Preoperative planning for functional neurosurgery

Historically, preoperative planning for functional neurosurgery has depended on the indirect localization of target brain structures using visible anatomical landmarks. Technological advances in neuroimaging have permitted marked improvements in MRI-based direct target visualization, allowing for refinement of “first-pass” targeting.

Boutet et al. reviewed studies relating to direct MRI visualization of the most common functional neurosurgery targets (subthalamic nucleus, globus pallidus, and thalamus) and summarize sequence specifications for the various approaches described in this literature.

The peer-reviewed literature on MRI visualization of the subthalamic nucleus, globus pallidus, and thalamus was obtained by searching MEDLINE. Publications examining direct MRI visualization of these deep brain stimulation targets were included for review.

Results: A variety of specialized sequences and postprocessing methods for enhanced MRI visualization are in current use. These include susceptibility-based techniques such as quantitative susceptibility mapping, which exploit the amount of tissue iron in target structures, and white matter attenuated inversion recovery, which suppresses the signal from white matter to improve the distinction between gray matter nuclei. However, evidence confirming the superiority of these sequences over indirect targeting with respect to clinical outcome is sparse. Future targeting may utilize information about functional and structural networks, necessitating the use of resting-state functional MRI and diffusion-weighted imaging.

Conclusions: Specialized MRI sequences have enabled considerable improvement in the visualization of common deep brain stimulation targets. With further validation of their ability to improve clinical outcomes and advances in imaging techniques, direct visualization of targets may play an increasingly important role in preoperative planning [1].

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Boutet A, Loh A, Chow CT, Taha A, Elias GJB, Neudorfer C, Germann J, Paff M, Zrinzo L, Fasano A, Kalia SK, Steele CJ, Mikulis D, Kucharczyk W, Lozano AM. A literature review of magnetic resonance imaging sequence advancements in visualizing functional neurosurgery targets. J Neurosurg. 2021 Mar 26:1-14. doi: 10.3171/2020.8.JNS201125. Epub ahead of print. PMID: 33770759.