UNIVERSITY of WASHINGTON

Undergraduate Research Symposium May 19, 2017 Mary Gates Hall

Online Proceedings

Poster Session 1

MGH 241, Easel 160

11:00 AM to 1:00 PM

An Evaluation of Existing Self-Report Outcome Measures for People with Amputations Who Have Limited Community Ambulation

Kavya Magham, Senior, Psychology
CoMotion Mary Gates Innovation Scholar, Mary Gates Scholar
Mentor: Murray Maitland, Rehabilitation Medicine
Mentor: Katheryn Allyn, Bioengineering
Mentor: Donald Fogelberg, Rehabilitation Medicine

Lower extremity amputations (LEA) affect more than 1 million people in the US. A large proportion of these individuals, about 300,000, have poor levels of community ambulation, meaning they have limited mobility. They can usually walk less than 300 ft before stopping for rest. Despite this, current patient-centered outcome measures were largely developed and tested with people who exhibit unrestricted community ambulation, and not people who have significant mobility challenges. The purpose of the current study is to evaluate if current, standardized questionnaires for people with LEA are relevant and comprehensive for people with lower levels of mobility. I conducted a literature review and a consultation with experts which resulted in items from twenty questionnaires. Items were compiled from the four most appropriate questionnaires into themes including: transfers, ambulation, static postures and activities of daily life. To assess comprehensiveness, my team and I compared the number of items in each general category across the questionnaires and found that ”mobility on uneven ground” is needed for this population. Additionally, I designed an interview strategy so that people with LEA and lower levels of mobility could expand on their opinions of the questionnaires. The combination of the feedback on survey items and interview questions led me to the create the final questionnaire with a Likert scale so that subjects could respond with the relevance of each question. Results from my research will ultimately be used to improve measurement tools that are responsive to meaningful differences in quality of life and functional mobility for this population.

Session 1S

New Diagnostic Tools for Seeing and Sensing Disease

Session Moderator: Benjamin Freedman, Medicine/Nephrology

JHN 175

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Investigating the Effect of Physiological Strain Cues on the Differentiation and Maturation Capacity of Muman Skeletal Muscle Myoblasts *in Vitro*

Rahil Hudda, Senior, Biology (Physiology)
Mentor: David Mack, Rehabilitation Medicine & Bioengineering, Institute for Stem Cell and Regenerative Medicine

The pharmaceutical industry’s “one-size-fits-all” approach to drug discovery, coupled with the use of animal models that do not maximize resources or accurately represent human disease, is a significant obstacle to the development of more effective treatments with the capacity to significantly improve patient wellbeing. The concept of personalized medication needs to be prioritized within the drug development process to advance the identification of drug candidates with the greatest potential to ameliorate patient-specific symptomatic progression. This is especially true in neuromuscular diseases like Duchenne Muscular Dystrophy and X-Linked Myotubular Myopathy, which show wide variability in severity and age of onset. Myogenesis is the formation of muscular tissue, specifically during embryonic development. The involvement of chemical cues to promote the fusion of myoblasts into multinucleated structures called myotubes is fairly well understood. However, the specific mechanical forces associated are yet to be characterized due to the complex cellular machinery at play. Recent evidence suggests that exposing muscle cells in culture to rehabilitation techniques, such as mechanical and electrical stimulation that mimic resistance exercise, has profound functional consequences. Therefore, I hypothesize that subjecting human skeletal muscle myoblasts (HSMM) to mechanical stretch will improve maturation in vitro and manifest a phenotype that mimics muscle tissue. To test this hypothesis, experiments are currently underway using the STREX Cell Stretching System to examine the var-

ious parameters that invoke differentiation of these HSMM cells. Varying cyclical strain frequencies and ratios along with durations of stretch and rest that mimic static/dynamic stretch cues from rehabilitation therapy are being used to determine the ideal stretch criteria for muscle cell growth and differentiation. This stretch protocol will eventually provide guidance toward the production of skeletal tissue engineered products *in vitro* to be used for drug development to promote the recovery of muscle function after injury and possibly forestall disease progression.

POSTER SESSION 3

MGH 241, Easel 137

2:30 PM to 4:00 PM

Optimization of Optogenetic Stimulation Methods for Spinal Cord Injury Rehabilitation

Benjamin Pedigo, Senior, Bioengineering
Mary Gates Scholar
Mentor: Chet Moritz, Physiology & Biophysics
Mentor: Sarah Mondello, Rehabilitation Medicine

Recent studies have shown that electrical stimulation of the spinal cord can manipulate spinal cord plasticity and may be effective in recovering motor function after spinal cord injury. The emerging field of optogenetics allows researchers to change a cell's membrane potential using light. Cells are made to express light-dependent ion channels (channelrhodopsins) which cause a cell to depolarize or hyperpolarize after being triggered by specific light wavelengths. Our lab has shown that optogenetics can be used to elicit forelimb movements in rats by stimulating the cervical spinal cord. Long-term methods for providing light stimulation *in vivo* are needed to explore the treatment potential of optogenetics. Initial experiments by our group using a LED implant stimulator demonstrated that long-term optogenetic stimulation of the spinal cord results in increased GAP-43 staining. GAP-43 staining highlights areas of new neuronal growth, suggesting an increase in neuronal plasticity in optogenetically stimulated rats. Animals in this study, however, also exhibited unusual tissue morphology around the site of implant. Current research is working to understand the possible sources of this tissue disruption, including heat production from the LED and inflammation induced by LED stimulator implantation near a spinal cord injury. To investigate the possibility of heat production, I developed a new implant prototype that incorporates a thermistor to monitor temperature changes during long-term light stimulation. I tested this implant design in anesthetized and freely-moving rats to investigate how different light stimulation parameters affected implant temperature. I then performed histological tissue analysis at the site of the implants to assess the effects these temperature changes had on tissue condition. The results from this work will inform the next generation of light stimulation implants, and help to improve function following spinal cord injury via optogenetic activation of neural tissue.

POSTER SESSION 3

MGH 241, Easel 136

2:30 PM to 4:00 PM

Epidural Stimulation for Rehabilitation

Josephine Cordelia (Josephine) D'angelo, Senior, Neurobiology
Mary Gates Scholar
Mentor: Chet Moritz, Physiology & Biophysics
Mentor: Sarah Mondello, Rehabilitation Medicine

Spinal cord injury (SCI) disrupts the communication between the body and the brain. As a result, people with SCI typically have significant sensorimotor deficits leading to a lower quality of life. Electrical epidural stimulation (EES)—that is, the stimulation of the spinal cord from the surface of the cord—has shown promise for enhancing recovery of the hindlimbs when applied to the thoracic spinal cord. The goal of this study is to determine whether this same therapy applied to the cervical spinal cord in rats with cervical injuries can improve forelimb function. Prior to injury, the rats perform multiple tasks: Irvine, Beatties and Bresnahan (IBB) task, Limb-use Asymmetry Test (LUAT), Automatic-pellet-reaching task, and a Lever task. Next, rats will receive a unilateral C4 hemicontusion and below the injury the rats will receive an epidural implant for stimulating the spinal cord. All of the rats will perform the former tasks—IBB and LUAT—once a week to track their recovery. Half of the rats will be stimulated via the epidural implant while performing the automatic-pellet-reaching task and Lever task in the hopes of inducing Hebbian plasticity to enhance functional recovery. We are currently testing different epidural implants to identify a method that provides robust, long-term EES. Post-injury performance will be compared to the rat's pre-injury performance. Subsequently, the rats are perfused for tissue analysis. We are optimizing the tissue analysis protocols for identifying GAP-43 immunoreactivity to determine if there was an increase in plasticity and axonal growth. Cresyl violet and myelin staining will also be used to measure the magnitude of the injury by staining the spared neurons and myelin.