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Effects of Hydrotherapy on postural control and electromyography parameters in men with chronic non-specific low back pain

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ABSTRACT

The aim of this study was to evaluate effects of hydrotherapy on postural control and electromyography parameters in men with chronic non-specific low back pain. Thirty men with chronic non-specific LBP divided into two hydrotherapy and control groups, randomly and equally. Electromyographic activity of erector spinae muscles and balance measured for both of groups before and after intervention. Hydrotherapy program was consisted of 24 sessions. Subjects in control group didn't have any special activity. Two-way variance was used to interpret the data and correlated and independent T-tests were used for analysis of data at the significance level of (P<0.05). Electromyographic activity of lumbar erector spinae muscles in both of sides didn't indicate a significant difference before and after intervention (P>0.05). However, a significant difference observed between two groups in balance index (P<0.05).

INTRODUCTION

Low back pain (LBP) is one of the most common musculoskeletal disorders and the leading causes of disability that have been reported[1]. Researchers have identified three levels of acute, sub-acute and chronic back problems[2, 3]. Most patients with acute low back pain recover regardless of treatment, but a limited number of patients do not respond to treatment and then enter chronic phase of their disease. Patients with chronic low back pain constitute 73 to 77 percent of patients with low back pain 85% of these patients cannot find any specific cause for their pain, which are classified as chronic nonspecific low back pain [4]. So far many therapeutic methods have been applied for the treatment of this syndrome, and it has been shown that movement therapy in patients with low back pain relievers back pain in them [5].

One of these methods is Hydrotherapy that recently has found a great popularity in sports and rehabilitation generally and especially in patients with low back pain and many sports therapists use this type of treatment in their rehabilitation programs. Water has been highly considered for the rehabilitation of patients with back pain due to unique physical characteristics and low risks. Floating in water allows the LBP patient to reduce the axial loading of the spine; ground reaction force is also reduced. Because of adhesion or viscosity features of water, strength exercises can also be included in the program of Hydrotherapy for patients with LBP[6].

Several studies have documented significant differences in action and performance of low back muscles and postural control in patients with low back pain through surface electromyography and balance detector devices. Therefore musculoskeletal disorders and muscle imbalance researchers consider less torque peak in electrical activity and instability and imbalance as the main cause of chronic back pain [7].According to the researchers, the performance and coordination of the lumbar extensor muscles of patients with low back pain becomes impaired as a result of misapplication and improper postures. These muscle dysfunction is associated with loss of control of neuromuscular system, disturbances in body's center of gravity situation and abnormal movements and increasing pain. The reasons for increasing postural in patients with low back pain can be impaired proprioception, dysfunction of the muscles surrounding the spine, delay in muscle response and decreased lower back muscles strength and coordination [8].Various several researches have shown that movement therapy in patients with chronic low back pain will increase the balance. In a study conducted by Corpus et al. (2008)effect of strength exercises of core body muscles on low back pain and balance in patients with nonspecific chronic low back pain was evaluated and results showed that increasing strength of the core body's muscles lead to preventing low back pain and improving balance in these patients [9].

So far the effects of Hydrotherapy on patients with low back painhas been repeatedly investigated by various purposes, but the effect of this type of exercise on balance and muscle electrical activity has been less taken into consideration in patients with low back pain. In a new study, Bressel et al. studied the activity of trunk muscles in healthy individuals while doing some exercises in water. In this study, individuals performed abdominal and trunk exercises in water to the level of the sternum. During this exercise, surface EMG were recorded of the right abdominal, external oblique, lower abdomen, Multifidus and Erector spinae muscles [10]. After analyzing the data, the researchers reported that Swiss Ball exercises and abdominal exercises in water increases the activity of all muscles [10]. Therefore, with respect to musculoskeletal and balance disorder in patients with nonspecific chronic low back pain and with regard to the fact that the exercise in water is considered as a useful for the treatment of low back pain patients because of its characteristics compared to dry environment, we decided to check the level of lumbar Erector spinae EMG activity as well as the balance of men with nonspecific chronic low back pain before and after a Hydrotherapy program. Our hypothesis in this study is lumbar muscles balance and electrical activity after a Hydrotherapy period this could improve the patient's condition and the segmental stability of the spine.

METHODS

This study was a quasi-experimental study with pretest and posttest and a control group. Statistical population for these study was comprised of all men with chronic low back pain referred to the Special clinic of Ghaem Hospital, Mashhad, in 2012.From which 30 samples voluntarily, and purposively were selected and randomly and equally were divided into two groups: exercise in water (N = 15) and control (N = 15) according to Inclusion criteria and comments of an orthopedic specialist.

The study inclusion criteria included the age between 20 and 40 years, low back pain lasting at least 3 months for diagnosis of chronic illness, physical full health, and lack of any surgery and fracture of the spine, lumbar lordosis, severe disc herniation, articular rheumatism, tumor and cancer, pain radiating down, lack of spine surgery, and pain caused by sciatica and other diseases that affect the research variables. The lack of any specific pathology in the spine was confirmed by radiographs with a specialist.

After sampling, both groups were introduced to the laboratory of Mashhad University Department of Sport Sciences and after getting consent letter and familiarizing the participants with the tests, Electromyography activity of the lumbar Erector spinae muscles and balance were respectively measured by surface EMG device (Biovision, Switzerland) and Biodex System (950-300 balance system sd,115 vac,50/60 z, America).In this study, the Biodex System (950-300 balance system SD, 115 vac, 50/60 z, America)was used to measure balance meter in the patients. This device consists of a graduated circular plate, known as a balance plate, which is located on a large tall with several sensors that can easily be shifted in different directions, according to the force caused by pressure of the feet. Eighth level of the device and the posture stability test were used according to the patient's condition for the study.

Test method by Biodex device was as following: first the person established on the balance plate in the defined state, then the impact point of the gravity center was matched to coordinate center of the balance meter screen and the balance meter plate was placed absolutely in the horizontal plane. By report on readiness and after pressing the start button, vibrations of the plate were transferred and recorded in memory device for 20 seconds; during this time, the

person should try to keep impact point of his gravity centerin the device's center of the coordinate screen. Test duration was 20 seconds that was repeated three times with an interval of 10 seconds.

At the beginning of the measuring EMG of the muscles, any excess hairs on the skin were cleaned by alcohol and a soft abrasive. Then the electrical activity of the Upper Lumbar Erector Spinae and Lower Lumbar Erector Spinae of left and right muscles were recorded by four pairs of surface electrodes (Lifen, China) placed in a 1 to 2 cm distance from each other. The junction of electrodes was in parallel with the muscle fibers at 6 cm outside the spinous processes of the vertebrae L1, L2 and 2 cm outside of the spinous processes of the vertebrae L5, S1 in both right and left sides of the spine, respectively[11,12]. Ground electrode was also installed in the posterior superior iliac spine(PSIS) that is closest bony prominence to the muscles. Maximal Voluntary Isometric Contraction (MVC) test of trunk extensor was used to record the lumbar Erector spinae muscle EMG activity (Figure 2). The test was consisted of 3 isometric trunk extensor each contraction for 5 seconds and 2 minutes rest between contractions. To test, the subjects laid prone on the bed, and then areas of hip, knee and ankle by 3 leather straps were firmly tied to the bed [11]. During the test of trunk, one had to extend his trunk to the end of motion range, and by the feeling any pain in the patient's spine, the test was terminated and the patient was excluded from the study. The exercise in water program was consisted of 6 weeks and 4 sessions per week (24 sessions) each training session between 45 to 60 minutes. Initial exercise sessions were easier and had less intensity, number of repetitions and duration. Exercises became more difficult in compliance with the principle of overload. Also exercises performed in water in the 4 positions: standing (walking to the front, back, sides and long steps), semi-bending (Cycling, flexion and extension of hip and knee and lower limb bilateral PNF patterns), supine (leg exercises) and the trunk strengthening exercises in the deep water (walking in water, adding weight during the walking, rotational movements of the trunk in the deep water) with emphasis on the spine stabilization exercises [14]. After measuring Balance and the Erector Spinaemuscle EMG activity, the experimental group carried out Hydrotherapy programs under the supervision of the hydrotherapist and the researcher. Control group also carried out their daily activities with no exercises, in this period. After training balance and muscle EMG were evaluated as post test to determine changes induced y exercise. SPSS version 18 was used for data analysis. Kolmogorov-Smirnov test used for determining the normality of the scores. Two-way variance was used to interpret the data of balance and paired sample and independent T-tests were used for analysis of EMG data at the significance level of 0.05.

RESULTS

According to Table 1there wasa significant difference between the two groups at 3 balance indexes of AP (P=0.036), ML (P=0.006) and overall stability index (P=0.005);and hydrotherapy increased all 3 balance indexes of patients with nonspecific chronic low back pain in the intervention group (0.05≥P) (Table 3).

Table 1: Effects of Hydrotherapy on balance indexes

Groups		Inter-group Variations **		Intra-group Variations *	Control		Intervention	
Variables	P	F	P	F	Post-test X ± SD	Pre-test X ± SD	Post-test X ± SD	Pre-test X ± SD
Overall stability	0.005	9.96	0.001	25.13	1.49±5.21	1.57±1.128	0.833±0.723	1.2±2.54
Anteroposterior stability	0.036	4.96	0.005	5.61	0.923±9.58	0.941±4.22	0.575±7.23	0.875±7.01
Internal-external stability	0.006	9.43	0.005	6.75	0.991±3.89	0.995±2.01	0.508±1.55	0.788±5.70

Table 2: The mean and standard deviation muscle EMG activity (mV) in the pre-test and post-test of experimental and control groups

Variable	Phase / Group	Post-test M ± SD	Pre-test M ± SD	Intra-group		Inter-group	
				sig	t	sig	t
ULESR EMG activity	Experimental	95.25±0.4	1.4181±.4	0990.	799.1	0.884	0.147
	Control	86.81±0.4	.25±15.92	2390.	234.1		
ULESL EMG activity	Experimental	94.83±0.5	0.73±6.70	0.444	794.0	0.746	0.328
	Control	03.39±1.5	.67±05.87	0.251	1.201		
LLESR EMG activity	Experimental	7.77±0.5	1.47±6.21	0.429	0.821	0.269	1.140
	Control	75.58±0.5	.67±05.63	0.415	1.234		
LLESL EMG activity	Experimental	.7777±0.5	0.98±5.59	0.444	0.719	0.603	0.527
	Control	.0229±1.5	27.±05.72	0.947	0.068		

According to Table 3, the muscle EMG activities of the Hydrotherapy group did not show significant difference (0.05<P) before and after the treatment period [ULESR (P =0.88), ULESL (P =0.74), LLESR (P =0.26), LLESL (P =0.60)].

DISCUSSION

The results indicated that Erector Spain lumbar muscle EMG activity statistically has not been changed (0.05<P) after 6 weeks of Hydrotherapy, However, a significant improvement was observed in balance index of patients (0.05>P).The results of the lower back muscle EMG activities are consistent with the results of Bicalho et al. [15] Arokoski et al. [16] Stevens et al. [17].These studies showed that rehabilitation exercises in dry environments such as spinal manipulation and stabilization exercises had no effect on activity of paraspinal muscles in patients with low back pain. Contrary to this research, Mannion et al. [18]Keller et al. [13] and Lewis et al. [19] reported that exercises and physiotherapy altered the electrical activity of the muscles of the trunk in patients with low back pain rehabilitation[13,18,19]. Different characteristics of environmental-training in these studies could be the possible reason for the contradiction between the results of this study and mentioned studies. Masumoto and Mercer compared the EMG activity of the lower limb muscles during walking on land and in water and concluded that activity of the muscles is lower while walking and creating maximum voluntary contraction in the water compared with land. It is possible that both buoyancy and hydrostatic pressure of water may remove the pressure on the muscles and joints in patients with low back pain and prevent a significant change in the level of muscle activity, especially Erector Spinae muscles, after a period of Hydrotherapy [20].

Regarding balance index, our results are consistent with the results of Corpus et al. (2008) and Ray et al. (2011). Their studies evaluated the effects of stabilization exercises on balance of patients with low back pain and concluded that these exercises can increase balance and stability in the patients [9, 21]. According to previous studies, impairment of both Global and Local muscular system are involved in the development of low back pain; however the dysfunctions in lumbar deeper muscles such as multifidus muscles the Interspinales muscles, and Inter transversales muscles have a greater role in creating of low back pain [22]. One probable mechanism explaining why significant changes have not occurred in the EMG activity of the lumbar Erector Spain muscles after the intervention can be as follows, probably more changes in the activity of the deeper muscles of lumbar spine after treatment period have occurred and strengthening and creating muscle balance in deeper muscles of lower back could be one reason for the reduction in pain intensity and increment of the stability and balance in people with low back pain after exercise in water. Yaqubi et al. noted that short term Abdominal Hollowing exercises have affected local and deep muscles of lower back in patients with low back pain in terms of electrical activity, whereas no change has been observed in the global muscle activity [23].In this study, other causes of the increase in balance can be attributed to the physical properties of water. Immersion and flotation of the body in water increases the input of deep receptors and thereby improve the balance of the body by greater stability and adjustment. Since water has a higher viscosity than air, so it has more resistant; therefore sensory feedback increases in water and raises the consciousness senses of the body [24].Another reason for exercise influence in water is due to a combination of the exercise effects on the vestibular system stimulation and vestibular inputs facilitation. Exposure with water can enhance inputs in skin stimulation and thereby increase the afferent nerve stimulation[25] therefore multi-sensory exercises such as exercise in water may provide the conditions to challenge balance system by stimulation of balance-involved senses and in this way be effective in improving balance.

CONCLUSION

The purpose of this study was to evaluate the effect of 6 weeks of Hydrotherapy on balance and EMG activity of lumbar muscles in patients with chronic non-specific low back pain. The results showed improvement in the balance level of the patients but however changes did not occur in the activity of the superficial muscles of patient's waist.

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