Optimizing GPi-DBS Electrode Placement: Cortical Visual Evoked Potentials as a Reliable Adjunct to Microelectrode Recording for Delineating The Ventral Pallidal Border

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Abstract

Introduction: Precise electrode placement is critical for successful Globus Pallidus Internus (GPi) Deep Brain Stimulation (DBS). However, accurately identifying the ventral GPi border near the optic tract (OT) is challenging. Microelectrode recording (MER) signals can be ambiguous in dystonia,[1] and the common use of general anesthesia precludes patient feedback for OT localization.[2] We investigated direct OT stimulation with cortical visual evoked potential (CVEP) recording as an objective method to delineate the ventral GPi boundary and optimize electrode placement.

Method: Nine patients undergoing bilateral GPi-DBS, some under general anesthesia, were prospectively studied with ethics approval. After initial MER-guided targeting, direct monopolar stimulation (3 Hz, 50μs, 1-3mA) was delivered near the OT to elicit CVEPs, recorded from occipital scalp electrodes. The N40-P70 wave amplitude was correlated with electrode position. The final DBS lead was placed immediately dorsal to the site of maximal CVEP amplitude. Post-operative MRI verified placement, and clinical outcomes were assessed at follow-up.

Results: Direct OT stimulation consistently elicited N40-P70 CVEPs in all 18 hemispheres. Amplitudes increased significantly with proximity to the OT while latencies remained stable, providing a reliable localization signal. CVEP-guided placement resulted in optimal ventral GPi electrode locations confirmed on post-operative imaging. All patients had significant clinical improvement without visual side effects.

Discussion: Our results show CVEP monitoring is a reliable method to define the ventral GPi limit, overcoming the limitations of subjective visual phosphenes, especially under general anesthesia where patient feedback is absent.[1,3] This is particularly useful in dystonia surgery where MER signals can be ambiguous.[2] Using an objective landmark for the OT enhances safety by preventing unwanted stimulation and avoiding deep exploratory penetrations, confirming its utility as a practical intraoperative tool.[3]

Conclusions: Direct OT stimulation with CVEP monitoring is a safe and effective adjunct to MER for GPi-DBS. It refines targeting by providing a clear physiological landmark for the ventral GPi border, improving accuracy and safety, especially for patients under general anesthesia.

References

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