

Trigeminal Neuralgia aches (TN) therapy with peripheral nerves signal actuation (PNS)

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Abstract

For people with Trigeminal Neuralgia (TN), It is a non-invasive advantage to use the peripheral nerves signal actuation (PNS) via skin and it is suitable even for people who suffering from the periodic Trigeminal nerve headaches with less intensity. It is a technical challenge to non-invasive cranial nerves actuation or nerves actuation through the head's skin because it is hard to patients and makes a lot of pain for them. These nerves actuation increase endorphin generation, as a result, the patient's pain tolerance limit will increase and this will prevent ache entry to neural system. This study is a clinical trial and the method is parallel trial that implemented on 50 hospitalization patients on neurology department of a hospital in Tehran. In this study, the pain intensity will be review and comparison on three modes; without electrical signal actuation; with low frequency electrical signal actuation (5Hz); and with high frequency electrical signal actuations (100Hz). There are one-way ANOVA (one way variance analysis), TUKEY and DUNNETT statistics tests to compare severity of pain average in several modes. The results showed significant differences between the patients who used peripheral nerves actuation (PNS) via skin before their headache or during headache ($P < 0.08$) as the minimum pain, when use the high frequency electrical signal and maximum pain is without using of electrical signal actuations. But there are no significant differences in pain intensity when use the low frequency electrical signal actuations.

Conclusion: Electrical signal actuation on Trigeminal Neuralgia in pain therapy is capable to makes so precise electrical impulses that can start an action potential with low simulant effects on Cranium (PERIOSTEUM) in nerves. Therefore, the patient can tolerant it and feel no pain.

Keywords:

Trigeminal Neuralgia (TN), Peripheral nerves actuation, Non-invasive.

1. Introduction

The headache international community classified the Trigeminal Neuralgia by two categories: classic and symptomatic. The classic Trigeminal Neuralgia has not a proven cause; also it could be with artery compression of Trigeminal nerve. The classic Trigeminal Neuralgia diagnosis needs to lack of any obvious clinically neurological disorder, while, symptomatic Trigeminal Neuralgia diagnosis needs to constructional disorders except artery compression diagnosis. The possible disorders are such as: Multiple sclerosis injuries; Tumors and base of skull involvement. Trigeminal Neuralgia (TN) is a rapid, snap and flash headache in one or two branches area of the Trigeminal nerves at the face. This disease is because of gradual injury of trigeminal nerve. This disease makes severe pain on Eyes, Teeth, Mandible, Frontal, Nose and etc. this pain almost occur only on the one side of face (Left or Right). This disease is one of the most painful aches known by human. Every year, many people suffering the Trigeminal nerve pain that decrease their normal activities. The electrical actuation increase and developed due the technology development, electrical actuation devices fabrication and growth of physiology knowledge [1, 2]. According to the subjects, doctors, patients and scientific research centers into the all of world are looking for treatments by suitable consequence and minimum side effects. In this way, peripheral nerves actuation (PNS) makes hopeful effects to periodic Trigeminal Neuralgia aches (TN) prevention. In the past, PNS worked by under skin's peripheral nerve branches electrical actuation through the implantation tools, but it

works now by new PNS technology that effect through the installed electrodes on the patient's skin with an external nerve actuation supply. It is a non-invasive advantage for people with periodic, low intensity Trigeminal Neuralgia (TN) to use the peripheral nerves signal actuation (PNS) via skin. There are many pharmaceutical and non-pharmaceutical methods to relieve the pain [3]. But because there are a lot of side effects in pharmaceutical methods, people prefer to use the non-pharmaceutical methods to pain reduction [2]. Some of non-pharmaceutical methods to pain therapy are such as: Mental deviation; Body relaxation; Empathy and skin actuation, also the electrical actuation is a kind of skin actuation to pain control [4]. The nerve electrical actuation through skin is the widest method in use of electricity to pain treatment [5]. In fact, it is a modified method of the acupuncture [6]. The pain control electrical actuations are according to the wall and MELZACK gates control theory [7, 8] and also, the electrical actuation makes the inner opiate system available and will release them [9]. Generally, poor electricity current will transfer on the patient's body via connected electrodes on the skin in the electrical actuation method [10]. Nowadays, there are known three standard methods to use the electrical actuations. These methods are as the following: A) usual electrical actuation method that call as high frequency electrical actuation [13] and use in high frequency (40~150Hz) and low current (10~30mA). In this method, the pain will reduce immediately by device turning on and after it's duration, the pain will be cured [14] B) Acupuncture electrical actuation: this method is call as the low frequency electrical actuation and use with low actuation frequency (1~10Hz) and high current (up to patients tolerance: 20~50mA). This method use when the other methods doesn't work on patients to cure them [5, 15, 16]. They believe it will be prevented at nervous system adaptation and electrical actuations by using this kind of electrical actuation and makes the treatment more effective. Generally, the electrical actuation is a non-invasive, light and safe with minimum side effect and inexpensive method to pain therapy [7, 17]. In the "Father" research, it is often effective to use the electrical actuation in pain reduction [1]. In the "Lauder" study which is about the electrical actuation effects to pain intensity, the maximum pain is belong to the "Control" group and minimum pain is belong to the "electrical actuation" group and there were meaningful differences in statistics reports

[18]. As "SMELTZER" and "BARE" say: the electrical actuation will obstacle the pain control gate on the posterior horn of the spinal cord by thick neurons A (Beta) actuation and will reduce the pain [19]. Also, there are a lot of differences between the high and low frequency electrical actuation to pain intensity [20]. The "BASHIRIAN" research (about electrical actuation effects to pain intensity by several frequencies) results are as following: the results say, the electrical actuation with high frequency is more effective than electrical actuation with low frequency in pain reduction. This result showed a meaningful statistics difference [21]. These detections show, the electrical actuation with higher frequency has most effect in pain intensity. In this way, the "CARROL" and "BOUSHER" say that, the electrical actuation with high frequency and low current is more effective and useful [22], also, the "EKBLUM" and "HANSSON" say: the electrical actuation is uses as an electrical actuation with high frequency and low current because, it is more effective for pain reduction to use the higher frequencies [23]. Studies show obviously the positive effect of the electrical actuation with high frequency to pain reduction via pain gates control [20]. It will reduce the pain to use a high frequency and low current in nerve fibers kind A (Beta) actuation and cure the pain through the pre-synaptic inhibition on pain feel transmission line in the posterior horn of the spinal cord [19]. There are several success rate of pain cure in electrical actuations. Generally, the studies show that 30 to 70 percent of patients experienced an effective pain treatment by electrical actuation [10]. This study is to determine the kinds of electrical actuations effect to Trigeminal nerve's pain intensity through skin. The first cure for Trigeminal Neuralgia is medical cure and most of patients got temporary treatment by selective medicines. But the patients who don't have positive response to medical treatments can use the nerve electrical actuation method via their skin [24, 25]. Dentists say, it is the Trigeminal nerve's pain, the cause of atypical face pain, specially, in patients by 40 years old and younger. Suitable knowledge and propos diagnosis of Trigeminal Neuralgia can be so effective in fast treatment. Don't use the incorrect and unnecessary cures.

2. Method

This study is a clinical trial and the method is parallel trial that implemented on 50 hospitalization Trigeminal Neuralgia (TN) patients on Neurology department and cure by electrical signed actuations. These patients selected by their contentment, then put them on three random groups. The selection criteria of people in study are such as: being Vigilant, being Literate, Not taking Morphine or Pethidine or ... from 6 hours ago, Not using electrical actuation from 6 hours ago. Data collection tools are: Questionnaire and Check list that includes two parts. The first part is about demographic like: Age, Gender, Level of education, Hospitalization department and the second part is about patient's pain intensity evaluation. In the test results part, it is important to do a multiple comparison between patient's pain intensity averages in several states. This method applies the electrical pulses in mA range to the patient's skin via electrodes. These pulses cross the skin and effect on the nerve membrane and then convert it from depolarization mode to polarization mode and therefore, the noises and negative energy in muscle will be move or destroy and the patient will be cure. Then it is a method that could be used in most of the pain therapies. It is a non-invasive method that applies a low current (1~3mA) to the head skin, during treatment. The action potential will not shoot directly in cortical neurons because the direct current wont simulation by discrete impulses and will polarization. Primary studies on the animals show the cerebral cortex's change activity because of the electrical current effect as increase or decrease of irritability depended on crossed electrical current situation. These effects will remain for a while by the protein, intracellular level AMP (Annual) and calcium amount but it is generally, reversible and without any side effects for cellular structure. Also the direct current electrical actuation is characteristic of the tools that use of AC current and makes impulses such as: CES, ECT, VNS, DBS, but in the TDCS unlike the methods as RTMS, it is not skull wall actuation by electromagnetism waves. This actuation is not like action potential response for the muscle contraction example. The alteration is for neurons reform and operation (Neuron modulation) then some of the researchers prefer to use the skull wall direct current polarization and these are two expression are same. There are three kinds of actuations: positive actuation (Anodal), Negative actuation (Cathode) and artificial actuation (Sham). In the positive actuation or anodal, it will increase the intended area irritability while it is vice versa in negative actuation. The Sham mode will be under study as

the control group. In this mode, a short actuation will apply that the patients don't understand it's time on their face. It is the important reason that helps to scientists to understand real effect at this method in comparison of the empathy or medicine. One of the most important advantages in this method is: it's capability to access to brain cortex changes after actuation. These changes term depended on actuation time and intensity. The brain action is according to depolarization hyperpolarization on membrane relaxation potential to earn accurate data, after pain intensity measurement by the data collector person, after a short time, the pain intensity measured by another data collector person in same way (VAS). The collected data by two persons were correlated 94.8 percent. In this way, to data collection, we recorded the demographic data, by patient interview pain intensity valuation done in three random groups (witness group without electrical signal actuation; under study group with low frequency electrical signal actuations_5Hz or Low; under study group with high frequency electrical signal actuation_100Hz or High). In the first group: without electrical signal actuation; in the second group: one minute after applying the electrical signal actuation with 5Hz frequency and 100us pulse time and current intensity nearby to the patient's tolerance while the electrodes are on skin and 6cm space between each electrode; in third group: one minute after applying the electrical signal actuation with 100Hz frequency and 100us pulse time and current intensity with a few higher that patient's tolerance. We used the statistics, descriptive and inferential methods to data analysis. All data described, classified and compared by absolute and relative frequency table preparation. To ease the descriptive statistics operations, data description and preparation of its table, the pain intensity by zero amount considered as NO PAIN, pain intensity considered as -3.5 and 0.1 SLIGHT PAIN, -6.6 and 9.9 considered as SEVER PAIN, -6.3 and 5.6 considered as MIDDLE PAIN and 10 is VERY INTENSE PAIN. We used the chi-squared test to groups similarity control in demography (Like: Gender, Age, Education Level) and also used the one way various test to comparison between pain intensity averages in three modes and used the DUNNETT test to designation the difference between the witness group pain intensity and other under study group pain. And finally, we used the TUKEY test to comparison between several states of pain intensity. Meaningful level considered less than 0.05.

3. Results

The chi-squared test in group similarity shows that all groups are in the same situation. This test used to show the groups similarity in demographic variables (Like: Gender, Age, Education level). The following is about comparison of the pain intensity average in several modes. In the table, there were no meaningful difference between electrical actuation and with high frequency actuation ($P=0.001$, $D=1.99$) but the pain intensity with low frequency actuation hasn't any meaningful difference ($P=0.287$, $D=0.82$). The result of this test is confirmed by DUNNETT. The pain intensity has no meaningful difference in low mode and high mode ($P=0.097$, $D=1.15$). This study's detections show that, the pain intensity's average without electrical signal actuations is 5.12, it is equal to 4.26 with two frequency actuations (5Hz) and 3.27 with 100Hz pulse, therefore, the patients feel maximum pain without electrical signal actuation and minimum pain with 100Hz pulse. The study's data show that, the pain intensity without electrical actuation has a meaningful difference by the pain intensity with high frequency electrical actuation. But it has no meaningful difference by low actuation. On the other studies, there are many differences between high frequency and low frequency electrical signal actuation's effect on the pain. The study's detections show that, there are no meaningful differences in several electrical signal actuation modes and between high and low frequency signals.

Table 1: Multiple Comparison Test between pain intensity averages in several electrical signal actuation modes.

<i>P Value</i>	<i>Averages Difference (TUKEY Test)</i>	<i>Other situation Study</i>	<i>Specific Case Study</i>
0.287	0.82	LOW	Without electrical Signal actuation
0.001	1.99	HIGH	Without electrical Signal actuation
0.295	-0.84	Without electrical signal actuation	Low frequency Electrical signal Actuation
0.099	1.15	HIGH	Without electrical signal actuation
0.001	-1.99	Without electrical signal actuation	High frequency Electrical signal actuation
0.099	-1.15	LOW	Without electrical signal actuation

4. Discussion

This is the base of the study to use two electrodes in positive and negative poles and put them on the patient's head by a wet sponge. The electricity will arrive to the brain cortex after head's skin and skull. The electricity in this area makes charge the neurons and cause to has positive and negative poles. This action will change the area activities. There are some notes in this method: 1.Electrical current intensity, time and direction 2.Electrodes position 3.Size of sponge 4.Number of meetings.

There is a new method that uses many electrodes instead of two electrodes. This method is known as TDCS with TDCS-HD quality. A primary study shows that TDCS-HD has a longer effect than general methods on the motion cortex. It is unknown yet to human, what happened in brain, during the TDCS. Anyway, there is only one general explanation on the human and animal tests results. Anode (Negative) is a place that lets to the electrodes, enter to the brain. Cathode (Positive) is a place that lets to the electrodes going out of the brain. Therefore, there is a negative load under the simulator cathode, like passengers who wait for subway and stand behind the train's doors. A little cathode can apply a focal load to brain. Then, we can find how much of the brain is under electrode effects and we can control the amount of the load by electrode size and also, we can control the brain's effected area by anodic electrode size too.

5. Conclusion

This study's result detections show that, the electrical signal actuations are effective on the pain reduction, so the patients has minimum pain when use the high frequency electrical signal actuation (100Hz). Then we can suggest a high frequency actuation beside the other methods to pain therapy. This shows dentists need to know why there are atypical pains such as trigeminal nerve's pain, it is more important on the patients with 50 years old or less. Apropos diagnosis of trigeminal neuralgia (TN) help to fast treatment.

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