

ΔF EFFECTS ON THE INTERFERENTIAL CURRENT ACCOMMODATION IN HEALTHY SUBJECTS



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ABSTRACT

Aims: To evaluate in how much time the interferential current (IFC) accommodation occurs, and how many times this accommodation happens in 10 minutes using different patterns of variations in the frequency of stimulation: ΔF null = 0; ΔF low = 30% and ΔF high = 70%. **Materials and methods:** crossover trial, with 15 volunteers, with mean age of 22.53 ± 0.91 years, of both genders. The patients were submitted to IFC for 10 minutes as bipolar with the electrodes longitudinally arranged on the vertebrae L1 and S1. The equipment parameters were: base frequency of 4000Hz, AMF 100 Hz, delivery ramp of ΔF 1:1, ΔF depending on the day and the subgroup, for 10 minutes. The accommodation threshold as well as how many times the current accommodated in the total time of stimulation were evaluated. **Results:** The time of the first accommodation and the number of accommodation evidenced no significant difference ($p > 0.05$). **Conclusion:** It was observed that there was no effect with the variation of the different ΔF analyzed.

Keywords: transcutaneous electric nerve stimulation, sensory thresholds, physical therapy modalities.

INTRODUCTION

Interferential current (IFC) can be termed as a method of electrical stimulation of alternated current of medium frequency which is generally used for pain relief¹. However, it is also applied in other clinical conditions, such as muscular reeducation, strengthening and edema reduction. It presents frequency which ranges in 1-10kHz, and uses low frequency signals, that is to say, ranging between 1 and 150Hz².

One of the advantages of IFC is the possibility of generating frequency modulated by the amplitude (AMF), interferential parameter, which is a low-frequency current deeply generated within the treatment area due to the interaction between two circuits of medium frequency³. The AMF importance is questionable, since there is a lack of effects which evidence significant differences with different AMF⁴.

The IFC intensity in the beginning of the therapy is gradually increased until the individual reports tingling sensation. As soon as this tingling sensation decreases, the intensity of the current can be increased in order to keep a steady stimulus⁵. This process is called "accommodation" and occurs due to the passage of information concerning the external relative changes in decreasing level of the stimulated sensors. The adaptation consists of decrease in the intensity of the response with steady intensity; in other words, the receptors initially respond with high frequency of impulses, progressively decreasing as the stimulus becomes steady⁶. The "accommodation" is tried to be avoided by the variation of the F delta (ΔF)⁷ in the interferential equipment.

The ΔF is a variation in the AMF which causes increase and decrease of frequency in standards pre-set in the equipment, which ranges from 1 to 100Hz. Thus, if AMF of 100Hz, with ΔF of 50Hz is applied, the modulation variation will occur between 100-150Hz. Such fact is also used to avoid the accommodation, since in addition

to the intensity, the frequency alteration is another factor which fights accommodation⁷.

The stimuli provided by the IFC may be local or generalized, depending on the configuration of the current applied to the skin. Contrary to other methods of low-frequency electrical stimulation, this one finds low resistance on the skin and is hence able to deeply penetrate without causing much discomfort⁸. Interferential current may be delivered on the skin in a bipolar manner (two electrodes) or a tetrapolar manner (four electrodes). In the bipolar manner only one circuit is used; therefore, there is no path crossing in depth and the interferential occurs in the machine itself rather than in the patient⁹.

The literature is not very conclusive on the optimum stimulation parameters used in the interferential¹⁰. Despite the general IFC use for pain control, there is lack of scientific evidence which justify its efficiency². Up to the present moment, no studies on the ΔF , the relation between the used parameters and the current accommodation have been found in the literature. Therefore, investigation with this topic becomes important and original.

The present study had the aim to evaluate how much time (minutes and seconds) the first sensation decrease of the interferential current (accommodation) takes to occur and how many times this accommodation occurs in 10 minutes, using different variation in stimulation frequency patterns: ΔF null = 0; low ΔF = 30% and high ΔF = 70%, when using AMF of 100Hz.

MATERIALS AND METHODS

This study is a crossover trial with random and blind sample. It was approved by the Ethics in Research Involving Humans Committee of the State University of Western Paraná – Unioeste, under legal opinion number 003/2011- CEP. Data collection was performed in the laboratory of studies of injuries and

physiotherapeutic resources for a three-week period, in which the volunteers arrived at pre-established times.

The volunteers received information about the aims and procedures of the study and were submitted to an evaluation for identification of possible non-inclusion factors. After they have accepted the invitation and been considered eligible for the study, the volunteers signed a consent form.

The inclusion criteria adopted were: a) availability to participate in the evaluations and tests at the pre-established days and times; b) the individuals should have felt the interferential current at least once in their lives. The non-inclusion and exclusion criteria were: a) a single absence; b) use of drugs which affected the central nervous system or balance, such as sedative or anxiolytic drugs; c) decrease of local sensitivity; d) patients with clinical history of back surgery; e) pregnancy.

Sample and procedures

The sample consisted of 15 healthy individuals, (three male and 12 female, mean age of 22.53 ± 0.91 years, mean weight of 66.93 ± 14.26 kg, mean height of 1.71 ± 0.09 m and BMI 22.52 ± 3.13). The volunteers received the interferential current (Ibramed®) (previously checked equipment), positioned at ventral decubitus with a thin pillow under their abdomen. The current was transmitted in bipolar manner, with electrodes longitudinally arranged on the L1 and S1 vertebrae. The used electrodes were silicone-rubber with 4cm^2 . The equipment parameters were: base frequency of 4,000Hz, AMF 100Hz, ΔF delivery ramp of 1:1, ΔF depending on the day and subgroup, for 10 minutes. Data collection was performed in consecutive days.

The sample was divided in three subgroups:

Subgroup 1 – composed of five individuals who received the current with ΔF null on the first day; with 30% on the second day; and with 70% on the third day.

Subgroup 2 – composed of five individuals who received the current with ΔF of 30% on the first day; with 70% on the second day; and null on the third day.

Subgroup 3 – composed of five individuals who received the ΔF current of 70% on the first day; null on the second day and with 30% on the third day.

Accommodation evaluation

After the placement of the electrodes and the definition of the parameters, the evaluator gradually increased the intensity of the current until the individual reports “tingling” sensation. The volunteers were instructed to say “yes” as soon as the tingling sensation of the current decreased; that is to say, when accommodation took place. The current intensity was increased every time the volunteers reported decrease of the sensation. During this period, the evaluator took note of the time the individual spent to say the first “yes” and how many times the volunteer repeated “yes”, obtaining hence the accommodation threshold (in seconds) and total of accommodations values, respectively.

STATISTICAL ANALYSIS

The size of the sample was calculated using standard deviation of 28, with difference to be detected of 25 (s), for a significance level of 5% and test power of 80%. The data were evaluated concerning their

normality by the D'Agostino & Pearson test, followed by ANOVA for repeated measures, with Bonferroni post-test for the accommodation threshold, with data presentation in mean and standard deviation. Evaluation of the number of times in which the accommodation occurred was performed through the data presentation in median and 1st and 3rd quartiles. The Friedman test with Dunn's post-test was used. In all cases the significance level was of 5%.

RESULTS

It was verified that there was no significant difference ($p > 0.05$) for the time of the first accommodation, considering all the analyzed ΔF , a fact which also repeated for the number of accommodation in 10 minutes ($p > 0.05$) (table 1).

Table 1. Comparison between the time of the first accommodation and the number of accommodations of the different ΔF of the IFC used in a 10-minute application time.

ΔF	Accommodation threshold		Total of accommodations		
	Mean	Standard deviation	Q1	Median	Q3
$\Delta F0$	41.93	25.78	3.00	3.00	3.00
$\Delta F30$	49.40	28.78	4.00	4.00	4.00
$\Delta F70$	43.73	29.63	4.00	6.00	4.00

Subtitles: the measurement standard was in seconds for the accommodation threshold. Q1 – 1st quartile, Q3 – 3rd quartile.

DISCUSSION

The interferential current is used for great variety of indications. According to Fuentes et al.¹¹, the interferential current is able to produce a relief effect to musculoskeletal painful conditions. Jorge et al.¹² evidence that despite its short duration effect, the IFC is able to reduce the inflammatory pain. Tugay et al.¹³ mention that the IFC is efficient in the primary dysmenorrhea and studies prove the beneficial effects of IFC in the intestinal function of children with chronic constipation¹⁴⁻¹⁶.

The study on interferential current is extremely important since despite being a technique widely used by physiotherapists, it does not present optimum parameters for stimulation; therefore, its therapeutic use is empiric, even to avoid accommodation.

The present study was performed with healthy individuals since its aim was to verify accommodation and not its therapeutic purposes, such as analgesia. Since it was a crossed study, planning with three subgroups was conducted. These subgroups were randomly selected and all volunteers received the current for three consecutive days and the three kinds of ΔF .

The delivery method used in this study was performed with two electrodes. Ozcan et al.⁹ mention that the bipolar manner may be clinically more efficient when compared with the tetrapolar manner, since it reaches more deeply and it is more comfortable to the patient. Moreover, according to what has been reported by Bircan et al.¹⁷, when the bipolar manner is used, the medium-frequency currents are pre-mixed in the device and are directly delivered to the skin, contrary to the tetrapolar method, through which the medium-frequency currents cross within the patient's body and therefore, probably offer lower skin impedance.

Since no other study with this approach has been found in the literature, the explanation for the use of ΔF was searched in user's manuals⁷, which is a widely used IFC resource for avoiding

accommodation. It has also been mentioned that higher ΔF are more efficient when compared with lower ones for prevention of accommodation. However, in the present study, in the last 10 minutes in which the volunteers were evaluated, a high number of accommodations was observed in a short period of time, there were no significant differences either between the different analyzed ΔF . Therefore, it can be concluded that this equipment does not interfere in accommodation when used in the bipolar technique, with AMF 100Hz and delivered with variation of one second, by the time analyzed.

A possible explanation for the lack of effects over the accommodation is that the variation in frequency for the AMF is wide; however, when the variation concerning the base frequency is observed, it is very narrow. When the base frequency is of 4,000Hz and AMF of 100Hz, stimulation frequency is of 4,050Hz, in variation of 30%, the base frequency ranged between 4,050-4,065Hz, and with 70% the variation was of 4,050-4,085Hz. Considering the work

by Palmer et al.⁴, in which the medium-frequency stimulation is mentioned as cause of the therapeutic effect rather than the low modulation, may explain the lack of ΔF effects.

The main limitation of this paper was the small number of scientific investigations which approach the accommodation and ΔF theme. Thus, further studies are necessary to evaluate accommodation during electro stimulation, and of it when dealing with different diseases.

CONCLUSION

It is concluded from the results presented that there was not any difference in the time and number of accommodations for the analyzed ΔF .

All authors have declared there is not any potential conflict of interests concerning this article.

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