

Deep Brain Stimulation Program



Movement Disorders Center

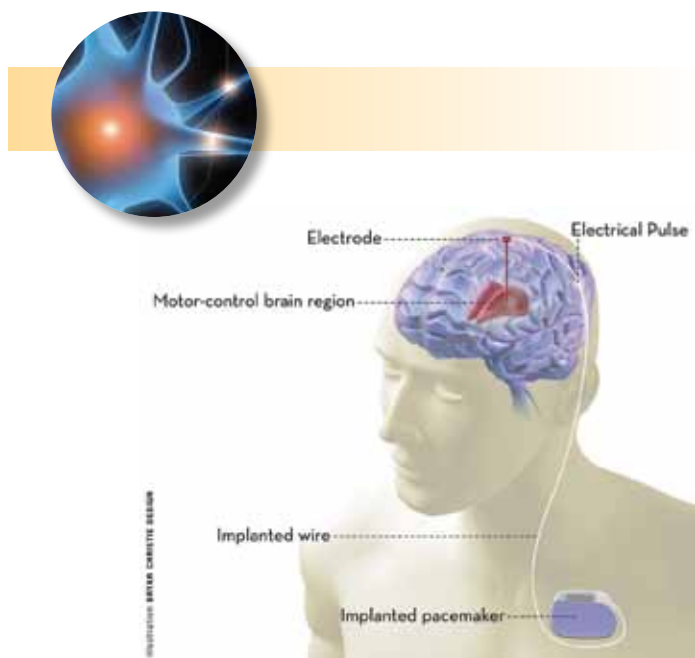
Effective surgical therapy is now available for three common movement disorders:

Essential Tremor | Parkinson's Disease | Dystonia

Treatment for movement disorders

For many years, treatment options for various movement disorders (including Parkinson's disease, essential tremor and dystonia), have been limited primarily to pharmacological therapy, whose effectiveness can decrease over time and whose side effects can be significant. Now, Deep Brain Stimulation (DBS) offers patients with these conditions an effective surgical option. In appropriately selected candidates, DBS relieves the tremor of essential tremor (ET) and Parkinson's disease (PD) as well as motor dysfunction such as rigidity, bradykinesia, dyskinesia and shuffling. In generalized and cervical dystonia studies have shown substantial progressive improvement in dystonic symptoms over several months that is sustained. In all three of these disorders results of the procedure may dramatically improve patients' quality of life.

In 1997, the FDA approved the use of unilateral DBS of the thalamus for treatment of tremor related to PD and ET. In 2002, the FDA extended its approval to include unilateral or bilateral stimulation of the subthalamic nucleus (STN) or internal globus pallidus (GPI) for PD. In 2003, the FDA approved unilateral or bilateral GPI or STN DBS for the management of select types of chronic, drug-refractory dystonia including generalized or segmental dystonia, hemidystonia and cervical dystonia. The University Hospitals Neurological Institute is one of a select group of centers nationally doing surgical therapy for dystonia and has NIH-funded research investigating the mechanisms involved in the therapeutic benefit of DBS in dystonia.



Movement Disorders team

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Deep Brain Stimulation

About Deep Brain Stimulation

At University Hospitals Neurological Institute, DBS surgery is performed in two stages. In the first stage one or two leads (thin, insulated wires) are stereotactically placed, with the guidance of microelectrode recording, into the targeted brain area (e.g., thalamus, internal globus pallidus or subthalamic nucleus). About seven to 10 days later, an extension wire, also insulated, is tunneled subcutaneously connecting the lead to the neurostimulators that are implanted just below the clavicle. About three to four weeks after the leads are implanted, the neurostimulators are programmed to send high-frequency electrical stimulation from the neurostimulator along the extension wire and the lead into the brain.

UH Neurological Institute's approach to DBS

The DBS Program at University Hospitals Case Medical Center brings together the expertise of movement disorders neurologists, stereotactic functional neurosurgeons, advanced practice nurses and neuropsychologists to provide a comprehensive approach to the care of patients considering or receiving DBS therapy.

The multidisciplinary program comprises highly trained and experienced physicians and practitioners. They are dedicated to providing efficient, coordinated care and a seamless experience for patients from the initial referral and evaluation through surgery, programming and their return back to the referring physician for continued care.

The center was the first in North America to treat Tourette syndrome with DBS. Our physicians continue to pioneer new advances in DBS with active research on dystonia and Parkinson's disease, as well as other neurological conditions. Every patient is evaluated by our multidisciplinary team of experts.



The team develops a comprehensive and collaborative treatment plan that is best suited to each person's unique situation. Team members draw upon their extensive clinical and research experience to devise appropriate, specific, individualized therapy.

In addition to the specialists' integrated expertise, patients and family members are given vital education and emotional support along the way. Because of the personalized care, patients have better outcomes resulting in shorter recovery times and a functional return to activities of daily living.

The UH Neurological Institute offers coordination of services providing extra convenience for patients as well as referring physicians and eliminating the frustration of coordinating multiple treatment modalities.

Benefits

DBS has significantly improved the quality of life for many patients, allowing them to regain their independence and resume many normal activities (see charts on next page). In clinical studies, at least eight out of 10 Parkinson's patients experience a significant improvement in functional ability with DBS. For patients with essential tremor, up to 90 percent will achieve significant relief from their incapacitating tremor. For patients with dystonia, more than 80 percent will experience significant benefit from DBS.

Other benefits:

- Bilateral DBS can control the symptoms of movement disorders on both sides of the body.
- DBS often decreases the amount of daily medication required to manage symptoms.
- Patients who suffer dyskinesia as a side effect of medication experience more than an 80 percent reduction.
- In contrast to older surgical therapies such as thalamotomy and pallidotomy, DBS is considered nondestructive and reversible allowing patients with DBS to be eligible for new surgical treatments should they become available.

Deep Brain Stimulation

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Risks

DBS, like any surgical procedure of the brain, carries inherent risks. In addition to the routine surgical risks related to bleeding, anesthesia and possible infection, DBS presents a small risk of neurological complications such as stroke, paralysis and speech impairment. DBS of the STN, GPi and thalamus generally results in relatively little change in thinking and memory. Decreases in language function and memory have been reported in some studies. Other studies have found no changes. Still yet other studies report improved language and short-term memory scores following DBS surgery. A small proportion of candidates for DBS are at higher risk for cognitive difficulties following DBS surgery. This group of patients includes those with pre-existing cognitive difficulties or dementia.

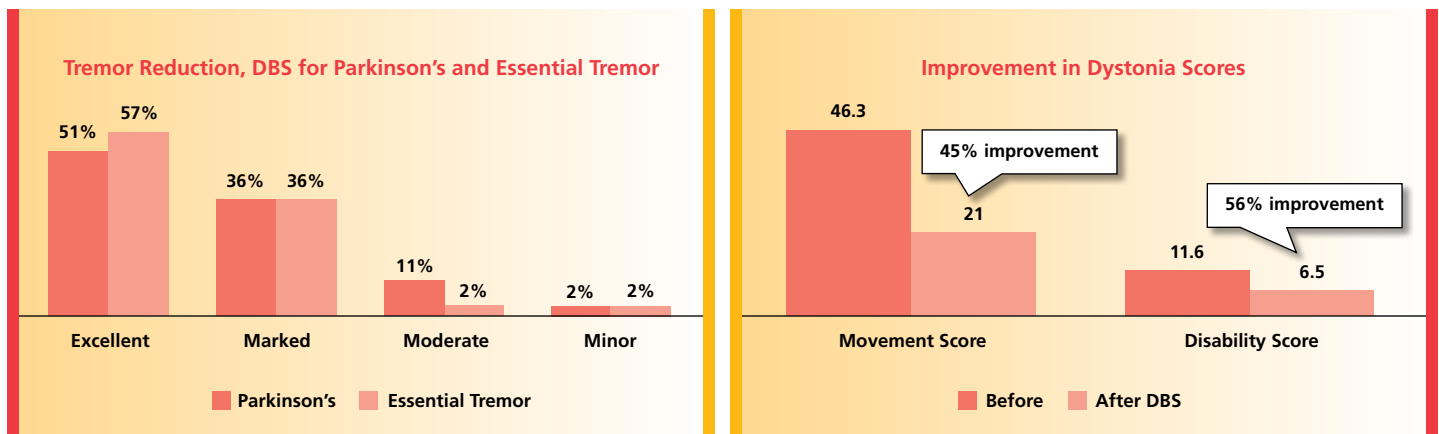
Who is a candidate?

DBS is appropriate for patients who no longer respond consistently to medications, or those who develop significant side effects after taking them. In Parkinson's disease DBS is particularly helpful for patients who have a history of a good response to medication but the response has become unpredictable with fluctuations between "ON" and "OFF" states, or complicated by significant dyskinesia, or the patient has tremor that is refractory to medications. Generalized dystonia patients with significant disability despite oral medications are excellent candidates. Cervical dystonia patients who have failed botulinum toxin due to drug resistance are also good candidates. Essential tremor patients who have failed medications and have disabling arm tremor are typically excellent candidates.

For all patient types, the DBS team makes use of a battery of tests, including neurological examination, neuropsychological examination and MRI scanning, to identify appropriate candidates. Surgical recommendations are made only after a careful analysis of all possible benefits and risks. Patients with significant cognitive decline, overwhelming health problems, or significant age-related health problems, are generally less optimal candidates.

Follow-up care and the primary physician

The DBS program is a tertiary care service. Our goal is to provide a continuum of high-quality care for all patients. After the procedure, patients with PD or ET are seen at the Movement Disorders Center about every two to four weeks for a period of two to three months to have adjustments made to their stimulators. Patients with dystonia are seen for programming every one to two months for a period of six to eight months to have adjustments made to their stimulators. Programming the neurostimulators is a process that requires balancing the amount of stimulation with medication needs to provide the best possible functional improvement. After that time, patients return to the care of their primary physician. Routine follow-up and care with a neurologist is necessary to ensure that each component of the disease and recovery are closely monitored. Patients should return to the center on an annual basis to check the status of their battery. The primary physician plays a key role in our center. Perioperative management is carefully coordinated with the preservation of ongoing care by all local physicians. The center strives to maintain an active partnership with primary physicians during all stages of patient care. The movement disorders team is always available to help with any questions or problems that arise.



Source: Esselink R, et al. Unilateral pallidotomy versus bilateral subthalamic nucleus stimulation in PD: a randomized trial. *Neurology*. 2004, 62(2): 201-7; Krauss J, et al. Concepts and methods in chronic thalamic stimulation for treatment of tremor: technique and application. *Neurosurgery*, 2001, 48(3): 535-43. Vidailhet M, et al. Bilateral deep-brain stimulation of the globus pallidus in primary generalized dystonia. *New England Journal of Medicine*, 2005, 352(5): 459-67.

Surgical Management of Movement Disorders

Patient selection and treatment goals

Parkinson's Disease

Necessary criteria:

- Confirmed diagnosis of PD, with levodopa responsiveness
- Optimized medical management, employing (as appropriate) carbidopa-levodopa, dopamine agonists, COMT inhibitors, amantadine, MAO inhibitors and anticholinergic medication

Realistic goals:

- Fewer fluctuations with increased "ON" time
- Improved tremor control (even if medication-refractory)
- Reduced bradykinesia (slowness)
- Reduced dyskinesia
- Possible reduction in medication

Unrealistic goals:

- Improved freezing that is unresponsive to medications
- Improved balance
- Improved memory
- Improved swallowing or bladder function
- Improved speech/hypophonia

Essential Tremor

Necessary criteria:

- Attempts to manage medically have proven unsatisfactory
- Patient must be functionally disabled by tremor

Realistic goals:

- Reduction in contralateral arm tremor
- Improved function of contralateral arm

Unrealistic goals:

- Reduction in head or voice tremor (may improve in some patients, particularly if bilateral surgery is performed, but is not consistent)

Dystonia

- Idiopathic focal (e.g., cervical), or primary generalized dystonia (e.g., DYT1)
- Must have developed substantial limitation to quality of life
- Attempts to manage medically (e.g., with botulinum toxin for focal dystonia or oral medications for generalized dystonia) have proven unsatisfactory
- Goals: reduction of involuntary movements and postures
- Often takes several months to achieve maximum results

Regardless of Diagnosis

Necessary criteria:

- No severe cognitive impairment
- Mood disorders if present are optimally managed
- Limited co-morbidity (neurologic and systemic illnesses)
- Medically able to undergo prolonged surgical procedure
- Able to attend follow-up stimulator adjustments
- Adequate social support
- Realistic expectations on part of patient and family

Pre-op evaluation:

- Consultation with a movement disorders neurologist and neurosurgeon
- ON/OFF testing for Parkinson's disease patients
- Neuropsychological evaluation
- High resolution MRI scanning for target planning

Surgical planning and performance

Target

- Unilateral or bilateral thalamic (Vim) DBS for essential tremor
- Unilateral or bilateral GPi or STN DBS for PD or Dystonia

Lesion vs. Chronic Stimulator Implant

- Lesions are effective and less expensive than DBS, but are irreversible. Missed targets or too large a lesion may lead to permanent neurologic deficits.
- DBS allows postoperative fine-tuning of stimulation parameters. If revision is necessary, the electrode may be withdrawn and replaced with minimal, if any, permanent sequelae. If new therapies are developed in the future, DBS produces no lesions which might hinder efficacy of the new therapy.

Unilateral or bilateral

- The greatest effect of unilateral DBS is benefit of symptoms contralaterally, however, some benefit is achieved ipsilaterally.
- Parkinson's disease is typically an asymmetric disease.
- Some patients with clearly asymmetric symptoms may need only unilateral implantation; some patients with bilateral essential tremor choose to have only one side treated.
- Patients with advanced PD with significant bilateral symptoms may require bilateral surgery to achieve satisfactory results.
- Risks and benefits of unilateral vs. bilateral surgery should be individually assessed.

Surgical Management of Movement Disorders

Surgical procedures

- Stereotactic frame and identification of target coordinates.
- Electrophysiologic recording using a microelectrode wire (as thin as a hair) is used to evaluate activity of individual neurons and identify their location within deep brain regions. This is a critical step that allows correction of errors in anatomically defined coordinates and fine-tuning of the targeting.
- Placement of the four-contact permanent stimulator electrode, with test stimulation to identify adverse effects (such as stimulation induced muscle contractions) and possible benefit (such as tremor reduction).
- The electrodes are usually implanted on one day; the pulse generators are usually placed a week later.
- The patient is generally awake during lead implantation and under general anesthesia for insertion of pulse generators.

Postoperative management

- After recovering from surgery (usually three to four weeks after lead implantation), pulse generators are activated. Stimulus parameters (contacts, polarity, voltage, pulse width, repeat rate) are adjusted in a systematic fashion by the advanced practice nurse.
- Medication regimens are simplified with a reduction in total medication after a stable benefit is achieved with DBS.
- The best "ON" state (with stimulator on) is expected to be about the same as the best "ON" state prior to stimulator placement (even with a lower postoperative medication dose). The real advantages of DBS are that the worst "OFF" state is usually significantly better with the stimulators on than prior to the operation, and that there are decreased fluctuations between on and off, resulting in increased daily "ON" time.
- For PD, expect four to six visits for adjusting stimulators over eight to 12 weeks.
- For ET, expect three to four visits for adjusting stimulators.
- For dystonia, expect benefits to develop slowly but progressively over approximately three to six months with adjustments made every one to two months with higher energy use and shorter battery life.

Collaborative effort

Primary neurologist

- Long-term relationship with patient; medical management
- Identification of suitable candidate
- Patient returns to primary neurologist after this treatment process



Tertiary care movement disorders neurologist

- Identification or confirmation of suitable candidate
- Intraoperative monitoring
- Postoperative stimulator and medication adjustment

Neurosurgeon

- Confirmation of suitable candidate
- Performance of the surgical procedure
- Postoperative surgical management

Advanced practice nurse

- Postoperative stimulator and medication adjustment
- Patient and family education
- Phone resource

Neuropsychologist

- Preoperative and postoperative evaluation
- Identification of suitable or high-risk candidate

Complications

- Intracerebral hemorrhage is rare but may lead to permanent disability or even more rarely death.
- Hardware infections are treated with antibiotics but when unresolved may necessitate removal and eventual replacement of the DBS system.
- Cognitive complications may occur but are more common in those with more significant preoperative cognitive deficits. Different surgical approaches may be recommended in patients with higher risk.
- Hardware breakdown can occur, necessitating replacement of the broken component(s). Batteries have a limited lifetime and require replacement every two to five years with typical settings.

Movement Disorders Team



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Neurologist

Major clinical interests: Evaluation and management of movement disorders patients for surgical therapies, Intraoperative neurophysiological mapping for DBS, Parkinson's disease, Dystonia, Tremor

Research interests: Mechanisms underlying benefit with DBS, Functional Magnetic Resonance Imaging (fMRI), Pathophysiology of Dystonia, Parkinson's disease and Essential Tremor

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Major clinical interests: Cancer pain, epilepsy surgery, facial pain, Gamma Knife stereotactic radiosurgery, movement disorders surgery, pain neurosurgery, peripheral nerve surgery, stereotactic & functional electrophysiology

Research interests: Functional electrophysiology

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Major clinical interests: Parkinson's disease and other movement disorders

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Cleveland | Ohio

About UH Neurological Institute

University Hospitals Neurological Institute is Northeast Ohio's first designated institute for the comprehensive care of patients with diseases affecting the nervous system. It has 15 Centers of Excellence that bring together some of the country's foremost experts in neurology, neurosurgery, neuropsychiatry, neuroradiology, neuro-oncology, neuro-ophthalmology, neurotology, neuropathology, neuro-psychology and related specialties. Under the direction of Warren Selman, MD, chairman of the Department of Neurological Surgery, and co-director Anthony Furlan, MD, chairman of the Department of Neurology, the Neurological Institute at University Hospitals offers the latest in innovative technology for the diagnosis and treatment of all neurological conditions and diseases.

To learn more about UH Neurological Institute or to refer a patient, contact us at:

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For more information about the DBS Program, contact:

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