

ASSFN Clinical Case:
Bilateral STN DBS Implant
for Parkinson's Disease

Parkinson's Disease

- Cardinal Signs:
 - Resting tremor
 - Rigidity
 - Bradykinesia
 - Postural instability
- Other Symptoms
 - Dystonia
 - Dysphagia
 - Autonomic dysfunction
 - Kyphosis
 - Depression
 - Dementia
 - Masked facies
 - Micrographia

PD Diagnosis

- Medical history and physical examination
 - Primary means of diagnosis
- Medication response
 - 2 month challenge of levodopa or dopamine agonist
- Imaging
 - MRI (may rule out other diagnoses)
 - Dopamine transporter SPECT (DaT scan)
 - Loss of dopamine neurons in PD as well as in atypical Parkinson-like diseases
 - May distinguish between PD and essential tremor

Parkinson's Pathology

- Loss of pigmented dopaminergic neurons in the substantia nigra pars compacta (SNpc)
- Lewy bodies and neurites

Anti-PD Medications

- **Carbidopa/levodopa**
 - Levodopa crosses the BBB
 - Carbidopa acts as a peripheral decarboxylase inhibitor
- **Entacapone**
 - Catechol-o-methyltransferase (COMT) inhibitor
 - Reduces peripheral metabolism of levodopa
- **Monoamine oxidase inhibitors**
 - Selegiline
 - Rasagiline
- **Other dopamine agonists**
 - Ropinirole
 - Pramipexole
- **Anticholinergic agents**
 - Trihexyphenidyl
 - Benztropine
 - Second-line for tremor only

Indication for Surgical Management

- Response to medication worsens with PD progression
 - Medication wears off before next dose
 - Motor fluctuations between “on” and “off” time
 - Dyskinesias
 - Abnormal involuntary movements
 - Side effect of dopamine agonists and levodopa
 - Dystonia
 - Rigid posturing
 - Early morning and during “off” periods

Rationale for Surgical Management

- SNpc dopaminergic degeneration causes improper functioning of direct and indirect pathways
- Modulation of overactive STN or GPi activity to overcome thalamic inhibition and allow for motor functioning

DBS

Advantages

- Reversible
- Non-destructive
- Stimulation titration
 - Maximize therapeutic effects
 - Minimize side effects
- Bilateral implantation
- Superior efficacy compared to best medical management*

Disadvantages

- Surgical risks
- Infection
- Finite battery life
- Disease progression may lessen DBS effect in the long term for some patients

*Follett et al 2010, Deuschl et al 2006, Weaver et al 2009, Williams et al 2010.

Case Presentation

- 59 year old right-handed female
- CC: Referred for advanced Parkinson's disease
- Symptoms
 - Began in 1996 with RLE tremor, diagnosed in 2000.
 - Takes stalevo 3x a day, wears off between doses
 - During “off” periods, unable to perform ADLs
 - Tremor persists during “on” periods
 - Some balance difficulty – has fallen twice
 - Important rigidity and bradikynesia
 - Clawing of toes in the right foot
 - Irregular jerking torso movements (dyskinesia)
 - Sleepiness (medication side effect)
- PMH: Cholecystectomy, urinary urgency

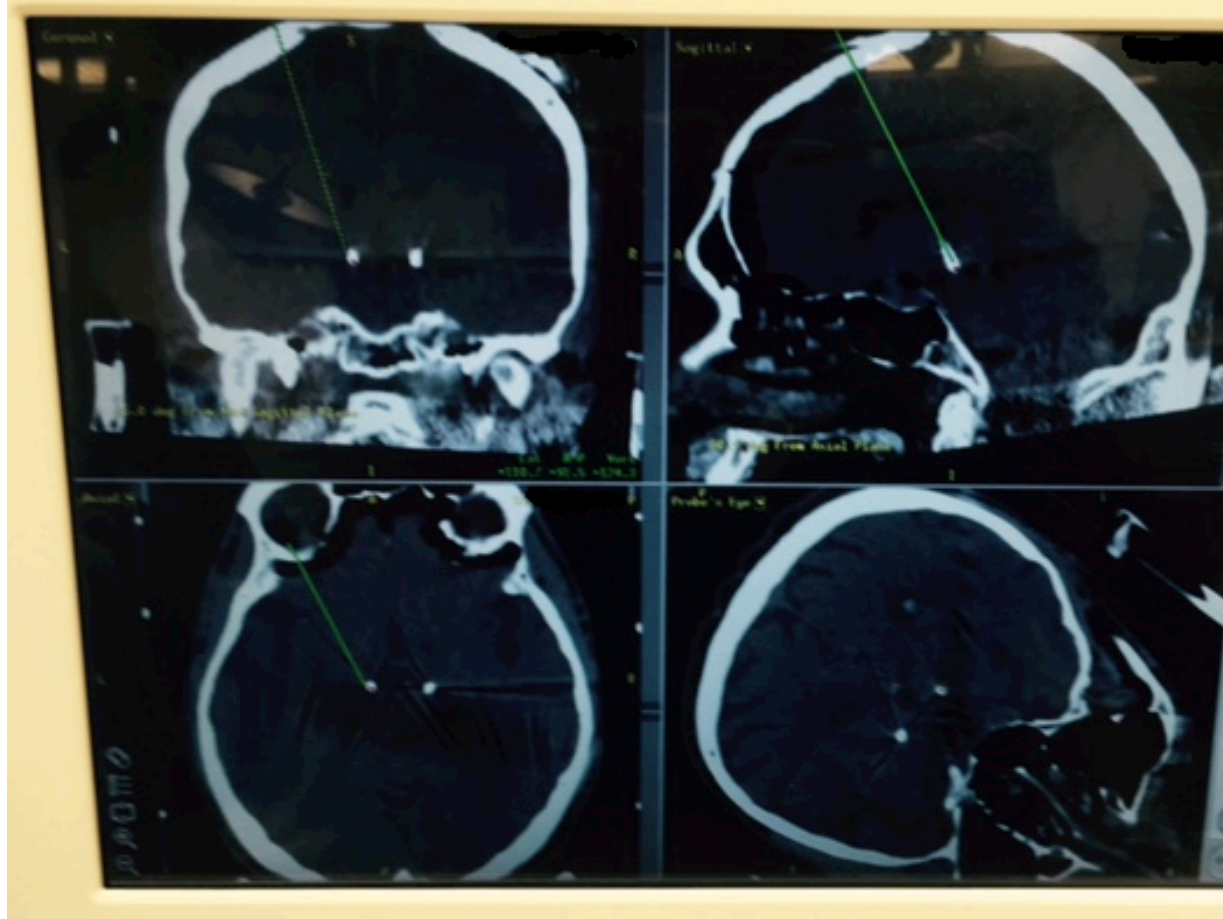
Management

- Referred for surgical consideration
- Evaluation by multi-disciplinary team including movement disorder specialist, neuropsychiatry, and neurosurgery
- Documented response to levodopa challenge

Preoperative

- 3T MRI scan 1-2 days before surgery
- Anti-PD medications stopped the night before surgery
- Frame placed the morning of surgery
- Head CT obtained in frame
- MRI and CT merged
- Surgical target coordinates calculated and trajectory reviewed

Targeting



Surgical target planning using a planning station.

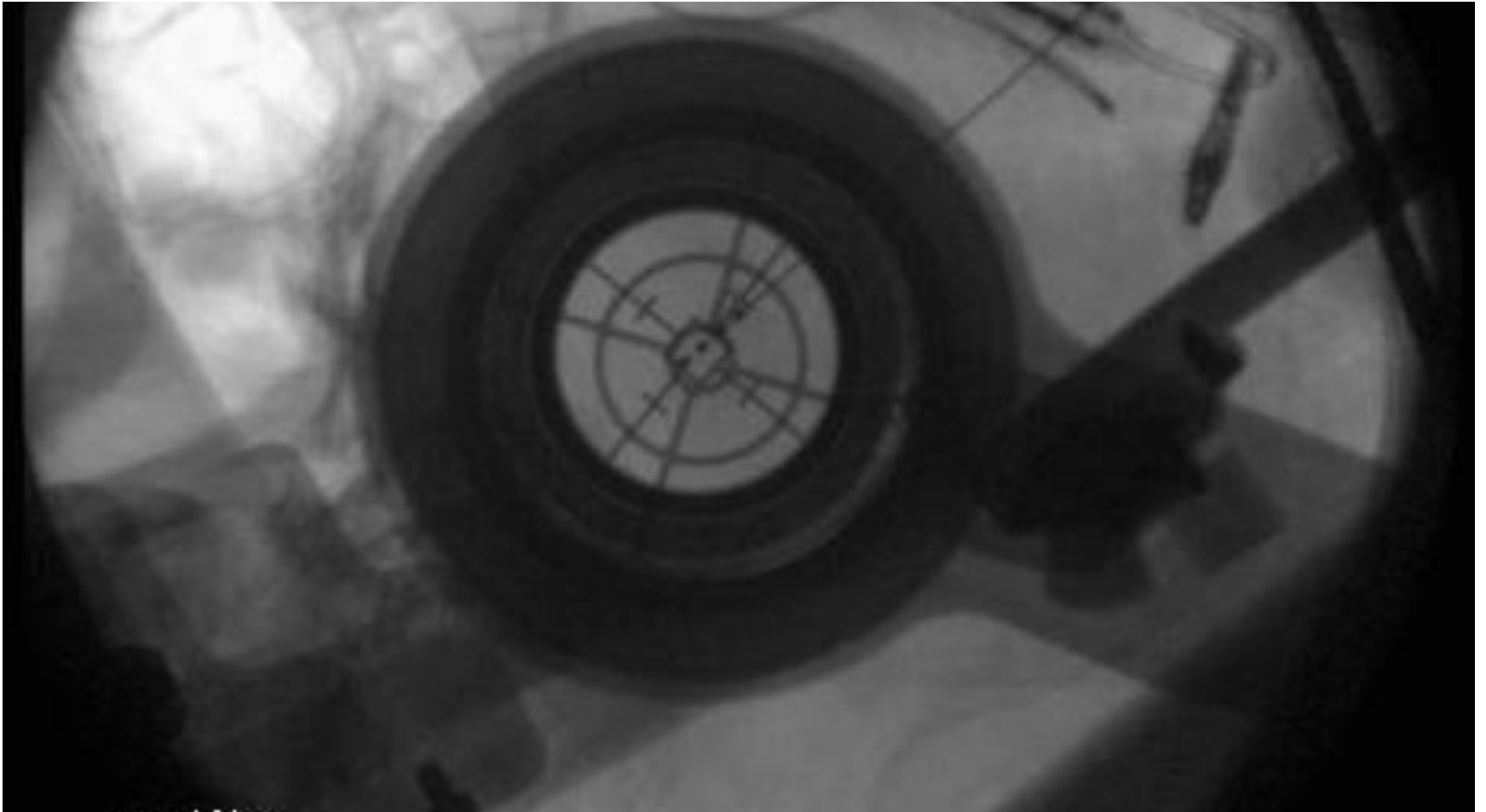
Intraoperative

- Patient's head secured in semi-reclined position
- Frame is assembled
- Fluoroscopy prepared
- After prepping and draping, burrhole is made using stereotactic coordinates
- Microelectrode is lowered with electrophysiologic recording and stimulation

Intraoperative

- Surgical target confirmed using coordinates, patient response to microstimulation, and lack of side effects to microstimulation
- Microelectrode removed and DBS lead placed
- Fluoroscopic confirmation of target location
- Lead connected and test stimulation performed
- Lead secured using locking skull cap
- Incision closed with lead coiled under scalp

Intraoperative Fluoroscopy

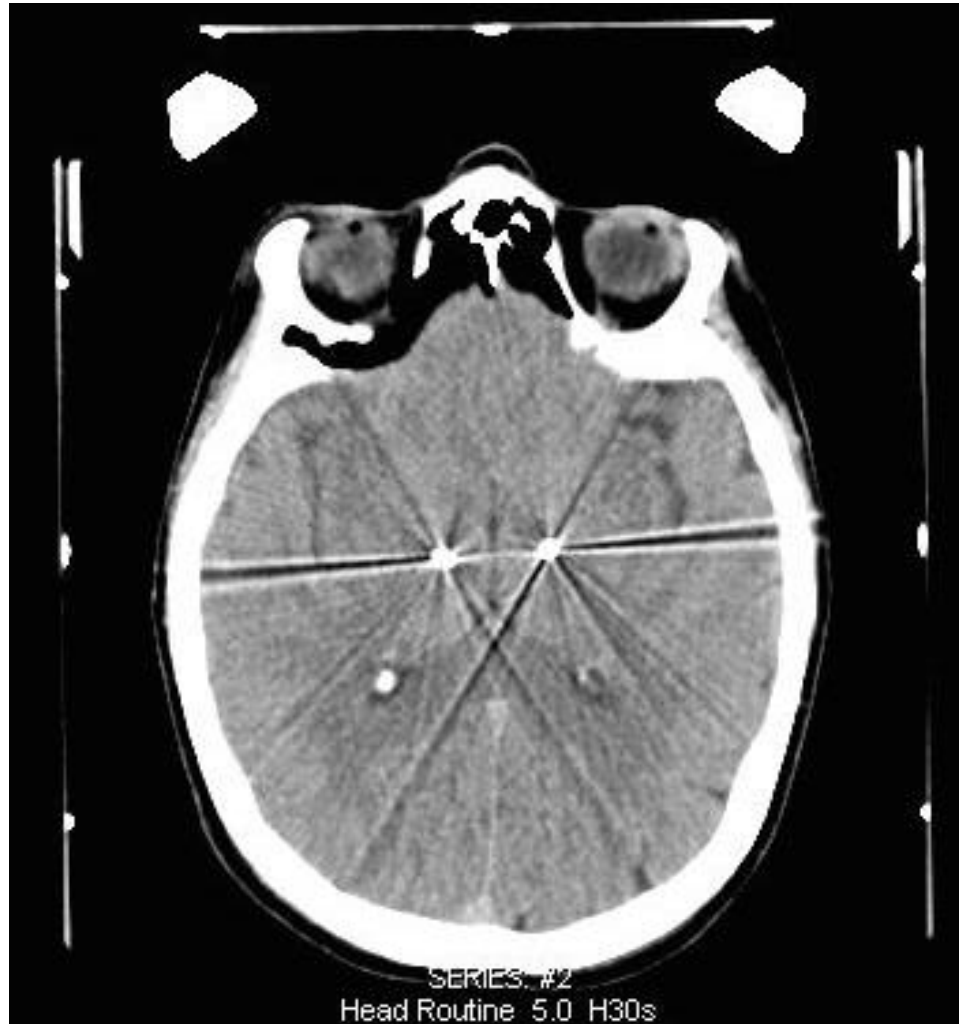


Fiducials attached to Leksell frame allow for precise targeting of DBS lead.

Postoperative Course

- Confirmatory head CT obtained
- Frame removed
- Patients usually discharged POD 1-2
- Extension and IPG placed during second surgery within 1-2 weeks
- Stimulation begins within several weeks and optimal parameters are gradually derived with testing

Postoperative CT



Postoperative CT in frame demonstrating lead position.

Postoperative CT



Scout imaging demonstrating leads (no frame).

References

1. Williams A, Gill S, Varma T, Jenkinson C, Quinn N. Deep brain stimulation plus best medical therapy versus best medical therapy alone for advanced Parkinson's disease (PD SURG trial): a randomised, open-label trial. *Lancet Neurol.* 2010;9(6):581-91.
2. Weaver FM, Follett K, Stern M, Hur K, Harris C, Marks WJ, et al. Bilateral deep brain stimulation vs best medical therapy for patients with advanced Parkinson disease: a randomized controlled trial. *JAMA.* 2009;301(1):63-73.
3. Follett KA, Weaver FM, Stern M, Hur K. Pallidal versus subthalamic deep-brain stimulation for Parkinson's disease. *N Engl J Med.* 2010; 362:2077-91.
4. Deuschl G, Schade-Brittinger C, Krack P. A randomized trial of deep-brain stimulation for Parkinson's disease. *N Engl J Med.* 2006; 355:896-908.

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