Peripheral nerves are pathways that connect the spinal cord to the rest of the body and mediate movement by muscles as well as sensation. Damage to these delicate nerves can lead to a debilitating loss of or change in sensation causing pain, weakness, or even paralysis. There are many kinds of peripheral nerve disorders, and they can have a devastating and lasting impact on a person’s quality of life.

At Northwestern Medicine, we recently launched the Peripheral Nerve Program to pursue breakthrough research, education, and clinical care for people with these complex and often painful disorders. We are conducting high-impact research that could potentially usher in new strategies for evaluating and treating individuals with peripheral nerve problems. As an academic medical center, we also are deeply committed to the education of future specialists in this area. Through our training programs, we are ensuring that patients across the globe will have access to a new generation of trained surgeons.

The Peripheral Nerve Program at Northwestern Medicine is led with distinction by Michel Kliot, MD, an international leader in the field of peripheral nerve surgery. Dr. Kliot is one of just a handful of national experts in peripheral nerve surgery. With Dr. Kliot’s vision and unique expertise, this program within the Department of Neurological Surgery is world-class and a contributor to notable advances.

The Peripheral Nerve Program brings together a multidisciplinary team including neurosurgeons, neurologists, radiologists, rehabilitation specialists, plastic surgeons, orthopaedic surgeons, otolaryngologist surgeons, anesthesiologists, pathologists, and intraoperative monitoring and pain management experts. By leveraging the tremendous resources of Northwestern University Feinberg School of Medicine, Northwestern Memorial Hospital, Ann & Robert H. Lurie Children’s Hospital of Chicago, and the Rehabilitation Institute of Chicago, we can provide the best care possible for our patients now while also developing new, innovative approaches. We are empowered through this specialized program to spearhead clinical care and research that is currently not being done anywhere else in the world.

Research and Innovation

At Northwestern Medicine, we are conducting high-impact research, including clinical trials, technology development, and basic research that continues to lead to improved clinical therapies for our patients with peripheral nerve problems.

Dr. Kliot and his colleagues also are looking to the future by leading clinical studies that focus on developing and further improving diagnostic tests and treatments. A portion of Dr. Kliot’s research is focused on the development of non-invasive methods for diagnosing and helping to treat peripheral nerve injuries and masses. For example, in partnership with Thomas Gallagher, MD, assistant professor of radiology/neurological surgery, new MRI techniques are allowing us for the first time to visualize axons both when damaged as well as when regenerating. These same techniques also provide the ability to visualize the relationship between nerve tumors and the surrounding peripheral nerve fibers from which these tumors often arise. Our ultrasound team, comprised of Tom Grant, DO,

“With the patient as our focus, our Peripheral Nerve Program team is dedicated to providing state-of-the-art and effective medical and surgical care to patients for the entire spectrum of peripheral nerve problems. Our research efforts are driving the next generation of therapies for these difficult and often painful problems.”

Michel Kliot, MD, Professor and Interim Chair, Department of Neurological Surgery, and Director of the Peripheral Nerve Program
professor of radiology, Imran Omar, MD, associate professor of radiology, and Kevin Blount, MD, assistant professor of radiology, is allowing us to preoperatively visualize important nerve pathology and to make an accurate diagnosis. In the operating room, ultrasound is helping us to identify and localize nerve pathology so that surgeries can be done more rapidly, safely, and effectively through smaller skin incisions.

The Peripheral Nerve Program team also is conducting cutting-edge research to enhance treatment and our understanding of peripheral nerve masses. In the area of tumor biology, Dr. Kliot is studying why many nerve sheath tumors stop growing on their own. He is exploring this question in an effort to apply this knowledge to the treatment of tumors that continue to grow. Program faculty members also are developing ways to reduce scar formation after surgery. Scars lead to problematic adhesions and can make future surgery more difficult and dangerous.

In the laboratory, Dr. Kliot has been involved in developing new methods to splice axons back together in the setting of acute nerve injury instead of attempting to regenerate the damaged nerve fibers. This research activity is highly complex and rigorous. It will require resources, time, and great collaboration to bring this work from the laboratory bench to the clinic where patients can benefit.

Daniela Menichella, MD, PhD, assistant professor of neurology, is leading a robust research program in the area of pain management.

New Frontier: Diffusion Tensor Imaging

As a new frontier in the surgical care of peripheral nerve problems, Drs. Kliot and Gallagher are using diffusion tensor imaging to create colorful blueprints to map delicate nerves. These images are displayed in the operating room and provide our neurosurgeons with images of the spinal cord, as well as the individual nerves coming off the spinal cord. Diffusion tensor imaging is an advanced technology that has long been used to map the brain. Now, Dr. Kliot and colleagues in neuroradiology and neurological surgery at Northwestern Medicine are harnessing this technology’s power to help them remove tumors tangled among delicate peripheral nerves. A conventional MRI, which highlights structures and not nerve fibers, pales in comparison.

According to Dr. Kliot, “You don’t want to damage the nerves since the nerves supply sensation, they supply strength, and they can create pain if they are mistreated.”

Water is in both our nerves and surrounding tissues. The movement of water, however, is more restricted in nerves and, thus, this property can be detected and visualized with diffusion tensor imaging sequences. Through diffusion imaging, surgeons can actually see how the nerve fibers envelop a tumor and thus work to remove the tumor without damaging the nerve fibers. This was not always possible in the past.

Education and Training

Each day, we proudly educate and train the next generation of clinicians and researchers in our unique and multidisciplinary setting. As part of our academic mission, neurosurgical faculty members provide education and training at all levels—to medical students, residents, fellows, and practicing surgeons. Through our residency and fellowship programs, we are training both clinical and research specialists, including experts in peripheral nerve disorders. These surgeons and scientists ultimately will provide advanced care to future patients and champion novel research and teaching programs. We believe that the vital educational element of our mission helps us attract the nation’s most exceptional surgeons to serve on our faculty and participate in our dynamic academic environment.
Patients who seek treatment at the Peripheral Nerve Program often present with the following conditions:

- Common nerve entrapment syndromes, such as carpal tunnel syndrome and ulnar nerve entrapment at the elbow, and less common nerve entrapment syndromes, such as thoracic outlet syndrome (TOS), pyriformis syndrome, and meralgia paresthetica to mention a few

- Open traumatic nerve injuries

- Closed traumatic nerve injuries, such as adult and birth brachial plexus injuries

- Nerve tumors including schwannomas and neurofibromas in patients with types 1 and 2 Neurofibromatosis and Schwannomatosis

- Other types of masses involving nerves such as ganglion cysts

- Undiagnosed peripheral neuropathies that require a biopsy

THROUGH NORTHWESTERN MEDICINE, WE ARE CREATING A NATIONAL EPICENTER FOR HEALTHCARE, EDUCATION, RESEARCH, COMMUNITY SERVICE, AND ADVOCACY.

Northwestern Medicine

Northwestern Memorial HealthCare and Northwestern University Feinberg School of Medicine are seeking to impact the health of humankind through Northwestern Medicine. We aspire to be the destination of choice for people seeking quality healthcare; for those who provide, support, and advance that care through leading-edge treatments and breakthrough discoveries; and for people who share our passion for educating future physicians and scientists. Our commitment to transform healthcare and to be among the nation’s top academic medical centers will be accomplished through innovation and excellence.

Through the Peripheral Nerve Program within the Department of Neurological Surgery and the Institute for Translational Neuroscience at Northwestern Medicine, we have an unprecedented opportunity to enhance the care provided to people struggling with peripheral nerve disorders and pursue research that will help us to bring forth innovations that improve care and outcomes. We recognize that every positive contribution we have made to neurological surgery discovery, care, training, and outreach has been made possible by donors who have continued to entrust us with their philanthropic support. We invite interested friends to join us in advancing our Peripheral Nerve Program through gifts of outright support and endowment.

On the Cover:

Magnetic Resonance Imaging (MRI) Neurogram using diffusion tensor imaging (DTI) with focused 3D tractography of the right brachial plexus including the C4, C5, and C6 spinal nerves. The study confirms a nerve sheath tumor arising from right C4 nerve. DTI provided additional detail of a capsule of nerve fibers surrounding the tumor with thinning of fibers anteriorly, suggesting a potential window for the surgical approach. Image courtesy of Thomas Anthony Gallagher, MD