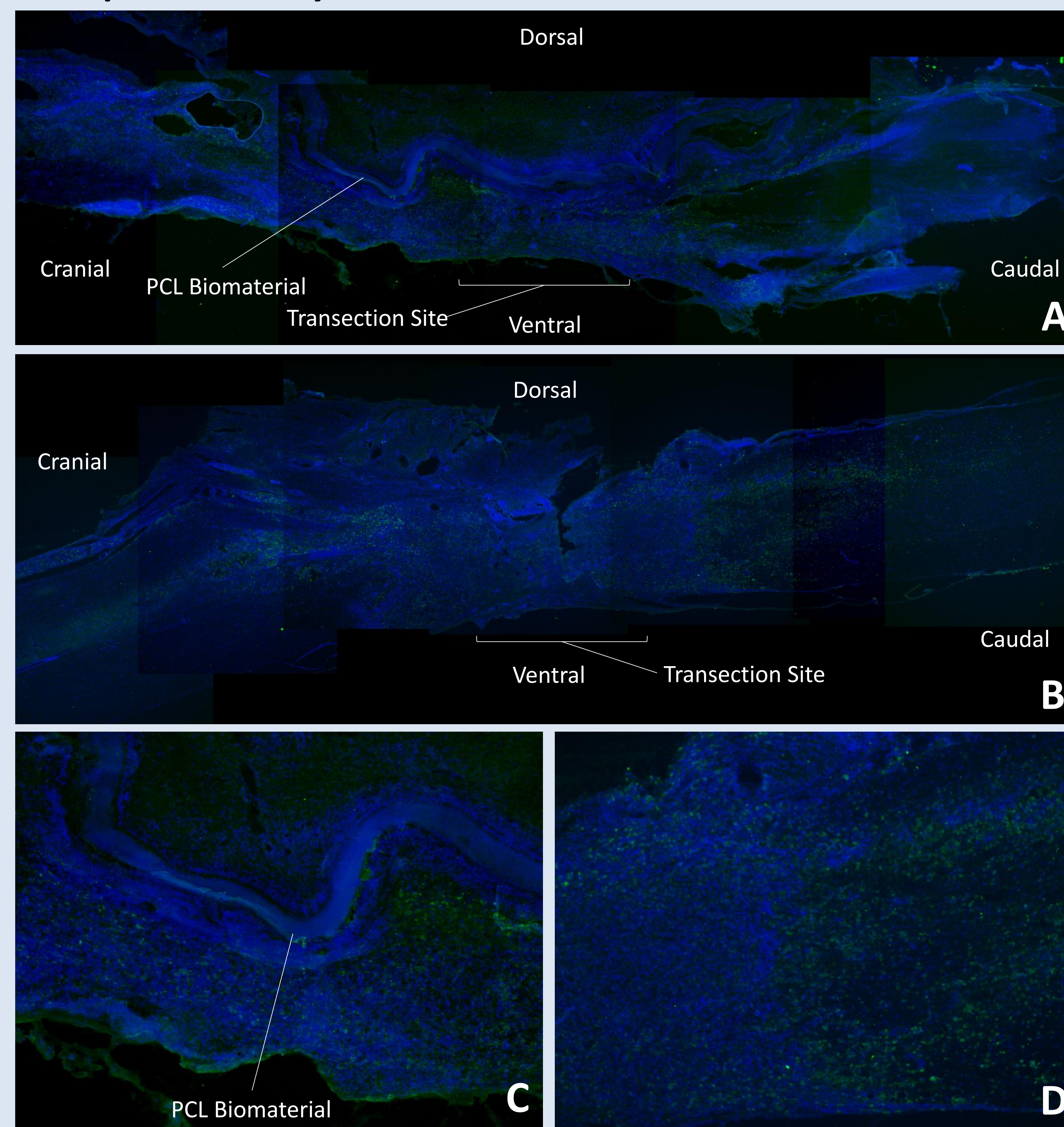
## Results

Figure 1. Locomotor scores after surgery, and before euthanasia.



Rat group represents the group of rats designated to live for 2 weeks, 4 weeks or 8 weeks. Data shown is locomotor score  $\pm$  standard error (n=3-4). Before surgery, every rat had a locomotor score of 21. The locomotor scores for rats treated with PCL biomaterial were compared with the control group through Tukey's pairwise comparisons. The test concluded that locomotor scores of the two groups were not significantly different.

Figure 2. Spinal cord cryosections stained with Hoechst and ED1



Spinal cords were from rats euthanized 2 weeks after surgery. Blue areas are cell nuclei stained with Hoechst and green areas are activated macrophages stained by ED1. Images A and B are composite images created from several images taken at 4x under UV light. (A) Spinal cord of a rat treated with PCL biomaterial. (B) Spinal cord of control rat. (C) Enlarged view of image A, showing the area cranially adjacent to the transection site. Image taken at 4x magnification. (D) Enlarged view of image B, showing the area caudally adjacent to the transection site. Image taken at 4x magnification. Transection sites shown in (A) and (B) shows extensive infiltration by unidentified cells.

## Conclusion

- BBB locomotor scores show that PCL biomaterial does not significantly affect normal recovery from spinal cord injuries
- Preliminary observations of the stained spinal cord sections show that there may be an elevated immune response and increased tissue scarring in the presence of PCL biomaterial

## Future Directions

- The error for the locomotor scores was high, and the sample size was low. To improve precision, future studies can be done with increased sample sizes
- Further staining and analysis of the spinal cords of the other rats must be done to confirm that PCL biomaterial causes increased tissue scarring and an elevated immune response.

## References

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## Acknowledgements

Special thanks to the Undergraduate Research Opportunity Program, and all members of the Tsai Lab. Special acknowledgement goes to Krystal Walker and Paulo Leme Jr., who performed all the surgeries.

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