The Differential Effect of Deep Brain Stimulation on Oculomotor Function in Parkinson's Disease Patients with STN or GPi Implants

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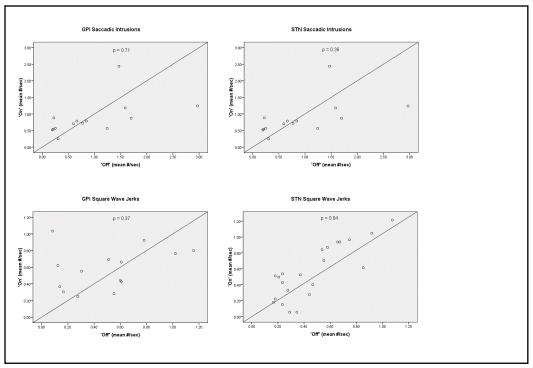
Introduction

Deep brain stimulation (DBS) of the globus pallidus interna (GPi) or subthalamic nucleus (STN) is an effective treatment for Parkinson's disease (PD), but differences in how each target affects basal ganglia circuits is poorly understood. While the STN and GPi are both components of the somatomotor circuit, only the STN is known to directly interact with the oculomotor loop. To test the hypothesis that anatomic segregation of functional loops in the basal ganglia is relevant to the mechanism of DBS, we measured the impact of GPi or STN stimulation on somatomotor and oculomotor function in PD patients.



Methods

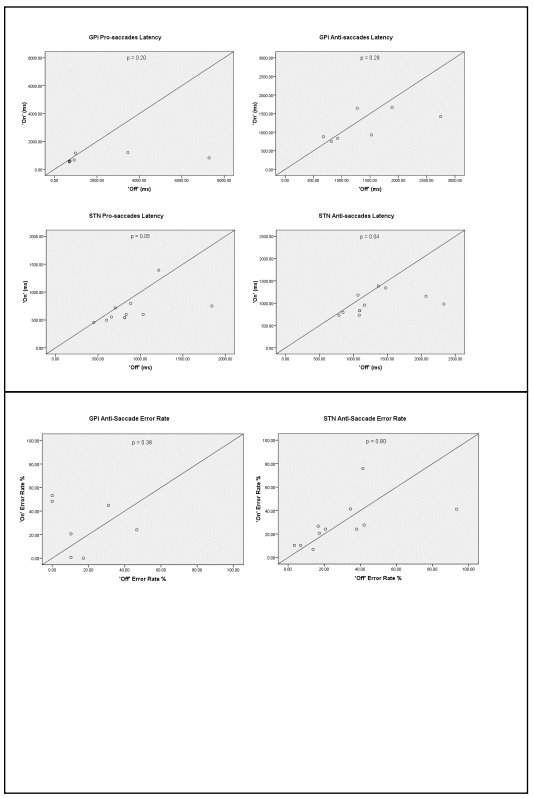
Nineteen PD patients with bilateral implants (8 GPi, 11 STN) were studied. Testing was performed with stimulation on, then off. Somatomotor function was tested using the UPDRS motor exam. For oculomotor testing, patients performed pro - and anti-saccade tasks while monitored with an infrared eye-tracker.

Results

UPDRS part III scores improved with both GPi and STN stimulation, with no significant difference in improvement between the two targets. For GPi patients, the mean number of saccadic intrusions/sec and square-wave jerks (SWJ)/sec during the fixation interval, as well as the latency and error rates during the pro- and anti-saccade tasks, were not significantly different with stimulation either on or off. However, for STN patients there was a significant increase in the mean number of SWJ/sec(p=0.04), and a significant decrease in latency for both pro - and anti-saccade tasks (p=0.05 and p=0.04 respectively) with stimulation versus without.

Conclusions

Stimulation of both GPi and STN similarly improved somatomotor function, but only stimulation of the STN resulted in significant changes in oculomotor function. This finding is an important physiological corroboration of the anatomical and functional segregation of basal ganglia circuitry, and suggests that target choice may have important implications in how DBS affects functions beyond the somatomotor loop.



Learning Objectives

By the conclusion of this session, participants should be able to 1) Describe the importance of understanding underlying basal ganglia functional anatomy with regard to DBS target selection, 2)Discuss, in small groups, the potential value of oculomotor testing for in Parkinson's disease patients to determine surgical treatment efficacy, 3)Identify which Parkinson's disease DBS target is most likely to affect both oculomotor and somatomotor basal ganglia loops