Brain Control (or …What To Do When Your Circuits Don't Work)

Eric E. Sabelman, PhD, Functional Neurosurgery Bioengineer, Kaiser Permanente Medical Group

Input/Output to/from the Brain

- Outputs:
  - Control one's own muscles
  - Synthetic speech
  - Control one's environment
- Inputs:
  - Sensory (vision, hearing)
  - Reduce pain
  - Damp epileptic feedback loops
  - Replace lost neuron linkages
  - Regulate behavioral pattern generators

How to treat mis-wiring of the brain?

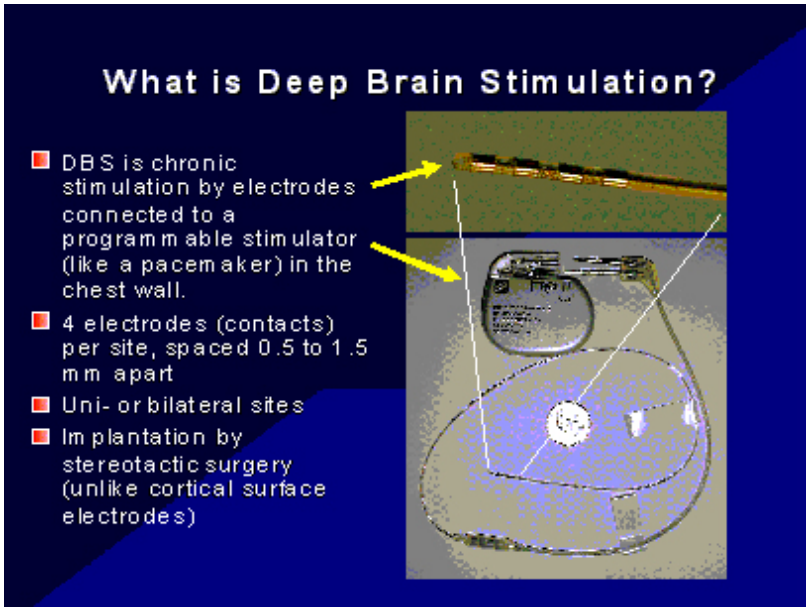
- Drug replacement
  - Injections, pills
  - Infusion pumps
- Surgically implanted prosthesis (electrodes)
  - Cortical (shallow)
  - Deep (basal ganglia)
  - Peripheral
- Regeneration
  - Stem cell implantation
  - Nerve guides

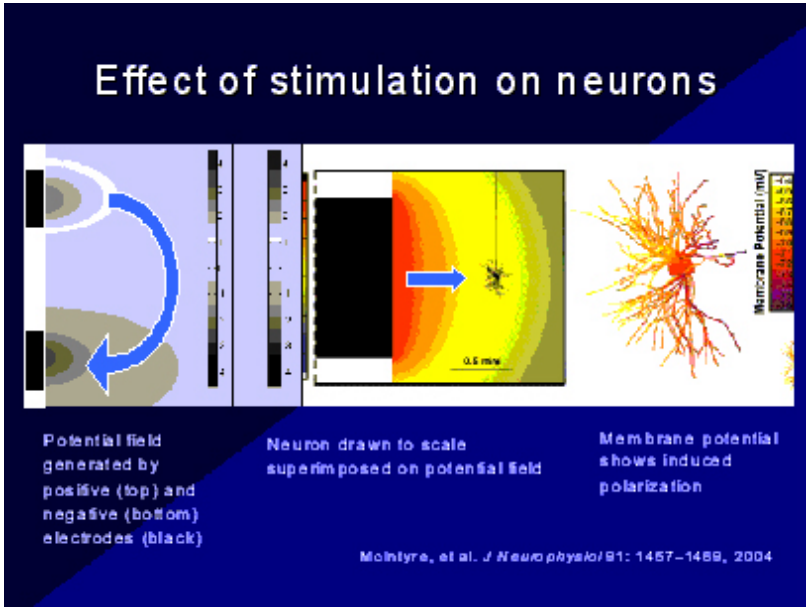
Limits of Drug Therapies

- Effective dose decreases
- Duration of effect decreases
- Side-effects increase

Stem cell implants

- Results of clinical trial of Parkinsons cell therapy
- Adult Stem Cells





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Why Deep Brain Stimulation?
Symptomatic treatment when medication is ineffective for:

Parkinson's Disease
Tremor syndromes
Pain syndromes
Primary dystonia
DOPA responsive dystonia
Tardive dyskinesia
Tourette's Syndrome
Anorexia Nervosa
Obsessive-compulsive disorder
Depression

Symptoms of Parkinson's Disease

tremor
rigidity
slowed gait (bradykinesia)
motor block or "FOG"

Deep Brain Stimulation Surgery at Kaiser Redwood City

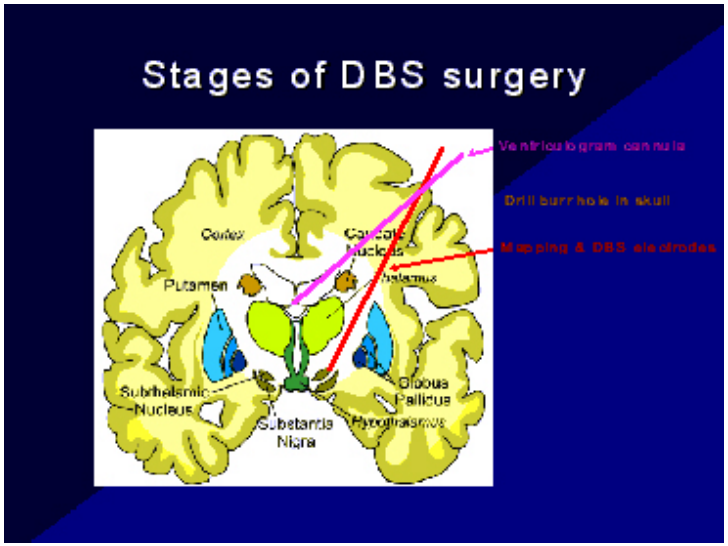
PD Patient Evaluation/Screening Process

1. Initial 1 hr consultation & MRI
2. Exclusionary criteria?
3. If anxiety related surgical risk factor noted, refer patient for relaxation training
4. Diagnostic evaluation - 1 hr to overnight
5. 2nd appointment(s) for further:
   a. medication
   b. diagnostic studies
   c. monitoring
6. Neuropsychological testing - 4 hrs
7. Case discussed by Review Board
8. Follow up appointment to discuss recommendations & surgery option(s) – 1 hr
9. Schedule surgery
10. Presurgery MR & CT imaging
11. Perioperative instructions – 1 hr
12. Post-surgical in-patient care – 3 days
13. Stimulator programming at 2, 6, 12 months – 4 hrs

Steps to insure targeting accuracy

Accuracy of +/- 0.5 mm requires:

- MRI localization of STN relative to anterior & posterior commisures
- Fuse MRI & CT for bone landmarks
- Ventriculogram at surgery start as reference to MRI
- Bilateral plane X-ray to locate electrode
- Recording multiunit neuron signals at known electrode depths
- Repeat X-ray & recording for each track



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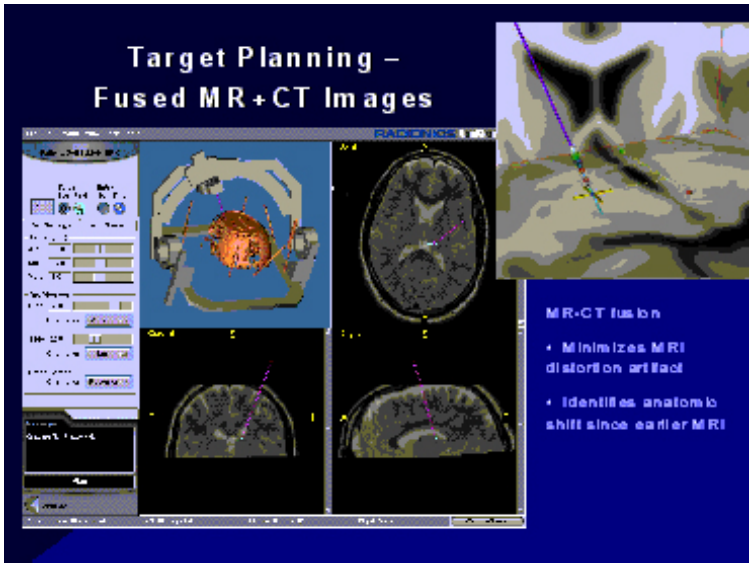
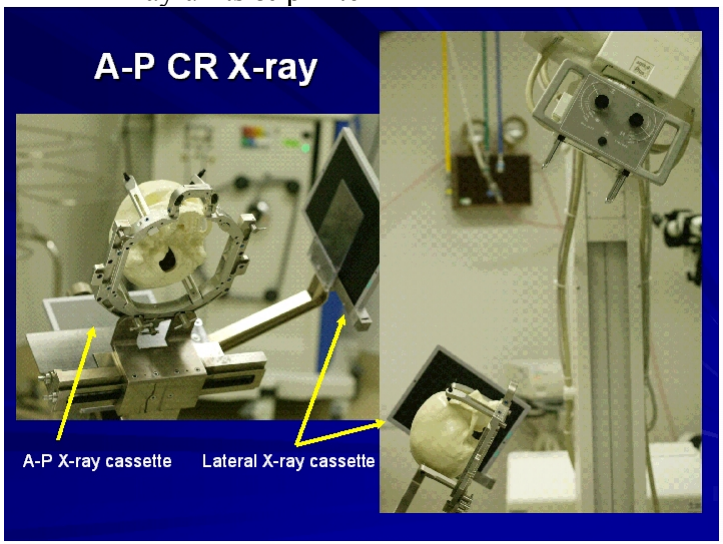


Operating room setup for DBS surgery:

RWC OR-6 - stereotactic floorstand & intraoperative CR
X-ray units & printer



In the Operating Room

DBS specialty team

Neurosurgeon
Nurse practitioner
Bioengineer/physicist

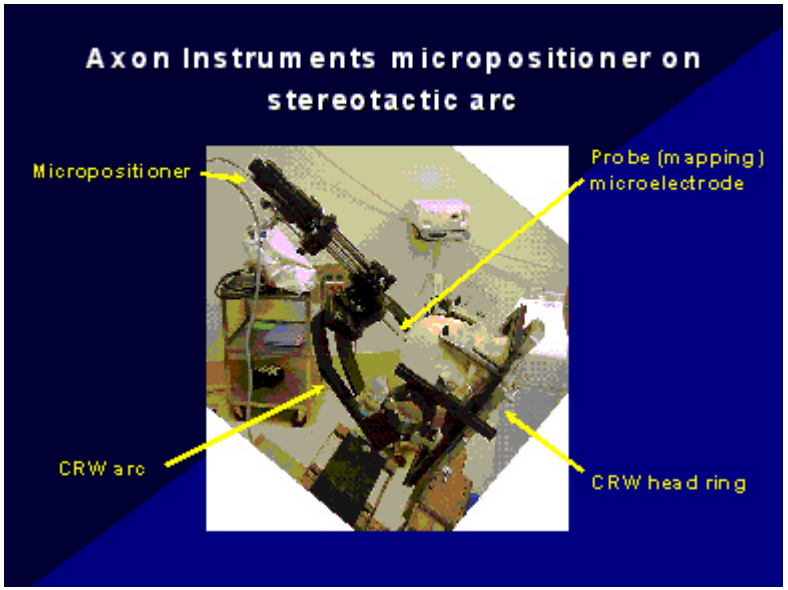
Hospital staff

Anesthesiologist
Scrub tech
Circulating nurse

Hospital services

Perioperative
Radiology

Mapping and permanent DBS electrodes inserted stereotactically



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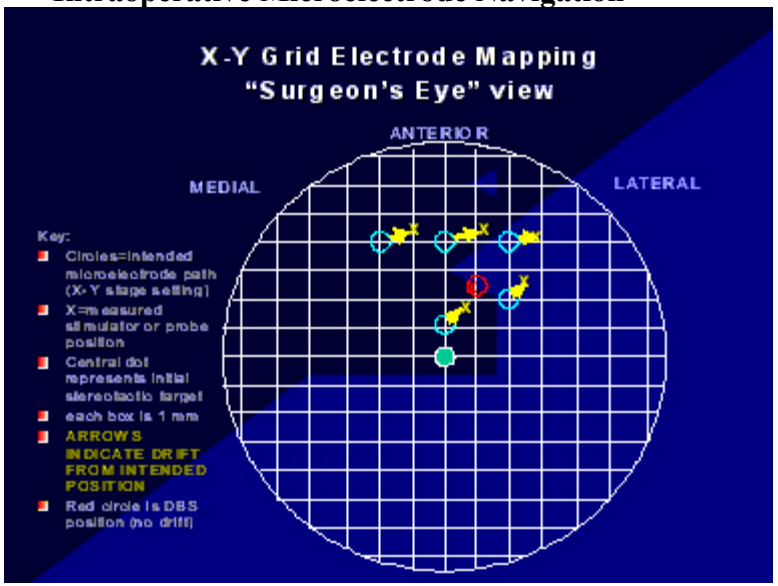
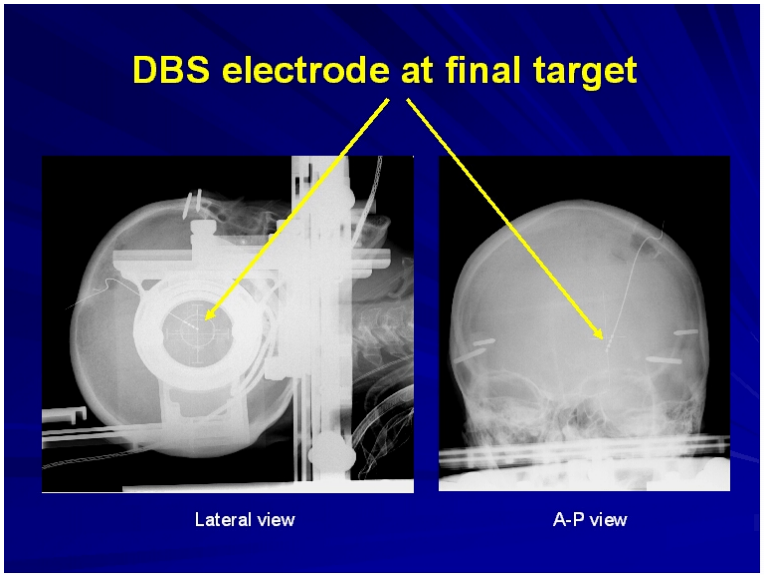
Intraoperative Microelectrode Navigation

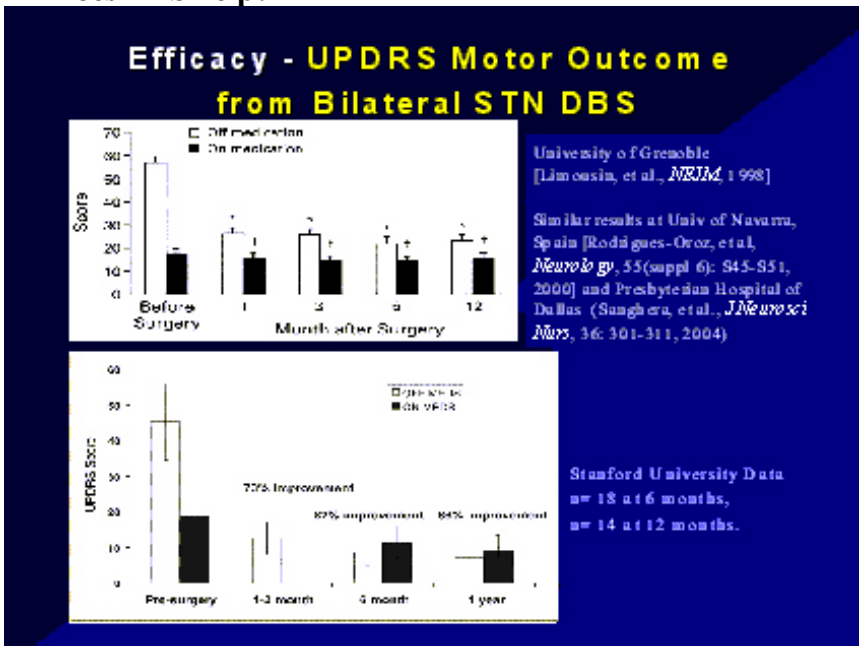




Final surgical steps:

Test stimulation after DBS implantation
Implant pulse generator
Post-surgical electrode location confirmation

Does DBS help?



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