DIRECTORY OF GRANT AWARDS
2026 GRANT CYCLE

2026 GRANT CYCLE

DIRECTORY OF GRANT AWARDS FOR SPINAL CORD INJURY AND DISEASE RESEARCH

DECEMBER 2025

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

This data was compiled in compliance with the New Jersey Commission on Spinal Cord Research's statutory mandate, N.J.S.A. 52:9E-1, "…to compile a directory of spinal cord research being conducted in the State."

The information contained within this directory is not all-inclusive. The research projects and researchers listed in this directory are all based in the State of New Jersey and have applied to and received funding during the fiscal year 2026 grant cycle. The research projects are not categorized or listed in any order.

This directory is not a complete listing of all scientific research being performed within the State of New Jersey due to the proprietary nature of the research being conducted at various institutions throughout the State. In addition, institutions are not obligated to share their research information with the New Jersey Commission on Spinal Cord Research.

Please feel free to contact the New Jersey Commission on Spinal Cord Research at P.O. Box 360, 25 S. Stockton Street, Trenton, New Jersey, 08625. The Commission's office can be reached by telephone at 609-913-5005, or by e-mail at NJCSCR@doh.nj.gov.

For information on the New Jersey Commission on Spinal Cord Research's grant award process, grant applications and deadlines, please see: www.state.nj.us/health/spinalcord.

2024 MEMBERSHIP INFORMATION

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NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

EXPLORATORY RESEARCH GRANT RECIPIENT:

Jaclyn Eisdorfer, Ph.D.
Rutgers, The State University of New Jersey
CSCR26ERG007
$204,927

Project Title:
Striatal dopamine as a behavioral gatekeeper for motor recovery after injury

Using circuit mapping, fiber photometry, and behavioral analysis, this project examines how dopamine in the dorsolateral striatum is involved in motor recovery after spinal cord injury.

Spinal cord injury (SCI) can lead to lasting movement problems, making it difficult for individuals to perform basic motor tasks. While rehabilitation programs that rely on repeated practice of specified movements can help, not all patients recover equally, and it remains unclear why some movements are relearned successfully while others are not. This project explores an overlooked part of the brain called the dorsolateral striatum (DLS), which is known to help form habits and stabilize motor actions in healthy conditions. Surprisingly, despite its importance in movement learning, the DLS has never been studied in the context of SCI. We believe that after injury, the DLS may play a key role in determining which movements are kept and which are discarded during recovery.

More specifically, we propose that dopamine (DA), a brain chemical released in the DLS, acts as a kind of "gatekeeper" that helps reinforce useful motor patterns and suppress those that are less effective. In other words, DA might help the brain decide which compensatory strategies are worth keeping and which should be replaced, which may be a key component of successful recovery. To test this, we will use cutting-edge technologies to track DA release in the DLS of mice with SCI. Using fiber photometry (a way to measure brain chemicals in real time) and optogenetics (which uses light to control the activity of specific neuronal circuits), we will determine how DA signaling changes after injury and how it relates to the rewiring of brain connections in the DLS. We will also use a machine learning tool called Motion Sequencing (MoSeq) to monitor and categorize the animals' behavior in great detail (down to millisecond-level patterns of movement). This will allow us to see if change in motor actions across recovery align with changes in DA signaling.

Finally, we will test how structured rehabilitation (treadmill training) affects DA release and behavioral recovery, compared to animals that recover without formal training. Our goal is to uncover whether DA in the DLS actively helps guide recovery by reinforcing beneficial movement strategies. Rather than just asking "can a patient move?", our work aims to understand "which movements are being reinforced, and why?"

This project is led by Dr. Jac Eisdorfer, a Rutgers Presidential Postdoctoral Fellow who will transition to a faculty position in the Department of Neurosurgery. She is joined by Dr. Max

Tischfield, an expert in brain circuits involved in movement and habit formation. Together, they bring a multidisciplinary approach combining SCI research, behavioral neuroscience, and cutting-edge data analysis. The work will generate essential preliminary data for larger grants and could establish a foundation for a new class of brain-based therapies to enhance movement recovery after SCI.

Contact Information:

Jaclyn Eisdorfer, Ph.D.
Rutgers, The State University of New Jersey
604 Allison Rd
Piscataway, NJ 08854
jaclyn.eisdorfer@rutgers.edu
732-259-2023

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

EXPLORATORY RESEARCH GRANT RECIPIENT:

Carol Gibson-Gill, M.D.
Veterans Biomedical Research Institute, Inc.
CSCR26ERG010
$193,273

Project Title:
An Exploratory Study of the Patterns of Dental Disease and Chronic Health Conditions in Veterans living with Spinal Cord Injury or Disorder to Address a Neglected Secondary Medical Condition

Our exploratory research to address a gap in spinal cord injury and disorder (SCI/D) care by using information in a large SCI/D healthcare database to investigate dental disease in Veterans with SCI/D, its association with the increased risk of chronic system diseases (i.e. cardiovascular diseases, etc.) seen after SCI/D to lay the foundation for future work that would inform interventions to decrease morbidity and mortality related to these secondary health conditions.

Spinal cord injury or disorder (SCI/D) is a devastating condition that has a tremendous impact on people it affects. People living with spinal cord injury or disorders (SCI/D) face life-long challenges that impact nearly every aspect of their lives [1,2]. It often results in chronic paralysis and multiple secondary health conditions (conditions that are directly or indirectly a result of damage to the spinal cord).[3] Some of the secondary health conditions (SHCs) reported include pain, depression, bladder & bowel incontinence, urinary tract infections, pressure sores, however, people with SCI/D also have an increased risk for poor oral health causing dental disease and chronic systemic diseases (e.g. diabetes, heart disease)[4,7-11]. Some researchers include dental disease [15]. These conditions negatively impact the health of this population of patients decreasing their quality of life (QoL) [3-5,12]. The average quality of life in people living with a SCI is below that of the general population [19]. The presence of SHCs is associated with a lower life expectancy than the general population [18].

Limited research has been done in dental disease in the SCI/D population, even though it has been shown to directly affect overall health and quality of life [13]. Research shows that CSDs are closely linked to dental diseases (dental cavities, gingivitis and periodontal diseases [20]. Maintaining good oral health can be challenging in the SCI population especially those with severe motor impairments. They are at risk for dental diseases (e.g. dental caries, gingivitis, periodontal diseases) due to multiple challenges they face including functional limitation in their upper extremities, dry mouth caused by medications for other SHCs (i.e. neurogenic bladder, depression, etc.), use of a mouth stick for controlling devices and wheelchairs, decreased access to dental care (not being able to get in the dentists' offices or dental examination room), increased tobacco use [6,15,24,34]. Despite the increased risk for developing dental disease after SCI/D, there is no large-scale research published in the literature in this area of SCI/D care. This is a huge gap in care for this population of people. When one considers what the definition of SHCs in SCI/D is, it is difficult to not include dental diseases as one of the SHCs.

Our first step to address this gap is conducting this exploratory research in Veterans living with SCI/D who have been to the Veterans Health Administration (VHA). The VHA is a good place to start as it is the single largest SCI/D comprehensive healthcare provider in the US [35,36]. It has a connected electronic medical record (EMR) system across its facilities and a large data warehouse. We hypothesize that Veterans with SCI/D with dental disease will have an increased risk of CSDs compared to those without dental disease. To test the hypothesis and achieve the project aims, the VHA data will be used to identify the existing data of a sample of 18,616 SCI/D Veterans between 10/1/2018 and 9/30/2024. A random sample of the cases identified for New Jersey (NJ) SCI/D Veterans (N=401) will be selected for quality control checks of the automated data with an in-depth review of the EMR for 10% of this sample (N=40). Descriptive statistics, bivariate tests and multivariate logistic regression models will be used for analysis. At the conclusion of this project, we will have in-depth information on the scope of dental diseases affecting SCI/D Veterans who are included in the VHA database to inform future quantitative and qualitative studies in this area of SCI/D health that can lead to the development of evidence-based interventions to address this secondary health condition.

Contact Information:

Carol Gibson-Gill, Ph.D.
Veterans Bio-Medical Research Institute, Inc.
385 Tremont Avenue
East Orange, New Jersey 07018
carol.gibson-gill@va.gov
(973) 676-1000 ext. 1564

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

EXPLORATORY RESEARCH GRANT RECIPIENT:

Monica Driscoll, Ph.D.
Rutgers, The State University of New Jersey
CSCR26ERG012
$200,000

Project Title:
Clearing Cellular Debris for Enhanced Regeneration

Conducting in vivo experiments on individual axotomized neurons, we will determine whether large vesicle extrusion can remove cellular debris that limits regeneration.

Spinal cord injury is devastating to patients and their families. Although medical science is learning about how to promote repair and regeneration in the spinal cord consequent to damage, much remains to be understood about the molecular mechanisms that could permit functional regeneration. One problem that arises in early injury is that considerable cellular debris can impair neuronal function and restoration. We have identified a novel mechanism by which neurons can clear themselves of threatening molecular trash—the neurons produce very large vesicles that selectively remove protein aggregates and damaged organelles. This neuronal "clear out" can enhance functionality in neuronal compromise models. The uncharted area that our proposal addresses is the potential to harness this large vesicle extrusion biology to improve neuronal regeneration.

We work in a simple animal model called C. elegans. This transparent animal has 959 cells, 302 of which are neurons. All cells can be visualized using fluorescent reporters, such that we can target individual neurons in the living animal to sever their neurites with a laser. We can then characterize regeneration of those axotomized neurons, often by testing genes for capacity to promote or inhibit regeneration. In this way, the field has identified many molecules, conserved with humans, that modulate regeneration.

Our plan is to take advantage of experimental approaches uniquely applied in the C. elegans model to address whether large vesicle removal of cell debris can enhance regeneration of axotomized neurons. We have discovered that application of pressure at precise points on the neuron can induce formation of large extracellular vesicles. We will systematically determine optimal pressure for exopher formation and define fundamental properties of pressure impact on neuronal vesicle formation and survival for representative neurons. We will use this novel tool to then address how axotomy impacts large vesicle extrusion and how an extrusion event might enhance regeneration.

Addressing these simple questions in a readily manipulated system should definitively address one facet of complex injury biology at the same time it may highlight the potential to pursue mammalian large vesicle extrusion strategies toward a novel therapeutic end.

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

Contact Information:

Monica Driscoll, Ph.D.
Rutgers, The State University of New Jersey
604 Allison Road
Nelson Labs A232
Piscataway, NJ 08854
driscoll@dls.rutgers.edu
848-445-7182

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

EXPLORATORY RESEARCH GRANT RECIPIENT:

Soha Saleh, Ph.D.
Rutgers Biomedical and Health Sciences
CSCR26ERG018
$185,415

Project Title:
Brain-Activation and Cognitive-Motor Interaction During Targeted Walking Tasks in Persons with Incomplete Spinal Cord Injury

The proposed study investigates how individuals with incomplete spinal cord injury engage brain networks during goal-directed walking, using mobile EEG to understand the interplay between cognitive function and motor performance, with the goal of informing more effective, brain-based rehabilitation strategies.

People with incomplete spinal cord injury (iSCI) often make significant progress with physical rehabilitation and may regain some ability to walk. However, even after successful recovery of basic walking ability, many individuals continue to face major challenges when navigating complex environments or performing tasks that require both physical movement and mental effort. Everyday situations, like stepping over obstacles, walking while distracted, or adjusting direction in response to sudden changes, can be especially difficult. These challenges can prevent people from walking safely in the community, increase their dependence on assistive devices, and elevate their risk of falls and injuries.

These difficulties may be linked not only to physical impairments but also to changes in brain function. Research shows that people with SCI are more likely to experience problems with thinking skills such as memory, attention, and mental processing speed. In fact, cognitive impairments are up to 13 times more common in individuals with SCI than in the general population. These problems may stem from the injury itself, changes in brain structure or function, or from related issues like poor sleep or chronic pain. Importantly, complex walking tasks rely heavily on the brain's ability to integrate movement with planning, decision-making, and attention. If thinking abilities are affected, the person may struggle to walk safely and efficiently, especially when multitasking or reacting to unexpected changes.

Despite this knowledge, current rehabilitation programs for SCI rarely include cognitive challenges in walking training. Most programs focus on repetitive movement without considering how thinking and decision-making contribute to walking in the real world. This is a missed opportunity. The brain is capable of adapting and reorganizing after injury, a process called neuroplasticity. Training that involves both the body and mind may enhance this neuroplasticity and lead to better outcomes. To improve rehabilitation, we need a deeper understanding of how the brain works during complex walking and how cognitive deficits affect walking performance.

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

Recent advances in technology now allow us to study brain activity during real-time walking using mobile electroencephalography (EEG), a noninvasive method of recording brain waves. These brain waves occur in different patterns depending on what the person is doing or thinking. For example, certain wave patterns reflect attention, memory, and motor planning. Our study will use mobile EEG to record brain activity in individuals with and without SCI as they walk toward visual targets under two conditions: one where the target is chosen ahead of time (pre-planned step), and another where the target appears unexpectedly and must be responded to in real time (unplanned reactive step).

We aim to understand how the brain responds during goal-directed walking under different task conditions, and how these responses differ between individuals with iSCI and those without injury. We also aim to study how walking performance and brain activity are influenced by thinking skills such as attention and memory.

This project represents an important step toward improving rehabilitation for people with SCI. By identifying the brain mechanisms that support complex walking and understanding how cognitive decline may interfere with walking performance, we can design better therapies. These therapies could include cognitive training during walking or personalized programs based on a person's brain activity patterns. Ultimately, our goal is to help people with SCI walk more safely and independently in their everyday lives.

Contact Information:

Soha Saleh, Ph.D.
Rutgers, The State University of New Jersey
33 Knightsbridge Road
Piscataway, NJ 08854
soha.saleh@rutgers.edu
(201) 467-9455

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

EXPLORATORY RESEARCH GRANT RECIPIENT:

Jonathan M. Grasman, Ph.D.
New Jersey Institute of Technology
CSCR26ERG019
$200,000

Project Title:
Developing a PPARgamma-agonist eluting scaffold for spinal cord repair

Our goal is to develop a composite collagen sponge, with longitudinally aligned pores, and PLGA microparticles to deliver sustained release of PPARgamma agonists that will encourage axonal growth and promote functional recovery in a rat transection spinal cord injury model.

There are no cures or standard practices that will universally lead to complete functional recovery from spinal cord injury (SCI). Current treatment paradigms are focused around robust physical therapy or otherwise maximizing patient quality of life using motion assist devices, such as wheelchairs or powered exoskeletons. Therefore, there is a significant and established need to develop alternative strategies to ultimately treat SCI to increase functional outcomes. Our group has identified alternative applications of commonly administered non-steroidal anti-inflammatory drugs (NSAIDs), such as ibuprofen, and other more specific peroxisome proliferator-activated receptor gamma (PPARg) agonists, where they have enhanced neuronal growth and regrowth after neuronal injury in culture. We propose to develop a scaffold delivery system that will promote aligned neuronal growth and deliver PPARg agonists locally to the SCI to reduce secondary injury resulting from inflammation and to enhance overall treatment efficacy.

This study is important, as it could develop a novel treatment for patients with SCI to restore functionality across the lesion using compounds that are already FDA-approved. It is our ultimate goal to develop therapeutics that can be implanted in patients to significantly improve quality of life after SCI.A hybrid graft composed of (i) UDCA (ursodeoxycholic acid) as an anti-inflammatory drug, (ii) an injectable hydrogel conjugated with glycol chitosan (GC) and oxidized hyaluronate (oHA), (iii) embryonic spinal cord-derived neural stem cells (eNSCs), and (iv) PEDOT (Poly (3,4-ethylene dioxythiophene)) conjugated PLGA (polylactic-co-glycolic acid) fiber as an aligned neuron-inducing scaffold will be transplanted into the SCI region for the repair. UDCA, chitosan, hyaluronate, eNSCs, PEDOT, and PLGA have all been approved by the FDA as medical treatments in clinics.

While the materials mentioned for this study are already approved by the FDA as therapeutic materials, the novelty of the developing hybrid graft stems from the systematically optimized harmony among these materials to facilitate functional SCI repair. Simply adding a large number of cells into the lesion does not guarantee better recovery, as numerous processes occur simultaneously after SCI. I believe that the hybrid graft, based on its anti-inflammatory and neuron-inducing effects, will have significant implications for SCI patients.

Contact Information:

Jonathan M. Grasman, Ph.D.
New Jersey Institute of Technology
323 Dr. Martin Luther King Jr Blvd.
Newark, NJ 07102
grasman@njit.edu
(973) 596-6964

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

EXPLORATORY RESEARCH GRANT RECIPIENT:

Nathan Hogaboom, Ph.D.
Kessler Foundation
CSCR26ERG025
$171,845

Project Title:
Pilot trial of a novel, non-invasive treatment for upper-limb spasticity in people with spinal cord injury

The goal of this project is to test the safety and effect of focused extracorporeal shockwave therapy as a non-invasive, non-pharmacological alternative treatment for upper limb spasticity in people with spinal cord injury.

Approximately 305,000 people live with a spinal cord injury (SCI) in the United States. Sixty percent of these individuals have tetraplegia, which can cause significant dysfunction of the arms and hands. One of the consequences of SCI is spasticity – involuntary activation of muscles that can hinder bodily functions and negatively affect participation in various aspects of life. Spasticity can lead to loss of functional independence and activity limitations, including employment, can cause pain, and can lead to mood disorders like depression. It can even interfere with rehabilitation and lead to hospitalization. In people with tetraplegia, spasticity of the arms and hands can have a tremendous impact on independence and quality of life, and thus regaining function in these areas remains a top priority.

Unfortunately, spasticity is difficult to treat. Common treatments include physical therapy, including exercise or stretching; medications such as Baclofen; and injections with agents like botulinum toxin (also known as Botox). Botox injections are often implemented alongside other modalities like therapy, yet they are invasive, tend to last for only a few months, and carry potential side effects. One potential non-invasive treatment for upper limb spasticity is focused extracorporeal shockwave therapy (f-ESWT), which involves an external application of high-pressure sound waves, similar to ultrasound. An applicator/handpiece is placed on the skin over the spastic muscle and the focused sound waves are applied. f-ESWT carries no long-term side effects with minimal discomfort during application. However, there has been limited research on this treatment option in people with SCI who have arm and hand dysfunction caused by spasticity. The purpose of this study is to fill in that knowledge gap. We will accomplish this by measuring different aspects of spasticity from the perspective of both the clinician and the person with SCI. These will include clinical measures, such as elbow and wrist range of motion, as well as how the treatment impacts the person's functional independence and quality of life.

We will also use ultrasound to look at the person's muscles to see if any beneficial changes occur in their structure and stiffness. People with SCI who meet eligibility criteria will be invited to the laboratory to receive f-ESWT, which will occur once per week for three consecutive weeks. Treatment will entail application of f-ESWT to the elbow and wrist flexor muscles. Participants will be invited back to the laboratory to have their spasticity measured by a clinician, be asked

questions about how their spasticity has impacted their lives, and have their muscles imaged with ultrasound. Findings from this study are expected to generate insight on whether f-ESWT could be a viable treatment option for spasticity of the arms and hands in people with SCI, and if a larger clinical trial is warranted. expected to generate insight on whether f-ESWT could be a viable treatment option for spasticity of the arms and hands in people with SCI, and if a larger clinical trial is warranted.

Contact Information:

Jonathan M. Grasman, Ph.D.
Kessler Foundation
120 Eagle Rock Avenue
East Hanover, NJ 07936
nhogaboom@kesslerfoundation.org
(973) 324-3584

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

FELLOWSHIP RESEARCH GRANT RECIPIENT:

Yijia Chen
Rutgers Biomedical and Health Sciences
CSCR26FEL003
$100,000

Project Title:
From Development to Repair: Elucidating the genetic control of muscle innervation in adult motor neuron subtypes

This project will identify transcription factors and their downstream targets that control motor neuron connectivity in adults and asses their potential for restoring function.

Spinal motor neurons are the nerve cells in the spinal cord that control muscle contractions and allow us to move. After a spinal cord injury (SCI), many of these neurons survive but lose their ability to reconnect with the correct muscle targets. As a result, individuals with SCI often experience long-term or permanent paralysis. While many treatment efforts focus on repairing the spinal cord itself, less is known about how to help surviving motor neurons re-establish the precise connections needed for coordinated movement.

Although the way motor neurons connect to muscles during embryonic development is well studied, our research suggests that adult motor neurons rely on different genetic programs, many of which are still unknown. This project aims to identify the specific molecular pathways that control how adult spinal motor neurons connect to muscle fibers.

Using genetically engineered mice and viral tools that allow selective activation or removal of genes in specific types of motor neurons, genes that are necessary for normal muscle targeting will be identified. Furthermore, whether the reactivation of these genes can restore lost connections in motor neurons that have lost their targeting ability will be assessed.

The results from this work may reveal new ways to help surviving motor neurons rebuild lost connections after SCI, offering potential strategies to improve recovery and restore movement. This research holds special value for the citizens of New Jersey, where approximately 300 new spinal cord injuries occur each year and thousands live with the long-term effects of paralysis. Improving our understanding of motor neuron repair addresses a major medical challenge and supports New Jersey's broader commitment to advancing research, promoting innovation, and enhancing the quality of life for individuals affected by SCI.

Contact Information:
Yijia Chen
Rutgers Biomedical and Health Sciences
683 Hoes Lane West, 356B
Piscataway, NJ 08854
yc1392@rutgers.edu
(732) 235-5089

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

FELLOWSHIP RESEARCH GRANT RECIPIENT:

Hye K Choi
Rutgers, The State University of New Jersey
CSCR26FEL009
$240,000

Project Title:
Fibronectin-Chitosan Hydrogel for Localized Delivery of Mechanoprogrammed MSC EVs in Spinal Cord Injury

This project aims to develop a bio responsive fibronectin–chitosan hydrogel system loaded with extracellular vesicles derived from nanoengineered mesenchymal stem cells to promote localized neuroregeneration and functional recovery after spinal cord injury.

Spinal cord injury (SCI) is a life-altering condition that can result in permanent paralysis, loss of sensation, and limited functional recovery. The central nervous system has very limited regenerative capacity, and current treatment options are mostly supportive rather than curative. One of the biggest obstacles to effective repair is the inability to restore the damaged neural connections that allow the brain to communicate with the rest of the body.

In recent years, extracellular vesicles (EVs) have emerged as a promising, cell-free approach to tissue regeneration. EVs are nanoscale packages naturally secreted by cells, carrying biological signals such as proteins, RNAs, and lipids. When delivered to injured tissues, EVs can reduce inflammation and promote regeneration. Among these, EVs derived from mesenchymal stem cells (MSCs) are especially promising due to their neuroprotective and immunomodulatory cargo. However, there are two key limitations that have slowed clinical translation of EV-based therapies. First, EVs are often heterogeneous and unpredictable in their content, making it difficult to ensure consistent therapeutic effects. Second, after injection, EVs rapidly diffuse from the target site, limiting their local efficacy.

This project proposes a novel and non-invasive strategy to overcome both limitations by engineering EVs through physical cues and delivering them in a biomimetic hydrogel. We use a specially designed line-shaped nanoscale surface to culture MSCs. This line nanopattern mimics natural tissue architecture and provides mechanical signals that stimulate the cells to activate pathways related to neural repair. Without any chemical or genetic modification, this process naturally programs MSCs to secrete EVs that are enriched in neuroregenerative factors such as brain-derived neurotrophic factor (BDNF). These EVs are biologically tuned to support neuronal survival, growth, and differentiation.

To ensure these engineered EVs stay at the injury site and act over time, we will embed them in an injectable hydrogel composed of fibronectin and chitosan. Fibronectin is a natural extracellular matrix protein that supports cell adhesion and neurite extension, while chitosan is a biocompatible material that forms a soft gel capable of retaining EVs through electrostatic interactions. Together, this composite hydrogel mimics the native environment of the spinal cord

and enables sustained, localized delivery of EVs. Importantly, this strategy is cell-free, avoids the use of genetic engineering or synthetic chemicals, and is compatible with clinical translation. The EV-hydrogel system will be tested in laboratory models to evaluate its ability to promote neural regeneration, reduce inflammation, and support functional recovery after spinal cord injury. We expect that this system will not only improve therapeutic EV precision and retention but also accelerate axonal regrowth in injured tissues.

Beyond SCI, this approach could be applied to other neurological disorders, including traumatic brain injury and neurodegenerative diseases. It represents a broader shift toward using physical microenvironments to control the healing signals secreted by cells, combined with advanced biomaterials to deliver those signals exactly where they are needed. By merging cell biology with material science in a precise and natural way, this project introduces a safer, smarter, and more adaptable method for neural regeneration.

Contact Information:

Hye K Choi
Rutgers, The State University of New Jersey
123 Bevier Rd
Piscataway, NJ 08854
hkc40@chem.rutgers.edu
(848) 445-2081

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

FELLOWSHIP RESEARCH GRANT RECIPIENT:

Barbara Gruszka
Rutgers Biomedical and Health Sciences
CSCR26FEL012
$100,000

Project Title:
Induction of STDP in Corticospinal Neurons using Multiphoton Holographic Optogenetic

This study investigates the use of multiphoton holographic optogenetics to precisely induce spike-timing-dependent plasticity (STDP) in corticospinal neurons, allowing for controlled modulation of synaptic strength and connectivity in the motor cortex following spinal cord injury.

For many years, scientists have been studying how to help the spinal cord heal after injury. While some progress has been made, researchers do not yet fully understand how the brain's communication with the spinal cord—especially through a pathway called the corticospinal tract—changes after an injury. This understanding is important because it could guide treatments that not only fix the spinal cord but also help the neurons in the brain reconnect and relearn how to control movement. This project uses a cutting-edge technique called multiphoton holographic optogenetics, which allows researchers to activate specific neurons with incredible precision in live, moving animals. The goal is to study how certain neurons that control movement (called corticospinal neurons) work together and how their connections can be strengthened or weakened based on the timing of their activity – a process known as spike-timing-dependent plasticity (STDP). First, we create a map showing how these neurons are connected. Then, by carefully controlling when each cell is active, we will try to change those connections. By investigating how the timing of neuronal activity affects the way neurons form new connections, we will assess how these changes might support recovery after a spinal cord injury. With this novel technology, the study aims to discover how injury affects brain circuits and whether those circuits can be retrained to help restore movement. This could lead to better treatments for individuals recovering from spinal cord injuries.

Contact Information:
Barbara Gruszka
Rutgers Biomedical and Health Sciences
679 Hoes Lane West
Piscataway, NJ 08854
bg581@scarletmail.rutgers.edu
(848) 445-9824

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

FELLOWSHIP RESEARCH GRANT RECIPIENT:

Alana Martinez
Rutgers, The State University of New Jersey
CSCR26FEL013
$105,000

Project Title:
Serotonergic Interneurons: Mediators of Motor Recovery After Spinal Cord Injury

This research investigates how spinal cord interneurons expressing serotonin receptor 6 (5HTr6+ interneurons) contribute to sensorimotor integration in normal conditions and rehabilitation-induced recovery after spinal cord injury, using mouse genetics and chemogenetics to map circuit connectivity changes and manipulate neuronal activity to reveal potential therapeutic targets for enhancing functional recovery.

Sensorimotor circuit integration in the spinal cord is crucial for normal motor function and adaptation after spinal cord injury (SCI). After injury, rehabilitation enhances functional motor recovery and is associated with plasticity of spared spinal circuits. Understanding how specific neurons contribute to this process could lead to more effective treatments. This research focuses on dorsal horn interneurons expressing the serotonin 6 receptor (5HTr6+ interneurons) in sensorimotor integration, examining their function in normal conditions and their potential as targets for promoting functional recovery following SCI. These neurons are uniquely positioned to influence recovery because they're strategically located in a spinal cord region receiving both sensory input and signals from the brain, they cross the midline (connecting left and right sides of the cord), and they form connections with other spinal interneurons crucial for sensorimotor function.

The central hypothesis is that 5HTr6+ interneurons contribute to sensorimotor integration in normal conditions and are influenced by rehabilitation to promote adaptive plasticity post-SCI. The first aim will map these neurons' connectivity in intact and injured spinal cords following rehabilitation. Using mouse genetics, we'll label inputs to 5HTr6+ interneurons from serotonergic projections and sensory neurons, as well as outputs to specific movement-related networks. We'll compare these connections across three conditions: intact spinal cord, injured spinal cord without rehabilitation, and injured spinal cord with rehabilitation. This will reveal how these interneurons integrate and relay sensory and modulatory information in both healthy and injured states, showing how rehabilitation influences circuit reorganization.

The second aim will determine these interneurons' contribution to corrective motor behaviors and functional recovery after spinal cord injury. Using chemogenetic techniques to manipulate their activity, we'll assess impact on corrective movements in healthy animals and on functional recovery in injured animals undergoing rehabilitation. We'll evaluate motor recovery using the Basso Mouse Scale to measure hindlimb function, while also employing sophisticated computer analysis of spontaneous movement using DeepLabCut technology. This approach will reveal subtle behavior changes that traditional scoring methods might miss, providing detailed

kinematic data about how these interneurons influence movement patterns following injury and during recovery.

This project will provide training in advanced neuroscience techniques while developing skills in experimental design and data analysis for pre-clinical SCI research. The research environment combines expertise in spinal cord injury with understanding of dorsal horn interneuron populations. The mentorship team includes accomplished researchers in mouse genetics, touch sensation, spinal cord circuits, translational research, motor control, and biostatistics, ensuring comprehensive training and guidance. Successful completion will elucidate fundamental mechanisms of sensorimotor circuit function and plasticity, potentially informing future rehabilitation strategies for SCI patients.

By focusing on 5HTr6+ interneurons within the context of SCI rehabilitation, this research aims to uncover how spared sensorimotor circuits are impacted by rehabilitation-based recovery, potentially opening new avenues for targeted therapeutics. Understanding how these specific neurons contribute to normal sensorimotor function and how they adapt after injury could lead to more personalized and effective rehabilitation protocols, improving quality of life for individuals with spinal cord injuries. The project aligns with the NINDS mission to reduce the burden of neurological disorders, providing insights that may translate into improved therapeutic strategies for individuals recovering from spinal cord injury.

Contact Information:

Alana Martinez
Rutgers, The State University of New Jersey
604 Allison Rd Nelson Labs B211
Piscataway, NJ 08854
amm815@scarletmail.rutgers.edu
(848) 445-1786

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

INDIVIDUAL RESEARCH GRANT RECIPIENT:

Bonnie Firestein, Ph.D.
Rutgers, The State University of New Jersey
CSCR26IRG003
$599,997

Project Title:
Novel cypin inhibitors for the treatment of SCI-induced neuropathic pain

We will optimize administration of two new inhibitors of the enzymatic activity of cypin, a guanine deaminase, with the eventual goal of clinical use for neuropathic pain following spinal cord injury (SCI).

Spinal cord injury leads to neuropathic pain, often the painful result of nerve damage, which can decrease quality of life. Our group has developed two new drugs that inhibit the guanine metabolizing enzyme cypin in the central nervous system that plays a role in this type of pain. Inhibition of cypin decreases pain when touched in mice with spinal cord injury. However, our previous inhibitors are not yet useful to treat humans. We used medicinal chemistry to produce many new drugs that are similar to our early drugs and that will have properties that are more suitable for development for human use. We then identified two of these drugs that have promise for treating SCI-induced pain; however, we need to optimize dosing and timing of administration of these drugs. We will continue using our spinal cord injury models to test the strength and optimized delivery of these drugs. This study is important, as it could help us identify drugs that could ultimately be used to decrease neuropathic pain after spinal cord injury in humans and improve quality of life after spinal cord injury.

Contact Information:
Bonnie Firestein, Ph.D.
Rutgers, The State University of New Jersey
604 Allison Road
Piscataway, NJ 08854
firestein@biology.rutgers.edu
(848) 445-8045

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

INDIVIDUAL RESEARCH GRANT RECIPIENT:

Sangmi Chung, Ph.D.
Rutgers Biomedical and Health Sciences
CSCR26IRG004
$600,000

Project Title:
Developing a Novel Therapy for Neuropathic Pain and Bladder Dysfunction after Spinal Cord Injury

In this study, we will address key questions for bringing GABAergic interneuron transplantation to treat neuropathic pains and bladder dysfunction to move this experimental therapy into clinical reality, determining optimal doses to correct neuropathic pains and bladder dysfunction, as well as determining synaptic connection specificity of grafted human GABAertic interneurons.

Previous studies have shown that transplanting neurons that inhibit other neurons can effectively treat neuropathic pain and bladder dysfunction in animal models of spinal cord injury. However, there are still many unanswered questions before this therapy can be tested in humans. Our goal is to determine the optimal dose of these inhibitory neurons needed to treat these conditions and ensure that they connect specifically with healthy neurons without causing unwanted side effects. We will use human stem cells to generate large numbers of inhibitory neurons, which we will then transplant into mice with spinal cord injuries. To make this therapy more practical for humans, we will also use gene-edited cells that are less likely to trigger immune rejection after grafting. If successful, our study could bring a new and potentially life-changing treatment option closer to reality for patients suffering from neuropathic pain and bladder dysfunction after spinal cord injury. This therapy has the potential to significantly improve their quality of life without the risk of addiction or other negative consequences.

Contact Information:
Sangmi Chung, Ph.D.
Rutgers Biomedical and Health Sciences
125 Paterson Street
New Brunswick, NJ 08901
sc3013@rwjms.rutgers.edu
(848) 932-7034

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

INDIVIDUAL RESEARCH GRANT RECIPIENT:

Simiao Niu, Ph.D.
Rutgers, The State University
CSCR26IRG008
$605,000

Project Title:
Wearable Gait Sensing Systems for Continuously Evaluating Spinal Cord Injury Rehabilitation in Animal Models

This project will design a battery-free wireless motion sensor to automatically analyze an animal's locomotor behavior, which provides an objective way to evaluate the animal's rehabilitation process after SCI and pave the way for future clinical applications in SCI patients.

A spinal cord injury (SCI) is damage to nerve cells and axons that send and receive signals from the brain to and from the rest of the body. The United States witnesses ~18,000 new SCI cases annually and ~9 billion dollars in annual related healthcare expenditures. SCI causes inflammation, scar formation, loss of neurons and neural connectivity, and loss of body functions below the injury site. To reduce the health burden of SCI, scientists have employed various animal studies to promote tissue regeneration and locomotor functional recovery, showing promising results. Animal studies are critical in SCI research since they provide an easier way to test potential SCI treatments and study the mechanism of SCI rehabilitation. Despite numerous available preclinical studies on SCI intervention in animal research, a fundamental gap persists in evaluating the intervention's locomotor behavioral outcomes and, thus, the SCI rehabilitation status in animal research. The current tools cannot realize continuous, data-efficient, automatic, and accurate locomotor monitoring and assessment, so there is a critical need to create an innovative, cost-effective, continuous, autonomous, and wearable monitoring tool capable of evaluating the locomotor behavior and effectiveness of clinical interventions for SCI animal models. Such a tool could pave the way for future developments with similar functionalities for human patients.

In this proposal, we will create a small-sized, lightweight, battery-free, and wireless motion sensor patch to capture the mouse's motion accurately during its SCI rehabilitation. Additionally, we will create a machine learning algorithm to analyze the collected motion data and automatically calculate a locomotor score so the locomotor behavior and rehabilitation status can be easily evaluated. Three specific aims are: Aim 1, design a wearable motion sensor for gathering mouse activity and gait data. Aim 2: Evaluate the wearable motion sensor using mice models of SCI and perform machine learning dataset collection. Aim 3: Develop a machine learning algorithm that calculates locomotor behavior scores and evaluates the SCI rehabilitation process.

After successfully completing the proposed studies, we anticipate the development of a hardware prototype for a wearable motion sensor alongside a machine-learning algorithm for locomotor behavior assessments in animal models. Our technology is poised to outperform current animal

model locomotor assessment methods in terms of accuracy and ease of use for two primary reasons. Firstly, our technology can continuously and autonomously monitor the rehabilitation process, allowing for behavior scale acquisition over hours or days on average. Consequently, the assessment requires fewer human resources and has better accuracy and noise robustness. Secondly, this technology eliminates human bias in assessment, providing the first objective and autonomous means of evaluating rehabilitation progress. The developed device will facilitate an objective assessment of therapeutic efficacy in SCI preclinical trials involving animal models. Facilitating comparisons of different treatment plans will significantly expedite therapy development. Moreover, the prototype and developed machine learning algorithm are readily adaptable to human patients. This adaptability holds promise for advancing similar technologies in human SCI rehabilitation research. Finally, the prototype is easily extendable to other diseases requiring locomotor behavior monitoring, such as Parkinson's disease, pain, arthritis, encephalomyelitis, etc.

Contact Information:

Simiao Niu, Ph.D.
Rutgers, The State University
599 Taylor Rd, Rm 304
Piscataway, NJ 08854
simiao.niu@rutgers.edu
(848) 445-6567

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

INDIVIDUAL RESEARCH GRANT RECIPIENT:

Li Cai, Ph.D.
Rutgers, The State University
CSCR26IRG010
$605,000

Project Title:
Role of Excitatory Interneurons in Sensorimotor Functional Recovery

This proposal investigates the specific role of excitatory interneurons and the mechanisms underlying functional recovery after spinal cord injury.

Spinal cord injury (SCI) disconnects the brain from the body, often causing permanent paralysis. Nerves in the spinal cord typically carry messages for movement and sensation, but injury damages these pathways. After an injury, the balance between different types of nerve signals is disrupted, which can prevent any remaining connections from working correctly.

Our research focuses on a specific type of nerve cell called "excitatory interneurons." Think of these as messengers that help activate nerve circuits. Some studies, including our work with a gene therapy called Gsx1, suggest that boosting these excitatory cells might help recovery after SCI. However, we don't know exactly which types of these excitatory cells are most important or how they help the spinal cord heal and regain function.

This project aims to understand the specific roles these excitatory nerve cells play in recovery. First, using a fluorescent tag, we will create special mice to precisely track a key group of excitatory cells (called vGlut2+). This will help us see where these cells are and how they develop. Second, using these mice and advanced genetic tools, we will test whether activating or silencing these specific excitatory cells after a simulated spinal cord injury can improve or worsen the recovery of movement and feeling. We will also closely study a unique group of helpful excitatory cells that appeared in our earlier gene therapy studies to understand what makes them special.

By figuring out which excitatory nerve cells are crucial for repair and how they work, we hope to identify new targets for therapies. Ultimately, this research could lead to better treatments to help people recover function and improve their quality of life after spinal cord injury.

Contact Information:
Li Cai, Ph.D.
Rutgers, The State University
599 Taylor Road
Piscataway, NJ 08854
lcai@rutgers.edu
(848) 445-6559

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

INDIVIDUAL RESEARCH GRANT RECIPIENT:

Victoria Eugenia Guadalupe Abraira, Ph.D.
Rutgers, The State University
CSCR26IRG011
$604,999

Project Title:
Pain as a Barrier to Recovery: Modulating Dorsal Horn Circuits to Enhance Rehabilitation After Spinal Cord Injury

This project aims to determine how a specific population of spinal cord neurons that express serotonin receptor 6 (5HTr6) regulate the balance between adaptive recovery and maladaptive pain outcomes after spinal cord injury by undergoing injury-induced molecular, physiological, and circuit-level changes that alter their sensory gating properties.

Pain as a Barrier to Recovery: Modulating Spinal Cord Circuits to Enhance Rehabilitation After Spinal Cord Injury

Spinal cord injury (SCI) causes debilitating pain in 65-80% of patients, often hindering rehabilitation efforts and recovery. This research investigates how the same spinal circuits that process sensory information can lead to either adaptive outcomes (improved motor function) or maladaptive outcomes (chronic pain) after injury. We have identified a specific population of neurons in the spinal cord, defined by their expression of serotonin receptor 6 (5HTr6), that may act as a critical "gate" determining whether sensory input promotes functional recovery or triggers pain after SCI.

Our preliminary data suggests that after injury, these 5HTr6-expressing neurons receive increased input from pain fibers while simultaneously losing important modulatory signals from the brain. This disrupted balance potentially transforms them from supporters of adaptive plasticity into drivers of chronic pain. Using advanced genetic tools, electrophysiology, and artificial intelligence-driven behavioral analysis, we will determine how these neurons change after injury and whether modulating their activity during rehabilitation can enhance recovery while reducing pain.

The project has three main objectives: First, we will characterize how injury alters the molecular and electrophysiological properties of 5HTr6-expressing neurons. Second, we will map how injury reshapes their connections with sensory inputs and motor-related circuits. Finally, we will test whether temporarily reducing their activity during rehabilitation sessions improves functional recovery and pain.

This research directly addresses multiple NJCSCR priorities by accelerating research to develop effective interventions for paralysis and other consequences of spinal cord injury. By identifying specific neural circuits that can be targeted to enhance recovery, our approach advances the field of spinal cord repair and regeneration using innovative ideas from multiple scientific domains.

Our work combines sophisticated mouse genetics, electrophysiology, and artificial intelligence-driven behavioral analysis to develop a comprehensive understanding of post-injury spinal cord circuit reorganization. The project fosters collaborative, interdisciplinary approaches, as evidenced by our assembled team of consultants with expertise in diverse areas of SCI research.

Neuropathic pain represents one of the most debilitating secondary conditions resulting from spinal cord injury, significantly impacting recovery and quality of life for New Jersey residents living with SCI. By elucidating the mechanisms that determine whether plasticity leads to pain or recovery, this research has direct relevance to the approximately 6,000 New Jersey residents living with traumatic spinal cord injuries.

The translational potential of this work is particularly compelling. Compared to other serotonin receptors, receptor 6 has been considered an especially attractive therapeutic target because it is expressed exclusively in the central nervous system with no known isoforms. Several 5HTr6-targeted compounds have already undergone clinical trials for other conditions, establishing safety profiles and CNS bioavailability. This NJCSCR funding will enable us to generate essential circuit-level data needed to pursue larger NIH or Department of Defense grants focused specifically on 5HTr6 pharmacology for promoting recovery while reducing pain after spinal cord injury, potentially creating a direct pathway to clinical translation for New Jersey residents with spinal cord injuries.

Contact Information:

Victoria Eugenia Guadalupe Abraira, Ph.D.
Rutgers, The State University
604 Allison Road, Nelson D251
Piscataway, NJ 08854
victoria.abraira@rutgers.edu
(424) 772-9909

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

INDIVIDUAL RESEARCH GRANT RECIPIENT:

Lauren Strober, Ph.D.
Kessler Foundation
CSCR26IRG019
$594,963

Project Title:
Surviving the Loneliness Epidemic: A Proposed Intervention to Reduce Social Isolation and Loneliness Among Persons with Spinal Cord Injury

The proposed investigation aims to adapt an existing, clinical, evidence-based intervention aimed at reducing loneliness and social isolation, the Community Re-Integration for Socially isolated Patients (CRISP), for use among individuals with spinal cord injury and subsequently examining its feasibility and effectiveness.

Humans are social beings, with social relationships being crucial for survival and good health. It is well appreciated that the health risks associated with loneliness or social isolation are as great, if not greater than the risk associated with other culprits of poor health or mortality. More specifically, a large review of 148 studies (over 300,000 study participants) found that social support and social integration had greater effects in predicting mortality than smoking, alcohol consumption, physical activity, obesity, and cardiovascular disease risk. Today, researchers have urged that social connectedness be considered a public health priority in the United States (US) and the Surgeon General Dr. Murthy laid out a framework for a National Strategy to Advance Social connection to address the epidemic of loneliness and isolation in the US. Among individuals with disabilities, the epidemic is even greater as individuals with disabilities are over four times more likely to experience loneliness and nearly twice as likely to feel socially isolated. Individuals who have sustained a spinal cord injury (SCI) are particularly prone to social isolation or loneliness. Nearly half of individuals with a SCI report experiencing loneliness despite being in long-term partnerships and 51% report feeling isolated from others.

Unemployment, physical limitations, limited access to transportation, functional dependence, increased effort and fatigue, secondary health conditions (e.g., pain, bowel/bladder issues), unsupportive social attitudes, among other factors all contribute to the high rates of social isolation and loneliness among individuals with a SCI. Given the detrimental effect of loneliness and social isolation on mental and physical health, in general, and the added risk among individuals with SCI, targeted interventions to reduce social isolation in this population is imperative. This is the focus of the proposed investigation. Specifically, the proposed project aims to adapt an existing, clinical, evidence-based intervention, the Community Re-Integration for Socially Isolated Patients (CRISP) for use among individuals with SCI. The CRISP intervention has previously been found to increase self-efficacy and reduce loneliness among individuals with multiple sclerosis and holds great promise for use in SCI given the shared experiences and barriers to socialization. In adapting the intervention, the next logical steps are to: (1) ensure the specificity and applicability of the CRISP intervention for individuals with SCI; and (2) determine the feasibility and effectiveness of the intervention among individuals

with SCI. This will be accomplished in three study phases. Phase I will consist of a collaborative approach among stakeholders (i.e., people with lived experience, carers of individuals with SCI, SCI researchers and practitioners), SCI Model Systems Consumer Advisory Board, the developer of the CRISP intervention, and project investigators to identify the unique needs of individuals with SCI to be adapted into the existing intervention. Phase II will consist of a preliminary feasibility study in which 12 individuals with SCI will complete the intervention to examine the acceptability and practicality of, and barriers to, implementing the adapted intervention to ensure usability among individuals with SCI. In Phase III, a pilot randomized controlled study will be conducted to determine the preliminary effectiveness of the CRISP-SCI intervention. The ultimate goal of the proposed project is to prepare the CRISP-SCI intervention for a larger clinical trial in which the immediate and long-term effects can be established. Once completed, it is anticipated that the CRISP-SCI intervention will be made available for broader use in clinical settings and reach more individuals with SCI. The overarching goal being to improve the overall health, well-being, and quality of life of individuals with SCI.

Contact Information:

Lauren Strober, Ph.D.
Kessler Foundation
120 Eagle Rock Avenue
Suite 100
East Hanover, NJ 07936
lstrober@kesslerfoundation.org
(973) 324-8459

NEW JERSEY COMMISSION ON SPINAL CORD RESEARCH

INDIVIDUAL RESEARCH GRANT RECIPIENT:

Denise Fyffe, Ph.D.
Kessler Foundation
CSCR26IRG021
$593,889

Project Title:
Spinal Cord Injury (SCI) Navigator Intervention: Bridging Gaps in the Prevention and Management of Pressure Injuries

The proposed study will conduct a 12-month pilot randomized controlled feasibility trial to test evidence-based, patient-centered SCI Navigator intervention can be delivered to empower wheelchair users with SCI to manage existing pressure injuries and prevent new injuries.

This study will test the practicality of how well an evidence-based, patient-centered SCI Navigator intervention can be delivered to empower wheelchair users with SCI to manage existing pressure injuries and prevent new injuries. Pressure injuries are a critical problem for people living with SCI, with negative consequences on nearly every aspect of their lives. Individuals with pressure injuries experience restrictions in their ability to move around, less participation in the community, greater unemployment and increased risk for future pressure injuries and premature death. More than 50% of people with SCI will experience a pressure injury during their lifetime. Many wheelchair users with SCI live with a single pressure injury for months to years of severely restricted sitting time before non-surgical healing occurs or before requiring surgery.

While a combination of surgery and medical approaches are often most effective in managing pressure injuries, they do not always offer a complete solution. The National Pressure Ulcer Advisory Panel (2011) report and self-reports from individuals with SCI concur that some pressure injuries are preventable, and that prevention is more cost effective than medical treatment. Practice guidelines promote self-management skills, support and education resources as leading methods pressure injury management and prevention.

Self-management skills, support and education interventions are designed to help people develop the knowledge and skills they need to promote their own well-being, while also providing environmental and social support to help them be successful. These programs have been found to be helpful for other health conditions, but a similar program to address pressure injuries among people with SCI has not yet been developed and tested. Patient navigation, a patient-centered, individualized intervention, helps identify and address barriers to care, assists with timely access to health or community resources and encourages self-management and personal choice through education and emotional support. Our research team recently collaborated with individuals with SCI, clinicians, caregivers and SCI community organizations to develop the Kessler Foundation SCI Navigator Program. Navigators provide education and supportive resources to people with spinal cord injury and their families as they transition across the rehabilitative care continuum – such as, from inpatient rehabilitation to their home and outpatient services. The SCI Navigator

Program also provides assistance to connect people with SCI to services available to them within the community, including those from SCI-specific services and organizations.

The proposed study will improve pressure injury treatment by providing the first available evidence for the feasibility and potential benefits of an SCI Navigator Program to provide consistent support and guidance to community dwelling wheelchair users with SCI who have pressure injuries. The SCI Navigator will assess and track pressure injury healing status and risk for 12 months while providing education and support to enhance knowledge and skills. The SCI navigator will assess and track pressure injury healing status and risk for 12 months while providing education, support and healthcare navigation strategies that address pressure injury self-management barriers. SCI Navigators will individually tailor their support to each client's personal pressure injury needs, with a focus on factors that can be changed to promote health and reduce risk of re-occurrence among community dwelling wheelchair users. This research will lead to the discovery of innovative self-management and education intervention that is essential to the well-being and quality of life of wheelchair users with SCI. We will use the findings of this pilot randomized controlled trial to prepare for scalability and sustainability of the intervention in future large multi-site clinical trial.

Contact Information:

Denise Fyffe, Ph.D.
Kessler Foundation
1199 Pleasant Valley Way
West Orange, NJ 07052
dfyffe@kesslerfoundation.org
(973) 324-3573