

Connectivity Analysis of Brain Circuits Modulated by Electrical Stimulation of the Ventral Capsule and Ventral Striatum in Patients with Obsessive-Compulsive Disorder

WSSFN 2025 Interim Meeting. Abstract 0043

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How to Cite: Laube K, Iglesias R, Ricci Arantes P, Miguel E, Hoexter M, Junior Gilberto C, et al. Connectivity Analysis of Brain Circuits Modulated by Electrical Stimulation of the Ventral Capsule and Ventral Striatum in Patients with Obsessive-Compulsive Disorder: WSSFN 2025 Interim Meeting. Abstract 0043. NeuroTarget. 2025;19(2):30.

Abstract

Introduction: Deep brain stimulation (DBS) targeting the ventral capsule/ventral striatum (VC/VS) is an emerging treatment for treatment-resistant obsessive-compulsive disorder (OCD). However, approximately 40% of patients fail to achieve significant symptom relief. Variability in clinical outcomes may reflect individual differences in the modulation of neural circuits. This study investigated the neural circuits modulated by VC/VS stimulation and their relationship to treatment response.

Clinical description: Nine patients with treatment-resistant OCD underwent VC/VS DBS at the University of São Paulo between 2016 and 2024. Symptom severity was assessed using the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS) preoperatively and one year postoperatively. Lead localization was reconstructed using Lead DBS 3.0, by co-registering postoperative CT scans with preoperative MRIs in MNI space. The volume of tissue activated (VTA) was estimated for each patient. Imaging preprocessing was performed using FSL; T1-weighted images were co-registered with diffusion tensor imaging (DTI), and probabilistic tractography was performed using each VTA as a seed. Cortical regions were labeled using the Automated Anatomical Labeling 3 atlas.

Results: Five patients were responders, and four were non-responders after one year. Among responders, right-sided VTAs were located more laterally within the anterior limb of the internal capsule (ALIC). Tractography revealed that stimulation consistently engaged fibers projecting to the medial orbitofrontal cortex (mOFC), superior and middle occipital cortices, and anterior thalamic nuclei. **Figure 1:** VTA-activated tract reconstructions to cortical targets using FSL tractography. Left in red, right in blue.

Discussion: VC/VS DBS modulates a distributed network implicated in the pathophysiology of OCD. Notably, enhanced connectivity to the mOFC—a region associated with salience processing and goal-directed decision-making—was observed in all patients. Connectivity with occipital areas

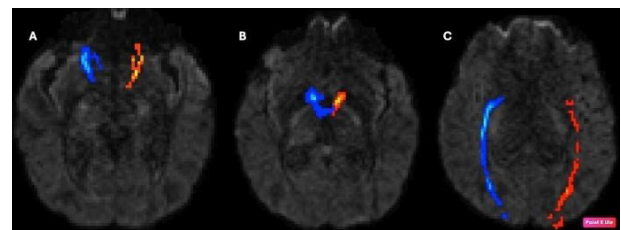


Figure 1: VTA-activated tract reconstructions to cortical targets using FSL tractography. Left in red, right in blue.

may reflect broader engagement of sensory-associative networks, though the functional relevance of this finding remains unclear.

Conclusions: Lateral stimulation within the ALIC is associated with improved clinical response and involved fibers projecting to the mOFC, anterior thalamus and occipital cortex. These findings support the strategy of targeting connectivity informed networks, rather than anatomical sites, to optimize DBS outcomes in OCD.

References

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