Automated Guidance of Post-Operative DBS Programming

Webinar Will Begin at 12:00 PM EDT
Outline

• Introduction to DBS
• Challenges and Technological Opportunities
  – Kinesia ProView
• Automated, Technology-Assisted DBS Programming
The clinical utility of deep brain stimulation (DBS) for the treatment of Parkinson’s disease is well established.
DBS Programming Workflow

Patient → Clinician

IPG

Programming Unit
Challenges in DBS

Clinician Training
• Great disparity in outcomes due to varied post-operative management

Vast Stimulation Parameter Space
• Thousands of combinations of DBS parameters (e.g., contact, polarity, frequency, pulse width, amplitude)
Challenges in DBS

Symptom Assessment

- Not possible to evaluate all symptoms, lack of sensitivity in clinical scales

Longitudinal Tracking

- Documenting programming sessions typically on paper, difficult to quickly review history
DBS Programming Workflow

Patient → Clinician

IPG

Programming Unit

[Image of brain and eye]
Automated algorithms for rating symptom severity:

- Tremor
- Dyskinesia
- Upper Extremity Bradykinesia
- Lower Extremity Bradykinesia
- Gait, Freezing of Gait
**Tremor tuning** produces sudden, dramatic effects on symptomatic benefit

**Bradykinesia tuning** produces gradual, fine effects on symptomatic benefit
Color-coded visualizations of DBS symptom response
DBS Programming Workflow

Patient → Clinician

IPG

Programming Unit
Objective quantification and visualization of deep brain stimulation response
HIPAA Compliant Log-in

User Name
Password
Admin
Login
<table>
<thead>
<tr>
<th>Patient ID</th>
<th>First Name</th>
<th>Last Name</th>
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<td>Trivison</td>
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Tuning Map Home Screen
Stimulation Settings

- Amplitude Configuration: 0 mA
- Stim Settings
- Kinesia Tasks: Postural Tremor, Rest Tremor
- Manual Tasks: Gait, Rigidity
- Side Effects: Muscle Twitch
- End Session

Stimulation Amplitude

Stimulation Settings

- Polarity: 00 OFF, 01 OFF, 02 OFF, 03 OFF, 04 OFF, 05 OFF, 06 OFF, 07 OFF, 08 OFF
- Frequency: 2.8 Hz, 130 Hz
- Pulse Width: 0.08 μ, 60 μ

Notes on this configuration would go here.
Populated Tuning Map

Amplitude Configuration
0 mA A

Stim Settings

Kinesia Tasks
- Postural Tremor
- Rest Tremor
- Finger Taps

Manual Tasks
- Gait
- Rigidity

Side Effects
None

End Session

Back

UPDATE MAP
Set Threshold
Assign Final Settings

Kinesia Tasks
- Rest Tremor
- Postural Tremor

Bradykinesia
- Finger Taps
  - Speed
  - Amplitude
  - Rhythm

Manual Tasks
DBS Programming Workflow

Patient

IPG

Programming Unit

Clinician
Automated DBS Programming

1. Motion sensor assessments to develop a functional map
2. Intelligent algorithms for navigating the parameter space to maximize symptomatic benefits while minimizing side effects and battery consumption
## Value Proposition

Automated programming has potential benefits for both clinicians and patients:

**Clinician**
- Improved workflow
- Improved patient outcome tracking

**Patient**
- Improved outcomes
- Reduced battery replacement
- Expanded access
- Reduced travel burden
Study Protocol

- 9 PD subjects with DBS visit clinic at 1, 2, and 4 months post-implant
- Conduct a standard monopolar review of parameter space
- At each stimulation setting, assess tremor (rest and postural) and bradykinesia (finger tapping and pronation/supination)
- Record final clinician-selected stimulation settings
DBS Functional Map

- **Rest Tremor**
- **Finger Tapping Rhythm**
- **Finger Tapping Speed**
- **Finger Tapping Amplitude**
- **Postural Tremor**
- **Pronosupination Speed**
- **Pronosupination Amplitude**
- **Pronosupination Rhythm**

Severity Score

- Amplitude (V)
- Severity Score
- Contact (,Case+)
Two algorithms were developed post-hoc to select the “optimal” stimulation contact and voltage combination across all motor tasks.

1. Therapeutic benefit
2. Battery life

Relative effectiveness of settings determined by the clinician and those determined by each algorithm were compared.
• Increased therapeutic benefit relative to the clinician settings in 14/16 programming sessions
  – 31.7% vs 45.1%
• Most often at expense of increase in stimulation amplitude
• Lower voltage while maintaining therapeutic benefit in 6/16 sessions – 50% reduction
Statistical Comparisons (paired t-tests)

Optimization of Therapeutic Benefit (n = 16)
- p < 0.0001
- p < 0.0001

Optimization of Battery Life (n = 6)
- p = 0.010
- p = 0.044

Total Motor Score
- OFF
- ON-Clinician
- ON-Algorithm

Stimulation Amplitude (V)
- p = 0.003
- p = 0.020
Conclusions and Implications

- Automated objective assessment in DBS programming can identify settings that:
  1. Improve symptoms, or
  2. Obtain similar benefit as clinicians with significant improvement in battery life
- “Online” evaluation of automated guidance of DBS programming ongoing
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Questions?

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