Deep Brain Stimulation for Essential Tremor

Exceptional healthcare, personally delivered
Deep Brain Stimulation

Having been seen by a consultant neurologist at and one of the Surgical Movement Disorder Nurse Specialists at Frenchay, members of the Functional Neurosurgical team, and been told that you may be a suitable candidate for Deep Brain Stimulation (DBS) surgery for treatment of your tremor, you might be left wondering what is ahead of you. We do not want to overload you with too much information, but will give you relevant information at each stage of your journey. This guide will give you some insight of what to expect.

1. Funding will be sought from your Primary Care Trust for your pre-surgical assessment and surgery.

2. Providing funding is approved you:
   a) may be seen in an outpatient clinic again by your Frenchay neurologist to assess your tremor further and to determine if there has been any improvement with new medication, or
   b) you may move directly to a pre-operative assessment to determine your fitness for general anaesthesia etc.

3. If following the above assessments you are considered suitable for surgery and you wish to proceed, you will be added to the DBS surgical waiting list.

4. You will be given an admission date for your operation.

What is deep brain stimulation (DBS)?

It is a brain surgery procedure performed under general anaesthetia to improve severe and disabling essential tremor.

The procedure involves:

- The implantation of 2 leads, each with 4 electrodes (otherwise known as “contacts”), into structures deep within the brain called the basal ganglia. An extension lead is positioned under the skin of the head, neck and shoulder. (Figure 1)
This wire is finally connected to a small unit called an Implantable Pulse Generator (IPG), which is placed under the skin just below the collarbone (Figure 1).

Deep brain stimulation (DBS) works by sending tiny electrical pulses to the selected area of the brain which improves the abnormal brain signals that cause tremor. The amount of stimulation provided by the IPG is adjusted by an external programming device. Your specialist nurse will be responsible for programming your IPG to ensure that you obtain the maximum control of your symptoms with minimum side effects. In addition, you will be provided with a hand held device (patient programmer) which allows you to switch the IPG on or off, adjust the level of stimulation you receive and check the life of the battery in your IPG. (Figure 2).

(Figure 2)

Picture courtesy of Medtronic Ltd

How will it help me?

In your case the reason for performing deep brain stimulation surgery is to reduce the severity of your tremor.

What is the success rate?

The severity of a person’s tremor is typically improved on average by 86% using this approach. The average improvement in manual dexterity is 60%, and patients have on average experienced an 80% improvement in their ability to perform activities such as washing, dressing and feeding themselves.
What are the risks of treatment?

There are some risks associated with the surgery. Though the incidence is small, the doctor will discuss these fully with you prior to you giving your consent for surgery.

At Frenchay, based on our complication rates, we consent for the following:

- Seizures (0.3%).
- Wound infection (1%).
- Speech deterioration such as slurred speech (up to 5%).
- **Stroke 1%**.
- Post-operative confusion and disorientation (transient) 1%.
- Medical and other complications from general anaesthesia [1,2] (Chest infection, DVT (clot in the leg) or PE (a clot that can lodge in the lungs).
- Balance problems < 1%.
- Breakage of electrodes (<1%).
- Current leak from electrode (<0.5).

Over time after surgery the following problems can occur with the device:

- Generator or “pacemaker” battery depletion (the battery life of a generator is usually 3 - 5 years) when driving two electrodes.
- Breakage of electrode or extension leads.
- A reaction to the implanted materials (guide tubes, electrodes or generator). N.B. These materials have been previously tested for toxicity and are approved for implantation.
- If the above occurs the implanted kit may need to be removed or replaced.

Deep brain stimulation for essential tremor
Stimulation related side effects:

These are side effects related to the high frequency electric current spreading to areas other than the planned target area. However, these side effects will disappear completely on reducing the electric current or stopping it completely. You may experience:

- Paraesthesias (sensation of pins and needles on your arms and legs).
- Changes in speech or language such as difficulty in speaking or speaking softly.
- Facial twitching and muscle tightness.
- Problems with eyelid opening. [1,2]
- Problems with balance that could cause difficulty with walking and falls.

How are the stimulating leads accurately placed into the brain?

In order for the surgeon to accurately place the stimulation leads at the desired brain target, three steps are required:

1) **Brain localisation:** A reference frame (stereotactic frame) is fixed to the patient’s head and they will have an MRI scan. Using specially designed surgical planning software, the target site in the brain is identified on the scan and its position relative to the stereotactic frame is measured and recorded as 3 dimensional coordinates (Figure 3). The software is then used to plan a safe trajectory through the brain, avoiding critical/vascular structures.
2) **Guided surgical implantation.** The patient is transferred to the operating theatre and the 3D coordinates are set in an instrument-aiming device that in turn is fixed to the stereotactic frame. This enables the surgeon to guide the stimulation leads with millimetre precision to the brain target through a drill hole made in the skull.

3) **Confirmation of accurate targeting.** Placement of stimulating leads with millimetre precision at the desired target is necessary to optimise the treatment and avoid side effects. Because the brain floats in fluid it can move during surgery and result in suboptimal lead placement and treatment outcome.

At Frenchay Hospital we have developed a technique in which a fine plastic guide tube (Figure 4) is passed to the target and the accuracy of its placement is confirmed with a high definition MRI scan taken during the operation. An electrode is then inserted to the verified target site down the guide tube. This technique typically requires a single pass and is carried out entirely under general anaesthesia.

The plastic guide tubes are an in-house investigational device that has been designed to enable us to perform your operation accurately whilst you are anaesthetised (asleep). Our method is also designed to minimise the risk of bleeding in the brain (stroke). We believe that it is a safer and more accurate technique than the alternatives.

The outcomes from your surgery, including the accuracy of lead placement, the benefits and side effects will be recorded and held on a hospital computer database. This information may be used for publications in medical and scientific journals or presented at specialist meetings. If this does happen, your identity will remain anonymous and we will ensure that you cannot personally be identified from any details that we publish.
What happens before I come into hospital?
It is important that you have your ears examined by your practice nurse/GP during the two weeks prior to surgery. If you have excessive build up of wax, you will be referred to the practice nurse for treatment. This is to prevent any temporary hearing impairment due to wax being compacted when the frame is applied.

What happens when I am in hospital before my operation?
Day 1 - Admission day
On admission you will have a routine examination by a doctor and routine observations by a ward nurse.

Day 2 - Application of frame
- You should have breakfast at 8 am and can continue to drink until 11 am. Thereafter you will be nil by mouth.
- Late afternoon or early evening you will be taken to the operating theatre for a general anaesthetic. While you are asleep the frame will be applied to your head and you will have a Magnetic Resonance Imaging (MRI) scan, which will be used to precisely locate the target for the deep brain stimulation. When you wake up in recovery, the frame will have been secured to your head with 4 rods. It may appear cumbersome but it is not particularly heavy and will not prevent you from moving about.
- It is important to eat later in the evening as you will be nil by mouth again the following morning. You may wish to bring some snacks with you, but a snack box can be provided.

Day 3 - Operation day
- Your operation will take place at 08.30 am on Friday, and will take approximately 4½ hours. (Occasionally, this will happen on a Wednesday afternoon.) The entire operation is performed under a general anaesthetic (i.e. with you asleep).
Your surgeon will place two specially designed plastic “guide tubes” and stylettes to the target area in the brain. The guide tubes will be secured to the skull. You will then be taken for a repeat MRI scan to check that the guide tubes are in the correct position.

Providing the guide tubes are in the correct position you will return to the operating theatre and the deep brain stimulating electrodes will be passed down the guide tubes to the target in your brain.

You will have a generator (“pacemaker”) implanted in your chest, which will be connected to your deep brain stimulating electrodes.

When you wake up, you will be in the recovery room, where you will stay for approximately 2 hours. The frame will have been removed and you will not have had any hair shaved. Your stimulator may be turned on after your operation and left at a low setting for 1-2 days.

**What happens to me after my operation?**

It is important to get up and move around as soon as possible, but you will also need to rest at regular intervals. 2 – 3 days following surgery your stimulator will be programmed. Over the next few days the stimulator may continue to be adjusted. You will receive instructions on how to use your own programmer, which will allow you to switch the stimulation on or off, alter the level of stimulation and check the life of the battery in the generator. Your stitches will be removed from your head and behind your ear after 5 days. The paper stitches will be removed from your chest after 7 – 10 days.

You may feel very sleepy and the tiredness can last 4 – 6 weeks.

**How long will I be in hospital?**

The usual length of time spent in hospital is 7 – 10 days. Before you go home your specialist nurse will give you an information pack and discuss follow-up care.
It will be necessary to make regular visits to Frenchay Hospital for follow-up care. The frequency of your visits will depend on your individual condition. However, it is most likely that you will be seen:

- At 8 weeks as an outpatient by your Movement Disorder Nurse Specialist for further programming of your stimulator.
- At 3 - 4 months as an outpatient by your Consultant Neurologist and Movement Disorder Nurse Specialist.
- At 6 months, 12 months, 2, and 5 years for assessment.

You will also need to attend Frenchay for 1 – 2 nights when the battery in your generator becomes low. This will entail a small operation under general anaesthetic to change the generator. The battery life will vary depending on the stimulator settings required to control your tremor, but the average battery life is 3 – 5 years.

References


NHS Constitution. Information on your rights and responsibilities. Available at [www.nhs.uk/aboutnhs/constitution](http://www.nhs.uk/aboutnhs/constitution) [Last Accessed March 2010]
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In an emergency out of hours your doctor should contact the neurosurgical registrar on call.

Frenchay hospital switchboard
0117 970 1212

www.nbt.nhs.uk

If you or the individual you are caring for need support reading this leaflet please ask a member of staff for advice.

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