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Subthalamic Nucleus DBS Sub-harmonic Oscillatory Activity Reflect Presence or Absence of DBS Responsiveness (P1-3.013)

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Abstract

Objective:

To correlate DBS sub-harmonics with patient responsiveness and investigate neurophysiological mechanisms subserving DBS induced sub-harmonics.

Background:

DBS induced sub-harmonics have been observed in multiple studies, but the relationship of sub-harmonics to clinical outcomes and underlying neurophysiology is ill-defined.

Design/Methods:

Electrophysiological recordings and MDS-UPDRS III were performed in two DBS patients without dyskinesia biweekly during a 10-week exercise program. Testing was conducted under four conditions (Levodopa/DBS both ON and OFF) during baseline and final visits and ON/ON in the sessions between.

Results:

P009 showed stimulation responsiveness in MDS-UPDRS III scores (55 OFF levodopa/OFF stimulation, 43 ON/OFF, 29 OFF/ON, 25 ON/ON), whereas P010 showed a similar response to medication but was less responsive to stimulation (57, 43, 45, 46). During baseline recordings, P009 (DBS 145 Hz) displayed increased spectral power in two subharmonic frequencies: ~108 Hz (¾ subharmonic, mean-0.086, SD-0.118) and ~72 Hz (½ subharmonic, mean-0.058, SD-0.079) OFF/ON levodopa/DBS. Increased spectral power at ~72 Hz (mean-0.025, SD-0.034) persisted in OFF/OFF. Increased spectral power at DBS sub-harmonic frequencies was not present under any condition in patient P010 (DBS 180 Hz) (mean-0.025, SD-0.0003).

P009 showed increased spectral power at ~108 Hz and ~72 Hz during sessions 1–4. Before session 5, DBS was clinically adjusted to 165 Hz. Increased spectral power was then present at the new subharmonic frequencies (~123 Hz and ~82 Hz) as well as at ~72 Hz (½ original DBS frequency). During the final session, increased spectral power was present at ~123 Hz and ~72 Hz with the patient OFF/OFF.

Conclusions:

DBS induced persistent oscillatory neural activity at DBS sub-harmonic frequencies that may serve as a biomarker for patient responsiveness to DBS therapy. DBS may activate natural resonance frequencies in the STN, or establish persistent oscillatory activity in neural circuitry through neural plasticity.

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