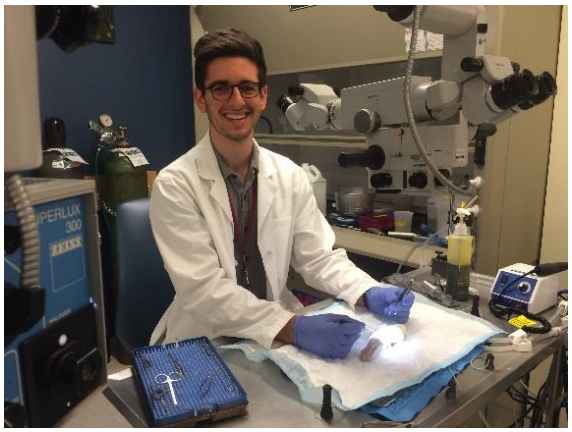

Modality-Specific Motor and Sensor Axon Regeneration Using Tissue Engineered Nerve Grafts

Joseph Maggiore (EAS 2019)
Advisor: Kacy Cullen

Over this summer, I worked in the Kacy Cullen Laboratory for Neuroregeneration. Whether through trauma or through surgical complications, nerve injuries are surprisingly common. Due to this common injury, one of the main goals of the Cullen Laboratory is to create solutions for this issue. This lab has already demonstrated through multiple experiments the advent of a novel tissue engineered nerve graft (TENG) that can guide, help, and stimulate regeneration in damaged nerves. Along with many other challenges with nerve regeneration, one main hurdle comes with the characterization of the degenerated nerve. Nerves can be characterized as sensory, motor, or a combination of both. With this characterization also comes the necessity to create a TENG that is compatible with the damaged nerve so that regeneration can be maximally facilitated. Therefore, my project was focused on creating a methodology for measuring motor versus sensory nerve regeneration in the rat sciatic nerve.

There are two regions of the spinal cord that can be used to characterize motor and sensory nerve regeneration – the dorsal and ventral roots. The dorsal root ganglia (DRG) that enervates the spinal cord contains the cell bodies of any sensory axons while the ventral rootlet contains any motor nuclei. Therefore, by applying a type of retrograde dye to an injury site or repair zone, the dye will travel all the way up the nerve to the spinal cord and the sensory and motor designated regions. Upon sacrificing the animal and harvesting the spinal cord, the DRG and ventral rootlet can be visualized and the fluorescently stained nuclei in each region can be quantified using a confocal microscope.

This project proved especially challenging for me because it required me to learn a ton of new skills – some of which I've never even heard of before. In order for me to be largely independent, I needed to learn all the necessary microsurgical procedures such as repairing a sciatic nerve, sacrificing and perfusing the animal, and isolating the spinal cord with DRGs intact. Additionally, I needed to learn multiple variations of immunohistochemistry procedures that could be then implemented on the sectioned spinal cord slides. Lastly, by using all these skills together, I needed to be able to have the necessary literature background information in order to collect data and create my own conclusions about what I saw under the microscope.

After learning all these necessary skills to conduct this project, I was ultimately successful in developing a method to quantify motor versus sensory regeneration. By looking at micrometer thin sections of the spinal cord, complete with DRG and ventral rootlet, I was able to obtain some useful results. Although I was unable to obtain clear images of the ventral rootlet fluorescence, I was successful in visualizing clear fluorescence in the DRG. In conclusion, over this past summer, I was able to develop a procedure that could help quantify motor versus sensory regeneration in peripheral nerves. I look forward to continuing this work in the Cullen lab over the coming years!