

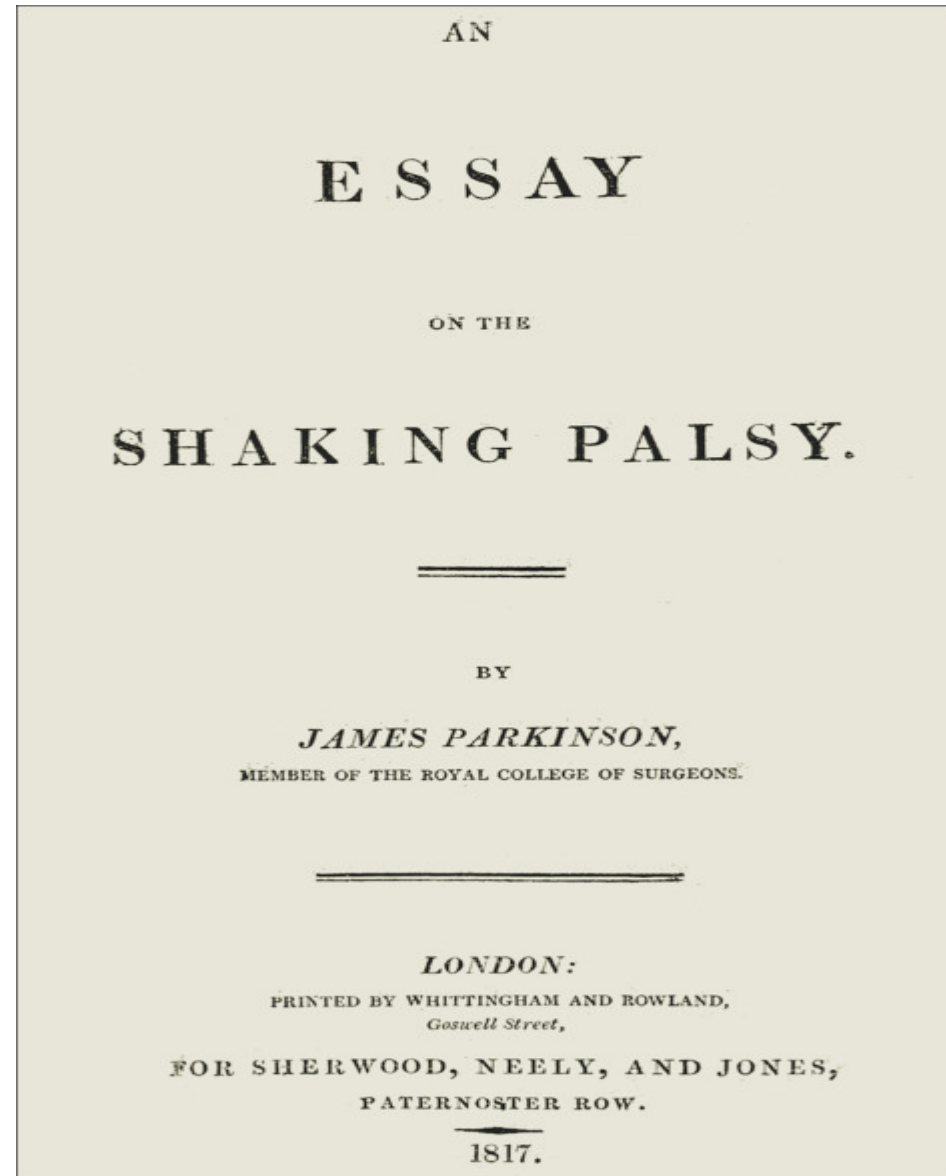
Surgical Treatments of Parkinson's Disease

Carter S. Gerard MD
Neurosurgeon
Swedish Neuroscience Institute

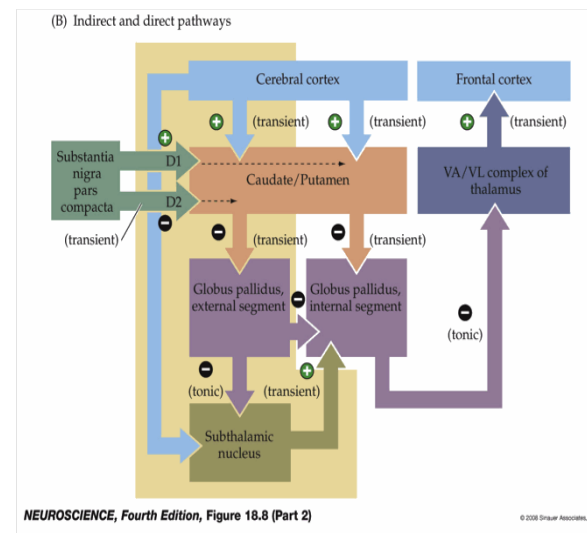
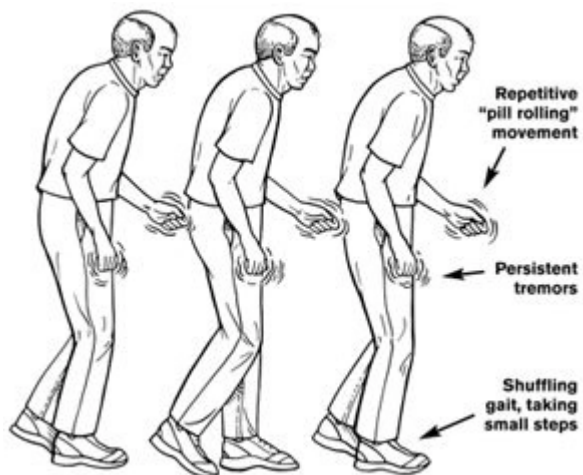
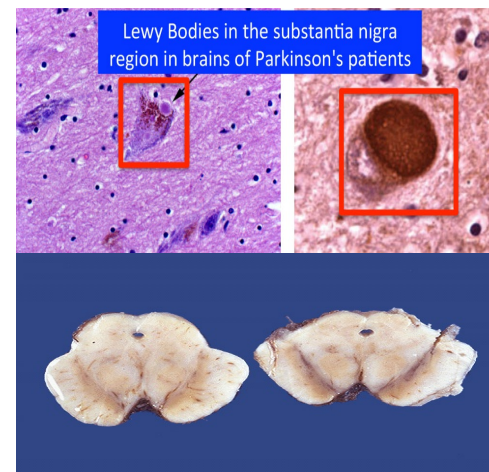
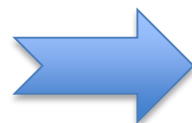
Disclosures

- None

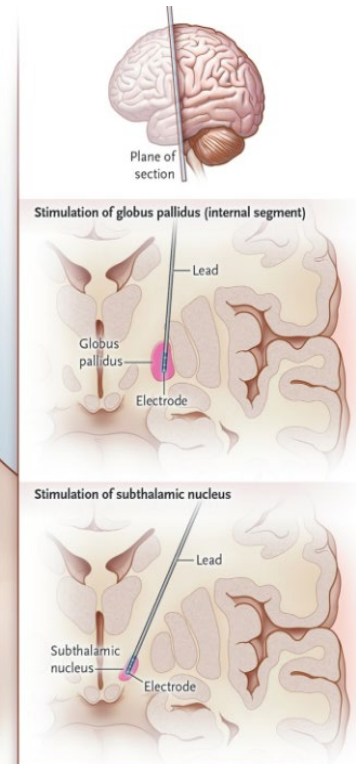
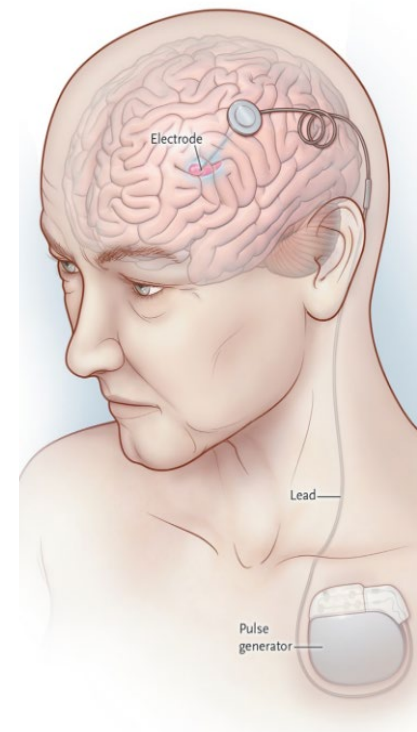
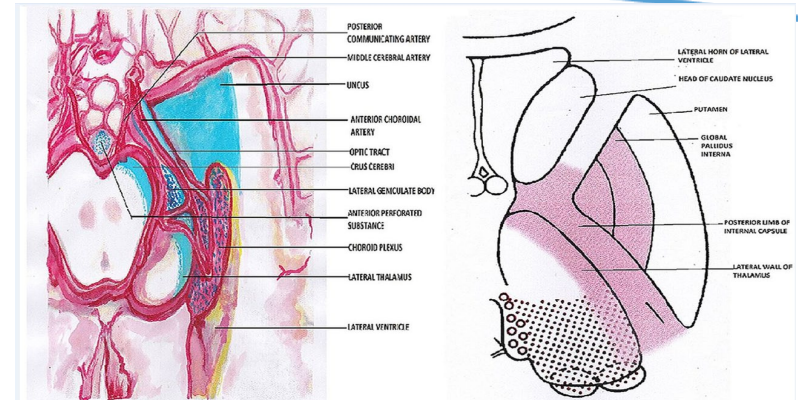
- **Resting Tremor**
 - *“Being even checked by the adoption of voluntary motion”*
- **Gait**
 - *“The legs are not raised to the height which the will directs”*
- **Nonmotor Symptoms**
 - *“The sleep becomes much disturbed”*
 - *“The bowels require stimulating medicines to function”*
- **Bradykinesia and Rigidity**
 - Later described by Charcot



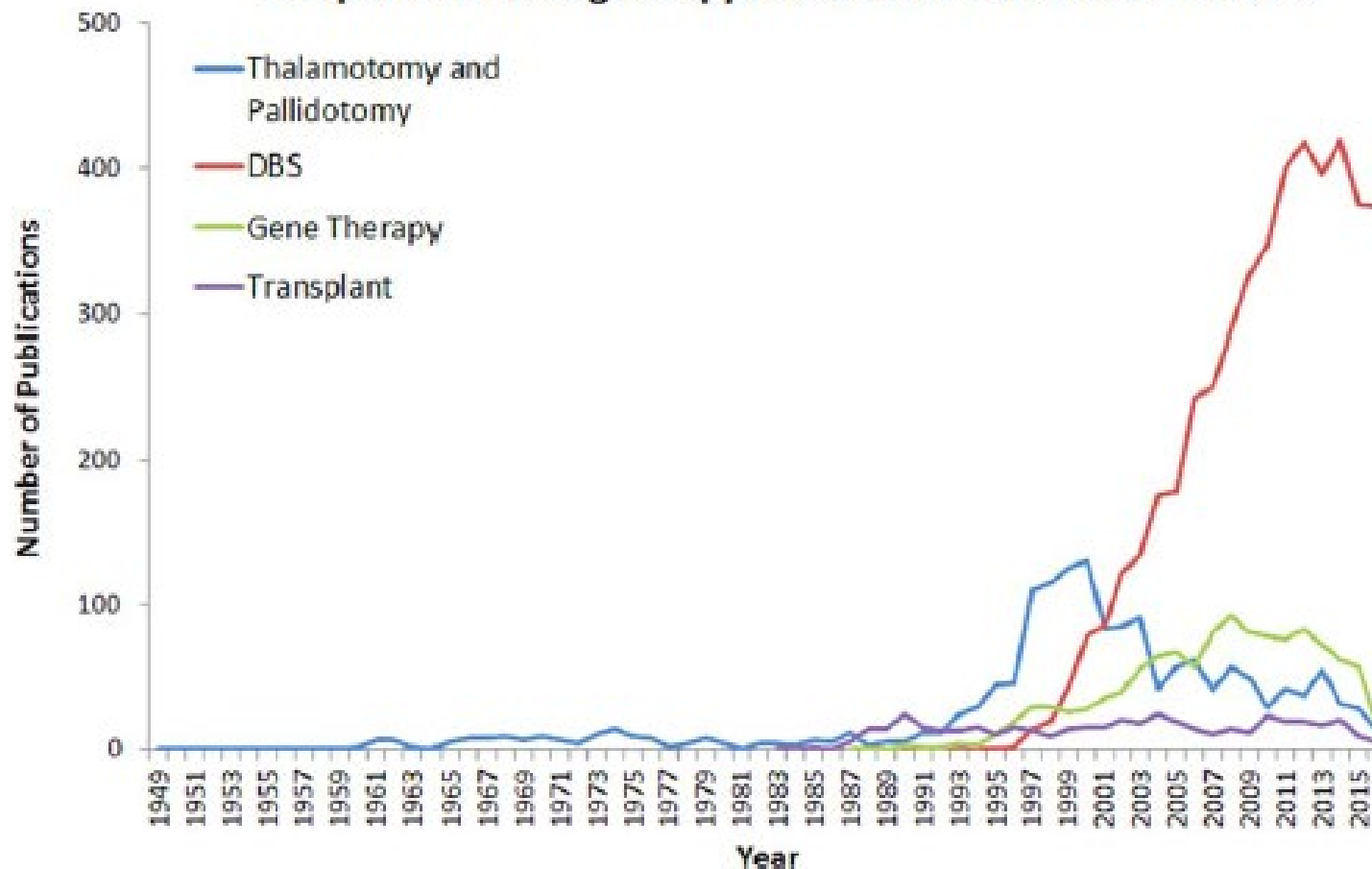
Environmental and Genetic Risk Factors



- **Prestereotactic Era (1890-1954)**
 - Surgeries involving the peripheral nervous system
 - Resection of precentral cortex
 - Open resection of the basal ganglia
 - 1950s- Cooper pioneered ligation of the anterior choroidal artery
- **Early Stereotactic Era (1947-1968)**
 - 1957 Cooper performs chemopallidectomies with procaine
 - Post mortem revealed thalamotomy in patient with significant tremor reduction
- **Latent/Levodopa Era(1968-1992)**
- **Ablative Surgery Era (1992-1999)**
- **Modern/DBS Era (1993-present)**

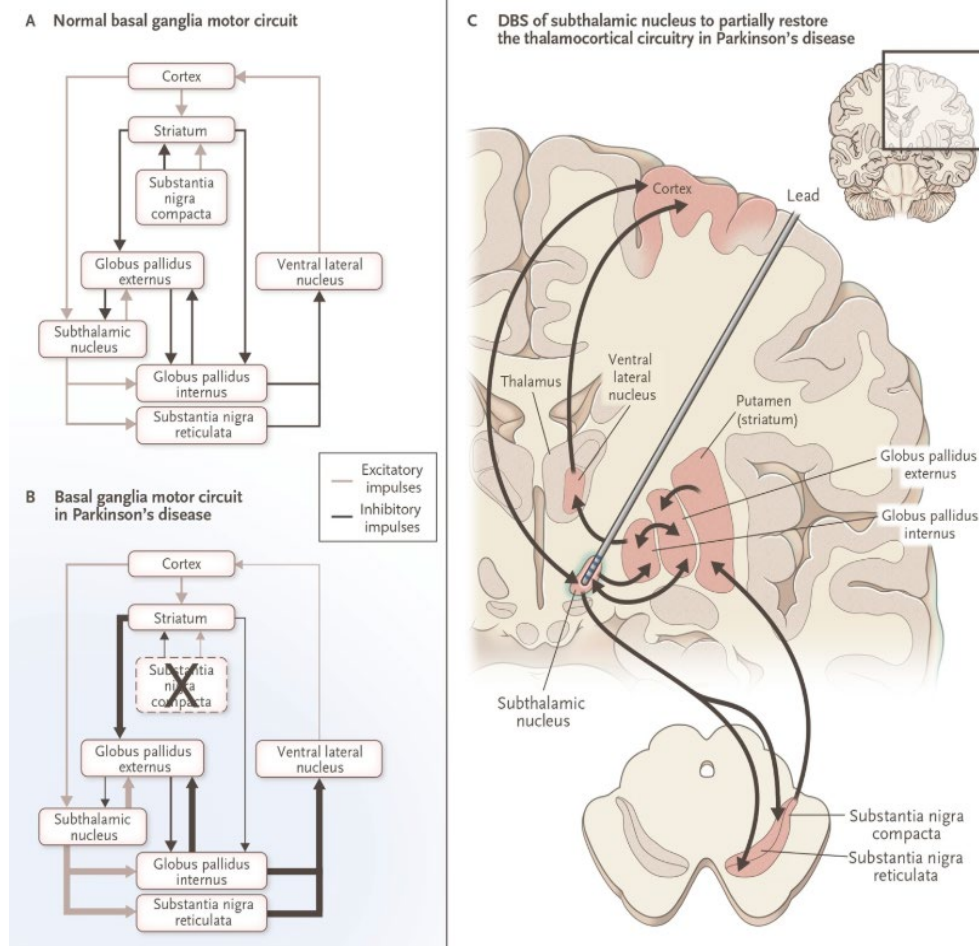


Comparison of surgical approaches for Parkinson's Disease



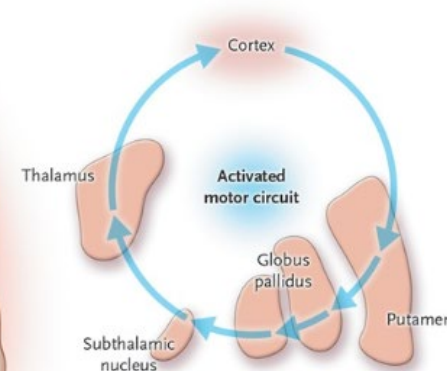
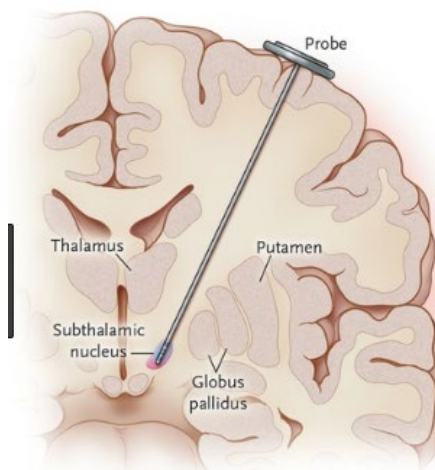
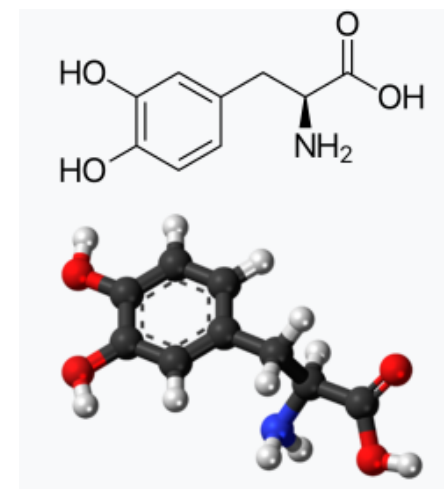
Deep Brain Stimulation

- 1950s -Deep brain stimulation first described
- 1968 – Development of levadopa
- 1987- Benabid and Pollock reported VIM stimulation for Parkinson's
- 1993 - Benabid and Pollock reported successful STN

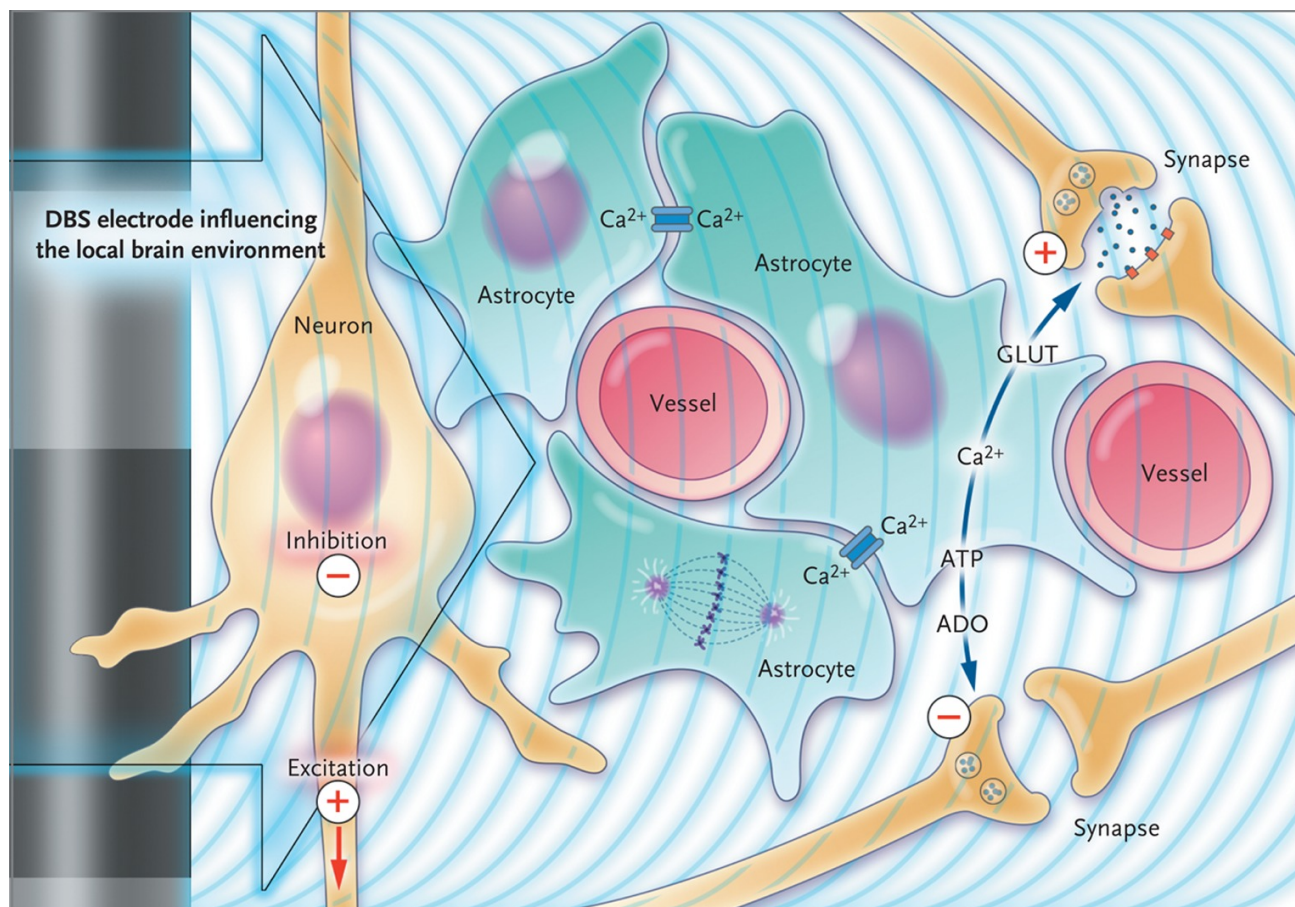


Who Can It Help?

- Confirmed Diagnosis Parkinson's Disease
- Responding to L-Dopa with side effects
- Absence of Dementia
- No Untreated Depression



How Does it Work?



What is the Goal?

Table 2. Patient Motor Diaries

Time	N
On, h/d ^b	
Without troublesome dyskinesia	
With troublesome dyskinesia	
Off, h/d ^b	
Asleep, h/d	

Abbreviation: CI, confidence interval
^aTest for the change scores from baseline
^b"On" and "off" time are described in minutes

Bilateral Deep Brain Stimulation vs Best Medical Therapy for Patients With Advanced Parkinson Disease: A Randomized Controlled Trial

Frances M. Weaver, PhD
 Kenneth Follett, MD, PhD
 Matthew Stern, MD
 Kwan Hur, PhD
 Crystal Harris, PharmD
 William J. Marks Jr, MD
 Johannes Rothlind, PhD
 Oren Sagher, MD
 Domenic Reda, PhD
 Claudia S. Moy, PhD
 Rajesh Pahwa, MD
 Kim Burchiel, MD
 Penelope Hogarth, MD
 Eugene C. Lai, MD, PhD
 John E. Duda, MD
 Kathryn Holloway, MD
 Ali Samii, MD
 Stacy Horn, DO
 Jeff Bronstein, MD, PhD
 Gatana Stoner, RN, CCRC
 Jill Heemskerk, PhD
 Grant D. Huang, PhD
 for the CSP 468 Study Group

DEEP BRAIN STIMULATION IS the surgical intervention of choice when Parkinson disease (PD) motor complications are inadequately managed with

Context Deep brain stimulation is an accepted treatment for advanced Parkinson disease (PD), although there are few randomized trials comparing treatments, and most studies exclude older patients.

Objective To compare 6-month outcomes for patients with PD who received deep brain stimulation or best medical therapy.

Design, Setting, and Patients Randomized controlled trial of patients who received either deep brain stimulation or best medical therapy, stratified by study site and patient age (<70 years vs ≥70 years) at 7 Veterans Affairs and 6 university hospitals between May 2002 and October 2005. A total of 255 patients with PD (Hoehn and Yahr stage ≥2 while not taking medications) were enrolled; 25% were aged 70 years or older. The final 6-month follow-up visit occurred in May 2006.

Intervention Bilateral deep brain stimulation of the subthalamic nucleus (n=60) or globus pallidus (n=61). Patients receiving best medical therapy (n=134) were actively managed by movement disorder neurologists.

Main Outcome Measures The primary outcome was time spent in the "on" state (good motor control with unimpeded motor function) without troubling dyskinesia, using motor diaries. Other outcomes included motor function, quality of life, neurocognitive function, and adverse events.

Results Patients who received deep brain stimulation gained a mean of 4.6 h/d of on time without troubling dyskinesia compared with 0 h/d for patients who received best medical therapy (between group mean difference, 4.5 h/d [95% CI, 3.7-5.4 h/d]; *P* < .001). Motor function improved significantly (*P* < .001) with deep brain stimulation vs best medical therapy, such that 71% of deep brain stimulation patients and 32% of best medical therapy patients experienced clinically meaningful motor function improvements (≥5 points). Compared with the best medical therapy group, the deep brain stimulation group experienced significant improvements in the summary measure of quality of life and on 7 of 8 PD quality-of-life scores (*P* < .001). Neurocognitive testing revealed small decrements in some areas of information processing for patients receiving deep brain stimulation vs best medical therapy. At least 1 serious adverse event occurred in 49 deep brain stimulation patients and 15 best medical therapy patients (*P* < .001), including 39 adverse events related to the surgical procedure and 1 death secondary to cerebral hemorrhage.

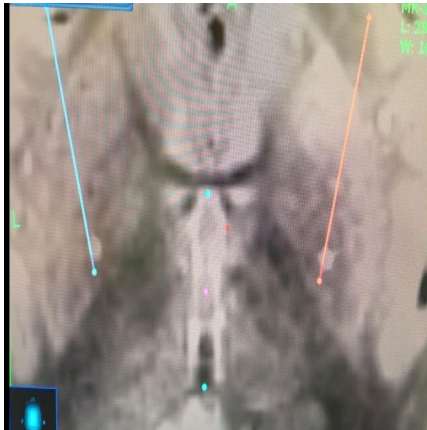
Conclusion In this randomized controlled trial of patients with advanced PD, deep brain stimulation was more effective than best medical therapy in improving on time without troubling dyskinesias, motor function, and quality of life at 6 months, but was associated with an increased risk of serious adverse events.

Best Medical Therapy Minus Deep Brain Stimulation	
Mean Difference (95% CI)	<i>P</i> Value ^a
-4.5 (-5.4 to -3.7)	<.001
2.3 (1.5 to 3.2)	<.001
2.5 (1.7 to 3.2)	<.001
-0.1 (-0.6 to 0.4)	.66

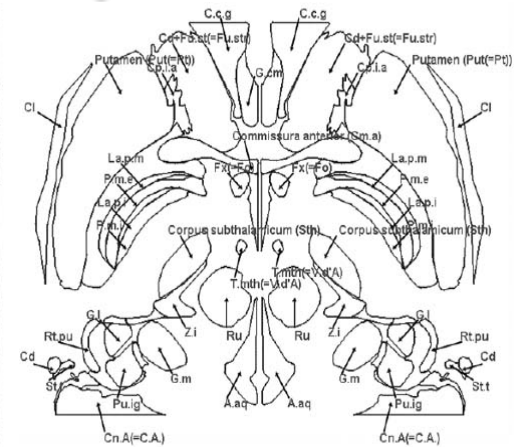
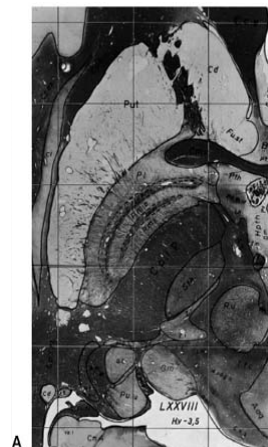
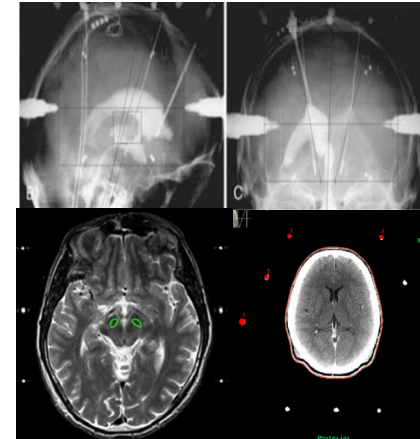
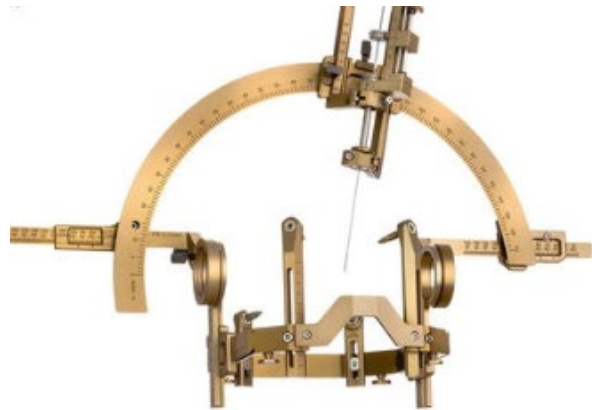
What Are The Risks



- Hemorrhage(<2%)
- Infection(2-3%)
- Seizure(1%)
- Hardware malfunction(2-3%)
- Stimulation side effects
 - Motor
 - Cognitive
 - Depression/Anxiety
 - Speech
 - Balance



Stereotactic Technique



“Millimeters Matter.”

**Stereotactic
and Functional
Neurosurgery**

Clinical Study

Stereotact Funct Neurosurg 2009;87:297-303
DOI: 10.1159/000230692

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Published online: July 29, 2009

Surgical Repositioning of Misplaced Subthalamic Electrodes in Parkinson's Disease: Location of Effective and Ineffective Leads

R. Mark Richardson^a Jill L. Ostrem^b Philip A. Starr^a

Departments of ^aNeurological Surgery and ^bNeurology, University of California, San Francisco, Calif., USA

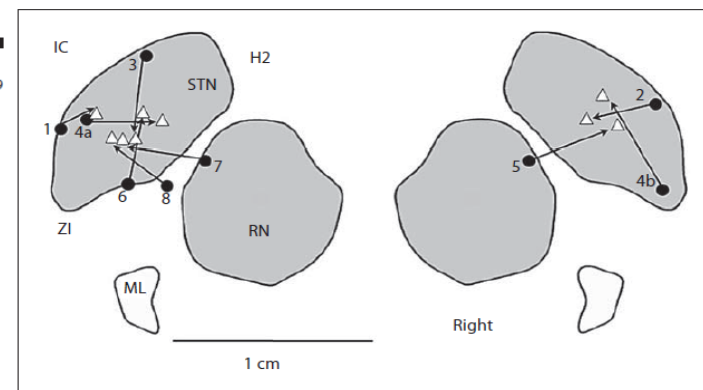
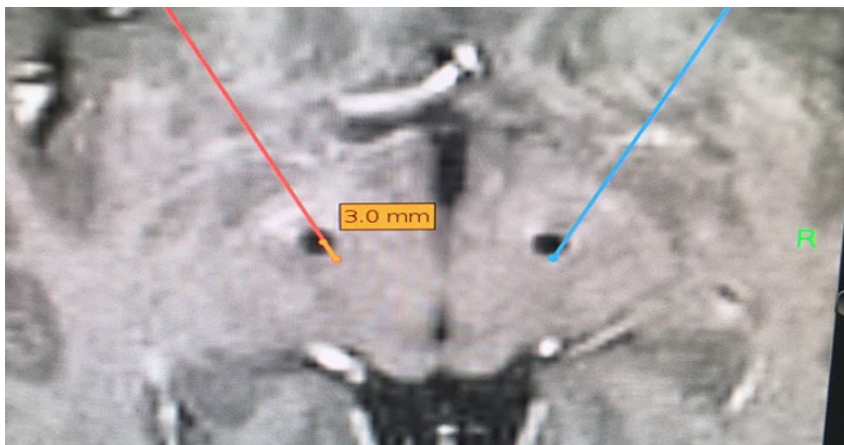
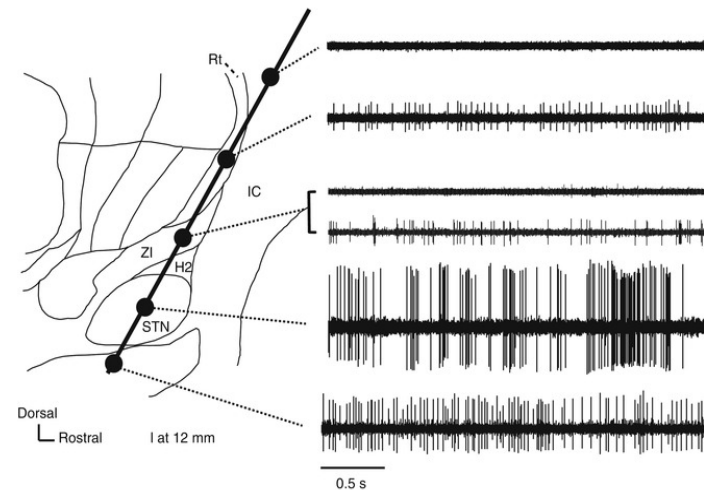
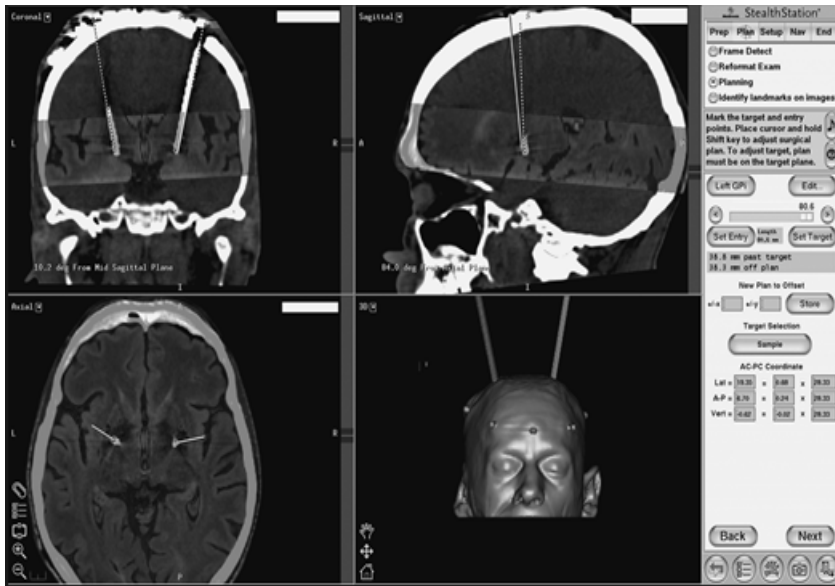


Table 2. Coordinates of original and repositioned leads with respect to the midcommissural point

Case No.	Lead location in the -4 mm vertical plane				Active contact coordinates of revised leads		
	original		revised		lateral	antero-posterior	vertical
	lateral	antero-posterior	lateral	antero-posterior			
1	-14.2	-1.6	-12.2	-0.6	-12.9	0.2	-2.8
2	14.3	-1.3	10.4	1.3	10.5	-1.6	-5
3	-10.1	-1.6	-10.8	-5.2	-10.3	-4.7	0.9
4a	-12.9	-2.5	-9.2	-2.5	-9.7	0.2	-1.0
4b	12.5	-5.2	-9.5	-0.1	9.8	0.1	-3.5
5	8.1	-4.1	11.6	-2.5	14.6	-1.3	-2.6
6	-11.4	-4.0	-10.7	-1.3	-11.2	0.2	-3.8
7	-7.1	-7.1	-11.2	-5.1	-11.4	-0.7	1.0
8	-7.9	-6.0	-11.7	-3.1	-12.5	-3.3	-1.9
Mean	11.0	-3.7	10.8	-2.5	11.4	-1.2	-2.1
SD	2.8	2.1	1.0	1.9	1.6	1.7	2.0

Confirmation: Anatomic or Physiologic

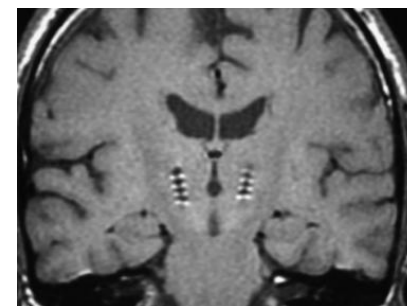


Asleep Techniques

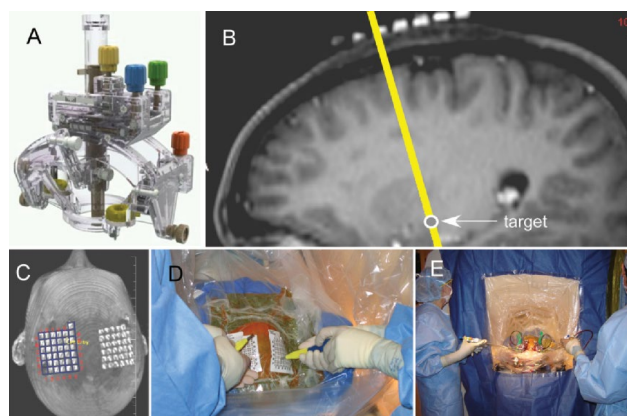
- CT Verified
 - Intraoperative CT



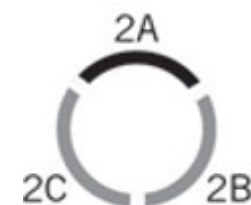
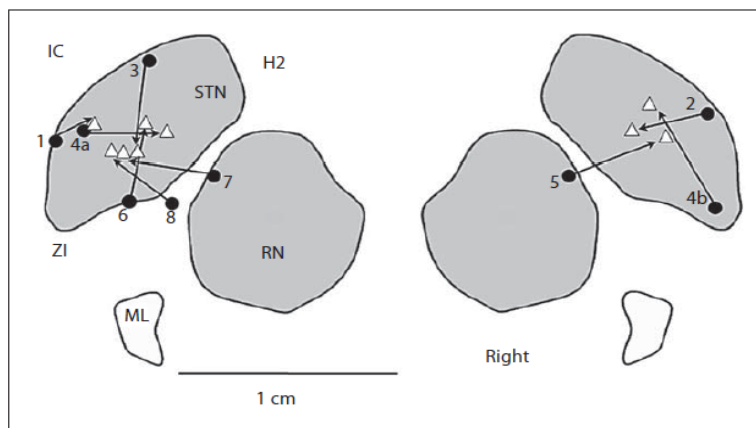
- MRI Verified
 - MRI prior to reversal of anesthesia




- MRI Guided
 - ClearPoint

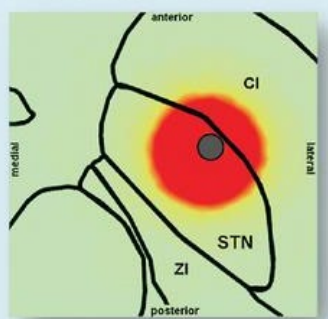



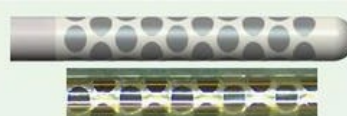
Directional Leads



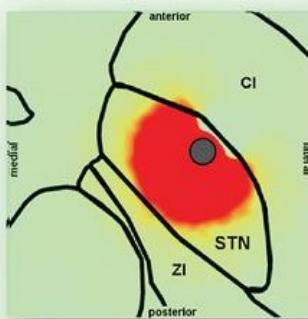



4 annular contacts



40 contacts, fully configurable

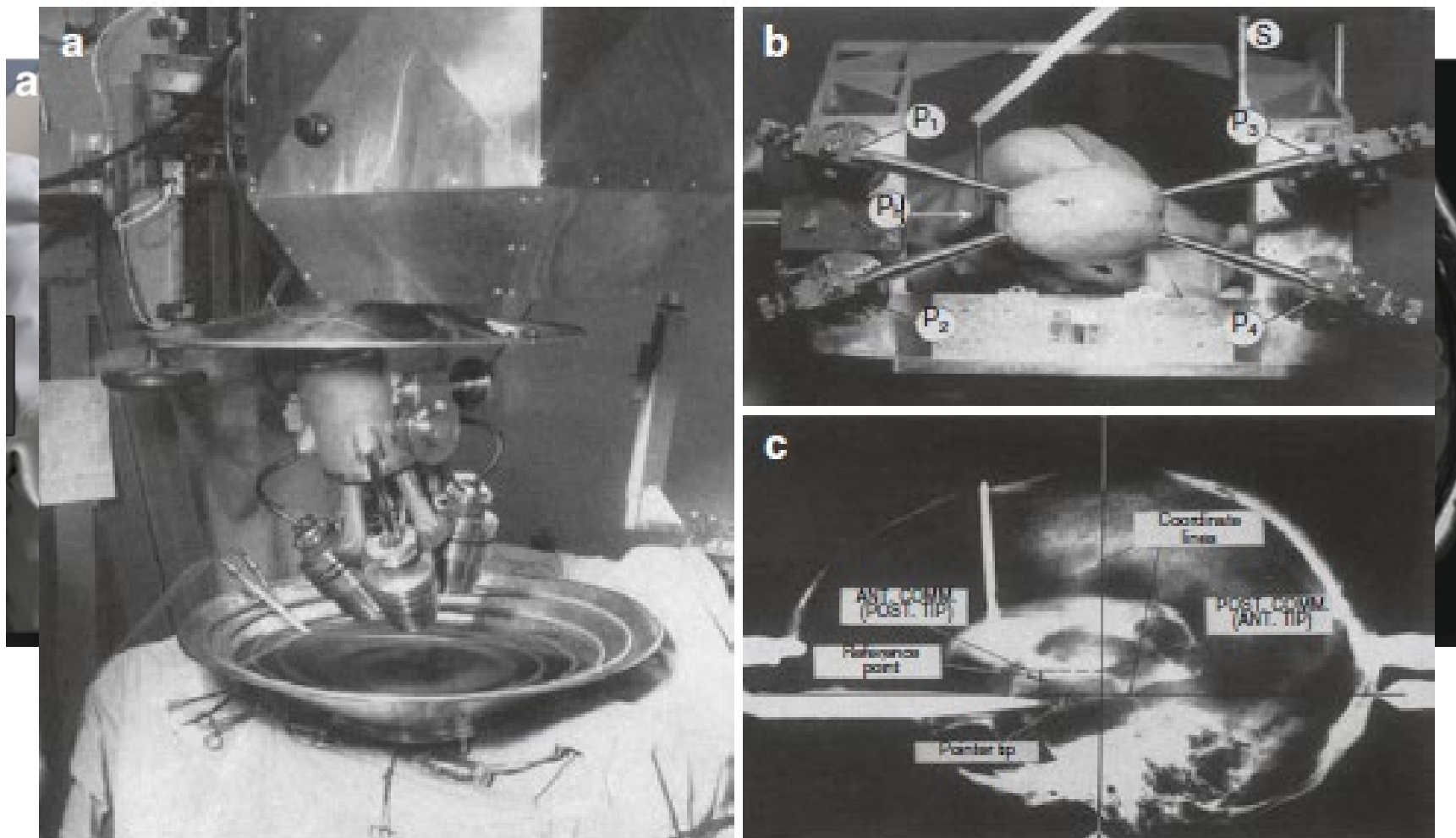





Future of DBS

- Closed-loop stimulation
- High resolution electrodes
- Miniaturization

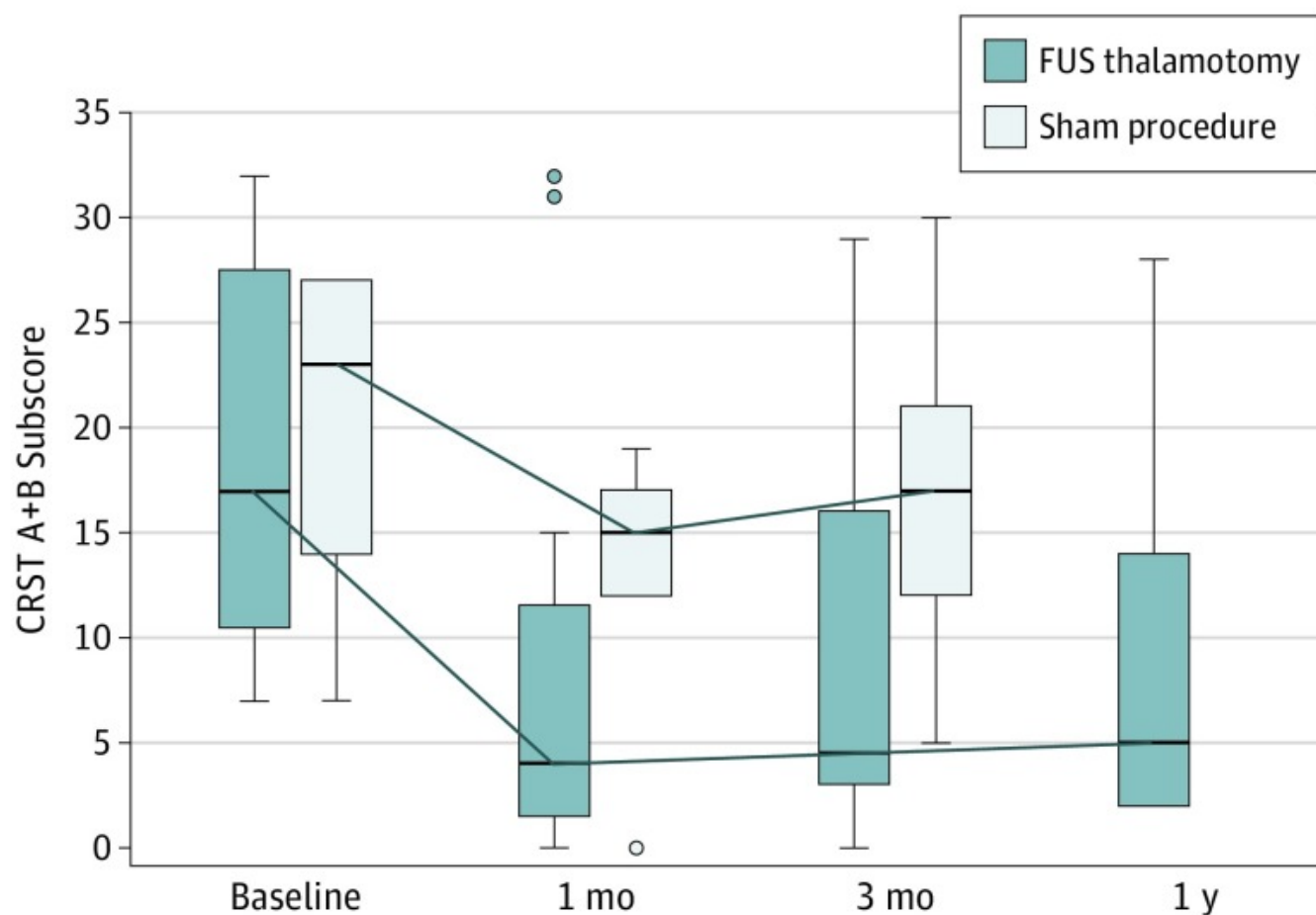
MR Guided Focus Ultrasound



Safety and Efficacy of Focused Ultrasound Thalamotomy for Patients With Medication-Refractory, Tremor-Dominant Parkinson Disease

A Randomized Clinical Trial

Aaron E. Bond, MD, PhD; Binit B. Shah, MD; Diane S. Huss, DPT, NCS; Robert F. Dallapiazza, MD, PhD; Amy Warren, MS; Madaline B. Harrison, MD; Scott A. Spering, PsyD; Xin-Qun Wang, MS; Ryder Gwinn, MD; Jennie Witt, MD; Susie Ro, MD; W. Jeffrey Elias, MD



Convection Enhanced Delivery

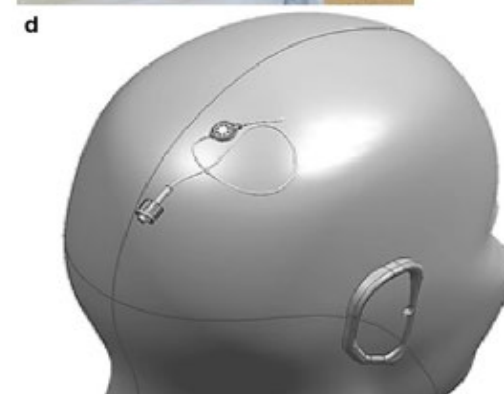
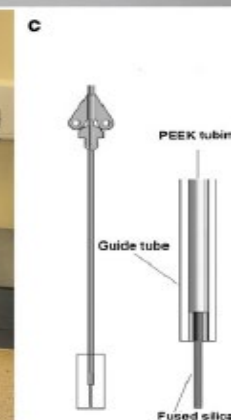
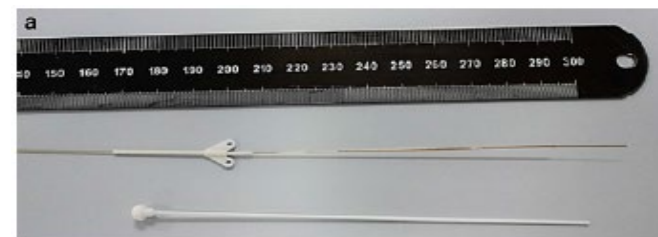
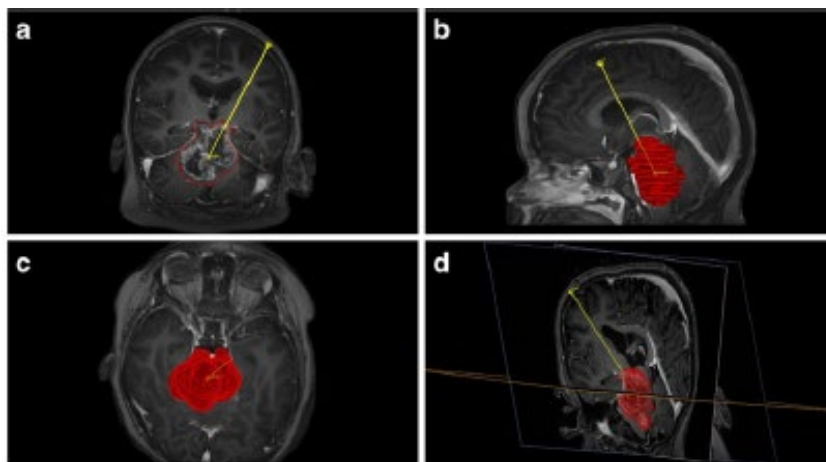
Acta Neurochir (2013) 155:1459–1465
 DOI 10.1007/s00701-013-1700-6

TECHNICAL NOTE - PEDIATRICS

Robot-guided convection-enhanced delivery of carboplatin for advanced brainstem glioma

N. U. Barua · S. P. Lewis · M. Woolley · S. O'Sullivan ·
 R. Harrison · S. S. Gill

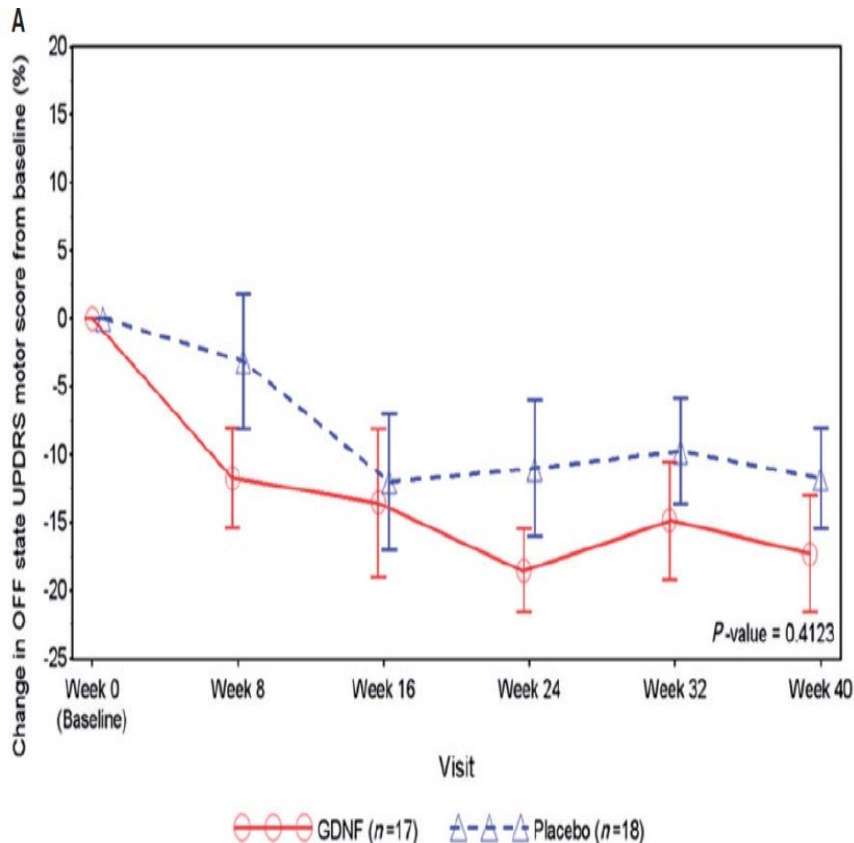
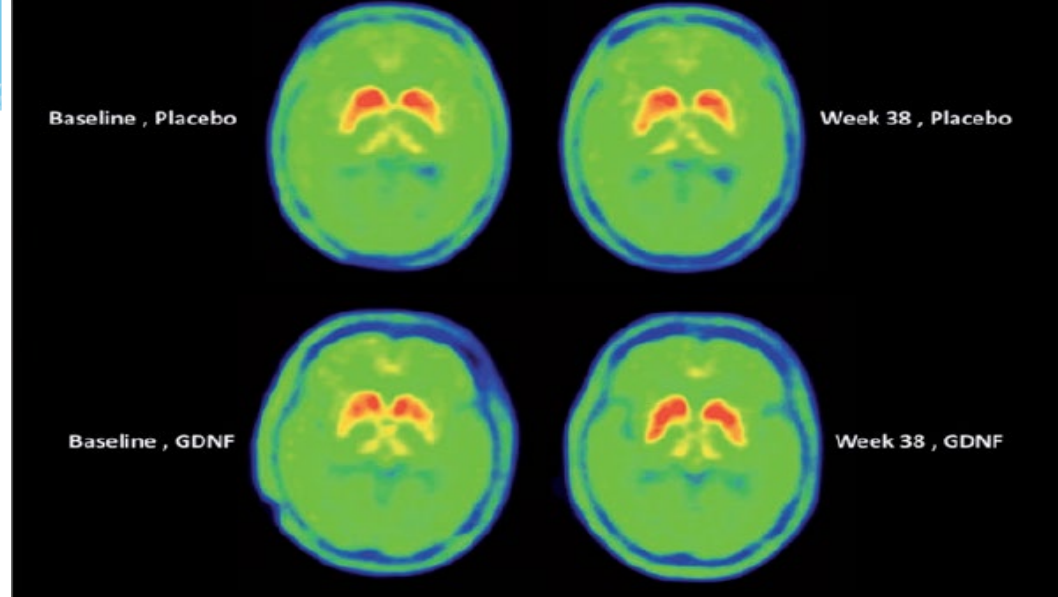
Received: 7 January 2013 / Accepted: 25 March 2013 / Published online: 18 April 2013
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CLINICAL TRIAL

Randomized trial of intermittent intraputamenal glial cell line-derived neurotrophic factor in Parkinson's disease

Alan Whone,^{1,2} Matthias Luz,³ Mihaela Boca,² Max Woolley,⁴ Lucy Mooney,² Sonali Dharia,² Jack Broadfoot,² David Cronin,² Christian Schroers,² Neil U. Barua,² Lara Longpre,³ C. Lynn Barclay,³ Chris Boiko,³ Greg A. Johnson,³ H. Christian Fibiger,³ Rob Harrison,⁴ Owen Lewis,⁴ Gemma Pritchard,⁴ Mike Howell,⁴ Charlie Irving,⁴ David Johnson,⁴ Suk Kinch,⁴ Christopher Marshall,⁵ Andrew D. Lawrence,⁶ Stephan Blinder,⁷ Vesna Sossi,⁷ A. Jon Stoessl,⁸ Paul Skinner,⁴ Erich Mohr³ and Steven S. Gill^{2,4}



A

Implanted catheters with in-line bacteria and particle filters

Transcutaneous port with mounted 4-line drug application set with in-line bacteria, air and particle filters

Drug delivery system used in study

B

Skull-mounted port

C

Gadolinium test infusion

D

Patient receiving infusion

E

GDNF study Infusion suite

