

Effect of Transcranial Direct Current Stimulation in a Patient with Frontal Chronic Post-Traumatic Encephalopathy

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Background & Objectives: Transcranial direct current stimulation (tDCS) is a potentially effective non-invasive neuromodulation method, used in experimental neurorehabilitation settings to increase neurological and functional recovery. Interestingly, its indication as a therapy for the rehabilitation of traumatic brain injury is still discussed. Here we proposed to (i) examine the feasibility and adherence to a longer training protocol than previously described in the literature (2x3 weeks) and (ii) assess the effectiveness in comparing cognitive training with sham tDCS and cognitive training with tDCS, in a single-case quasi-experimental study involving a patient with chronic working memory (WM) and executive function impairment following a severe traumatic brain injury.

Material and Methods: The participant was a partially institutionalized 46-year-old female (MoCA score 18/30) who sustained a very severe traumatic brain injury at the age of 14, with residual amnesic and frontal symptoms. WM (2-Back task) and inhibition (Go/No-Go task) were trained following an A-B design, involving first three weeks of cognitive training + sham-tDCS followed by three weeks of cognitive training + tDCS. Neuropsychological visits and fMRI assessments were performed before and after the A and B training phases.

Results: (i) The participant attended 100% of the planned appointments and reported overall satisfaction toward her participation; (ii) Several classical indices of performances were extracted from trials of A and B phases and were analysed with Nonoverlap of All Pairs (NAP) (3) and Tau-U (4) index. We identified an overall increase in performance in the tDCS training phase as compared to sham tDCS training, for the 2-Back task (medium-sized decrease in false alarm rate, Tau-U = 0.8; large-sized increase in correct rejection rate, NAP = 0.93). In the Go/No-Go tasks however, while the mean response time for Hits was faster (NAP = 0.64), accuracy decreased (NAP for all correct responses = 0.43). fMRI data reveal higher right anterior cingulate and medial frontal activities after tDCS than to sham training, for the 2-Back task.

Conclusions: Our study showed that a 2x3 weeks training protocol was possible and enjoyable for our patient, and that cognitive training coupled with tDCS induced specific performance improvements in WM. These clinical results bear potential for the rehabilitation of executive disorders in patient with severe traumatic brain injury.

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