Symptom Network Modulation by Deep Brain Stimulation in Obsessive-Compulsive Disorder

1 Introduction

Heterogeneity of symptom presentation in patients with obsessive-compulsive disorder (OCD) is a key source of outcome variability following deep brain stimulation (DBS) [1]. While targeting a dedicated fiber bundle in the internal capsule is successful in “average” patients [2,3,4], personalized treatment may require modulating a blend of multiple symptom tracts [5].

Aim

To segregate the global OCD response tract into a set of subcortical related to improvements of obsessions, compulsions, depression, anxiety, and global functioning.

2 Methods

Patient Cohort

N = 70 OCD patients with bilateral DBS to five different stereotactic targets – anterior limb of the internal capsule (ALIC), bed nucleus of the stria terminalis (BNST), inferior thalamic peduncle (ITP), subthalamic nucleus (STN), & ALIC / STN combined.

Symptom Improvements:

Obsessions vs. compulsions (Yale-Brown Obsessive Compulsive Scale), depression (Beck Depression Inventory / Montgomery Asperg Depression Rating Scale / Hamilton Depression Inventory), anxiety (Hamilton and Beck Anxiety Inventories / state section of the State-Trait Anxiety Inventory), and general level of functionality (Global Assessment of Functioning).

Lead-DBS Based Preprocessing Pipeline [6]: Electrode reconstructions & estimation of local DBS impact (electrical field modeling).

DBS Fiber Filtering [7]: Identification of neuroimage streamlines from a normative group. Connectivity discriminative for beneficial stimulation effects per symptom domain and confirmation of these tract models using in-sample correlations as well as 5-fold cross-validations (CV).

3 Results

Electrode Placement in Multicentric OCD-DBS Patient Cohort

Across variable DBS electrode placements as a function of centers and surgeons (see panel A), therapeutic stimulation effects on global obsessive-compulsive symptomatology converged on a shared prefronto-cortical streamline bundle passing through the ALIC (see panel B, a).

This model showed positive in-sample associations (R = 0.46, p < 1e-16) and was robust to five-fold CV (R = 0.28, p = 0.024).

This global OCD response tract could be segregated into symptom-wise bundles (see panel B, b).

4 Discussion

Presented networks may improve our understanding of the underlying pathophysiology and mechanism of action of DBS attributed to various OCD symptoms.

Further, they may prove valuable in the context of transdiagnostic symptoms or in personalized tailoring of treatment to symptom constellations of individual patients [1,5].

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Just like a prism breaks up the light, DBS can be used as a tool to segregate brain connecting to symptom tracts.