

[S19.003] The Effects of Subthalamic Nucleus Deep Brain Stimulation on Vocal Tract Dynamics in Parkinson's Disease. American Academy of Neurology 04/01/03

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OBJECTIVE: Speech motor control and voice production remain a significant issue where STN DBS is used in managing parkinsonism. The purpose of the present study is to determine the effects of DBS on speech and vocalization using objective measures of (1) orofacial muscle force dynamics and stiffness, and (2) speech aerodynamics.

BACKGROUND: Speech motor control and voice production remain a significant issue today where STN DBS is used in managing parkinsonism. Benabid et al. (2000) report 20% of their STN DBS patients manifest significant hypophonia, rendering the PD patient unintelligible. It might be that the patient, as far as the hypophonia is concerned, is not medically treated because of the significant reduction of drug doses and is not surgically treated because of the nonplacement of the electrode into the STN area mapped for voice and speech control (Benabid et al., 2000). Therefore, methods are needed to assess vocal tract physiology in these patients to alleviate the residual symptoms known as hypophonia and dysarthria.

DESIGN/METHODS: Twenty patients with idiopathic PD underwent bilateral STN DBS implantation. The vocal tract protocols were administered pre- and post-operatively with the Medtronic Soletral stimulator switched 'ON' and 'OFF', in combination with meds 'ON' and 'OFF.' Measures of laryngeal airway resistance were obtained during repetition of syllables and words. Perioral stiffness was assessed using a linear servo motor to produce sequential lengthening of the perioral tissues totalling 27 millimeters in 9 equal steps. Repeated-measures ANOVA, and regression modeling were used to quantify the patterns of aerodynamic reorganization associated with STN DBS. Lip stiffness coefficients were derived to map changes in perioral force per unit of change in muscle length.

RESULTS: Significant changes were found in the vocal tract aerodynamics and perioral stiffness following DBS implantation. A substantial number of our PD test patients (~30%) manifest deterioration in speech and vocalization in spite of improvement in limb motor control following bilateral STN DBS. Most notably was the reduction in subglottal airway driving pressure, yielding a decrease in laryngeal airway resistance from 35-38 cmH₂O/LPS to values less than 5 cmH₂O/LPS reflecting a 'leaky' laryngeal mechanism. Approximately one-third of the PD test patients showed significant, and occasionally dramatic improvements in vocal tract function. The biomechanical measures of perioral stiffness also yielded significant results as a function of test condition and muscle length.

CONCLUSIONS: Bilateral STN deep brain stimulation produces highly variable results among vocal tract systems, with many patients exhibiting significant impairments in speech and vocalization during STN DBS. Aerodynamic and biomechanical assessments of orofacial and vocal tract muscle systems provides detailed information on neuromotor reorganization among these often overlooked cranial sensorimotor systems.

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