Deep Brain Stimulation

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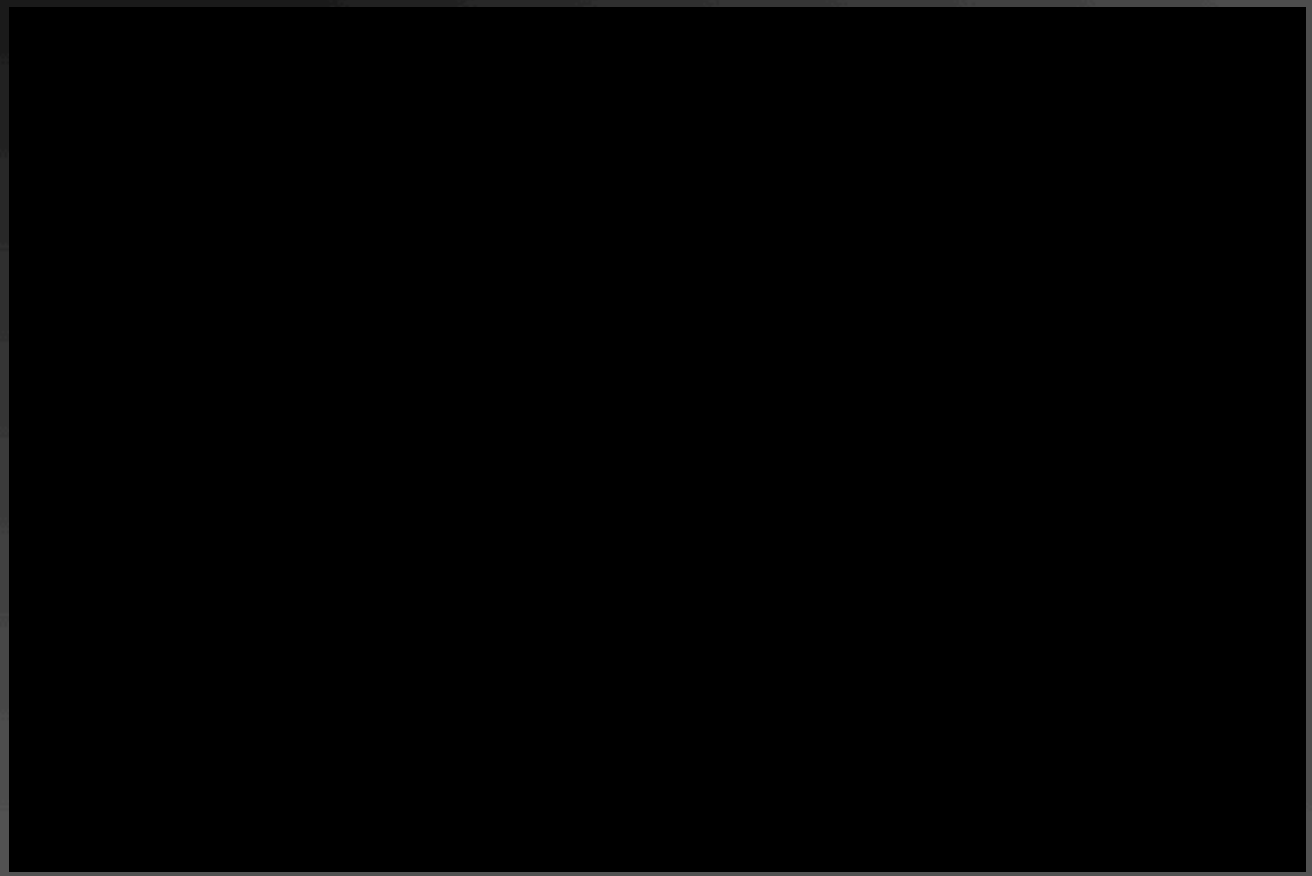
Deep Brain Stimulation for Parkinson's Disease



Approved Indications

- **Essential Tremor**
  - FDA approved in 1997
- **Parkinson's disease**
  - FDA approved in 2002
- **Dystonia**
  - FDA approved (HDE*) in 2003

Obsessive Compulsive Disorder

FDA Approved (HDE*) in 2009

Over 30,000 patients implanted worldwide

Deep Brain Stimulation

- A treatment using a surgically implanted medical device developed to reduce tremor and improve Parkinson's Disease symptoms
- Chronic high frequency electrical stimulation of deep brain structures (neuromodulation)
- Stimulation is adjusted as needed to get the best possible reduction of symptoms

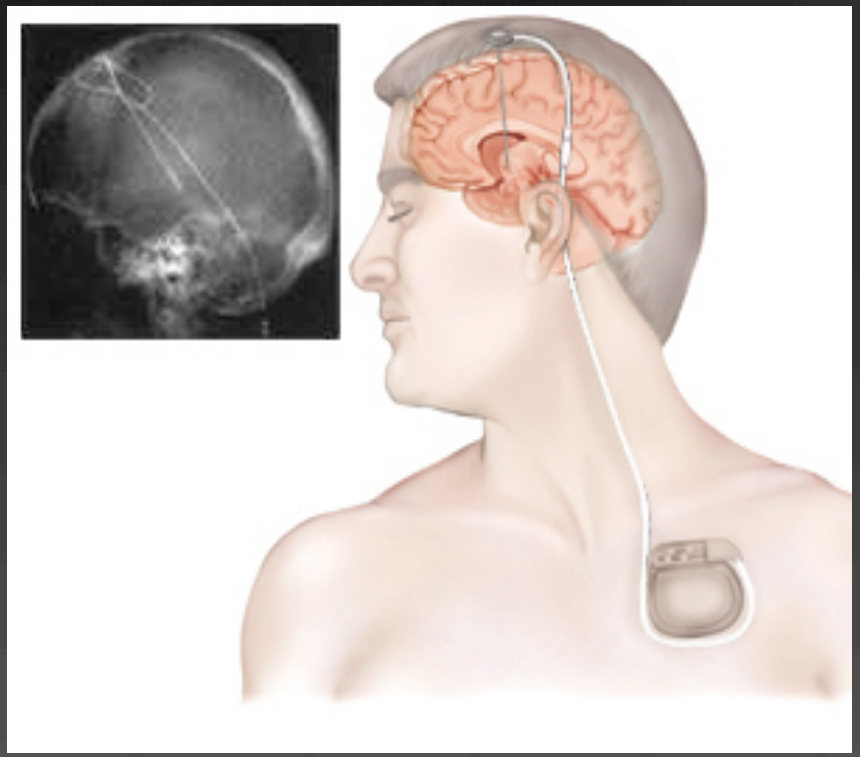
Stages of DBS Surgery

- Electrode placement
  - Head frame (placed) matched with MRI and CT
  - Target site identified, trajectory planned, coordinates agreed
  - Local anesthetic, one incision, patient awake
  - Microelectrode recordings/mapping target
  - Electrodes implanted
  - Test macrostimulator to confirm site

Stages of DBS Surgery

- Impulse generator (battery) placement
  - Identify generator needed
  - General anesthetic
  - Two incisions
  - Internalization of wires concealed under scalp and tunneled down neck
  - Generator implanted in chest wall

Implanted Device



- lead implanted
- wire tunneled behind the ear and down neck
- Impulse generator inserted below clavicle

Disease Symptoms Treated

- Parkinson's Disease
  - Rest tremor when limb at rest without gravity, rigidity, bradykinesia, and postural instability
- Essential Tremor
  - Action tremor during voluntary movement which is functionally disabling
- Multiple Sclerosis Tremor
  - Combination of rest and action tremor which is functionally disabling

DBS for Dystonia

- Idiopathic primary dystonia
- Normal cognitive status and MRI
- Interfering with ADLS or causing musculoskeletal deformity
- Failed response to oral meds or botulinum toxin A and/or B
- Realistic expectations, risk/benefit accepted

Parkinson's Disease Treatment: Continuum of Interventions

Ideal Patient Profiles

- Parkinson's Patient
  - Idiopathic PD with troubling motor symptoms
  - Optimized on PD meds, continued response to levodopa part of the time, but experiencing unfavorable SE from meds
  - Controlled hypertension, no anticoagulation or other medical conditions contraindicating surgery, no active infectious processes, no significant dementia or depression
  - Moderate to severe dyskinesias
  - Severe motor fluctuations, short "on" time
  - Realistic expectations; risk/benefit acceptable

Parkinson's Symptoms Treated With DBS

- Dyskinesias nearly eliminated
- Off time reduced
- Rigidity and bradykinesia improved
- Tremor suppressed
- Gait and posture variably improved

Outcomes: DBS for PD

- Overall 85% of patients show improved motor function after DBS
- Motor fluctuations are significantly reduced
- These benefits are durable for at least a decade
- Many patients can reduce their medications guided by their physician

Patient & Family Teaching

Extensive pre, peri, and post-op education:

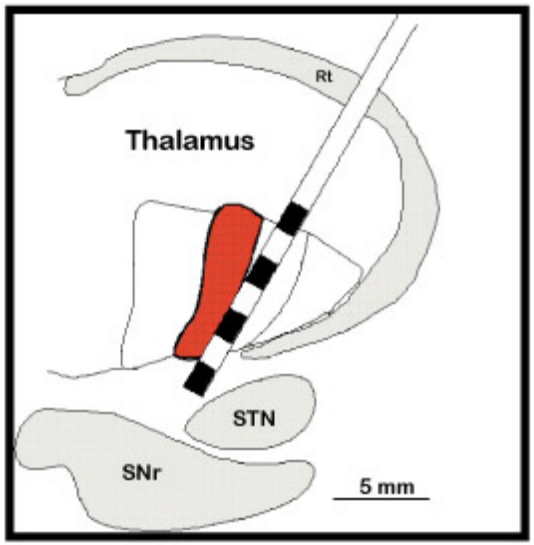
- pre-tests include, MRI, neuropsychological exam, medical clearance from PMD, routine pre-op tests, EKG etc.
- levodopa challenge video exam
- DBS electrode and battery placement procedures explained
- risks
- realistic expectations
- use of DBS device, programming, side effects of stimulation and safety precautions
- med adjustment

Pre-operative Assessment

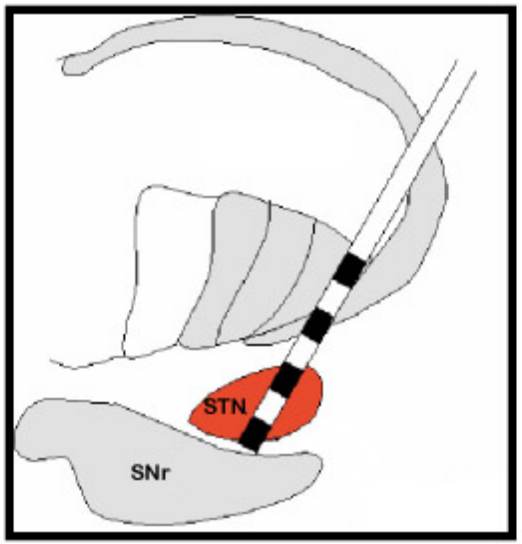
- Neurosurgeon- mechanics and risks
- Magnetic Resonance Image (MRI)
  Medical clearance- primary care giver
- Pre-admission testing- blood work, EKG, chest x-ray

Stereotactic Head Frame

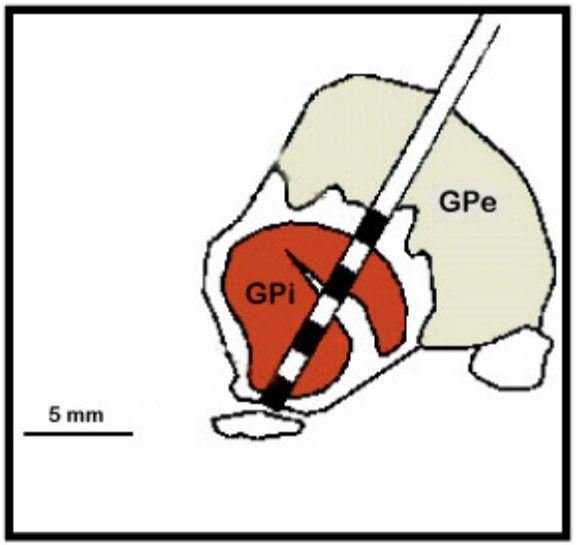
Target Sites for Activa Therapy



Vim Thalamus:
Essential Tremor



Subthalamic Nucleus:
Parkinson's disease
and Dystonia



Globus Pallidus:
Parkinson's disease
and Dystonia

Why Is the Patient Awake?

- Neurologist activates brain neurons with patient movement to help us locate the area of the brain to place the electrode.
- Patient cooperates with exams of tremor, muscle tone and rigidity.
- Assessment of efficacy versus side effects, patient reports any numbness, tingling or other sensations.
- Drugs interfere with the electrical activity of the brain.

Microelectrode Recording

- Sounds like static in the background.
- When we hear a cell, Dr. Trinidad will examine you.
- The pattern of the cells helps us to locate the correct spot for the electrode.

IntraOp

Risks of Surgery

- 1-2% chance of intraoperative hemorrhage
- 3-5% chance of infection
- 3-5% chance of hardware breakage
- Transient confusion
- Perioperative seizure

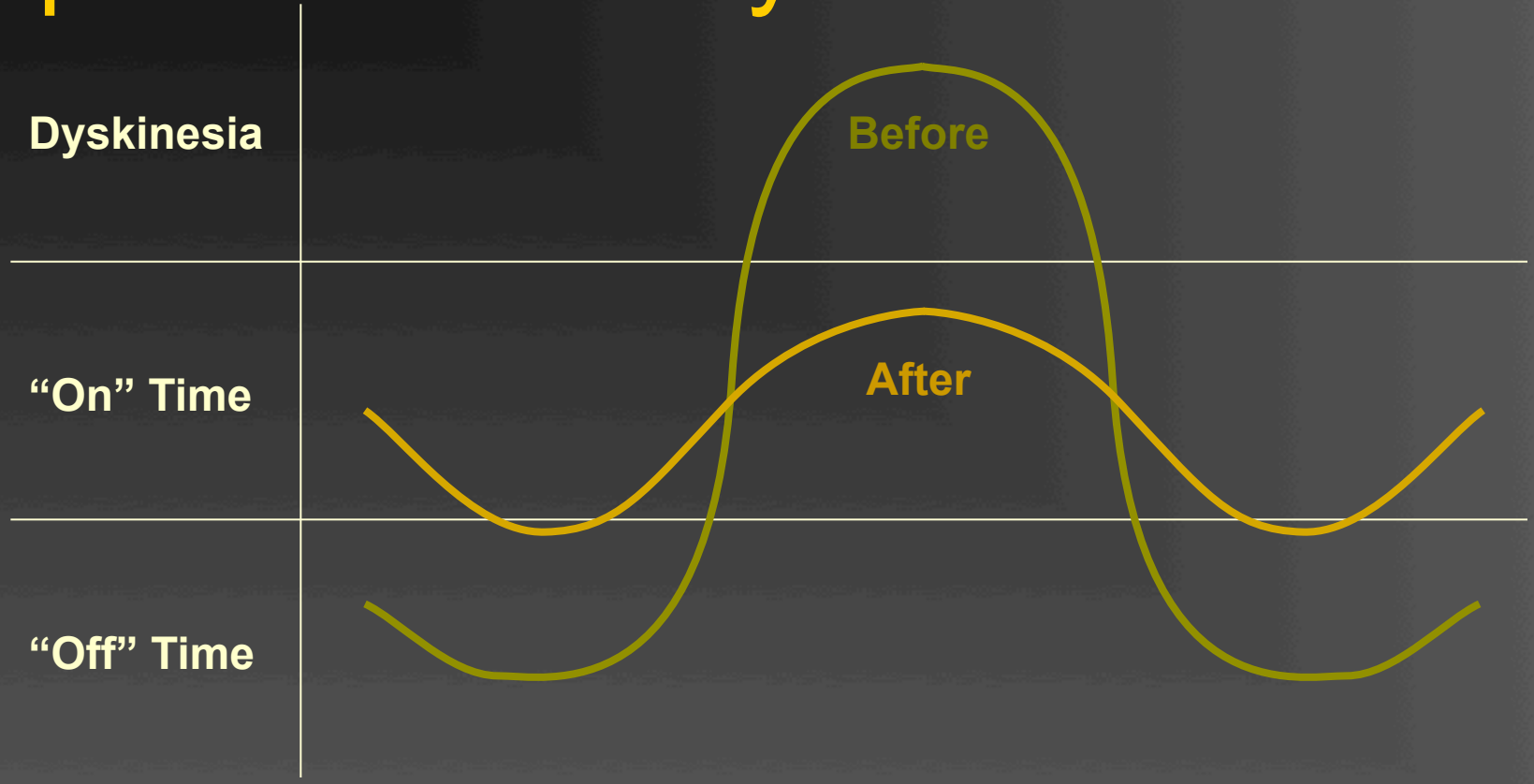
Deep Brain Stimulator Programming

- Postpone initial programming 4-6 wks after surgery since micro-lesion effect
- Withhold meds for first session
- Programs via telemetry
- May need a few sessions to optimize results

PD Symptoms Improved With DBS

- Tremor & rigidity—almost immediate improvement
- Bradykinesia, akinesia and gait disorders—some pts immediate response, others are delayed
- Dyskinesia-side effect of meds, usually eliminated
- Smooths out motor activity

Efficacy: Benefits of Activa Therapy Impact on Mobility

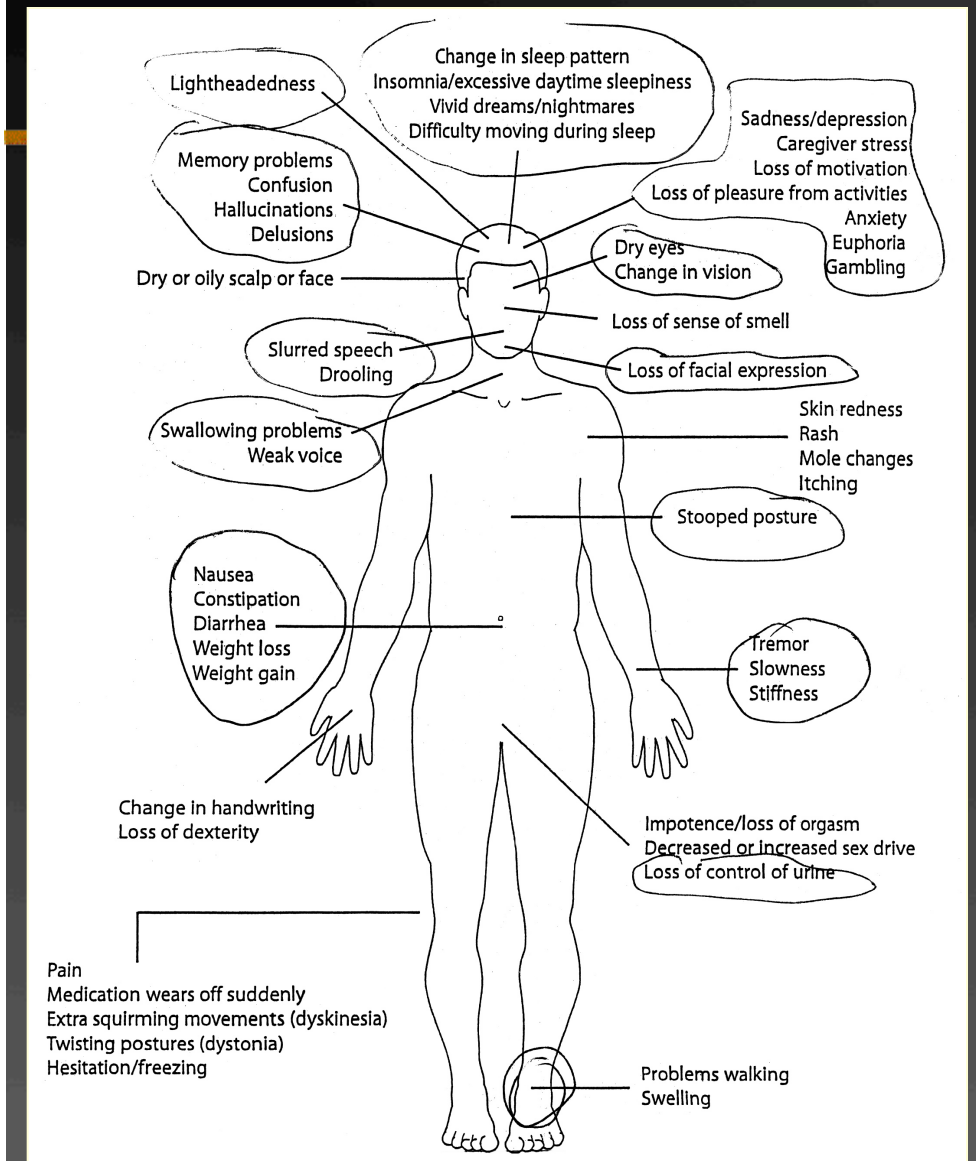


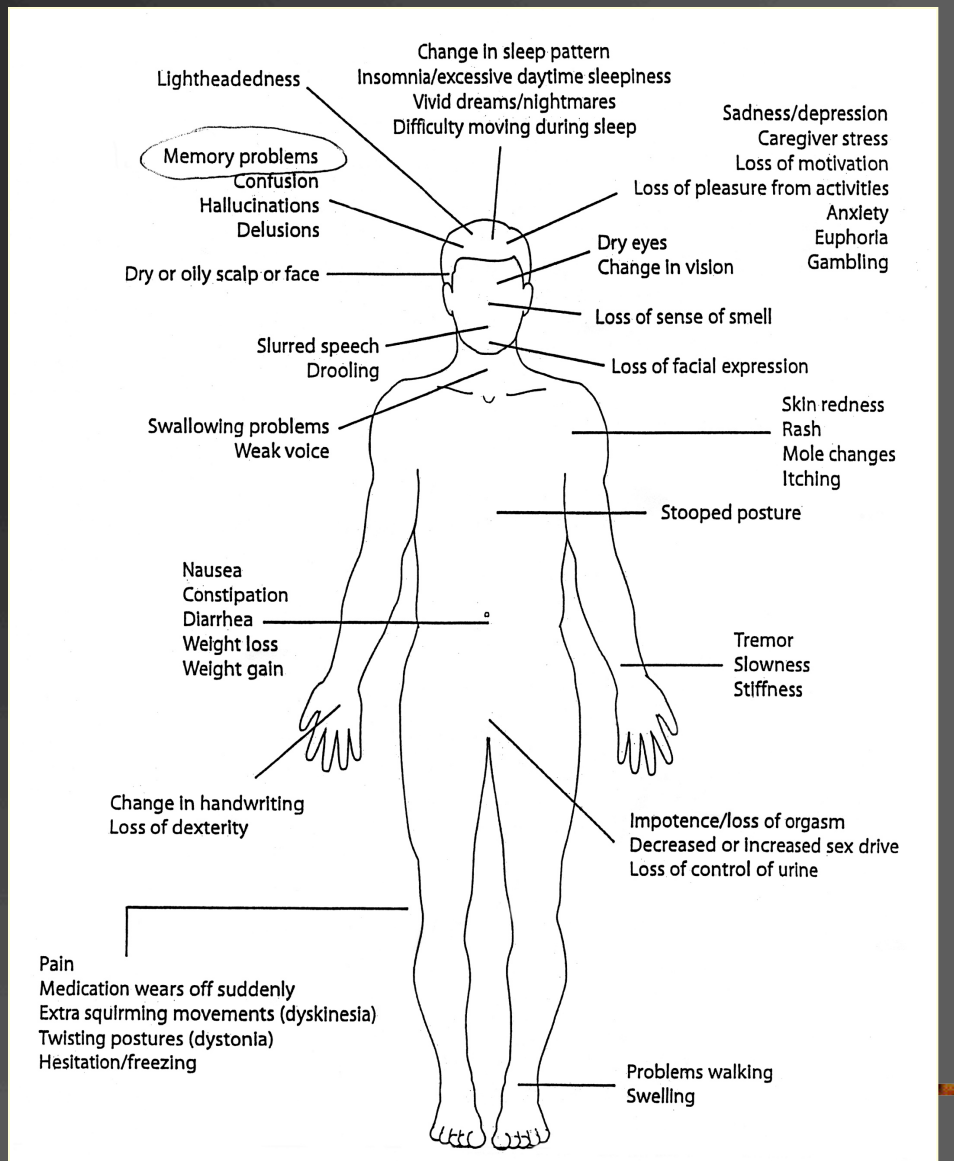
This graph is only for illustrative purposes and does not represent actual "on" and "off" time.

After Initial Programming

- Return to clinic for stimulator and medication adjustments as needed
- Resume ADL's
- Rehab—speech therapy, gait training, support group
- Most of all—be patient

Common Problems in Parkinsonism and/or Side Effects of Medications





Conclusions

- For Parkinson's patients receiving inadequate benefit from optimized pharmacotherapy, DBS can:
  - Reduce symptoms
  - Enhance functional capacity
  - Sometimes reduce medication requirements

  Successful outcomes from DBS therapy are achieved with:
  - Proper patient selection and education
  - Accurate surgical implantation
  - Optimal post-operative management