Peter A Tass, J Neurol Clin Neurosci
ISSN:2752-809X | Volume 06

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Received date: 11-06-2022 | Accepted date: 14-06-2022 | Published date: 26-07-2022

Vibrotactile coordinated reset fingertip stimulation – treating Parkinson's with a vibrating glove

Abnormally strong neuronal synchronization is a hallmark of Parkinson's disease (PD). In medically refractory PD patients, standard deep brain stimulation (DBS) reduces specific symptoms during stimulus delivery. Coordinated Reset (CR)-DBS is a computationally developed technique which uses dedicated patterns of electrical stimuli to specifically counteract abnormal neuronal synchronization by desynchronization. The very goal of CR stimulation is to make neuronal populations unlearn abnormal synaptic connectivity patterns, in this way inducing long-lasting relief. Long-lasting therapeutic and desynchronizing CR-DBS effects were demonstrated in Parkinsonian (MPTP) monkeys and externalized PD patients. To provide a non-invasive alternative to DBS, we developed vibrotactile Coordinated Reset (vCR) fingertip stimulation. To this end, instead of administering electrical bursts through depth electrodes, we non-invasively deliver weak vibratory bursts in a CR mode to patients' fingertips. In a first-in-human study, vCR fingertip stimulation was administered to 5 idiopathic PD patients for in total 4 h per day on 3 consecutive days. Off-medication kinematic assessments revealed improved gait and bradykinesia during stimulation days and after 1 month after cessation of stimulation. In a pilot study, six idiopathic PD patients were treated with vCR stimulation delivered for in total 4 hours per day for 3 months. Patients' conditions were evaluated after medication withdrawal (off medication) by means of MDS-UPDRS III scores and EEG recordings before and after 3 months of vCR. vCR therapy caused a statistically and clinically significant reduction of PD symptoms off medication together with a significant reduction of high beta (21-30 Hz) power in the sensorimotor cortex (https://www.youtube.com/watch?v=dSjv6m4xLH0). Additionally, in a case series in 3 idiopathic PD patients, 6+ months of vCR therapy caused a significant motor improvement, where off-medication MDS-UPDRS III scores decreased linearly. The ultimate goal of vCR is to induce sustained symptom relief by non-invasively delivering weak vibratory stimulation patterns only regularly or occasionally.

Recent Publications:

1. A. Khaledi-Nasab, J.A. Kromer, P.A. Tass: Long-lasting desynchronization of plastic neuronal networks by double-random coordinated reset stimulation. Frontiers in Network Physiology 2:864859 (2022)

2. M. Madadi Asl, A.-H. Vahabie, A. Valizadeh, P.A. Tass: Spike-timing-dependent plasticity mediated by dopamine and its role in Parkinson's disease pathophysiology. Frontiers in Network Physiology 2:817524 (2022)

3. P.A. Tass: Vibrotactile Coordinated Reset Stimulation for the Treatment of Parkinson's Disease. Neural Regeneration Research. 17(7):1495-1497 (2021)

Biography

Peter A Tass studied medicine (MD, Ulm and Heidelberg Univ., Germany), physics (PhD, Stuttgart Univ., Germany), and mathematics (diploma, Stuttgart Univ.) and made a Habilitation in physiology (RWTH Aachen University, Germany). Since 2017 he is Professor of Neurosurgery in the Department of Neurosurgery, Stanford University Medical School, Stanford, CA, USA. Peter A. Tass investigates and develops neuromodulation techniques for understanding and treating neurologic conditions such as Parkinson's disease, epilepsy, dysfunction following stroke and tinnitus. He creates invasive and non-invasive therapeutic procedures by means of comprehensive computational neuroscience studies and advanced data analysis techniques. Peter A. Tass has published more than 160 peer-reviewed papers (h-index 55), is inventor or co-inventor on more than 270 patents and received a number of national and international awards. Stanford lab homepage: http://med.stanford.edu/tass-lab.html.

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