

# **Thalamotomy and Thalamic Deep Brain Stimulation**

## **Surgical Treatment for Tremor**

Tremor to some patients may be just a nuisance and may not require any treatment; however, there are many people who are disabled by tremor and for whom drug therapy has not been successful. Surgical treatment is available to this group of people, provided that they meet the criteria set by the neurological and neurosurgical team.

Surgical treatment for severe tremor in Parkinson's disease became popular as early as the 1950's and is still a widely accepted treatment. The surgical procedure, thalamotomy, was initially performed using an early form of stereotactic surgery and at that time produced a reduction of tremor with a low rate of symptom recurrence. With the advent of technology we now have much improved methods of performing stereotactic surgery. The options of thalamotomy and/ or deep brain stimulation (DBS) are now available for patients with various types of tremor.

### Some Basic Anatomy

The basal ganglia, structures deep in the center of the brain, have long been known for control of movement. The thalamus, one of these centers, serves as a "switch board" to relay information about movement and sensation to and from other parts of the brain and the body. It also contains nerve cells that normally send out rhythmic discharges to the opposite side of the body. However, the exact reason why these discharges may become abnormal and result in tremor in patients is unknown. It seems to stem from the result of complex interactions in certain centers for tremor control in the basal ganglia, particularly the thalamus.

### Tremor

Tremor can be described as a rhythmical, involuntary oscillatory (swinging) movement of one or more body parts.

There are different varieties of tremor which are classified according to the pattern of presentation in three positions. The tremor is usually assessed with hands at rest, with hands held up and outstretched, and during movement. The following descriptions may help to clarify the differences between some of the varieties.

- Resting Tremor occurs while the person is at rest and is not voluntarily moving the muscles of the hand. It usually disappears, at least momentarily, with movement and may reappear when the hands are held in an outstretched position. This variety of tremor is seen in Parkinson's disease and often affects one side of the body more than the other.

- Physiologic tremor, sometimes referred to as a postural tremor, is a fine rapid tremor of the hands which can be caused by fatigue, anxiety, drug intoxication, or other causes. It can be demonstrated by holding the hands up and outstretched. This type of tremor is a natural phenomenon and is usually of no concern.)
- Essential Tremor usually affects the upper limbs, however, it can involve the head and voice. It does not occur at rest but is present with hands held up and outstretched, as in a postural tremor. It usually becomes more pronounced and exaggerated with movement. It is an inherited disorder which may slowly worsen over time to cause a significant functional disability.
- Intention Tremor or cerebellar tremor refers to the postural or movement type of tremor which becomes worse as the finger moves closer to the target. The “finger-to-nose” test demonstrates the problem. A defect in the cerebellum is responsible for this type of tremor. This tremor may be a symptom of a neurological condition such as Multiple Sclerosis.

### Surgical Considerations

Neurosurgery for the control of tremor should not be considered unless medication therapy has been given a fair trial and found to be unsuccessful. The decision to have surgery should be taken seriously as there is an element of risk. As well, there are certain criteria that must be met before a person can be considered for surgery. In discussions with your neurologist and neurosurgeon, the criteria and risks, as well as your options will be explained to you. If surgery is an option and you agree to proceed, appointments will be arranged for preliminary testing and base line purposes.

### Thalamotomy

Although thalamotomy has been a treatment option for many years, new surgical and imaging techniques have improved the outcome of this surgery. Thalamotomy is a stereotactic surgical procedure in which a small hole is made in the skull and then a lesion (destruction of cells) is made in a specific area of the thalamus, the centre for the control tremor. The lesion immediately arrests the tremor on the opposite side of the body. Because the surgeon requires the assistance and cooperation of the patient during the surgery, the patient is awake throughout the procedure. This treatment is not reversible, nor is it a cure for the underlying condition; however, the benefits may last many years. It is also important to note that in a small percentage of patients the tremor can reappear in a few weeks or months.

### Deep Brain Stimulation (DBS)

DBS is a technique using the same stereotactic procedure as for thalamotomy. The difference is that a small lead (a very thin insulated wire electrode) is implanted into the tremor control centre of the thalamus instead of a lesioning technique. The lead is

connected to an impulse generator (battery) by way of a small wire. The impulse generator delivers electrical impulses which stimulate the tremor control area resulting in a reduction or cessation of the tremor. It is, therefore, somewhat like a cardiac pacemaker.

This is a two part surgery with the implantation of the lead being the first part of the surgical procedure followed by connection and implantation of the lead extension and the battery a few days later. The patient must be awake during the implantation of the lead as the surgeon requires the patients assistance and cooperation. If the tremor cannot be suppressed during surgery the procedure is stopped. If all goes well the patient will return to the operating room on the second day to have the lead extension and the battery implanted under a general anaesthetic. The stimulator lead is tested during surgery and again prior to implanting the battery. With this system the patient can turn the stimulator on or off using a special magnet or controller. The amount of stimulation needed to suppress the tremor may need to be adjusted by our nurse-clinician. These adjustments will require visits back to the Movement Disorders Clinic. Initially these adjustments may need to be done frequently (every 1-2 weeks) until the proper settings are determined.

### The Risks due to Surgery

All surgery carries some element of risk. For DBS the risks of complication are low but may include any of the following:

- 1:200 (0.5%) chance of death due to hemorrhage
- 2 to 3 % chance of a major complication such as a stroke, hemorrhage/bleeding
- 10% chance of permanent numbness, weakness, speech and/or swallowing problems, drooped face, bladder urgency or frequency, or difficulty with concentration and memory
- 40% chance of mild, transient occurrences of the above side effects
- Small chance of seizures or infection
- Transient confusion
- Headache

Initially, periodic adjustments in programming the stimulator will be needed. During this adjustment period some people may experience the following side effects:

- Transitory, but mild changes in sensation in a limb or a small area on the face
- Occasional transient dizziness or feeling of being lightheaded

### Risks due to the Implanted Stimulator

The overall risk of any these hardware-related complications (all of which are treatable but may require repeat surgery) over 4 years is 20%, meaning about 5% per year.

- Infection / rejection / breakage of hardware
- Malfunction of hardware

The stimulator requires a battery which will last 2-4 years, and replacement will require a minor surgery. It is expected that within the next few years a re-chargeable battery will be developed.

### Preparation for Surgery

A decision to consider surgical treatment is made during doctor-patient discussions on management of the condition. The patient is then referred to the neurological/neurosurgical team in the Program for Surgical Treatment of Tremor. The patient is assessed by Dr. Kraft, Dr. Kiss, and Karen RN or Pia RN to determine whether the patient will meet the criteria for surgery. If the criteria are met and the patient is agreeable to proceed, a number of baseline assessments are arranged and the patient is booked for surgery. The baseline assessments may include a CT scan or an MRI of the brain, neuropsychological testing, and a video taping session along with some additional testing and counseling by the nurse coordinator. The nurse will review the planned surgical procedure with the patient and family members, providing an opportunity to ask any questions they may have.

### In Hospital

The patient will be admitted to hospital early in the morning the day of surgery. After admission the patient will go to a day unit and from there will be taken to the MRI department in radiology where they will be fitted with a very special frame which will be secured to the head. An MRI will be done with the frame on to obtain the necessary coordinates to be used for calculations during surgery.

The patient will then be taken to the operating room where the procedure will take place. It is very difficult to determine exactly how long the surgery will take. Relatives will need to wait patiently for news from the operating room or recovery room. One of the nurses from the Movement Disorder Clinic will keep the relatives informed as to the progress of the surgery. If the surgical procedure is a thalamotomy and there are no complications the patient will be discharged the next day. If a deep brain stimulator (Deep Brain Stimulation) is implanted the patient will stay in hospital until he returns to the operating room within a few days to complete the second part of the procedure.

After surgery Dr. Kiss will either meet with the family or call to discuss the surgery. It may take from one to several hours before relatives can visit with the patient after surgery.

The patient will return to the Movement Disorder Clinic one week after discharge to see the nurse-clinician for suture removal and incision check. The nurse-clinician will keep in touch by telephone to make an appointment in about 1 month for programming.

### The Cost

In Canada, the surgical procedures and any support services are covered by the health plans of all provinces. If you are not a resident of Canada, contact the administrator of your health insurance plan to ask if you are eligible for coverage.

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