Post-mortem brain dissections for clarification of the three-dimensional anatomy involved in Deep Brain Stimulation for OCD

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Introduction

Although recent studies have demonstrated the efficacy of deep brain stimulation (DBS) for the treatment of debilitating and treatment refractory obsessive-compulsive disorder (OCD), no standardized stimulation target exists for this disorder. We have performed meticulous micro-anatomical post-mortem brain dissections to clarify the three-dimensional neuroanatomy and important fiber pathways that are potentially important in OCD DBS.

Methods

Ten hemispheres from adult formalin-fixed cadaver brain specimens were dissected using meticulous microneurosurgical technique and recorded in numerous photographs. We carefully investigated the anatomy of various targets for OCD DBS including nucleus accumbens (NAcc), anterior limb of internal capsule (ALIC), subthalamic nucleus (STN), inferior thalamic peduncle (ITP), and adjacent structures and fiber pathways.

Results

ALIC and NAcc are the most common targets for OCD DBS. ALIC is comprised of the anterior thalamic peduncle and frontopontine fibers. The anterior thalamic peduncle, which conveys fibers connecting the prefrontal and orbitofrontal cortices to the mediodorsal thalamic nucleus, was identified medial to the frontopontine fibers. Based on anatomical relationships, stimulation in the region of the NAcc may impact adjacent structures including: nucleus basalis of Meynert (posterior to NAcc), septal nucleus (posterior, medial, dorsal), bed nucleus of stria terminalis (posterior, dorsal), diagonal band of Broca (posterior, medial) and the olfactory stria (ventral). The medial forebrain bundle and the lateral hypothalamic nucleus were identified medial to the anterior aspect of the STN. The ITP, carrying primarily amygdalo-fugal fibers, was identified posterolateral to the column of the fornix. The anterior commissure serves as a useful landmark to localize these structures.

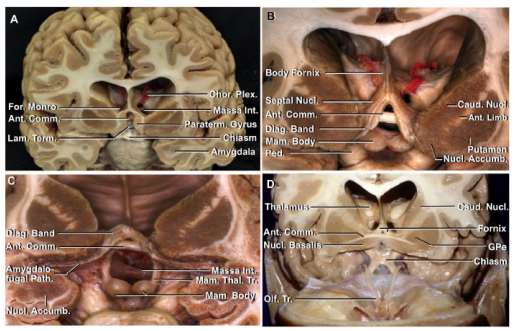
Conclusions

DBS is a promising therapy for severe, treatment refractory OCD, however, the optimal target for stimulation and the mechanism of effect of this therapy remain unclear. An improved understanding of the three-dimensional neuroanatomy involved is a critical first step toward developing a standardized neurosurgical procedure with consistently good outcomes.

Learning Objectives

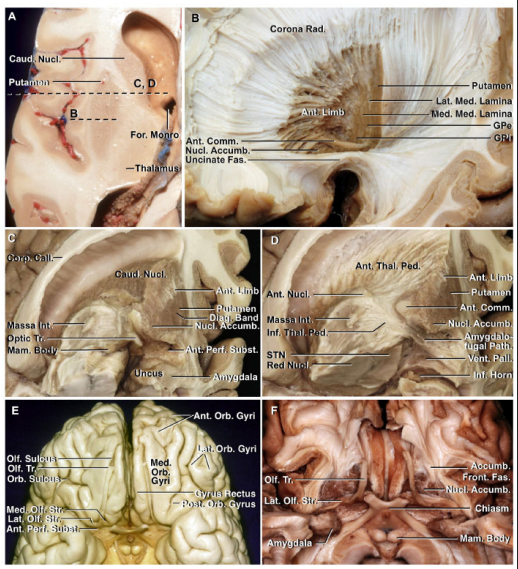
The participants should be able to 1) Describe the neuroanatomical relationships of structures that are potentially relevant to OCD DBS, and 2) Understand the current neurosurgical approaches to OCD.

Figure 1



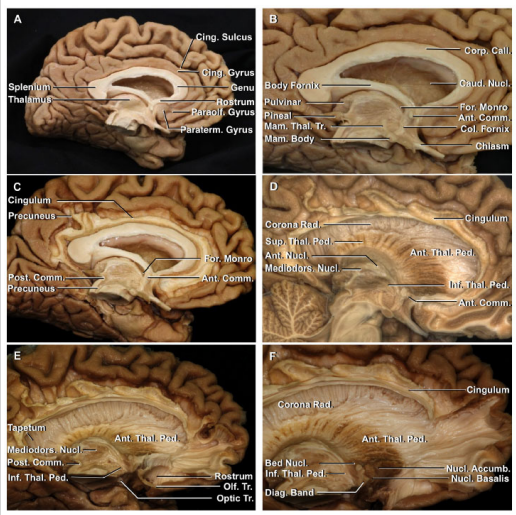
Serial coronal sections from anterior to posterior (A-D).

Figure 2



A: axial section showing the basal ganglia and the internal capsule. B. Lateral view showing the relationship between the ALIC and basal ganglia. C, D. Oblique views showing the striatum and the thalamocortical connections. E, F. Inferior views.

Figure 3



Medial views of the left hemisphere.

Ant, *Anterior*; Accumb, *Accumbens*; Call, *Callosum*; Caud, *Caudate*; Cing, *Cingulate*; Chor, *Choroid*; Col, *Column*; Comm, *Commissure*; Corp, *Corpus*; Diag, *Diagonal*; Fas, *Fasciculus*; For, *Foramen*; Front, *Frontal*; GPe, *Globus Pallidus Externa*; GPi, *Globus Pallidus Interna*; Inf, *Inferior*; Int, *Intermedia*; Lam, *lamina*; Lat, *Lateral*; Med, *Medial*; Mam, *Mammillary*; Mediodors, *Mediodorsal*; Nucl, *Nucleus*; Orf, *Olfactory*; Orb, *Orbital*; Paraterm, *Paraterminal*; Paraolf, *Paraolfactory*; Paraterm, *Paraterminal*; Path, *Pathway*; Ped, *Peduncle*; Perf, *Perforated*; Post, *Posterior*; Rad, *Radiata*; Str, *Stria*; Subst, *Substance*; Thal, *Thalamic*; Tr, *Tract*; Vent, *Ventral*;