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Research Article

The Effect of Shortwave Diathermy Treatment on Muscle Power in Patients with Chronic Low Back Pain

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ABSTRACT

Objective: The goal of this study was to investigate the effects of shortwave diathermy therapy combined with exercise on lumbar muscle strength.

Patients and methods: Our study was an interventional study involving 90 patients with chronic low back pain who were admitted to our clinic between 2007-2008. Patients were randomized into 3 groups (each group had 30 patients). The same exercise programs were given to all groups. Patients in the first group were applied placebo shortwave diathermy treatment, the second group was applied continuous shortwave diathermy and the third group received pulsed shortwave diathermy. Isokinetic muscle strength measurements of the patients were performed before and three months after the treatment.

Results: In our study, the only significant difference observed between the groups was in isometric flexion strength and interestingly the first group had higher improvement compared to the other groups. In regard to within group comparisons, Group 1 was found to have significant improvements in strengths for:isometric flexion, isokinetic flexion (60°/sec and 120°/sec), isokinetic extension (60°/sec and 120°/sec). Group 2 had significant improvements in isokinetic flexion and extension (60°/sec) and also isokinetic extension (120°/sec). In Group 3, none of the improvements were found to be significant.

Conclusion: Our findings indicate that there are no significant differences between exercise therapy alone and exercise therapy in combination with diathermy (either continuous or pulsed) in terms of their effects on lumbar muscle strength, even though marginal differences in some of the measurements were observed.

Keywords: Chronic low back pain; Lumbar muscle strength; Exercise

INTRODUCTION

Lumbar pain is one of the most common medical disorders in today's society affecting the population of both developed and developing countries [1-4]. Although chronic low back pain (CLBP) is considered to be multifactorial, weakness of the extensor muscles of the lumbar spine is suggested to be a risk factor [5-8]. Additionally, patients that suffer from CLBP may tend to limit their use of back muscles in order to prevent pain, which may lead to the atrophy of lumbar extensor muscles [9,10]. Normally, extensor muscles of the back are stronger than flexors and reports have suggested that the strength ratio is around 1.3:1 (extensor: flexor); however, the strength ratio is reversed in

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patients with CLBP due to accelerated weakening of extensor muscles. The decrease in lumbar muscle strength and endurance may solely be the cause of pain, or this condition may increase the possibility of CLBP development [11,12].

Exercise is a proven CLBP treatment method that can be used as a stand-alone therapy or in combination with other different methods [13]. Randomized controlled trials have demonstrated that lower back exercises reduce the level of pain and improve the functional status of patients with CLBP [13,14].

Shortwave diathermy, is one of the deep heating methods used in the treatment of musculoskeletal disorders [15]. The main effects of this modality are: increased cell membrane permeability, improvement of mitochondrial function, modulation of enzymatic activity and an increase in tissue flexibility [16]. Additionally, shortwave diathermy treatment before performing exercise therapy has been shown to increase the range of articular motion [17,18]. This brings to mind that short-wave diathermy combined with exercise can have a synergistic effect. However, the number of studies evaluating this dual therapy combination and its effects on the treatment of reduced strength and function in lumbar muscles is limited. In this study, we aimed to investigate the effect of shortwave diathermy therapy combined with exercise on lumbar muscle strength.

METHODS

This was an interventional study involving 90 patients who were admitted to our clinic between 2007-2008 with CLBP. All patients aged between 40–65 years who were found to have CLBP for at least 6 months were included in the study. Patients who had advanced cardiovascular disease, abnormal neurologic findings in their neurological examination, and those who could not perform physical activity or undergo diathermy treatment were excluded. The study was approved by the Clinical and Laboratory Research Ethics Committee of Dokuz Eylül University Faculty of Medicine.

The socio demographic characteristics of patients and the duration of lumbar pain were recorded. After enrollment was completed, patients were randomly divided into 3 groups. There were 30 patients in each group. In the first group, placebo shortwave diathermy was applied while the device was closed. Continuous shortwave diathermy (27.12 MHz frequency and 11.06 m wavelength, 200 watts) was applied in the second group, while the third group received pulsed shortwave diathermy (27.12 MHz frequency and 11.06 m wavelength, 200 watts, 0.3 ms pause).

The first exercise routine was perfomed under physician supervision and the patients were asked to perform the given exercise schedule at their home. Patients were asked to perform 3 sets of the routine 10 times a day and also to keep a record of their schedule in an exercise diary. Shortwave diathermy treatment seances were 20 minutes long and were scheduled 5 days a week for 3 weeks (total number of seances was 15).

Evaluation of lumbar muscle strength

The isokinetic muscle strength measurements of patients were performed using a Cybex isokinetic system (Cybex-Norm) before and 3 months after the treatment. Before each test, submaximal warm-up exercise was performed. Body flexion and extension measurements were made at 60°/sec and 120°/sec angular velocities with 5 repetitions.

Statistical Analysis

All analyses were performed on SPSS v21. The Shapiro Wilk test was used for normality check. Comparison between groups were made with one-way Analysis of Variances (ANOVA) or Kruskal Wallis test for continuous variables (according to normality of distribution), while the Chi-Square test was used for comparison of categorical variables. Evaluation of repeated measurements were made with the Wilcoxon Signed Ranks test for within groups and the differences between repeated measurements were calculated.Between group comparisons of these differences were performed with the Kruskal Wallis test. The Bonferroni correction method was used for pairwise comparisons. P values that were lower than 0.05 were accepted to show statistical significance.

RESULTS

We included 90 patients (17 males and 73 females) into our study, mean age was 51.36 ± 6.07 years. We divided them into three groups. There was no significant difference between our groups regarding age, body mass index (BMI), education status, working status, symptom duration, diagnosis of magnetic resonance, paracetamol intake and number of days of exercise. Males were more frequent in the Group 3 than other groups (p=0.044) (Table 1).

Table 1: Summary of patients' characteristics regarding treatment groups.

	Group 1	Group 2	Group 3	p
N	30	30	30	N.A
Age	51.47 ± 6.50	51.63 ± 6.26	50.97 ± 5.59	0.908
Gender (Male)	3(10.00%) a	4(13.33%) a	10(33.33%) b	0.044
BMI	25.35 ± 3.82	25.42 ± 3.66	25.07 ± 3.26	0.924
Education Status				
Primary	8(26.67%)	6(20.00%)	9(30.00%)	0.794
Secondary	6(20.00%)	9(30.00%)	6(20.00%)	
High	10(33.33%)	12(40.00%)	9(30.00%)	
University	6(20.00%)	3(10.00%)	6(20.00%)	

Working Status				
On Foot	10(33.33%)	10(33.33%)	5(16.67%)	0.257
Housewife	16(53.33%)	15(50.00%)	15(50.00%)	
On Chair	4(13.33%)	5(16.67%)	10(33.33%)	
Symptom Duration (year)	5(0.5-20)	3.5(1-17)	2.25(0.5-30)	0.185
Diagnosis				
Bulging	5(16.67%)	9(30.00%)	6(20.00%)	0.615
Protrusion	9(30.00%)	9(30.00%)	14(46.67%)	
Extrusion	3(10.00%)	2(6.67%)	2(6.67%)	
Spinal Stenosis	1(3.33%)	2(6.67%)	0(0.00%)	
Degeneration	12(40.00%)	8(26.67%)	8(26.67%)	
Paracetamol Intake	0(0-23)	0(0-30)	0(0-9)	0.294
Exercise(Day)	89.5(10-90)	75(2-90)	70(12-90)	0.976
Data given as mean ± standard deviation or median (minimum - maximum) for continuous variables regarding normality and frequency (percentage) for categorical variables				
Same letters denote lack of significant difference between groups				

When we evaluated isometric muscle strength, flexion strength was significantly higher after treatment than before for Group 1 (p=0.002), (Figure 1), on the other hand there was no significant difference between measurements regarding extension (p=0.380) and rotation (p=0.069) strength. There was no significant difference between before and after treatment results regarding flexion, extension and rotation muscle strength for other groups. The increase in isometric flexion strength was significantly higher for Group 1 than Group 3 (p=0.025), while there were no significant differences between Group 2 and Group 1 (p=0.999), and also Group 2 and Group 3 (p=0.168) in terms of increase. There was no significant difference between our groups regarding isometric extension strength (p=0.679) and isometric rotation strength (p=0.054) (Table 2 and Figure 2).

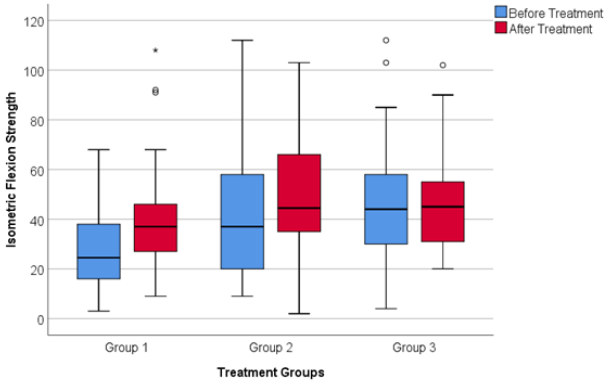

Figure 1: Isometric flexion strength.

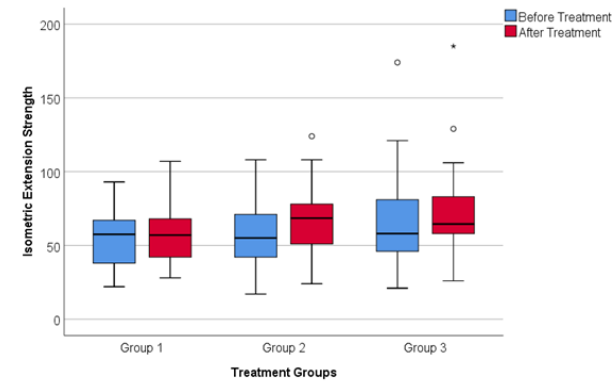

Figure 2: Isometric extension strength.

When we evaluated isokinetic muscle strength at 60°/sec angular speed, flexion strength (p=0.017) and extension strength (p=0.005) were significantly higher after treatment than before treatment for Group 1, while there was no significant difference between measurements regarding rotation strength (p=0.432). In Group 2, flexion strength (p=0.007) and extension strength (p=0.028) were significantly higher after treatment than before treatment, while there was no significant difference between measurements regarding rotation strength (p=0.611). In Group 3, there was no significant difference between before and after treatment results regarding flexion, extension and rotation muscle strength. When groups were compared with each other, there were no significant differences in terms of the increases in the isokinetic flexion, extension and rotation strength at 60°/sec angular speed (Table 2).

Table 2: Summary of measurements of muscle strength regarding treatment groups and comparison results.

		Group 1 (n=30)	Group 2 (n=30)	Group 3 (n=30)	p(Between Groups)
Isometric Flexion	Before	24.5(3 - 68) a	37(9 - 112) ab	44(4 - 112) b	0.025
	After	37(9 - 108)	44.5(2 - 103)	45(20 - 102)	

p(Within Groups)		0.002	0.068	0.882	
Isometric Extension	Before	57.5(22 - 93)	55(17 - 108)	58(21 - 174)	0.679
	After	57(28 - 107)	68.5(24 - 124)	64.5(26 - 185)	
p(Within Groups)		0.38	0.083	0.07	
Isometric Rotation	Before	56.1(10 - 140)	71.85(23.2 - 172.3)	79.4(9.3 - 166.7)	0.054
	After	61.85(17.8 - 257.1)	79.95(18.7 - 167.2)	63.4(24.9 - 147.5)	
p(Within Groups)		0.069	0.733	0.227	
Isokinetic Flexion (60°/sec)	Before	33.5(2 - 89)	42(3 - 136)	53.5(15 - 117)	0.051
	After	38.5(1 - 121)	67(3 - 160)	55(5 - 145)	
p(Within Groups)		0.017	0.007	0.905	
Isokinetic Extension (60°/sec)	Before	16(2 - 43)	23.5(4 - 53)	25(2 - 75)	0.868
	After	22.5(2 - 43)	27(6 - 45)	30(3 - 92)	
p(Within Groups)		0.005	0.028	0.067	
Isokinetic Rotation (60°/sec)	Before	192.85(100 - 380)	212.55(50 - 750)	209.55(1.3 - 444.5)	0.533
	After	189.3(14.3 - 400)	214.25(50.3 - 878.9)	178.1(35.7 - 566.7)	
p(Within Groups)		0.432	0.611	0.265	
Isokinetic Flexion (120°/sec)	Before	9(2 - 70)	11(3 - 102)	14(3 - 59)	0.538
	After	15.5(2 - 88)	17(4 - 108)	16.5(2 - 105)	
p(Within Groups)		0.012	0.046	0.213	
Isokinetic Extension (120°/sec)	Before	6(2 - 42)	7(2 - 46)	7.5(3 - 24)	0.854
	After	7(3 - 87)	10(3 - 35)	8(2 - 47)	
p(Within Groups)		0.038	0.246	0.056	
Isokinetic Rotation (120°/sec)	Before	150(60 - 725)	138.75(43.3 - 755.6)	177.5(50 - 1050)	0.477
	After	134.3(50 - 725)	133.3(81.6 - 900)	143.65(75 - 441.7)	
p(Within Groups)		0.737	0.487	0.316	
Data given as median (minimum-maximum)					
Same letters denote lack of significant difference between groups.					

When we evaluated isokinetic muscle strength at 120°/sec angular speed, flexion strength (p=0.012) and extension strength (p=0.038) were significantly higher after treatment than before treatment for Group 1, while there was no significant difference between measurements regarding rotation strength (p=0.737). In Group 2, flexion strength (p=0.046) was significantly higher after treatment than before treatment, while there was no significant difference between measurements regarding extension strength (p=0.246) and rotation strength (p=0.487). In Group 3, there was no significant difference between before and after treatment resultsin terms of flexion, extension and rotation muscle strength. Finally, there were no significant differences between our groups regarding the amount of increase in

isokinetic flexion, extension and rotation strength at 120°/sec angular speed (Table 2).

DISCUSSION

In this study, patients who received only exercise therapy (the first group), continuous diathermy with exercise (the second group), and pulsed shortwave diathermy treatment with exercise (the third group) were compared in terms of lumbar muscle strength.

It is well known that lumbar muscle weakness results in early fatigue in patients with chronic low back pain [19,20]. In a study, the effects of exercises on lumbar extensors were investigated in patients with chronic low back pain; it was reported that exercise was beneficial and significant improvements in the strength of the back extensors were observed [21]. In a recent meta-analysis study of 39 randomized controlled clinical trials, the efficacy of exercise in patients with chronic low back pain was assessed. The study concluded that exercise programs including strength/resistance and coordination/stabilization were effective in the treatment of CLBP [22]. In our study, the only significant difference observed between the groups was in terms of isometric flexion strength which revealed that the first group had higher strength.

Concerning isometric flexion strength, significant improvement was observed in the first group which received only exercise therapy compared to the third group which received exercise and pulsed shortwave diathermy combined. In fact, results of the second and third groups were higher in terms of total muscle strength after treatment, but the initial muscle strength of the first group was significantly lower than the second and third; therefore, the improvement observed in the first group was significantly higher than the other groups. Although the patient groups were similar to each other in many of the parameters, the number of male patients in the third group was significantly higher than Groups 1 and 2. This may have been the cause of the difference in initial muscle strength and could have affected the results. However, as we also compared the amount of increase in each group, our results remain relevant. Nevertheless, the consistency of these results should be reassessed by a study with a larger sample size and randomization methods to ensure a balanced distribution of men and women in groups.

In a study quite similar to ours, continuous and pulsed shortwave diathermy combined with exercise were compared by the formation of 3 groups; the first group had continuous shortwave diathermy, the second and third groups received pulsed shortwave diathermy (200 Hz maximum pulse power of 300 W) [23]. According to the results, the group which received pulsed shortwave diathermy treatment achieved a significant increase in muscle strength in the back extensor muscle group. Besides, it was stated that there was no difference between the second group and the third group in terms of muscle strength. However, the aforementioned study lacked a control group who were only given exercise treatment, and also, muscle strength was measured with a goniometer. Furthermore, in the current study, both pulsed and continuous diathermy were applied at a frequency of 27.12 MHz and at a wavelength of 11.06 m and 200 watts.

Other studies on this topic also exist. For instance, Danneels et al. evaluated the effect of 3 treatment modalities on the strength of the lumbar multifidus muscle in patients with CLBP. They reported that a significant strength increase was achieved in the group receiving stability training with dynamic-static resistance [24]. However, it was stated that diathermy was applied to all 3 groups before performing exercise. Therefore, it is not possible to evaluate the effect of diathermy treatment according to the results of this study.

In our study, results of isokinetic flexion at 60°/sec and 120°/sec were determined to be significantly improved in Groups 1 and 2. However, there was no significant difference between the two groups. In terms of isokinetic extension, there was a significant increase in Groups 1 and 2 at 60°/sec, while only the first group showed significant increase in terms of isokinetic extension at 120°/sec. In the third group, no significant results were obtained in any of the evaluations. In addition, we could not detect any significant difference between the 3 groups in the results for isometric rotation and isokinetic rotation (60°/sec-120°/sec). In a study in which the effect of exercise on isokinetic muscle strength was investigated, it was reported that there was a significant increase in isokinetic extension strength, while there was no significant difference in isokinetic flexion [25]. Although this is comparable to our study in terms of exercise results, they did not evaluate diathermy therapy; therefore, comparisons with our study could not be performed. Additionally, the fact that there are many differences between studies in terms of variables, study design, methods used for treatment and measurements, and number of samples, limits the possibility of making an accurate comparison.

There were some limitations in our study. The first limitation was the fact that the muscle strength in the first group was significantly lower than the other groups and the number of men in Group 3 was significantly higher than the other groups. These may have been the parameters that affected our results. The second limitation of our study is the fact that patients were asked to perform their exercise programs at home after they performed the routine once under physician supervision. Although patients were asked to record their exercises in a diary, it is not possible to ensure that all patients performed their routine in accordance with the directions given. This may also be a parameter affecting the results.

CONCLUSION

Our findings indicate that there are no significantdifferences between exercise therapy alone and exercise therapy in combination with diathermy (either continuous or pulsed) in terms of their effects on lumbar muscle strength. However, our results are from a single center and there is a requirement for multicenter studies with higher numbers of patients and better randomization to ensure that all baseline characteristics of patients are similar. Additionally, although it would be arduous, future studies may benefit from conducting all exercise routinesunder the supervision of a physiotherapist or a

physician in order to ensure all patients conform to the exercise routine.

CONFLICTS OF INTEREST

All authors declare that there is no potential conflict of interests.

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