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RESEARCH ARTICLE

Immediate effect of auricular acupuncture on electromyographic activity and muscle strength of the upper trapezius descending fibers

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ABSTRACT:

Background: Acupuncture is an ancient technique that, when applied to specific points on the body, triggers physiological responses in the muscle. Studies with surface electromyography (EMG) began to correlate the electrical activity of skeletal striated muscles with acupuncture points, but there are still few studies with evidence. **Objective:** To analyze the immediate effect of auricular acupuncture on the EMG activity and muscle strength of trapezium descending fibers. **Methods:** Clinical and prospective study, composed of a sample of 15 individuals, in which they participated in three stages: stage 1 corresponding to control, stage 2 - corresponding intervention and stage 3 corresponding to placebo. The instruments used for evaluation were surface EMG and dynamometry of the trapezius muscle descending bilaterally during maximal voluntary isometric contraction. For the intervention, semipermanent needles were inserted into the auricular acupoints: Shemmen, Kidney, Sympathetic, shoulder and shoulder joint and to the placebo - the needle was inserted at the point of the trachea. The experiment was performed with a fixed interval of seven days between steps. The t-test and the Wilcoxon test were used for intragroup comparisons and the two-way ANOVA test for intergroup comparison. **Results:** There were significant intragroup reductions in trapezius muscle strength for downward intervention, however, for EMG activity there was no statistical difference. **Conclusion:** It is concluded that auricular acupoints decreased the force of the trapezius muscle downward fibers.

Keywords: Electromyography; auriculotherapy; muscle striated; muscle strength.

BACKGROUND

Acupuncture therapy is an age-old technique that uses the principles of traditional Chinese medicine, in which man must be in harmony with the primordial forces of nature, yin and yang - two opposing and complementary principles that make up the whole universe, being that this harmony creates a balance that can be translated as health[(1)]. In the human body we find several specific points known as acupoints, which when stimulated peripherally triggers specific responses to the brain[(2-4)].

In an attempt to better understand the physiological responses resulting from acupuncture and to increase the reliability of the results obtained in controlled trials, some modern diagnostic techniques, such as functional magnetic resonance imaging, have been used to demonstrate possible correlations between acupuncture points and specific areas of the brain[(5, 6)]. In addition, studies with surface electromyography (EMG) began to correlate the electrical activity of striated skeletal muscles with acupuncture points when they were stimulated or not[(7)]. EMG monitors the electrical activity of

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excitable membranes, representing the measure of the potencies of action of the sarcolemma, as a voltage effect in function of time[8, 9].

One well known mode of acupuncture is auricular acupuncture, which consists of acupoints located in the ear, which represent parts of the human body, which when stimulated treat symptoms and pathologies[10]. Politti et al.[11] emphasize that the peripheral stimulation caused by auricular acupuncture is able to modulate the activation of the motor units and the firing frequency of the motor units.

There are still gaps in the literature regarding the effect of auricular acupuncture on the EMG activity, mainly in relation to the immediate effect of this technique. Further research is needed to clarify the role of auricular acupuncture in various health conditions. In view of the presented aspects the study had, as an objective, to analyze the immediate effect of the auricular acupoint on the EMG activity and muscular strength of the trapezius descending fibers.

METHODOLOGY

Study design and sample

Clinical and prospective study, where individuals participated in the three stages: stage 1 - corresponding to the control (first week), stage 2 - corresponding to the intervention (second week) and step 3 - corresponding to placebo (third week) (figure 1). Students of the physiotherapy course of a Federal University were invited to participate in the study and the sample consisted of 15 individuals. The study was carried out at the Federal University of Alfenas, unit II - Santa Clara, in the Movement Analysis Laboratory.

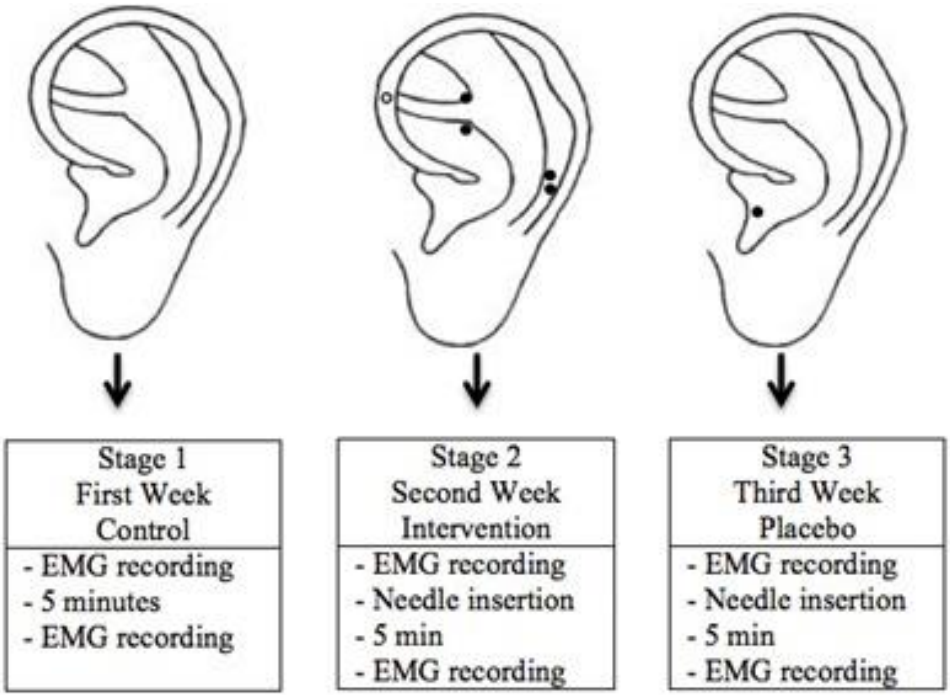

Figure 1. Stages of the groups in weeks

Inclusion criteria for the sample were students enrolled in the physiotherapy course of the Federal University of Alfenas, aged 20-35, who accepted to participate in the study. And the exclusion criteria were individuals with a body mass index (BMI) greater than 29.99 and users of myorelaxant drugs. Sample flowchart (figure 2).

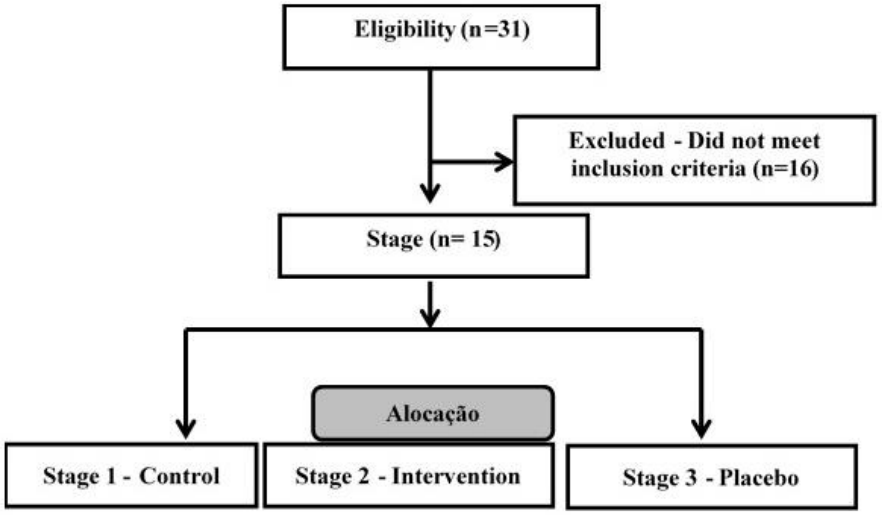

Figure 2. Sample flowchart

The study was approved by the Research Ethics Committee (protocol: 773.954) of the University and met the precepts contained in resolution 466/12 of the National Health Council. Participants signed the Free and Informed Consent Term of the research.

Evaluation

The subjects of the research were evaluated through an Assessment Sheet with demographic data (sex, age and BMI), Surface EMG and dynamometry.

Surface Electromyography

The Surface EMG has, as technical characteristics, the EMG System of Brazil: EMG-800C Model, 16-bit Resolution / Analog Conversion Board; EMG amplifier with total gain gain of 2000 times, bandpass filter from 20 to 1000 Hz, 4 active unipolar surface electrodes with 20 times preamp gain, shielded cable and end pressure clip, common rejection mode> 100 dB, Software for signal collection and analysis with sampling frequency of 2000 Hz per channel. Windows platform, common rejection module => 100 dB, gain of preamplifiers (cables) = gain 20 (with differential amplifier), gain of each channel = gain 100 times (configurable), impedance of system = impedance 109 Ohms, noise ratio = signal noise rate <3 μV RMS, hardware filters in the equipment = FPA (high pass) with cutoff frequency of 20 Hz and FPB (low pass) with a cutoff frequency of 500 Hz, carried out by an analog filter of the Two-pole Butterworth type. The dynamometry was performed with the same EMG process, the same equipment, which is coupled to a load cell, where at the same time dynamometry and EMG were collected.

The trapezius muscle was evaluated bilaterally during the maximal voluntary isometric contraction with load cell resistance (dynamometer). The EMG signal was recorded by recording three collections at two distinct moments (pre and post evaluation). For the first control stage, at the first moment (pre-evaluation) three EMG and dynamometry collections were carried out, after 5 min a second registry was carried out again. For the second and third stage, three EMG and dynamometry collections were carried out at the first moment (pre-evaluation) and sterile 1.5mm disposable, semi-permanent (DongBang®) atrial needles were inserted. At the second moment (after 5 minutes of insertion of the needles) a second record was taken.

The procedure for EMG evaluation involved the placement of surface electrodes. Firstly, skin trichotomy and hygiene with 70% alcohol (Parati®) were carried out in order to reduce skin impedance, avoiding interference and better signal acquisition[12]. The EMG signal was collected in the musculature in maximal voluntary isometric contraction (MVIC) against resistance of the load cell[13]. The verbal command for MVIC ("force, force") was used. The subject was positioned on a bench with their feet flat on the floor, without shoes and in a neutral position[14]. The spinal process of the seventh cervical vertebra (C7) was individually palpated and the monopolar active electrodes (Medtrace®) were placed in the middle of the distance between the acromion and the spinous process of C7[13] (Figure 1). The reference electrode was placed in the styloid process of the ulna on the right side of the subject. In order to collect the EMG data of the MVIC, the individual performed the shoulder elevation, with duration of contraction of 5 seconds.

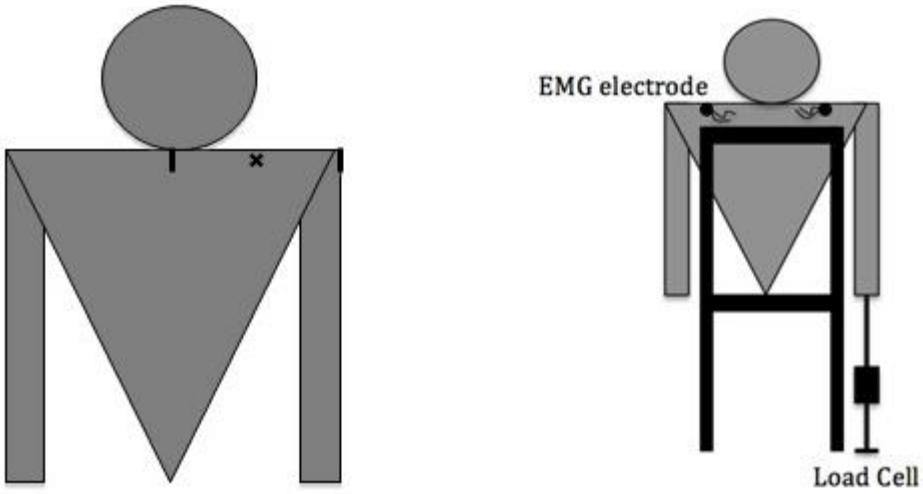

Figure 3. Electrode placement and electromyography collection

Protocol of steps

Step 1 – The individuals were evaluated through EMG and dynamometry initially, after 5 minutes there was a new evaluation. The method chosen for step 2 - intervention was the Chinese school of auricular acupuncture. For this stage the individual is positioned comfortably in a sitting position. The hygiene of the right auricular pavilion with the use of alcohol drenched cotton was performed and semipermanent needles were later inserted by a professional specialized in the area of acupuncture and with 10 years of experience. In the Shenmen acupoints (Point located at the vertex of the angle formed by the lower and upper root of the anti-helix), Rim (point located in the cimba shell, near the junction of the lower root of the anti-helix in the midline of the shenmen point), Sympathetic (point located in the middle of the lower root of the helix membrane), shoulder joint (Point at the same level as the Supratrágica notch) and shoulder (Point located in the middle of the Scapula, at the level of the upper edge of the Helix Root). The systemic needle (Spring 8 Dux®), size 0,18x8mm, was inserted into the right ear, with depth 1.5 mm. Manual stimulation. Cybernetic points (shenmen, kidney and sympathetic) were used as the opening point followed by the points of the shoulder joint and shoulder point[15] and all individuals were right-handed. After reevaluation, these needles were withdrawn.

For step 3 placebo the needle was inserted into the acupoint of the trachea (point located at the level of the bronchial point and 1 mm from the latter towards the auditory meatus), after reevaluation this needle was withdrawn. The same volunteers served as control, intervention and placebo respectively. Consequently, the experiment was carried out in three stages, with a fixed interval of seven days.

The analysis of the EMG signal was evaluated by the median frequency, and the mean of the three samples was calculated, and for the analysis of the force, the average of the three collections was also performed and later used for statistics.

Statistical analysis

The test was used to verify the normality of the data (Shapiro-Wilk) and later the t-test was applied in pairs and the wilcoxon test was used for intragroup comparisons, the two-way ANOVA test was used in the intergroup comparison. Significance was adopted where p <0.05 and the program used was SPSS version 20.0. The G* Power 3.1 program was also used to verify the size of the sample effect and the size of the sample, where the effect size was adopted from 0 to 0.4 a low effect, 0.5 to 0.7 an effect moderate and> 0.8 a high effect and power (P) was considered> 0.8[16].

RESULTS

The sample was characterized by 15 individuals, five males and 10 females, with a mean age of 33,5 years and a mean body mass index of 21,8 kg/cm². It can be observed in Table 1, that there was a significant reduction in muscle strength for the 2-intervention stage when dynamometry was analyzed, however, for the other variables and steps there was no statistical difference. The effect size was low, however, step 2 presented the mean effect size and the sample calculation was below 0,8.

Table 1. Comparative analysis intra and intergroups in the stages

	Step 1 – Control				**Step 2 – Intervention**				**Step 3 - Placebo**				**Intergroup**	
	Before	After			Before	After			Before	After				X
Variable	95%CI		*p*	d power	95%CI		*p*	d power	96%CI		*p*	d power	Before	After
Freq. M. (HZ)														
R	74.15±7.19 70.16 – 78.14	74.54±8.68 69.63 – 79.45	0.68[a]	0.04 0.05	76.99±13,40 69.25 – 84.73	73.28±10.65 67.13 – 79.44	0.25[a]	0.30 0.19	69.45±7.70 65.07 – 74.25	69,59±8,67 64.35 – 74.73	0.86[a]	0.01 0.05	0.23[C]	
L	73.23±8.99 68.27 – 78.24	73.24±9.24 68.35 – 78.95	0.76[a]	0.001 0.05	75.52±11.59 68.83 – 82.22	79.42±10.40 73.41 – 85.43	0.07[a]	0.35 0.24	69.40±9.55 64.15 – 75.44	70,55±6,81 66.53 – 74.69	0.45[a]	0.13 0.07	0.29[C]	
Dina (Kgf/m)														
R	13.00±8.86 10.39 – 15.60	11.53±4.68 8.94 – 14.13	0.27[a]	0.19 0.10	14.50±2.17 13.24 – 15.75	12.88±2.87 11.22 – 14.53	**0.04[a]***	0.62 0.65	10.69±5.45 7.49 – 14.02	12.10±5.81 8.45 – 15.36	0.20[a]	0.25 0.14	0.08[C]	
L	12.18±3.98 9.97 – 14.39	11.39±4.20 9.06 – 13.71	0.45[a]	0.19 0.10	15.22±5.48 12.05 – 18.39	12.81±2.30 11.48 – 14.14	**0.04[b]***	0.50 0.44	10.51±5.59 7.00 – 13.64	11,43±5,82 7.82 – 14.72	0.34[a]	0.16 0.08	0.11[C]	

Note: [a]tpaires test; [b]Wilcoxon test; [C]ANOVA Two-Way; R: Right; L: Left; Freq. M.: Median Frequency; HZ: hertz; Dina: Dynamometer *p<0.05; d- effect size; power >0,8%.

DISCUSSION

The main finding of the study was that there was a reduction in the muscular strength of trapezius descending fibers, when the immediate effect was analyzed by dynamometry after intragroup intervention, however it was not possible to verify changes in the recruitment of the motor units through the median frequency in the other stages. An important factor that can be discussed is the time the semipermanent needle stays in the auricle. In the study of Politti et al[17] the analysis of the median frequency was performed, affirming that auricular acupuncture can act as a modulating mechanism of muscle activity and suggests that the electromyographic activity of the muscle with a longer fixation time of the needles be studied and also after the withdrawal of the semipermanent needles. He also recommended that needle manipulation be continued to achieve better results. A difference when compared to the Politti et al[17] study was in relation to the methodology, in which the collection was performed bilaterally, and unilateral atrial acupuncture and at different atrial points was carried out.

The study Cao et al[18] reports on Mackenzie's theory, in which sensory stimulation of needles can provoke functional responses in muscles, vessels and ligaments without a single myelotome. Karavis[19] explains how acupuncture being a sensitive stimulus can cause muscle contraction or relaxation, this process is called viscerae-visceral reflex. This reflex is activated when there is ipsilateral or contralateral direct stimulation, that is, when a deep needle is placed in or near a ganglion. It is common for sensory stimulation and reaction to be ipsilateral, however in this study unilateral auricular acupuncture points were used and there was relaxation of the trapezius muscles inferior fibers of the two sides analyzed.

Leung[20] state that almost all sensory and rhythmic information is conducted at the level of nuclei of the reticular formation, where they are processed, analyzed and finally these peripheral stimuli reach higher neural centers. The reticular formation is a group of neurons and neural fibers that join nuclei between them and with neural centers, in which there is part of the regular function of muscle tone mechanisms, motor, autonomic and sensorial functions. Thus, it can be considered that the sensorial stimulus given by auricular acupuncture may have reached these central nuclei and in response having muscle relaxation.

In the study by Calamita et al.[21], it was found that there was muscle relaxation of the trapezius muscle of systemic acupuncture, analyzed before and after the treatment by EMG and the RMS data, its results corroborate with the findings of this study. Other authors[22] also found that a single session of systemic acupuncture produces a reduction of muscle activity of the anterior tibial muscle when the points ST36 and SP9 were stimulated and that the ST36 point decreased muscle strength, leading to relaxation. This proves that acupuncture influences muscle activity, strength and relaxation.

Silva et al.[23] in his study analyzed RMS through EMG the immediate effect of atrial acupuncture on trapezius muscle fibers and obtained relief from pain and muscle relaxation. This stimulus involves neurophysiological actions that go beyond the inhibition of pain, in this case, led to generate a mechanism that inhibited muscle activity, which also occurred with this study. Politti et al.[11], it was not possible to affirm

that auricular acupuncture has influences on muscle activity, analyzed by RMS, and suggests that in the next studies the experiment be conducted while the muscle studied performs its main action, which was carried out in this study.

The size of the sample, randomized clinical trials, and the time spent with the needles were the main limitations of the study, it is suggested that a longer intervention time, such as remaining 24 hours with the atrial needles and or having more sessions during the study. However, the auricular acupuncture technique is considered easy to apply and immediate to achieve goals with the patient who wishes to decrease the tension of the trapezius muscle downward fibers.

CONCLUSION

It was concluded that the auricular acupoints did not influence the EMG activity, however, it reduced the strength of the trapezius muscle downward fibers five minutes after the intervention.

Authors' contribution: ATSS and AMSVT contributed to the study design; KBS performed data collection. BC and GOM contributed to the design and tabulation of the data. AAP, ATSS, BC, GOM and AMSVT contributed to the critical review, corrections and approved the final version.

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Conflict of interest: The authors declare no conflict of interests for this study.

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