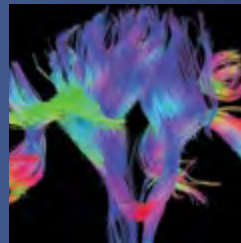


PENN NEUROSCIENCES



Break through the darkness



PENN NEUROSCIENCES

WELCOME TO PENN NEUROSCIENCES	2
ABOUT PENN NEUROSCIENCES	4
The Penn Neuroscience Center	5
Cutting-Edge Research Translated into Advanced Treatments.....	5
PENN NEUROSCIENCES PROGRAMS	6
Spine Diseases and Disorders.....	8
Stroke and Neurovascular Conditions	8
CLIFTON'S STORY	9
DON AND CORINNE'S STORY	10
Movement Disorders.....	11
Dementia and Cognitive Disorders.....	11
Epilepsy and Seizure Disorders	12
Neuromuscular and Peripheral Nerve Disorders	12
BERT'S STORY	13
RACHAEL'S STORY	14
Neuro-Ophthalmology.....	15
Multiple Sclerosis.....	15
AMANDA'S STORY	16
Neurocritical Care	17
Neuroinflammatory and Autoimmune Conditions	17
Cranial Base Tumors and Disorders	18
Brain Tumors and Neuro-Oncology.....	18
TAMARA'S STORY	19
Neurotrauma	20
General Neurology	20
Neurorehabilitation	21
Neurodiagnostics.....	22

WELCOME TO PENN NEUROSCIENCES

We are pleased to introduce you to Penn Neurosciences and the programs that make us the region's best for neurological care.

This overview is designed to highlight the ways that our team of neurologists, neurosurgeons, clinical specialists, and researchers from Penn Medicine come together to provide comprehensive care for people with a range of brain, spinal cord and nervous system conditions.

At Penn Neurosciences, we offer the region's most advanced treatment options and groundbreaking clinical trials. Penn Neurology and Penn Neurosurgery are top-ranked in the region and nationally by *U.S. News & World Report* because, in addition to being focused on treating neurological disorders, we're conducting research and developing breakthroughs that bring new hope for patients and caregivers today.

As diagnostic and treatment options for neurological conditions continue to develop, Penn Neurosciences will play a leading role in the discovery and implementation of these new treatments. At the same time, we remain dedicated to providing responsive and compassionate care to the people who matter most: our patients.

Sincerely,



M. SEAN GRADY, MD

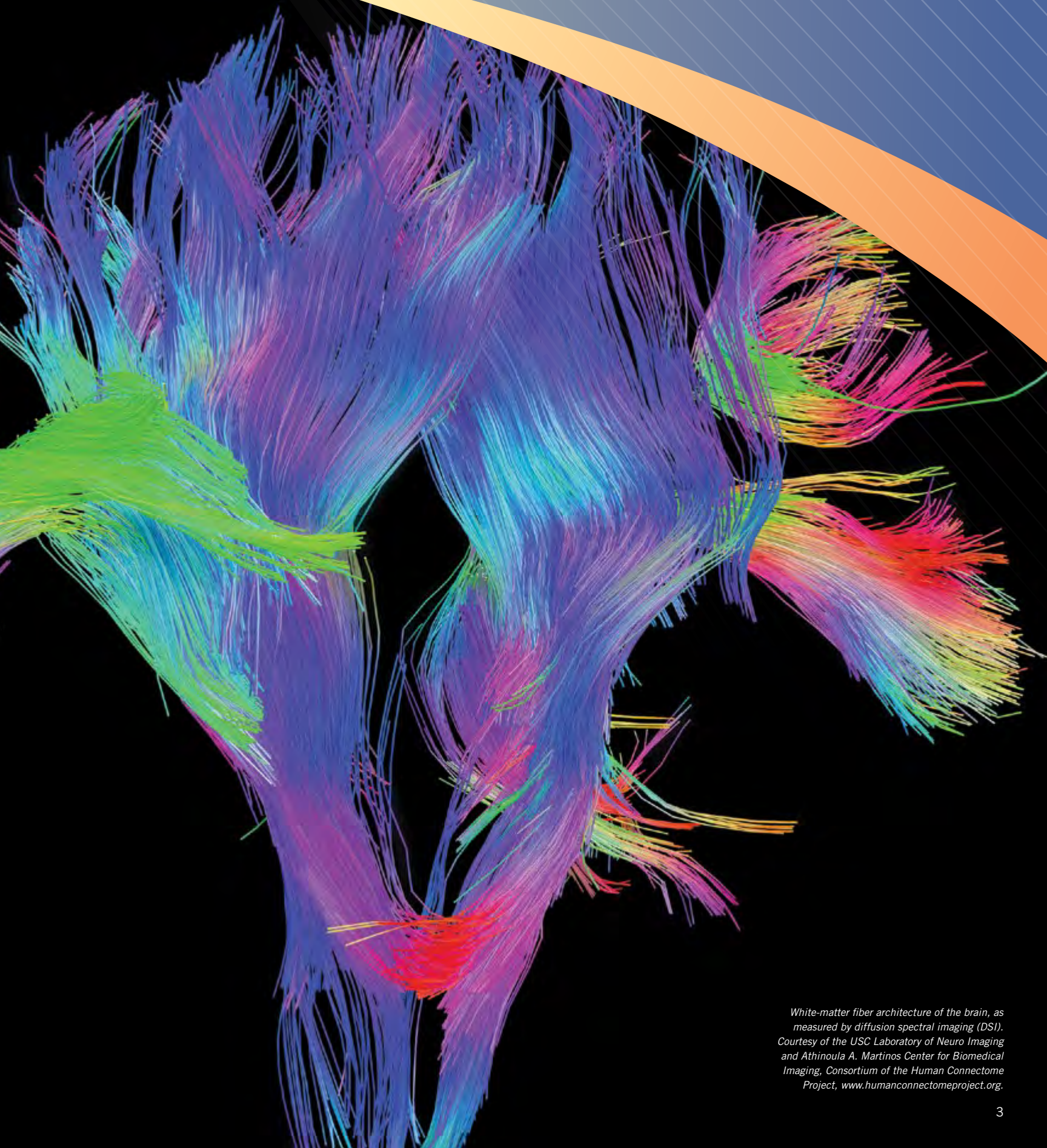
*Chair, Department of Neurosurgery
Charles Harrison Frazier Professor of Neurosurgery*



FRANCES E. JENSEN, MD, FACP

*Chair, Department of Neurology
Professor of Neurology*





White-matter fiber architecture of the brain, as measured by diffusion spectral imaging (DSI). Courtesy of the USC Laboratory of Neuro Imaging and Athinoula A. Martinos Center for Biomedical Imaging, Consortium of the Human Connectome Project, www.humanconnectomeproject.org.



ABOUT PENN NEUROSCIENCES

Penn Neurosciences is one of the leading neuroscience programs in the nation. It brings together experts from neurology, neurosurgery, neurodiagnostics, neuropsychology, neuro-ophthalmology, neuroradiology, rehabilitation and psychiatry.

Physicians, surgeons, advanced practitioners, nurses, and a wide range of specialists and researchers collaborate to diagnose complex neurological diseases and disorders of the spine, brain and nervous system. Penn providers care for patients, taking into account their environment, genetics and personal experiences. Individual treatment plans are then tailored to each patient's needs.

At Penn Neurosciences, patients and referring providers benefit from not only having access to experts in their field, but also to cutting edge research that is translated into clinical practice, allowing Penn to provide patients with the latest, safest and most advanced treatment options. By embracing new technology and seeking the highest quality and best outcomes possible, Penn is leading the way in the clinical advancement of neurological conditions. Alliances with other resources at Penn Medicine, as well as the greater University of Pennsylvania, afford unique advantages for translating discovery.

Penn neurologists and neurosurgeons are leaders in the development of clinical trials and are dedicated to training the next generation of medical professionals. Both Penn Neurology and Penn Neurosurgery offer educational programs that include residency and fellowship opportunities.



► Above: The Penn Neuroscience Center is located at the Perelman Center for Advanced Medicine.

THE PENN NEUROSCIENCE CENTER

The Penn Neuroscience Center, located at the Perelman Center for Advanced Medicine in Philadelphia, provides patients with access to neurology, neurosurgery, neurodiagnostics, neuropsychology and neuro-ophthalmology in one central, convenient location. The 40,000 square foot Neuroscience Center includes exam and consultation rooms, a neurodiagnostic center, a radiology reading area and space for research coordination and clinical trial enrollment.

Penn neurologists and neurosurgeons also provide care in the community at more than a dozen locations in Pennsylvania and New Jersey. To learn more, visit PennMedicine.org/Neurosciences.

CUTTING-EDGE RESEARCH TRANSLATED INTO ADVANCED TREATMENTS

Researchers at Penn Neurosciences engage in basic science, translational and clinical research on a wide range of topics in the field. The team collaborates closely with specialists from multiple disciplines to discover treatment options for patients with conditions of the brain, spine or nervous system.

The University of Pennsylvania is ranked second nationally in National Institutes of Health (NIH) funding. Penn Neurology and Penn Neurosurgery receive more than \$18 million annually in NIH support and other external grant sources.

Research and clinical trials are being conducted for multiple neurological conditions, including neurodegenerative disorders, dementia, stroke, epilepsy, neuro-oncology, peripheral nerve, spinal cord injury, brain trauma, cranial base surgery, multiple sclerosis, movement disorders, and hereditary and metabolic disorders of the nerve and muscle.

To learn about clinical trials currently available to patients, please call 215.662.4484.



AT PENN NEUROSCIENCES, WE'RE CONDUCTING RESEARCH AND DEVELOPING BREAKTHROUGHS THAT BRING NEW HOPE FOR PATIENTS AND CAREGIVERS.

PENN NEUROSCIENCES PROGRAMS



PENN NEUROSCIENCES OFFERS A VARIETY OF PROGRAMS designed to help patients manage a range of brain, spinal cord and nervous system conditions. Each program is comprised of a team of specialists who are dedicated to helping patients break through the darkness of their neurological condition.

BRAIN TUMORS AND NEURO-ONCOLOGY

- » Brain Tumor Center
- » Center for Cranial Base Surgery
- » Pituitary Center
- » Penn's Center for Personalized Diagnostics

CRANIAL NERVE DISORDERS

DEMENTIA AND COGNITIVE DISORDERS

- » Cognitive Neurology Program
- » Penn Memory Center
- » Frontotemporal Degeneration Center

MOVEMENT DISORDERS

- » Functional and Restorative Neurosurgery
- » Penn's Center for Neurodegenerative Disease Research
- » Morris K. Udall Centers of Excellence for Parkinson Disease Research
- » National Parkinson Foundation Center of Excellence
- » Parkinson's Disease and Movement Disorders Clinic
- » Huntington's Disease Center of Excellence

MULTIPLE SCLEROSIS

- » Penn Comprehensive MS Center

NEUROINFLAMMATORY AND AUTOIMMUNE CONDITIONS

NEUROPSYCHOLOGY

NEUROCRITICAL CARE

- » Clinical Traumatic Brain Injury Research Center

NEURODIAGNOSTICS

- » Neurodiagnostics Lab

NEUROGENETICS

NEUROMUSCULAR AND PERIPHERAL NERVE DISORDERS

- » Center for Peripheral Nerve Disorders
- » Charcot-Marie-Tooth Center of Excellence
- » Penn Comprehensive ALS Center
- » Guillian-Barre Syndrome/Chronic Inflammatory
- » Demyelinating Polyneuropathy Center of Excellence
- » Muscular Dystrophy Association Clinic

NEURO-OPHTHALMOLOGY

NEUROREHABILITATION

- » Brain Injury Rehabilitation
- » Concussion Clinic
- » Penn Spasticity Clinic

NEUROTRAUMA

- » Neurotrauma Center

SEIZURES AND EPILEPSY

- » Comprehensive Epilepsy Center

SLEEP CONDITIONS

SPINE DISEASE AND DISORDERS

- » Penn Spine Center

STROKE AND NEUROVASCULAR CONDITIONS

- » Comprehensive Stroke Center
- » Primary Stroke Centers

PENN NEUROSCIENCES IS **TOP RANKED IN THE REGION** AND **ONE OF THE BEST IN THE NATION**, AS WELL AS ONE OF THE BUSIEST, SEEING MORE THAN 114,000 NEW PATIENTS YEARLY.

SPINE DISEASES AND DISORDERS

The Penn Spine Center brings together a specialized team of neurosurgeons, orthopaedic surgeons, rehabilitation specialists, interventional radiologists and pain treatment specialists to treat back and neck pain.

Specialists at the Penn Spine Center work together to determine the best approach for patients and utilize conservative treatments, avoiding surgery if possible. Penn's nonoperative spine specialists are experts in rehab medicine, pain intervention, pain psychology and interventional radiology techniques. Surgery is recommended only when nonsurgical treatment cannot achieve the desired results. When surgery is needed, Penn neurosurgeons and orthopaedic surgeons are trained in the most advanced surgical techniques, including minimally invasive surgery.

The Penn Spine Center has a dedicated team who focuses on the diagnosis and treatment of spine cancer, a complex condition that requires individualized and expert therapy. Management of spinal tumors often involves surgery, radiation and medical treatments.

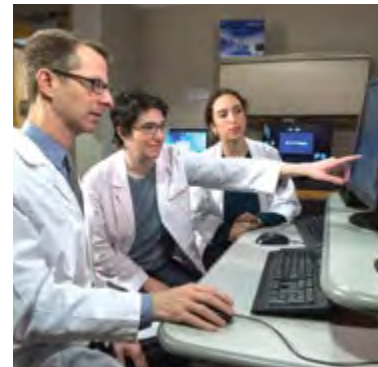


STROKE AND NEUROVASCULAR CONDITIONS

Penn vascular neurologists, neurosurgeons, and neuroradiologists evaluate, diagnose and treat stroke and other diseases affecting the blood vessels in the brain. The team provides the best possible prevention, treatment and recovery options for people with stroke and related problems.

As the region's leaders in patient-oriented stroke research, Penn is pioneering opportunities for stroke treatment beyond standard clinical care. The team specializes in providing endovascular therapy for ischemic stroke and provides neurorescue transfer services for outside hospitals that need to transfer a stroke patient. Penn physicians and specialists publish more research on stroke than all other regional hospitals combined.

Penn's stroke specialists provide real-time, remote consultation 24/7 for hospitals without local expertise. For hospitals that do have local stroke expertise, Penn helps to rapidly identify patients who will benefit from specialized interventions and therapies available at Penn.



PENN'S COMPREHENSIVE STROKE CENTER

The Penn Stroke Center, located at the Hospital of the University of Pennsylvania, is recognized as a Comprehensive Stroke Center by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO). Additionally, Penn Presbyterian Medical Center, Pennsylvania Hospital, Lancaster General Health and Chester County Hospital are designated as Primary Stroke Centers.

Joint Commission-certified Comprehensive Stroke Centers are required to have:

- A dedicated neurocritical care unit
- A system that optimizes the benefits of carotid artery procedures
- Advanced neurodiagnostic tools
- Advanced practice nurses
- Certified vascular neurologists, neurosurgeons, neuroradiologists and vascular surgeons
- Advanced resources for acute treatment of stroke patients available 24/7

This designation recognizes Penn's capabilities to treat the most complex stroke cases.



The Joint
Commission



American Heart
Association
American Stroke
Association

CERTIFICATION

Meets standards for

Comprehensive Stroke Center

“PENN HAD THE BREAKTHROUGH TECHNOLOGY, TEAM AND EXPERTISE TO ACT QUICKLY AND REMOVE THE CLOT IN MY BRAIN.”



CLIFTON | SEVERE STROKE

“EVERY WEEK WE GET THE WHOLE FAMILY AROUND THE TABLE, AND THE PARTY STARTS WHEN I WALK IN.

But when a massive stroke left me paralyzed on my left side, no one expected me to ever walk again. Except my team at Penn. They had the breakthrough technology, team and expertise to act quickly and remove the clot in my brain. A few weeks later I walked out of the hospital on my own—and that is worth Penn Medicine.”

—**CLIFTON**, *Severe Stroke Patient*

**“PENN’S BREAKTHROUGH CLINICAL TRIALS ARE MAKING HUGE STRIDES,
AND THEY WON’T STOP UNTIL THEY CURE THIS DISEASE.”**



“IT FEELS VERY LONELY SOMETIMES, LIVING WITH SOMEONE YOU’VE KNOWN YOUR WHOLE LIFE, BUT THEY’RE FORGETTING. Alzheimer’s is like saying goodbye to him a little bit each day. That’s why we’re at Penn. Penn has helped us in a way no one else could to break through the isolation of this disease. Their breakthrough clinical trials are making huge strides, and they won’t stop until they cure this disease. Today, my husband still remembers me—and that is worth Penn Medicine.” —**CORRINE, WIFE OF DON**, *Alzheimer’s Patient*



MOVEMENT DISORDERS

Neurologists and neurosurgeons at Penn provide evaluation, diagnosis, treatment and management for all types of movement disorders, including dystonia, essential tremor, Huntington's disease, myoclonus, Parkinson's disease, atypical parkinsonisms, spinocerebellar ataxia and other ataxia disorders, tardive dyskinesia, and Tourette syndrome and other tic disorders.

Penn's Parkinson's Disease and Movement Disorder Center, with its medical and surgical therapies and experimental therapeutics, is internationally recognized for both its clinical and diverse research programs. With the National Parkinson Foundation Center of Excellence at Pennsylvania Hospital and one of only six national Centers of Excellence at the Philadelphia Veterans Administration Hospital, Penn leads the way in reducing the impact of these disorders.

Additionally, the Huntington's Disease Program at Pennsylvania Hospital provides patients with a variety of therapeutic trials and genetic counseling.



- ▶ Penn has performed more than 1,200 deep brain stimulation (DBS) procedures, the primary surgical treatment for restoring brain function, making it the one of the largest treatment centers in the U.S. Penn is the first in our region to offer MRI-guided Focused Ultrasound (MRgFUS) for treatment of essential tremor, eliminating the need for open surgery.

DEMENTIA AND COGNITIVE DISORDERS

Penn Medicine's memory and dementia program specializes in the diagnosis of common, as well as complex, forms of progressive cognitive impairment, including Alzheimer's Disease.

The Penn Memory Center offers investigational medications and diagnostic procedures, such as neuroimaging and genetic screens. In addition, the team provides the latest medication-free treatments, including non-invasive brain stimulation for cognitive impairment due to head injury, chronic stroke, and dementia, and behavioral therapies for speech and cognition.



NATIONALLY-RECOGNIZED CARE AND TRANSLATIONAL RESEARCH OPTIONS are available at The Penn Memory Center, focusing on memory deficits, and The Frontotemporal Degeneration Center, focusing on younger-onset progressive cognitive and language impairments.

EPILEPSY AND SEIZURE DISORDERS

The Penn Epilepsy Center is the premier comprehensive center in the region, and one of the top in the nation. Using a team approach, Penn offers the newest medication trials and brain imaging techniques to map seizures. The team consists of neurologists and neurosurgeons who specialize in epilepsy and specialists across multiple other disciplines at Penn, including neuropsychology, neuroradiology, nuclear medicine, psychiatry, and psychosomatism.

Treatment options for epilepsy patients include:

- **Medical therapy and cognitive support**
- **Neuromodulation therapy:** advanced medical devices that work to elevate or suppress activity of the nervous system for the treatment of seizure disorders and epilepsy, including the Vagus nerve simulator device and the responsive neurostimulation device
- **Minimally invasive epilepsy surgery:** laser ablation, RNS devices, and endoscopic epilepsy surgery

The team at Penn is one of the world's leaders in monitoring patients continuously throughout their evaluations, in the operating room and throughout their hospitalizations to prevent complications and "silent" or subclinical seizures.



- ▶ **One of the many diagnostic services available for epilepsy patients at Penn is a modern six-bed Epilepsy Monitoring Unit (EMU) with Video electroencephalography (EEG) for the evaluation of individuals who are candidates for surgery and for differential diagnosis of "spells."**

THE NATIONAL ASSOCIATION OF EPILEPSY RECOGNIZES THE PENN EPILEPSY CENTER AS A LEVEL 4 EPILEPSY CENTER, which requires a center to have the professional expertise and facilities to provide the highest-level medical and surgical evaluation and treatment for patients with complex epilepsy.



NEUROMUSCULAR AND PERIPHERAL NERVE DISORDERS

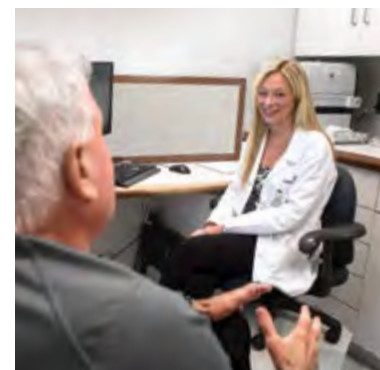
Penn neurologists and neurosurgeons evaluate, diagnose and treat patients with a variety of neuromuscular and peripheral nerve conditions through several subprograms at Penn.

Individuals with conditions such as trigeminal neuralgia, peripheral nerve tumors, and other problems with the peripheral nervous system are evaluated by Penn Medicine's neurosurgeons and neurologists at the Penn Center for Peripheral Nerve Disorders. The team works with each patient to determine the best medical and surgical treatments.

The Charcot-Marie-Tooth Center of Excellence is the largest center on the east coast to specialize in the diagnosis of this common cause of neuropathy.

For patients who have inherited diseases of the nerve and muscle as well as myasthenia gravis and Lambert-Eaton syndrome, the Muscular Dystrophy Association Clinic provides advanced care. The team works with the Children's Hospital of Philadelphia (CHOP) to provide lifespan care for patients.

The Guillian-Barre Syndrome/Chronic Inflammatory Demyelinating Polyneuropathy Center of Excellence has experts who can diagnose and treat these disorders, and has both inpatient and outpatient units.



- ▶ **Penn has pioneered endoscopic surgery for trigeminal neuralgia, hemifacial spasm and other disorders of the cranial nerves.** Complex brachial plexus tumors and trauma patients receive the latest techniques and reconstruction. Additionally, research to reconstruct the nerves with novel artificial materials is underway at Penn.

ALS

The largest in the region, the Penn Comprehensive Amyotrophic Lateral Sclerosis (ALS) Center at Pennsylvania Hospital specializes in multidisciplinary, comprehensive care of ALS patients. The Penn ALS team includes physicians, nurses, therapists and counselors who are all dedicated to the care of people with ALS. Additionally, ALS patients may have the opportunity to participate in advanced clinical trials.



**“WITHOUT PENN MEDICINE’S ROLE,
I WOULD STILL BE HAVING SEIZURES—LOTS OF SEIZURES.”**

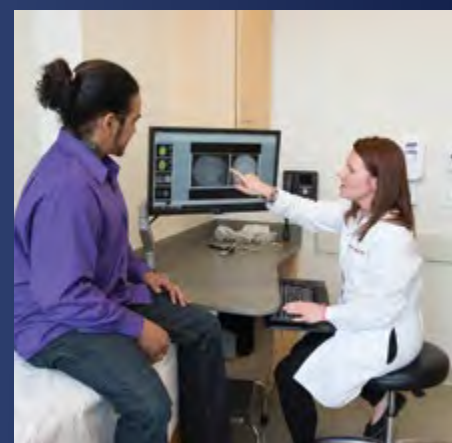


BERT | EPILEPSY

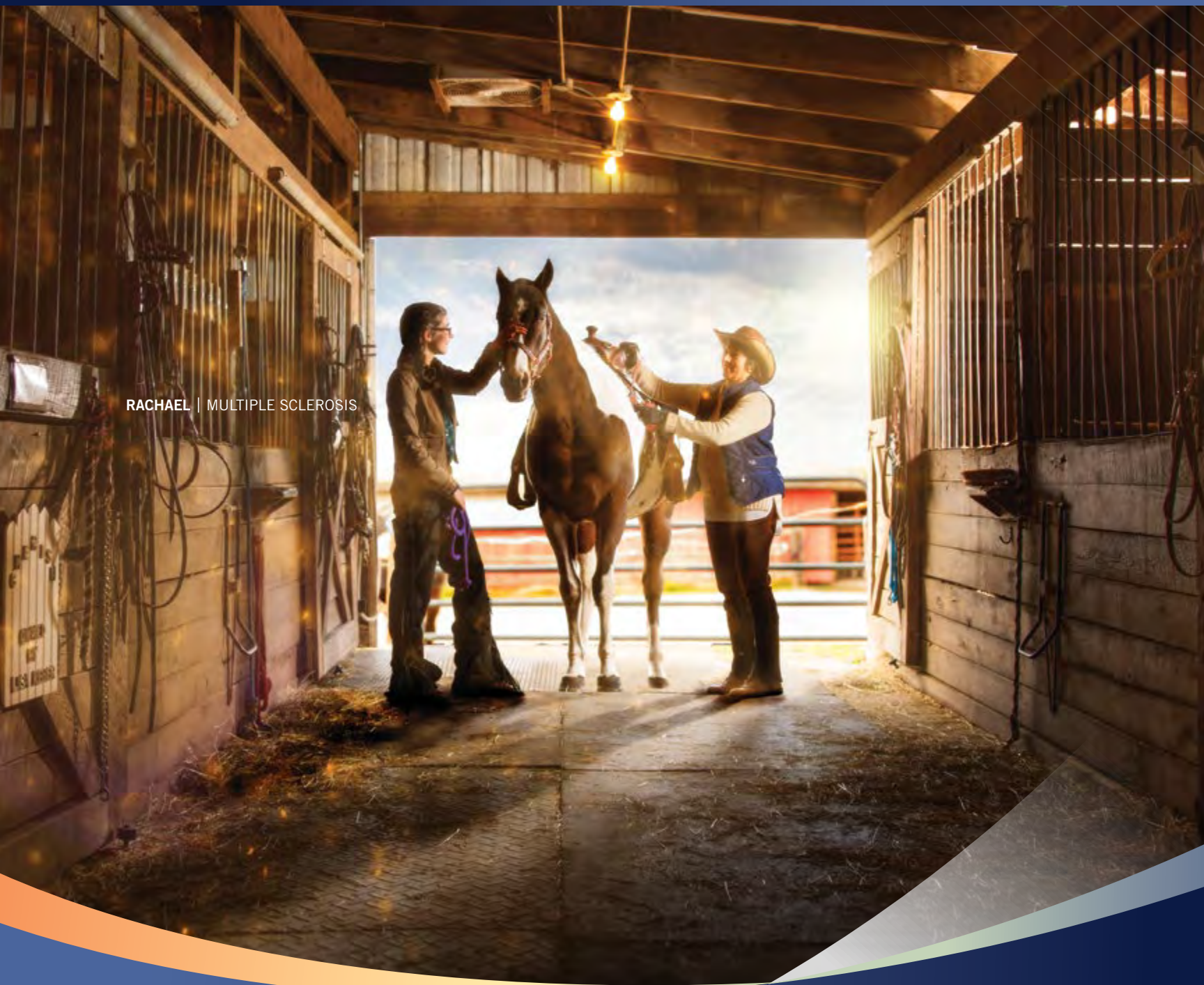
“PRIOR TO COMING TO PENN MEDICINE, MY SEIZURES WERE HAVING EFFECTS ON MY MEMORY. If I had a really bad night or day’s worth of seizures, I might not know where I’m at, what I did the day before, or maybe even the week before. While in school, I would have a full semester behind me—and then I’d have a bad night of seizures, and completely forget everything I had learned that semester.

The day after my surgery at Penn, I wanted to get up out of bed—I felt well. With the epileptic drug and Penn’s surgery, I am 100% seizure free. Without Penn Medicine’s role, I would still be having seizures—lots of seizures. At worst, I could be dead.

It’s nice to be alive. It’s awesome to be in school. I can work. It’s a beautiful thing to share with anybody the difference that Penn Medicine has made.” —**BERT, *Epilepsy Patient***

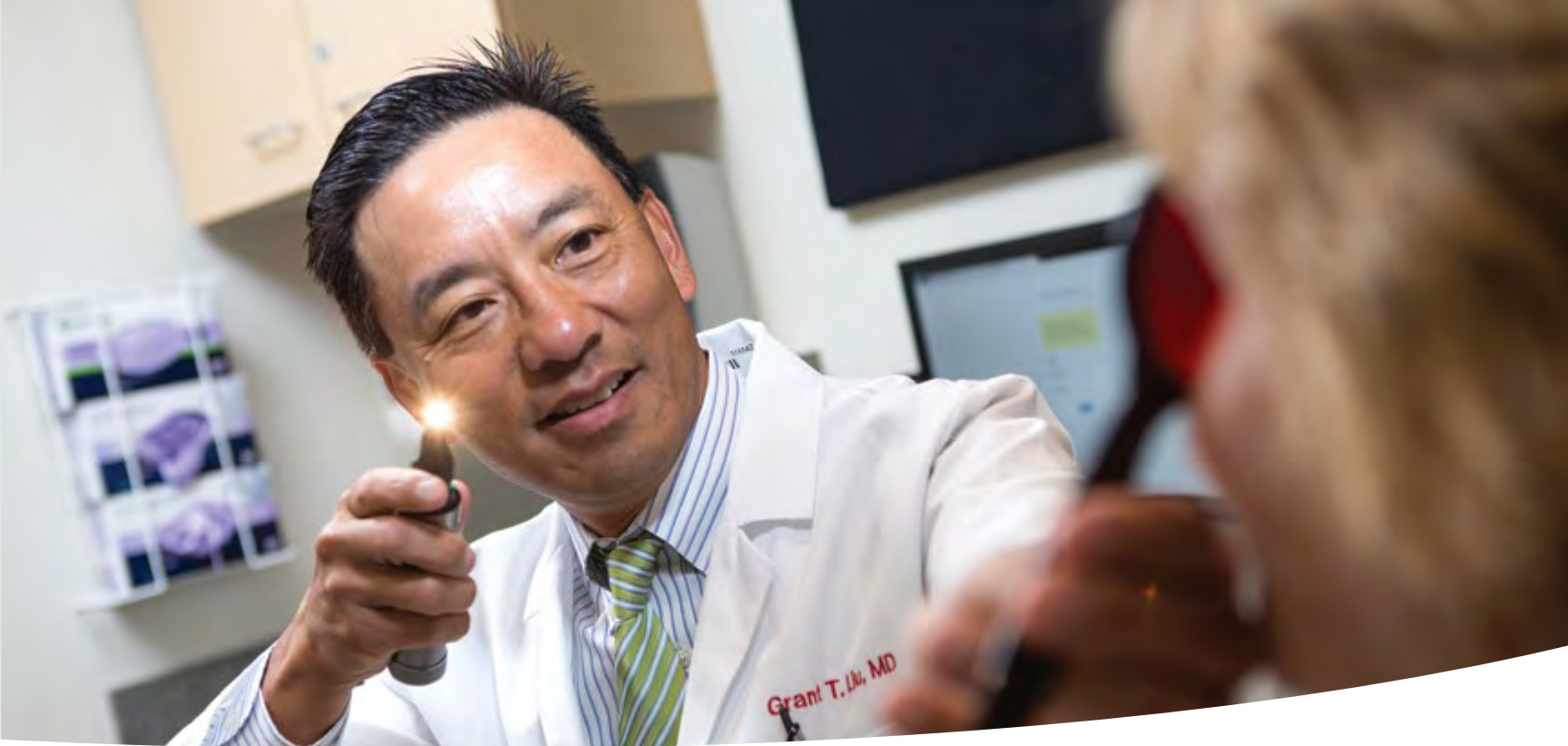


“ONLY PENN COULD PUT ALL OF THE PIECES TOGETHER AND GIVE ME THE DIAGNOSIS, TEAM AND TREATMENT I NEEDED TO GET BACK IN THE SADDLE—AND THAT IS WORTH PENN MEDICINE.”



RACHAEL | MULTIPLE SCLEROSIS

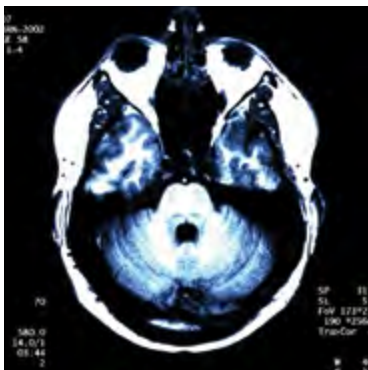
“MS IS LIFE CHANGING, ESPECIALLY WHEN YOU DON’T KNOW YOU HAVE IT. I WAS TOO EXHAUSTED AND WEAK TO RIDE MY HORSE, AND JUST KNEW SOMETHING WASN’T RIGHT. For years, I searched for an answer, and had lost hope—until I went to the region’s #1 ranked Neurosciences program. Only Penn could put all of the pieces together and give me the diagnosis, team and treatment I needed to get back in the saddle—and *that* is worth Penn Medicine.” —**RACHAEL, *Multiple Sclerosis Patient***



► In collaboration with both the **Scheie Eye** and **Penn Neurological Institutes**, the Penn Neuro-Ophthalmology Program is one of the largest in the nation.

NEURO-OPHTHALMOLOGY

Penn's Neuro-Ophthalmology Program bridges the fields of neurology and ophthalmology through the diagnosis and management of patients with neurological disorders that affect vision and eye movements. Currently consisting of specialists from Penn Neurology and Ophthalmology Departments, Penn Neuro-Ophthalmology has a rich history and active clinical and research components.



MULTIPLE SCLEROSIS

The multiple sclerosis (MS) team at Penn works with experts across several disciplines to provide diagnosis, care and management of MS and associated disorders. The Penn Comprehensive MS Center offers consultation, diagnosis and continued care for patients who are newly diagnosed with MS, and those with suspected MS, relapsing and progressing MS, and other forms of neuroinflammatory and demyelinating disease. The Penn MS Center is focused on teamwork to deliver patient-centric care.

Patients at the Penn MS Center may benefit from:

- **Access to onsite outpatient infusion clinic** for intravenous medication administration
- **Collaboration** with the Children's Hospital of Philadelphia (CHOP)
- **Support groups** for patient education and continued therapy
- **Training and support** for symptom management, self-injection of immunomodulatory therapies, and counseling
- **Dedicated MS pharmacist and pharmacy counseling**, a service that is not offered at any other MS center in the region and few in the nation



The National MS Society designated the **PENN MS CENTER AS A NATIONAL MS COMPREHENSIVE CARE CENTER**. This achievement recognizes the ability of the Penn MS Center to provide comprehensive care to patients with MS.

**“PENN’S RESEARCHERS PINPOINTED MY RARE DISEASE,
AND ACTUALLY CREATED THE TREATMENT THAT CURED IT.”**



AMANDA | RARE AUTOIMMUNE DISEASE

“I WAS HAVING TERRIBLE HEADACHES, PARANOIA AND DELUSIONS. EVERY DOCTOR I SAW GAVE ME THE WRONG DIAGNOSIS OR ASSUMED I WAS CRAZY. My mom knew better and wouldn’t give up. When my body started to shut down, she took me to Penn. Their researchers pinpointed my rare disease, Anti-NMDA Receptor Encephalitis, and actually created the treatment that cured it. That breakthrough is why I’m alive and with my mom today—and that is worth Penn Medicine.” —**AMANDA**, *Rare Autoimmune Disease Patient*

NEUROGENETICS

Genomic analysis is reshaping neurology in all areas. Penn has a neurogenetic service, including a dedicated neurogenetics counselor, to evaluate the genetic basis of disease across many subspecialty areas of neurology, including those syndromes that have been previously undiagnosed.



NEUROCRITICAL CARE

Penn's Neurocritical Care Program serves patients with life-threatening acute neurological injury. Penn has one of the most technologically advanced NeuroICUs in the nation and a team with the most experience and expertise in multi-modality neuromonitoring nationwide.

Board-certified neurointensivists, advance practice providers, neurocritical care fellows and dedicated nurses with expertise in neurointensive care, stroke and trauma are a part of the team who staff Penn's 24/7/365 NeuroICUs. The team also includes pharmacologists, respiratory therapists, physical and occupational therapists, and social workers, and works closely with neurosurgeons, anesthesiologists, traumatologists, stroke neurologists, palliative care and pain specialists, emergency physicians, and other medical specialists.



Penn has a dedicated Clinical Traumatic Brain Injury (TBI) Research Center, the goal of which is to provide **ACCESS TO NOVEL AND NATIONAL CLINICAL DIAGNOSTIC AND THERAPEUTIC TRIALS IN TBI CARE AND OUTCOMES.**



NEUROINFLAMMATORY AND AUTOIMMUNE CONDITIONS

Penn leads the way in developing diagnostic panels for rare autoimmune disorders such as autoimmune encephalitis, neuropathy, and paraneoplastic syndromes. Penn offers advanced autoantibody testing and clinical care for patients with these diseases. Physicians from Penn's Program in Autoimmune Neurology discovered many forms of autoimmune encephalitis and are currently conducting translational research on autoimmune diseases.



CRANIAL BASE TUMORS AND DISORDERS

Tumors of the skull base, face and neck require special expertise and can affect vision, hearing, pituitary function and vascular supply to the brain. The Center for Cranial Base Surgery consists of neurosurgeons, otolaryngologists, neuro-ophthlamologists, radiation oncologists and medical oncologists who meet regularly to discuss these complex cases and formulate treatment plans. Penn's innovations include use of special dyes to help tumors glow for safer surgical removal, endoscopic skull base surgery, proton beam therapy and robotic surgery. The team works closely with endocrinologists in the Penn Pituitary Center to provide the most advanced medical and surgical treatment for patients with pituitary disorders.



► Penn neurosurgeons are evaluating the use of fluorescent dyes and near infrared light to see cancer cells that would otherwise be invisible, with the hope being to assist in a more complete resection of brain tumors.

PENN'S CENTER FOR CRANIAL BASE SURGERY is the only comprehensive program in the region for cranial base surgeries, and a pioneer in the development of minimally invasive surgical procedures and imaging techniques. Penn can treat patients with cranial base tumors that were previously considered inaccessible.

BRAIN TUMORS AND NEURO-ONCOLOGY

The Brain Tumor Center at Penn is nationally recognized for innovative, leading edge therapy of benign and malignant tumors originating in the brain, as well as metastatic cancer that originates in areas other than the brain.

Every patient is reviewed by a team that includes neurosurgeons, radiation oncologists, medical oncologists, neurologists, neuro-oncologists and neuroradiologists. Together, they develop a personalized plan based on each patient's testing and imaging results. Working closely with Abramson Cancer Center and the Roberts Proton Therapy Center, the Brain Tumor Center offers medical and radiation therapy with the latest devices, including Gamma Knife and proton therapy, and provides access to clinical trials.

Brain surgery is performed using image guidance and special techniques, such as intraoperative speech and motor mapping. Penn's Center for Personalized Diagnostics provides genomic testing to help patients enter specific immunotherapy trials such as CAR-T and other NIH-sponsored trials. These trials are unique in this region; Penn is one of only 10 participating institutions in the North American Brain Tumor Consortium Clinical Trials Network.



► The brain tumor and neuro-oncology team at Penn includes recognized leaders in the treatment of rare and complex neurologic cancers and neurologic complications associated with cancer.

Patients at Penn can benefit from a variety of **BREAKTHROUGH CLINICAL TRIALS THAT CAN HELP IMPROVE THE QUALITY OF LIFE FOR THOSE WITH NEUROLOGICAL DISORDERS.** For more information about brain tumor and other neurological clinical trials, call **215.662.4484.**



**“PENN INVENTED A WAY TO MAKE MY TUMOR GLOW,
SO GOING INTO SURGERY THEY COULD SEE EVERY LAST BIT.”**



TAMARA | BRAIN TUMOR

“MY DAUGHTER AND I WERE DANCING WHEN THE DIZZINESS STARTED. Then the constant migraines came—that’s when they found the brain tumor. After getting multiple opinions, I chose Penn. It was a dark time, but Penn’s doctors gave me confidence. They invented a way to make my tumor glow, so going into surgery they could see every last bit. Thanks to this breakthrough, my daughter and I can shine again on the dance floor—and that is worth Penn Medicine.” —**TAMARA**, *Brain Tumor Patient*



NEUROTRAUMA

The Neurotrauma Center, located at Penn Presbyterian Medical Center, takes care of the most complex brain and spinal trauma conditions in the region. Working closely with the Penn trauma team, the Neurotrauma team's ability to save the lives of patients and improve their outcomes is unmatched.

Along with Penn neurocritical care specialists, Penn neurosurgeons manage a multitude of conditions, including raised intracranial pressure and seizures with multimodality monitoring, which was pioneered at Penn.

The Penn Neurotrauma team is a part of the **NIH-NEURO EMERGENCY TRIALS NETWORK**, providing patients access to new clinical trials.

► **Above:** The Penn Neurotrauma Center is designated as a Level I Trauma Center.



GENERAL NEUROLOGY

At Penn Neurology, neurologists diagnose and treat the full spectrum of basic and complex neurological disorders. Through Penn's general neurology program, patients have access to related subspecialists who work together using a multidisciplinary approach. The team works one-on-one with patients to reach an accurate diagnosis and create individualized treatment plans with the goal of achieving the highest quality of life possible.

Penn neurologists evaluate and address a variety of symptoms that may be caused by a neurological condition including:

- **Amyloid Neuropathy**
- **Amyloidosis**
- **Dizziness**
- **Fainting**
- **Memory problems/confusion**
- **Physical impairments/limb weakness/problems walking**
- **Sensory problems (tingling, pain, numbness)**
- **Seizures**
- **Sleep problems**
- **Slurred speech/speech problems/difficulty remembering words**
- **Vision changes**

NEUROLOGY-SLEEP CONDITIONS

Penn Neurology, in collaboration with the Penn Sleep Center, uses a multidisciplinary approach to care to address and treat all primary neurologic sleep disorders as well as sleep disturbances that arise in other neurological conditions.

Not all sleep disorders are caused by a neurologic condition. If a neurological condition is suspected to be the cause or contribute to a sleep disorder, a neurologist with specific expertise in sleep medicine will provide care.

NEUROREHABILITATION



► Penn Neurorehabilitation research focuses both on the **development and use of “hands on” robots** to support and move the upper limbs in functional activities and on **understanding the causes of impairment** and how to best apply these systems to provide effective rehabilitation.

For patients with physical and cognitive impairments and disabilities caused by a neurological disorder, such as stroke, or a spine or brain injury, Penn’s neurorehabilitation services are an essential part of the care plan. Led by the Penn Medicine Department of Physical Medicine and Rehabilitation, neurorehabilitation is offered to patients as outpatient or inpatient services. Neurorehabilitation at Penn integrates compassionate care with expert medical and rehabilitation services to restore patients to the maximum level of cognitive and physical function.

Penn Neurorehabilitation refers to a group of therapies that aims to enhance the quality of life for patients who have neurologic disorders or injuries. Each patient receives an individualized treatment plan to help patients regain physical mobility, strength, endurance and acquire the skills to live the most independent life possible.

Penn’s neurorehabilitation team is made up of multidisciplinary specialists including neurosurgeons, neurologists, physiatrists, physical therapists, occupational therapists and speech pathologists.

Neurorehabilitation treatments include occupational therapy, physical therapy, recreational therapy, spasticity treatment, speech therapy, vestibular rehabilitation, and vision therapy. Patients requiring neurorehabilitation services have access to several specialty rehab clinics, including the Penn Spasticity Clinic, the Penn Brain Injury Rehabilitation Program, the Penn Concussion Clinic, and the Penn Spinal Cord Injury and Disorders Rehabilitation Program.



Penn Medicine offers comprehensive inpatient and outpatient neurorehabilitation for patients who suffer from a Traumatic Brain Injury (TBI) and mild TBI through **PENN'S CENTER FOR BRAIN INJURY AND REPAIR**.

The Center has been in existence for over 30 years at Penn and is **ONE OF ONLY FIVE DESIGNATED BRAIN INJURY CENTERS NATIONWIDE**.

The team is actively researching ways to halt the progressive damage initiated by mild to severe TBI.





NEURODIAGNOSTICS

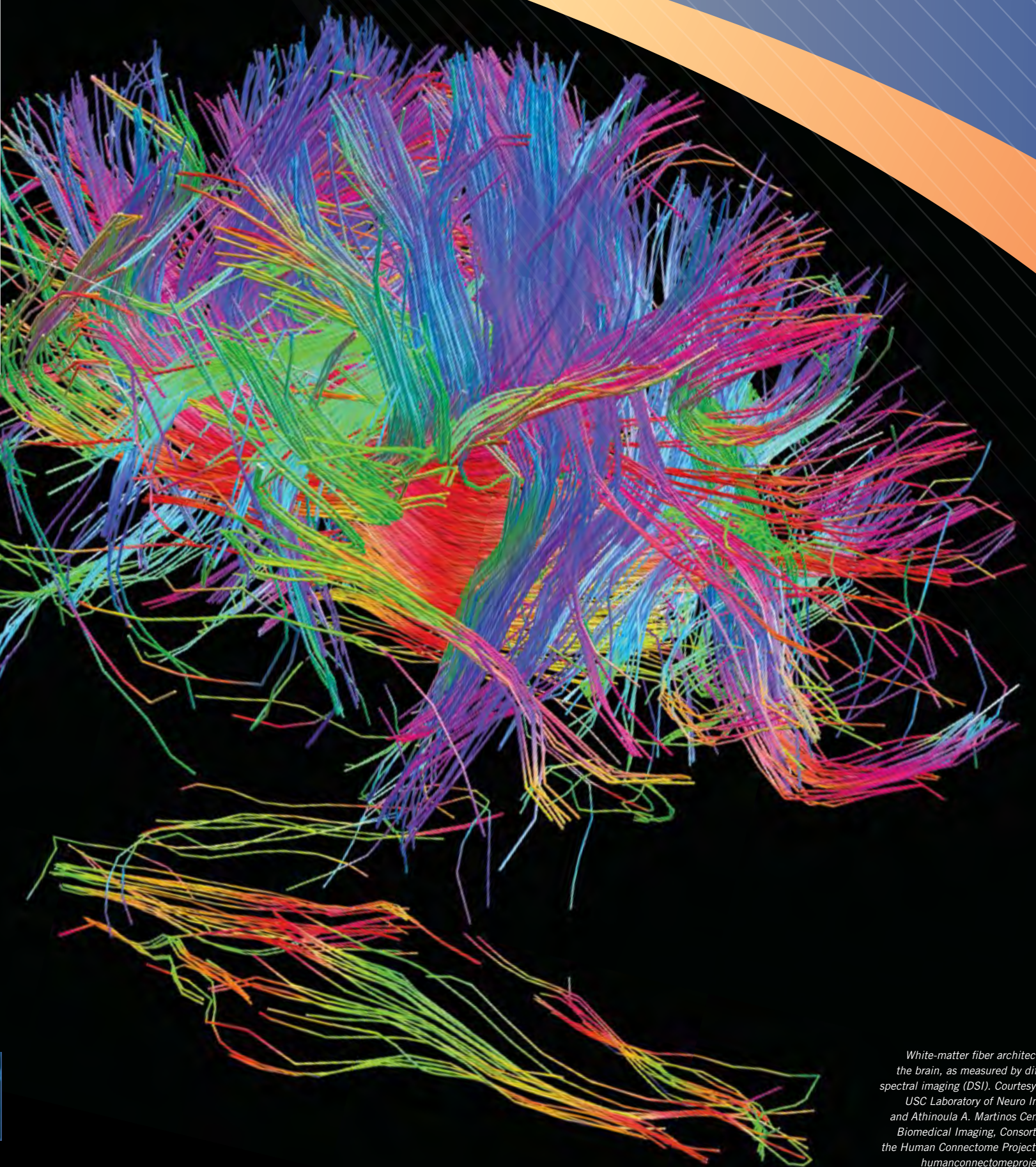
Penn Neurosciences uses the most advanced neurodiagnostic technology (NDT) tools and techniques to aid our expert technologists and neurologists in diagnosing diseases and conditions, including epilepsy, multiple sclerosis, stroke, Parkinson's disease, myasthenia gravis, and nerve conditions. In the Penn Neurodiagnostic Lab, technologists record and analyze the electrical activity of the brain, blood vessels, visual pathways, spinal cord and nervous system using the following techniques:

- **Electroencephalography (EEG)**
- **Long term EEG monitoring**
- **Evoked potentials**
- **Electromyography (EMG) and nerve conduction**
- **Quantitative sensory testing**
- **Single fiber EMG**
- **Intraoperative neuromonitoring**
- **Transcranial Doppler**
- **Carotid ultrasound**
- **Visual field testing**
- **Optical Coherence testing (OCT)**
- **Fundus testing**
- **Neurogenetics screening**
- **Neuro-Immune screening**

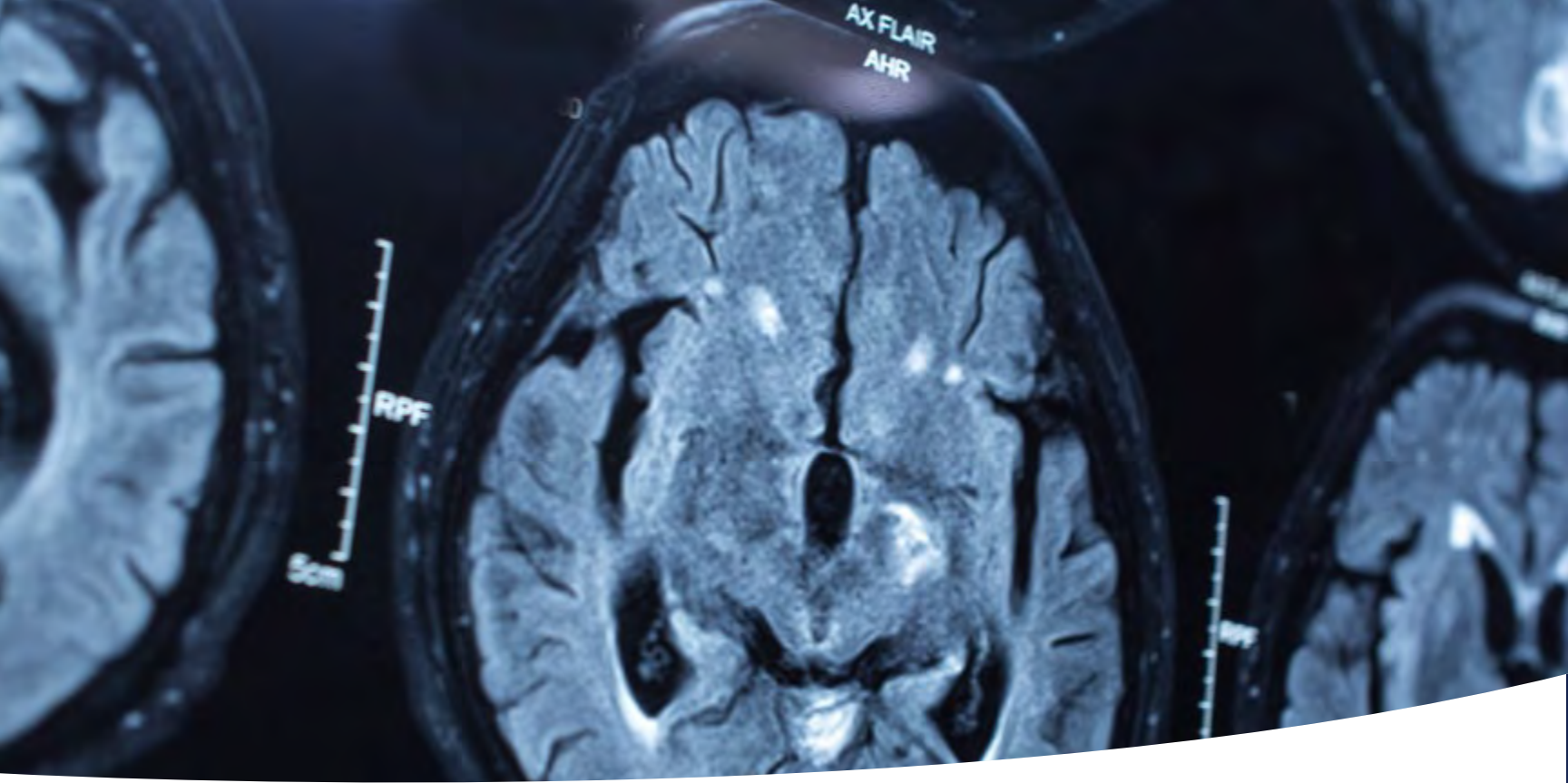


The Penn Medicine Neurodiagnostic Lab is also **THE PRIMARY SOURCE FOR NDT CLINICAL EDUCATION** in the Philadelphia region.





White-matter fiber architecture of the brain, as measured by diffusion spectral imaging (DSI). Courtesy of the USC Laboratory of Neuro Imaging and Athinoula A. Martinos Center for Biomedical Imaging, Consortium of the Human Connectome Project, www.humanconnectomeproject.org.



NEURORADIOLOGY

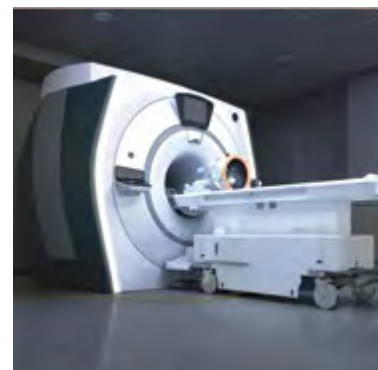
Penn Neuroradiology is among the top programs in the U.S. with a full complement of outstanding faculty and staff dedicated to providing excellent clinical care, cutting-edge research and first-rate education.

Neuroradiology is the subspecialty of radiology that conducts imaging of the brain and nervous system, head, neck and spine. Imaging methods used in neuroradiology include x-ray, CT, ultrasound and MRI. Interventional neuroradiology, a specialty within neuroradiology, is primarily dedicated to the treatment of disorders of the blood vessels of the neck and brain from inside the blood vessels.

The Penn Neuroradiology team uses the most technologically advanced imaging services, while limiting radiation dose to the absolute minimum necessary to obtain the most precise results. Areas of advanced imaging include:

- **MR spectroscopy for the study of brain tumors and epilepsy**
- **MR and CT perfusion imaging for the study of stroke and brain tumors**
- **MR and CT angiography for the noninvasive study of the arteries that supply the brain**

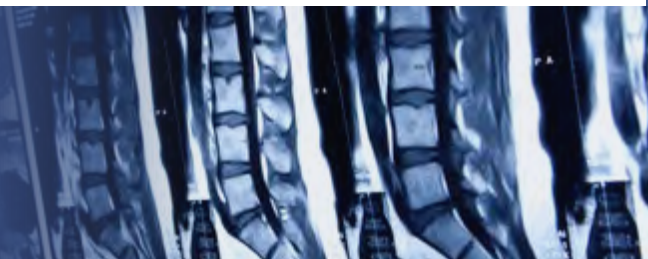
Patients who need radiology services have access to diagnostic imaging and radiology services in several convenient Penn locations throughout the Philadelphia region.



- ▶ **Advanced Imaging:** Our team of dedicated, subspecialty trained neuroradiologists utilize state-of-the-art technology, while limiting radiation dose to the absolute minimum necessary to obtain the most precise results.

ADVANCED SPINAL IMAGING

Spinal dural fistulas are the most common type of spinal vascular malformations. Penn Neuroradiology treats subtle spinal dural fistulas with noninvasive localization. This approach reduces the time for endovascular localization and treatment from the typical three hours to less than 30 minutes.





Penn Medicine

800.789.PENN PennMedicine.org