Long term impact of DBS on gait in PD: a Kinematic study

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Introduction

Deep Brain Stimulation (DBS) provides considerable symptomatic relief to patients with Parkinson's Disease (PD). While it is well established that DBS improves tremor, slowness, rigidity, and dyskinesia, its long-term effects on gait are less well understood.

Clinical Significance

Although many studies consider the acute effects of DBS on gait, evidence regarding longitudinal changes in gait is sparser (Collomb-Clerc et al 2015, Cossu et al 2017, Roper et 2016). This study investigates the effect of DBS on gait parameters before and after surgery.

Methods

Database review from our kinematics laboratory between 2015 to 2018 identified 22 patients that had gait parameters measured before and after DBS procedures and at nominal 12-month follow-up. DBS targets were as follows: globus pallidus internus, N=14 (8 unilateral / 6 bilateral); subthalamic nucleus, N = 9 (6 / 3). After excluding incomplete records, data of N=19 PD patients were analyzed.

On two separate visits (pre-surgical and follow-up), each patient was assessed with a full-body 3-dimensional optical motion capture system (Motion Analysis Corporation, Santa Rosa, CA) using a customized configuration of 60 reflective kinematic markers. Patients completed a standardized battery of gait tasks including multiple replicates of self-selected walking over a distance of 4.7 m. Ten standard gait outcomes, including gait speed, step length, and cadence, were extracted from kinematic marker data using OrthoTrack 6.6.0. Other clinical variables including Movement Disorder Society-Unified Parkinson Disease Rating Scale (MDS-UPDRS) and levodopa equivalent doses (LEDD) were also recorded.

Pre-surgical assessments were performed in the "medication on state." Follow-up assessments were performed in the "DBS stimulation on" and "medication on" state. This was expected to simulate a real-world scenario and changes in gait while the patient was on optimal therapy. Statistical significance of changes in study variables over time was assessed with paired t-tests. Type-I error was controlled with a Bonferroni procedure. For visualization of the relative sizes of effects of time on each study variable, changes from pre-surgical to

follow-up were expressed as average differences / standard deviation (referred to as Cohen's *d*; Cohen 1992).

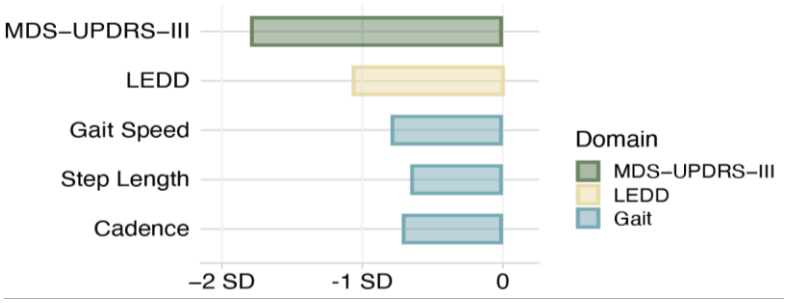

Figure 1. Changes in outcome measures 15.4±4 months after DBS surgery presented as standardized effect sizes.

Results

Average age was 61.2±7.8 years and disease duration, 10.5±3.9 years. Five were female. The average time between pre-surgical and follow-up visits was 15.4±4 months. At follow-up, there were significant reductions in MDS-UPDRS-III "on" state score (13.9±8.6 vs. 19.8±10.7 points, p=0.004) and in LED (942±491 vs. 1437±513 mg, p<0.001), consistent with overall improvement in parkinsonian symptoms. However, there was worsening of gait parameters after DBS surgery when compared to preoperative baseline. There was a significant deficit (reduction) in gait velocity (94±25 vs. 111±21 cm/s; p=0.001). This was not correlated with DBS target location, disease duration, severity of motor symptoms or levodopa dose adjustments. There was also an increase in total support time (p=0.003), double support time (p=0.002) with decrease in cadence (p=0.003), decrease in swing phase (p=0.003) and decrease in single support time (p=0.003). Other gait parameters such as step width, stride length or step length did not show significant changes. Figure 1 demonstrates the pattern of changes in which overall symptom severity and LED improved, but gait measures declined as relative effect sizes.

Discussion

Our study reveals overall worsening gait for in PD patients that have undergone DBS procedures despite improvement in other motor symptoms. A possible explanation may be disease progression given a long period between assessments. Further study is warranted to better understand the efficacy and neurophysiology of DBS and its effect on gait.

References

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Disclosure Statement

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