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Symptom specific tractography correlates with, and can be used to suggest optimal parameters for DBS programming and surgery

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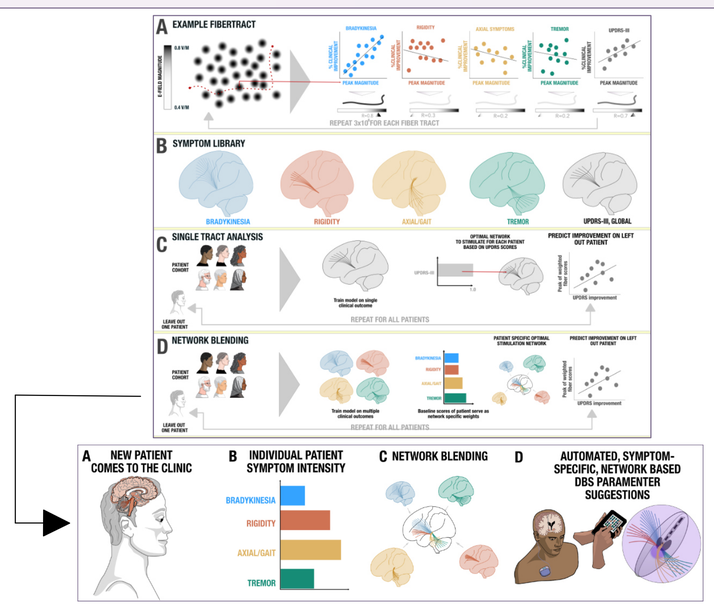
INTRODUCTION

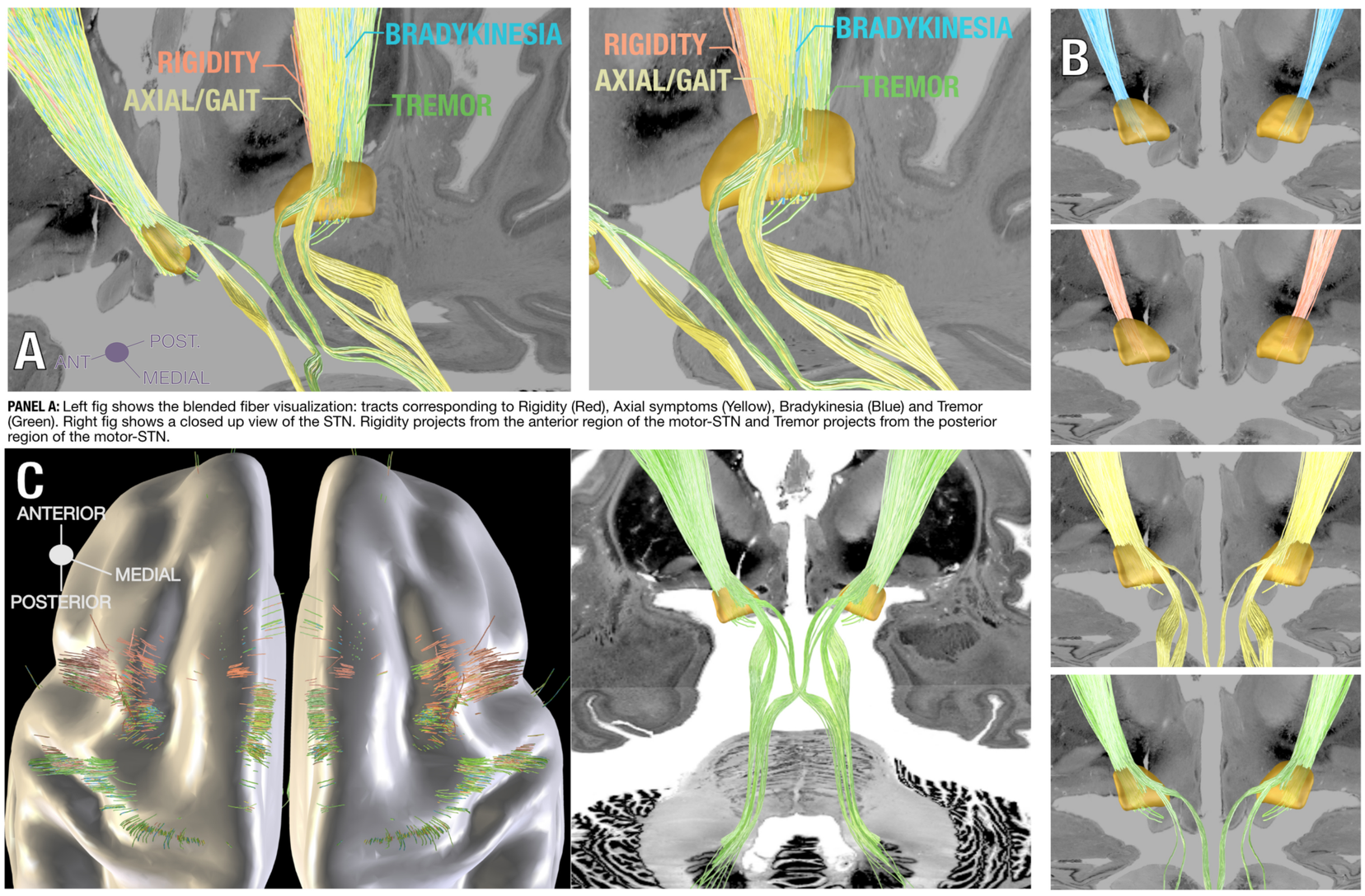
- **Different symptoms map to different brain networks in Parkinson's Disease.**
- **Evidence is accumulating that DBS can differentially modulate these networks.**
- **Here, we introduce a novel method termed multi-symptom fiber filtering to test which symptoms map to which structural connections in the human brain.**

METHODS

- **3 Cohorts (N = 129) with STN-DBS.**
- **Calculate electrical fields and stimulation volumes using a finite element model approach.**
- **Calculate percentage improvements in clinical sub-scores along four axes of motor symptoms in PD (Bradykinesia, Rigidity, Axial symptoms and Tremor) using pre- and post - operative UPDRS scores.**
- **Apply DBS fiber filtering (Baldermann et al., 2019) to identify specific tract connections in the subthalamic region using the connectome created above.**
- **Develop brute force bottom-up algorithm to suggest optimal DBS stimulation parameters that would maximally engage the symptom specific tracts relevant for individual patients.**



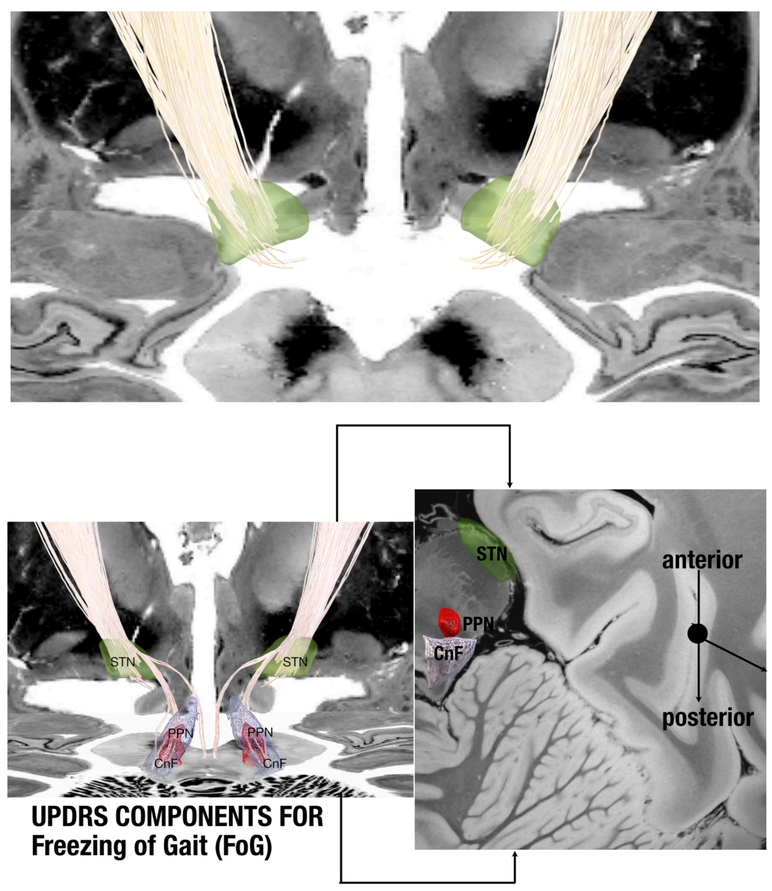
RESULTS



PANEL A: Left fig shows the blended fiber visualization: tracts corresponding to Rigidity (Red), Axial symptoms (Yellow), Bradykinesia (Blue) and Tremor (Green). Right fig shows a closed up view of the STN. Rigidity projects from the anterior region of the motor-STN and Tremor projects from the posterior region of the motor-STN.

PANEL C: Left figure shows the cortical projections of the fiber tracts. Right figure shows unthresholded tracts corresponding to the improvement in tremor symptoms. These tracts form the DRT at the STN level and project to the M1 region at the cortical level.

PANEL B(a-d): Each sub-figure represents the projection of tracts corresponding to each of the sub-symptoms of the UPDRS, visualized separately but generated via the network blending method.



Tract representative of Freezing of Gait (FoG) passes through the pedunculopontine nucleus (PPN) and the cuneiform nucleus (CnF).

CONCLUSIONS

- **Specific networks associate with symptom specific improvement.**
  1. **Tremor maps to M1 and Cerebellum via the cerebellothalamic pathway**
  2. **Bradykinesia and Rigidity map to premotor regions**
  3. **Axial symptoms map to midbrain regions.**
- **We can now pave the way for personalizing DBS with symptom adjusted treatment in individual patients.**

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