UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

Senior Design Project Description

Company Name	Mechanical Engineering	**Date Submitted**	*07/31/2020*
Project Title	Hypoxia nerve injury in the microfluidic platform **(BIO_NERVE)**	**Planned Starting Semester**	Fall 2020

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

Discipline	Number	Discipline	Number
Mechanical	2	Electrical	1
Computer	1	Systems	
Other (Biomed Eng, Biology , Chemistry)	1		

Project Overview and Requirements:

Develop a compartmentalized culture system for inducing axonal hypoxia

Rationales: There are currently limited treatments available for Peripheral Neuropathy as a result of lack of basic understanding of the disease. New experimental models are needed to identify novel therapeutic targets. Emerging evidence points at a role of nerve ischemia and distal nerve hypoxia in axonal neuropathy. The induced vascular damage is usually not as sever at the neuronal somata due to their central location within a body. As a result they are not exposed to hypoxia. **Hypothesis:** Peripheral vascular dysfunction inflicted in nerve damage and neuropathies results in differential oxygen levels at the distal axons and cell bodies. The *in vitro* model to study the mechanisms of these diseases that replicates oxygen differences in subcellular microenvironments will allow identification of the evoked signaling pathways. **Approach:** Primary sensory neurons will be plated in a somatic chamber connected to an axonal chamber with parallel microchannels. The cell bodies are too bulky to pass through; therefore, the axonal chamber will exclusively contain distal axons. The culture device consists of a thin layer polidymethysiloxane (PDMS) with microchannels sandwiched between a glass substrate and 3D-printed base. Neurons will be grown in regular media and only after axons extensively elongate in the axonal chamber, they will be exposed to hypoxia. This will be achieved by snapping on a 3D-printed lid that remains open at the somatic, but seals the axonal chamber, and enables a hypoxic media flow. The schematic of the experimental procedure is shown in Fig.1.

Innovation: To our best knowledge this will be the first *in vitro* model of axonal hypoxia. As such, it can be used to study the mechanisms of multiple other diseases that are linked to distal

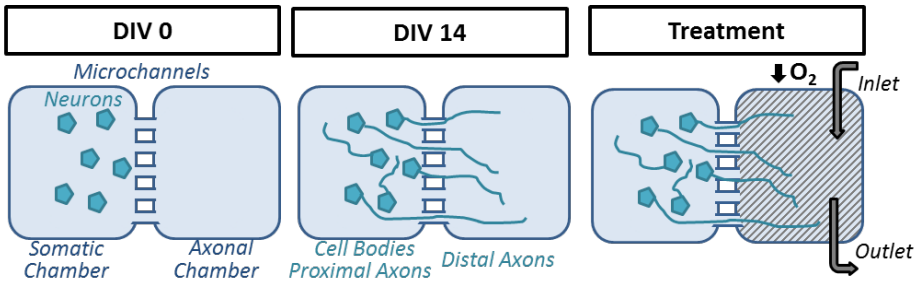

Figure SEQ Figure * ARABIC 1. Schematic of the experimental procedure for exposing spatially constrained hypoxia to distal axons.

dysfunctions of endoneurial vascular system, e.g., peripheral nerve injury. Furthermore, this model offers multiple advantageous for integration with other cell types, and e.g., studying axon/glia interactions under hypoxia with and without hyperglycemia

Expected Deliverables/Results:

Deliverables include:

- Axonal Hypoxia model in the microfluidic chamber
- Simulation of Axonal Hypoxia.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- 3D Printing, Microfluidics, Neuroscience, Cell culture, optical sensing, microfluidic simulation.