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Traumatic Brain Injury: Is Neurofeedback the Best Available Therapy?

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Traumatic brain injury (TBI) can be easily diagnosed in the case of major head trauma with positive structural imaging findings (MRI-, CT- of the brain). Unfortunately, if the injuries are subtle-no major alteration of the consciousness—making the diagnosis of mild TBI (mTBI) can be more challenging. More recently, electrical imaging called quantitative electroencephalography (QEEG) has been useful in confirming mTBI diagnosis [1-3].

Despite the relatively high occurrence of TBI's, the available therapies for this condition are limited-relying primarily on symptomatic treatment and with unsatisfactory results. Chronic sequela of TBI include neurological impairments (cognitive deficits such as ADD-like symptoms, seizures, headaches, weakness, numbness and/or balance problems) and are frequently associated with psychiatric dysfunction (depression, anxiety, PTSD, etc.). Pharmacotherapy, cognitive behavioral therapy, physical therapy, and occupational therapy are frequently employed in the rehabilitation of these patients.

Neuromodulation represented by neurofeedback (NFB; also called EEG-biofeedback), has been known as a potential therapeutic modality for fifty years. This type of biofeedback uses real-time displays of EEG to illustrate brain activity. One or two sensor based NFB therapy required in many instances 50 or more sessions in order to achieve the therapeutic goals. Z-score Low Resolution Electro-magnetic Tomography Analysis (LORETA) 19-electrode (cap system) NFB was relatively recently introduced to the market (Applied Neurosciences, Inc.). This system has the potential for faster results based on the larger number of electrodes (scalp sensors) applied during treatment [4]. In Z-Score NFB, a real-time comparison to an age-matched population of healthy subjects is used for data acquisition—simplifying protocol generation and allowing clinicians to target modules/hubs that indicate abnormalities in networks related to the patient's symptoms [5]. Z-score NFB increases specificity in operant conditioning, this provides a guide that links extreme Z-score outliers to symptoms and then reinforces Z-score shifts toward states of greater homeostasis and stability. The goal is increased efficiency of information processing in brain networks related to the patient's symptoms [6].

This technology has been recently shown to be effective in therapy of many neuropsychiatric disorders including: chronic pain, depression, stroke rehabilitation as well as cognitive dysfunction [6-9]. The potential advantage of neuromodulation over pharmacotherapy is its ability of bypassing the digestive tract to interact almost directly with dysregulated neurons. This creates the opportunity to potentially lower side effects while increasing therapeutic gains.

Our clinical research has previously demonstrated the efficiency of LORETA Z-score NFB in patients suffering from epilepsy, chronic pain, Alzheimer's disease, autistic spectrum disorders, attention deficit hyperactivity disorder and other neuropsychiatric conditions [9-14]. Recently published papers [15,16] reported the marked improvements of cognitive function, MRI abnormalities, and quality of life of TBI patients subjected to NFB. Post-NFB findings have shown significant increase in cortical grey matter (GM) volumes and fractional anisotropy (FA) of cortical white matter (WM) tracts [15]. Similar MRI findings were previously reported by University of Montreal group [17] in a randomized study performed on normal volunteers. Also other groups reported beneficial effects of NFB in therapy of TBI patients [16,18].

Preliminary data coming from my clinic indicates a very promising response of TBI patients to LORETA Z-score NFB therapy. The majority of patients reported an improvement of their TBI-related symptoms within ten NFB sessions. Many of them were also found to have an objective cognitive improvement documented by a computerized cognitive testing. In addition to that, this type of NFB rehabilitation therapy was able to normalize many QEEG abnormalities identified in TBI patients during the initial pre-NFB evaluations. This editorial serves as the introduction to the upcoming original article reporting the effectiveness of Z-score LORETA NFB in therapy of patients suffering from TBI. Preliminary results of this study were presented during the International Society for Neurofeedback and Research (ISNR) 2014 meeting and subsequently published in the abstract form [19]. In the future a larger placebo controlled study may be beneficial to further document efficiency of this type of NFB in therapy of TBI patients.

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