

Human Connectome-Based Tractographic Atlas of the Brainstem Connections and Surgical Approaches

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Introduction

The brainstem is one of the most challenging areas for the neuro- surgeon because of the limited space between gray matter nuclei and white matter pathways. Diffusion tensor imaging-based tractography has been used to study the brainstem structure, but the angular and spatial resolution could be improved further with advanced diffusion magnetic resonance imaging (MRI). Objective: To construct a high-angular/spatial resolution, wide-population-based, comprehensive tractography atlas that presents an anatomical review of the surgical approaches to the brainstem.

Methods

We applied advanced diffusion MRI finer tractography to a population-based atlas constructed with data from a total of 488 subjects from the Human Connectome Project-488. Five formalin-fixed brains were studied for surgical landmarks. Luxol Fast Blue-stained histological sections were used to validate the results of tractography.

Results

We acquired the tractography of the major brainstem pathways and validated them with histological analysis. The pathways included the cerebellar peduncles, corticospinal tract, corticopontine tracts, medial lemniscus, lateral lemniscus, spino- thalamic tract, rubrospinal tract, central tegmental tract, medial longitudinal fasciculus, and dorsal longitudinal fasciculus. Then, the reconstructed 3-dimensional brainstem structure was sectioned at the level of classic surgical approaches, namely supracollicular, infracollicular, lateral mesencephalic, perioculomotor, peritrigeminal, anterolateral (to the medulla), and retro-olivary approaches.

Conclusions

The advanced diffusion MRI fiber tracking is a powerful tool to explore the brainstem neuroanatomy and to achieve a better understanding of surgical approaches.

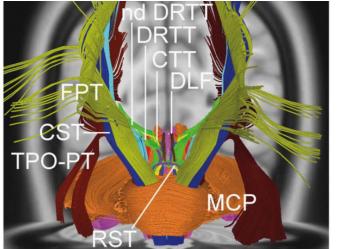
Learning Objectives

- 1) Re-define the anatomy of safe entry-zones on the basis of tractographic reconstruction of white matter tracts.
- 2)Present novel findings about cerebellar connections

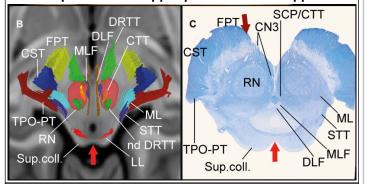
References

Meola A, Yeh FC, Fellows-Mayle W, Weed J, Fernandez-Miranda IC.

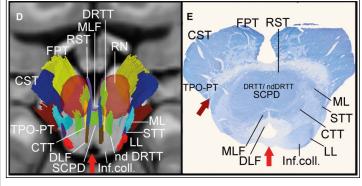
Reconstructed Tracts of the Brainstem



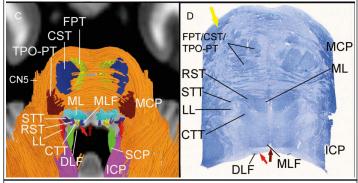
supracollicular appr./ perioculomotor appr.



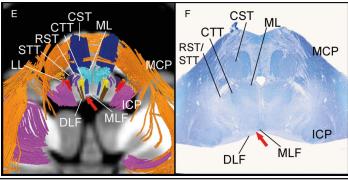
infracollicular /lateral mesencephalic



suprafacial appr./peritrigeminal appr./ midline appr.



infrafacial appr.



oretro-olivary appr./ anterolateral appr.

