Study of the effectiveness of interferential current as compared to transcutaneous electrical nerve stimulation in reducing chronic low back pain*

Estudo da eficácia da corrente interferencial em comparação à estimulação elétrica transcutânea na redução da dor lombar crônica

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ABSTRACT

BACKGROUND AND OBJECTIVES: Chronic low back pain has an incidence of 70% in general population and induces significant limitations. As treatment, physiotherapy stands out with a wide variety of techniques among them, for pain relief, electrotherapy is a useful tool. This study aimed at comparing the analgesic effects of transcutaneous electrical nerve stimulation and interferential current in patients with chronic low back pain.
METHODS: Randomized clinical trial carried out between August 2013 and May 2014 in the clinic school of physiotherapy, Ulbra-Torres, with chronic low back pain patients. Patients were divided in two groups: intervention group (IG) treated with interferential current and control group (CG) treated with transcutaneous electrical nerve stimulation. Visual analog scale, Oswestry Questionnaire and Roland Morris Disability Questionnaire were used for baseline evaluation. Patients were treated for five weeks, twice a week, in a total of 10 interventions. At the end, they were re-evaluated and one month after they were submitted to follow-up with the visual analog scale.
RESULTS: Participated in the study 28 patients, being 14 in IG and 14 in CG. Sample was homogeneous intragroups for gender, age, color and mean pain duration. There has been significant pain improvement in both groups by the visual analog scale and functionality improvement by Oswestry and Roland Morris Disability Questionnaires when comparing baseline and final evaluations ($p<0.05$).
CONCLUSION: There were positive results in chronic low back pain improvement both with transcutaneous electrical nerve stimulation and interferential current, without significant difference between transcutaneous currents.

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RESUMO

JUSTIFICATIVA E OBJETIVOS: A dor lombar crônica possui incidência de 70% na população induzindo a limitações significativas. Como tratamento,a fisioterapia destaca-se com ampla variedade de técnicas, onde para o alívio da dor a eletroterapia é uma ferramenta aliada. O objetivo deste estudo foi comparar os efeitos analgésicos da estimulação elétrica transcutânea e da corrente interferencial em pacientes com lombalgia crônica.
MÉTODOS: Ensaio clínico randômico realizado entre agosto de 2013 e maio de 2014 na clínica escola de fisioterapia da Ulbra - Torres, com pacientes com dor lombar crônica. Os pacientes foram divididos em dois grupos: grupo intervenção (GI), recebendo tratamento através da corrente interferencial e grupo controle (GC), realizando tratamento através da estimulação elétrica transcutânea. Foi realizada avaliação inicial com a escala analógica visual, Questionário de Oswestry e Questionário de Incapacidade Roland Morris. Atendidos por cinco semanas, duas vezes na semana, totalizando 10 intervenções, ao final eram reavaliados e após um mês submetidos a um *follow-up* com escala analógica visual.
RESULTADOS: Participaram do estudo 28 pacientes, sendo 14 no GI e 14 no GC. A amostra foi homogênea intragrupos para gênero, idade, cor e média de tempo de dor. Encontrou-se melhora significativa em ambos os grupos na dor pela escala analógica visual e funcionalidade pelosquestionários de Oswestry e de Incapacidade Roland Morris da avaliação inicial paraa final ($p<0,05$).
CONCLUSÃO: Houve resultados positivos na redução da dor lombar crônica com aplicação tanto com estimulação elétrica transcutânea quanto com corrente interferencial, não havendo diferença significativa entre as correntes transcutâneas.
Descritores: Dor lombar, Fisioterapia, Estimulação elétrica transcutânea.

INTRODUCTION

Chronic low back pain (CLBP) is one of the most common problems in developed countries[1,2]. It is estimated that more

than 70% of adults have at least one low back pain (LBP) episode along their lives[3], causing frequent physical limitation in individuals below 45 years of age[4]. Functional incapacity and chronicity related to this disease are complex and multifactorial phenomena, associated with high social and health costs[5-7]. In general, CLBP is not a consequence of specific diseases, but rather of a set of causes such as inflammatory, degenerative and neoplastic diseases, congenital defects and also by influence of socio-demographic and behavioral factors and daily activities[8].
In the reeducation of patients about risk factors for vertebral diseases, physiotherapy and pharmacological therapy are the foundations to manage spinal pain. In physiotherapy, electrotherapy may be useful to minimize such patients' symptoms[9]. In addition to manual therapy and exercises, electrotherapy methods are widely used to decrease pain. Among them, the best known methods are transcutaneous electrical nerve stimulation (TENS) and interferential current[1,10,11].
Interferential current is medium frequency current producing low skin impedance and allowing deeper tissue penetration[10], thus being considered effective to immediately decrease pain[12]. In electrical stimulation with TENS, electrical impulses vary in intensity and frequency when stimulating the nerve in spinal cord pathway, blocking pain transmission and being used for musculoskeletal pain relief, including LBP of any etiology[13,14].
To investigate the suggestive analgesic effect of currents, scales such as the visual analog scale (VAS), which quantifies pain intensity, and Roland Morris (RMSQ) and Oswestry questionnaires, with check the functionality of CLBP patients, are used and are extremely important for the reliability of the research[5,15-22].
Notwithstanding previous studies indicating electrotherapy as favorable resource to decrease CLBP, there are questions about which current is the most effective. This study aimed at comparing analgesic effects of TENS and interferential current in chronic low back pain patients.

METHODS

This is a randomized clinical trial, developed according to Regulating Guidelines and Standards for research involving human beings. Data were collected between August 2013 and May 2014 in the clinic school of physiotherapy, ULBRA – Torres Campus.
Individuals were invited to participate in the study and were oriented about objectives, methodology and application methods. All eligible CLBP patients have signed the Free and Informed Consent Term.
Sample was made up of individuals with LBP equal to or above 5 according to VAS, for more than three months and who were not being submitted to any other pharmacological or physical treatment at the moment of the study, aged above 18 years and with nonspecific pain. Exclusion criteria were patients who during the study were under analgesics, females in the first quarter of gestation, patients with previous history of low back surgery, patients clinically diagnosed with rheumatic disease, with signs of radiculopathy and pain irradiation to lower limbs, who have missed two consecutive or three alternate sessions, with any cognitive disorders or incapacity to answer to questionnaires and with contraindications for electrotherapy (cardiac patients with pacemaker).
All patients went through the same baseline evaluation and were evaluated with VAS, Oswestry and RMSQ questionnaires, which were filled by patients according to their symptoms.
After baseline evaluation, patients were randomly divided in intervention group (IG) being treated with interferential current and control group (CG) being treated with TENS.
CG was treated with TENS in the acupuncture form, with patients in the prone position, with two channels and electrodes (10x10cm) positioned to surround pain area, closing pain circuit, using gel and fixation tape, with frequency adjustment of 20Hz and pulse width of 10 pulses per second (pps), with 30-minute application time and intensity according to patients' tolerance. Procedures were performed twice a week for a period of five weeks, in a total of 10 interventions.
IG was treated with interferential current in the tetrapolar form, with patients in the prone position. Electrodes (5x10cm) were positioned to close pain circuit being placed in the lumbar spine on the central pain point, using gel and fixation tape. Carrier frequency was 4000Hz, with modulated frequency amplitude (MFA) of 20Hz, ΔMFA of 10Hz and inclination of 1/1 during 30 minutes, and intensity according to patients' tolerance. After removal of electrodes, patients' application area was cleaned with paper towel to remove excessive gel. In the sequence, electrodes were washed in running water and dried with paper towels. This procedure was always performed after the individual treatment of each patient.
At intervention protocol completion (five weeks of intervention), patients were re-evaluated with AS and Oswestry and RMSQ questionnaires.
Thirty days later, patients were submitted to follow-up evaluation where VAS was applied to check the maintenance of late analgesia of the proposed treatment.

Sample calculation and randomization

The statistical program EPI-INFO®, version 7.0 was used to calculate sample size. After the literature review, it was observed prevalence of approximately 70% LBP in the population[3]. Knowing that the population of the city is approximately 40,000 and using a power of 80%, a reliability level of 95% and an effect power of 40, we have reached the estimated number of 20 subjects for each study group. Believing that losses and refusals would remain around 50%, we have reached the final number of 30 subjects for each study group.

Statistical analysis

The program SPSS (Statistical Package for the Social Sci-

ences) version 17.0 was used as database and statistical package. Data were entered twice to prevent typing mistakes and were expressed in mean and standard deviation. Then, they were statistically analyzed by parametric paired Student's *t* test for analysis inside each group from treatment beginning to completion, and non-paired Student's *t* test for analysis of variables between groups. Wilcoxon and Mann-Whitney tests were used for non-parametric variables, respectively, for inside each group and between groups. Significance level was $p<0.05$.

This study was approved by the institution's Ethics and Research Committee under number 319.672.

RESULTS

From the initial sample, 28 patients have completed all study stages, being 14 in each group. From these, 22 were females. Mean age was 61.93 years. Mean pain evolution time was 8.11 years. Table 1 shows sample characterization by groups. Groups where homogeneous in gender, age, skin color, occupation and pain duration.

Table 2 shows qualitative information about patients' functionality, where the level of involvement was markedly decreased in both groups. At baseline evaluation, all individuals had moderate to severe pain, and at treatment completion, 26 subjects had scores considered as mildly affected, 13 in each group.

Figures 1 and 2 show quantitative information on patients' functionality impairment. Both groups had significant functional scores improvement; however there has been no difference between them both in baseline and final evaluation. Figure 1 shows that Oswestry Disability Index baseline score was 17.64±4.36 for CG and 16.21±2.86 for IG. Final evaluation has decreased to 6.50±4.35 e 3.93±0.27, respectively.

As to Roland Morris questionnaire scores, control group had 13.64±4.45 decreasing to 5.43±2.60 (p=0.0001). The

Table 2. Oswestry questionnaire classification for both groups

Variables	Control group (n=14)	Intervention group (n=14)	p value
Baseline evaluation (n)			
Moderate	11	13	
Severe	3	1	0.60
Final evaluation (n)			
Mildly affected	13	13	
Moderate	1	1	1.00
p value	0.0003	0.001	

*Chi-square.

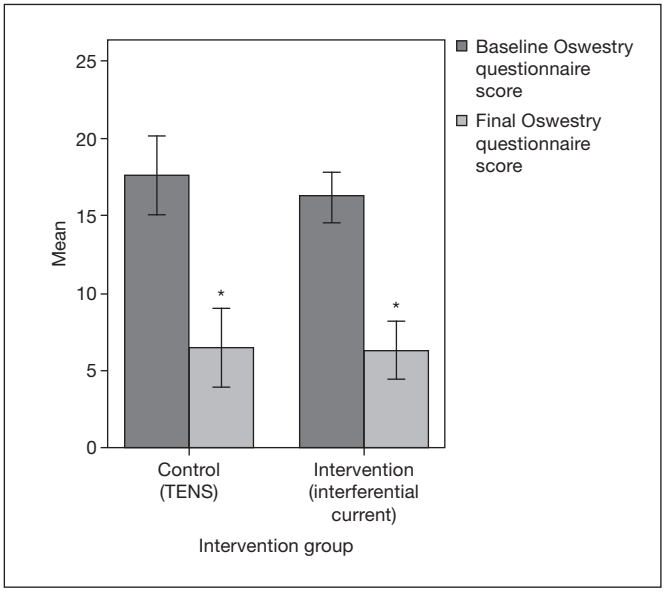

Figure 1. Oswestry Disability Index questionnaire scores for both studied groups

*p<0.05 as compared to baseline evaluation.

Table 1. Sample characterization

Variables	Total (n=28)	Control group (n=14)	Intervention group (n=14)	p value*
Gender n. (M/F)	6/22	2/12	4/10	0.65
Mean age, (years) (SD)	61.93 (9.66)	60.64 (10.55)	63.21 (8.89)	0.40
Skin color				
Caucasian	28	14	14	
Afro-Brazilian	0	0	0	-
Occupation n. (%)				
Housewife	9 (32.1)	5 (35.7)	4 (28.6)	
Professor	5 (17.9)	3 (21.4)	2 (14.3)	
Sales rep.	3 (10.7)	1 (7.1)	2 (14.3)	
Housemaid	2 (7.1)	0	2 (14.3)	
Others	9 (32.2)	5 (35.6)	4 (28.5)	0.47
Mean pain duration (years) (SD)	8.11(4.80)	8.43 (4.90)	7.79 (4.81)	0.64

*Chi-square.

intervention group has decreased Roland Morris score from 12.64±3.00 to 3.79±2.74 (p=0.0001). There has been no statistically significant difference between groups at intervention completion.

Figure 3 shows the level of pain observed by VAS, where there is significant improvement when comparing baseline and final evaluation for both groups, with maintenance of analgesia in the follow-up period. There has been no difference between groups.

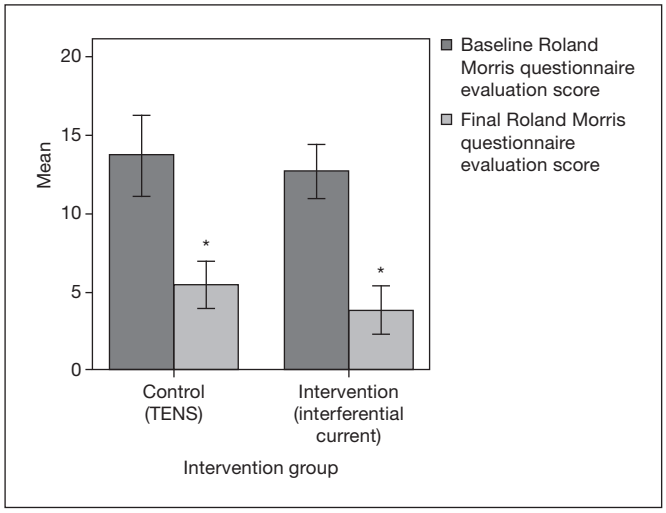

Figure 2. Roland Morris questionnaire results for both studied groups

*p<0.05 as compared to baseline evaluation.

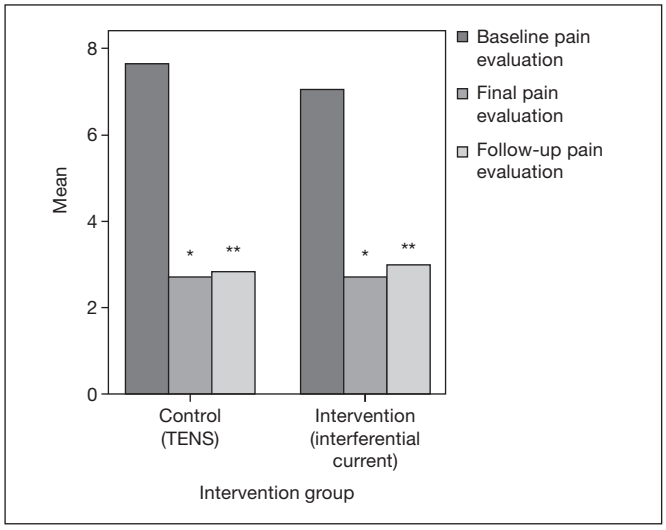

Figure 3. Pain score variation based on visual analog scale for control and intervention groups during the study period

*p<0.05 as compared to baseline evaluation, ** p<0.05 as compared to baseline evaluation inside group.

DISCUSSION

Sample was homogeneous intragroups for gender (p=0.65), age (p=0.40), skin color and mean pain duration (p=0.54). We have also evaluated the effects of electrotherapeutic currents on quality of life and functionality, because the literature shows that these issues are affected in CLBP patients[23,24].

Studies have shown that the application of interferential current and TENS to treat low back pain is a feasible intervention method, significantly effective and well tolerated by patients[6,9,10,12,15,25-27]. Other physiotherapeutic interventions were found to treat this disease, such as laser, short-waves, Bernard diadynamic currents, electroacupuncture and other kinesiotherapeutic resources[6,9,10,12,15,25,26].

It was also observed that there is still no consensus about the best intervention for low back pain patients, or about treatment duration and its frequency, being such information widely variable in the literature[6,9,10,12,15,25,26].

Our study has evaluated homogeneous groups, which is not very common in other studies and might have interfered with results. We have found divergences with regard to sample characteristics, suggesting one justification for the lack of consensus on treatment parameters[27]. Other authors had difficulties with divergent conclusions due to the use of different parameters and devices for this practice[28].

Our results confirm Faccil et al. results[10], who have shown the efficacy of both interferential current and TENS, without statistically significant differences between them. The beneficial effect of both currents was also observed in a review[29]. In both studies, electric stimulation parameters were similar.

This analgesia may be interpreted as increased pain threshold and conventional TENS may be responsible for this effect since it interferes with painful sensations transmission to supraspinal levels. TENS and interferential current with low stimulation frequency may induce analgesia via endogenous opioids release[30].

A different study has used electroacupuncture and interferential current in 10 sessions, without significant changes in the way techniques were applied[10]. However, both were beneficial and were similar to our study results. This result is confirmed by other studies[24,28], with the only difference that one study has applied just eight sessions[24].

Study with LBP pregnant women divided in four groups (control, exercises, analgesic drugs and TENS) has shown that TENS was the most effective treatment method[15]. As opposed to this finding, a different study has reported that exercises were very effective and had long-lasting effects, characterizing and suggesting the use of both feasible treatments[24].

Studies[26,27] with TENS, short-waves, interferential current, Core training and exercises have reported that when electrotherapy was associated to exercises, results were even more satisfactory. Authors have pointed out the applicability of an exercise program as beneficial and highly effective tool to treat pain and reestablish individuals' function[4,24]. A different study has broadly advocated the use of electrotherapy with positive results[29], because there has been significant LBP decrease in patients submitted to treatment. A recent systematic review refers and confirms TENS analgesic effect, however points that its results as compared to other modalities still require further studies[31].

Buchmuller et al.[32] have used TENS for a group and the other group received placebo treatment for a period of three months. Results were satisfactory already in the sixth intervention week and, at the end of three months results were only maintained, with is similar to our study, where at treatment completion (five weeks) pain had been cut in half, that is, statistically significant, and at follow-up (one month later) results were maintained. When using therapeutic exercises, there has been favorable improvement in functional capacity and pain decrease in LBP patients in the same period[33].

The literature has clearly shown the importance of an exercises program associated to the above-described treatments, for further efficacy and quality of the protocol to be applied.

CONCLUSION

Our study has shown positive results for CLBP decrease with the use both of TENS and the interferential current, without significant difference between transcutaneous currents.

When secondary effects are evaluated, it is possible to observe through patients' reports that the analgesic effect of both currents was maintained as from the third session. TENS was easy to apply and is a well-tolerated treatment modality, not requiring patients' cooperation which helps when pain-induced limitation is taken into consideration. As to follow-up, our results were beyond expectations and were extremely important for the reliability of proposed treatment, suggesting also that this type of population should be submitted to such protocol in alternate periods for a better quality of life.

REFERENCES

1. Zambito A, Bianchini D, Gatti D, Viapiana O, Rossini M, Adami S. Interferential and horizontal therapies in chronic low back pain: a randomized, doubleblind, clinical study. Clin Exp Rheumatol. 2006;24(5):534-9.
2. Licciardone JC, Minotti DE, Gatchel R, Kearns CM, Singh KP. Osteopathie manual treatment and ultrasound therapy for chronic low back pain: a randomized controlled trial. Ann Fam Med. 2013;11(2):122-9.
3. França FR, Burke TN, Hanada ES, Marques AP. Segmental stabilization and muscular streng thening in chronic low back pain: a comparative study. Clinics. 2010;65(10):1013-7.
4. Costa D, Palma A. O efeito do treinamento contra resistência na síndrome da dor lombar. Rev Port Cien Desp. 2005;5(2):224-34.
5. Salvetti Mde G, Pimenta CA, Braga PE, Corrêa CF. [Disability related to chronic low back pain: prevalence and associated factors]. Rev Esc Enferm USP. 2012;46(Spec No):16-23. Portuguese.
6. Puppin MA, Marques AP, Silva AG, Futuro Neto HA. Alongamento muscular na dor lombar crônica inespecífica: uma estratégia do método GDS. Fisioter Pesqui. 2011;18(2):116-21.
7. Djavid GE, Mehrdad R, Ghasemi M, Hasan-Zadeh H, Sotoodeh-Manesh A, Pouryaghoub G. In chronic low back pain, low level laser therapy combined with exercise is more beneficial than exercise alone in the longterm: a randomised trial. Aust J Physioth. 2007;52(3):155-60.
8. Silva MC, Fassa AG, Valle NC. [Chronic low back pain in a Southern Brazilian adult population: prevalence and associated factors]. Cad Saude Publica. 2004;20(2):377-85.Portuguese.
9. Carvalho AR, Fungueto EM, Canzi IM, Barbieiro C, Moraes V, Bertolini GR, et al. Correntes diadinâmicas de Bernard e Iontoforese no tratamento da dor lombar. Fisioter Movim. 2005;18(4):11-9.
10. Faccil LM, Nowotny JP, Tormem F, Trevisani VF. Effects of transcutaneous electrical nerve stimulation (TENS) and interferential currents (IFC) in patients with nonspecific chronic low back pain: randomized clinical trial. Sao Paulo Med J. 2011;129(4):206-16.
11. Tugay N, Akbayrak T, Demirtürk F, Karakaya IC, Kocaacar O, Tugay U, et al. Effectiveness of transcutaneous electrical nerve stimulation and interferential current in primary dysmenorrhea. Pain Med. 2007;8(4):295-300.
12. Cheing GL, So EM, Chao CY. Effectiveness of electroacupuncture and interferential electrotherapy in the management of frozens houlder. J Rehabil Med. 2008;40(3):166-70.
13. Jorge S, Parada CA, Ferreira SH, Tambeli CH. Interferential therapy produces antinociception during application in various models of inflammatory pain. Phys Ther. 2006;86(6):800-8.
14. Dounavi MD, Chesterton LS, Sim J. Effects of interferential therapy parameter combinations up on experimentally induced pain in pain-free participants: a randomized controlled trial. Phys Ther. 2012;92(7):911-23.
15. Keskin EA, Onur O, Keskin HL, Gumus II, Kafali H, Turhan N. Transcutaneous electrical nerve stimulation improves low back pain during pregnacy. Gynecol Obstet Invest. 2012;74(1):76-83.
16. Briganó JU, Macedo CS. Análise da mobilidade lombar e influência da terapia manual e cinesioterapia na lombalgia. Semina: Ciências Biológicas e da Saúde. 2005;26(2):75-82.
17. Pinheiro J, Figueiredo P, Branco J, Ramos S, Ferreira L. [Non specific chronic low back pain and function: a clinical study in a physical medicine and rehabilitation consultation]. Acta Med Port. 2011;24(Suppl2):287-92. Portuguese.
18. Inoue M, Nakajima M, Hojo T, Kitakoji H, Itoi M. Spinal nerve root electroacupuncture for symptomatic treatment of lumbar spinal canal stenosis unresponsive to standard acupuncture: a prospective case series. Acupunct Med. 2012;30(2):103-8.
19. Monteiro J, Faísca L, Nunes O, Hipólito J. [Roland Morris disability questionnaire – adaptation and validation for the Portuguese speaking patients with back pain]. Acta Med Port. 2010;23(5):761-6. Portuguese.
20. Vigatto R, Alexandre NM, Correa Filho HR. Development of a Brazilian Portuguese version of the Oswestry Disability Index: cross-cultural adaptation, reliability, and validity. Spine. 2007;32(4):481-6.
21. Assis FD, Amaral C, Tucci C, Costa SM. Uso terapêutico da radiofrequência pulsátil no gânglio dorsal da raiz de L2 na lombalgia discogênica. Coluna/Columna. 2009;8(2):139-42.
22. Stefane T, Santos AM, Marinovic A, Hortense P. Dor lombar crônica: intensidade de dor, incapacidade e qualidade de vida. Acta Paul Enferm. 2013;26(1):14-20.
23. Zaniewska R, Okurowska-Zawada B, Kułak W, Domian K. [Analysis of quality of life in patiens with low back pain after receiving transcutaneous electrical nerve stimulation (TENS)]. Med Pr. 2012;63(3):295-302. Polish.
24. Maher CG. Effective physical treatment for chronic low back pain. Orthop Clin NorthAm. 2004;35(1):57-64.
25. Gur A, Karakoc M, Cevik R, Nas K, Sarac AJ, Karakoc M. Efficacy of low power laser therapy and exercise on pain and functions in chronic low back pain. Lasers Surg Med. 2003;32(3):233-8.
26. Bordiak FC, Silva EB. Eletroestimulação e core training sobre dor e arco de movimento na lombalgia. Fisioter Mov. 2012;25(4):759-66.
27. Atamaz FC, Durmaz B, Baydar M, Demircioglu OY, Iyiyapici A, Kuran B, et al. Comparison of the efficacy of transcutaneous electrical nerve stimulation, interferential currents, and short wave diathermy in knee osteoarthritis: a double-blind, randomized, controlled, multicenterstudy. Arch Phys Med Rehabil. 2012;93(5):748-56.
28. Chou R, Huffman LH. Non pharmacologictherapies for acute and chronic low back pain: a review of the evidence for an American Pain Society/American College of Physicians Clinical Practice Guideline. Ann Intern Med. 2007;147(7):492-504.
29. Osiri M, Welch V, Brosseau L, Shea B, McGowan J, Tugwell P, et al. Transcutaneous electrical nerve stimulation for knee osteoarthritis. Cochrane Database Syst Rev. 2000;(4):CD002823.
30. Gomes AO, Silvestre AC, Silva CF, Gomes MR, Bonfleur ML, Bertolini GR, et al. As influências de diferentes frequências da estimulação elétrica nervosa transcutânea no limiar e intensidade de dor em indivíduos jovens. Einstein. 2014;12(3):318-22.
31. Kerai S, Saxena KN, Taneja B, Sehrawat L. Role of transcutaneous electrical nerve stimulation in postoperative analgesia. Indian J Anaesth. 2014;58(4):388-93.
32. Buchmuller A, Navez M, Milletre-Bernardin M, Pouplin S, Presles E, Lantéri-Minet M, et al. Value of TENS for relief of chronic low back pain with or without radicular pain. Eur J Pain. 2012;16(5):656-65.
33. Korelo RI, Ragasson CA, Lerner CE, Morais JC, Cossa JB, Krauczuk C. Efeito de um programa cinesioterapêutico de grupo, aliado à escola de postura, na lombalgia crônica. Fisioter Mov. 2013;26(2):389-94.