Original Article

Evaluation of interferential current adaptation in bipolar and tetrapolar forms in women with chronic non-specific low back pain: cross-over clinical trial

Avaliação da adaptação da corrente interferencial nas formas bipolar e tetrapolar em mulheres com lombalgia crônica não específica: ensaio clínico cruzado

Katlen Ludke de Lima[1]
Priciane Tais Krampe[2]
William Henrique Battisti[3]
Dérrick Patrick Artioli[4]
Gladson Ricardo Flor Bertolini[5]

[1-3]Universidade Estadual do Oeste do Paraná (Cascavel). Paraná, Brasil. katlenludke@hotmail.com, prici_tais@hotmail.com, william98battisti@gmail.com
[4]Centro Universitário Lusíada (Santos). São Paulo, Brazil. derricksantacasa@hotmail.com
[5]Corresponding author. Universidade Estadual do Oeste do Paraná (Cascavel). Paraná, Brazil. gladsonricardo@gmail.com

ABSTRACT | INTRODUCTION: The interferential current is a widely used modality; however, it presents as a limiting factor the amount of accommodation, which is common in electrostimulation. Despite having some resources that aim to reduce physiological adaptation, it is not fully effective in this sense, but there may be differences due to the technique of use. Thus, the present study aimed to analyze whether there are differences in the accommodation for bi- or tetrapolar forms in individuals with chronic nonspecific low back pain. **METHODS:** Crossover clinical study, consisting of 15 volunteers with chronic nonspecific low back pain, who received bipolar or tetrapolar therapy in subsequent weeks. They were explained about the current accommodation and that they should be told when it occurred, and in this way, the number of times that the phenomenon occurred, the time needed until the first accommodation occurred, the initial intensity of the current used, and how much it increased after the first accommodation were computed. **RESULTS:** None of the variables analyzed had a significant difference between the two techniques (p>0.05). **CONCLUSION:** The techniques analyzed showed no differences in accommodation in young women with nonspecific low back pain.

KEYWORDS: Low back pain. Physiological adaptation. Electric stimulation therapy.

RESUMO | INTRODUÇÃO: A corrente interferencial é uma modalidade bastante utilizada, porém, apresenta como fator limitante a quantidade de acomodações, o que é comum em eletroestimulação. Apesar de possuir alguns recursos que visam reduzir a adaptação fisiológica, não é totalmente eficaz; neste sentido, pode haver diferenças devido à técnica de uso. Assim, o presente estudo pretendeu analisar se há diferenças na adaptação para as formas bipolar ou tetrapolar em indivíduos com dor lombar crônica não específica. **MÉTODOS:** Ensaio clínico cruzado, composto por 15 voluntárias com dor lombar crônica não específica, as quais receberam terapia bipolar ou tetrapolar em semanas subsequentes. Foi explicado sobre a adaptação à corrente e o que deveria avisar quando ocorresse, e, desta forma, foi computado o número de vezes em que o fenômeno ocorreu, o tempo necessário até ocorrer a primeira adaptação, a intensidade inicial da corrente utilizada e o quanto aumentou-se após a primeira adaptação. **RESULTADOS:** Para nenhuma das variáveis analisadas, foi observada diferença significativa entre as duas técnicas (p>0,05). **CONCLUSÃO:** As técnicas analisadas não mostraram diferenças na adaptação em mulheres jovens com dor lombar não específica.

PALAVRAS-CHAVE: Dor lombar. Adaptação fisiológica. Terapia por estimulação elétrica.

Submitted 05/31/2021, Accepted 07/12/2021, Published 08/04/2021
J. Physiother. Res., Salvador, 2021 August;11(3):495-500
http://dx.doi.org/10.17267/2238-2704rpf.v11i3.3858 | ISSN: 2238-2704
Designated editors: Abrahão Baptista, Katia Sá

How to cite this article: Lima KL, Krampe PT, Battisti WH, Artioli DP, Bertolini GRF. Evaluation of interferential current adaptation in bipolar and tetrapolar forms in women with chronic non-specific low back pain: cross-over clinical trial. J Physiother Res. 2021;11(3):495-500. http://dx.doi.org/10.17267/2238-2704rpf.v11i3.3858

Introduction

Nonspecific low back pain affects people in all age groups and is characterized by not having a determined cause. It generates alterations in daily activities and can be initiated by physical and/or psychosocial factors, which leads to the loss of work and study days, especially in its chronic form, which lasts from 3 months on. Although its clinical course is generally favorable, drug and non-pharmacological therapies are often necessary for its treatment.[1,2] Among the tools used in physiotherapy treatment, one can mention the interferential current, which, despite controversies[3,4], has proven effective in reducing low back pain in isolation[5,6] or prior to exercise protocols.[7]

The interferential current is characterized by being of the medium frequency (thus being able to reach deep tissues), in which two currents with a small difference in their frequencies interfere with each other, generating a new low frequency modulated current. The main purpose of its use is the reduction of pain.[8,9] However, during its use, it is widespread the occurrence of adaptation of peripheral nerves, requiring that the intensity of the current be increased so that the stimuli are adequate to its objective.[9] Adaptation occurs when a stimulus is applied on a neuronal receptor, reaches a plateau, and the action potentials become reduced in frequency. Such phenomenon is due to the increase in potassium conductance and, subsequently, the inactivation of sodium channel.[10]

The interferential current has some resources that aim to reduce the physiological adaptation to a constant stimulus, which is variations in the frequency (Δf)[11] of the modulated current (MFA), delivered in certain patterns of rising and decay[12], however, in healthy individuals, they have not achieved their goal, which has also been observed when changing the base frequency of the current.[13] However, the bipolar form has been shown to accommodate more quickly than the tetrapolar in healthy individuals.[14] Since the modality is generally used in people with pain, and the adaptation generates the need for more direct care to the patient, the present study intended to analyze whether there are differences in the adaptation to bi- or tetrapolar forms in individuals with chronic nonspecific low back pain.

Materials and methods

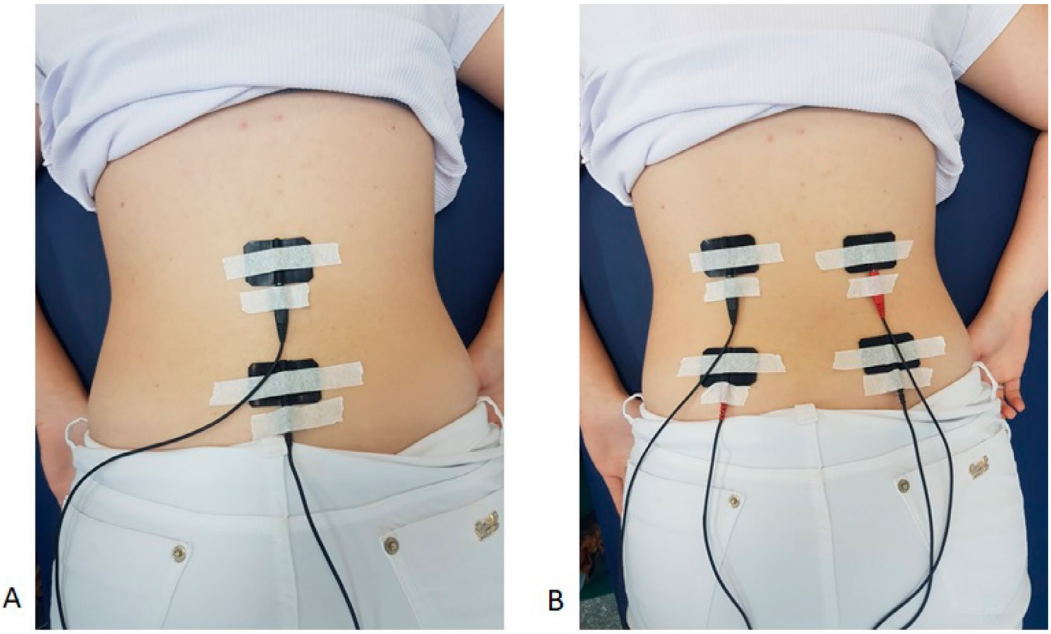
This was a quasi-experimental, longitudinal, quantitative, cross-over study, blinded by the evaluator. The sample group was composed of 15 female volunteers, selected directly and by convenience.

In the first moment, each volunteer explained the intentions and procedures of the research and questioned her interest in participating in it. Once the invitation was accepted, and the inclusion and noninclusion criteria were met, the informed consent form was signed and approved by the research ethics committee (opinion number 3,325,098, CAAE 93672318.9.0000.0107).

The inclusion criteria were: being a university student, having persistent low back pain for at least four months, and aged between 17 and 28 years. The non-inclusion criteria were: specific low back pain, use of drugs that affect the central nervous system, physical exercise, non-agreement to participate in the study, pregnancy, and neuromusculoskeletal diseases (besides chronic low back pain).

The 15 volunteers were separated into 2 subgroups by lottery (https://www.graphpad.com/quickcalcs/randomize1/) so that the form of therapy applied (bipolar or tetrapolar) was alternated in all participants, with a separation of 1 week. The parameters used were: base current of 4 kHz, AMF 100 Hz; ΔF0, lasting 20 min, with a difference in application between bipolar mode (electrodes placed on the spinous process of L1 and L5 - fig. 1A), and the tetrapolar mode (applied laterally 3 cm from the spinous processes of L1 and L5 - fig. 1B), the electrodes were made of silicone rubber, with an area of 8 cm2 each.

Figure 1. Electrode positioning of the interferential currents in bipolar (1A) and tetrapolar (1B) form



It was explained, prior to the application of the current, about the adaptation of the current and that when this phenomenon occurred, they should request that the intensity be increased until they felt the same initial stimulus again. The variables analyzed were: a) the total number of accommodations; b) time needed until the first adaptation occurred (in seconds); c) initial intensity (in milliamperes); d) increased intensity the first time the current was accommodated. Being "a" and "b" primary endpoints and "c" and "d" secondary endpoints.

Statistical analysis

The data were analyzed by the Biostat 5.0 program. The evaluation of normality was performed by the Shapiro-Wilk test, for parametric data the paired t-test was used, and for nonparametric data the Wilcoxon test was used; in all cases the accepted significance level was 5%. Thus, the analysis of the total number of accommodations and times for the first adaptation to occur was presented in a graph showing median and dispersion, and for the initial intensity and its increase the graph showed mean and standard deviation. The sample (n=15) was calculated based on an effect size of 0.9, α=0.05, and a power of 95% (G*Power 3.1.9.7).

Results

The sample was 20.0±1.2 years old, height 1.65±0.06 m, body mass 63.7±14.7 kg and BMI 23.4±4.9. In none of the variables analyzed there were significant differences in the comparisons, both for total accommodations and time for the first (fig. 2), and for the intensities involved (fig. 3). All 15 volunteers were analyzed and there were no missing data.

Figure 2. Variables related to interferential current adaptation. A. Number of accommodations for both bi and tetrapolar form. B. Time taken until the first adaptation

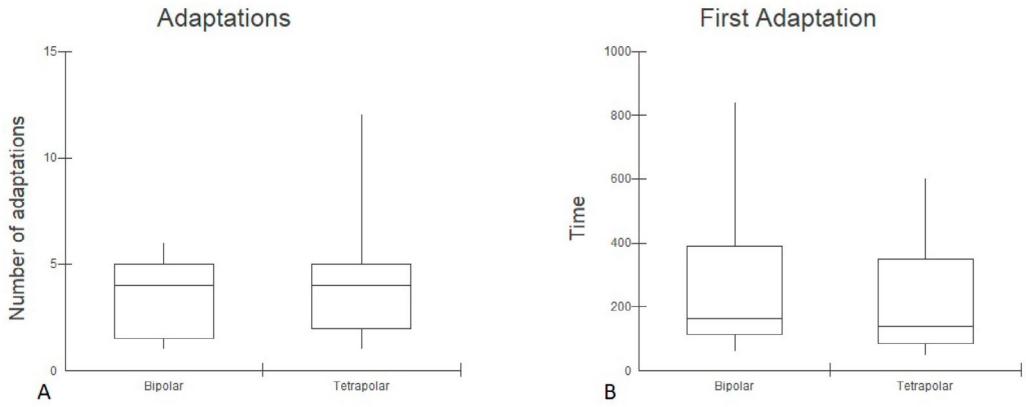
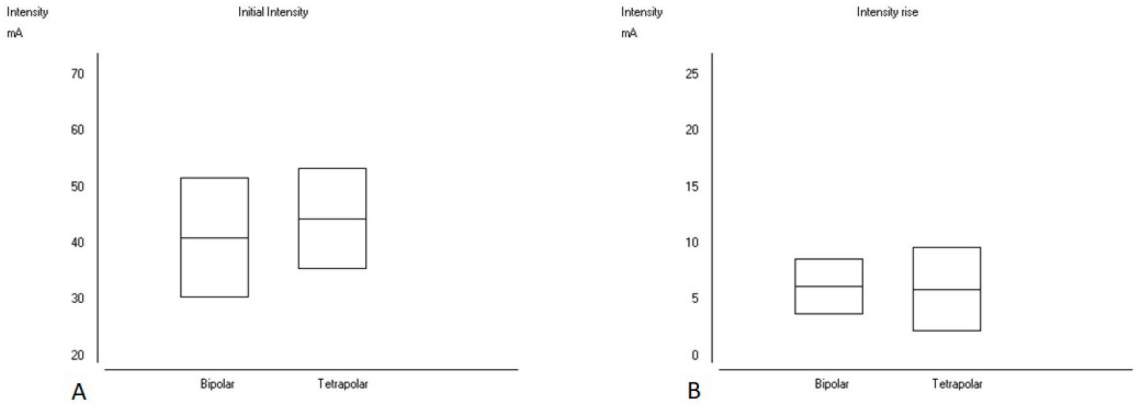


Figure 3. Current intensity related variables. A. Initial intensity used in the different subgroups. B. Raising the intensity when the first adaptation is reached



Discussion

This study compared the adaptation of bipolar interferential current with that observed in the tetrapolar form in women with chronic nonspecific low back pain, and no differences were observed in both types of stimulation. Both forms of therapy are used in clinical practice, and studies indicate benefits when used to reduce pain[3,6,15], being that the tetrapolar form, also called "true," has the advantage of greater spread of the current, thus giving a larger treatment area.[16]

In research with healthy individuals, it was observed that the tetrapolar form presented a greater adaptation threshold. It took a long time between the beginning of the application until the moment in which the volunteer reported the need to increase the intensity when compared to the bipolar form.[14] However, in rare cases, the current is used below the motor threshold in healthy individuals; thus, this study intended to test the current forms in lumbar spinal pain patients. Nonspecific low back pain leads to limitation of physical capacity, which enables various therapeutic resources, such as electrophysical agents for pain relief, which can facilitate for these patients to participate in an exercise program.[3,6,17–19] However, the constant need for readjustments in the intensity of the current can be difficult for both the patient and the therapist, who always needs to be close to the equipment; thus, the observation of which type of current or which resource can guarantee a longer time without the need to increase the intensity due to adaptation to the stimulus is important.

Since the electrostimulation currents, especially those below the motor threshold, produce the rapid adaptation, that is, they need constant attention, some currents are provided with changes in frequency and intensity, to reduce the need to raise the current amplitude, such as TENS, which is characterized by being of low frequency, and in current equipment they have the VIF modality, in which both phase duration and frequency are altered, also changing the electrical load applied. When comparing this modality with conventional TENS and burst in individuals with nonspecific low back pain, Costa et al.[20] observed that there were fewer accommodations in the former, although there were no differences in the adaptation thresholds. Silva et al.[21] did not observe differences in adaptation when comparing the frequencies of 7, 100, and 255 Hz of TENS.

For the interferential current in healthy subjects, no differences were observed when analyzing variations in the base frequency[13] or resources such as the Δf[11] and different ramps of presentation.[12] In the present study, no significant variations were observed between the groups either in the threshold of adaptation or in the number of adaptations, i.e., the time required for the adaptation to occur was similar for the groups, as well as the number of times that it was necessary to increase the current for the analgesic stimulus to remain active. Furthermore, in healthy volunteers, Dallacorte et al.[22] compared variations between genders and observed that men needed higher current intensities to obtain pleasant levels of stimulation, having a higher threshold and a lower number of accommodations. In this study, even having as a methodological design the crossover, we chose to use only symptomatic young women, and aiming to reduce a possible influence of the initial current intensity in the accommodations, we decided to compare both this variable and the amplitude used to increase in the first episode of adaptation. There were again no statistical differences in both variables for the two ways of application, indicating the proximity of stimulation thresholds for both forms.

A limitation of this crossover study model is applying a single intervention, which may interfere with a possible "learning" of the sensation of stimulation. Therefore, it is suggested that future studies evaluate whether the sum of therapies may influence the variables under analysis. Additionally, noteworthy as limitations are the parameters and the sample used, which does not reflect all the individuals in which this form of therapy is used; however, it is believed that it can guide what to expect from individuals of different sexes and ages.

Conclusion

It is concluded that when comparing bipolar and tetrapolar forms, there were no significant differences in adaptation in young women with chronic nonspecific low back pain.

Author contributions

Lima KL, Krampe PT, Battisti WH participated in the conception, design, data collection, and scientific article writing. Artioli DP participated in the conception, design, data interpretation, and critical revision of the manuscript. Bertolini GRF participated in the conception, design, statistical analysis of the research data, interpretation of the results, and critical revision of the scientific article.

Competing interests

No financial, legal, or political conflicts involving third parties (government, private companies, and foundations, etc.) have been declared for any aspect of the submitted work (including but not limited to grants and funding, advisory board participation, study design, manuscript preparation, statistical analysis, etc.).

References

1. Maher C, Underwood M, Buchbinder R. Non-specific low back pain. Lancet. 2017;389(10070):736-47. https://doi.org/10.1016/s0140-6736(16)30970-9

2. Chenot JF, Greitemann B, Kladny B, Petzke F, Pfingsten M, Schorr SG. Clinical practice guideline: Non-specific low back pain. Dtsch Arztebl Int. 2017;114(51-52):883-90. https://doi.org/10.3238/arztebl.2017.0883

3. Albornoz-Cabello M, Maya-Martín J, Domínguez-Maldonado G, Espejo-Antúnez L, Heredia-Rizo AM. Effect of interferential current therapy on pain perception and disability level in subjects with chronic low back pain: A randomized controlled trial. Clin Rehabil. 2017;31(2):242-9. https://doi.org/10.1177/0269215516639653

4. Franco KM, Franco YS, Oliveira NB, Miyamoto GC, Santos MO, Liebano RE, et al. Is interferential current before pilates exercises more effective than placebo in patients with chronic nonspecific low back pain?: A randomized controlled trial. Arch Phys Med Rehabil. 2017;98(2):320-8. https://doi.org/10.1016/j.apmr.2016.08.485

5. Corrêa JB, Costa LOP, Oliveira NTB, Lima WP, Sluka KA, Liebano RE. Effects of the carrier frequency of interferential current on pain modulation and central hypersensitivity in people with chronic nonspecific low back pain: A randomized placebo-controlled trial. Eur J Pain. 2016;20(10):1653-66. https://doi.org/10.1002/ejp.889

6. Serafim A, Rabel J, Neves M, Silva T, Bertolini G. Evaluation of acute low back pain in women after treatment with interferential current. J Pre-Clinical Clin Res. 2019;13(2):57-60. https://doi.org/10.26444/jpccr/109752

7. Franco YR, Franco KF, Silva LA, Silva MO, Rodrigues MN, Liebano RE, et al. Does the use of interferential current prior to pilates exercises accelerate improvement of chronic nonspecific low back pain? Pain Manag. 2018;8(6):465-74. https://doi.org/10.2217/pmt-2018-0034

8. Fuentes JP, Olivo SA, Magee DJ, Gross DP. Effectiveness of interferential current therapy in the management of musculoskeletal pain: a systematic review and meta-analysis. Phys Ther. 2010;90(9):1219-38. https://doi.org/10.2522/ptj.20090335

9. Goats GC. Interferential current therapy. Br J Sport Med. 1990;24(2):87-92. https://doi.org/10.1136/bjsm.24.2.87

10. Krueger-Beck E, Nogueira-Neto GN, Neves EB, Nohama P. Potencial de ação: do estímulo à adaptação neural. Fisioter mov. 2011;24(3):535-47. https://doi.org/10.1590/S0103-51502011000300018

11. Pivetta KM, Bertolini GRF. Efeitos do ΔF sobre a acomodação da corrente interferencial em sujeitos saudáveis. Rev Bras Med Esporte. 2012;18(5):330-2. https://doi.org/10.1590/S1517-86922012000500009

12. Guerra TEC, Bertolini GRF. Efeitos da variação da rampa de entrega do ΔF sobre a acomodação da corrente interferencial em mulheres saudáveis. Rev Dor. 2012;13(1):25-9. https://doi.org/10.1590/S1806-00132012000100005

13. Grando F, Bernardino G, Carvalho J, Bosco J, Arago F, Bertolini G. Comparison of interferential current accommodation using three different base frequencies. Int J Ther Rehabil Res [Internet]. 2014;3(2):5. Available from: https://www.researchgate.net/profile/Gladson-Bertolini/publication/273716261_Comparison_of_interferential_current_accommodation_using_three_different_base_frequencies/links/55195b170cf273292e714fe1/Comparison-of-interferential-current-accommodation-using-three-different-base-frequencies.pdf

14. Fiori A, Cescon CLC, Galesky JDF, Santos TACD, Brancalhaõ RMC, Bertolini GRF. Comparison between bipolar and tetrapolar of the interferential current in nociceptive threshold, accommodation and pleasantness in healthy individuals. Eur J Physiother. 2014;16(4):201-5. https://doi.org/10.3109/21679169.2014.933875

15. Okuyama EB, Yoshida GSO, Weirich RV, Assai TM, Artioli DP, Bertolini GRF. Effect of tetrapolar interferential current on primary dysmenorrhea associated with low back pain: randomized clinical trial. J Heal Sci. 2019;21(3):204. https://doi.org/10.17921/2447-8938.2019v21n3p204-207

16. Beatti A, Rayner A, Chipchase L, Souvlis T. Penetration and spread of interferential current in cutaneous, subcutaneous and muscle tissues. Physiotherapy. 2011;97(4):319-26. https://doi.org/10.1016/j.physio.2011.01.008

17. Urrútia G, Burton AK, Morral A, Bonfill X, Zanoli G. Neuroreflexotherapy for non-specific low-back pain. Cochrane Database Syst Rev. 2004;(2):CD003009. Cited: PMID: 15106186

18. Goubert D, Van Oosterwijck J, Meeus M, Danneels L. Structural changes of lumbar muscles in non-specific low back pain. Pain Physician. 2016;19(7):E985-E1000. Cited: PMID: 27676689

19. Karvat J, Antunes JS, Bertolini GRF. Corrente interferencial como forma de tratamento em pacientes com dor lombar. Publ UEPG Ciencias Biol e da Saude [internet]. 2016;22(1):7-13. https://revistas2.uepg.br/index.php/biologica/article/view/6694

20. Costa ER, Roth F, Pauli G, Gozzblr VB, Anguera MG, Bertolini GRF. Accommodation and pleasantness of different forms of transcutaneous electrical nerve stimulation in individuals with nonspecific lumbar pain. Int Phys Med Rehabil J. 2018;4(2):86-9. https://doi.org/10.15406/ipmrj.2019.04.00179

21. Silva DO, Ferreira AS, Gonçalves AV, Costa MD, Zilio M, Fréz AR, et al. Effects of different transcutaneous electrical nerve stimulation frequencies regarding adaptation and pleasantness. Sci Med. 2014;24(3):264-8. https://doi.org/10.15448/1980-6108.2014.3.17739

22. Dallacorte DA, Sprizon GS, Bueno KS, Hotz PG, Aragão FA, Bertolini GRF. Comparison of the effects of interferential current between male and female healthy adults. Sci Med. 2017;27(3):ID27660. https://doi.org/10.15448/1980-6108.2017.3.27660