

COMMENTARY

MEG and Pico-Tesla-TMS in Patients with Dystonia or Autism

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Transcranial Magnetic stimulation (TMS) is a method with diagnostic and therapeutic uses in a lot of neurological conditions. It is secure, non-invasive and was developed as a substitute to transcranial electrical stimulation. Magnetoencephalography (MEG) is considered as a non-invasive method for recording the magnetic fields produced by the neuronal brain activity.

Professors Anninos and Tsagas (1) invented an electronic device that can increase the (2-7Hz) irregular frequencies of the recorded MEG for each dystonia or autism patient towards frequencies of less or equal to its frequencies of the alpha frequency range (8-13Hz). The electronic device consists of one generator that produces alternative low voltage of frequencies from 2-7Hz, and supplies a number of selected coils of one group which consists of alike rows of coils, or a plurality of groups of similar coils arranged in rows. The pico-Tesla (pT) ($1\text{pT}-10^{-12}\text{ T}$)-TMS electronic device is a modified helmet enclosing up to 122 coils that cover the 7 brain regions: Frontal, Vertex, Occipital, right-left Temporal and right-left Parietal. It produces modulations of the magnetic flux (intensity: 1-7.5pT) in the alpha frequency range (8-13Hz) of each patient (Figure 1A).

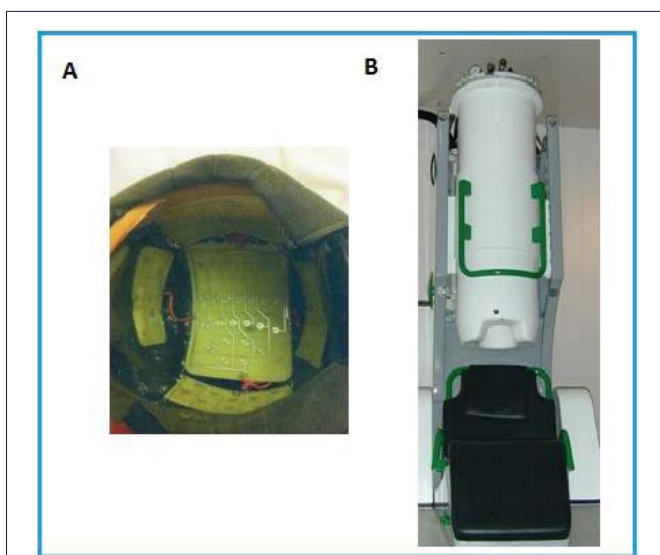


Figure 1: A) The configuration of the stimulation coils within the helmet of the electronic device. B) The 122 channel MEG system inside the shielded room.

In our lab, using a whole-head 122 channel gradiometer device (Neuromag-122, Neuromag Ltd, Helsinki, Finland) we performed MEG in an electromagnetically shielding room (Figure 1B). Our MEG were taking with sampling frequency rate of 256Hz and associated Nyquist frequency of 128Hz, which was well above the constituent frequency components of interest and avoid aliasing artifacts. The MEG filtered with cut-off frequencies at 0.3 and 40Hz. The research protocol were approved by the Research Committee of our Democritus University of Thrace. Funding for this work was provided by a collaboration of General Secretariat of Research and Technology, GR and the ERGO AEBE, INC, GR under a research program (Grant Number: 80623).

We developed a software program in our lab in order to detect the amplitude of the primary dominant frequency of the power spectra of the MEG obtained from each patient and channel after the application of Fast Fourier Transform (FFT). Then we looked for interest at (alpha: 8 - 13Hz) for calibration of the electronic device and (2 - 7Hz) for the analysis at the primary dominant frequency of the power spectra of the MEG obtained from each patient and channel after the application of FFT.

The pT-TMS device was constructed for each patient to generate a square wave (so that to look like the firing activity of neurons in the brain). Using the electronic device in the above mentioned patients with abnormal MEG activity and symptoms we have found a significant effect of an increase in the 2-7Hz frequencies range toward the patients' alpha rhythm followed by an improvement also of their MEG [1].

The mechanism by which the application of the pT-TMS has some beneficial effects in these patients is unidentified. Although, one potential reason is that these magnetic fields (pT-TMS) have been shown to influence the activity of the pineal gland which regulates the endogenous opioid functions and the dopaminergic modulation. Furthermore, the pineal gland is a controller of our immune system through the action

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on the thymus gland generating the infection fighting T-cells which are needed to neutralize foreign invaders such as viruses and bacteria. If the thymus gland shrinks with the age or due to other disorders its ability to generate T-cells is sapping. Another point related to PG is the alpha rhythm. The alpha rhythm is classically described as a bilateral posterior rhythm of substantially constant frequency in the range of 8-13Hz which is enhanced by mental relaxation and blocked attention. Since the full expression of alpha rhythm has been shown to occur with puberty, it is possible that the establishment of alpha rhythm is subject to neuroendocrine influences. Nocturnal plasma melatonin levels have been shown to decline progressively during childhood reaching a lowest point at puberty. This gradually decline in melatonin secretion during childhood facilitates the maturation of alpha rhythm [2-6]. Consequently, the presence of alpha rhythm could be used as a neurophysiological marker for the activity of the PG and for the disorders associated with absent or delayed maturation of it such dystonia, autism and other disorders which might be related to disturbances of PG melatonin functions in early life [2-6].

This technique of the pT-TMS might be considered as a non invasive secure and effective modality in managing the symptoms

of patients with dystonia or autism. However, additional investigation with more patients is required in order to estimate the prospective effect of pT-TMS and its important role.

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