Surgical Treatment of Movement Disorders

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Historical Aspects of Surgical Treatment
• 1947 – Spiegel & Wycis used stereotactic surgery landmarks within the brain (air encephalograms) and an electrode carrier
• 1952 – Cooper inadvertently cut an artery which supplied the globus pallidus and the patient improved.
• 1960s – Microelectrode recording was introduced but with the arrival of Sinemet, surgeries lessened

New Techniques: Procedure is safer and better
• MRI allows better localization
• Improved stereotaxis and delivery of the electrode.
• Stereotactic techniques involve location of a target in 3-D space by reference to a cartesian coordinate system (3 planes at right angles to each other intersecting at a point)
• Advances in understanding of the physiology

Patient Selection For DBS For PD
• Secure diagnosis of Parkinson's Disease: cardinal features
• Good response to l-dopa
• Either:
  • Motor complications not controllable pharmacologically including dyskinesias, or
  • Medically refractory tremor
• Exclusions: cognitive impairment/dementia; severe psychiatric illness; other illnesses

Patient Selection For Essential Tremor
• Medically refractory Essential Tremor
  – Should have trials of primidone and propranolol
• Exclusions: Cognitive impairment; psychiatric disease

Patient Selection For Dystonia
• Medically refractory generalized dystonia
• Cervical dystonia refractory to Botulinum toxin injections
• Exclusions: Cognitive impairment; psychiatric disease
Evaluation Protocol

The Team

Implanted System

Target Sites

Postoperative Issues

- Patients usually discharged within 2 days
- Initial programming in our center is at 3-4 weeks post-op. Some centers do this earlier
External Components

8840 N’Vision® Clinician Programmer

DBS Programming

• Programmable Parameters
  – Voltage: 0-10.5 V
  – Pulse Duration: 60-450 us
  – Frequency: 30-185 pps
  – Electrode Configuration

• Programming Approach
  – Impedance check
  – Establish adverse effect threshold: dysarthria, diplopia, muscle contractions, paresthesias, mood changes
  – Observe for symptom suppression

Importance of Lead Location

Properly selected electrode on a properly located DBS™ lead provides optimal therapeutic benefit with minimal stimulation-induced adverse effects.

STN
Sensory Pathways
Motor Pathways

Stimulation Parameters

Unipolar: Spherical field
Bipolar: More focused field

Follow Up Visits and Adjustment of Medications

• With STN for PD stimulation there is a 40-70% reduction in l-dopa; adjustments of medications are made in parallel with changes in stimulation parameters
• Follow up visits are usually at 3 month intervals but may spread out to once a year if the patient has a local neurologist managing their disease

Patient Control of Stimulators

• With Vim stimulators; patients may turn the stimulator off at night to spare battery life. There may be less development of tolerance
• Patients with GPi and STN stimulators leave them on all the time
• DBS Patient Programmer allows patients to:
  • Turn stimulator on and off
  • Control amplitude, pulse width and rate with physician-prescribed limits.
  • Change therapy group that is active
  • Monitor stimulator battery life
Subthalamic Stimulation for IPD

"ON" Time Without Dyskinesias Improves from 27% to 74% of a Patient’s Waking Day*

Before Surgery (n=96)

- ON with Dyskinesia
- ON without Dyskinesia
- OFF

6 Months After Surgery Bilateral STN Activa® implant (n=91)

- ON with Dyskinesia
- ON without Dyskinesia
- OFF


Bilateral Deep Brain Stimulation vs Best Medical Therapy for Patients With Advanced Parkinson Disease: A Randomized Controlled Trial


- Randomized clinical trial of bilateral DBS vs best medical therapy (255 patients)
- Subthalamic nucleus (n=60), Globus Pallidus (n=61), best medical therapy (n=134)

Off time (hr)
L-dopa*
On w/o dyskinesias (hr)
Quality of Life (ADL)

Serious Adverse Events:
- 49 in DBS group, 19 in controls
- Most (83%) resolved at 6 months
- One death due to brain hemorrhage
- Surgical Site infections: 12 pts
- Device-related: 8 pts
- Cardiac complications: 4 pts

Quality of Life (ADL)
Working Memory

Serious Adverse Events:
- An undesirable experience associated with use of a medical product resulting in death or is life threatening or leads to hospitalization or disability or requires treatment to prevent permanent impairment or damage.

* equivalence

Vim Stimulation for Essential Tremor

Improvement in Tremor Score After DBS

Neurostimulation for Parkinson’s Disease with Early Motor Complications


- 251 PD patients with early motor complications
- Randomly assigned to DBS plus medical therapy or medical therapy alone
- Primary endpoint: Quality of Life (PDQ-39) significantly improved
- UPDRS off medications improved by 17.5 for DBS vs only 1.2 for medical therapy
DBS for Dystonia

Adverse Events

<table>
<thead>
<tr>
<th></th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td><strong>STIMULATION</strong></td>
<td></td>
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<tr>
<td>Dysarthria</td>
<td>9.3%</td>
</tr>
<tr>
<td>Weight gain</td>
<td>8.4%</td>
</tr>
<tr>
<td>Depression</td>
<td>6.8%</td>
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<tr>
<td>Eyelid opening apraxia</td>
<td>3.6%</td>
</tr>
<tr>
<td>Stimulation-induced dyskinesia</td>
<td>2.6%</td>
</tr>
<tr>
<td>Manic Episode</td>
<td>1.0%</td>
</tr>
<tr>
<td>Miscellaneous motor</td>
<td>4.0%</td>
</tr>
<tr>
<td>Miscellaneous psychiatric</td>
<td>3.5%</td>
</tr>
</tbody>
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| **SURGICAL**           |      |
| Transient confusion    | 15.6%|
| Intracranial Hemorrhage| 3.9% |
| Infection              | 3.7% |
| Pulmonary Embolus      | 0.5% |
| Miscellaneous          | 3.3% |

| **DEVICE**             |      |
| Electrode/wire replacement | 4.4% |
| Device dysfunction      | 3.0% |
| Infection              | 1.9% |
| Migration              | 1.5% |

Reasons for Inadequate Benefit

- Incorrect diagnosis
- Wrong indications
- Inappropriate expectations
- Poorly placed leads
- Device malfunction
- Sub-optimal programming


Conclusions

- Deep brain surgeries useful in treating patients with Parkinson’s Disease who are experiencing motor complications including dyskinesias
- Deep brain surgeries useful in treating medically refractory Essential Tremor (and other tremors), tremor-predominant Parkinson’s Disease, and Dystonia