SUBTHALAMIC DEEP BRAIN STIMULATION: MAPPING NON-MOTOR OUTCOMES TO STRUCTURAL CONNECTIONS

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INTRODUCTION

- In Parkinson’s disease, deep brain stimulation of the subthalamic nucleus reliably improves motor symptoms, but non-motor outcome is variable.
- Non-motor outcome could be improved by stimulating or avoiding specific brain circuits.
- However, this approach is limited since numerous non-motor symptoms would need to be accounted for.

AIMS

- We aimed to identify key dimensions of neuropsychological and neuropsychiatric outcome.
- We identified the structural connections whose stimulation was associated with these dimensions.
- Finally, we tested whether stimulation of these structural connections could predict individual symptom outcomes.

METHODS

- Patients: 59 Parkinson’s Disease patients, assessed before and 6 months after deep brain stimulation surgery to the bilateral subthalamic nucleus (Brasov, Australia).
- Identification of the main dimensions of non-motor outcomes: Principal Component Analysis (PCA) applied on ten clinical scores assessing changes in cognition, affective behavior, anxiety and mood, impulsivity, and empathy.
- Localization of the DBS electrodes and electric field (E-field) modeling using the Lead-OBS toolbox.
- Structural connectivity analysis: Identification of the fiber tracts whose stimulation was associated with the principal component (PC) scores based on a normative structural connectome (“Fiber-filtering”). Change in LEDD used as a covariate.
- Prediction of individual symptom outcomes based on overlap with the tracts and PCA decomposition.
- Validation in an independent cohort.

RESULTS

- Predictive tracts
- In-sample correlation between overlap with fiber tracts and PC scores
- In-sample correlation with clinical outcomes
- Out-of-sample validation

CONCLUSIONS

- Changes along an extensive neuropsychiatric score battery were mapped to the modulation of four tract bundles in the human brain.
- The degree of modulation of these tracts was able to explain variance in individual symptom outcomes both in-sample and out-of-sample.
- The proposed approach could pave the way towards personalized deep brain stimulation tailored to the patient’s symptoms.

We propose a new approach to map changes along extensive clinical score batteries to the modulation of a small set of fiber tract bundles in the human brain - These tracts might be used to predict and improve the outcome of deep brain stimulation.