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Network Influence of the Cerebellum for Predicting DBS Response in Patients with Advanced Parkinson's Disease

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Network Influence of the Cerebellum for Predicting DBS Response in Patients with Advanced Parkinson's Disease

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Introduction: Deep brain stimulation (DBS) is a treatment option for reducing motor symptoms in patients with Parkinson's Disease (PD) when first-line medication becomes ineffective. Existing literature has hypothesized that the clinical outcome of DBS may depend on brain connectivity profiles of the stimulation site to distant brain regions. However, the potential of brain connectivity profiles to predict response to DBS in PD remains unclear.

Objective: This study aimed to investigate how changes in structural and functional connectivity may relate to patient response to DBS, through the examination of brain network changes using graph theory.

Methods: Ten patients with advanced PD were included in this study. Diffusion tensor imaging (DTI) and resting-state fMRI scans were acquired prior to DBS implantation. Pre-DBS and post-DBS UPDRS-III scores were obtained. Network analysis of the DTI and fMRI scans was performed using GRETNA to compute structural and functional graph theory metrics, respectively. Metrics were correlated with UPDRS-III improvement to identify significant correlations to UPDRS improvement due to DBS.

Results: Combined structural and functional graph theory metrics highlighted 32 structures to be significantly correlated with UPDRS-III improvement. Mainly, connections to the cerebellum were found to be significantly correlated with UPDRS-III improvement across several metrics for both structural and functional connectivity.

Discussion: This work combined DTI, fMRI, and graph theory analysis to evaluate improvement with DBS. Several imaging biomarkers were identified that are robust predictors for UPDRS-III improvement. This work warrants investigation into the compensatory effect of the cerebellum and other potential biomarkers for identifying DBS candidates.