Ohio Advisory Board Awards - 2023 Third Frontier SCI Program

Megan Reissman, of University of Dayton, for *Assessing Clinical Translation of VR Based Upper Extremity Rehabilitation after SCI*

Funded by Ohio Third Frontier, the research team has investigated the use of Virtual Reality (VR) hardware and commercial VR software (Beat Saber, Beat Games) as a means for addressing gaps in post SCI rehabilitation. Our current work addresses the need for a low cost method for quantifying movement data, using VR tracking hardware, that can be implemented in clinical environments. In the lab, we have validated the simultaneous collection of VR (low cost) and infrared motion capture (gold standard). We created and tested custom movement levels (rehab-games) and data extraction packages to validate that they provide consistent, repeatable, and engaging movement tasks for persons with SCI. The next critical gap is the translation of this approach to impact a greater number of individuals in Ohio with SCI. To achieve this, we will focus on VR based tracking approaches with testing occuring at clinical collaborator sites or under at-home conditions. We propose to leverage existing structures in the VR gaming community to share our rehab-game level designs, to record performance data directly from at-home or clinical users, and to host a SCI specific league that will connect individuals across Ohio and beyond. This allows us to impact a greater number of Ohioans with SCI by reaching them in the clinic or in their homes. Beyond this, it is critical that new rehab-game levels directly advance SCI specific therapeutic goals, and that the SCI community (persons with SCI, advocates, clinicians) be directly involved throughout the design process (Participatory Design).

Anne Bryden, PhD, OTR/L, of Case Western Reserve University, MetroHealth, for *Implementing Upper Extremity Lower Motor Neuron Assessment in Cervical SCI*

Early assessment of lower motor neuron (LMN) integrity in the upper extremities of individuals with cervical spinal cord injury (SCI) is critical, as certain interventions may restore function before permanent paralysis occurs. Importantly, knowledge of LMN status informs surgical and rehabilitative strategies to increase function after SCI. Without this testing, individuals with tetraplegia are missing critical opportunities to maximize their functional abilities. The assessment involves applying surface electrical stimulation to the nerves of weak and paralyzed muscles, and performing a manual muscle test to score muscle contraction responses. Muscles with LMN pathology will not respond to stimulation. Assessment of LMN integrity is not conducted in clinical practice even though it provides important information about intervention options for arm and hand function. We propose an implementation study that will develop strategies to promote LMN assessment, including stakeholder-informed development of a handheld stimulator unit to streamline test procedures.

Yu-Shang Lee, PhD, and Ching-Yi Lin, PhD, of Cleveland Clinic Lerner College of Medicine of CWRU, for *Advancing a Novel Scar-Degradation Peptide to Repair Chronic SCI*

The ultimate goal of this project is to advance toward translation of a promising CSPG reduction peptide (CRP) which targeting inhibitory scars to repair CHRONIC spinal cord injury (SCI). We will further investigate (1) how the reduction of inhibitory CSPGs by CRP to enhance synaptic plasticity leading to functional recovery and (2) if the combination of CRP with activity-dependent rehabilitation can maximize the recovery and neuroplasticity following CHRONIC SCI using a preclinical rodent model. (3) We will perform a comprehensive study to determine the CRP stability (both thermal and plasma) to guide future IND-enabled studies.

Ceren Yarar-Fisher, PhD, of Ohio State University, for *The Role of Microbiome on Bowel Health after SCI*

Improving bowel function is one of the most important goals for individuals with spinal cord injury (SCI). In addition to bowel accidents, constipation is a common complication that significantly decreases quality of life. Constipation affects most individuals with chronic and complete SCI, especially those with tetraplegia. Unfortunately, current management for bowel problems for the SCI population, such as addressing diet and bowel habits, are not typically effective, and some can be invasive. This is why researchers, clinicians, and patients must seek other ways to improve bowel function.Discovering best practices for improving bowel function would benefit individuals with SCI and improve their quality of life. Eventually, our studies are expected to lead to the development of supplements, pharmacological agents, and fecal transplants for individuals with SCI and those with similar disabling conditions. These developments are expected to bring national and global recognition while opening new funding streams for the technologies, products, start-ups, and industries at the OSU College of Medicine and across the entire university and the State.

Megan Moynahan, MS, of Case Western Reserve University, for *KeyGrip: Handgrasp Made Simple*

KeyGrip is envisioned to be a simple implanted system to restore hand grasp to people with cervical spinal cord injury. It has been designed for commercialization based on over four dozen interviews with engineers, surgeons, therapists, people living with spinal cord injury, business experts, regulatory and reimbursement specialists, entrepreneurs, and members of industry. Its design features specific tradeoffs to assure it will not only provide reliable grasp but will also confer a positive value proposition to hospitals and payers once commercialized. Using seed funding in 2023, we determined that a commercial product could be used nearly as-is for the KeyGrip application, and separate funding will be used to obtain FDA regulatory approval to begin a first-in-human study of KeyGrip in 2024. While that system can be used in select individuals, the final KeyGrip product will require modified electrode designs to assure the reliability and expected performance for hand grasp. For the proposed project, the specific aims include developing a novel electrode for KeyGrip;

completing bench tests of the electrode and introducing it into an on-:going investigational device exemption (IDE); and restoring lateral grasp to 12 people with cervical spinal cord injury, through their enrollment in the KeyGrip clinical trial. This project will continue to strengthen Ohio as the recognized leader for innovations in neuroprosthetic systems, with an anticipated Ohio-based spin-out company.

Timothy Lucas, MD, PhD, MHCI, of Ohio State University, Wexler Medical Center with Battelle Memorial Institute and Spark Biomedical, for *Improved Hand Function Following SCI with a Non-Invasive Neuromodulation Therapy*

The objective of this proposal is to integrate and critically evaluate our sensorimotor system in affected individuals. In 3 aims conducted over a 2-year period, we test our central hypotheses that (1) the combination of real-time sensory feedback with EMG-triggered FES will improve ADL performance, and (2) the addition of non-invasive, activitydependent neuromodulation will improve rehab outcomes.

Eric Schearer, PhD, of Cleveland State University, for *Bringing Robot Assistants into the Homes of People with Cervical SCI*

The objective of this project is to define and deliver the basic functionality that allows early adopters with cervical SCI to control,hands-free, a fully portable robot to reliably complete meaningful feeding tasks in their homes. The core project team includes experts in robot control, experimental phenomenology, and occupational therapy, and a spinal cord injury consumer advocate.