Hypothesis or Research Question(s): The objective of this research is to compare the different techniques used to elicit pudendal nerve somatosensory evoked potentials (SEPs) in people with spinal cord injury and able-bodied controls. We hypothesize that the different techniques currently being used in the literature to elicit pudendal SEPs will alter the results of these recordings.

PROJECT BACKGROUND & SUMMARY

The pudendal nerve is located in the pelvis and carries important sensory information about the urogenital and bowel systems to the sensory centers in the brain. A healthy pudendal nerve is crucial for proper urogenital and bowel function (e.g. urination, defecation, sexual arousal), and any impairments to this nerve can result in symptoms such as urinary/bowel incontinence, pelvic pain, or sexual dysfunctions. One way to assess the integrity of the signal between the pudendal nerve and the brain is by conducting a pudendal nerve somatosensory evoked potential (SEP) assessment. In this test, a non-painful electrical current is applied on the skin over top of the pudendal nerve, and recordings are taken from the brain using electroencephalography (EEG). Information extracted from the EEG signals can inform clinicians and researchers if there is an impairment in the signals transmitted to the brain from the pudendal nerve.

Pudendal nerve SEP assessments are of considerable clinical importance for many individuals with nervous system injuries or symptoms of urogenital or bowel dysfunction. However, there is a lack of consensus in the clinical and scientific community regarding how best to perform this assessment. Our laboratories have recently conducted a systematic review on the methodologies used to elicit and record pudendal SEPs, and have identified a number of different electrodes that may be used to stimulate the pudendal nerve in various configurations on both male and female anatomy. The purpose of this project is to compare different methodologies (electrode type and location) used to elicit pudendal SEPs in individuals with known neurological impairments and able-bodied controls. Working with members of our laboratories, the students will be responsible for collecting and analyzing pudendal SEP recordings from a number of individuals with known neurological impairment (spinal cord injury) and able-bodied controls. Using data collected from our previous systematic review, the students will employ different protocols, such as altering electrode type or electrode configuration, to determine if these variations in protocol provide significantly different results.

The questions addressed in this study are at the cross-roads of neurophysiological and clinical research. Our laboratories have a long-standing collaborative relationship and, together, bring the necessary equipment, techniques, and expertise required to execute this project.

BENEFIT TO THE STUDENTS

We are requesting support for two students who will be involved in all aspects of the research process. Prior to these students joining our laboratory, we will have completed UBC Clinical Research Ethics Board application and Vancouver Coastal Health Research Institute Operational Approval requirements so that the students can begin work on the project immediately. Senior laboratory members will train the students on how to conduct the SEP assessments using techniques and protocols that have already been established in our laboratories. Students may also learn how to conduct SEP recordings from other nerves (e.g. tibial nerve) that share the same spinal segmental innervations. The students will have
**2023 Multidisciplinary Research Program in Medicine Project:** Exploring techniques used to elicit and record pudendal nerve somatosensory evoked potentials in people with spinal cord injury and able-bodied controls

ample time to practice these skills, including the use of an electrical stimulator (DS7 Stimulator, Digitimer Ltd, UK) and 32-channel electroencephalography (EEG) system (BrainVision, USA), prior to data collection on study participants. One student will be responsible for collecting data from able-bodied individuals, while the second student will be responsible for collecting data from individuals with spinal cord injury. Both students will have support from the lab coordinators to recruit participants from pre-existing participant databases, and will have the opportunity to recruit more widely as well. Students will also be taught how to analyze these data to extract outcomes of interest (e.g. time from stimulation to response in brain; size of brain signals) using custom software (MATLAB, MathWorks, USA) and conduct basic statistical analyses. Finally, students will be expected to prepare scientific posters describing their project and results using a graphic design program (Adobe Illustrator, Adobe, USA).

Through their involvement in all aspects of this research study, from data collection and analysis, to statistical analysis and results preparation, the students will gain insight into the execution of high quality research programs. The students will be supervised day-to-day by the Post Graduate Student Advisor and be trained on certain tasks by other senior laboratory members including laboratory managers, coordinators, doctoral students, and technicians. They will also have regular, weekly contact with both the faculty of medicine supervisor and non-faculty of medicine co-supervisor in the form of laboratory meetings.

This project will provide students with a unique opportunity to engage with equipment and protocols that may otherwise only be accessible in specialized neurophysiological or clinical settings. The students will be interacting directly with research participants and will have the opportunity to develop skills around communication and knowledge translation. Students will also be exposed to basic data analysis and computer programming techniques to conduct these analyses, which may translate to other practical future applications. While the students will always have the support of our laboratory personnel, we also expect the students will be able to independently conduct aspects of this research after enough practice, giving them professional development opportunities around leadership, critical thinking, and decision making.

The institution that houses our laboratories provides excellent professional development opportunities for students including monthly lectures from other students across a diverse range of faculties, regular 'lunch-and-learn' seminars, and frequent social events. The students involved in this project will not only be exposed to the research being conducted in our laboratories, but across many different departments at the university. We expect they will be able to interact and network with a variety of individuals including clinicians, primary investigators, research staff, and fellow students.

We expect that the results from these two projects will produce at least one peer-reviewed publication, and multiple conference abstracts. There will be opportunities for the students to become co-authors on these publications/abstracts, as well as present their findings at local academic conferences.