Deep Brain Stimulation for Essential Tremor
Welcome to OHSU’s guide to deep brain stimulation surgery for patients with essential tremor. For some patients with essential tremor, DBS surgery offers life-changing relief.

DBS isn’t for everyone, though. This guide explains the benefits and risks. It will also tell you how we learn if you are a good candidate.
What is DBS?

DBS stands for deep brain stimulation. It comes from a small device that works like a pacemaker for the brain. Tiny leads, or electrodes, are placed in parts of your brain that control movement. The leads are connected by thin wires to a small device in the chest called an implanted pulse generator. The pulse generator sends steady, low-voltage electrical pulses to the leads. This stimulates those areas in your brain.

Researchers believe these pulses change the abnormal network of nerve signals in essential tremor. Or the pulses may change the brain chemicals that cause tremors and other symptoms.

DBS involves two surgeries. In the first surgery, your doctor puts in:

- **The leads:** Your doctor places the tiny leads, or electrodes, in parts of the brain that control movement.

In the second surgery, your doctor puts in:

- **The extensions:** Your doctor puts thin wires called extensions under the skin of the shoulder, neck and head.

- **The implanted pulse generator:** Doctors also call this an IPG or stimulator. Your doctor places it under the skin, usually below your collarbone, then connects it to the extension wires.
After surgery, your DBS team will adjust the stimulator settings. This is called programming. You may need several programming sessions to get the most relief. After that, you or your provider can use a programming device to adjust your stimulator or check the battery.

The leads go in one part of the brain: the thalamus.
Meet our clinical leaders

OHSU’s DBS team is one of the most experienced in the nation and has received international recognition for its pioneering research and treatment. Leading experts from various specialties participate in your care from a meticulous evaluation to determine if you can benefit from DBS, through follow-up care after your procedure, or other treatments if DBS isn't right for you.

Kim J. Burchiel, M.D., F.A.C.S.

Dr. Burchiel has done more than 1,000 DBS surgeries. He is one of the most experienced DBS surgeons in the United States. He was the first doctor in the U.S. to successfully treat a Parkinson's patient with DBS surgery. In 2011, he introduced asleep DBS, making the surgery faster, safer and more precise.

Dr. Burchiel led the OHSU Medical School's Department of Neurological Surgery for 27 years. He served as president of the Society of Neurological Surgeons. His honors include the 2015 Distinguished Service Award from the American Association of Neurological Surgeons.

Dr. Burchiel is teaching the next generation of OHSU neurological surgeons, building on OHSU’s proud legacy as an institution of learning.

Matthew Brodsky, M.D.

Dr. Brodsky is an associate professor and the medical director of OHSU’s DBS program. He brings 18 years of experience taking care of people who are candidates for DBS including pre-operative assessment of candidacy, and post-operative programming and medical management. He recently led OHSU’s team to publish outcomes of asleep DBS that found equivalent, and in some instances superior outcomes compared to awake DBS. He is actively involved in research looking at better ways to deliver DBS, and has trained over 20 fellows in techniques of DBS programming who have gone on to practice throughout the U.S.
Team approach

You will receive coordinated care from a team of specialists. These include experts in neurological surgery, neurology, physical therapy, speech therapy, neuropsychology and other areas. The team works together to give you the best treatment at every stage, from your first appointment to your care after surgery. Our specialists are experts in balance, gait, caring for older adults and other issues that are important for essential tremor. To learn more about our team members, visit www.ohsubrain.com/dbsteam.

Research

OHSU doctors and researchers are continually improving treatment for movement disorders. We have published dozens of studies on DBS and hundreds on Parkinson’s disease.

Screening

Our careful evaluation process makes sure you have DBS only if it is very likely to make a real difference. We offer other treatment options if DBS is not a good option for you.

Partnerships

Our nationally recognized OHSU Parkinson’s Disease and Movement Disorders Program helps medical team members and scientists turn laboratory discoveries into treatments as quickly as possible.
How do I get a referral or ask questions? Call us at 503-494-4314 or email dbs@ohsu.edu.

Our team

Neurological surgery

Kim J. Burchiel, M.D., F.A.C.S.
Antonia Gragg, M.S., P.A.-C.
Ahmed M.T. Raslan, M.D.

Neurology

Shannon Anderson, M.P.A.S., P.A.-C.
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You don’t have to be awake for DBS

Asleep DBS

In asleep DBS, you have surgery under general anesthesia. You are not aware of any part of the procedure. During your surgery, the doctor uses high-resolution scans to precisely place the tiny electrodes in the brain. Asleep DBS is faster and safer.

Awake DBS

In awake DBS, you stay awake during surgery. You have medication to keep you comfortable, but you are aware of the procedure. This is because you must respond to questions and move to help the doctor place the DBS electrodes in the right part of your brain. Many patients are anxious about being awake during brain surgery.
Why choose OHSU?

Dr. Kim Burchiel of OHSU was the first doctor in the United States to perform DBS to treat Parkinson's disease. No other medical center has OHSU’s experience with this procedure. Our team has excellent results and uses the most advanced technology available.

- **Experience:** OHSU is a leading center for DBS surgery. Since 1991, our team has done more than 1,000 procedures. Recently, a study ranked OHSU in the top four DBS providers for all teaching hospitals in the United States.

- **Excellence:** The Journal of Neurosurgery published a study of 60 OHSU patients who had asleep DBS. The study found this procedure was more precise than awake DBS and had very low risk. OHSU patients also have few complications from surgery. A recent study showed that fewer than four of every 100 DBS patients needed to return to the hospital within 30 days of having DBS. That puts OHSU among the nation’s best.

- **Low cost:** The cost of DBS at OHSU is among the lowest in the nation.

- **Technology:** Your regular doctor remains part of your health care team. We help your doctor track your care online. We also make sure your doctor can contact your OHSU specialists at any time.

- **Convenience for patients outside Portland:** We treat patients from all over the world. You may be able to have some appointments by secure video link, saving you the time and expense of some trips to Portland.

- **Nationally recognized program:** OHSU’s Parkinson's Disease and Movement Disorders Program has been named a Center of Excellence by the Parkinson's Foundation. The center demonstrates OHSU’s commitment to the most advanced patient care, research and education.
When should I consider DBS?

- Your propranolol, primidone or other medications do not work to control your tremor.
- You have severe side effects from your medications.
- Essential tremor causes problems with daily activities, such as eating.
Am I a candidate for DBS?

Deep brain stimulation can offer significant benefits for some patients, but it’s not for everyone.

To have DBS, you must:

• Be able to have general anesthesia.

• Stop taking certain medications one to two weeks before surgery.

You are not a good candidate if:

• You or a caregiver cannot use a programmer to check the battery.

• You are not healthy enough for surgery.
Benefits and risks of DBS

DBS is renewable. The battery lasts one to four years, and your DBS team can replace it with a minor, low-risk, outpatient surgery.

Benefits

- DBS can improve your quality of life by reducing tremor. You can regain the ability to do daily activities such as getting dressed.
- DBS is reversible. Your DBS team can turn off your stimulator. The system can be left in place or removed.
- DBS is adjustable. Your team can change the settings to make it more effective or to reduce side effects.

Symptoms DBS helps

DBS mainly helps with action tremors of the leg and hands.

Symptoms DBS does not help

It is not as helpful with voice or head tremor.
Surgical risks

DBS is safe and effective. But, like all surgeries, it carries risks and possible side effects. Your DBS team will talk with you about the risks in detail. We will cover possible side effects later in this guide.

Risks include:

- Infection.
- Bleeding in the brain.
- Stroke.
- Part of the DBS system breaking.
- The stimulator not working.
Your steps to DBS at OHSU

Your DBS journey for essential tremor has four steps at OHSU. If you live outside Portland, Oregon, you might have several of these appointments with your own doctor. Or you might have them by secure video link. This is for your convenience, making it possible for you to travel to Portland only for surgery. Bring a family member or caregiver to all your appointments.

**Step 1 — Meet with a neurologist and neurological surgeon**

You’ll meet with an OHSU movement-disorder-trained neurologist about candidacy and then a neurological surgeon. They will determine if you could be a candidate for DBS. If you are not a good candidate for DBS, you will get recommendations for other treatments.
Step 2 — Presurgery appointments

- **MRI:** You will have a precise scan with OHSU’s powerful 3-Tesla MRI unit before surgery. The images will allow your neurosurgeon to begin planning where to place the leads during surgery.
  - This MRI is typically done without sedation. But please do not eat or drink before your appointment, in case you do need sedation or anesthesia. We will tell you how long to stop eating or drinking for, before the MRI.
  - If you do need sedation, you might need an extra day for this appointment.
  - Please bring a caregiver with you.

- **Neurological surgery:** You will sign a surgical consent form and can ask any questions. You and your family will also receive instructions for coming to the hospital on the day of surgery and for post-surgery care.

- **Presurgery physical examination:** This can often be done the day before surgery. We want to make sure you are healthy enough for surgery and anesthesia.
**Step 3 — Surgery**

Stage 1

- **Arrival and anesthesia:** You’ll come to OHSU Hospital on the day of your surgery. The procedure will take two to three hours. In the operating suite, you’ll be placed under general anesthesia. You will not be aware of anything during the procedure.

- **CT scan:** Your DBS team will position your head in a secure frame connected to a high-resolution CT scanner. The team will take a scan to match up with your high-resolution MRI images from before surgery. This will give your neurosurgeon the most accurate information possible for placing the leads.

- **Placing the leads:** Your neurosurgeon will place the leads, then take another CT scan to make sure they’re in the right place. You will spend the night in OHSU Hospital and, in most cases, leave the next day.

Stage 2

- **Placing your stimulator:** Through a small incision above your ear, your neurosurgeon and his or her team will connect extension leads under the skin from the ends of the DBS leads to the implanted pulse generator, placed below your collarbone. This is done in a second surgery two to 10 days after the first one. This surgery takes about one hour. Your stimulator will not be programmed. You will leave OHSU the same day.
Step 4 — Programming and follow-up care

• **Programming your stimulator:** After your second surgery, a physician assistant, neurologist or both will program your stimulator. They will adjust the DBS settings with a small device called a programmer. You may need several programming sessions before you get the best symptom control. You will also receive a handheld programmer so you can check your stimulator’s status and battery.

• **Follow-up appointments:** Patients will be seen monthly until the programming settings have been optimized. After optimization you will return to seeing your doctor periodically for continued essential tremor care. You or a caregiver should have the battery checked at least every six months by a DBS provider. Your settings may be adjusted as your disease progresses or as needed.

**If you live outside the Portland area:** You might be able to do some steps in your home community. You can do this with your local doctor and by video link with OHSU specialists.

It is best to have a caregiver with you at home as you heal from surgery.
Make sure to tell your DBS team about all your medications and health conditions. You must stop taking some medications one to two weeks before surgery. Talk to your main doctor or cardiologist before stopping. Medications you need to stop before DBS surgery include:

- Warfarin (brand name: Coumadin)
- Plavix
- Apixaban (Eliquis)
- Dabigatran (Pradaxa)
- Rivaroxaban (Xarelto)
- Cilostazol (Pletal)
- Ibuprofen (one brand name is Motrin)
- Indomethacin (Indocin)
- Naproxen (brand names include Naprosyn and Aleve)
- Ketoprofen (Orudis)
- Celecoxib (Celebrex)
- Aspirin or medications that contain aspirin
Recovering from surgery

Call the DBS team at OHSU immediately if you see any sign of infection.

This includes:

• Blood or other fluid coming from a wound.
• Tenderness, redness or swelling at an incision.
• Fever.

Important: Do not put any creams or antibiotic ointments on your incisions. Do not take any antibiotics by mouth.

Whom to call

• For wound care questions: 503-494-4314.

• After hours or on weekends: 503-494-8311. Ask the OHSU operator to page the neurology or neurological surgery resident on call.
Other guidelines after DBS surgery

• **Rest:** Take it easy as much as possible. Go back to your regular activities slowly.

• **Incisions:** Keep your incisions dry for the first two weeks. But don’t cover them except when you shower. If they accidentally get wet, gently pat them dry as soon as possible. Also, keep your incisions clean. Make sure bedding, hats and wigs are clean. Wash your hands after handling pets or other animals.

• **Falling:** You have an especially high risk of falling in the weeks after DBS. Be cautious. If you used a walker or cane before surgery, keep using it until you are stronger and steadier.

• **Bruising and tenderness:** Some bruising near incisions is normal. You might also have swelling around your eyes for a week or two. Tenderness or numbness near incisions and behind the ear may last as long as a month.
**What to expect after DBS**

**Maximum symptom control:** It usually takes a few months and several adjustments to your stimulator to see the full benefit of DBS.

**The honeymoon phase:** Occasionally symptoms can improve temporarily after surgery. Doctors call this the microlesion or honeymoon effect. It can last days or weeks. Do not lower or change your medication doses without talking to your neurologist. Not everyone experiences a honeymoon phase. Many patients report no change to symptoms and some report a temporary worsening of symptoms. Stay in touch with your neurologist to ensure your experience matches your expectations.
Before you have any procedure or imaging, tell your health care team that you have a DBS system. They can call the technical help line for your device with questions. Medtronic, Boston Scientific and Abbott are the device makers we use. The health care team should contact OHSU with any questions before your procedure or imaging. They can also contact the device maker directly. Call OHSU’s DBS team at 503-494-7231 or 503-494-4314 before you have any procedure or imaging.

How to handle specific procedures:

**Diathermy: Never have this**

Diathermy is a deep-heat treatment that uses high-frequency electromagnetic currents. It can cause tissue damage, serious injury or death.

**MRI: Call us first**

Have your provider call us about the strict guidelines for providing a scan while keeping you safe. Most MRIs should be done here at OHSU.
**Surgery: Call us first**

Your surgeon or a member of the surgery team must call your device maker or your DBS provider to discuss the safety of the surgical tools they plan to use. You must turn your DBS off and turn the voltage to zero for the procedure. You can return to the previous settings right after the surgery.

**Defibrillation or cardioversion: Turn your DBS off if possible**

When possible, turn off your DBS. Tell the person using the defibrillator or doing cardioversion to keep the pads as far away from your stimulator as possible while still being effective. At least two inches is recommended. If you don’t have time for these things during an emergency, let the person use the defibrillator to save your heart.

**EKG, CT scan, diagnostic ultrasound or X-ray: Safe**

These are completely safe, but tell the technician that you have an implanted device. Turn your DBS off before EKGs or CT scans to keep them from interfering with the scan.
Cost and insurance

The cost of DBS is different for each person. It depends on your insurance and other factors. The DBS team will help you learn the details.

Does Medicare cover DBS? Read the Medicare standards for DBS or call the number on your Medicare card to learn more. You must still pay deductibles, coinsurance and copayments.

What about other health insurance? Non-Medicare health insurance often covers DBS if you get approval before surgery. Your doctor’s office usually has to get authorization from your insurance company prior to surgery. This often means your doctor writes a letter saying why you are a good candidate.
Visiting Portland

Portland offers many lodging options, excellent restaurants, superior mass transit and a generally mild climate. OHSU’s DBS sites are centrally located and accessible by car, bus, light rail and the Portland Aerial Tram. Some helpful websites:

- **Lodging and dining:** Travel Portland at [www.travelportland.com](http://www.travelportland.com).

- **Transit:** TriMet (bus and light rail) at [www.trimet.org](http://www.trimet.org).

- **Tram:** The Portland Aerial Tram at [www.gobytram.com](http://www.gobytram.com) offers easy access between our sites at the South Waterfront and Marquam Hill. Free courtesy tickets are available for patients and their loved ones.

- **Learn more at** [www.ohsubrain.com/dbs](http://www.ohsubrain.com/dbs).

How do I get a referral or ask questions? Call us at 503-494-4314 or email dbs@ohsu.edu.
Getting here and parking

We provide DBS services at two locations, depending on the appointment. These are OHSU Hospital on Marquam Hill and the Center for Health & Healing at the nearby South Waterfront campus. For directions and parking information, please visit www.ohsu.edu/parking.
Information for caregivers

When you take care of someone with essential tremor, you may feel needed and important. You may find it difficult if your loved one needs less help after DBS. On the other hand, you might feel overwhelmed as a caregiver. You may be disappointed if DBS isn’t a “miracle cure” and you still have significant caregiving responsibilities. The International Essential Tremor Foundation and the Family Caregiver Alliance offer tips for caregivers of essential tremor patients. These include:

- **Be prepared:** Learn what your loved one can and can’t do alone. Understand your finances, including if and when to get power of attorney.

- **Find a support group:** The International Essential Tremor Foundation keeps a state-by-state list at [www.essentialtremor.org/find-a-support-group](http://www.essentialtremor.org/find-a-support-group).

- **Get help:** Seek help among family, neighbors, your religious congregation, senior centers and services such as Meals on Wheels. Consider hiring help with cooking, bathing and dressing. You can make a list of chores to share with family and friends who are willing to help for a few hours but aren’t sure what you need.

- **Nurture your relationship:** Caregivers who have good relationships with the patient have better health and lower rates of depression.

- **Learn more:**
  - International Essential Tremor Foundation: [www.essentialtremor.org](http://www.essentialtremor.org)
Questions and answers about DBS

Is DBS a cure?

No. DBS can make your quality of life much better but it does not cure essential tremor or keep it from getting worse over time.

Is DBS experimental?

No. OHSU has been performing DBS for 25 years. The procedure is FDA-approved for treating patients with essential tremor.

Will DBS make my essential tremor symptoms go away?

If you’re a good candidate for DBS, you can expect it to significantly improve your symptoms.

Will DBS keep me from doing certain activities?

Talk to your neurologist about specific activities. After you recover from surgery, DBS should not keep you from regular activities such as swimming, bathing, sexual activity or sports.

Can I stop taking medication after DBS?

Most patients can discontinue many of their essential tremor medications and reduce the amount of other medication they take under the guidance of their neurologist.

How can I know for sure if I’m a candidate for DBS?

Our team of specialists will do a thorough evaluation.
How long will the benefits of DBS last?

This is different for everyone. For most patients, benefits last many years. A 2012 study published in Stereotactic and Functional Neurosurgery found that patients with essential tremor reported significant improvement regardless of whether they had had surgery one year before or four years before.

I don’t live near Portland, Oregon. Can I still consider OHSU?

Absolutely. Our DBS team can work with patients from any area. You may have some appointments by secure video link.

Can I still see my regular neurologist?

Yes. OHSU makes your regular health care provider a partner in your care through the entire DBS process.

I’m not a candidate for DBS. Now what?

Our specialists will talk with you and your doctor about other treatment options.

Will I feel the electric pulses from my DBS?

No; however, you will feel changes during programming and possibly when the device is turned on and off.

Will my stimulator trigger the metal detector at the airport?

There have been no reports of this happening but it’s a good idea to get a medical card for your wallet that describes your DBS system. You can show the card to security officers and ask for a manual body scan. It is a good idea to carry your programmer when traveling.
Should I have a medical alert bracelet?

It’s a good idea but not necessary. In an emergency, the bracelet can tell someone that you have a DBS system. It can include warnings, and it can alert them to the card in your wallet with emergency contacts.

Can I use appliances and tools?

You can use most household appliances and tools with no problem.

Can I control my DBS programming?

Talk to your neurologist. Some patients have a controller that lets them adjust their DBS stimulator. The controller also lets them turn the stimulator on or off, or check the battery.

Will surgeons shave my head?

No. Only small patches will be shaved for the incisions. Your hair will grow back.

Will wires from the device show?

The DBS system is completely under the skin. If you are bald you will see the cranial caps. For many people you can see the wires under the skin when they turn their head. It looks similar to a muscle tendon.

Can I have DBS and a heart pacemaker?

Yes. The devices need to be at least 10 inches apart. This might mean your DBS stimulator is placed in your right chest area instead of your left chest.
Where to learn more

“All I can say to anyone thinking about DBS is this: It’s not a cure, but it’s the next best thing. Everyone may not have equal results, but for me, the results have been nothing short of miraculous. I love it. I wear my DBS with pride.”
— Thom, who had DBS surgery at OHSU with Dr. Burchiel

At OHSU

To learn more about DBS at OHSU, visit www.ohsubrain.com/dbs.

National

Find more at each site by entering DBS in the search field.

International Tremor Foundation: www.essentialtremor.org; find specifics on DBS at essentialtremor.org/treatments/surgical-treatments

Tremor Action Network: www.tremoraction.org

National Institute of Neurological Disorders and Stroke, essential tremor: Go to www.ninds.nih.gov and type “essential tremor” in the search field.

Medtronic, essential tremor information: www.medtronicdbs.com/essential-tremor

St. Jude Medical (now Abbott): www.sjm.com

Boston Scientific: www.bostonscientific.com

The International Essential Tremor Foundation keeps a state-by-state list at www.essentialtremor.org/find-a-support-group.
Each Parkinson’s patient is unique, as is their treatment plan. The guide below provides a general idea of the journey a typical DBS patient might experience.

1. **Diagnosed with idiopathic Parkinson’s disease**
2. **Significant quality-of-life impact**
   - Symptoms are no longer controlled adequately with medication
3. **Consider deep brain stimulation (DBS) surgery as an option and discuss with your neurologist**
4. **DBS candidacy evaluation** (typically requires one to two days)
   - Confirm idiopathic PD diagnosis
   - Cognitive function testing
   - Physical therapy: motor testing while on medication (e.g., Sinemet, L-dopa) and off medication
   - Speech and/or swallowing evaluation
   - Additional factors considered: comorbidities, age, degree of disability
   *Some or all of these appointments may need to occur at OHSU with a movement disorders neurologist or neurological surgeon, if unable to be provided by your referring provider.

5. **DBS surgery at OHSU**
   - **Local patients — Oregon and Southwest Washington**
     - **DAY 0**
       - Brain imaging (under anesthesia if needed)
       - Preoperative visit with a neurosurgeon, receive medical clearance for procedure*
     - **DAY 1**
       - DBS surgery, admitted as inpatient to OHSU
     - **DAY 2**
       - Recovery day in hospital, discharge
     - **DAYS 5–10**
       - Implant IPG, discharge from hospital that day
     - **DAY 30**
       - Wound check, initial stimulator programming with OHSU neurology
       *Within a week prior to surgery
   - **Traveling patients**
     - **DAY 0**
       - Arrive Portland, Oregon
     - **DAY 1**
       - Brain imaging (under anesthesia if needed)
     - **DAY 2**
       - Preoperative visits with a neurosurgeon, receive medical clearance for procedure
     - **DAY 3**
       - DBS surgery, admitted as inpatient to OHSU
     - **DAY 4**
       - Morning evaluation and discharge from OHSU before noon
     - **DAY 5**
       - IPG implant surgery as outpatient, discharged later in day
     - **DAYS 6–9**
       - Healing and recovery
     - **DAY 10**
       - Wound check and initial stimulator programming with OHSU neurology

6. **Follow-up appointments (in person or via telemedicine)**
   - Post surgery: neurology visit, ongoing programming adjustments/optimization
   - Post surgery: neurology visit, ongoing programming adjustments/optimization
   - Post surgery: neurology visit, ongoing programming adjustments/optimization
   - Six-month intervals: follow-up care visits
   *Some or all of these appointments may need to occur at OHSU with a movement disorders neurologist or neurological surgeon, if unable to be provided by your referring provider.
How do I get a referral or ask questions? Call us at 503-494-4314 or email dbs@ohsu.edu.