

## EFFECTS OF CRANIAL ELECTRO STIMULATION (CES) ON MODULATED BRAIN WAVES

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### Abstract: -

Cranial electrotherapy stimulation (CES) is a noninvasive electro stimulation therapy which has been shown to alleviate anxiety, sleep disorders, and depression. These effects are thought to be caused by changes in concentration. In spite of changing neurotransmitters, this method has the ability to change the EEG pattern of brain waves. The application of CES has been approved by FDA.

**Keywords:** - Cranial electrotherapy stimulation; depression; anxiety



**BACKGROUND**

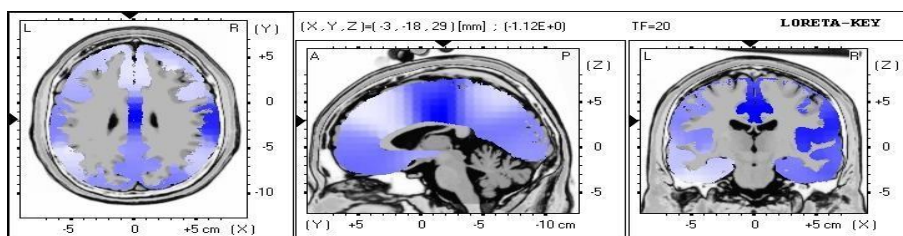
A variety of cranial electro stimulation (CES) devices have been used since the 1950s. These devices send a pulsed, weak electrical current (<4 mA) to the brain via electrodes placed on the scalp above the eyebrows, maxilla-occipital junction, ear lobes, temples, or mastoid processes. Over the last decade, a large number of psychiatrists are integrating CES treatments into their clinical practice because it has few side effects (1% or less), is noninvasive, and improve depression, anxiety, and insomnia (Kirsch, Nichols, 2013). The electrical intervention can modulate brain function and change or facilitate electro chemical function of brain and finally, it can cause relaxation or tension release (Ferdjallah, Bostick, Barr, 1996). The EEG pattern changes have been seen both with 0.5 and 100 Hz cranial electrical stimulation (Schroeder & Barr, 2001).

**Case Presentation**

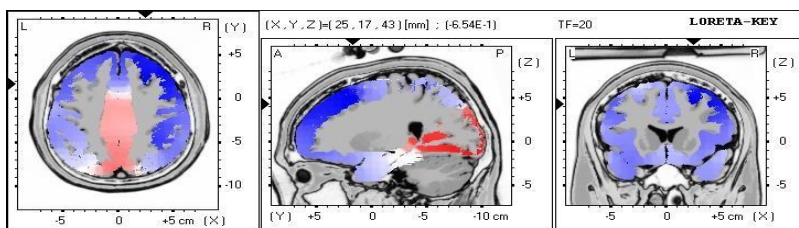
A 51 years old man patient with anxiety and sleep disturbances was studied in a duration of 3 weeks. The CES applied twice a day for 6 successive sessions, with  $\beta_1, \beta_2$  and  $\alpha$  stimulation within 20 minutes for each session, respectively. Five minutes of Eyes-closed resting EEG data using Mitsar system collected from the 19 electrode sites of the scalp according to international 10/20 system, referred to linked earlobes in a sound attenuated room ,before and two weeks after the last stimulation. Then 1minutes of artifact-free data were extracted from the EEG records for quantitative analysis. Both neuroguide and Loreta reports indicate an increase at modulated waves.

**Results**

We observed ameliorating of anxiety, mood and fatigue. Regarding to EEG pattern the modulated waves promoted after intervention (figures 1-5).

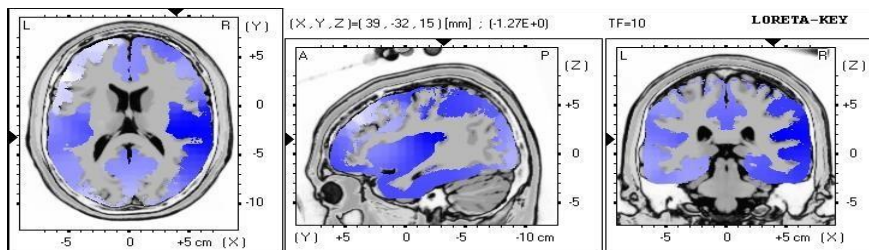


**Figure 1: Before intervention (20 Hz)**

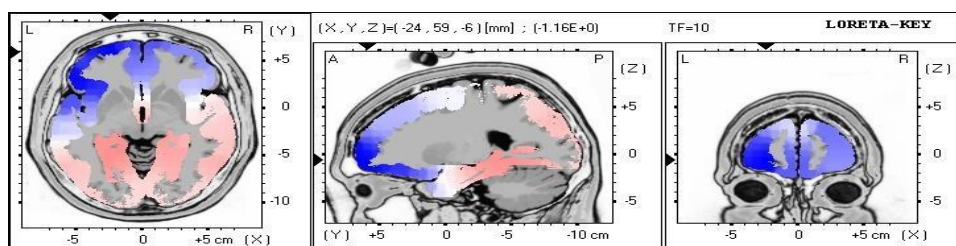


**Figure 2: Two weeks after intervention (20 Hz)**

Note that EEG source localization of beta waves is enhancing in cingulate gyrus (Red areas).

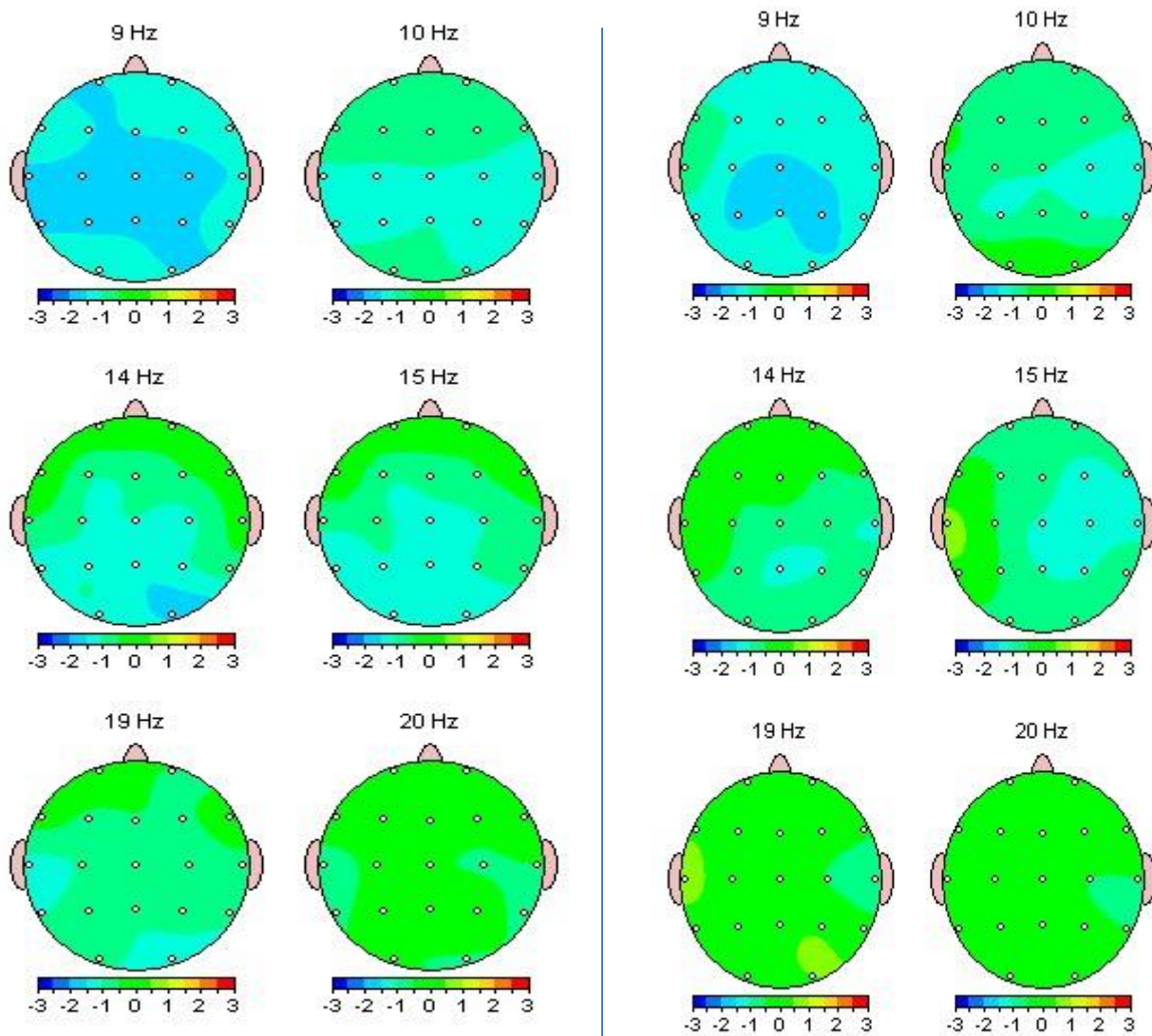


**Figure 3: Before intervention (10 Hz)**



**Figure 4: Two weeks after intervention (10 Hz)**

Note that EEG source localization of alpha waves is enhancing in posterior regions.



**Figure 5: Neuroguide report (spectral analysis) Left before and Right two weeks after intervention. In the left panel, pale blue areas indicate less activity**

As you see on figure 5 the alpha and beta waves have promoted after CES

### Discussion

In recent years several brain stimulation techniques have been employed by clinicians in the treatment of various mental disorders (Temel Y et al., 2012). Cranial electrotherapy stimulation has been proved in treatment of anxiety, depressive disorders (Hashemi et al; 2015) and provides a fundamental adjunctive treatment for drug withdrawal that have not responded to common therapy (Kirsch & Nichols; Roger L Waite, 2014). The EEG power spectra has been affected by CES (Schroeder & Barr, 2001).

Electroencephalographic studies express that cranial electrotherapy stimulation increases alpha activity (increased relaxation, mental alertness or clarity), reduces beta activity which is associated with a reduction in anxiety, ruminative thoughts, and obsessive/compulsive-like behaviors, and reduces delta activity that attenuate the fatigue (Kirsch, et al., 2013).

Neurotransmitter studies show that cranial electrotherapy stimulation increases serotonin, beta endorphins, and adrenocorticotrophic hormone, norepinephrine and melatonin, gamma-amino butyric acid, cholinesterase, and dehydro epiandrosterone. CES also reduces serum cortisol levels (Shealy, Cady, Culver- Veehoff, 1998; Liss, Liss, 1996). Consistent with the mentioned researches, our studies support the same results. Furthermore it assume that CES may accelerate the delivered frequencies.

### Conclusion

Cranial electrotherapy stimulation may affect EEG pattern, according to the type of stimulation. Some psychological traits such as anxiety sleep and mood disorders meliorate after CES too. This method may engage an adjuvant therapy in psychiatric disorders.

### Consent

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-chief of this journal.

### Competing Interest

The author declares that he has no competing interest

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