Deep Brain Stimulation: Current Indications and Future Directions

Jean-Philippe Langevin, MD
Director, Restorative Neurosurgery
Pacific Neuroscience Institute
Objectives

- Deep Brain Stimulation (DBS)
- Current and emerging indications for DBS
- Closed-loop DBS (epilepsy)
- Surgical technique and frameless DBS
Electrical stimulation of a specific region of the brain
St. Jude Medical DBS implant
Directional Stimulation
Future of Current Steering

Dijk KJ et al. J Neural Eng 2015;12 (4)
## Current and Emerging Indications

### Neurology
- Parkinson’s Disease
- Essential Tremor
- Dystonia
- Epilepsy (Neuropace)

### Psychiatry
- Obsessive-Compulsive Disorder (HDE)
- Depression
- Addiction
- PTSD
Quality of life improvement

Pre-operative

Post-operative
DBS works by disrupting signals

DBS Center of Excellence

- Patient Selection
- Electrode placement precision
- Post-operative care
Bilateral Deep Brain Stimulation vs Best Medical Therapy for Patients With Advanced Parkinson Disease: A Randomized Controlled Trial

Frances M. Weaver; Kenneth Follett; Matthew Stern; et al.


### Table 2. Patient Motor Diary Outcomes

<table>
<thead>
<tr>
<th>Time</th>
<th>Best Medical Therapy (n = 134)</th>
<th>Deep Brain Stimulation (n = 121)</th>
<th>Best Medical Therapy Minus Deep Brain Stimulation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline, Mean (SD)</td>
<td>6 mo, Mean (SD)</td>
<td>Mean Difference (95% CI)</td>
</tr>
<tr>
<td>On, h/d&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.0 (2.9)</td>
<td>7.1 (3.3)</td>
<td>0 (−0.5 to 0.5)</td>
</tr>
<tr>
<td>Without troublesome dyskinesia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With troublesome dyskinesia</td>
<td>4.2 (3.1)</td>
<td>3.9 (3.3)</td>
<td>−0.3 (−0.8 to 0.3)</td>
</tr>
<tr>
<td>Off, h/d&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.6 (2.9)</td>
<td>5.7 (2.8)</td>
<td>0 (−0.4 to 0.5)</td>
</tr>
</tbody>
</table>
EarlyStim Trial

![Graph showing PDQ-39 Summary Index Score over months since randomization. The blue line represents medical therapy, starting at 30.2 and trending up to 30.4. The red line represents neurostimulation, starting at 18.9 and trending up to 22.4.](image-url)
Quality of Life Improvement
DBS FOR ESSENTIAL TREMOR
Tremor reduction

DBS Off

DBS On
EPILEPSY: CLOSING THE LOOP
Closed Loop System

- Closed Loop System
- Condition Biomarker
- Implant Computer
- Target Response
- Self-Programming
- Chronic Monitoring
Closed-loop Neuromodulation
Benefits of RNS for Epilepsy

- Median reduction overall: 1 year 44%; 2 years 53%
- Responder rate: 1 year 44%; 2 years 55%

DBS FOR OCD
Activated PET in OCD patients

Benefits: 35% Reduction in Severity

ADVANCE IN SURGICAL TECHNIQUE

Frameless DBS
Frame-based vs Frameless
3D Printed Custom Mini-Frame
Computerized Targeting
Accuracy and Complications

- Dislodged fiducial (s): 0.1 % (3)
- Infection: 0004% (1)
- Starfix not fitting: 0.004% (1)
- Accuracy: 1.24-1.99 mm
Conclusion