Surgical Treatments for Movement Disorders

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Surgical Options for Movement Disorders

- Several options for patients with movement disorders
- Today will primarily focus on Parkinson's Disease & Essential Tremor

- Options include:
  - Deep Brain Stimulation
  - Focused Ultrasound
  - Ablative therapies
  - Radiosurgery
  - Duopa (PD patients)

Deep Brain Stimulation

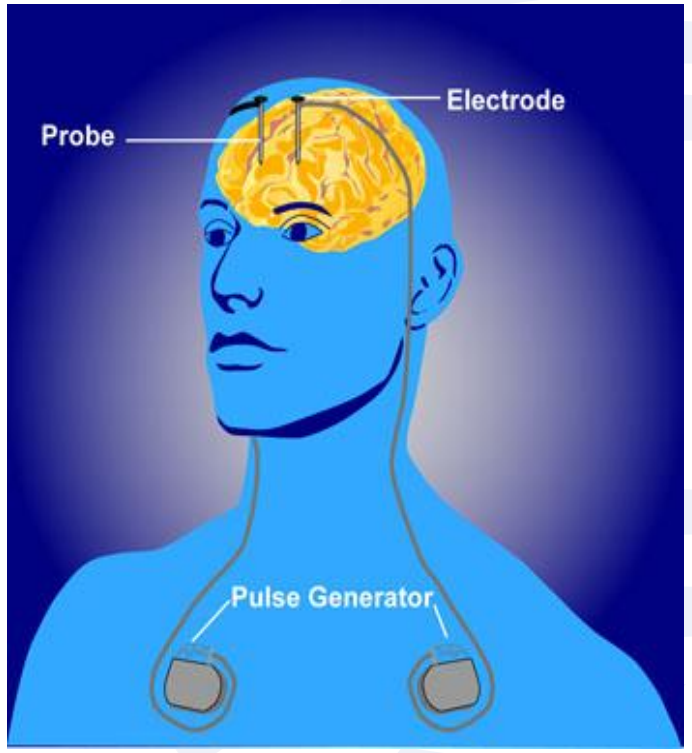
- What is it?
  - Implanted device (“brain pacemaker”) to manage symptoms of a variety of neurologic disorders
  - Most used for movement disorders, such as Parkinson’s Disease, Essential Tremor, and dystonia
  - Some applications for psychiatric disease, such as refractory OCD and Tourette’s syndrome

- How does it work?
  - Electrical stimulation is sent to certain areas of the brain that control the symptoms of several movement disorders.
  - Parkinson’s Disease
    - ***Blocks abnormal firing of neurons,*** caused by a lack of dopamine, which is crucial for transmitting nerve cell signals. Restores some degree of normal communication within the basal ganglia motor system.
  - Essential Tremor
    - Modulates the connections between the cerebellum and the thalamus, reducing the severity of disabling tremor
  - Exact mechanism is still unclear

Parts of a DBS system

Implanted components include:

- Pulse Generator (IPG) or “battery”
- DBS lead
- Extension wire
- Burr hole cover



Who are good candidates?

- Parkinson's Disease:
  - Disabling symptoms despite adequate trial of medications at optimum dosage
  - Good response to Carbidopa-levodopa
  - Intolerance to side effects of drugs at therapeutic dosage
  - Absence of significant dementia/atrophy
  - Medically fit
  - Appropriate Expectations

- Essential Tremor:
  - Failure of multiple medications in managing ET
  - Medically fit
  - Appropriate expectations

Who are not good candidates?

Patients with:

- Untreated psychiatric illness
  - psychosis
  - depression
- Cognitive impairment
  - Dementia/ Alzheimer’s
- Other major medical problems
  - Require medical clearance
- Unrealistic goals and expectations

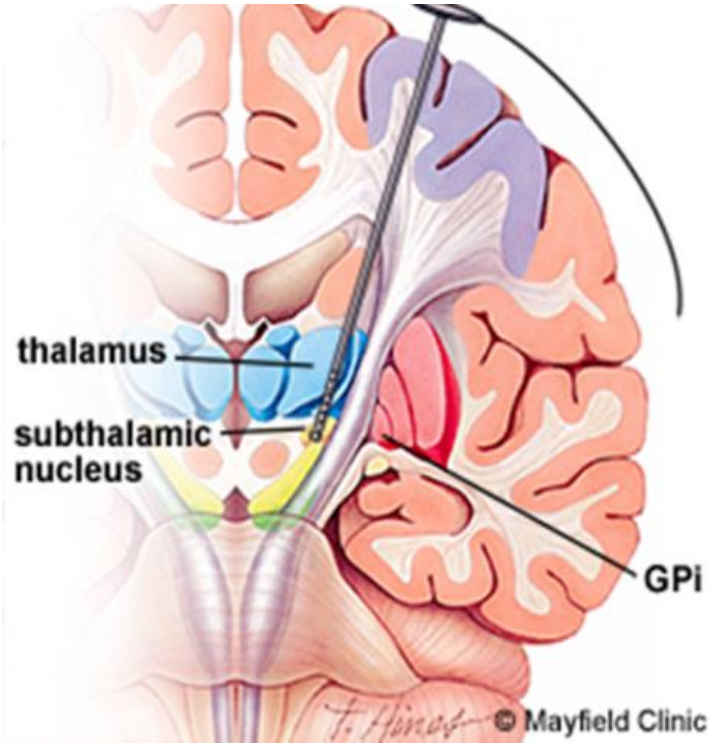
What symptoms respond to DBS therapy?

- Parkinson's Disease:
  - Motor symptoms
    - Rigidity
    - Bradykinesia
    - Tremor (to a degree)
    - Dyskinesia
    - Dystonia
  - If it responds to levodopa, likely to respond to DBS

- Essential Tremor:
  - Extremity (limb) tremor
  - Head/postural tremor (to a small degree)

What happens before surgery?

- Selection by a **Movement Disorders specialist**
- Testing **on and off medications (PD only)** CAPSIT
  - Parkinson's patients only
  - Defined off testing (12 hours)
  - Defined on testing (therapeutic and supra-therapeutic testing)
  - Well-documented response to dopaminergic drugs
- Evaluation by a **Neuropsychologist**
  - Well-rested and on-meds
  - Testing can take several hours
  - Family member present to participate
  - Purpose is to assess executive function, presence of dementia, presence of mood disorders
    - Findings from this can affect choice of target, or even the decision on whether to move forward with DBS
- **MRI** for surgical planning
  - Typically last step before surgery
- Evaluation by **Neurosurgeon** to determine surgical candidacy

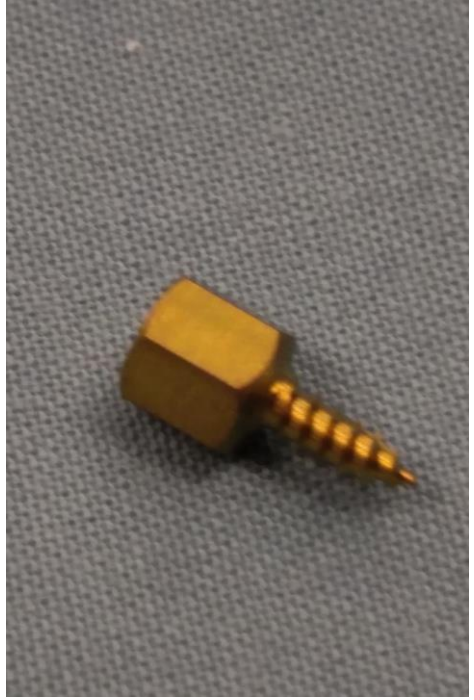


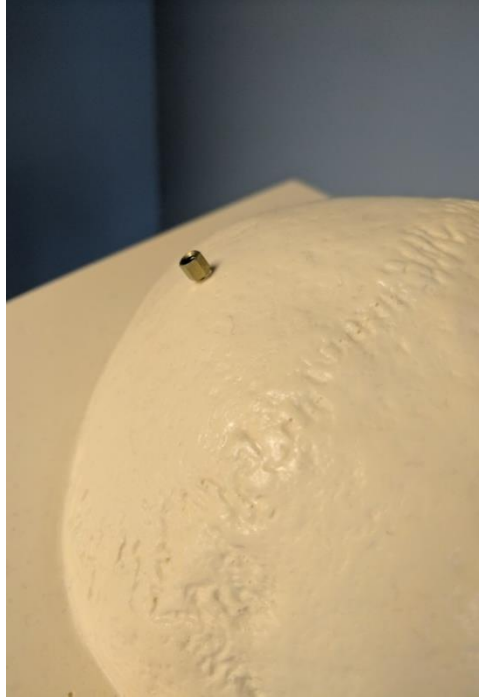
How are DBS systems implanted?

- ***Fiducial marker placement.***
  - Small bone screws placed along with CT scan for surgical planning prior to awake DBS lead surgery (same day surgery)

    OR

    Surgical frame placed in OR on the same day as DBS lead placement for asleep procedures
- ***DBS lead placement*** (1 or 2 leads).
  - Typically performed awake, off medications.
  - Overnight one night in the hospital
  - For asleep cases, procedure is similar, with overnight stay as well.
- ***Battery placement.*** Performed asleep, medications ok. Same day surgery.





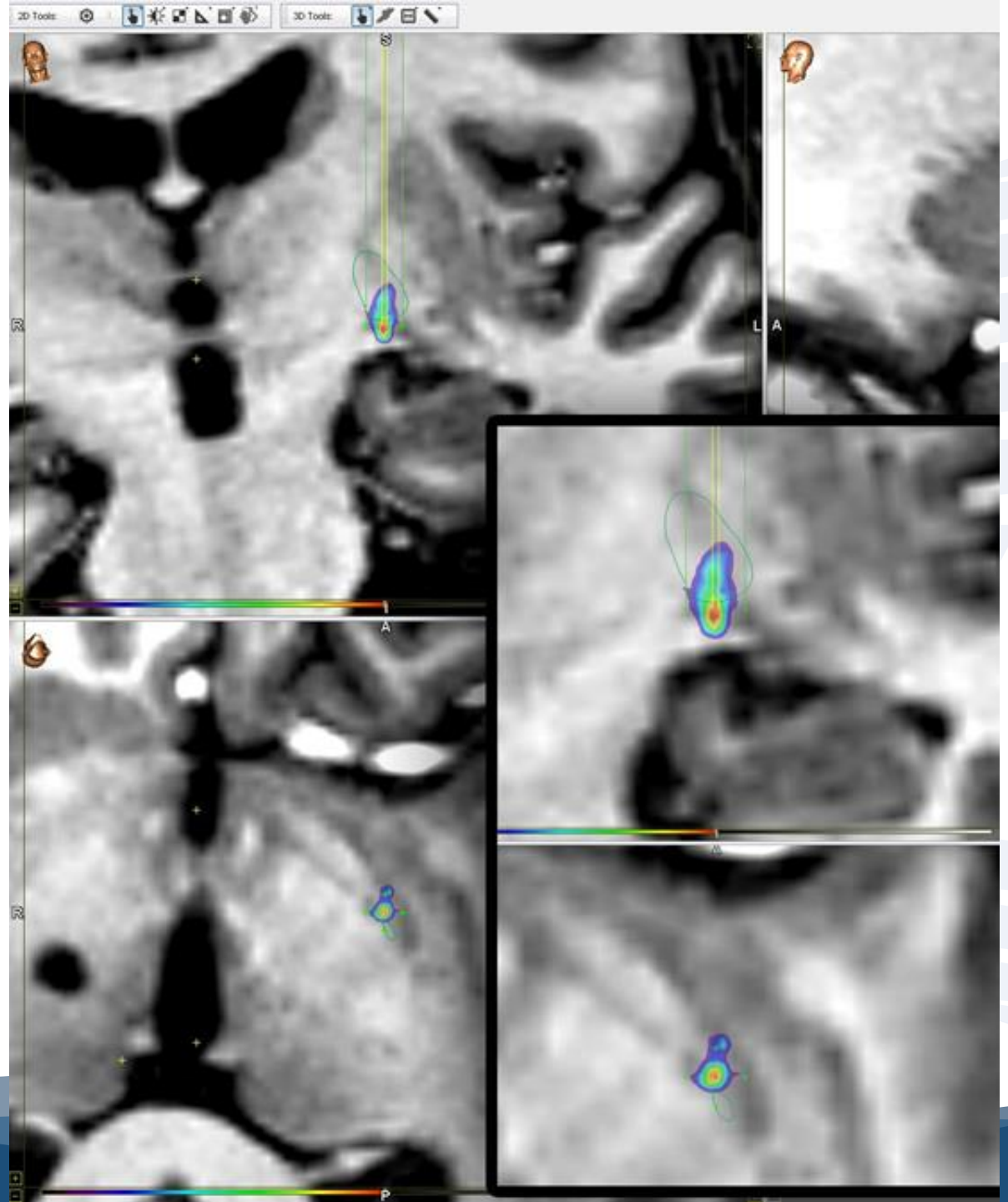
DBS STAGE 1:
Fiducial Marker Placement

- Small bone screws
- Placed under general anesthesia
- CT scan performed

Patient-specific 3D platform made for the DBS electrode placement

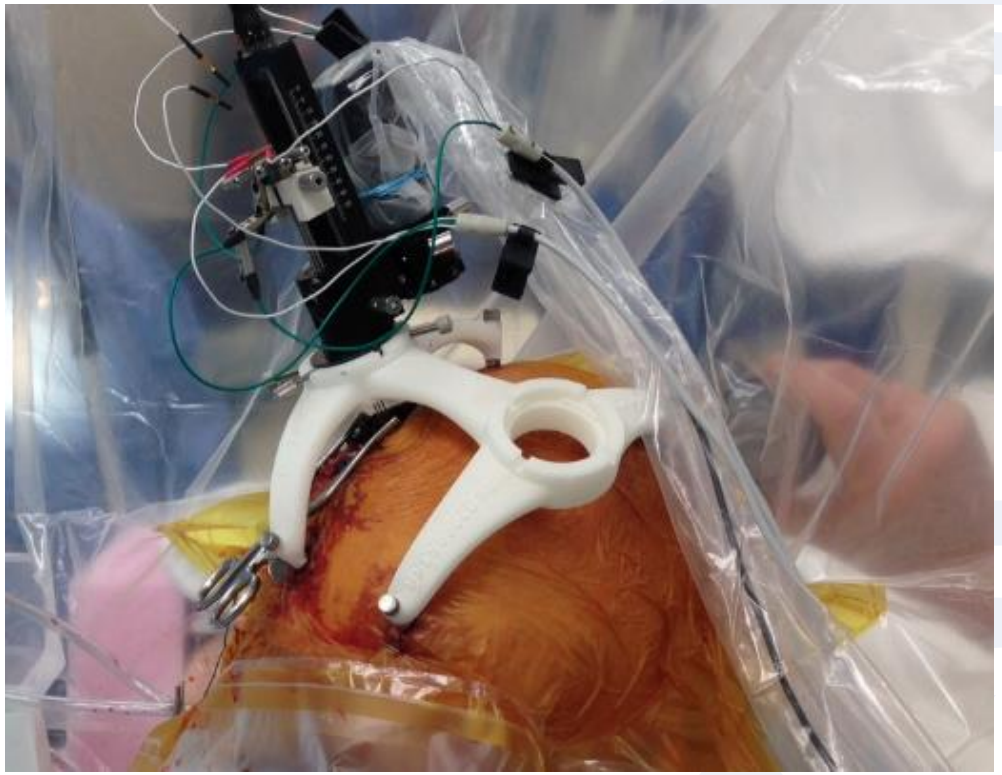
This is a separate procedure…

CT, MRI, & Atlas fusion



Stage 2: DBS Lead Placement & Testing

- Biggest procedure of the three
- Starts off with patient in twilight sleep
  - Prep, attach the Starfix platform to the fiducial screws
  - Incision, drill burr hole, place recording electrodes
- Wake patient up, microelectrode recording (listening to the cells)
- Lead placement followed by efficacy and side effect testing
- Patient back to sleep, close incision.

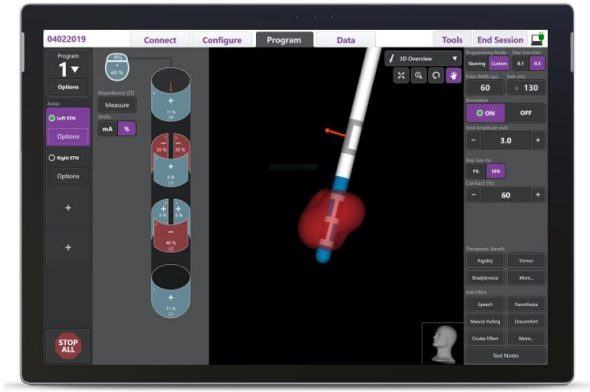


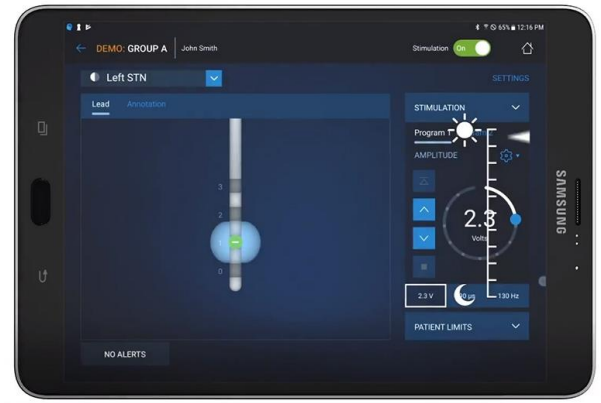
Stage 3: Battery Placement

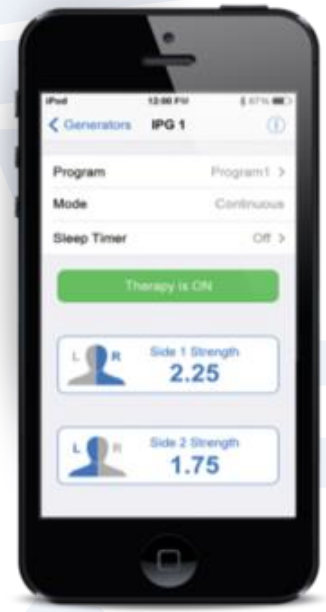
- Chest wall
- General anesthesia
- Approximately 1 week later
- On meds; continue to hold blood thinners
- Same day surgery

“Stage 4:” Programming

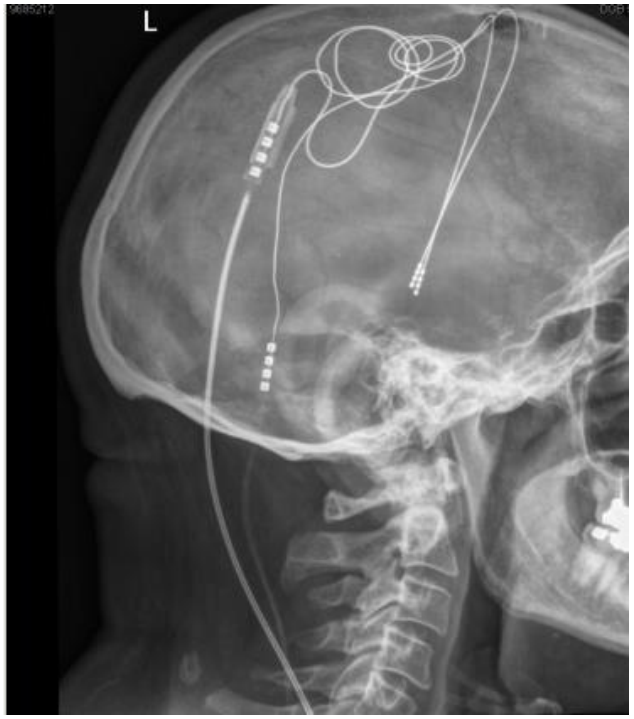
- Think of it as adding a new medication
- Don’t expect one and done
- May take 3 - 6 months to fully optimize
- Have a support system including others that have had this done before
- Review your CAPSIT
- Keep a diary before and after.
- Newer technologies, such as remote programming, have made the process a bit easier







Risks of Surgery & MRI



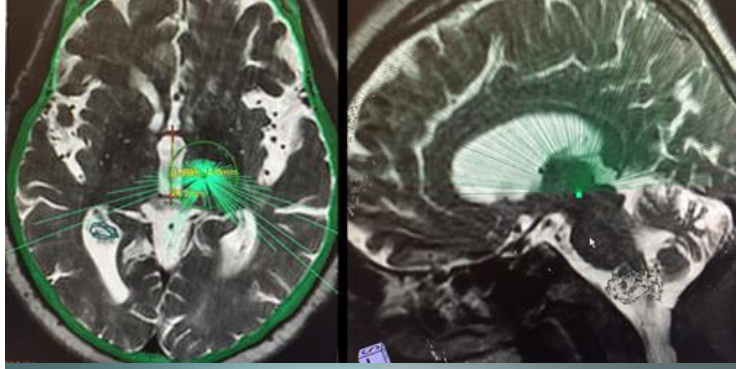
- Bleeding
- Infection
- Stroke/Hemorrhage
- Seizure
- Transient confusion
- Headache
- Device Complications:
  - Infection
  - Lead Breakage
  - (can occur through device lifetime

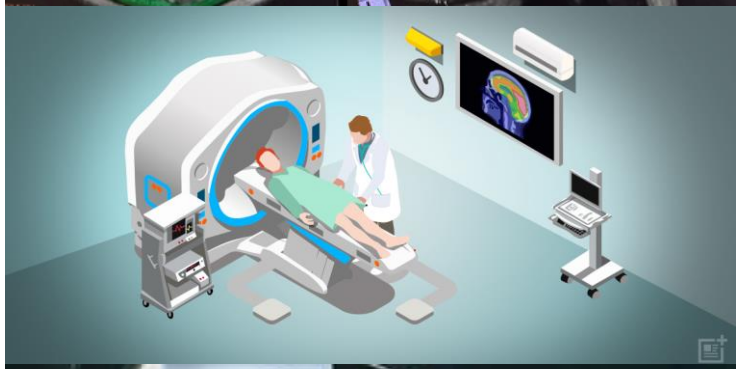
- Most current devices are MRI compatible/conditional
- Important to have MRIs done at a center that does them often

Deep Brain Stimulation Takeaways

Advantages	Disadvantages
• Therapy can be turned on or off • It is programmable (*neuromodulation*) • Can be adjusted to maintain therapy as disease progresses (to a degree) • Is surgically reversible (system can be removed) • Very effective • *New indications in PD	• Surgical procedure / incisions • complications, infections, etc. • Implanted device

- Very effective therapy for motor symptoms of Parkinson's disease and essential tremor
- Therapy successfully used over last 20 years for PD/ET
- Goal to improve quality of life, and better control of medications
- A time investment, but ultimately beneficial
- If you feel you are a candidate, discuss with your neurologist.

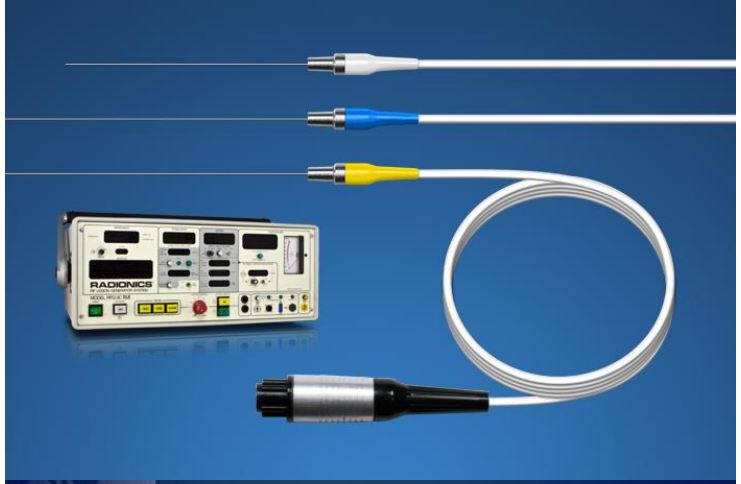




MRI Guided Focused Ultrasound

- Newer therapy option
- FDA approved for treatment of unilateral Essential Tremor in 2016, and in 2021 for unilateral Parkinson's disease
- Ablative therapy
- Uses focused ultrasound beams under MRI guidance to heat target deep nuclei to create a lesion
  - Efficacy profile and outcomes like other ablative therapies
  - No incisions
  - Non-reversible therapy, complications and side effects can occur
  - However, good for patients who may not be a good surgical or DBS candidate

Other Ablative Therapies



- **Surgical RF Ablation**
  - Similar to DBS, but a lesion is created at the target as opposed to a lead being placed
  - Lesion typically creates a durable, persistent effect
  - Procedure is irreversible
  - Commonly used before DBS, less used today
  - Specific circumstances for use apply

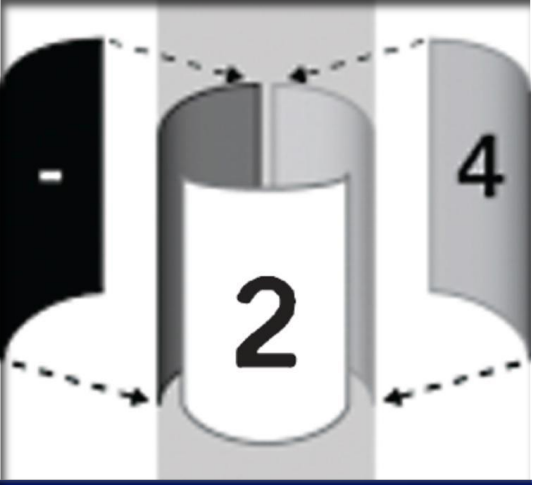
- **Radiosurgery**
  - Lesion created with focused radiation
  - Takes time for effect to set in
  - Some variability in effectiveness, but typically >80%
  - Specific use-case scenarios, more frequently used in essential tremor
  - Complications can arise from ablation

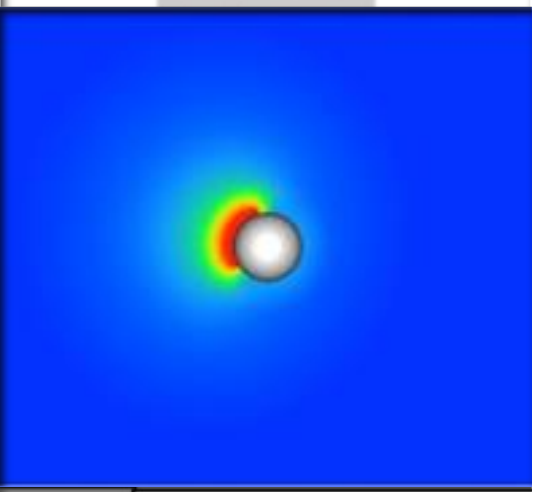
What does the future hold?

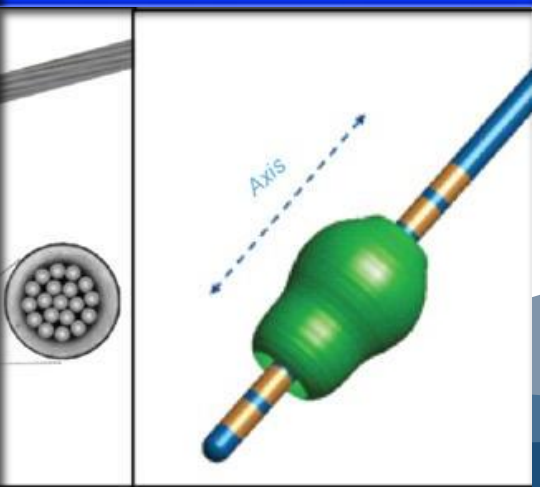
- Great promise for surgical therapeutics
- Expansion of DBS Criteria
  - DBS originally FDA approved in 1997
  - Indications for Parkinson's and traditional teachings targeted towards advanced PD
  - EARLYSTIM trial (NEJM, 2013) found DBS superior to medical therapy in patients with early motor complications
  - Feb 2016: FDA approves expanded criteria for DBS with PD:
  - Diagnosis of PD for at least 4 years
  - Early motor complications
- Consideration for DBS therapy earlier in their disease course
- Potential for improved quality of life at a sooner point and for greater length of time

- New indications for DBS

New DBS Technology



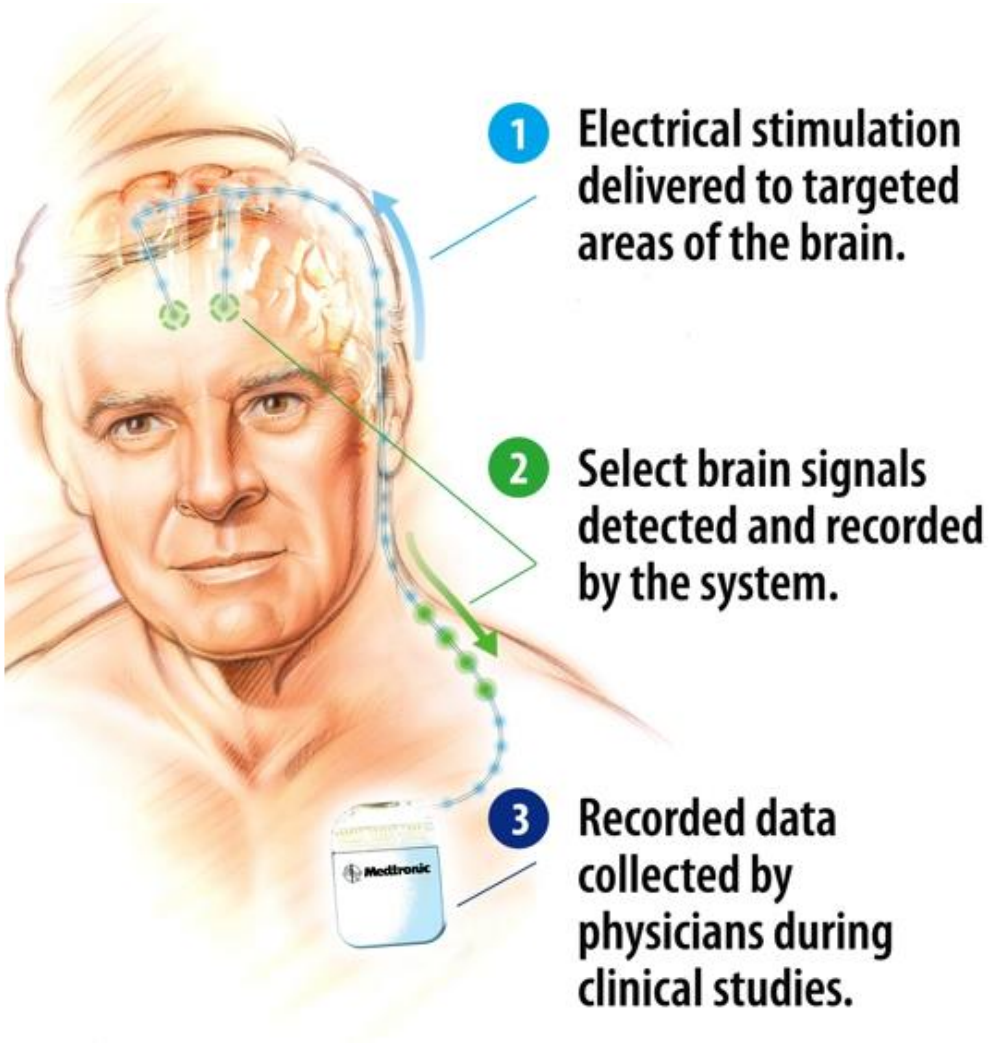




- Infinity DBS system given FDA approval and launched in the US in late 2016
- Vercise DBS system given FDA approval and launched in the US in 2018
- Sensight DBS system given FDA approval and launched in US in 2021

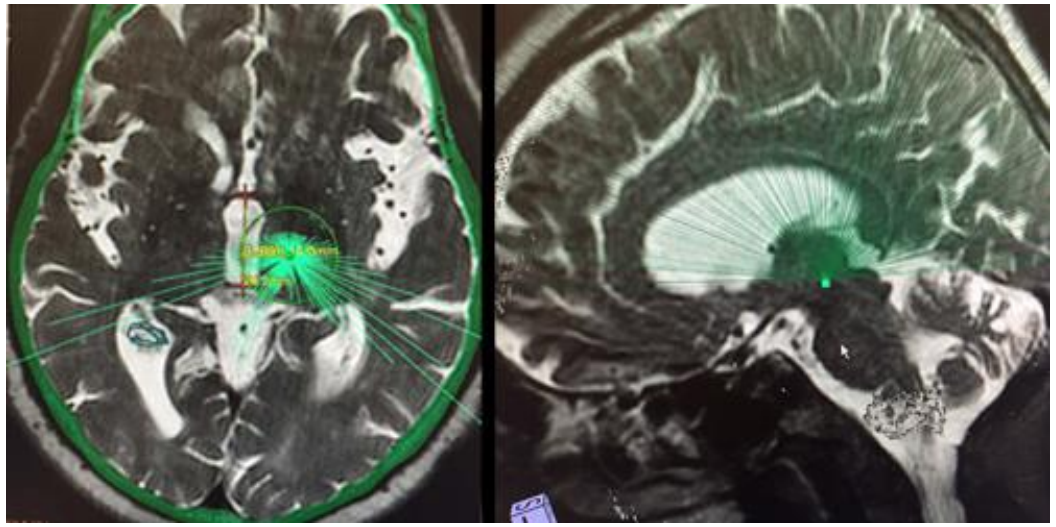
- Features:
  - Directional DBS lead offers options for difficult programming situations
  - Wireless programming platforms
  - MICC allows for complex field shaping
  - Some allow for a small degree of internal feedback & “closed-loop” programming

Closed Loop / Adaptive DBS



- “Closed-loop” DBS refers to the concept of a DBS system responding to and adapting stimulation based on internal findings and cues from the brain itself
- Active research with the investigational systems is ongoing
- Still a long way from a true “closed-loop” system
- New advances every year

New Focused Ultrasound Technology



- Expansion of availability in the US
- Recent approval of use for Parkinson's disease
- Approval for bilateral therapy in ET likely to occur in the future
- Expansion in terms of what MRI scanners can be used to implement the technology (increased availability)

Deep Brain Stimulation (DBS) Program at Westchester Medical Center (WMC)

- Spans the entire WMC Health Network
- Two primary sites for clinical visits (movement disorder specialists)
  - WMC (Valhalla, NY)
  - Mid-Hudson Regional Hospital (Poughkeepsie, NY)
- DBS Surgery
  - Neurosurgery clinic visits and surgeries occur at WMC (Valhalla, NY)
  - Utilize all 3 DBS Vendors
  - State of the art equipment:
    - FHC StarFix DBS System
    - ROSA Robot
    - Globus Excelcius GPS Robot

Questions?