Center for Neurological Restoration
Movement Disorders Management and Deep Brain Stimulation
Cleveland Clinic Neurological Institute  
Center for Neurological Restoration

Dear Colleague,

Cleveland Clinic’s Center for Neurological Restoration is an integrated, multidisciplinary team offering the latest medical and surgical interventions to patients with intractable movement disorders and other neurological impairments.

When you make a referral, your patient will be seen by specialists including neurologists, neurosurgeons, psychiatrists, neuropsychologists, neurophysiologists, imaging specialists, specialized nurses and midlevel providers. Within the past year we have hired two new neurosurgeons, both fellowship-trained in movement disorders, to reduce wait times and maintain our commitment to exceptional patient care. Our team is not simply a working group bridging the distance between specialties; rather, we are colleagues working side by side at a single center.

Our center is one of the most experienced in the world in performing deep brain stimulation (DBS) surgeries, having implanted hundreds of neuromodulation devices to improve function and quality of life in patients with disabling movement disorders. The recent addition of our intraoperative MRI suite (IMRIS) for DBS and other neurological procedures represents a significant advance in patient safety and our commitment to integrating innovative technologies.

Only a small number of U.S. centers offer a variety of surgical options for managing Parkinson disease and other movement disorders, and ours is one of them. Our approach is centered on individualizing the choice of surgical technique to each patient’s needs and characteristics. As is true in pharmacologic management, one size may not fit all.

We have expanded our basic and clinical research programs, providing more opportunities for your patients to participate in appropriate clinical trials of emerging treatment modalities. While our DBS-related research is focused on movement disorders, our investigators are also studying novel therapies for disabling neuropsychiatric disorders such as treatment-resistant depression, obsessive-compulsive disorder, stroke-related motor impairment and refractory chronic pain syndromes.

We invite you to consider us a principal resource for consultation and referral when you have movement disorder patients who need specialized medical management or may be candidates for surgical intervention. We welcome the opportunity to partner with you in caring for your patients. Our specialists are available around the clock and committed to serving you and your patients. Please contact our Referring Physician Hotline, available 24/7 for all your needs, at 855.REFER.123 (855.733.3712).

Andre G. Machado, MD, PhD  
Director, Center for Neurological Restoration  
Center for Neurological Restoration  
Cleveland Clinic Neurological Institute

Hubert H. Fernandez, MD  
Section Head, Movement Disorders  
Center for Neurological Restoration  
Cleveland Clinic Neurological Institute

LEFT: Neurosurgeon Andre Machado, MD, PhD, guides placement of an electrode in a targeted area of a patient’s brain during deep brain stimulation surgery.
Medical Management Made Convenient and Accessible

Medical management is the cornerstone of movement disorder care. Specialists in the Movement Disorders Section of our Center for Neurological Restoration are available for consultation regarding the often-complex differential diagnosis of movement disorders, as well as for medical management and counseling. Given the frequency of psychiatric, behavioral and cognitive comorbidities in movement disorder patients, we have integrated these components of care at our center, which includes two neuropsychologists and one psychiatrist focused on movement disorders.

To streamline and simplify patient visits, the entire Movement Disorders Section team is based at a single location on Cleveland Clinic’s main campus. The space is conveniently located on the third floor of the freestanding Mellen Center building on the corner of East 89th Street and Euclid Avenue, separate from the hospital’s busiest areas. Parking is available in front of the building, which is wheelchair accessible. Our space is designed for managing chronic neurological disorders and includes ample exam rooms, imaging capabilities, and wide corridors and doorways.

Leveraging Long-Standing Expertise in Deep Brain Stimulation

DBS is an effective treatment modality for patients with advanced movement disorders and is FDA-approved for the treatment of Parkinson disease, essential tremor and dystonia.

The Center for Neurological Restoration ranks among the world’s leading centers in DBS surgery and postoperative care, as well as in research and innovation. Our neurologists, neurophysiologists and neurosurgeons work in close collaboration to optimize outcomes, facilitated by our patient-centered approach. Our physicians are subspecialty- and fellowship-trained in techniques of microelectrode recording, intraoperative physiology, and stereotactic and functional neurosurgery.

A Diversity of Surgical Choices

Recommending surgery for Parkinson disease and other movement disorders is no simple task. Patients have variable presentations of motor features as well as different behavioral, cognitive and medical comorbidities. Decisions about surgical candidacy depend on more than just the potential for alleviating motor features; they must also consider the other domains of neurological function.

Given the diversity of patient-specific needs and characteristics, no single surgical approach is ideal for all patients. While technologies such as intraoperative imaging bring important new capabilities, they are not a replacement for existing methods. Some patients may be ideal candidates for surgery with awake physiology and testing, whereas others may be better candidates for a DBS procedure under general anesthesia. The decision should not be limited by the institution’s capabilities. Rather, it should be based on which method is best for each patient.
At Cleveland Clinic we have made massive investments to bring a diversity of surgical choices to our movement disorder patients. These include DBS implantation guided by awake intraoperative physiology as well as surgery guided by intraoperative imaging under general anesthesia. The choices are discussed with our patients and then considered during our multidisciplinary patient management conference (see below). This enables us to account for patient and surgeon preferences as well as nuances observed by neurologists, psychologists and psychiatrists in our quest to reach the best decision for each patient. The options we can draw on include:

- **Various approaches to DBS**, including frame-based surgery, frameless surgery, intraoperative MRI under general anesthesia, and guidance by intraoperative physiology
- **Ablative procedures** such as thermoablation and Gamma Knife® radiosurgery
- **Investigative approaches in the context of clinical trials**, including use of intraoperative physiology under anesthesia, use of an intra-abdominal levodopa pump, administration of novel cognitive tests during DBS implantation and use of music to affect brain physiology during DBS surgery

**Patient Management Conference**

Your patient will undergo an extensive screening process to determine his or her candidacy for DBS or an alternate procedure. A significant strength of the Center for Neurological Restoration team lies in our regular patient management conferences, where our multidisciplinary team reviews each patient’s case and prepares a recommendation.

The patient management conference takes into account key components of the multidisciplinary assessment, including:

- Evaluation by a movement disorder neurologist
- Evaluation by a neurosurgeon specializing in DBS
- Neuropsychological evaluation
- Neuroimaging
- Patient records and referring physician notes

Some individuals also undergo a specialized psychiatric evaluation for movement disorder patients. If you believe your patient has behavioral comorbidities, please indicate this in your referral.

**Neuropsychological Evaluation**

As a DBS candidate, your patient will undergo an assessment by a neuropsychologist specializing in movement disorders and DBS. This formal assessment focuses on cognitive abilities and is an essential part of our multidisciplinary approach to treatment.
The neuropsychological evaluation is critical to determining whether a patient’s cognitive skills have been impaired by the underlying disease process or treatment side effects. Patients with significant cognitive difficulties may not be suitable candidates for DBS.

The neuropsychological evaluation has two parts:

- **Interview (1 to 1½ hours):** A neuropsychologist interviews your patient and a family member separately to assess how the movement disorder has affected the patient’s life.
- **Neuropsychological testing (3 to 4 hours):** A neuropsychology technician administers tests to measure concentration, memory, and verbal and visual abilities. Testing is usually completed in one visit.

**Innovations in DBS Surgery**

Surgical techniques for DBS vary among facilities and surgeons. At Cleveland Clinic, DBS implantation is routinely guided by advanced imaging, stereotactic techniques and microelectrode recording. The intraoperative findings are used to guide postoperative programming, which actively involves the neurophysiology team.

Pulse generators for DBS are typically implanted in the infraclavicular region, either unilaterally or bilaterally. Within weeks, these stimulators are activated for the first time during an outpatient procedure performed by a neurologist with a nurse practitioner or physician assistant.

For patients who cannot tolerate or are not candidates for traditional awake DBS surgery guided by microelectrode recording, Cleveland Clinic has installed and validated (for DBS) an interventional MRI suite, called IMRIS Neuro, attached to a conventional operating room. The MRI machine is suspended from the ceiling and moved into the operating room only when needed.

The IMRIS system allows surgeons to evaluate the location of the lead in the brain prior to completion of the surgical procedure. Guided by feedback from the system, the neurosurgeon can plan and precisely place the leads while the patient is under general anesthesia. Previously, almost all DBS required awake surgery.

**Benefits to Your Patient**

Our center is one of the top institutions offering DBS surgery in an intraoperative MRI suite, allowing the procedure to be completed under general anesthesia.

Unlike lesioning procedures such as pallidotomy or thalamotomy that involve intentional destruction of nervous tissue, the effects of DBS are reversible. Moreover, the stimulation can be modified over time as your patient’s disease progresses.
Although not without risk, DBS surgery has been shown to be safe and effective, with beneficial effects lasting several years:

- In patients who initially responded well to dopaminergic medication but exhibited side effects over time, DBS is likely to yield significant improvements in symptoms such as tremor, rigidity, dyskinesia and bradykinesia.
- Some patients experience substantial improvements in freezing and gait.
- DBS increases “on” time, reduces “on-off” fluctuations and allows for medication reduction.

**Risks**

Like any surgical procedure, DBS has risks, the most serious being intracerebral hemorrhage. Other risks include cognitive and other neurological problems as well as complications that may require surgical revision, including lead infection and erosion, hardware problems (leads, pulse generators and extensions) and limited efficacy.

Patients are often elderly and disabled, and medical comorbidities may pose a higher risk of perioperative complications.

**Research to Advance Neurorestorative Therapies**

Cleveland Clinic continues to conduct forward-looking research in neurorestorative therapies for patients with disabilities secondary to neurological and psychiatric disorders:

- We are leading the first-ever controlled clinical trial of DBS targeting the ventral striatal region for post-stroke pain syndrome.
- In collaboration with Donald Malone, MD, Chair of Cleveland Clinic’s Department of Psychiatry and Psychology, our center is playing a lead role in the development of DBS to treat neuropsychiatric disorders.
- We are among a few institutions worldwide that have collaborated — for a decade now — on studies of DBS for disabling obsessive-compulsive disorder (OCD). This work underlies the FDA’s approval of DBS, under a humanitarian device exemption, for use in patients with refractory OCD.

The scope of our research extends well beyond DBS. For instance, biomedical engineer Jay Alberts, PhD, is investigating how forced exercise, performed under strict parameters, can alter motor function in patients with Parkinson disease. This promising and innovative work grew out of a trip during which Dr. Alberts’ tandem bicycle partner, a Parkinson patient pedaling at a given pace, noticed motor function improvements that lasted beyond the duration of the exercise.
Access to Clinical Trials

Our comprehensive Movement Disorders Clinical Trials Program, under the direction of Hubert Fernandez, MD, is one of the nation’s most recognized programs of its type, offering patients the chance to consider the very latest in pharmacologic and nonpharmacologic advancements in Parkinson disease and other movement disorders. Program highlights include:

- Comprehensive clinical trial offerings to Parkinson patients at all stages of the disease
- Active membership in the Parkinson Study Group, the Huntington Study Group and the Dystonia Study Group — the continent’s oldest and most respected consortia of clinical trialists in movement disorders
- Pioneering work in clinical trials of nonpharmacologic interventions for Parkinson disease and other movement disorders, such as exercise therapy, repetitive transcranial magnetic stimulation, computerized cognitive behavioral therapy and DBS surgery
- Clinical trial offerings in orphan conditions such as Huntington disease, dystonia and spasticity

Comprehensive, Multidisciplinary Care for All Movement Disorders

The Center for Neurological Restoration has assembled one of the nation’s largest teams of dedicated specialists — including neurologists, neurosurgeons, neuropsychologists and specialized nurses, together with physical, occupational, speech and swallow therapists — under one roof to provide truly comprehensive care for patients with any movement disorder. Highlights of our distinctive clinical offerings include:

- A full-day, comprehensive, interdisciplinary shared medical appointment (“Taking Control of Parkinson Disease”) for newly diagnosed Parkinson patients and their caregivers, designed to empower patients with the knowledge to confidently navigate through the complexities of this lifelong disorder
- A half-day multidisciplinary clinic for all patients with Huntington disease, including evaluations by a neurologist, a psychiatrist, a geneticist, and physical and occupational therapists
- Ultrasound-guided botulinum toxin injections for precise delivery to small, thin and deep muscles — one of the region’s first offerings of this type for movement disorders
- Integration of the Computer Assisted Rehabilitation Environment (CAREN) system into the care of patients with movement disorders — a system not offered by any other program in the region
- A streamlined, hassle-free, two-day evaluation for all DBS candidates, including brain imaging and neuropsychological testing as well as neurological, neurosurgical and psychiatric assessment

RIGHT: The CAREN system is an immersive virtual reality treadmill that safely customizes rehabilitation challenges to a patient’s ability and performance level. Movement disorder patients are among the primary populations using CAREN since its installation at Cleveland Clinic in 2013, the first nonmilitary installation of the system in the Americas.
Referring Physician Hotline
855.REFER.123 (855.733.3712)
clevelandclinic.org/refer123
Available 24/7 for all your needs.

Physician Directory
View our staff online at
clevelandclinic.org/staff.

Same-Day Appointments
Cleveland Clinic offers same-day appointments to help your patients get the care they need, right away. Have your patients call our same-day appointment line, 216.444.CARE (2273) or 800.223.CARE (2273).

Track Your Patients’ Care Online
Establish a secure online DrConnect account for real-time information about your patients’ treatment at Cleveland Clinic at clevelandclinic.org/drconnect.

Physician Referral App
Contacting us is easier than ever. Download our free Physician Referral App today at the App Store or Google Play.

Consult QD – Neurosciences
A blog for the latest insights and perspectives from Cleveland Clinic experts. Visit today and join the conversation. consultqd.clevelandclinic.org/neurosciences

About Cleveland Clinic
Cleveland Clinic is an integrated healthcare delivery system with local, national and international reach. At Cleveland Clinic, more than 3,000 physicians and researchers represent 120 medical specialties and subspecialties. We are a nonprofit academic medical center with a main campus, eight community hospitals, more than 75 northern Ohio outpatient locations (including 16 full-service family health centers), Cleveland Clinic Florida, Cleveland Clinic Lou Ruvo Center for Brain Health in Las Vegas, Cleveland Clinic Canada, Sheikh Khalifa Medical City and Cleveland Clinic Abu Dhabi.

In 2014, Cleveland Clinic was ranked one of America’s top 4 hospitals in U.S. News & World Report’s “Best Hospitals” survey. The survey ranks Cleveland Clinic among the nation’s top 10 hospitals in 13 specialty areas, and the top in heart care (for the 20th consecutive year) and urologic care.
Cleveland

ANDRE G. MACHADO, MD, PHD  
Neurosurgeon | Director, Center for Neurological Restoration  
Specialty interests: DBS for movement disorders, Parkinson disease, tremor, dystonia, surgical treatment for refractory chronic pain and headaches, spinal cord stimulation, intrathecal pumps, surgical treatment of spasticity

HUBERT H. FERNANDEZ, MD  
Neurologist | Section Head, Movement Disorders  
Specialty interests: Pharmacologic and nonpharmacologic treatment of movement disorders, nonmotor aspects of movement disorders (dementia, depression, anxiety hallucinations, etc.), Parkinson disease, Huntington disease, Tourette syndrome, tremors, dystonia, chorea, tics, gait disorders  
Dr. Fernandez sees patients in Northeast Ohio, Florida and Nevada.

ANWAR AHMED, MD  
Neurologist  
Specialty interests: Movement disorders, tremor analysis, Parkinson disease, dystonia, botulinum toxin injections for dystonia, DBS for movement disorders

JAY ALBERTS, PhD  
Biomedical Engineer | Director, Cleveland Clinic Concussion Center  
Research interests: Effects of DBS on motor function of Parkinson patients, effects of unilateral DBS on bilateral motor function, effects of a strict exercise regimen on motor function
KRISTIN APPLEBY, MD
Neurologist
Specialty interests: Movement disorders including dystonia, essential tremor and Parkinson disease

DARLENE FLODEN, PhD, ABPP-CN
Neuropsychologist
Specialty interests: Neuropsychology, DBS, executive function, neuroeconomics, Parkinson disease, fMRI

JOHN GALE, PhD
Biomedical Engineer
Research interests: Basal ganglia physiology, Parkinson disease, motor control, motivation, translational neurotechnologies

MICHAL GOSTKOWSKI, DO
Neurologist
Specialty interests: Movement disorders, Parkinson disease, dystonia, botulinum toxin injections for dystonia, medical treatment of movement disorders

ILIA ITIN, MD
Neurologist
Specialty interests: Movement disorders including Parkinson disease, essential tremor, gait disorder and dystonia; botulinum toxin injection for dystonia and spasticity; ataxia; Huntington disease
DARLENE A. LOBEL, MD, FAANS

Neurosurgeon

Specialty interests: DBS for movement disorders, neuropsychiatric disorders, and emerging indications; frameless DBS, stereotactic neurosurgery, spinal cord stimulation for chronic pain disorders, surgical management of spasticity

DONALD A. MALONE JR., MD

Psychiatrist | Director, Center for Behavioral Health Chair, Department of Psychiatry and Psychology

Specialty interests: Psychopharmacology, mood disorders, anxiety disorders, neuromodulation

SEAN NAGEL, MD

Neurosurgeon

Specialty interests: DBS for movement disorders, surgical treatment of chronic pain, headache and craniofacial pain including trigeminal neuralgia, surgical treatment of spasticity, Gamma Knife radiosurgery

CYNTHIA S. KUBU, PhD, ABPP-CN

Neuropsychologist

Specialty interests: Neuropsychiatry; neuropsychological assessment in the neurosurgical treatment of epilepsy, movement, psychiatric and neurobehavioral disorders; dementia; neuroethics

RICHARD LEDERMAN, MD, PhD

Neurologist

Specialty interests: Performing arts medicine, electromyography, peripheral nerve disease, movement disorders, Tourette syndrome, botulinum toxin injections for movement disorders
MAYUR PANDYA, DO  
*Neuropsychiatrist | Director, Huntington Disease Comprehensive Care Clinic*

Specialty interests: Neurobehavioral disorders in Parkinson disease and other movement disorders, adult psychiatry, Huntington disease

ELA B. PLOW, PhD, PT  
*Biomedical Engineer*

Research interests: Stroke, motor skill learning, neurorehabilitation, neuroplasticity following disease and recovery, neuroimaging to study mechanisms of neuroplasticity, noninvasive brain stimulation to evaluate and direct mechanisms of plasticity to promote learning and recovery

JOSEPH RUDOLPH, MD  
*Neurologist*

Specialty interests: Parkinson disease, atypical parkinsonian disorders, DBS, botulinum toxin injections for dystonia, chorea, cognitive and sleep-related complications of Parkinson disease

STEWART TEPPER, MD  
*Neurologist*

Specialty interests: Headache
Cleveland Clinic Florida

NESTER GALVEZ-JIMENEZ, MD, MSc, MS (HSA), FACP
Neurologist | Director, Department of Neurology (Florida)
Specialty interests: Parkinson disease and other parkinsonian syndromes, botulinum toxin therapy, dystonia diagnosis and management, Huntington disease, akathisia and restless legs syndrome, Tourette syndrome, tremors and myoclonus

BADIH ADADA, MD
Neurosurgeon
Specialty interests: Neurological surgery, skull base and vascular neurosurgery, DBS for movement disorders, epilepsy surgery

TARANNUM KHAN, MD
Neurologist
Specialty interests: Parkinson disease, movement disorders, dystonia, blepharospasm, hemifacial spasm, gait disorders, essential tremor, botulinum toxin treatment for dystonias, migraine headaches, post-stroke spasticity, DBS programming

RAMON LUGO, MD
Neurologist
Specialty interests: Parkinson disease, chorea, dystonia, blepharospasm, hemifacial spasm, movement disorders, botulinum toxin treatment

Cleveland Clinic Nevada

RYAN WALSH, MD, PhD
Neurologist
Specialty interests: Parkinson disease and movement disorders
Center for Neurological Restoration locations

Center for Neurological Restoration staff coordinate care and provide access to clinical trials for patients at multiple locations across Northeast Ohio as well as in Nevada and Florida. Physicians practicing outside of Northeast Ohio may participate in the center’s patient management conferences and, when needed, refer their patients who are DBS candidates to neurosurgeons in Cleveland.

- **Cleveland Clinic Main Campus**
  Mellen Center/U3
  1950 E. 89th St.
  Cleveland, OH 44195
  866.588.2264

- **Lakewood Hospital**
  14601 Detroit Ave.
  Lakewood, OH 44107
  866.588.2264

- **Medina Hospital**
  1000 East Washington St.
  Medina, OH 44256
  866.588.2264

- **Richard E. Jacobs Health Center**
  33100 Cleveland Clinic Blvd.
  Avon, OH 44011
  866.588.2264

- **Willoughby Hills Family Health Center**
  2570 SOM Center Road
  Willoughby Hills, OH 44094
  866.588.2264

- **Cleveland Clinic Florida**
  2950 Cleveland Clinic Blvd.
  Weston, FL 33331
  877.463.2010

- **Cleveland Clinic Nevada**
  888 W. Bonneville Ave.
  Las Vegas, NV 89106
  702.483.6000