Deep Brain Stimulation

ศรัณย์ นันทอารี

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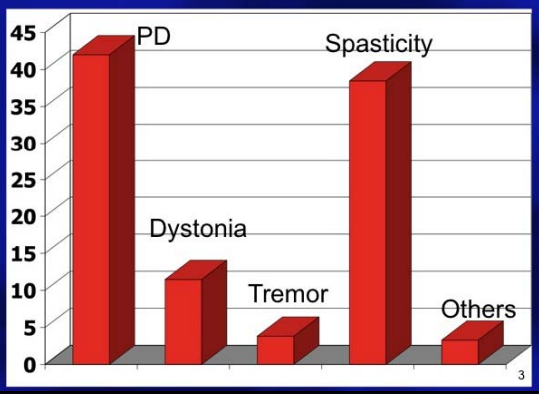
- Parkinson's disease
- Dystonia
- Nonparkinsonian tremor
- Other rare or less clarified indications

>200 patients in the last 9 years



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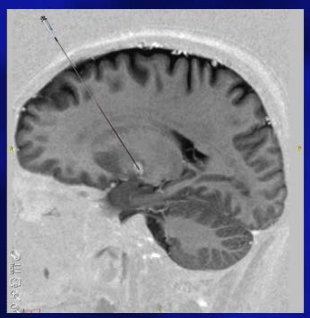
Surgical options

- Ablation
- Deep brain stimulation (DBS)
- Other less effective or ongoing research treatments
  - •Gene therapy
  - •Cell transplantation
  - •Intracranial GDNF infusion
  - •Motor cortex stimulation

Ablation

Thalamotomy

Pallidotomy



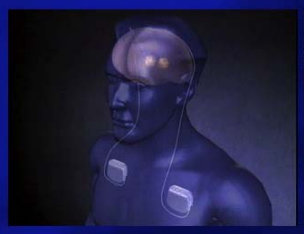
DBS vs Ablation

DBS

- •Permit bilateral procedure
- •Reversible
- •Postop management
- •Device related complications

HIGH COST

Deep Brain Stimulation (DBS)



Stimulation by frequency higher than neuronal firing will give suppression effect, not stimulation

1. Parkinson's Disease

Long Term Complications of L-dopa

- Motor fluctuation *
  1. Wearing-off phenomenon
  2. On-Off phenomenon
- Dyskinesias *
  1. Chorea
  2. Dystonia
- Mental status changes
  1. Confusion
  2. Visual hallucinations
  3. Psychosis

Long-term Complications of L-dopa

OFF time
Parkinsonism

ON time
Dyskinesia

History of treatment

Before 1950s- no effective treatments

↓

1950s- Thalamotomy era

↓

1960s- Levo dopa era, end of surgery

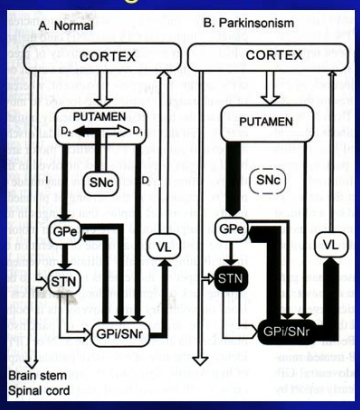
↓

1990s-witness long term complication of L-dopa, resurgence of surgery: pallidotomy

↓

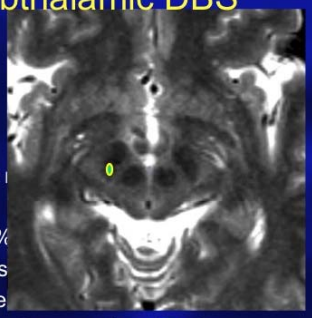
2000s-Subthalamic nucleus stimulation

Rating model of PD



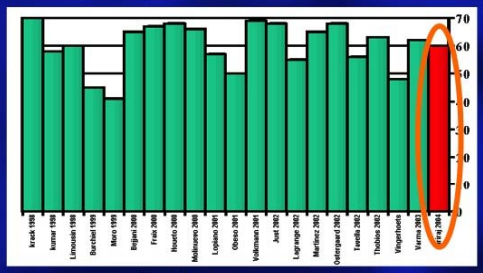
DeLong MR; Trends Neurosci 13:281-285,1990

Bilateral Subthalamic DBS



- Target: dorsolateral STN
- All cardinal features of PD
- "Off" UPDRS improve 60%
- Increase "on" time 6 hours
- Reduce medication require
- Reduce dyskinesia 74% by decreased medication

Siriraj long-term STN outcomes



- Improved "Off" time motor score 60%
- 33% medication reduction
- 13% of cases could stop all medication

Nunta-aree S, J Med Assoc Thai 2010; 93:529-39.

JAMA The Journal of the American Medical Association

Class 1

Bilateral Deep Brain Stimulation vs Best Medical Therapy for Patients With Advanced Parkinson Disease

A Randomized Controlled Trial FREE

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, b

JAMA. 2009;301(1):63-73.

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The NEW ENGLAND JOURNAL of MEDICINE

Class 1

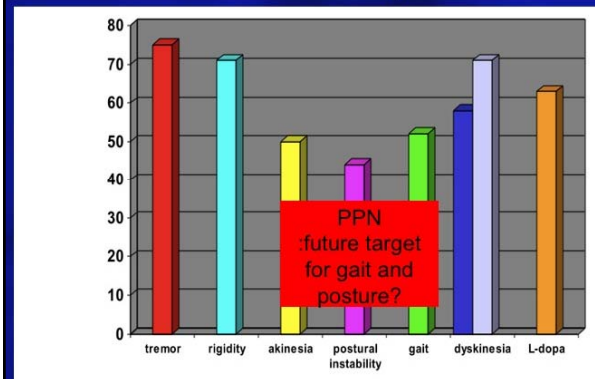
Neurostimulation for Parkinson's Disease with Early Motor Complications

CONCLUSIONS

Subthalamic stimulation was superior to medical therapy in patients with Parkinson's disease and early motor complications. (Funded by the German Ministry of Research and others; EARLYSTIM ClinicalTrials.gov number, NCT00354133.)

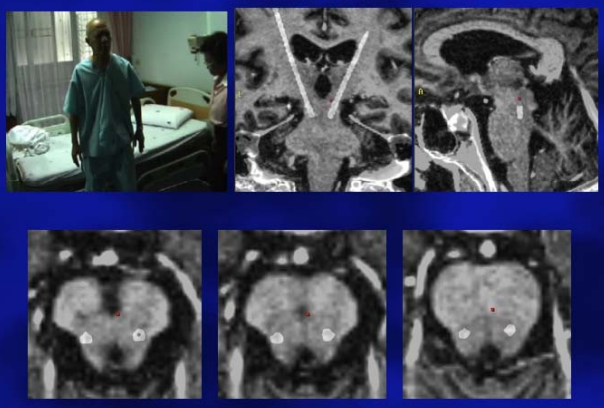
N ENGL J MED 368;7 NEJM.ORG FEBRUARY 14, 2013

Results at 5 years



N Engl J Med 2003;349: 1925-1934

PPN-DBS



25 Hz PPN-DBS for gait disturbance

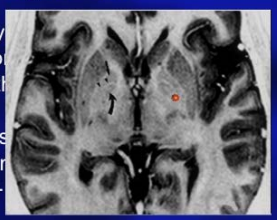
preop postop

2. Dystonia

DBS for Dystonia

- General or segmental dystonia
- Selected cases of focal dystonia
  - Cranio-cervical dystonia (Meige synd)
  - Complex cervical dystonia
  - Task-specific focal hand dystonia

Surgery for dystonia



- Target: uncertain, recently (Vo may better than GPi fo STN may be combined wit
- Many reports show impres surgery in patients with pri dystonia, especially DYT-
- Surgical outcomes in secondary dystonia are more variable and less conclusive than primary dystonia
- In contrast with PD, no challenge test for dystonia to predict surgical outcomes

NonDYT-1 Primary General Dystonia

preop

2 mo postop

Delay & gradual improvement

1 mo postop

2 mo postop

Class 1

The NEW ENGLAND JOURNAL of MEDICINE

DBS for Primary General Dystonia

Randomized controlled trial of DBS vs.sham stimulation for primary dystonia

- Improvement 40% in stimulation group vs 5% in sham-stimulation group

N Engl J Med 2006; 355(19):1978

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DBS for Primary General Dystonia

French multicentre trial of DBS for primary general dystonia showed improvement of 51% at 1 year. One third of patients improved more than 75%. (N=22)

N Engl J Med. , 2005, 352(5):459-467

The improvement in this cohort maintained in 3 years follow-up.

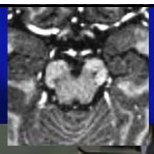
Lancet Neurol. , 2007, 6:223-229

Siriraj Outcomes of Primary dystonia

- Mean improvement of BFMDRS 71%
- Craniocervical symptom, such as facial contraction, spasmodic dysphonia, and laryngopharyngeal dystonia, which were not improve in PD, improved very well in dystonia.
- Mobile type and segmental type got the fastest improvement and the best outcomes

Cranio-cervical dystonia

Mobile dystonia
Fast improvement



preop postop

Mobile dystonia
Fast improvement

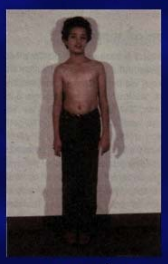
preop A few days postop

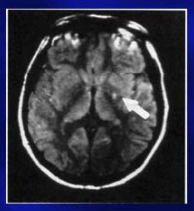
Mobile dystonia
Fast improvement

preop 1 day postop

Cerebral Palsy

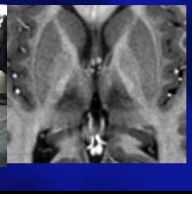
There were reports of dystonic CP could improve by pallidotomy





preop postop

3 of 4 cases of secondary dystonia from cerebral palsy failed to improve



Bruton agammaglobulinemia

Siriraj outcomes of Secondary dystonia

- Various response.
- Mean Improvement of BFMDRS 30%
- DBS was much better than pallidotomy

; need a larger pallidotomy than for P.D.??

Possible predictive factors

- Primary segmental 82%
- Primary mobile 75%
- Primary general 20%
- Tardive 97%
- Dominant bulbar symptom

GOOD

- Hallervorden-Spatz
- Stroke 100%
- Traumatic 47%
- Hemidystonia

MAY BE GOOD

- Infection 0%
- Huntington 0%
- CP 0%

POOR

3. Tremor

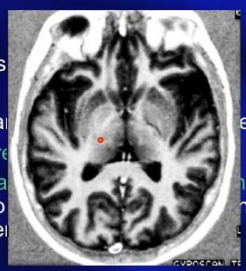
Resting tremor

Postural tremor

Intention tremor

Surgery for Tremor

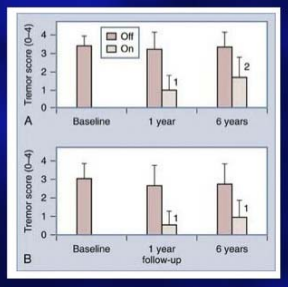
- Target: Vim (Vop and occas
- Thalamic procedures appea es,
  resting tremor > postural tr
  distal limb tremor > proxima or
  (some suggests to target Vo nd
  taget Zi for proximal limb tre
- Thalamic surgery makes immediate improvement in contralateral tremor



Thalamic surgery makes immediate tremor improvement

DBS for essential tremor

Multicentre European study
: sustained improvement after 6 years



action tremor

postural tremor

J Neurol Neurosur Psychiatry. 2003;74:1387-1391

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Essential tremor

5. Rare or unclarified indications

- Hemiballism
- Tourette syndrome
- Tardive disorders
- Chorea
- etc

Hemiballism

preop

postop

1 DBS = 860,000 Bath !!

Average Thai income = 150,000 Bath/ year
impossible for most patients

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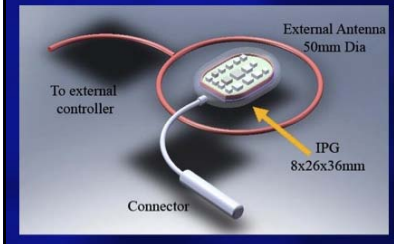
Made by Mahidol University



ดร เซ็ง มโนรัตน์
คณะวิศวกรรมศาสตร์ ม.มหิดล

Other Neuromodulations

- Major depression
- Obsessive compulsive disorder
- Tourette syndrome
- Epilepsy
- Minimally conscious state
- Obesity
- Cluster headache
- Chronic pain
- Central apnea

Novel Technologies

- "Smart" Systems for On-Demand Pacing
  - Neuropace™
    - Medically-refractory epilepsy
    - Implantation of depth & cortical electrodes
    - Detects abnormal brain activity
    - Responds by delivering stimulation prior to sz-onset
    - Multi-center, FDA-approved, industry-sponsored
- Such a closed-loop stimulation may
  - Improve results by delivering therapy only when needed
  - Decrease demands on stimulation systems
    - Q: Development of seizure prediction algorithms?
    - Q: Intervene with stimulation or drug → seizure aborted?

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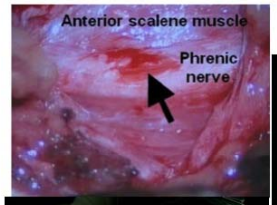
Phrenic Nerve Stimulation



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Auditory Brainstem Implant

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