

Deep Brain Stimulation For Parkinson's Disease

Rajesh Pahwa, MD

Director, Parkinson's Disease and Movement Disorder Center

Kelly E. Lyons, PhD

Director of Research and Education
Parkinson's Disease and Movement Disorder Center

Jules M. Nazzaro, MD

Director, Stereotactic and Functional Neurosurgery

University of Kansas Medical Center



Introduction:

Parkinson's disease (PD) is a progressive neurodegenerative disease. Levodopa is currently the most effective medication for the treatment of PD. When levodopa is initiated, PD symptoms improve and are under control throughout the day. However, the long-term management of PD with levodopa is complicated by the development of motor fluctuations and dyskinesia. Motor fluctuations represent an inconsistent control of symptoms with times during the day when PD symptoms are under reasonable control (on medication states) and times when PD symptoms are bothersome (off medication states). Initially, with the addition of other PD medications or with changes in dosing schedules, these off states can be avoided. However, as the disease progresses, these fluctuations become unpredictable and cannot be managed by medication adjustments. Patients may also develop involuntary dance-like or wiggling movements, known as dyskinesia, which in some patients can be more disabling than the actual PD symptoms. Approximately 50% of PD patients develop motor fluctuations and/or dyskinesia after five years of treatment with levodopa. When motor fluctuations and dyskinesia cannot be managed by medications, surgical treatments for PD are often considered. In addition, it is estimated that tremor responds to medications in only about 50% of PD patients. Patients with medication resistant tremor may also benefit from surgical therapy.

Surgical therapy for PD has been used since the 1950s. However, after the discovery of levodopa, surgical therapies were abandoned due to a high rate of surgical complications and the dramatic benefits of levodopa. The development of motor fluctuations and dyskinesia with levodopa therapy, improvements in surgical techniques, a better understanding of the anatomy and physiology of the brain and better brain imaging techniques like magnetic resonance imaging (MRI) led to the reintroduction of surgical therapies for PD.

Types of Surgeries for Parkinson's Disease:

The current surgeries approved by the Food and Drug Administration (FDA) for the treatment of PD include lesion surgeries and deep brain stimulation (DBS). Lesioning and DBS are typically covered by major insurance companies.

Lesion Surgery: Lesion surgeries involve destroying a particular part of the brain to control the symptoms of PD. Lesion surgeries for PD include:

1. **Thalamotomy:** a part of the ventrointermediate (VIM) nucleus of the thalamus is destroyed primarily to reduce tremor.
2. **Pallidotomy:** a part of the globus pallidus interna (GPi) is destroyed to control the primary symptoms of PD (tremor, rigidity, slowness).
3. **Subthalamotomy:** a part of the subthalamic nucleus (STN) is destroyed to control the primary symptoms of PD (tremor, rigidity, slowness).

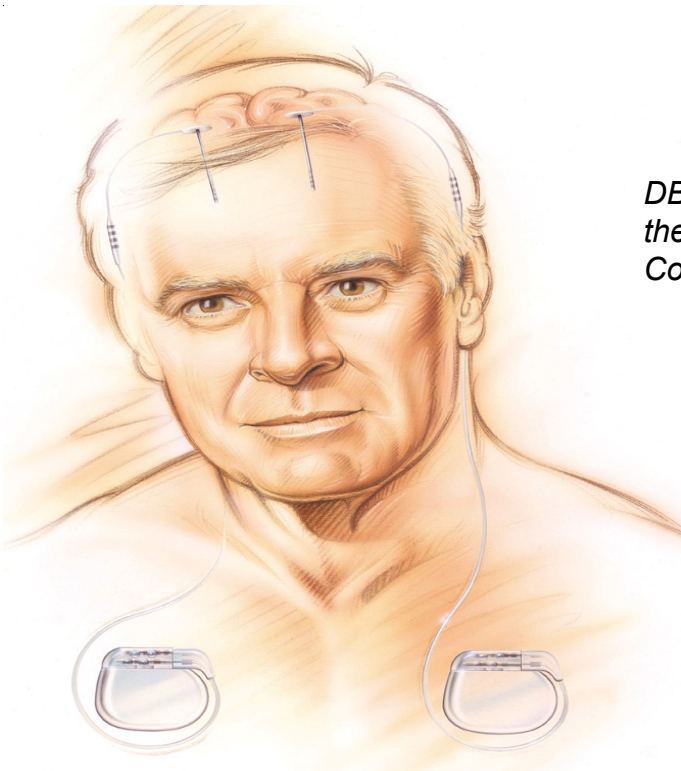
The majority of movement disorder surgical centers do not routinely perform lesion surgeries. This is because lesion surgeries have been reported to result in more surgical complications than DBS and by destroying parts of the brain it is possible that future treatments might not be helpful. In addition, bilateral lesion surgeries are not recommended as they can result in severe complications related to speech, balance and walking. Therefore, DBS is currently the surgical procedure of choice for PD.

Deep Brain Stimulation: DBS involves implanting an electrode in the brain and connecting it with an extension wire to an implantable pulse generator (IPG) which is pacemaker-like device or battery most often placed in the chest. The electrode can be placed in different parts of the

brain which include:

1. Thalamic stimulation: the electrode tip is placed in the ventrointermediate (VIM) nucleus of the thalamus primarily to control tremor.
2. Globus pallidus interna (GPi) stimulation: the electrode tip is placed in the GPi to control the primary symptoms of PD (tremor, rigidity, slowness) and dyskinesia.
3. Subthalamic nucleus (STN) stimulation: the electrode tip is placed in the STN to control the primary symptoms of PD (tremor, rigidity, slowness) and dyskinesia.

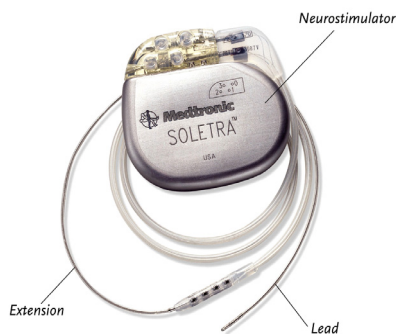
One side of the brain controls the opposite side of the body, hence if the electrode is implanted on the left side of the brain, symptoms on the right side of the body are improved. In order to improve symptoms on both sides of the body, two DBS systems are generally implanted, one on the right side of the brain and one on the left. These surgeries are NOT a cure for PD, they treat the underlying symptoms of the disease.



*DBS system implanted on both sides of the brain,
Courtesy of Medtronic, Inc*

Deep Brain Stimulation (DBS)

In 1997, the FDA approved the use of the Activa Tremor Control Therapy which uses a DBS electrode, extension wire and an implantable pulse generator (IPG) for thalamic stimulation to control parkinsonian and essential tremor. In 2002, the FDA approved the use of the Activa Parkinson's Control Therapy for GPi and STN stimulation to control the primary symptoms of PD (tremor, rigidity, slowness) and dyskinesia.



Implantable pulse generator (IPG or neurostimulator), extension wire and electrode, Courtesy of Medtronic, Inc

Each DBS electrode has four contacts at the tip; one, two, three or all four contacts can be turned on depending on patient symptoms and location of the electrode.



DBS electrode

Courtesy of Medtronic, Inc

The implantable pulse generator (IPG) is usually implanted under the skin below the collar bone. The electrode and the IPG are connected by an extension wire. The extension wire is tunneled from the electrode in the brain under the skin on the side of the neck to the IPG in the chest. There are two kinds of IPGs available: 1) Soletra which controls one electrode and hence a patient who has bilateral surgery would require two Soletra devices; 2) Kinetra allows the electrodes from both sides of the brain to be connected to one IPG. The Kinetra IPG is approximately twice as big as the Soletra. The IPG is programmed by a physician or nurse specialist. The patient can turn the device on and off with an Access Review™ Therapy Controller which provides information as to whether the devices are on or off and the battery status.

The advantages of DBS compared to lesion surgeries include no destruction of the brain so future treatments or procedures could later be treatment options, the ability to change stimulation parameters to increase benefit or reduce side effects and the ability to perform bilateral operations without causing permanent speech impairment or other serious side effects. The disadvantages of DBS include the cost of the system, the fact that an object is implanted in the brain which increases the risk of infections, the need to periodically replace the battery (IPG) and the possibility of mechanical problems or malfunctions of the device and its components.

Thalamic Stimulation

It was observed that during thalamotomy high frequency stimulation (greater than 100 hz) of the target site in the brain had the same effect as destruction of the site. This led to the development of the DBS technique. Several studies have evaluated the benefits and safety of thalamic DBS. Approximately 90% of patients have marked reduction in tremor on the side opposite of the surgery after thalamic DBS. Some patients show a micro-thalamotomy effect,

a reduction of tremor after implantation of the electrode, but before the stimulator is turned on. This is most likely due to swelling of the brain at the electrode site and this effect typically goes away in two to four weeks after the swelling has resolved. Rarely, this effect may persist due to a small lesion that may have occurred during placement of the electrode. Thalamic stimulation primarily improves tremor and does not typically have any effect on slowness, rigidity, dyskinesia or walking and balance difficulties. Long-term studies of thalamic stimulation have shown that although tremor continues to be improved, other parkinsonian symptoms including slowness, rigidity and gait difficulties continue to progress. Hence, thalamic stimulation is not usually recommended for PD patients unless the only disabling symptom is tremor and rigidity and slowness are minimal and do not appear to be progressing.

Subthalamic Stimulation:

STN stimulation is currently the most commonly performed surgical procedure for PD. Electrodes are usually implanted on both sides. All the major parkinsonian signs (tremor, slowness, rigidity) improve with bilateral STN surgery. There is marked reduction in dyskinesia due to a reduction in antiparkinsonian medications, a marked increase in on time (good symptom control) and a marked reduction in off time (poor symptom control) after surgery. In the medication off state, the ability to perform typically improves by 30-70% and tremor, slowness and rigidity typically improve by 40-75%. Antiparkinsonian medications are usually reduced by 30-80% after surgery. The best improvement that a patient can expect after surgery is usually equal to the best improvement that they get with their antiparkinsonian medications (best medication on state); however, the patient typically is in the on state for a longer period of time with reduced dyskinesia. Tremor is the only symptom that may improve more with STN DBS than with medications alone. Long term results of STN stimulation demonstrate that the improvements seen after surgery (decreased off time

and dyskinesia) and reductions in antiparkinsonian medication dosage persist. However, due to disease progression after 3-5 years PD symptoms may worsen but generally are still less severe than prior to surgery. Over time patients may develop other features of advanced disease like dementia, hallucinations and paranoia.

Pallidal Stimulation:

The results of GPi stimulation are usually similar to STN stimulation except there is typically no reduction in antiparkinsonian medication. The improvement in PD symptoms in the medication off state has been reported to be 25-50% and the improvement in daily functioning has ranged from 20% to 70%. When measured by patient diaries, there is a significant reduction in dyskinesia resulting in an increase in on time during the day. Long term results suggest that there is some decrease in efficacy after long term follow-up. In addition, there is progression of the disease and patients may develop symptoms such as dementia, hallucinations and paranoia. GPi stimulation has also been shown to be effective for the treatment of dystonia.

Candidates for surgery:

STN and GPi DBS candidates:

The criteria to identify patients for STN and GPi stimulation are similar. The team including a neurologist, neurosurgeon and neuropsychologist determines if a patient is a candidate for surgery.

The following criteria are used to identify surgical candidates:

1. Diagnosis of *idiopathic Parkinson's disease*. Patients should not have atypical PD like multiple system atrophy (MSA), progressive supranuclear palsy (PSP) or other neurodegenerative conditions as atypical forms of PD have been shown to respond poorly to the surgeries.
2. Patients should be *responsive to levodopa*. Patients with typical PD are responsive to levodopa and atypical PD patients are generally not levodopa responsive. In addition, response to levodopa prior to surgery is the best predictor of surgical outcome. The results seen with DBS are generally comparable to the best medication on state for an extended period of time.
3. Patients should have *motor fluctuations or dyskinesia that cannot be controlled with medications*. Patients should have tried multiple classes of PD medications and should consider surgery when disability persists. Some patients who do not have motor fluctuations or dyskinesia but have *medication resistant tremor* would also be candidates for the surgery if their tremor is disabling.
4. There should be no significant *cognitive or behavioral abnormalities* as these symptoms may worsen after surgery.

5. Patients who *cannot tolerate anti-parkinsonian medications* due to side effects and have disabling PD symptoms may be candidates for surgery.
6. Patients should have the physical health and stamina to be able to undergo the surgical procedure.
7. Patients should have *realistic expectations* from surgery. These procedures are not a cure for PD and the disease will continue to progress. In addition, the best improvement is related to an increase in on time, a reduction in dyskinesia and improvement in medication resistant tremor.

The following criteria are usually used to exclude patients from surgery:

1. *Atypical PD*
2. *Significant cognitive or behavioral abnormalities*
3. *Absence of significant disability* during medication off states.
4. *Lack of family support.* As the surgical evaluation and stimulation programming may require frequent sessions it would be difficult for the patient to have significant improvement if someone was not available to assist with attending these visits.
5. Presence of *uncontrolled hypertension, cardiac or other medical problems.* The DBS system is compatible with some cardiac pacemakers, this should be determined prior to approval for surgery.
6. Presence of *significant emotional problems* like major depression, uncontrolled mania or suicidal tendencies.

Thalamic Stimulation:

Thalamic stimulation is rarely performed in PD patients and is generally used for patients with essential tremor. However, it may be used in patients with a combination of essential tremor and PD. Thalamic DBS may be recommended for PD patients with disabling tremor with minimal slowness and rigidity. Candidates should not have significant cognitive, behavioral or emotional abnormalities as these may worsen after surgery. There should be no uncontrolled medical problems and family support should be available.

The Evaluation:

A movement disorder neurologist with experience in DBS surgery initially evaluates the patient and reviews the medical history, medication schedules, past trials of medications and the overall neurological condition. If this initial evaluation suggests that the patient may benefit from surgery and the symptoms cannot be managed with medications, the patient is referred to the neurosurgeon and the neuropsychologist and a brain scan (MRI) and levodopa challenge are scheduled.

The neurosurgeon evaluates the patient to determine if the patient can tolerate the surgery and discusses the procedure as well as the benefits and risks of the surgery.

The neuropsychological exam measures cognitive functions, memory, mood, behavioral functions, coping ability and quality of life. These tests are mainly pencil and paper tests and involve answering a variety of questions. The tests are usually performed with the patient in the medication on state and the patient can take breaks during the tests. This exam is done before surgery and is done to exclude patients with cognitive and behavioral problems.

The patients will undergo a *levodopa challenge* under the supervision of a neurologist specializing in movement disorders. The patients are evaluated without taking any antiparkinsonian medications for 12 hours, the medication off state. They then receive their antiparkinsonian medications and after the medications have kicked on they are reevaluated in the medication on state. The patient should typically have a good response to antiparkinsonian medications to be considered a candidate for surgery. This response to antiparkinsonian medication helps the movement disorder neurologist predict the response patients will obtain after surgery.

All of these procedures are outpatient. Based on the results of the levodopa challenge, MRI and neuropsychological tests the patient is referred to the anesthesiologist for preoperative tests like an electrocardiogram (EKG) to test heart functions and general blood tests. If you have a medical condition like heart disease, clearance for surgery from your cardiologist is necessary. If you do not have a regular cardiologist and have abnormal heart function, you may be referred to a cardiologist in case the cardiologist needs to be involved in your care during the hospitalization.

Surgical procedures:

STN DBS is the most commonly performed surgical procedure for PD and it is usually performed on both sides of the brain. At the University of Kansas Medical Center it is usually done over four separate operations. This is done to provide the most comfort to the patient and to obtain the best surgical outcome.

First Surgery: The first surgery consists of inserting the DBS electrode on one side of the brain, usually the right side. The patient is admitted the night before surgery to allow withdrawal of anti-parkinsonian medications as surgery is performed while the patient is awake in the medication off state. If the patient has difficulty sleeping or anxiety a mild sedative may be prescribed. Surgery

usually begins at 5:30am the following day. On the day of surgery, at the patient's bedside, a stereotactic frame (a halo-type device) is attached to the patient's head. This stabilizes the head and helps the neurosurgeon locate the precise target. To attach the stereotactic frame, the neurosurgeon uses local anesthesia on four small areas of the head to secure the frame with small screws that attach to the outer part of the skull.



Dr. Nazzaro attaching the frame



Stereotactic head frame

Once the stereotactic frame is placed, the patient undergoes a detailed MRI brain scan. This MRI takes approximately 30 minutes and is done to locate specific regions in the brain like the STN. After the MRI, the patient is brought to the operating room holding area and is seen there by the anesthesiology and nursing teams. During this time, the neurosurgical team is planning the operation using the brain MRI and a special computer system to measure the distance and the location where the electrode needs to be placed. This usually takes about 30 to 60 minutes. Once this has been determined the patient is sent to the operating room.

The patient is awake during surgery, but may be mildly sedated in the operating room for comfort. The patient is placed on the operating bed with the head frame secured to the bed so that the head is still but the patient can move their arms and the legs. An area on the top of the head is shaved (you should NOT shave your own head prior to surgery), cleaned and then numbed with local anesthesia. A skin incision approximately two inches long is made on the top of the head. Following this, a hole the size of nickel is made and a microelectrode is passed through this hole into the brain.



Patient undergoing stereotactic brain scan

The microelectrode is smaller than the DBS electrode and helps to localize the exact position in the brain where the DBS electrode will be implanted. After the DBS electrode is in place, test stimulation is done to assess if there are any side effects to stimulation. During test stimulation, the patient is awake and asked to perform tasks such as counting out loud, and moving the opposite-side of the body. If the test stimulation does not result in unwanted side effects and PD symptoms are responding, the electrode is secured to the skull with a plastic cap like device that fits in the hole that was created. The other end of the electrode will be connected to the DBS IPG (battery) in a separate operation. Once the electrode is secured, the stereotactic frame is removed and the patient is then taken to the recovery room. The actual surgical procedure usually lasts about three to four hours. Following surgery, a CT (brain scan) of the head is performed to confirm no unexpected complications from surgery. The patient is generally discharged the following morning.

Second Surgery: Approximately one to two weeks later, the second surgery is performed which involves implantation of the IPG and connection of this power source to the brain electrode with the use of an extension wire. This procedure is performed under general anesthesia. The patient comes into the hospital on the day of surgery and the patient is discharged later that day. The IPG is generally implanted beneath the skin in the upper chest and is connected to the DBS electrode with an extension wire that is tunneled under the skin.

Third Surgery: Approximately one month later, the patient will have the third surgery to implant the second electrode in the brain. This is like the first surgery except it is performed on the other side of the brain. The MRI is not repeated for this surgery. Rather, after placement of the stereotactic

frame, a CT brain scan is obtained. The neurosurgeon uses this scan, together with the brain MRI obtained at time of your first surgery, to plan the operation.

Fourth Surgery: The fourth surgery is performed one to two weeks later to implant the second IPG and connect it to the second electrode that was implanted. This surgery is similar to the second surgery described above.

In some patients the first and the third surgery (right and left electrode implantation) can be performed on one day and the second and fourth surgery (right and left IPG placement) could be performed one week later. This depends on how well the patient can tolerate being without their PD medications for an extended period of time and if they have the stamina to undergo the prolonged procedure.

Adverse Effects:

Side effects can be divided as those due to the surgery, those due to the stimulation and those due to the DBS device/hardware.

Surgery-Related Complications

The risks for these surgeries are similar to those for other brain operations. They include the risk of death (less than 1 in 500), bleeding in or around the brain (less than 3 in 100), stroke (less than 1 in 100), seizures after surgery (less than 2 in 100), infections (less than 5 in 100) and bleeding under the IPG (less than 3 in 100). Death is rare and generally due to a severe bleed in the brain or postoperative complications like pulmonary embolism or severe infection. Major complications that do not resolve like stroke, swallowing or speech difficulties,

weakness or numbness on the opposite side of the surgery may occur in 1-2% of the patients. Similar complications that later resolve, occur in approximately 5% of the patients. Patients with cognitive problems before surgery are more likely to be confused after surgery. Confusion occurs in approximately 5% of the patients and can take months to resolve. These patients are also more likely to have hallucinations and psychosis after surgery. Other potential complications include vision difficulties, memory problems, sleepiness, abnormal movements, and leakage of fluid that surrounds the brain. Patients who develop infections are treated with antibiotics and may require removal of the electrode, extension or the IPG and re-implantation after the infection has cleared which may be up to 6 months.

There is minimal pain from these procedures, as the brain has no pain sensations. A local anesthetic is used for securing the pins of the head frame to the skull and for the incisions which can cause some pain. Once the stimulator is implanted, there may be discomfort and pain from incisions and sometimes behind the ear where the extension is located. However, healing occurs quickly and pain medications can be used if needed.

In addition, there are risks from general anesthesia as with any surgical procedure and these can include pulmonary embolism (blood clot to the lung), heart attack, stroke, and respiratory failure

Stimulation-Related Complications:

Side effects related to stimulation are usually dependent on the exact location of the electrode placement and are reversible with stimulation changes or reduction and are usually well tolerated. These include numbness, speech difficulties, swallowing difficulties, weakness, vision difficulties and headaches. If stimulation related adverse effects persist or are bothersome, a scan of the head should be performed to determine the exact location of the electrode and electrode.

repositioning may be required.

Occasionally after surgery especially after programming and with reduction in the medications, some patients may develop psychological problems like apathy and depression that can rarely lead to suicidal behavior, mania, hyper-sexuality, and psychosis like paranoia and hallucinations. If these occur they should be treated appropriately. Some patients may have speech and balance difficulties leading to falls after programming.

Hardware Related Complications:

Like with any mechanical device, the DBS hardware can have problems and parts may need to be replaced. The battery (IPG) needs to be replaced every 2-7 years depending upon usage and stimulation settings. This is done under local anesthesia.

Programming:

The IPG needs to be programmed before the DBS system can function. Usually the neurologist or a nurse clinician under the supervision of the neurologist will program the device. The neurosurgeon or neurophysiologist may also program the device. Programming is usually initiated 4-6 weeks after the third (implantation of second brain electrode) surgery to allow the brain to heal. Programming refers to the setting of the device so that the PD symptoms are best controlled.



Programming equipment: handheld programmer and console programming unit used by the neurologist or specialized nurse to program the stimulators. Courtesy of Medtronic, Inc

The device is turned on and off with an Access Review™ Therapy Controller.



*Access Review™ Therapy
Controller for use by the patient
to turn the device on and off.
Courtesy of Medtronic, Inc*

Programming is usually performed in one to four hour intervals until symptoms are improved. Initial programming is usually performed with the patient in the medication off state. It generally takes 3-4 sessions of programming and medication adjustments to get the best results. The programming sessions can be intense; they take patience, endurance, and stamina on the part of the patient as well as cooperation and support from family and friends.

Access Review™ Therapy Controller:

DBS surgery for PD typically requires stimulation to be on continuously for 24 hours. Often magnetic fields like theft detectors turn the device off. The patient may not realize the device is off until PD symptoms get worse. The Access Review™ Therapy Controller allows the patient to turn the device on and off, to check if the system is on and to check the status of the battery. This prevents unnecessary visits to the doctor's office and helps the patient to get the maximum benefit from DBS therapy.

Contraindications:

DBS is contraindicated (should not be done) in patients who have a medical diagnosis that requires MRI scans using a full body transmit radio-frequency (RF) coil, a receive-only head coil, or a head transmit coil that extends over the chest area. Performing MRI with this equipment when a DBS system is implanted can cause tissue lesions from component heating, especially

at the brain electrodes, resulting in serious and permanent injury including coma, paralysis, or death. ***You should discuss with your neurologist/neurosurgeon before having any MRI.***

For patients with DBS, diathermy (eg. short wave diathermy, microwave diathermy and therapeutic ultrasound diathermy) which is the generation of heat in tissue by electric currents and is usually performed by dentists and physical therapists is contraindicated (should not be done) because the energy can be transmitted to the brain through the extension wire and electrodes and can result in brain tissue damage and possibly death. In addition, diathermy can damage the IPGs.

Frequently asked questions:

How does DBS work?

The exact way that DBS works is not known. As the benefits of DBS are similar to those seen after lesion surgeries it has been suggested that DBS reduces the over-activity in the targeted nuclei, namely the thalamus, GPi or STN. The other possibility is that the electrical discharges from these nuclei become abnormal and irregular in PD patients. DBS resets the electrical discharges and makes them regular. The other possibility is that DBS releases neurotransmitters or other chemicals in the brain.

Will my Parkinson's Disease be cured?

Surgery will not cure your PD. DBS helps to control the symptoms of PD.

Will my insurance cover my surgery?

All major insurance carriers and Medicare pay for the surgery if you are an appropriate candidate. Some insurance companies require pre-approval, so you should discuss the surgery with your insurance company.

How do I choose a surgical center?

When determining where to have DBS surgery you should select a center that has extensive experience with DBS procedures and has information available to you, the general public and the medical community regarding the outcome of past surgeries. The center should have a team consisting of a neurologist, neurosurgeon, neuropsychologist and programmer all with special expertise in the surgical treatment of movement disorders. At the University of Kansas we have been performing DBS surgery since 1994, we have state of the art equipment, and we have an experienced DBS surgical team consisting of a neurologist specializing in movement disorders with extensive experience in DBS candidate evaluation, selection and management, a neurosurgeon with extensive DBS experience, a neurologist/ neurophysiologist with expertise in microelectrode recording, a neuropsychological team with extensive experience in DBS candidate evaluation and two nurse clinicians with extensive experience in DBS programming.

Can one of my family members be with me during surgery?

Most centers do not allow family members in the operating room but they can be updated periodically by a member of the surgical team.

Should I take my medications the day of surgery?

You will not take your PD medications on the day of surgery when the electrodes are implanted in the brain. Regarding non-PD medications, you should make sure the neurosurgeon knows all the medications that you are taking and you should discuss in advance which ones are appropriate to take the day of surgery. You will be allowed to take your PD medications after the surgery when you are in the recovery room. On the day of the surgery for IPG placement your PD medications will be taken as usual with a sip of water before and following the surgery.

Is all my hair shaved?

To help avoid infection, all the hair on the side of the surgery will be removed with electric clippers (similar to a buzz cut). You should NOT shave your head before surgery because if you develop an infection it will delay your surgery; however, you can have your hair cut short prior to surgery.

Does it hurt when the surgical head frame is attached to my head?

Local anesthesia is used before the frame is screwed onto the head and it should not hurt. You should let the surgeon know if it hurts which would mean that the local anesthetic has not started working. If you are particularly anxious the surgeon may give you a mild sedative to help you relax.

How long will I be in the hospital?

Persons usually stay in the hospital for two nights, you are admitted the day before the electrode is implanted and are released the day following surgery if there are no complications. The IPG is implanted about one week later as an outpatient procedure.

Why are the batteries implanted separately from the other surgery?

Due to the length of time and strenuous nature of the implantation of the electrodes it is usually preferred to perform the IPG implantation on a separate day.

Will this make my head look strange and will you be able to see the device?

In the majority of patients you will not be able to tell that electrodes have been implanted. In some patients, especially those who are bald, there can be two bumps high on the forehead where the electrode was implanted on each side. Nothing should show through the head or neck. If you can see the electrode or the extension wire it means the skin has eroded and you need to see your doctor immediately.

I wear glasses. Will my glasses irritate the extension wire behind my ear?

The extension wire is not usually bothered by glasses. Rarely there may be some discomfort or the skin around the electrode may be irritated. If this occurs you should contact the surgical center immediately.

Since the batteries (IPGs) are under the skin near my collar bone, will they show under my clothes?

Depending on a person's build, the battery may appear as a small bulge under the skin, however, they are usually not visible under clothing. If the batteries are visible, causing discomfort or interfering with your activities (such as firing a gun when hunting), you should discuss this with the neurosurgeon as your device can be implanted in the abdominal area if necessary.

When will my stimulators be turned on?

The stimulators are turned on 4-6 weeks after the second DBS electrode (third surgery) is implanted.

What does the stimulation feel like, does it make a noise, how will I know if it is on or off?

Most people are not able to feel the stimulation, however some patients may feel a tingling sensation when the device is first turned on. The system does not make any noise. Typically patients are able to tell that the stimulator is off because their PD symptoms get worse. The Access Review™ Therapy Controller will tell you if the system is on or off and also monitor the battery usage.

Will I take the same amount of medication after surgery?

The majority of PD patients who undergo STN surgery will be able to reduce their medications by approximately 50%. Patients who undergo GPi or thalamic stimulation surgery will typically not be able to reduce their medications.

Are there activities I can't do once I have this surgery?

It is recommended you don't do any strenuous physical activity for at least one month after surgery to make sure that the sutures have healed.

What is meant by programming?

Programming is turning the devices on and adjusting different parameters like the amplitude of the current, frequency, pulse width and the active contacts used to get benefit from the electrical stimulation without having any adverse effects.

How much better will I be after surgery/programming?

The surgery (after programming) typically reduces dyskinesia and off time. PD symptoms, other than possibly tremor, will not be better than your best medication on state, however, the surgery should extend the amount of time that you spend in the on state. If your PD symptoms are not improved, if your PD symptoms get worse or if you are having side effects you should contact the surgical center and schedule an evaluation to determine if the electrodes were implanted in the proper location and if all components are working properly. Additional surgery may be necessary if the electrodes are not in the proper location or if there are malfunctions with the device.

What are some of the problems that can happen with these stimulators?

The stimulators can be turned off spontaneously by any magnets. Theft detectors and airport or other security devices may cause uncomfortable increases in stimulation and these should be avoided if possible. You will receive an ID card explaining the DBS device that you can present during such situations. In addition, there can be malfunction of the stimulators that can result in shocking sensation, tingling, numbness or other neurological symptoms.

Can I have an MRI?

DBS is contraindicated (should not be done) in patients who will be exposed to Magnetic

Resonance Imaging (MRI) using a full body transmit radio-frequency (RF) coil, a receive-only head coil, or a head transmit coil that extends over the chest area. Performing MRI with this equipment when a DBS system is implanted can cause tissue lesions from component heating, especially at the brain electrodes, resulting in serious and permanent injury including coma, paralysis, or death. ***You should discuss with your neurologist/neurosurgeon before having any MRI.***

What is diathermy and when is it used?

Diathermy is electrically induced heat or “deep heat”. It is used by a number of healthcare professionals including dentists, chiropractors, physical therapists, sports medicine personnel, etc. Diathermy that uses shortwave, microwave or ultrasound energy can cause permanent nerve or tissue damage in patients with a DBS system even if the diathermy is set at power levels that do not cause deep heating. ***You should not have any procedure that involves diathermy.***

Can I have dental work done?

You can have dental work done, however your dentist should not use diathermy during the procedure.

Does this surgery give me more energy?

The surgery reduces your off time and time you have dyskinesia during the day and this can result in improved quality of life which can make you feel like you have more energy. It does not directly increase your energy level.

Will my personality change with this surgery?

Some patients may have increased depression, mania, and/or agitation or may become hypersexual after stimulation has been turned on. If there is any change in your personality you

need to inform your doctor so that you can be treated appropriately.

How long are the batteries good for?

Depending on the settings of the stimulators your batteries can last from 2 to 7 years.

What do you do to replace the batteries?

Battery replacement is done under local anesthesia and is an outpatient procedure. An incision is made in the chest to remove the IPG and replace it with a new one. Rechargeable batteries are currently not available.

Do I need to turn these devices off? When and Why?

You would typically not need to turn the devices off and can leave them on 24 hours a day. If you develop increased dyskinesia before your medications are adequately reduced you will need to turn the devices off until your medication wears off. In addition, if you have any adverse events or other problems with the device you can turn it off and contact your neurologist or neurosurgeon immediately.

How often do I need to see my neurologist?

After initial programming is completed you will need to see your neurologist every 3-4 months during the first year after the surgery to have your medications and programming checked and fine tuned if necessary and typically annually thereafter.

How often do I need to see the neurosurgeon?

Once your incision has healed you do not need to see the neurosurgeon unless you require the battery to be replaced or have problems with your devices that need surgical correction.

How often do I need to come for programming? How will I know when I need to come back?

When programming is initiated you will need to come for programming several times to adjust

your stimulators and medications. This usually requires 3-4 visits over a period of 10 days. After that you may need fine tuning every 3-6 months.

Do I have to go to the same place where my surgery was done to be programmed or for follow up care?

Your initial programming is done at the University of Kansas Medical Center to make sure the system is working properly. After the initial programming, you can have your devices programmed at another location. If you do not plan to have your devices programmed at the University of Kansas Medical Center you should discuss this with the neurologist and neurosurgeon prior to undergoing surgery.

After surgery, you will receive a Patient Manual from the manufacturer of the DBS system. You should read this manual for a full description of the DBS system and detailed safety information.

**For an appointment to be evaluated for DBS surgery,
please call 913-588-6782.**