Combined thalamic and Subthalamic nucleus stimulation in Parkinson Disease

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Background

Deep brain stimulation (DBS) is an FDA approved therapy for the symptomatic treatment of movement disorders including essential tremor, Parkinson's disease, and dystonia. Effective treatment depends upon patient selection, the appropriate selection of the target for stimulation, and post-operative programming. Typically, patients will have electrodes placed into a single unilateral target for unilateral symptoms and a single target bilaterally for bilateral symptoms. In this report, we present two PD patients who have been implanted with three electrodes representing a single unilateral target, the VIM of the thalamus to control tremor, and a single bilateral target, the subthalamic nucleus STN, to control the progressive parkinsonian symptoms.

Clinical Details

One patient with idiopathic PD initially had good response to unilateral tremor with a left ViM thalamic lead, subsequently developed severe left-sided dyskinesias and underwent right STN lead placement with good response. Ten years after his initial surgery the patient had progressive right sided dyskinetic side effects and motor fluctuations on his right and underwent left STN placement. Interestingly, the patient had significantly better symptom control with all three leads activated. A second PD patient underwent right ViM placement for tremor symptoms, followed by left STN placement for bradykinetic symptoms. She developed worsening left sided bradykinesia and rigidity and a right STN lead was added. Similarly, this patient's symptoms have been well controlled with all three leads activated.

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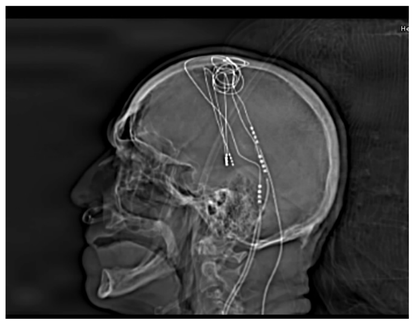
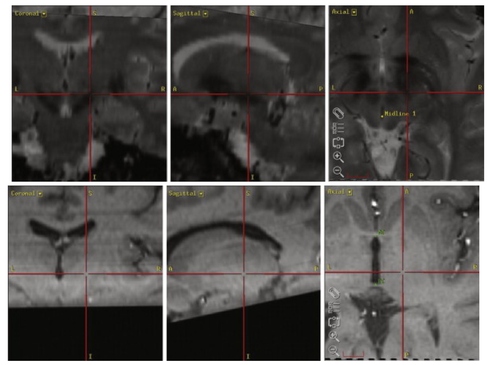
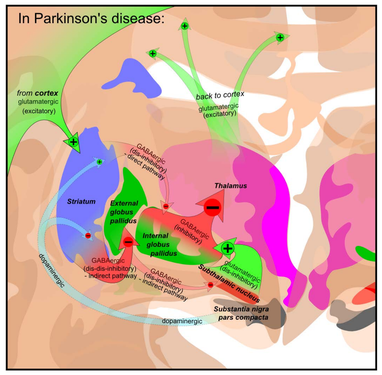
Surgical considerations with multiple target DBS



Lateral plain film demonstrating bilateral STN and left thalamic leads and extensions

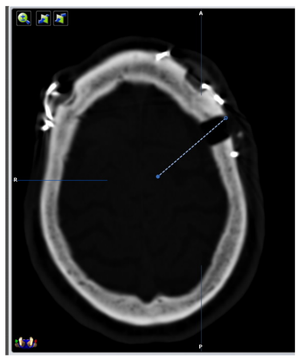


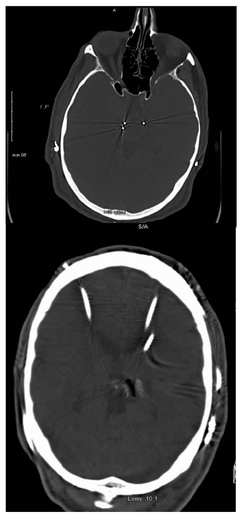
Coronal, sagittal and axial views of STN and Vim targets on MRI



Parkinson Disease connectivity map

Burr hole and planned trajextory for Left STN lead in patient with existing Right STN and left thalamic leads





Axial CT scans showing course and targets of three leads

Target	Lateral (x) to MCP	Ant/post (y) to MCP	Vertical (z) to MCP
Vim	.55 AC-PC length	.25 AC-PC length	0
STN	12mm	3mm posterior	4mm below

Technical difficulties…

- Accurate implantation in patients with ipsilateral existing, functional hardware
- Location/placement of multiple generators
- Tunneling/securing multiple lead extensions
- Goal should be to first not disrupt an existing, effective system

Conclusions

- Movement disorders involve the interaction of multiple independent circuits within the BG
- These cases demonstrate that dysfunction within these circuits may be effectively treated with DBS at different targets depending on the clinical presentation
- Stimulation of new targets does not necessarily replace effective stimulation at existing targets and can provide additional therapeutic imrovements.

Future of multi-target DBS

- Hardware must evolve for ease of implantation in more complex cases
- Evaluation of role for multiple target implantation in younger patients earlier in disease course
- Continued basic science research into cellular mechanisms underlying effects of DBS