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

(Hamani, Saint-Cyr, Fraser, Kaplitt, & Lozano, Brain, 2004)

Fig. 1 Representation of the major anatomical structures and fibre tracts associated with the subthalamic nucleus. AL = ansa lenticularis, CP = caudate putamen, FF = Fields of Forel, GPe = globus pallidus externus, GPi = globus pallidus internus, H1 = HI Field of Forel (thalamus), IC = internal capsule, LF = lenticular fasciculus (L2), 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.

FIGURE 2

A. Axial

B. Coronal

1 cm

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**FIGURE 2.15.** Sensorimotor, associative, and limbic divisions of the subthalamic nucleus, based on their input and output connections. (Based on Parent A, Hazrati LN. Functional anatomy of the basal ganglia. II. The place of subthalamic nucleus and external pallidum in basal ganglia circuitry. Brain Res Rev 1995;20:128-154, with permission.)
Programming with Gusto

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

Three Dimensional STN Anatomy

- Medial and posterior = leminiscal 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 = congruate 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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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 → 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 Ω; current drain <12-30 μA
  - **Open Circuit**:
    - Soletra impedance >2000 Ω; current drain <7-9 μA
    - Kinetra impedance>4000 Ω; current drain <7-9 μA
  - **Short Circuit**: impedance <250 Ω; current drain >500 μA
Open Circuit – loss of one or more contacts

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 Ω; current drain >500 µA
- 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**

- **Soletra** 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
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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