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Research article

Interferential Current Combined with Lumbopelvic Stabilization Exercises in Patients with Degenerative Disc Disease with Symptoms of Chronic Low Back Pain

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Abstract

Contextualization: Chronic low back pain is one of the most common symptoms among the population. Lumbar disc herniation is one of the most common degenerative diseases related to low back pain. Among the techniques for the treatment of pain, lumbopelvic stabilization exercises (core) and electrotherapy are highlighted.

Objective: To evaluate the effectiveness of a core stabilization program combined with interferential current in patients with chronic low back pain caused by protrusion and/or lumbosacral disc herniation.

Methods: Randomized clinical trial with 26 patients with chronic low back pain caused by protrusion and/or lumbosacral disc herniation. Subjects were randomized into group CORE + Interferential Current (GIC) and group CORE + Placebo Interferential Current (GPIC). It were evaluated the level of pain (VAS) and the functionality by the Oswestry (ODI) and Roland-Morris (RMDQ) questionnaires.

Results: GIC reduced the level of pain from 7.23 to 3.69 ($p< 0.05$) and GPIC reduced it from 6.62 to 3.08 ($p< 0.05$). The ODI scores decreased in both groups.In the GIC, this decrease was from 18.85 to 11.77 ($p< 0.05$). Yet in the GPIC, the decrease was from 17.15 to 9.08 ($p< 0.05$). The RMDQ scores of the GIC decreased from 13.00 to 8.38 ($p< 0.05$); in the GPIC, this decrease was from 10.69 to 6.31 ($p< 0.05$).

Conclusion: Both groups significantly reduced the low back pain and improved the functional capacity, which shows that lumbopelvic stabilization exercises were shown to be effective in the treatment of discogenic low back pain with or without association of interferential current.

Keywords: *Electrotherapy; Exercises; Low back pain*

Abbreviations

GIC: Group CORE + Interferential Current; GPIC: Group CORE + Placebo Interferential Current; VAS: Visual Analogue Scale; ODI: Oswestry Disability Index; RMDQ: Roland-Morris Disability Questionnaire; LBP: Low Back Pain; LDH: Lumbar Disc Derniation; IC: Interferential Current; ULBRA: Universidade Luterana do Brasil; FMA: Frequency Modulated Amplitude; SPSS: Statistical Package for the Social Sciences

Introduction

Low back pain (LBP) is one of the most common symptoms among the population, being prevalent in many countries, making it an economic and public health problem [1,2]. It is estimated that about 70% to 80% of individuals have suffered or will suffer LBP at some point in their lives [1]. Persisting for more than three months, LBP is considered chronic [2], which is related to the reduced stability of the spine due to loss of control of the passive (vertebrae, discs, ligaments) and active (muscles and tendons) mechanisms and of the motor control [3]. As a result, it may occur hypoesthesia, decreased strength, muscular endurance and flexibility, thus hindering the individual's daily activities [4,5].

Degenerative diseases of the spine such as disc herniation, spinal stenosis and degenerative spondylolisthesis are some of the causes of emergence of LBP [6]. Lumbar disc herniation (LDH) is one of the most common degenerative diseases that produce symptoms of low back pain [6]. It is a musculoskeletal disorder, which occurs due to rupture of the annulus fibrosus subsequent to the displacement of the central mass of the intervertebral disc in the dorsal or dorsolateral spaces of the disc [7,8]. The discopathies and disc herniations assiduously reach the lumbar spine due to the high mobility of this, especially in thelumbosacral region [7]. These disc changes can be caused by poor posture, overweight, falls, daily stress and muscle imbalance, mainly due to the weakness of the lumbar stabilizers [7-9]. Although it is the leading cause of spinal surgery, the result of conservative treatment is favorable in most cases [10].

The rapeutic resources for the treatment of low back pain are varied, standing out, among these, electrotherapy and kinesiotherapy [11]. Among the various forms of electrostimulation is the interferential current (IC) [12,13]. This is characterized by transcutaneous application of alternating medium-frequency current (4,000 Hz) amplitude modulated at low frequency (0-250 Hz) [12,13]. This modulation at low frequency that occurs within the tissues is theoretically responsible for reaching deeper tissues [14]. It is a simple, safe and non-invasive method [14,15]. It is widely used to treat different diseases, whose main clinical goal is pain relief [15].

The stabilization of central muscles, also called "core", involves performing exercises to improve strength, endurance and motor control of the abdominal and lower back muscles, emphasizing the deep muscles of the trunk, especially the transversus abdominis and multifidus muscles [5,11,16]. The approach of the core muscles prevents injuries and provides relief from lower back pain [17].

The aim of the study was to evaluate the efficacy of a core stabilization program combined with IC in patients with chronic low back pain caused by protrusion and/or lumbosacral disc herniation.

Materials and Methods

Randomized clinical trial with 26 patients of both sexes aged 51.35 ± 12.51, ranging between 18 and 74 years. The study was approved by the Research Ethics Committee of the Universidade Luterana do Brazil, under opinion No. 473.042 and performed in the Physiotherapy School Clinic of ULBRA –Torres Campus, from March 2014 to October 2015.

It were included subjects with chronic low back pain caused by protrusion and/or lumbosacral disc herniation, pain level above five on the visual analogue scale (VAS), who were not performing any other type of therapeutic approach at the time of the study, with confirmatory magnetic resonance imaging and/or CT scan to discopathy or disc herniation. It were excluded from the study patients who were making use of analgesic medication, women in the first three months of pregnancy, subjects with history of surgery on the lower back, patients diagnosed clinically with rheumatic disorders, with radiculopathy signs and radiating pain to the lower limbs, those who missed two consecutive sessions or three alternating sessions, with any cognitive impairment or inability to answer questionnaires and with contraindications to electrotherapy (heart disease patients with pacemaker).

Initially, the eligible subjects were asked to participate in the study. Subsequently, they were instructed about the objectives, the methodology and the application form, and then, they were asked to sign the Free and Informed Consent Term (FICT). Through a box with envelopes containing folded papers with the group number, the subjects were randomly divided according to the chosen envelope intogroup CORE + Interferential Current (GIC)or group CORE + Placebo Interferential Current (GPIC).

The evaluations were performed previously to the intervention protocol and at the end of treatment. It were evaluated the level of pain, by visual analog pain scale (VAS), and the level of functionality, through the questionnaires: Oswestry Disability Index (ODI) [18] and Roland-Morris Disability Questionnaire (RMDQ) [19], both validated for the Portuguese language.

The intervention protocol was conducted twice a week for six weeks. The GIC used an average frequency generator, IBRAMED® brand, model Neurodyn. It was used an application in quadrupole form with the subject in the prone position, with a pillow under the abdomen in order to reverse the physiological lumbar lordosis. Rubber electrodesof 5 x 10 cm were used, positioned so as to interfere with both channels and closing the circuit of pain over the central point of pain. Gel was used as a transmitter means and tape was used for fixation. The carrier frequency was 4,000 Hz,frequency-modulated amplitude(FMA) of 20 Hz, modulated amplitude variation (ΔFMA) of 10 Hz and 1:1 inclination for thirty minutes. The intensity was set according to the tolerance of each patient. For GPIC, the same parameters were used, nonetheless, being the intensity at zero. After the treatment, the electrodes were removed and washed in running water, dried with paper towel and disinfected with 70% alcohol.

The core stabilization exercise protocol (CORE) was developed from the protocol proposed in the studies of Marshall and Murphy (2005 and 2006) [20,21]. It were used exercises based on static postures, starting with a maintenance of the posture for five seconds, being repeated 10 times at intervals of 30 seconds between each exercise. As the program evolved, the degree of difficulty in controlling the posture increased, as well as the posture control time, which increased to 10 seconds. In all exercises, the researchers used verbal command of continuous contraction of stabilizers during the exercises ("abdominal press").

Exercise	Description of the exercise	Repetitions
Exercise 1	Bridge in prono on Swiss ball.	10 x
Exercise 2	Anterior bridge on Swiss ball.	10 x
Exercise 3	Lying on the ball in unipodal.	10 x
Exercise 4	Cross bridge exercise.	10 x
Exercise 5	Lift the ball with the legs in the supino position.	10 x
Exercise 6	Bridge in supine on the Swiis ball in unipodal.	10 x
Exercise 7	Mini squat.	10 x
Exercise 8	Abdominal press in Swiss ball.	10 x

Table 1: *Intervention protocol with CORE exercises.*

It was used the SPSS (Statistical Package for the Social Sciences) version 17.0 as database and statistical package. Data were entered twice in order to avoid typos and expressed as mean and standard deviation. Then, they were statistically analyzed by the paired Student's t test for analysis within each group from the beginning to the end of treatment and the unpaired Student's t test for analysis of the variables between the groups. For nonparametric variables, Wilcoxon and Mann-Whitney tests were used, respectively, within each group and between groups. The significance level for the statistical test was set at $p< 0.05$.

Results

43 patients were initially selected, 17 subjects being excluded for not meeting the eligibility criteria. The final results refer to a sample of 26 patients of both sexes aged between 18 and 74 years, with a mean age of 51.35 ± 12.51 years (Figure 1).

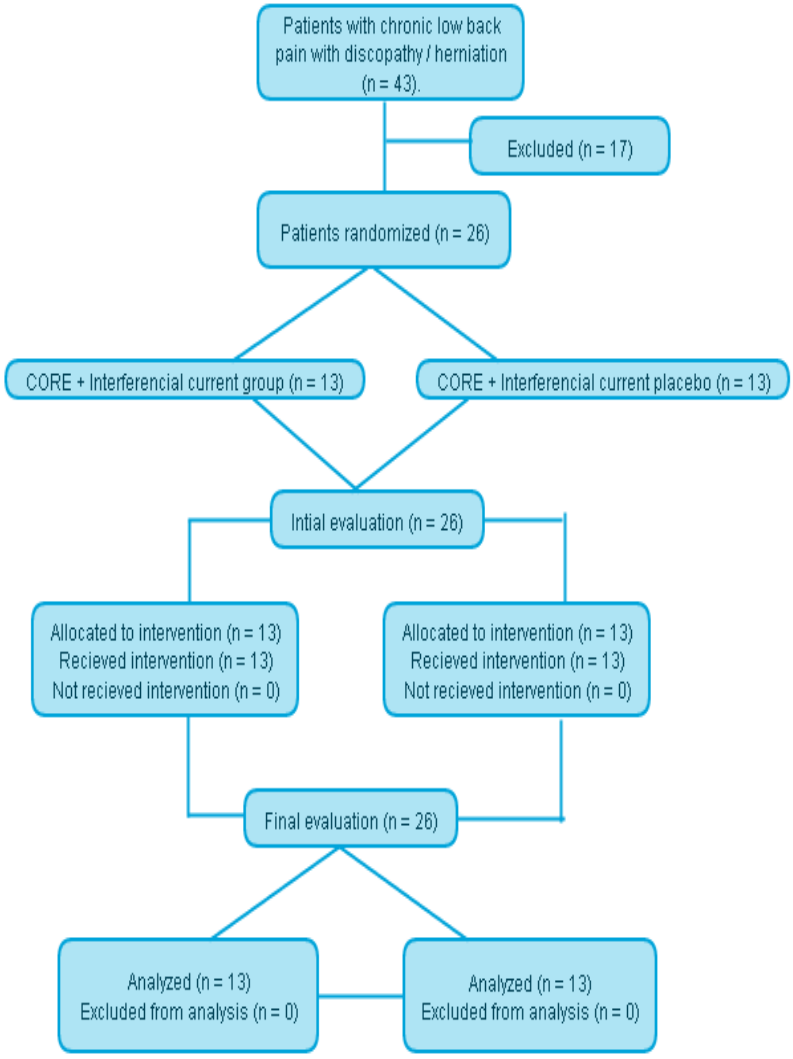

Figure 1: *Study flow chart.*

These patients were randomly divided into two groups: group CORE + Interferential Current (GIC), composed of 11 women and two men, aged 53.62 ± 15.00 years, with pain time of 5.31 ± 4.99 years, and group CORE + Placebo Interferential Current (GPIC), composed of seven women and six men, aged 49.08 ± 9.49 years and with pain time of 4.31 ± 5.45 years. The groups were homogeneous in terms of the variables of gender, age, skin color, subjects' activity and pain time.

Through the VAS, it was found that both groups significantly reduced the level of pain from baseline to final assessment. The GIC presented initial pain level of 7.23 ± 1.48 and, after intervention, it was reduced to 3.69 ± 2.05. The GPIC showed 6.62 ± 1.75 at baseline, reduced to 3.08 ± 1.97 after the intervention protocol (Figure 2).

Variável	Total (n = 26)	CORE + IC group (n = 13)	CORE + IC Placebo group (n = 13)	p value
Gender n. M/F	8/ 18	2/11	6/7	0,08
Age, years (n ± dp)	51,35 ± 12,51	53,62 ± 15,00	49,08 ± 9,49	0,52
Skin color, n (%)				1,00
White	26 (100,0)	13 (100,0)	13 (100,0)	
Black	0 (0,0)	0 (0,0)	0 (0,0)	
Activity, n (%)				0,21
Housewife	4 (15,4)	1 (7,7)	3 (23,1)	
Retired	5 (19,2)	5 (38,5)	0 (0,0)	
Housekeeper	2 (7,7)	0 (0,0)	2 (15,4)	
Mason	2 (7,7)	1 (7,7)	1 (7,7)	
Dressmaker	2 (7,7)	1 (7,7)	1 (7,7)	
Salesman	2 (7,7)	2 (15,4)	0 (0,0)	
Others	10 (38,4)	3 (23,0)	6 (46,1)	
Pain time, months (n ± dp)	4,81 ± 4,92	5,31 ± 4,99	4,31 ± 5,45	0,15

Table 2: *Characterization of the study sample.*

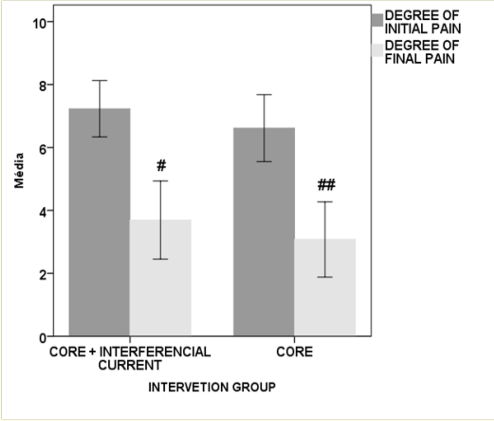

Figure 2: *Pain level assessment by EVA pre and post intervention.*

 # p= 0,0001 compared to baseline.

p = 0,0001 compared to baseline.

The ODI scores decreased significantly from baseline to final assessment in the two study groups. The GIC initially reduced the score 18.85 ± 5.77 to 11.77 ± 6.57 after the intervention. Yet GPIC reduced the score 17.15 ± 7.19 to 9.08 ± 6.44 after the intervention (Figure 3).

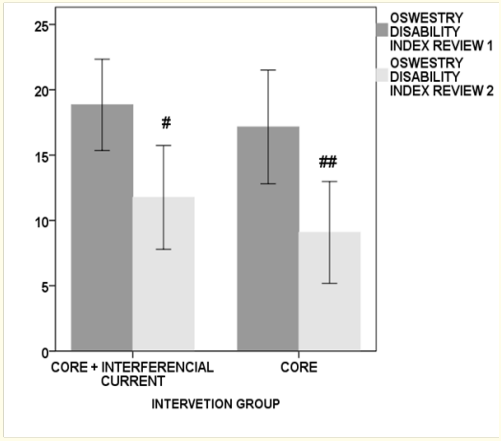

Figure 3: *Oswestry disability index pre and post intervention.*

#p = 0,0001 compared to baseline.

##p = 0,0001 compared to baseline.

Both groups significantly reduced the RMDQ scores from baseline to final assessment. The GIC presented initial score of 13.00 ± 3.91, reduced to 8.38 ± 3.47 after the intervention. Yet GPIC reduced the score 10.69 ± 6.71 to 6.31 ± 4.92 after the procedure (Figure 4).

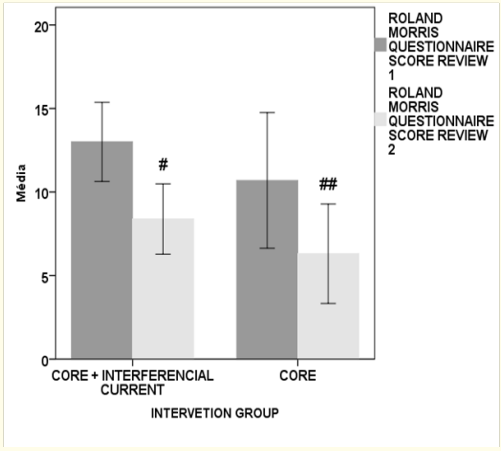

Figure 4: *Roland morris questionnaire scores pre and post intervention.*

#p = 0,0001 compared to baseline.

##p = 0,024 compared to baseline.

Analyzing the disability classification through the Oswestry questionnaire, it was found that, initially, 15.4% of the subjects of the GIC were classified as critically ill. After the intervention, none of these were classified that way. 30.8% were classified as slightly affected. Yet in the GPIC, 77% of patients were initially classified as low/moderate. After the intervention, 53.8% of these were classified as slightly affected.

Variável	CORE + IC group(n=13)	CORE + IC Placebo group(n=13)
Serious		
Initial	2 (15,4)	4 (30,8)
Final	0 (0,0)	0 (0,0)
Moderate		
Inicial	10 (76,9)	6 (46,2)
Final	9 (69,2)	6 (46,2)
Little Affected		
Inicial	1 (7,7)	3 (23,1)
Final	4 (30,8)	7 (53,8)
p value	0,005	0,025

Table 3: *Functional classification of Oswestry disability index pre and post intervention (n, %).*

Discussion

In this study, it was sought to evaluate the effect of the combination of a lumbopelvic stabilization program (CORE) with the interferential current in individuals with chronic low back pain caused, specifically, by protrusion and/or lumbosacral disc herniation. The study refers to a sample of 26 patients of both sexes, with mean age of 51.35 ± 12.51 years. Both intervention groups were homogeneous with regard to gender, age, skin color, subjects' activity and pain time. The effects of electrotherapy combinedwith CORE were analyzed specifically on the level of pain, the quality of life and the functionality of these patients.

It was observed, through VAS, a reduction in pain in both groups after the intervention protocol. We believe that the decrease in the algic state occurs by the activation of the synergism of the stabilizing muscles, reducing the pressure on the innervated structures during movements of the lumbopelvic region. According to Reinehr., *et al.* Increased strength of the flexor and extensor muscles of the trunk is important to increase the intra-abdominal pressure and thereby decrease the spinal pressure, which reduces the occurrence of problems in the lumbar spine [22]. The benefit of this treatment could also be observed in the study by Kim., *et al.* where the authors found a significant increase in the activity of core muscles [23].

The results of our study corroborate those found in the study by Pereira., *et al.* who found a significant improvement both in the mean pain index and in the functional capacity after the treatment of 12 sessions of a core stabilization exercise program in patients with chronic lumbalgy [24]. The authors demonstrated that the core exercises can be an effective method of treatment for lumbalgies. Andrusaitis., *et al.*used a sample of women with chronic low back pain divided into groups A (reinforcement) and B (stabilization). Forboth groups, the treatment consisted of 20 sessions. Group B achieved a significant improvement in pain reduction and functionality compared to group A [25].

Regarding the functional and disability levels, assessed by ODI and RMDQ, the results showed improvement at the end of the intervention protocol in both groups. Similar results were also found by Moon., *et al.*comparing the effects of lumbar stabilization exercises and dynamic lumbar strengthening exercises on the maximal isometric strength of the lumbar extensors, pain intensity and functional disability in patients with chronic low back pain [26]. The authors concluded that the lumbar stabilization exercises were more effective in strengthening the lumbar extensor and, consequently, bringing functional improvement [26].

Kong., *et al*. made measurements to assess the body angles during exercise and the level of functionality in patients with chronic lumbalgy [1]. The subjects were divided into three groups with different bridge exercises. After eight weeks, a reduction in ODI was observed in all groups [1]. The results of Hicks., *et al.* showed significant decreases in the VAS and in the functionality index after an eight-week lumbar stabilization exercise program [27]. Leite., *et al*. in their study, reported an improvement in pain and functional performance after

treatment of 12 sessions of a segmental stabilization exercise program in patients with nonspecific chronic low back pain [28]. These various results reported in the literature corroborate our findings, which show that it is possible to reduce low back pain in patients with chronic lumbalgy in a relatively short period of intervention.

The combination of electrotherapy, for example, the medium-frequency interferential current, in the treatment of chronic low back pain caused by discogenic disease consists in a viable form of intervention, tolerated by patients. Our study did not show a significant effect of itwhen combined with lumbopelvic stabilization exercises. Unlike our findings, studies reported in the literature using interferential current and neuromuscular electrical stimulation combined with exercises for the core musculature or general exercises reported that when there was a combination of electrotherapy with the exercises, the results were even more satisfactory [11,12,29,30].

Facci., *et al.* compared the effects of TENS and interferential current in patients with nonspecific chronic lumbalgy [31]. The subjects were divided into TENS (group 1), interferential current (group 2) and control (group 3). Patients assigned to electrotherapy received 10 sessions, while the control group remained untreated. There was treatment efficacy with both the interferential current and the TENS, with no statistically significant difference between them [31].

It was also found in the literature other physical therapy interventions associated with analgesic electrotherapy as a treatment for this disease. Franco., *et al.* evaluated the efficacy of the combination of the interferential current with the Pilates method for the treatment of patients with nonspecific chronic low back pain [12]. The subjects were divided into the group of interferential current and Pilates and the group of placebo interferential current and Pilates. It was observed that the group of interferential current and Pilates was more effective than the placebo group in reducing pain [12].

The present study showed an imbalance of the patients during the exercises, possibly due to the weakness of the lumbar stabilizers, leading to an abnormal movement of the lumbopelvic column. Body stability is directly linked to the control of the central nervous system (CNS) by the sensory response of the osteoligamentous structures and by the control of the active musculature [32]. Thus, any dysfunction of these factors promote instability and, as a result, the body tends to compensate the instability somehow, causing imbalance between the muscles and pain [32]. Renkawitz., *et al.* Observed that there is a close relationship between the muscle imbalance of the paraspinal muscles and the low back pain [33]. After a stabilization training program, this imbalance improved, as a result, the pain [33]. It seems to be clear that, in addition to the contraction of the deep abdominal musculature, one must also associate the activation of the most superficial muscles so that all act as adjuncts in improving chronic lumbalgy.

One limitation of the study was that it only evaluated the immediate effect of a stabilization program combined with interferential current, ie, soon after the final intervention. We believe further studies are important, with larger samples and evaluating these findings after a follow-up period, in order to evaluate the long-term maintenance of the effects after the protocol.

Conclusion

Both groups showed a reduction in low back pain and improved functional capacity, which shows that lumbopelvic stabilization exercises appear to be effective both alone and in combination with analgesic electrotherapy in patients with chronic low back pain caused by protrusion and/or lumbosacral disc herniation.

Conflict Of Interest

All authors have no conflict of interest or financial interest in this work.

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