Programming DBS: Trouble Shooting Strategies

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Common Problems Encountered in DBS Therapy

Lead location → suboptimal placement?

Programming suboptimal?

Device-related issues or malfunction?

Has there been an over zealous medication reduction?
(pt under-medicated?) Or unrealistic expectations?
Is it a Lead Location Problem?

• What does the post-op MRI show?
• 1.5 tesla magnet only


Post-Operative MRI
Fig. 1 Representation of the major anatomical structures and fibre tracts associated with the subthalamic nucleus. AL = ansa lenticularis; CP = cerebral peduncle; FF = Fields of Forel; GPo = globus pallidus externus; GPi = globus pallidus internus; HI = HI Field of Forel (thalamic fasciculus); IC = internal capsule; LP = lenticular fasciculus (H2); PPN = pedunculopontine nucleus; Put = putamen; SN = substantia nigra; STN = subthalamic nucleus; Thal = thalamus; ZI = zona incerta.
Lead Location Directly Influences Programming: STN

Affective changes from stimulating SNr. STN Limbic region may be more anterior to motor region.

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Programming with Gusto

- Has each contact been screened using *maximum tolerated voltage* to assess ceiling threshold?
  - Determines therapeutic window
  - Titrate just below maximum tolerated voltage
- Kinetra batteries require higher voltages

Three Dimensional STN Anatomy

- Medial and posterior = leminscal fibers
- Lateral and anterior = capsular fibers
- Anterior to motor = limbic pathways?
- Deep and medial = SNr = limbic
- Medial and deep = IIIrd nerve
- Lateral to STN, genu of capsule = conjugate gaze eye signs
## STN Side Effects at Low Thresholds

**Expected side effects from lead location:**
- Persistent Paresthesias → Too posterior or medial (Lemniscal fibers)
- Dysarthria, pulling/contractions → Too lateral (Capsule)
- Diplopia → Too deep, anteromedial
- Dyskinesias → In optimal location
- Mood changes → Too anterior and medial
- **No effect at high voltages** → Too superior or anterior

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  - Programming suboptimal?
  - Device-related issues or malfunction?
  - Has there been an over zealous medication reduction?
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Is Problem a Device Malfunction?

• Impedance checks – verify electrical integrity
• Kinetra (use 4.0V or 4.5V to run checks)
• Soletra (use std 1.5V to run checks)
• Short circuit = two contacts or wires connecting $\rightarrow$ rapid battery depletion
• Open Circuit = loss of one or more contacts with sudden loss of efficacy

Impedance Readings

– Impedance & current drain indicate status of system (applies to Soletra)

  • Normal: impedance 600-1300 $\Omega$; current drain <12-30 $\mu$A
  
  • Open Circuit:
    • Soletra impedance >2000 $\Omega$; current drain <7-9 $\mu$A
    • Kinetra impedance>4000 $\Omega$; current drain <7-9 $\mu$A
  
  • Short Circuit: impedance <250 $\Omega$; current drain >500 $\mu$A
Open Circuit – loss of one or more contacts

Electrode Impedences
(1.5 V, 210 µs, 30 Hz)

<table>
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<tr>
<th>Electrode Pair</th>
<th>Impedance (Ω)</th>
<th>Current (µA)</th>
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<tbody>
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<td>&gt;2000</td>
<td>&lt;7</td>
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<tr>
<td>2 &amp; 3</td>
<td>1217</td>
<td>13</td>
</tr>
</tbody>
</table>

Wire Bond failure = Loss of unipolar, but preserved bipolar function.

This pt had loss of efficacy in Monopolar setting, but, preserved function in bipolar setting.

Lead Fracture – Open Circuit
Short Circuit

- Short Circuit: Two wires making contact
- Impedance < 250 $\Omega$; current drain > 500 $\mu$A
- Rapid depletion of battery life

Kinetra Impedance Challenges

- Less reliable and harder to interpret
- Run 900’s - 1800’s (wider range, and sometimes higher than Soletra)
- Often similar readings between many contacts/settings – unclear how to interpret
Subjective loss of efficacy after routine Kinetra battery change – note fluid in contacts 3 and 2. Impedances were high, but not as high as open circuit readings (> 4000, current drain <7) (Post-op Readings = 1880’s - 2121 imp with <15 current drain.)

Low Battery Issues

- **Solestra** low battery = < 3.60V, common for pts to want ‘more juice’ or feel less well
- **Kinetra** low battery = < 2.40V, uncommon for pts to feel loss of efficacy (start surgical referral at 2.50V)
- Advanced PD patients have required inpatient admission due to severe PD sx’s after battery failed
- Goal is to monitor battery and replace **before** battery fails
- Need 2-4 weeks to plan replacement surgery
Common Problems Encountered in DBS Therapy

Lead location → suboptimal placement?

Programming suboptimal?
Volts pushed up to just below side effects?
At high voltages, what are the side effects?

Device-related issues or malfunction?
  – Hardware issues: wire fracture or crushed?
  – Factory recall ‘wire bond’ disruption in battery

Has there been an over zealous medication reduction?
(pt under-medicated?)

Patient Education: Identify Secret Unrealistic Expectation(s)

• Managing Pt expectations “mantra”
  – DBS is not a cure for PD, can’t find ‘holy grail’ settings
  – Optimal results from stimulation different for each patient

• DBS settings and medications often need to be adjusted concurrently with STN (goes against rule to change one variable at a time)

Adjunctive therapies needed for advanced pts: physical therapy, occupational therapy and speech therapy often indicated

• Depression common after medication reduction