Optimization of DBS Based on Structural Brain Connectivity in Pediatric and Adolescent Patients with Inherited and Adquired Dystonia

WSSFN 2025 Interim Meeting. Abstract 0027

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Cómo citar: Marquez Franco R, Loução R, Hagelschuer L, Cid Rodríguez FX, Schmahl R, Andrade P, et al. Optimization of DBS Based on Structural Brain Connectivity in Pediatric and Adolescent Patients with Inherited and Adquired Dystonia: WSSFN 2025 Interim Meeting. Abstract 0027. NeuroTarget. 2025;19(2):12.

Abstract

Introduction: Dystonia in pediatric patients presents unique clinical and neuroanatomical challenges, often involving complex network-level dysfunctions beyond isolated basal ganglia abnormalities.[1] Understanding the structural connectivity differences between acquired and inherited dystonia is essential for the planning of DBS.[2] This study investigates the structural connectivity in inherited and acquired dystonia using quantitative probabilistic tractography and connetomic measurements.

Method: We analyzed 44 pediatric dystonic patients treated with DBS at the University Hospital Cologne. Individualized structural connectivity connectomes matrices were generated with a focus on key motor and associative regions. Comparative analyses were performed between patients with inherited versus acquired dystonia.[3-10]

Results: Preliminary findings reveal that a total of 44 patients were included and 13 presented complete pre- and 12-month postoperative BFMDRS scores. The mean preoperative BFMDRS score was 87.08, and the postoperative score was 73.17, yielding a mean clinical improvement of 13.92 points. Both Wilcoxon ($p = 0.012$) and paired t-test ($p = 0.045$) analyses confirmed a statistically significant reduction in dystonia severity following DBS. Subgroup analysis revealed that patients with inherited dystonia experienced the greatest median clinical improvement. Patients with acquired dystonia exhibited reduced streamline density and fractional anisotropy (FA) in thalamo-cortical and cerebello-thalamic pathways (Wilcoxon $p < 0.05$).

Discussion: A statistically significant reduction in BFMDRS score, suggest efficacy of DBS in the GPi for improving motor symptoms. Especially in pediatric dystonia inherited dystonia compared to acquired dystonia.

Conclusions: This study demonstrates that pediatric dystonia subtypes are associated with distinct patterns of structural brain network disruption. These findings highlight the importance of connectome-based characterization for phenotyping dystonia and optimizing patient-specific DBS targeting. Structural connectivity biomarkers may improve patient selection and predict therapeutic response in children undergoing DBS.

References

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