

The Importance of Neurorehabilitation Research: Helping Rebuild Lives After Spinal Cord Injury

Spinal cord injuries typically lead to sudden, substantial, and unexpected loss of function for hundreds of thousands of individuals around the world every year, and even small improvements in function can meaningfully impact an individual's quality of life. But how do clinicians know which treatments they should use to provide the greatest possible benefits for their patients? Research is the answer. Scientific research is fundamentally linked with advances in medicine. As we learn more about how the nervous system recovers after injury and new technologies are introduced, we depend on new research to identify which neurorehabilitation treatments will be best for which patients. ASNR Member Edelle Field-Fote, PT, PhD, FAPTA, FASIA, is conducting important research that has the potential to enhance motor recovery in individuals after spinal cord injury. Over more than two decades, federal research grants have provided essential support for her to carry out this research. She shares more about her work in this interview.



1. Can you tell us about your position and your research program?

I currently hold the positions of Director of the Shepherd Center Spinal Cord Injury (SCI) Research Program & Hulse Laboratory, Professor in the Department of Rehabilitation Medicine at Emory University School of Medicine, and Professor of the Practice in the School of Biological Sciences at Georgia Institute of Technology (Georgia Tech). My research team is dedicated to improving motor function in persons with SCI through the development of clinically accessible neuromodulation and neurorehabilitation approaches. Our studies are informed by the latest neuroscience research and guided by outcomes that have true meaning for persons with SCI. In my role at Emory University and Georgia Tech, I serve as the director of graduate studies for the Emory DPT / Georgia Tech PhD in Applied Physiology dual degree program.

2. What inspired you to get involved in neurorehabilitation research?

I have a clinical background as a physical therapist, and early in my career, I worked clinically with individuals with SCI. As a person in my 20s, many of the people I worked with were my age, and I was highly motivated to find ways to help them improve their functioning and quality of life. I decided to pursue a PhD. In my first year neuroscience class, I was amazed to learn that the spinal cord, via central pattern generators, could generate complex movement without any input from the brain. I thought that there might be a way that I could apply this information to people with SCI. In my PhD dissertation studies, I worked in a lab that had a long history of studying a turtle model of complete SCI. My studies focused on bilateral coordination, and they showed that even after complete spinal cord transection, the spinal central pattern generators

could generate very elegant bilateral scratching behaviors. The scratching is highly coordinated, and it resembled the limb movements produced during swimming and walking. I had some disheartening times as the end of my PhD training was approaching because there didn't seem to be a lot of interest in hiring a junior physical therapy faculty who knew a lot about turtle scratching behavior 😊. However, this was right around the time when Christopher Reeve was injured, and there started to be a lot of interest in SCI research. It was also the time when locomotor training was starting to become a topic of research investigation, and walking is the behavior most closely related to turtle scratching. So, I was fortunate enough to be offered a postdoc position at the Miami Project to Cure Paralysis. There, I was awarded my first NIH grant to study locomotor training assisted by reflex activation in participants with SCI, which was the foundation for my research career.

For me, the key inspiration for focusing on neurorehabilitation is the knowledge that without a doubt the best approach available for improving function after SCI is practice-related neuroplasticity. For the first 20 years of my career, I was at the Miami Project to Cure Paralysis. So, I was nested in this center of excellence in SCI research where I engaged with colleagues whose studies focused on biologic, pharmacologic, and device-related interventions to address SCI. At this point in time, neurorehabilitation is the intervention that has the largest and most meaningful effects on the function of people with SCI. And so my team focuses on identifying ways to make practice and training even more effective through neuromodulation approaches, such as transcutaneous spinal stimulation, non-invasive brain stimulation, and somatosensory stimulation, to amplify the training-related effects. But we always emphasize that training is the key, as it activates the neural circuits that we want to target with neuromodulation. For that reason, we often work closely with our clinical colleagues at Shepherd Center to translate our findings to the clinic.

3. How has federal funding benefited or influenced your research/career?

Federal funding, particularly from the National Institutes of Health, has been a key reason for the success I've had in my research career. The first NIH grant I received as a postdoc provided support at a critical point in my career that helped me transition to being an independent investigator. From that point, additional NIH grants have allowed my lab to examine how different interventions affect motor function in people with SCI, paving the way for potential new treatment approaches. I've had the good fortune to have some excellent program officers who have been so helpful throughout the course of my career. My work has also been funded by the Department of Defense (through the Spinal Cord Injury Research Program), so it's been very disheartening to see that, at least for this year, there will not be a call for proposals. I'm hopeful that this will be a one-year miss, and that the program will resume next year. I've also benefited from funding from foundations, such as the Foundation for Physical Therapy Research and the Craig H. Neilsen Foundation. These groups have been really important to the progress my lab team has made, especially through providing funding to collect the pilot data needed for federal grant applications.

4. What do people in your studies say about what it's like to be involved in your research?

Because my team focuses on neuromodulation approaches for augmenting the effects of training, the studies that we do are founded on the principles of motor learning and task-specific, task-directed training periods. For that reason, we really encourage participants to continue training even after they complete our studies. I'm always very heartened when our participants come back months or even years later and show us the progress that they've made even since the time that they finished one of our studies.

5. What are some of the outcomes or impacts of your federally funded research that you are most proud of?

In the early 2000's, my team was the first to investigate the value of activating cortical circuits as a way to improve hand function in people with tetraplegia. I was inspired by a lecture I saw that showed that after SCI, the brain was reorganized in a way that made it unlike brain organization in people without SCI. I reasoned that, while there wasn't anything we could do about the damage to the spinal cord, if we could get the brain to be better at sending information through the remaining pathways, we might be able to improve hand function. We trained participants by having them practice functional tasks and combined this training with somatosensory stimulation (below the motor threshold). This allowed us to activate the somatosensory cortex, which is a key driver of the excitability of the motor cortex. Prior to that time, there had been no studies applying the principles of task-directed training for hand function in persons with SCI. The emphasis had been solely on the use of splinting and orthotics to compensate for hand impairment. Because I had been leading locomotor training studies, it was clear that the same principles could be applied to training the hand. Since that time, there has been growing interest in directly activating the motor cortex through non-invasive brain stimulation approaches, and my team continues to be involved with these efforts as well.



Through their research, Dr. Field-Fote's team is gathering valuable new information about how people with SCI respond to neuromodulation and neurorehabilitation approaches that will inform new treatments to improve how people with SCI can move and engage with the world. They prioritize making sure the approaches they develop are clinically accessible so that as many people as possible can benefit from them. This kind of research is essential for improving clinical care and providing meaningful improvements in quality of life for people living with SCI today.