

The Effect of Weak Magnetic Stimulation on Head Injury Patients

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Transcranial magnetic stimulation (TMS) of several Tesla demonstrated by Baker, *et al.* [1] is being explored as a noninvasive technique for treating neurological disorders and exploring brain function. Anninos and Tsagas [2] invented an electronic tool that emits pico-Tesla (pT) TMS (1 pico - Tesla = 10×10^{-12} Tesla) and enhance the frequencies (2 - 7Hz) of every individual towards the alpha frequency range (8 - 13Hz) [4-10]. The "Neural Net Model" [11] explained that pT-TMS causes a temporal neuronal inhibition in areas showing abnormal action in the frequency range of 2-7Hz as other researchers referred [12,13].

This commentary is a continuation of our previously published work [3]. We provide another method of the evaluation of MEG signals after the application of pT-TMS on head injury (HI) patients. Our prior research was double blind.

Our MEG system was already explained in our previously published work [3]. Five patients which are 2 male and 3 female volunteers within 30 - 71 years of age were included in the study. The Research Committee of our University approved the study. We developed a software program in order to identify the primary dominant frequency of the power spectra of the MEG with the use of Fast Fourier Transform (FFT) (Figure 1). We used the alpha frequency (8 - 13Hz) for the calibration of the electronic tool and the (2 - 7Hz) frequencies for the MEG analysis.

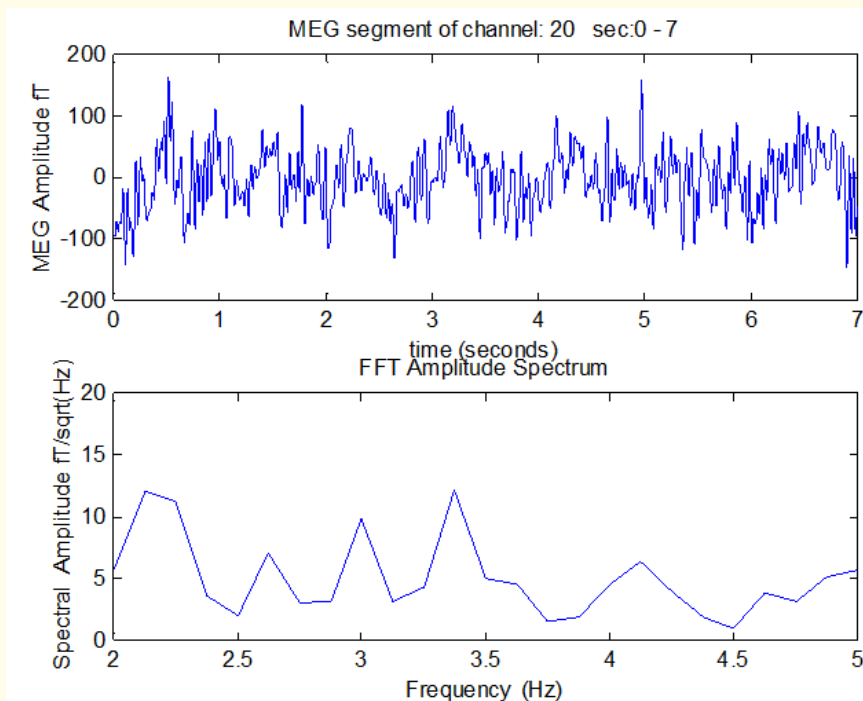


Figure 1: A) A MEG segment of 7 sec duration recorded from a patient. B) We observe that the primary dominant frequency is 2.1Hz after the application of FFT.

The study protocol was as follows: Every HI patient was scanned in two sessions. The first consisted of 2-min resting state MEG scan. We used the MEG to find the patient’s alpha frequency (8 - 13Hz) for the calibration of the device. During the second session 2-min of pT-TMS were applied with the patient sitting comfortably just outside the scanner room and afterwards additional 2-min of resting state MEG recordings were taken.

In Table 1, we observe the effect of the pT-TMS. In this table the BS (before stimulation) and AS (after stimulation) are the effects before and after pT-TMS for every one of the 5 patients. Table 2 shows the statistical analysis using unpaired t-test with 3 out of 5 patients (60%) to have a statistical significance.

Patients	Right Temporal		Left Temporal		Right Parietal		Left Parietal		Frontal		Vertex		Occipital	
	BS	AS	BS	AS	BS	AS	BS	AS	BS	AS	BS	AS	BS	AS
1	4.56	4.56	5.19	4.81	4.25	5.00	5.00	4.81	3.19	5.00	3.13	4.81	2.69	5.00
2	0.88	1.06	1.19	1.19	0.88	0.63	2.19	1.13	3.50	1.19	2.19	2.13	3.25	2.00
3	1.22	4.53	1.72	4.56	1.22	4.53	1.72	4.66	2.34	4.63	1.50	4.56	0.66	4.56
4	0.25	5.36	1.75	4.00	0.63	5.36	0.63	4.00	0.50	0.70	0.63	5.38	1.88	5.00
5	4.56	2.63	4.69	2.94	4.56	2.63	3.44	2.94	1.06	2.31	3.38	4.75	4.63	3.50

Table 1: This table shows the effect before (BS) and after (AS) the pT-TMS for each HI patient.

Patients	BS Mean ± SD	AS Mean ± SD	t-test statistical significance < 0.05
1	4.0014 ± 0.99	4.86 ± 0.16	0.0443
2	2.004 ± 1.093	1.333 ± 0.54	0.1702
3	1.483 ± 0.53	4.58 ± 0.050	0.0001
4	0.896 ± 0.64	4.26 ± 1.68	0.0003
5	3.76 ± 1.32	3.10 ± 0.82	0.2823

Table 2: Statistical analysis of the 5 HI patients of table 1.

In our research we increased the abnormal dominant frequencies of 2 - 7Hz band due to the effect of the pT-TMS in patients with HI which are a common feature of many of the diseases that affect the brain. In our patients the brain injury were mostly bump or bruise traumatic brain injury with headache and loss of coordination.

After applying the pT-TMS to the HI patients we observed a preliminary effect of an enhance in their frequencies of the 2 - 7Hz across the HI patients and a substantial improvement and normalization of their MEG as it is shown in tables 1 and 2 in which we can see that in 3 out of 5 patients the results are statistical significant at the level 0.05 (60%). The reason that the application of the pT-TMS enhance the abnormal frequencies observed in the HI patients are under investigation. However, these applied magnetic fields have shown to influence the action of the pineal gland which has an important role to the endogenous opioid functions [15] and the dopaminergic modulator [16]. Although our results are taken in a small number of patients, they encourage more studies to be conducted.

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