

Electrophysiological characterization of the microlesion effect after deep brain stimulation in patients with parkinson's disease

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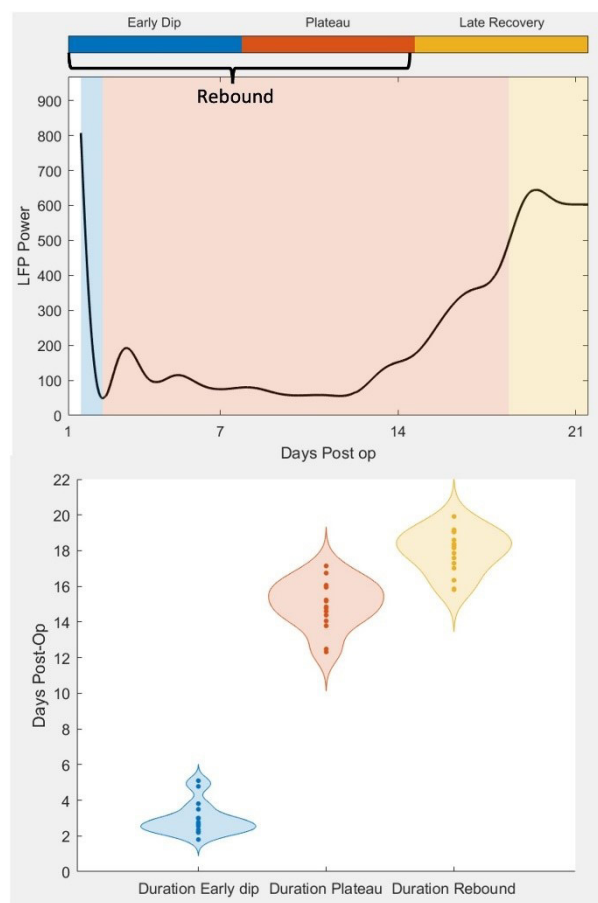
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Abstract

Introduction: The microlesion effect after STN-DBS for Parkinson's disease (PD) corresponds to a transient period of motor symptoms improvement after surgery, even with no stimulation being delivered.^{1,2} However, there are no studies probing the electrophysiological properties of this period. Recently available technology allowing continuous recording of neurophysiological activity from DBS electrodes³ provides an invaluable opportunity to interrogate and physiologically describe this period. The current work aims to characterize the electrophysiological signature of the microlesion effect in PD patients undergoing STN-DBS.

Method: Using Brainsense technology, we continuously recorded local field potentials (LFPs) from 10 STN-DBS patients (20 hemispheres), from implantation day until stimulation was switched on, four weeks later. Data analysis was performed using the computational toolbox DBScope. Clinical data collected included PD phenotype, disease duration, age-of-onset and changes in MDS-UPDRS-III.

Results: Median disease duration was 11 years; pre-operative MDS-UPDRS-III score was 54.4 ± 13.3 and preoperative LEDD was 1291 ± 418.6 mg. Study population clearly displayed microlesion effect, with significant reductions in MDS-UPDRS-III (-11.5 points, $p=0.0098$ med-off pre-op vs med-off/stim-off). Average frequency used for chronic sensing was 19.48Hz (beta). Temporal evolution of beta power displayed three clearly distinct periods: early dip, during which beta power decreases sharply to its minimum at 2.8 ± 1.8 days; plateau, during which beta power remains low, lasting 12.7 ± 2.3 days; late recovery, during which signal magnitude starts to slowly rebound. Temporal evolution of beta power was highly correlated across hemispheres. No correlation was found



between duration of plateau and clinical variables.

Discussion: Following the power of the beta-band, our study clearly demonstrates an electrophysiological microlesion effect, evolving throughout the first post operative weeks. This is the first electrophysiological description of the microlesion effect with real-world, patient-derived data. The temporal window of signal rebound we describe may guide the optimal timing for initiating neurostimulation after surgery.

Conclusions: Further analysis on the electrophysiological signatures could potentially instruct adaptive-DBS protocols that entrain the STN physiology to recapitulate and prolong the beneficial clinical state that characterizes the microlesion period.

References

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