UC DAVIS HEALTH

Departments of Neurology and Neurological Surgery

Deep Brain Stimulation Program

Deep Brain Stimulation Surgery: What to Expect

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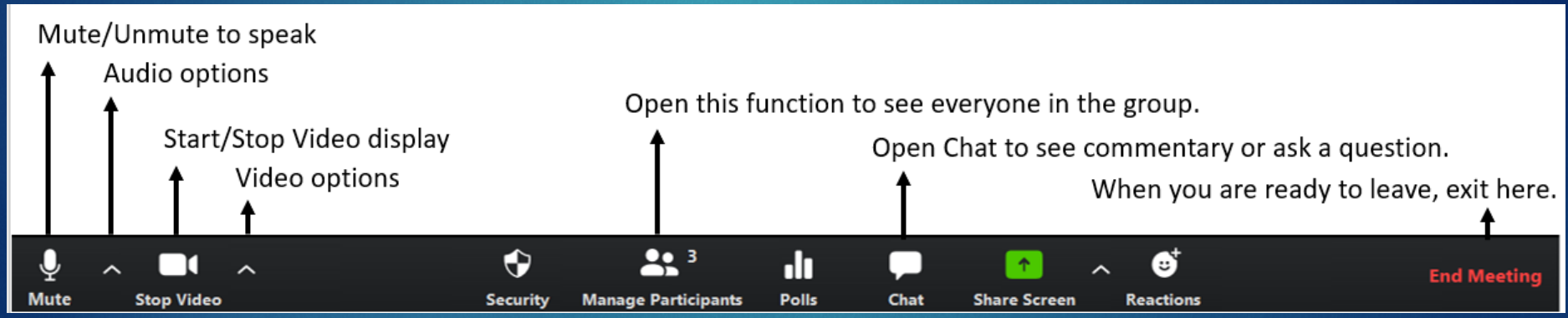
PROGRAM COORDINATOR

Zoom Overview



U.C. Davis
Deep Brain Stimulation Team

- **Neurosurgery**:
  - Dr. Kia Shahlaie, MD, PhD
  - Claire Basco, MSN, FNP-BC, CNRN
  - Surgical Coordinator: Robert Dillman
- **Neurology: Movement Disorders:**
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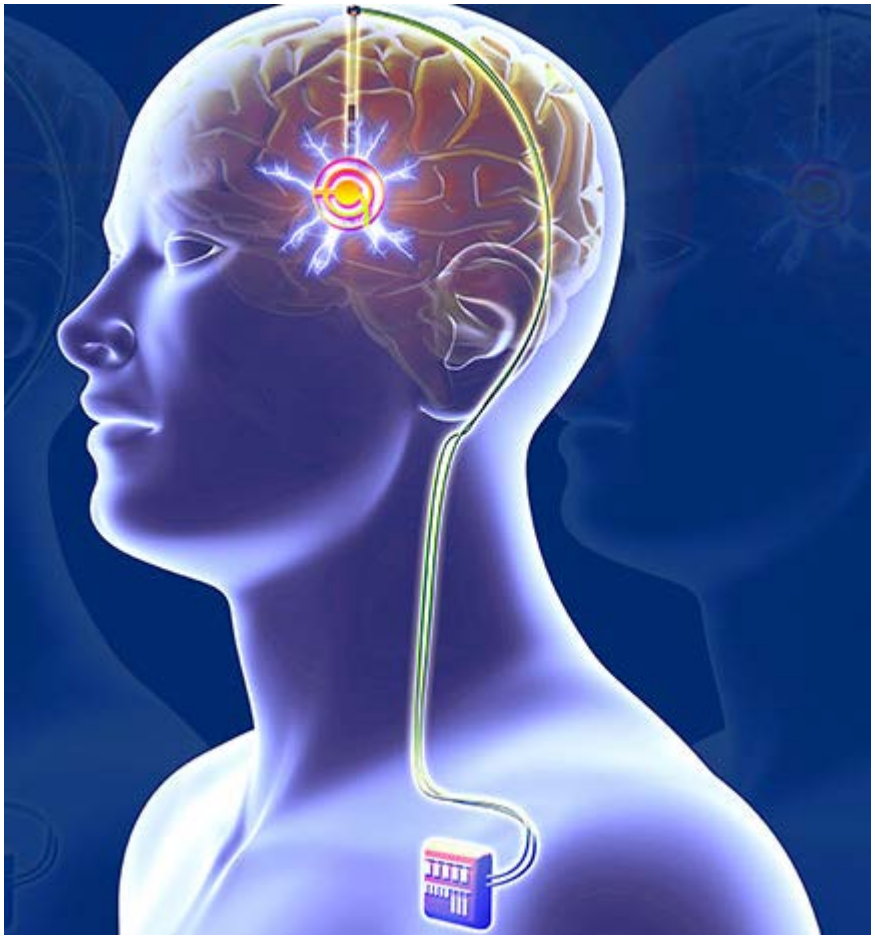
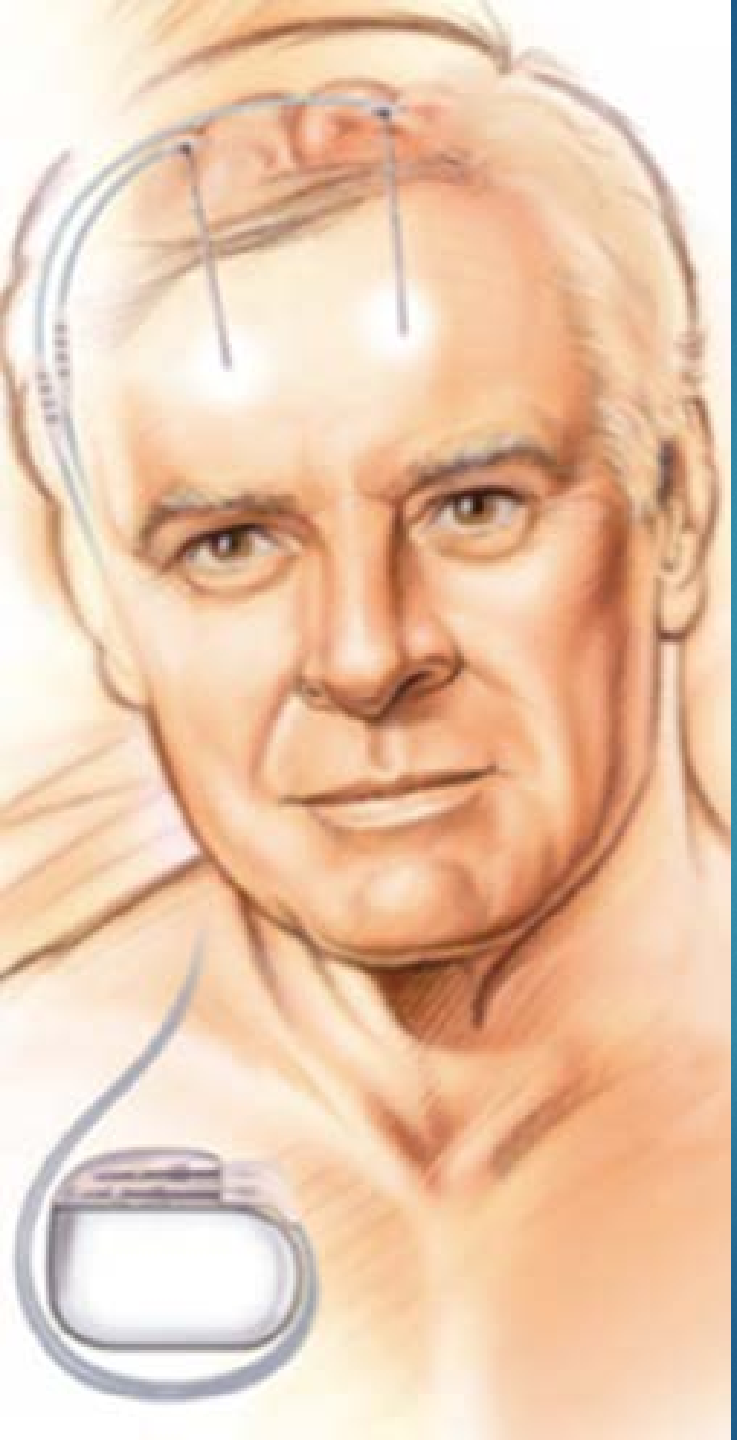
  - Dr. Josh Dayananthan, MD
  - Dr. Sasha Duffy, DO
  - Dr. Kristina Hart, DO
  - Dr. Malhado-Chang, MD
  - Dr. Vicki Wheelock, MD
- **Neurology: Epilepsy:**
  - Dr. Masud Seyal, MD, PhD
  - Dr. Trishna Kantemneni, MD
  - Dr. Kiran Kanth, M.D.
  - Dr. Jeff Kennedy, MD
  - Dr. Katherine Park, MD
  - Dr. Craig Watson, MD, PhD
- **Neurophysiology**: Dr. Kevin O'Connor, PhD
- **Neuropsychology/ Psychiatry:**
  - Dr. Sarah Farias, PhD
  - Dr. Michelle Chan, PhD
  - Dr. Debra Kahn, MD
  - Dr. Alyssa Weakley, PhD
- **Program Coordinator**: Laura Sperry, MSN, RN, ANP-BC
- **Clinic Coordinator:** Kandis Kaltenbach
- **Administrative Coordinator:** Meriah Horton

What is Deep Brain Stimulation (DBS)?

- DBS is a neurosurgical procedure that involves implanting brain electrodes and a neurostimulator ("brain pacemaker"; battery)
- The neurostimulator sends signals to specific targets in the brain
- Directly modifies brain activity in a controlled manner.
- Reversible
- DBS has been around since 1987
- Globally more than 175,000 people have been implanted with DBS (as of 2020)



Strickland, 2017.



Approved Indications

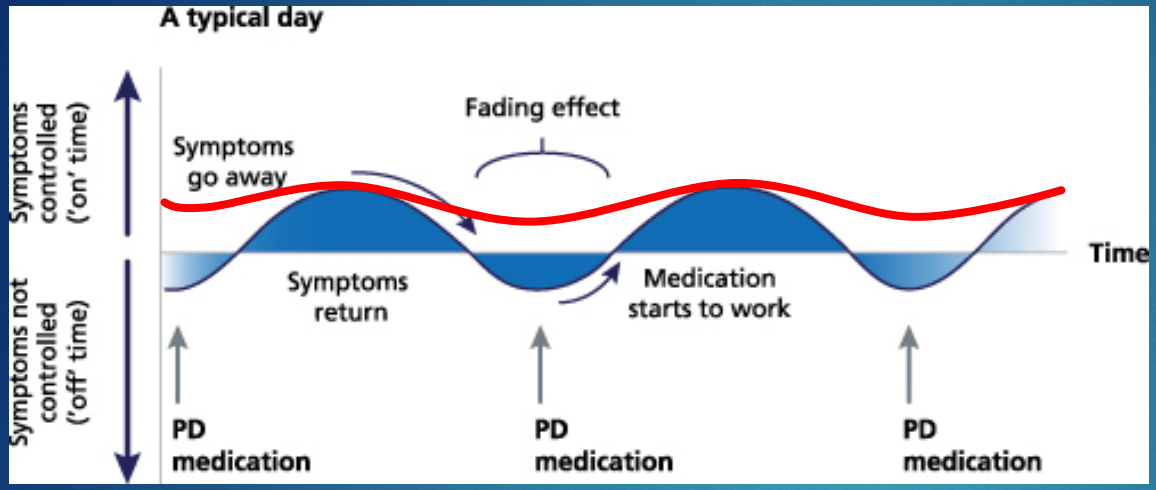
- Essential Tremor:
  - FDA approved in 1997
- Parkinson's disease:
  - FDA approved in 2002
  - FDA expanded approval in 2/2016 to include recent onset of motor complications after >4 years of PD
- Dystonia:
  - FDA approved in 2003
- Obsessive Compulsive Disorder:
  - FDA approved in 2009
- Epilepsy
  - FDA approved in 2018

Benefits of DBS for Essential Tremor

- Improved ability to do everyday activities
- Less tremor
- Less disability (as reported by the patients)

Benefits of DBS for PD

DBS is typically *as effective* as "best" dopamine response…



~ 30% improvement in motor scores

~ 40% improvement in ADL scores

~ 50% reduction in PD medication needs (STN)

Likely to improve:

- ✓ Tremor
- ✓ Rigidity (tightness)
- ✓ Bradykinesia (slowness)
- ✓ Dystonia
- ✓ Dyskinesia*

Unlikely to improve:

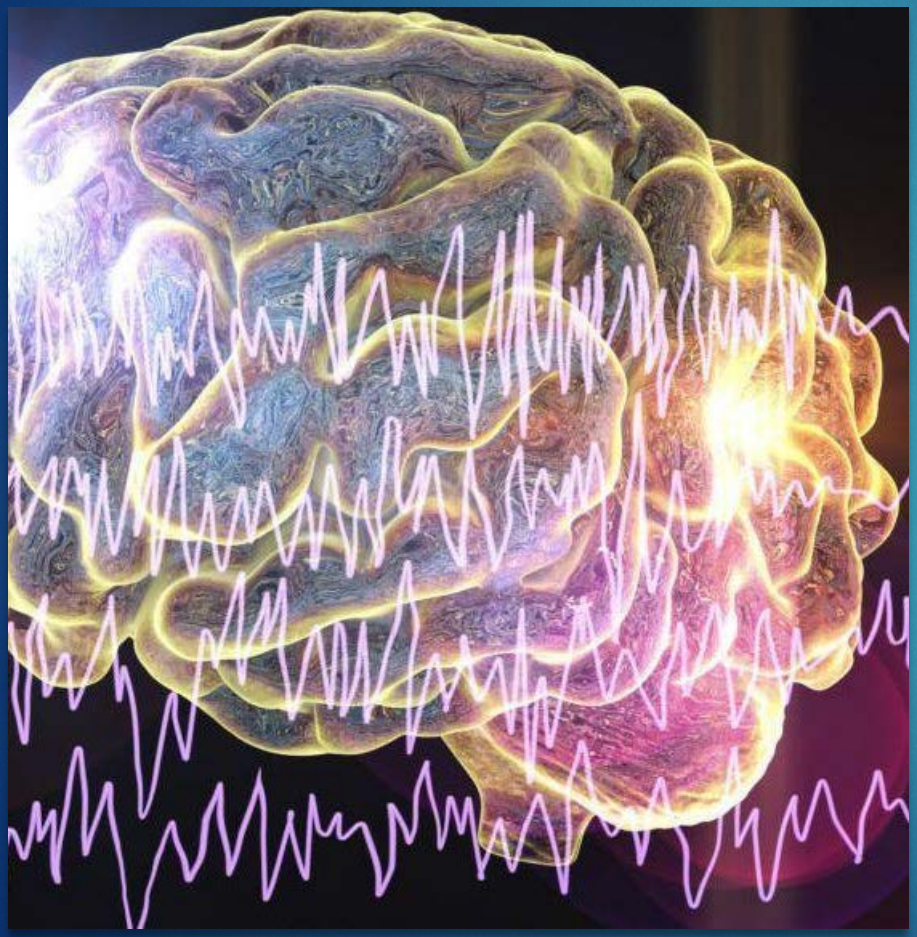
- ✓ Gait instability / falls
- ✓ Freezing of gait
- ✓ Speech
- ✓ Swallow
- ✓ Cognitive deficits

Benefits of DBS for Dystonia

- DBS does not cure dystonia
- DBS can decrease the abnormal movements and postures of dystonia by 30-50%, depending upon the type of dystonia
- If you are being treated with Botox® before DBS surgery, you will likely resume treatment after surgery

Rupam, Rukmini, & Swetha, 2017.

Benefits of DBS for Epilepsy



- DBS does not usually cure epilepsy
  - Goal is to lessen the frequency and intensity of seizures
- DBS can be used for patients with epilepsy who have partial-onset seizures (+/- generalization), who have failed 3 or more antiepileptic medications
- Benefits become more evident over time
  - Average 70% reduction in seizures at 5 years

Gompel, 2018.

What are the *risks* of DBS surgery?

- Stroke: bleeding or loss of blood flow to the brain (<2%)
- Medical problems: heart attack, blood clot to lungs or legs, breathing problems (<2%)
- Seizure (<5%)
- Infection: immediate or delayed (5%)
- Post-op confusion or hallucinations
- Men: difficulty urinating
- Mood changes
  - Mania: abnormally elevated mood
  - Depression, anxiety
  - Apathy
- Cognitive decline: word finding
- Falling

DBS Candidate Evaluation

Neurology consult with movement disorder specialist

- Neurosurgery consult
- Neuropsychology consult
- Movement Disorders: On/ Off Testing (PD) or Off Testing (ET, Dystonia)
- Epilepsy: Diagnostic studies to evaluate source/ type of seizures
- Screening MRI

DBS CASE CONFERENCE:

Review results of evaluation with multidisciplinary team to develop recommendations for or against DBS surgery

DBS Hardware

Medtronic Activa/Percept DBS System

- FDA Approved for PD (2002), Essential Tremor (1997), Dystonia (2003), OCD (2009), Epilepsy (2018)

Boston Scientific Vercise/Gevia DBS System

- FDA approved for PD 12/2017

Abbott/ St Jude Infinity DBS System

- FDA approved in 2016 for PD and ET

Medtronic Activa/ Percept DBS System

- Battery Longevity:
  - Activa SC/PC IPG: every 3-5 years.
  - New Percept PC IPG lasts 20% longer and is 20% smaller.
  - Activa RC: approx. 15 years.
    - Recharging system was updated July 2020.

- Full-body MR Conditional DBS systems. New Percept IPG approved for 1.5T and 3T MRI

Medtronic Clinician Programmer

- Samsung Galaxy tablet Introduced 2018
- Connects via encrypted Bluetooth
- Touchscreen interface
- Review patient usage, battery status, visualize neuronal activation and adjust therapy settings.

New Patient Programmer

- Customized Samsung smartphone
- Preloaded application allowing patients to monitor and optimize treatment between appointments
- New Percept application allows patients to put device into MRI mode to check for compatibility
- 36 available language options

Abbott, 2019

Challenges with Conventional Omnidirectional DBS Therapy

- Complex anatomy makes precise targeting/ stimulation necessary to avoid side effects
- Side effects often limit therapeutic benefit
- Progression of disease often requires increased therapy settings

New Percept IPG (June 2020)

BRAINSENSE™ TECHNOLOGY

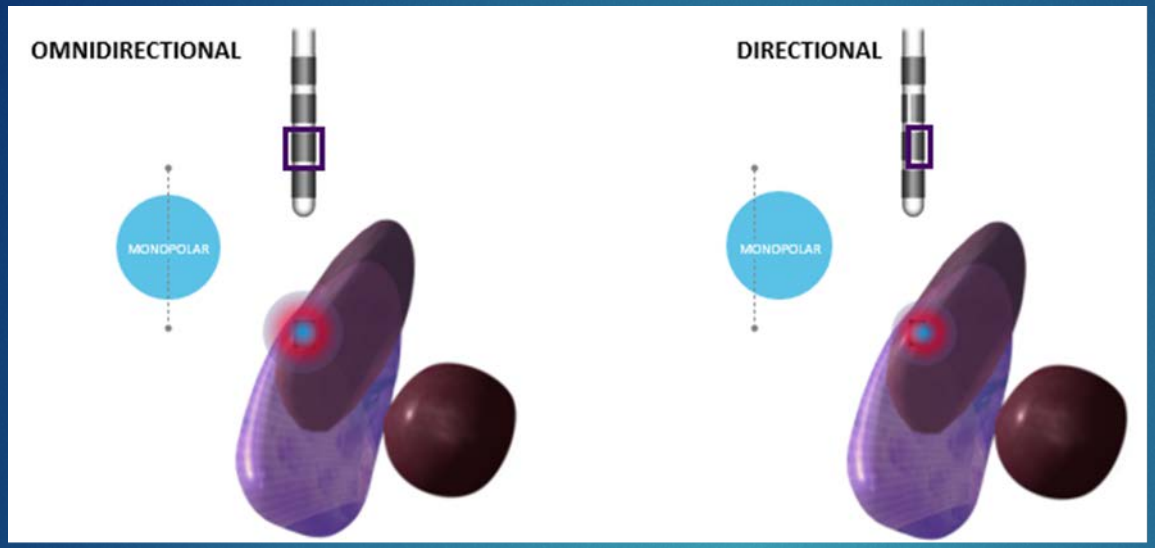
- Captures brain signals during therapy
- Brain signals can be associated with patient-recorded actions or experiences like symptoms, side-effects or medication intake.
- More tailored and data-driven neurostimulation treatment.

DIGITAL DIARY

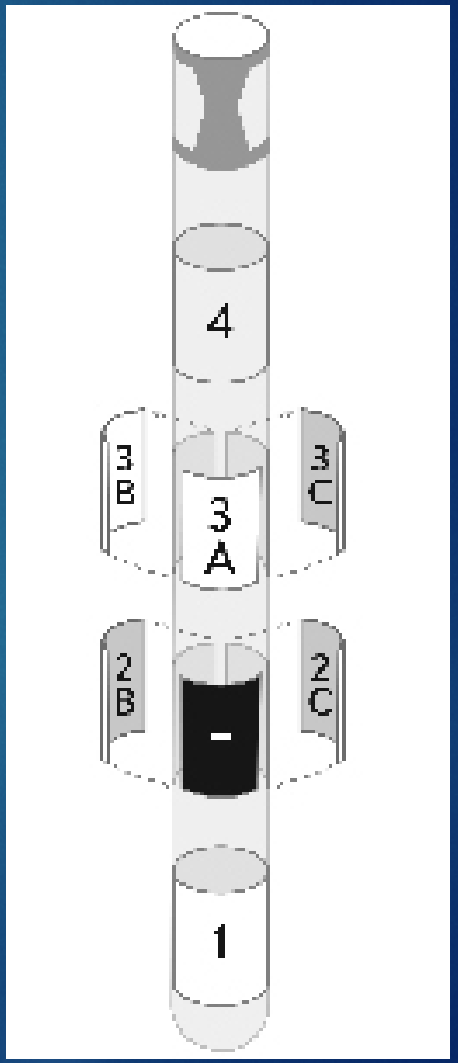
- Patients can use their patient programmer to track events (medications, side effects etc) eliminating the need to carry a notebook or diary.

Abbott/ St Jude Infinity DBS System

- Apple platform (iPod Touch and iPad mini)
  - App can be downloaded to personal iPhone
  - Pending FDA approval for: remote programming
- Wireless controller with Bluetooth connection
- Battery Longevity: 3-5+ years
- Full body MRI Conditional
- Contoured IPG shape
- Directional leads

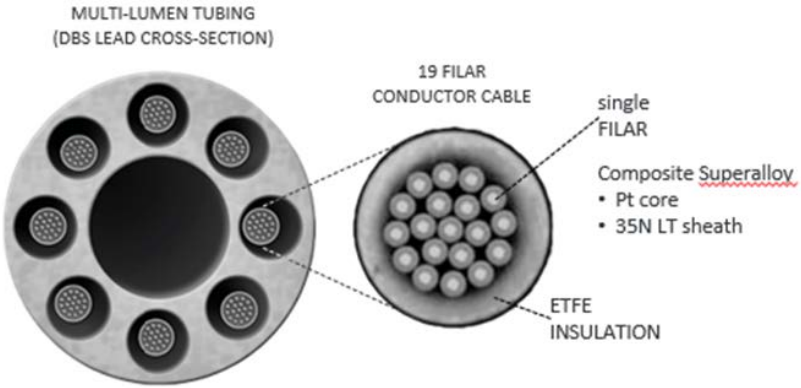


- Directional leads allow programmers to “steer” current to different parts of the brain, tailoring treatment to reduce side effects



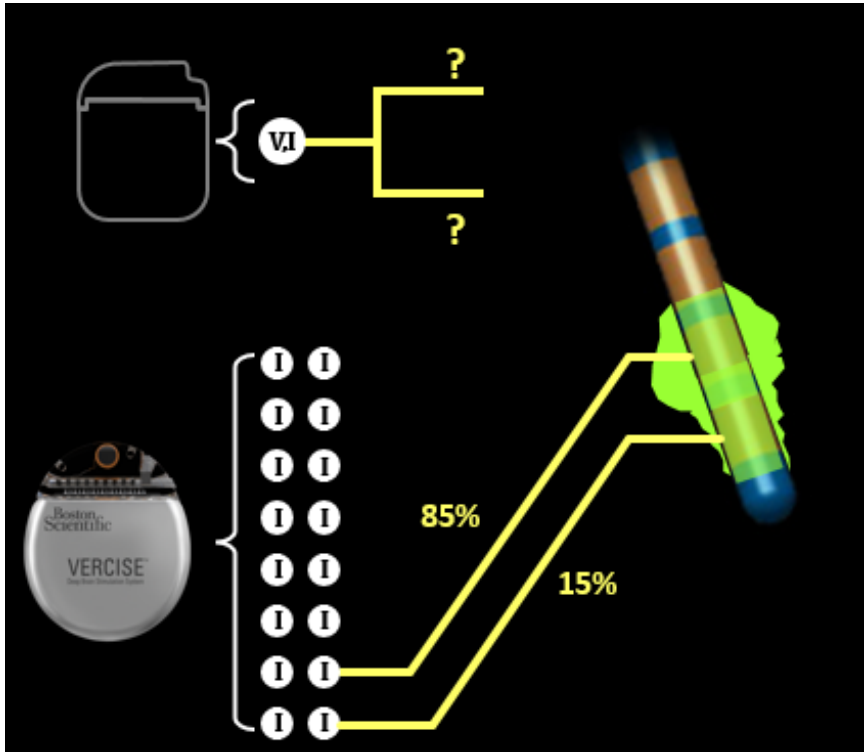
Boston Scientific Vercise DBS System

- Directional leads
- Battery Longevity:
  - Vercise PC IPG 3-5 years.
  - Vercise Gevia RC IPG 15 years: smallest, rechargeable battery available in U.S.
- MRI:
  - Vercise PC: head MRI only
  - Gevia RC: full body MRI conditional
- Contoured IPG shape
- Multi-lumen design to prevent short circuits



M.I.C.C.
Multiple Independent Current Control

- **Conventional stimulators use a single electrical source** (IPG)
  - If using multiple electrodes, stimulation flows to area of lowest impedance
  - Less predictable stimulation field
- **MICC: Each contact has its own current sources**:
  - Increased control over the stimulation field - **accurate and precise targeting**
  - Desired stimulation remains stable despite alterations in impedance at other leads
  - Allows unique field shapes



Vercise Gevia Charging System

- Wireless – patients can be active while charging
- Charging collar is lightweight, adjustable and available in 2 sizes
- Charge 15-20 minutes every day or 3-4 hours every 1-2 weeks

Surgery Preparation

Medical clearance by PCP, mental health providers and/or specialists

Stop use of tobacco and/or marijuana/ CBD products 1-3 months prior to surgery

Within 30 days: Preoperative evaluation with neurosurgery or PCP: labs, EKG, targeting brain MRi

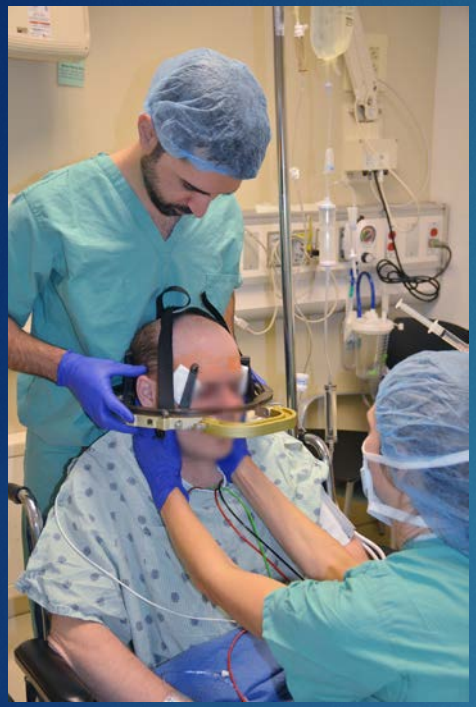
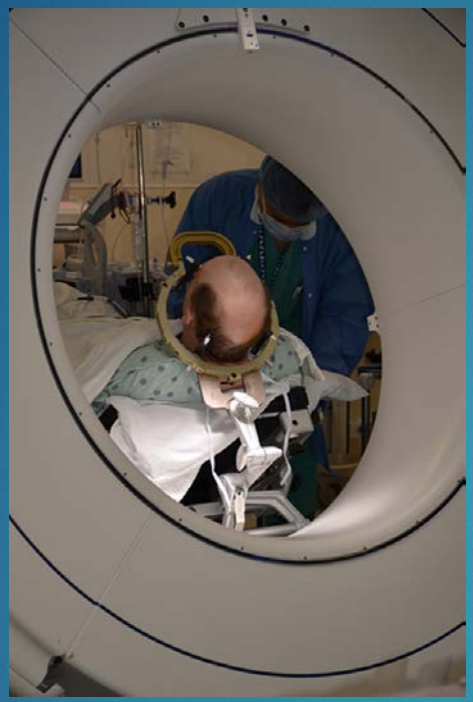
Hold medications:

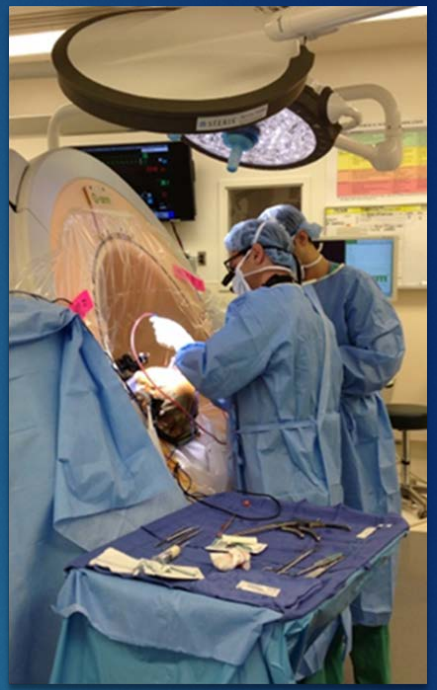
Estrogen: 4 weeks
Blood-thinning agents (aspirin, Plavix , NSAIDS etc.): 7-14 days

1-3 days prior: The Admissions Office will contact you with arrival time and instructions

Movement Disorders: Hold movement disorder medications at midnight

*EPILEPSY: TAKE YOUR AED MEDICATIONS AS USUAL TO PREVENT AN INTRAOP SEIZURE!

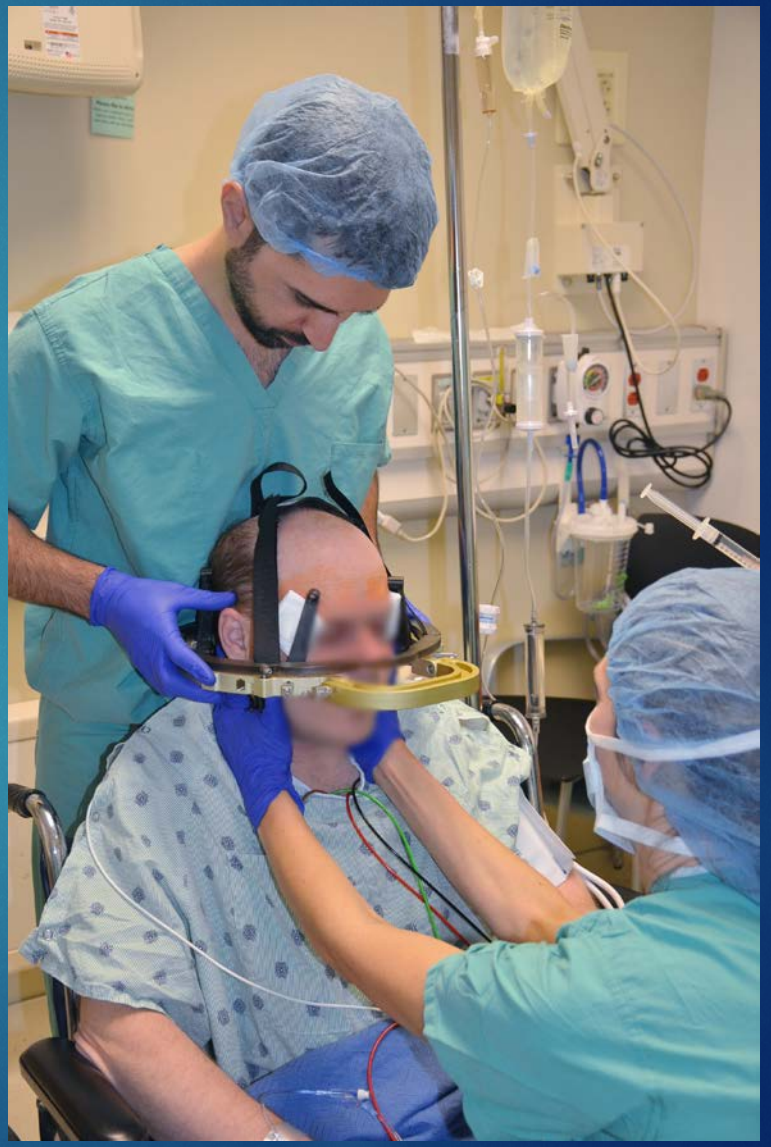





What to Expect Day of Surgery: Stage 1 (lead implantation)

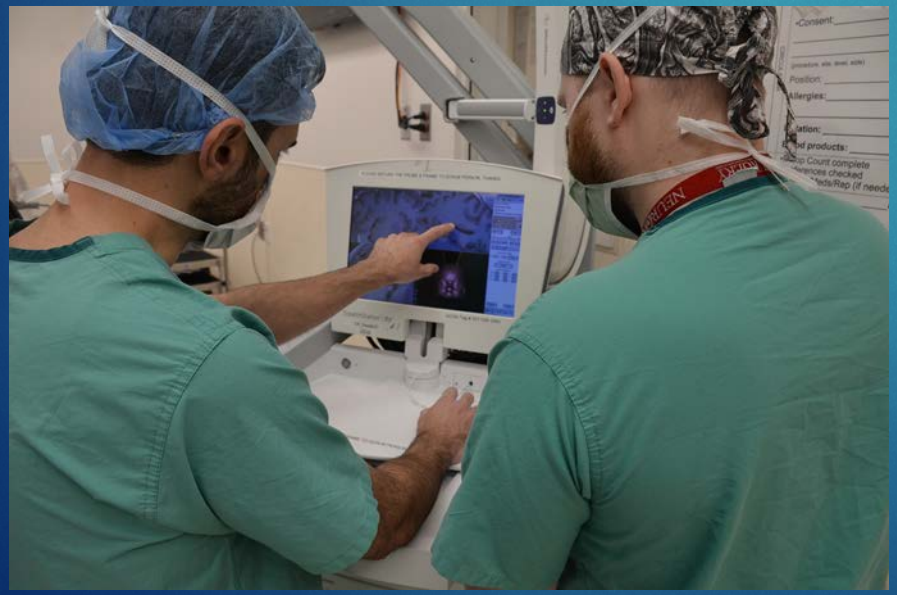
First Steps

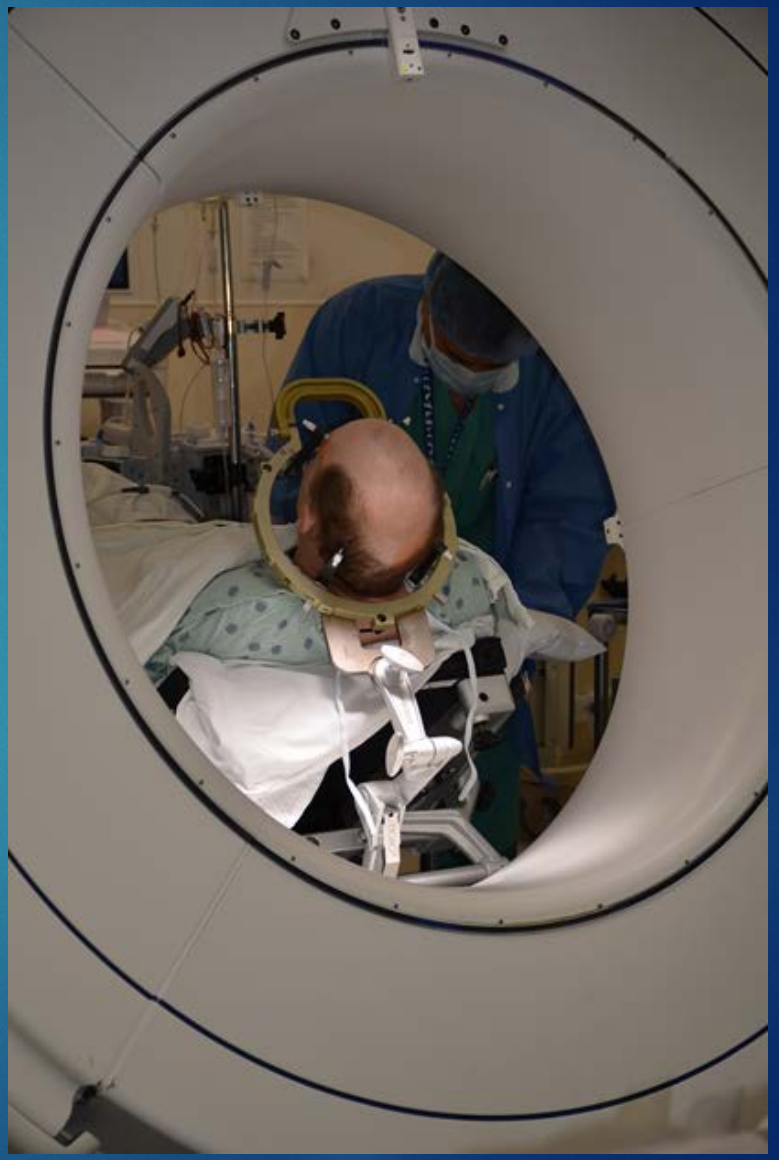
- IV line placed to prevent dehydration and allow administration of medications.
- Final assessments and consents completed by the anesthesiologist, surgical nurse, DBS NP and neurosurgeon
- Frame Placement:
  - IV medication administered to help you relax before the headframe is placed
  - Local anesthetic injected to numb the skin



Final Preparations

- Head CT:
  - Merged with the pre-op MRI to ensure accurate targeting
- Operating Room:
  - “Beach chair position”
  - Arterial Line placed: monitors blood pressure
  - Anesthesia administered so you can sleep
  - Urine catheter inserted
  - Surgical site prepped: hair clipped





DBS Surgery

Scalp is numbed so surgeon can make a small incision in the skin and an opening into the skull is drilled ("Burr hole").

Equipment is set up and lead is inserted

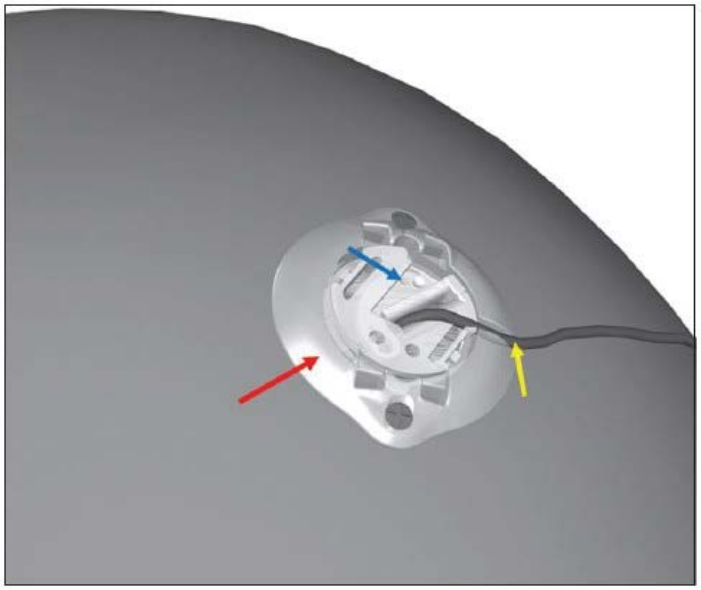
- You may be **awake or asleep** for lead placement and test stimulation with equal outcomes.

- For some targets, placement of the lead is done by the neurophysiologist with "microelectrode recording"
  - If awake, you will do passive and active range of motion movements with the assistance of the DBS team
    - You will hear noise that sounds like radio static
- The stimulator may be turned on to evaluate symptom control and side effects, as appropriate
  - If needed, we can adjust the positioning of the electrode at this time.
    - Potential side effects: numbness, tingling, pulling, a sensation of tightness, double vision or difficulty speaking.
    - A final portable CT scan will be obtained to confirm placement.
    - Once placement is confirmed, the anesthesiologist will give you medication to go back to sleep, if you were awake

Final Steps...

- Completing the surgery:
  - The small hole(s) in your skull will be closed holding the lead firmly in place
  - A plastic cap covers the hole to keep it sealed
  - Your scalp incision(s) will be closed
  - The headframe will be removed
  - The urine catheter will be removed

- Recovery:
  - Your family and friends can see you once you are awake
  - You will be admitted to our neuro unit for a 1 night hospitalization and discharged after a post-op MRI is completed



Neurologyindia.com, 2015

Stage 2: Extension and Battery Placement

- This surgery typically takes place 1-2 weeks after the lead(s) is/are placed
- This is an outpatient procedure
- You will be asleep (general anesthesia) for this surgery
- Most people find this 2nd procedure more taxing than the actual brain surgery

Post-Surgery Care

Wound Care

- **Head wound site**:
  - Bandages remain in place for 24 to 48 hours post-op
  - Stitches removed 7-10 days after surgery.
- **Pin sites** (where the head frame was attached):
    - Ice packs help to decrease swelling and discomfort
- **Battery and connector sites:**
  - Closed internally and covered with steri-strips externally. The steri-strips will fall off as the wounds heal.

Bathing

- You may shower on day 3 post-surgery
- No long steamy showers or hot tubs for 6-8 weeks.
- You can wash your hair with baby shampoo and pat the incision dry
- You may gently clean the incision sites to remove any debris. (Hydrogen peroxide works well)

Symptoms

- Normal symptoms: swelling at the pin sites, the incisions, and your face
    - Swelling and minor bruising around the eyes will resolve gradually.
- Neck and/or chest swelling and bruising should resolve within 2 weeks post-op.
- Microlesion Effect: PD or ET symptoms may be temporarily relieved and will then return.

Reasons to contact our office

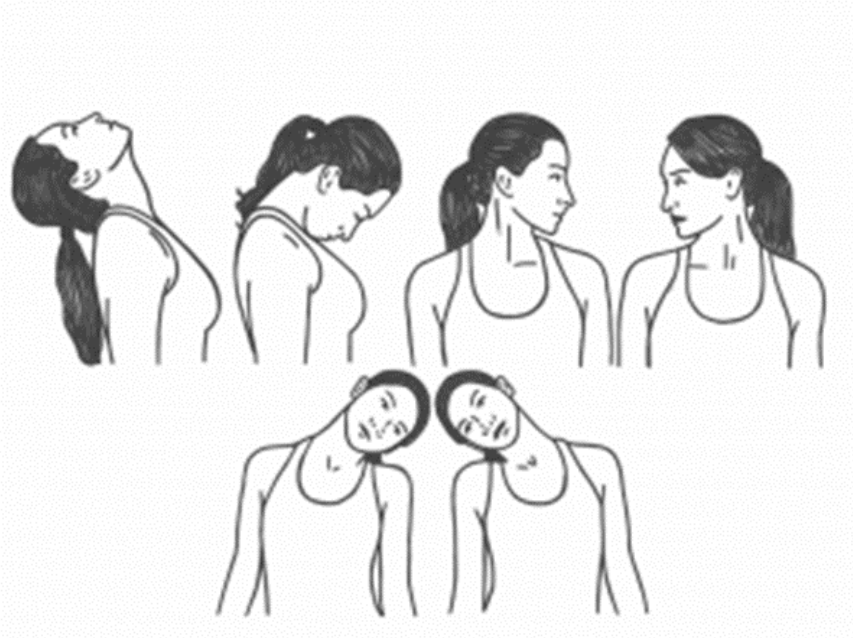
- **Incision**:
  - Bleeding or drainage
  - Increased tenderness, redness, puffiness
  - Separation of wound
- **Body symptoms:**
  - Fever or chills
  - Dizziness or lightheadedness that is new
  - Headaches not relieved by medication
- **Other:**
  - Weakness in limbs or facial muscles
  - Speech changes
  - Confusion or mentation changes

Complications

- If sudden and/or severe changes occur, do not hesitate to **call 911** or **go to the ER**.

Neck Range of Motion Exercises

- To limit scar tissue attaching to the extension wires causing a pulling sensation, practice daily GENTLE range of motion exercises to ensure maximum neck mobility post-surgery



Prehab Exercises, 2019, Retrieved from http://www.prehabexercises.com/eliminate-forward-head/

Post-Surgery Precautions

NO STOOPING, STRAINING, OR SQUATTING for 4 to 6 weeks: 20# weight limit; no gardening/ lifting weights/ running

Do not:

Drive for 2 weeks

Fly for 2 weeks

Avoid long car trips for 4-6 weeks

To reduce infection for 6-8 weeks after last surgery:

No swimming/ hot tubs

Avoid gyms

Defer dental procedures

Avoid hair coloring/ permanents

Avoid hair cuts with clippers

Pending occupation, take 4-8 weeks off

After 2 weeks, advance activity as tolerated

No sexual relations for 3-4 weeks

To reduce facial swelling, sleep on additional pillows

Turning On

Movement Disorders:

- Your stimulator will be turned on approximately 4 weeks after the implant date.
  - For Parkinson's disease, hold your Parkinson's disease medications for this appointment.
  - The first activation/ programming session will take several hours.
- Future programming sessions will take approx 1 hour
- Optimum stimulation results can take 3-6 months of programming adjustments

Epilepsy:

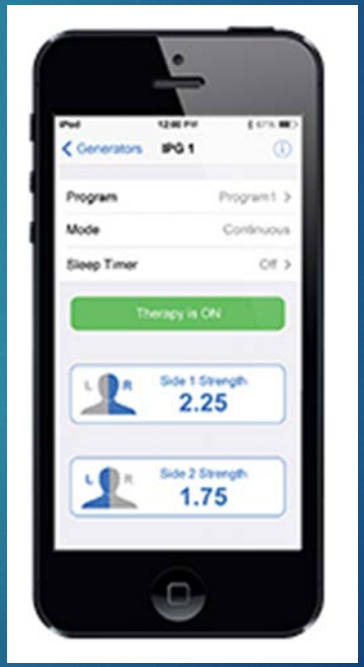
- Programming adjustments will be made with your Epilepsy specialist at your follow-up appointments.

Patient Programmer

Medtronic

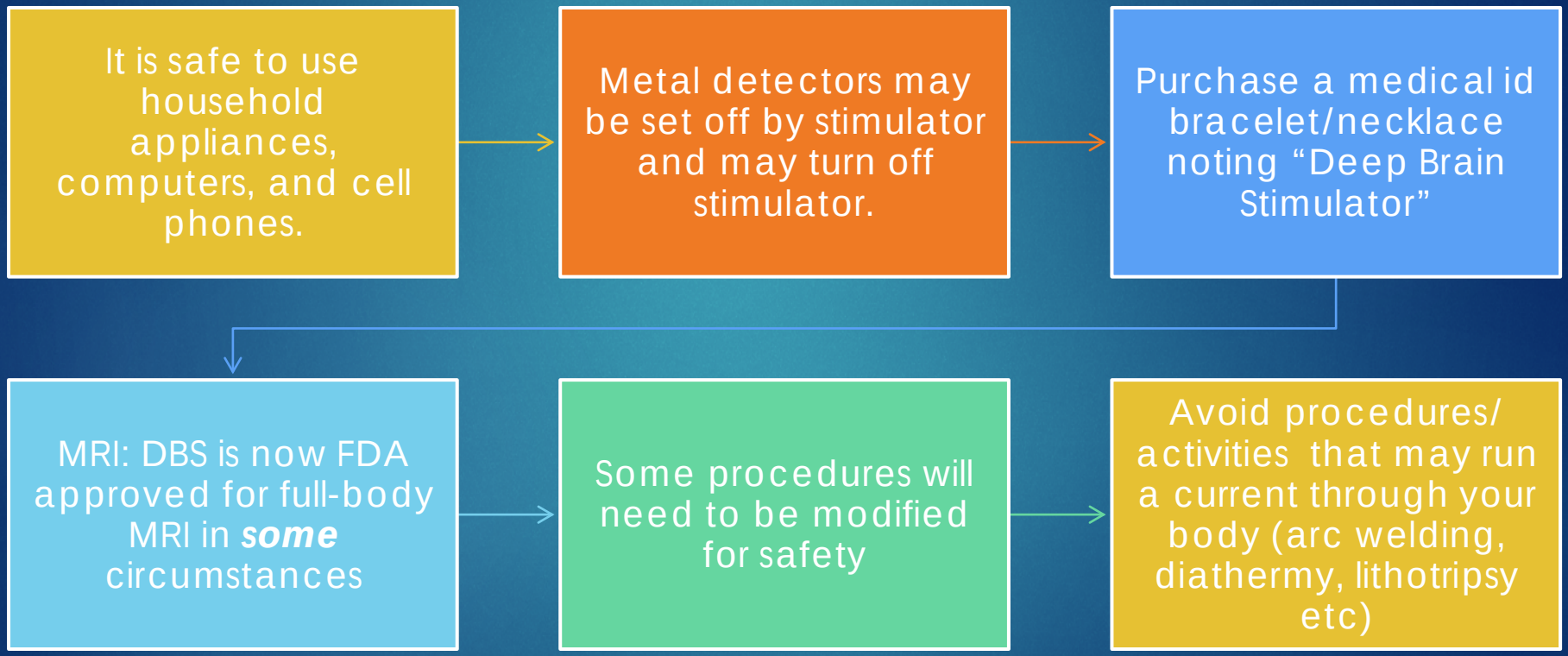
Boston Scientific

Abbott



BRING PROGRAMMER/ ALL EQUIPMENT TO INITIAL PROGRAMMING!

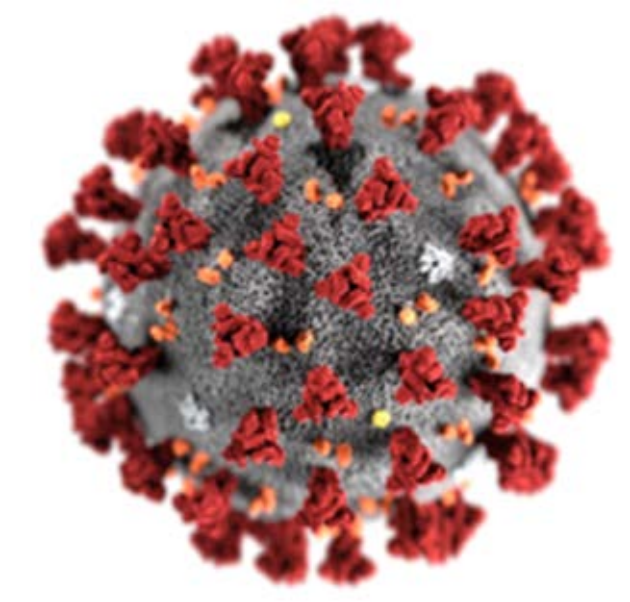
Safety Concerns



Living with DBS

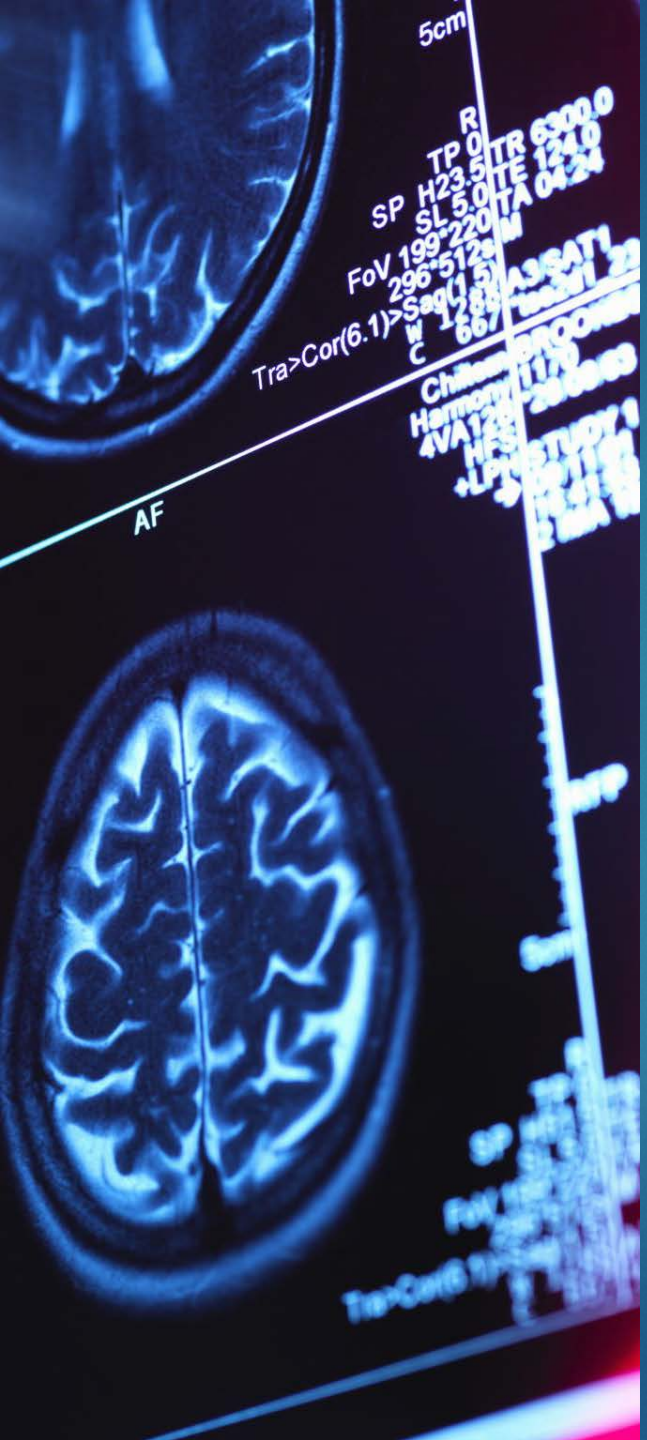
- Dentist: Prophylactic antibiotics not required
- EKG – turn off DBS prior to procedure
- CT, diagnostic ultrasound, x-ray, mammogram are safe
  - MRI conditional
- Monitor battery status regularly
  - Requires replacement approx. every 3-5 years
  - Rechargeable batteries last approx. 15 years
  - Surgery often done under sedation with local anesthetic

Current COVID Precautions



- **Patients**:
  - 1-2 days prior to surgery: COVID swab test
    - This test must be NEGATIVE to proceed with surgery
  - Patients will wear a surgical mask when awake before and during surgery

- **Visitors**:
  - 1 **symptom-free** visitor > 16 years of age per patient
  - Everyone is **screened** for symptoms of illness upon entering the hospital/ clinics
  - Every visitor must wear a **mask** for the entire visit
  - Visitors must remain in the patient's room or cafeteria for the entire visit
  - Practice **physical distancing** and limit time in the public spaces



Questions?

Call Laura Sperry, MSN, ANP-BC
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916-734-3588