

Neurofeedback and Migraine

Neurofeedback

Neurofeedback is a computer-supported therapy procedure for clinical use, in which selected parameters of the patient's own brain activity are made perceptible. For this purpose, brain waves are measured in real time on the surface of the head (neuro), which influences an audiovisual animation (feedback). Since all signals, recorded by the sensory organs of the central nervous system, are constantly analyzed for their relevance, the audiovisual neurofeedback signals represent a kind of mirror for the brain of its own activities. Such a direct feedback, based on proven treatment protocols and electrode positions, aims to improve the brains' ability to regulate itself. Since self-regulation is an essential and fundamental function of the brain, the clinical spectrum of treatment is very broad, in which neurofeedback can be used as a lead therapy or therapy component to alleviate the symptoms of mental disorders and illnesses, for attention and concentration problems and in rehabilitation.

There are various neurofeedback methods, which all follow the principle of EEG measurement and frequency component dependent feedback outlined above, but differ in their implementation, EEG feature extraction and feedback control. So-called "frequency band" methods follow the rules of standardized frequency ranges within the "classic" EEG spectrum (1-40 Hz) for feature extraction and aim at the brain reducing certain activities and increasing others. In contrast, neurofeedback training of slow cortical potentials (SCP) aim to control those activities in the very low frequency ranges below 0.1 Hz¹. SCP neurofeedback training can affect the amplitude of these slow activities and led to self-regulatory clinical effects². The so-called Infra-low Frequency-Neurofeedback (ILF) has proven to be particularly effective and it was recently shown in a blinded, controlled fMRI study that such training leads to changes in connectivity in certain nuclei of the brain³. ILF neurofeedback represent a combination of frequency band and SCP training with regard to the frequencies of the extracted brain activities, but beyond that also follows a stand-alone, individualized and symptom-based approach. In ILF neurofeedback the training frequency of the slow SCP activities is individually optimized and the course of therapy is dynamically adapted to changes in clinical symptoms.

Since its discovery in the late 1960s, a total of nearly 2,000 medical research papers on neurofeedback or EEG-Biofeedback have been published (PubMed, October 2020). These include basic studies on the functioning of neurofeedback as well as clinical studies, case studies and reviews on the use of neurofeedback in a wide range of indications. As an addendum to this text on the methodology of neurofeedback a list of key publications have been selected and can be found below prior to the *Literature* references.

In order to represent the research results as broadly as possible, the following studies are methodologically based on various neurofeedback methods – hence, they all have in common to aim for an improved regulation of the brain.

Neurofeedback as a treatment for Migraine, tension-type Headache and chronic Pain

Migraine is a common, ictal, disabling and often progressive disorder characterized by pronounced excitability of the central nervous system^{4,5,2}. The disorder is characterized by recurrent episodes of seizure-like forms of headache and associated symptoms like nausea and sensitivity to light and noise and thus, often accompanied by sensational and sensibility disorders⁶. While classical biofeedback is already considered a clinical standard in the treatment of migraine⁷⁻⁹, due to its emending influence on neural dysregulation, Neurofeedback has also been widely accepted and reviewed as a useful treatment for Migraine, other primary headaches, like tension-type headache, and (chronic) pain in general^{10,11}, as well as a rehabilitative treatment after strokes and in cranial brain trauma¹¹.

In a controlled clinical study using quantitative EEG (QEEG) guided neurofeedback to treat recurrent migraine headache, 25 out of 46 patients (54%) experienced a complete cessation of their migraines, and 18 patients (39%) experienced a reduction in migraine frequency of greater than 50%, while 17 out of 25 patients (68%) of the control group, who got a conventional drug therapy, experienced no change in headache frequency, respectively 5 patients (20%) had a drop in headache frequency of less than 50% and only 2 patients of more than 50%¹².

The effect of neurofeedback on the treatment of stress-induced primary headache was investigated by Farahani and colleagues. In a randomized controlled clinical trial 45 healthcare providers with primary headache were randomly allocated to either of three groups, subjects of the neurofeedback (NFB) and the transcutaneous electrical nerve stimulation (TENS) groups received over a period of 5 weeks, 3 sessions per week of their respective treatment, while the participants of a control group received none of these treatments. It turned out that treatment with NFB and TENS caused significant decrease in the frequency, severity, and duration of headache in both experimental groups in comparison to the control group¹³.

In accordance to the reasonable assumption that neurofeedback training improve the self-regulation capabilities of the brain, such treatment also alleviate symptoms that often accompany a primarily migraine, headache or chronic pain problematic, such as nausea, stimulus sensitivity and sleep problems¹⁴⁻¹⁶. When applied in a suitable frequency over a period of time, the effects of neurofeedback training can be expected to persist for months or years after the end of the therapy^{8,17}.

Summary and outlook

There is a growing body of clinical and scientific evidence that ILF-Neurofeedback can be beneficial in the treatment of migraine, primary headache and chronic pain, with also long-lasting alleviation on accompanying symptoms, like nausea, stimulus sensitivity or sleep problems.

This information was brought you by BEE Medic GmbH, Germany. For further information on neurofeedback, questions on its clinical indications, as well as how to plan, conduct and publish your neurofeedback-related clinical work, feel free to contact us at medwiss@beemedic.de.

Selected key publications on the methodology of Neurofeedback

- Dobrushina, O. R. et al. Exploring the brain contour of implicit infra-low frequency EEG neurofeedback: a resting state fMRI study. *Int. J. Psychophysiol.* 131, S76 (2018).
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3. Dobrushina, O. R. *et al.* Modulation of Intrinsic Brain Connectivity by Implicit Electroencephalographic Neurofeedback. *Front. Hum. Neurosci.* **14**, 1–13 (2020).
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