Microsurgical Anatomy of the Thalamus

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Introduction

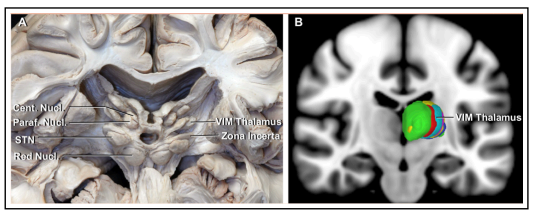
Deep brain stimulation(DBS) is a common treatment for medication refractory essential tremor. Despite the extensive practice of the ventral intermedius(VIM) thalamus as a DBS target, unveiling the extensive functional connectivity of the nucleus, relating its structural connectivity to the stimulation-induced adverse effects, still remains challenging. Mastering the three-dimensional (3D) anatomy of the thalamic nuclei should be the fundamental goal in order to achieve the best surgical results, due to the deep-seated position of these nuclei, its variable shape and relatively small size and extensive structural connectivity.In the present study, we aimed to delineate the 3D anatomy of the thalamic nuclei and unveil the complex relationship between the anatomical structures within the thalamic region.

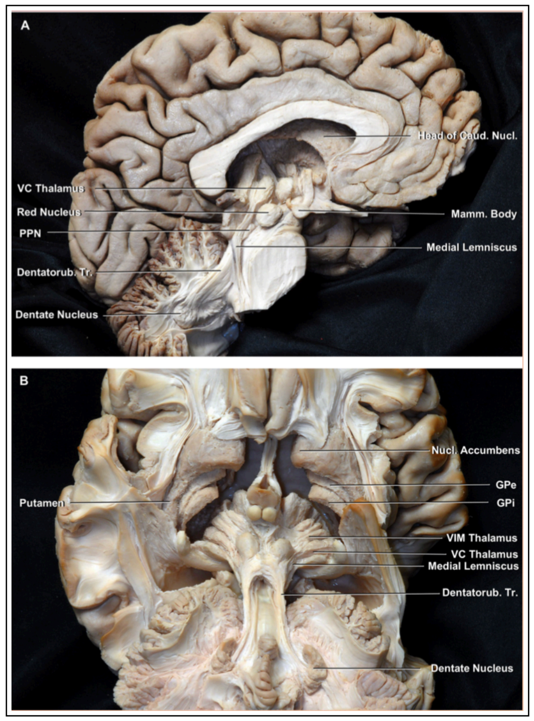
Methods

Fiber dissection were performed in 20 hemispheres and one cadaveric head in accordance with the Klingler method. All around fiber dissections from all aspects of the brain were performed in a stepwise manner to reveal the 3D anatomy of the thalamus. The thalamic nuclei were segmented in the serial 400μm thick histological sections according to cytoarchitectonic criteria and projected into MRI space.

Results

Our study correlated the results of thalamic fiber dissection with those of 3D MRI reconstruction and tractography (Figure 1). A 3D terrain model of the thalamic area have been built in order to clarify its anatomical relations with the putamen, GPi, GPe, internal capsule, caudate nucleus laterally, subthalamic nucleus and zona incerta inferiorly. We also described the relationship of the medial lemniscus and dentatorubrothalamic tract (Figure 2) by using tractography with 3D thalamic model.





Conclusions

This study revealed the complex 3-D anatomy of the thalamic area. In comparison with previous clinical data on thalamic targeting, our results promises further understanding on the structural connections of the thalamus, the exact location of the fiber compositions within the region and the clinical applications such as stimulation induced adverse effects during DBS targeting.

Learning Objectives

1) Provide a deeper learning of the thalamic nuclei.

2) Demonstrate the position of the ventral intermediate nucleus and ventral oralis nucvleus.

References

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