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Can Intraoperative Therapeutic Window Data Predict Chronic Contact Selection in Deep Brain Stimulation?

Abstract: Deep brain stimulation (DBS) programming relies on selecting electrode contacts that maximize clinical benefit while minimizing side effects. The therapeutic window (range of current yielding symptom improvement without adverse effects) is a key criterion in this decision, yet its quantitative role in clinical contact selection remains underexplored. This study investigated the influence of the therapeutic window recorded intraoperatively (ITW) on chronic contact selection and evaluated its predictive value for DBS programming. Intraoperative stimulation test data from 37 Parkinson's Disease patients were analyzed to compute ITW at multiple positions along the implantation trajectory. These positions were mapped to chronic electrode contacts, which were labeled as chronically chosen or not chosen. The relationship between ITW and contact selection was assessed using ranking analyses, nonparametric comparisons, and a Bayesian hierarchical logistic regression model. Predictive performance was evaluated using leave-one-out cross-validation. Clinically chosen contacts exhibited significantly larger ITWs than non-chosen contacts. ITW was a significant determinant of contact selection but explained only a limited proportion of variance (~10%). Prediction of chronic contact selection based on ITW

showed moderate predictive performance (ROC-AUC = 0.73, PR-AUC = 0.61). These findings demonstrate that ITW significantly contributes to clinicians' programming decisions and can support automated contact selection frameworks. At the same time, the low explained variance indicates that ITW is insufficient as a standalone chronic contact predictor and should be combined with other biomarkers.

Keywords: Deep Brain Stimulation, therapeutic window, programming

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