Methods: The subject was a male (76y) with bilateral STN-DBS (unipolar stimulation at 160Hz and 3.3V). The experimental design consisted of an "OFF" followed by an "ON" stimulation condition. In both conditions, the subject performed a self-paced finger tapping (FT) task followed by a finger sequence (FS) task with his right hand in blocked design (30-s task, 30-s rest, repeated 5 times). During performance of the FT/FS task with the right hand, changes from rest in oxygenated (O_2Hb) and deoxygenated haemoglobin concentrations were measured by an fNIRS system (Oxymon MkIII, AMS) from 15 channels covering the contralateral cortical sensorimotor network. EEG signals from 256 channels (GES-300MR, EGI) were collected synchronously with fNIRS signals.

Results/Discussion: Concomitant with the improved FT/FS task performance, fNIRS results showed a reduction in contralateral cortical sensorimotor network activation (i.e. smaller and less variable increase in O_2Hb over the 5 FT/FS task blocks) in the "ON" than "OFF" condition. The EEG results indicated that the mean power in the Beta and Gamma bands were lower in the "ON" than "OFF" condition. However, the mean power in the Delta band, which was approximately at the FT/FS movement frequency (1-3 Hz), was higher in the "ON" than "OFF" condition.

Conclusion: This case study showed that STN-DBS facilitates voluntary finger movement performance by a more efficient cortical activation pattern to perform the finger movement tasks, possibly by facilitating the voluntary frequency band (Delta) and suppressing the involuntary frequency bands (Beta/Gamma).

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Effects of ON and OFF subthalamic nucleus deep brain stimulation on cortical activation during finger movements tasks: a simultaneous fNIRS and EEG study

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Subthalamic nucleus deep brain stimulation (STN-DBS) therapy is an effective treatment for the motor symptoms of advanced Parkinson's disease (PD). However, the underlying neurophysiological mechanisms for the motor improvement are uncertain. We utilised a simultaneous functional near-infrared spectroscopy (fNIRS) and electroencephalography (EEG) neuroimaging approach to map cortical activation changes to motor performance in a PD patient "ON" and "OFF" STN-DBS.