Application Observation to prove the relaxation effect by means of a Quantitative electroencephalogram

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Introduction

So far, earcandles have already successfully been used for 20 years by physiatrists and physiatrically oriented doctors. The treatment with earcandles as a monotherapy or as a concomitant therapy has found a wide range of application within the practice of naturopathy. This soft alternative therapeutic method has firmly been established with great success.

A considerable number of troubles within the area of the head e.g. sinusitis, rhinitis, colds, hearing difficulties, tinnitus, and migraine are treated using this therapy, and regarding the relaxation therapy, the earcandle has been used **to overcome stress disturbances,** amongst others in case of **stress symptoms** e.g.:

- nervosity
- unrest
- hyperactivity
- sleep disorder
- concentration disorders
- headache

From time immemorial, the basic principle of the earcandle application has been known to be used by various culture groups.

In my holistic medicine oriented practice, earcandles are also quite often used for relaxation purposes.

So, what is behind this principle? Regarding a merely physical point of view, the effects of heat and pressure fluctuation are measurable parameters emitted by the earcandle.

In order to make the effects of the earcandle measurable, in particular the relaxation described by the patients over and over again, a **quantitative image generating electroencephalogram** (qEEG) was recorded from suitable stressed patients in my medical practice immediately prior to and upon the earcandle application.

Fundamental Physiological Principles

In medical science, the qEEG and its image-generating representation as a **Brain Map** is a well-known method to objectively measure the status of cerebral performance. **Any change in the functional state of a human being will equally cause changes in the image of his/her brain waves, the qEEG.** There are only slight changes in the voltage at the surface of the skull, but they can still be visualized by state-of-the-art computer measuring methods.

As a result, maps of the cerebral function, so-called Brain Maps, are established. Our nerve cells are generating electric pulses with various frequencies.
These various frequencies have different functional meanings. Since the implementation of EEGs it has already been realized that mainly occipitally located cerebral regions generating pulses of a frequency range between 7 and 12,5 Hz. will entail a relaxation, i.e. any kind of induced relaxation will enhance the occipital pulses of 7-12,5 Hz.

This frequency range is called **alpha frequency.** There is a distinction to be made between alpha 1 having a frequency between 7.0 and 9.5 Hz and alpha 2 having a frequency between 9.5 and 12.5 Hz. Special mathematical methods will enable the calculation of the so-called **alpha performance** on the basis of this qEEG component. The **alpha performance** is a factor that is still more sensitive to any changes in the state of the cerebral performance. If the qEEG is recorded from as many discharge points as possible at the surface of the skull, a map of the qEEG performance can be calculated and printed out.
If a change in the state of the functional cerebral performance is actually triggered by the application of the ear candle, it should also be possible to measure this central effect by means of this procedure.

Using a quantitative image-generating qEEG, attempts have been made on the basis of the neurophysiology of relaxation reaction to objectivize the increase in the absolute alpha performance necessary for a relaxed wakefulness.

A patient during the application of an earcandle

Methods

Fifteen female patients with pronounced stress symptoms were included in a five months' application survey. The patients subjected to an earcandle treatment in my practice were asked to undergo a qEEG checkup prior to and upon the treatment.

The qEEG of any patient was discharged in a quiet examination room. To this effect, the test person was comfortably seated in an armchair with an adjustable back-rest inclination (deviation from the vertical position by 30°) specially provided for that purpose. An electrode cap manufactured by the Company Electro Cap Co., USA, and incorporating 17 electrodes according to the positions of the international 10/20 system was put on the patient's head.

16 analog signals were recorded as potential differences between the electrodes of the cap and the reference electrode Cz (Medtronic GmbH, Germany). The analog signals were digitized by a screening frequency of

512 Hz/12 bit. The input impedance (AC = 10 MOhm; DC = 20 MOhm) ensured a sufficient signal/ noise margin in case of fluctuations of the electrode resistances within a range between 1 and 50 kOhm. A common reference was determined from the16 bipolar potential differences to Cz, i. e. the „Common Average Reference", corresponding to the median over the entire16 electrode pairs per digital measuring moment. The measuring values per electrode (n=17) were then converted into the reference "Common Average Reference", thus resulting in 17 digital virtually unipolar base EEG signal values. The Medtronic EEG System stored the digital source data without any filtering. The source signal was continuously displayed on a monitor for the purpose of visual artefact detection and control.

Recording the qEEG

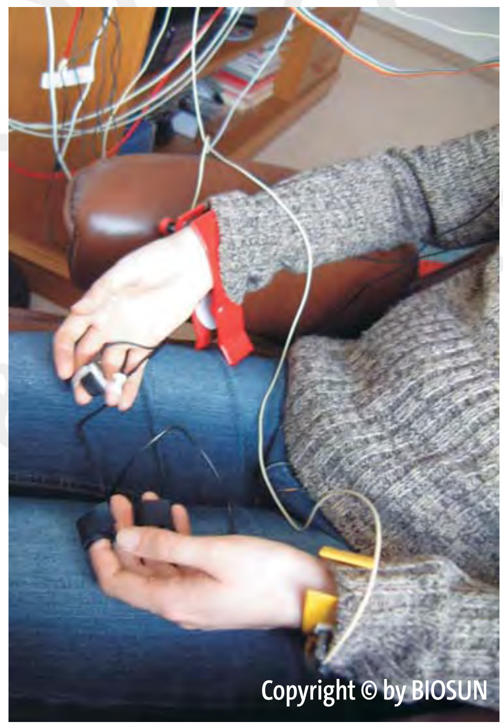
Using the Lagrange interpolation, 82 digital intermediate values were determined on the basis of these 17 real digital EEG signal values. Thus, there was a total number of 99 digital base EEG signal values of 17 real and further 82 virtual electrodes per measuring moment available for the topographic representation (512 values/s and electrode). Upon the Lagrange interpolation, the phase and frequence relations among the electrodes remained unaltered. Thereafter, the 99 digital base EEG signal values per measuring moment were transformed into the frequency range using the Fast Fourier Transformation (FFT). This transformation is based on the use of 4 seconds data periods (Hanning fenestration; data smoothing).

Clinical experience and pharmacological EEG investigations demonstrate that it is reasonable to subdivide the EEG in the following frequency ranges:

Delta Frequency	1,25 to 4,50 Hz
Theta Frequency	4,75 to 6,75 Hz
Alpha-1 Frequency	7,00 to 9,50 Hz
Alpha-2 Frequency	9,75 to 12,50 Hz
Beta-1 Frequency	12,75 to 18,50 Hz
Beta-2 Frequency	18,75 to 35,00 Hz

The electrical power resulting from the analysis [μV] will be integrated within these frequency ranges and referred to the frequency as power density [μV /Hz] respectively. The coloured maps of the cerebral function, the brain maps, were calculated on the basis of these data. The elaborately prepared analysis of the base qEEG data and the image generating processing were carried out after recording.

In addition, the state of the vegetative excitation was measured via **the peripheral vegetative parameters**, e. g. the electric skin conductance, the electromyogram, the cardiac rate, and the breath frequency, as well as the temperature of the skin surface. Adequate sensors were connected to two fingers of the left hand (skin conductance, temperature) and to one finger of the right hand (cardiac rate) as well as to the right-hand and lefthand nuchal musculature (electromyogram). An extension-sensitive breast belt registered the respiration. The qEEG and the peripheral vegetative parameters were subsequently recorded for five minutes while the patient kept her eyes open and for another five minutes while the patient kept her eyes closed. Thereafter, the electrode cables were separated from the measuring systems, and the patients went back to the treatment room in order to be treated with the earcandles while comfortably lying on a couch.



Recording the peripheral parameters

The application was carried out as recommended by the manufacturer, and the treatment was repeated at the other ear by means of a second earcandle without any break after having changed the sides.

Upon the bilateral application, the patient was again seated in the armchair. The electrode cables were then connected to the measuring instruments, and the entire parameters were again recorded, just as prior to the application for a period of five minutes with open eyes and closed eyes respectively.

Results

Subjective Results

Describing their experience, the patients unanimously stated that they felt very comfortable and relaxed already during the burning process of the earcandles. After getting up, changing the room to the qEEG department and the relevant actions as well as upon the qEEG-recording itself, the patients equally reported that they felt very well. They felt that the internal stress they had experienced after work when they arrived at the practice had kind of dissolved.

Results of the Quantitative Electroencephalogram

The qEEG and the maps of the functional brain state accordingly calculated prior to and upon the ear candle application confirm a significant increase mainly in the occipital alpha performance upon the earcandle application.

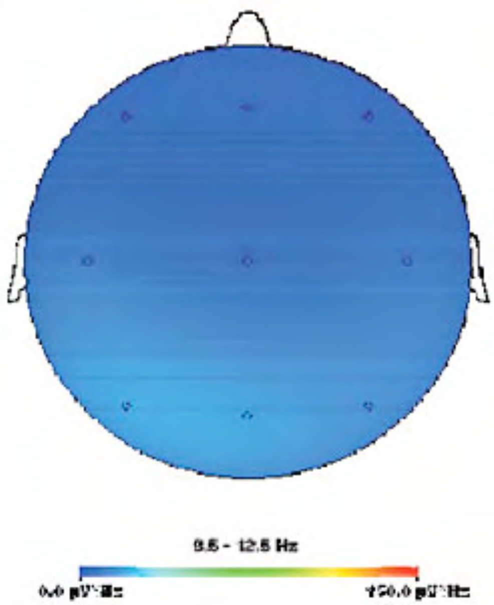
Depending on the individual initial basis of the central excitation condition in the untreated stressed condition, the increase in the alpha performance could be noticed within the slower alpha-1 frequency band, the faster alpha 2 frequency band, or within both frequency ranges as well.

An increase in the occipital alpha performance could be measured in case of all the patients examined as well in the functional state „eyes open" as in the state „eyes closed". The performance changes are qualitatively evaluated on the basis of the colour-coded absolute performance values and the functional maps.

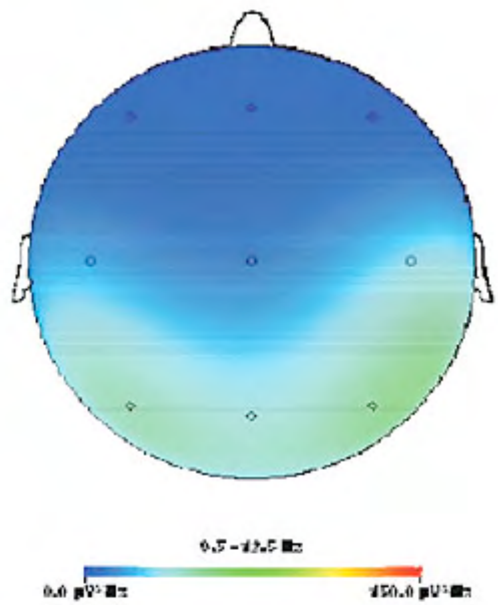
The colour-coded absolute spectral performances are exemplarily demonstrating the **increase in the alpha performance** as well upon the application of the earcandle as by closing the eyes. **A more pronounced colour difference** achieved by closing the eyes upon the earcandle application (right-hand figures) as compared to the functional changes after having closed the eyes prior to the earcandle application (left-hand figures) is also striking. Qualitatively compareable changes could either be observed in the alpha 1 or the alpha 2 frequency ranges for all the 15 examined patients. This statement will be confirmed by the following figures of the functional maps of the cerebral function.

Brain Map

Spectral alpha 2 performance (V2/Hz) during the functional state „eyes open“

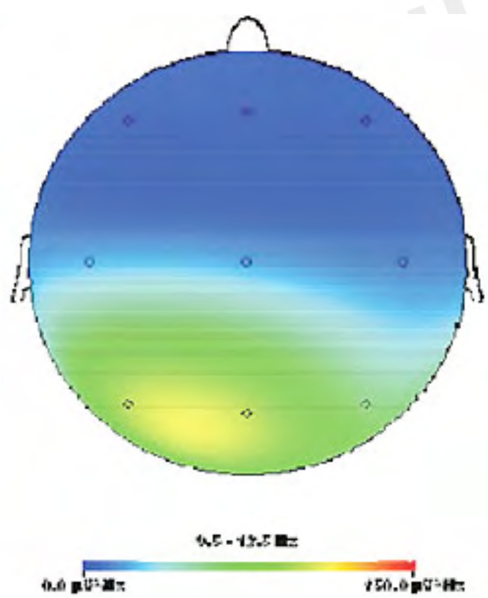


prior to the earcandle application

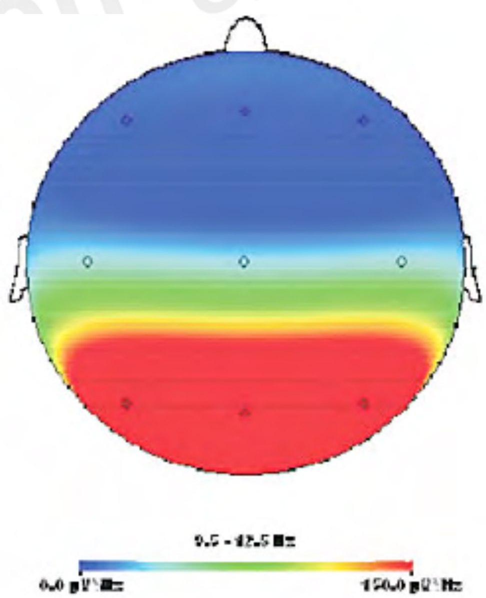


upon the earcandle application

Spectral alpha 2 performance (V2/Hz) during the functional state „eyes closed“



prior to the earcandle application



upon the earcandle application

Peripheral Vegetative Parameters

Upon application of the earcandles, the peripheral parameters measured are broadly showing the following changes:

Electrical skin conductance (S):	▼
Electromyogram (V):	▼
Cardiac rate (1/min.):	▼ up to ▶
Respiration frequency (1/min.):	▼ up to ▶
Skin surface temperature (°C):	▲

Upon application of the earcandle, the neurophysiological reaction shows a reduction of the vegetative excitation state.

Summary

In case of all the patients treated with earcandles, an increase in the spectral alpha performance, mainly within the occipital regions, could be measured on the basis of the initially described neurophysiological characteristics of a relaxed wakefulness.

Any situations and states reducing the central alpha performance and thus restricting the neurophysiological regulation width to achieve an optimum information processing, are inevitably entailing a reduced attention. An example of everyday life shows e.g. that somebody trying to strictly concentrate in an overstimulating environment will close his/her eyes in order to reduce the additional information input via the optical system. This will enhance the central alpha performance consequently improving the attention, so that the central information processing will not be disturbed

Assuming that any analyzed frequency range will cause selective changes of the neurotransmitters in the brain, the complicated central processing steps in our brain will be comprehensible. E.g. an increase in the spectral alpha 1 performance of our brain will entail an increase in the serotonin concentration in certain cerebral regions (Dimpfel and colleagues, 1989). Serotonin has been described to be a happiness hormone which has supplementarily to be raised, amongst others in order to improve depressive states within the brain.

In a state of uninfluenced wakefulness the occipital alpha performance will be increased. Closing the eyes will induce an increase in the alpha performance. A reduced information input may explain why a lot of people are developing a significantly better concentration ability if their eyes are closed. The attention will grow as soon as the neurophysiological preconditions are fulfilled.

The ability to generate the occipital alpha performance is reduced by stress and psychic strain, leading to a state of internal unrest and the inability to relax and concentrate, just as in case of the patients I had treated. Therefore, it would be advisable to increase the alpha performance in the qEEG in order to recover a sufficient regulation width.

This is how the neurophysiological preconditions for the ability to relax, to pay attention, to concentrate, and to subjectively feel well could be established.

All these reactions could measurably be released upon application of the earcandle. The fundamental neurophysiological factors of the considerably increased subjective well-being are due to the increase in the alpha performance released by the earcandle treatment.

The central changes are correlating with the peripheral changes. Mainly the decrease of the electric skin conductance measured for all the patients describes a reduction of **vegetative excitation state**. The simultaneous decrease of the cardiac rate and the respiration frequency is equally due to the reduction of the vegetative tone. The peripheral blood vessel tone is equally reduced as it is physiologically related to it, and the **peripheral circulation is increased**. This effect correlates with an increase of the skin surface temperature measured in case of almost all the patients.

The measurable increase in the skin surface temperature during and after the application of the earcandles does not represent an immediate effect of the heat emitted by the earcandle but it is due to the mechanisms released within the brain of the patient by the application of the earcandle. The processes measured in the qEEG are reflecting **central relaxation mechanisms** also inducing a change of the vegetative excitation level, which, in turn, is related to a relaxation of the peripheral blood vessels. This is how the circulation of the peripheral blood is improved, which directly explains the temperature rise of the skin surface.

Thus, the application of the earcandle indirectly produces a **subjectively perceptible feeling of warmth** via known neurophysiological means.

All the measured changes taken together are an explanation for the wellbeing felt by all the patients upon application of the earcandles. It is, therefore, possible to state that the relaxation effect is not only due to a subjective feeling but that it is based on measurable and reproducible physiological principles.

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