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Effects of core stabilization exercises in patients with non-specific low back pain: Huber Motion Lab versus conventional

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Abstract

Introduction: This study aimed to determine the effects of core stabilization exercises with Huber® Motion Lab on pain, depression, and activity levels in patients with non-specific low back pain (LBP).

Materials and methods: In this study, 30 patients with non-specific LBP were allocated either to an experimental or to a control group. Both groups received a conventional physiotherapy program for 15 sessions. In addition, the control group performed 30 minutes of core stabilization exercises on the floor, whereas the experimental group used the Huber® Motion Lab device. The main outcome measures were pain severity (Visual Analogue Scale VAS), depression (Beck Depression Inventory BDI), and disability level (Oswestry Disability Index ODI) that were performed on the first and the last day of the program.

Results: At the end of the program, all outcome measures improved significantly in both groups ($p < 0.001$). Between-group comparison of mean change score revealed significantly greater improvements regarding VAS (7.40vs4.23), BDI (29.52vs13.81), and ODI score (51.78vs25.29) for the experimental group compared to the control group ($p < 0.001$).

Conclusions: For patients in this study with non-specific LBP, both with and without Huber® Motion Lab, core stabilization exercises in addition to a physiotherapy program were beneficial in terms of pain severity, depression, and disability level in favor of Huber® Motion Lab.

Keywords

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Article

Effects of core stabilization exercises in patients with non-specific low back pain: Huber Motion Lab versus conventional

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Abstract: Introduction: This study aimed to determine the effects of core stabilization exercises with Huber® Motion Lab on pain, depression, and activity levels in patients with non-specific low back pain (LBP). Materials and methods: In this study, 30 patients with non-specific LBP were allocated either to an experimental or to a control group. Both groups received a conventional physiotherapy program for 15 sessions. In addition, the control group performed 30 minutes of core stabilization exercises on the floor, whereas the experimental group used the Huber® Motion Lab device. The main outcome measures were pain severity (Visual Analogue Scale VAS), depression (Beck Depression Inventory BDI), and disability level (Oswestry Disability Index ODI) that were performed on the first and the last day of the program. Results: At the end of the program, all outcome measures improved significantly in both groups ($p < 0.001$). Between-group comparison of mean change score revealed significantly greater improvements regarding VAS (7.40vs4.23), BDI (29.52vs13.81), and ODI score (51.78vs25.29) for the experimental group compared to the control group ($p < 0.001$). Conclusions: For patients in this study with non-specific LBP, both with and without Huber® Motion Lab, core stabilization exercises in addition to a physiotherapy program were beneficial in terms of pain severity, depression, and disability level in favor of Huber® Motion Lab.

Keywords: Huber® Motion Lab, back pain, core stabilization, exercise, depression, disability.

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1. Introduction

Low back pain (LBP) is one of the most frequent musculoskeletal pain syndromes that generates substantial work disability and healthcare costs [1]. Non-specific LBP, defined as pain with no identifiable cause, accounts for about 85% of cases [2]. The pain that develops due to the deterioration of the static and dynamic responses resulting from the biomechanical loading of the body gradually develops into non-specific LBP [3]. Providing the static and dynamic balance of the *columna vertebralis* depends on both muscular and joint structures having sufficient flexibility and robustness as well as accurate information from proprioceptors. When the *columna vertebralis* is damaged for any reason, joint limits are restricted by stimuli from mechanoreceptors, and fast reflex muscle contraction and joint protection cannot be achieved to prevent new injuries [4].

Although a wide range of measures, such as surgery, drug therapy, conservative therapy, and rehabilitation, are used in the management of LBP, various physiotherapy approaches are often used to provide fast reflex muscle contraction and joint protection [5]. The most used method is exercise. Abdominal and/or back extensor muscles activation by specific exercises is advocated to reduce pain and disability [6]. Exercise programs usually consist of combinations of different exercises, such as stabilization exercises that affect the spine statically and dynamic exercises that focus on proprioceptive training. Stability exercises aimed to improve strength, endurance, and neuromuscular control of trunk muscles. Weakness of core muscles, insufficient control, and delayed muscle contraction of core muscles are risk factors for non-specific LBP [7]. For this reason, rehabilitation strategies should be directed toward core muscles along with medical and conventional treatments. In the literature, it has been determined that core stabilization exercises are effective in relieving pain and increasing the functionality of non-specific LBP patients in comparison with conventional exercises [8].

The Huber® Motion Lab is a new generation of therapeutic exercise device for trunk muscles that aims to provide mobility, balance, flexibility, strength, and endurance while providing biofeedback. The contribution of technology practices to rehabilitation strategies is gradually increasing, also providing management continuity and motivation. In low-back pain, Huber® Motion Lab is mainly used for strengthening as well as for expected benefits such as providing biofeedback and increasing exercise motivation. Despite a wide usage of the Huber® Motion Lab in clinic applications, there is a limited number of studies in the literature [9]. The aim of the current study was to determine the effects of core stabilization exercises with the Huber® Motion Lab in comparison with conventional core stabilization exercises on pain severity, depression, and activity levels in patients with non-specific LBP. The hypothesis of the present study was that patients with non-specific LBP who had a conventional physiotherapy program with core stabilization exercises using Huber® Motion Lab had better outcomes compared to patients who had undergone a conventional physiotherapy program and core stabilization exercises.

2. Materials and Methods

2.1. Study Design and Participants

This study was a randomized controlled trial and received ethical approval from the Medipol University Ethics Committee. The participants with nonspecific LBP (n = 30) were recruited from the Fizyotek Private Clinic of Physiotherapy and Rehabilitation. All participants gave informed consent to participate in the study. Patients with LBP for at least 3 months that was not caused by a specific known condition between the ages of 18–70 were included. Participants were excluded if they demonstrated evidence of any of the following: spinal fractures or dislocations, infections, malignancies, previous surgery, instability such as spondylolisthesis or spondylolysis, metabolic or inflammatory back pain, and neurological loss. The participants were randomly allocated to either an experimental (n = 15) or a control (n = 15) group. The randomization was done using computer-generated random numbers.

2.2. Intervention

Both groups received conventional physiotherapy programs including hot pack, ultrasound (6 min), Transcutaneus Electrical Nerve Stimulation (TENS) (20 min), and soft tissue massage (10 min) to the lumbar region, 3 days a week, for 5 weeks (15 sessions in total). In the conventional physiotherapy program, superficial heating with hot packs was applied to the low back region for 15 minutes to raise the threshold for pain, produce analgesia by acting on free nerve endings and decrease muscle spasms. Ultrasound therapy was used as deep heating to enhance connective tissue extensibility. Slow circular movements were applied by the transducer head over the painful paravertebral low back region. 1 megahertz frequency, 1.5 watt/cm2 intensity, an ERA of 4cm, a BNR of 1:5, and

5 minutes of duration in continuous mode ultrasound therapy were applied. TENS is used for reducing pain with conventional stimulation mode at 80 Hz pulse frequency and 100 μsec pulse width. 4 electrodes (2x2 cm) were placed over the most painful lumbar region. The amplitude was increased up to the subjects' perception of paresthesia. Soft tissue massage was performed to areas restricted by the damaged tissue with the aim of increasing blood circulation, helping to relieve pain, and improving general mobility and range of motion.

In addition to this conventional physiotherapy program, the control group performed core stabilization exercises, whereas the experimental group used the Huber® Motion Lab device. Both groups performed 30 minutes of exercises 3 days a week, for 5 weeks. In the control group, core stabilization exercises focused on the lumbar multifidus and transversus abdominus muscles. The most well-known and easy-to-understand exercises like plank (front/side, with ball/without ball), and push-up (front/side, with ball/without ball) were chosen. Patients performed exercises 3 sets 10 times on the floor without any discomfort, under the supervision of a physiotherapist (Figure 1). The patients in the experimental group were asked to keep the pelvis stable, activate the core area as taught, and stay on the rotating platform of the device. During each of these exercises, the Huber® Motion Lab was constantly monitored for the possibility of falling due to the loss of balance related to the rotating platform.

Figure 1. Core stabilization exercises for the control group.

In the Huber® Motion Lab system (LPG Systems, France), an oscillating platform and a column support highly sensitive ergonomic handles. The Huber® Motion Lab aims to increase overall stability, balance, coordination, and posture for the spinal structure by requiring the user to remain steady in an unsteady environment, strengthening, regaining automatic reflexes, and dual-tasking. The automated technology utilizes highly perceptive sensors that precisely target problem areas. A motorized, oscillating platform causes instability, causing the spine to strive to maintain equilibrium. Ergonomic arms adapt to all patient body types and sizes. The interactive, computerized display provides immediate evaluations of areas of strength and weakness. Acting as a virtual trainer, Huber® Motion Lab utilizes an interactive performance display helping create a customized, ongoing training program. Touch sensors precisely isolate muscle groups to strengthen areas of weakness or instability. At the beginning of the session, an instantaneous strength assessment is undertaken by sensors, which determines the level of power to be used during treatment. Following the assessment, a series of exercises for both the upper and lower body are performed depending on the level of balance and coordination. The oscillating

platform rotates to the left or right, shifting the body off-balance and forcing it to maintain stability by exercising the core muscles of the trunk.

2.3. Outcome Measures

The main outcome measures were pain severity (Visual Analog Scale – VAS), depression (Beck Depression Inventory – BDI), and the disability level (Oswestry Disability Index – ODI) that were performed on the first and the last day of the treatment program.

VAS is a standard 10-cm horizontal scale. The patient points out the severity of pain by placing a mark between 0 to 10 designated "No pain" and "Pain as bad as it could be" [10]. For clinical decision-making, the minimal clinical important difference (MCID) for VAS had been suggested as 20mm [11].

The participants' depression levels were assessed with BDI. It measures the depth and behavioral manifestations of depression and consists of 21 items, each of which has four responses of increasing severity. Numerical values from 0–3 were assigned to each statement to indicate the degree of severity. A total score from 0–9 was considered normal, 10–16 reflected mild depression, 17–29 reflected moderate depression and 30 or above was considered severe depression [12].

The patients' disability level in both groups was measured by the ODI. This form is a method used by someone to measure the performance of activities required for daily living and to define limitations. ODI measures functional inactivity in daily living activities such as personal care, lifting, walking, sitting, sleeping, sex life, social life, and travel. There are 10 questions in this form. There are 6 options in each question and the patient is asked to choose the best expression that describes the situation. Each sentence is scored from 0 to 5. A score of 0–20 reflects minimal disability, 21–40 moderate disability, 41–60 severe disability, 61–80 crippled, and 81–100 bed-bound [13, 14]. MCID was accepted as 10 points [15].

2.4. Statistical Analysis

Statistical analyses were performed using the Windows-based Statistical Package for the Social Sciences for Windows (SPSS version 22.0, Chicago, IL, USA). In the statistical analysis of baseline data of the groups, the Mann-Whitney U test was used. Statistical analysis was done utilizing the Wilcoxon test before and after treatment comparison of the data in the groups. A p-value of less than 0.05 was considered significant. Effect size with r and Cohen's d values were calculated. In line with Cohen's recommendations, d values of 0.20, 0.50, and 0.80 were interpreted as small, moderate, and large, respectively. As a result of the post-hoc power analysis with the G-Power program (Universitat Kiel, Germany), the power of the study was calculated as 79.20% with 0.05 error and 0.92 effect size [16].

3. Results

Fifteen patients in the control group (8 female, 7 male), and 15 patients in the experimental group (6 female, 9 male) were included in the study. Baseline characteristics are presented in Table 1.

Table 1. Baseline characteristics of the participants (Mann Whitney U Test)

	Gender	Experimental Group (Mean±SD)	Control Group (Mean±SD)	*p*
Age (year)	Female	40.25 ± 4.92	36.41 ± 4.23	0.745
	Male	51.17 ± 4.53	49.64 ± 3.81	0.924
BMI (kg/m²)	Female	25.51 ± 2.93	23.52 ± 2.75	0.457
	Male	24.72 ± 3.14	23.93 ± 2.86	0.534

There was no significant difference in baseline characteristics of patients between both groups ($p > 0.050$). No adverse event or dropout was observed in either group. Baseline outcome measures are presented in Table 2. Despite randomization, the severity of pain, depression, and disability were milder in the control group than the experimental group.

Table 2. Baseline characteristics of the participants.

	Experimental Group (Mean±SD)	Control Group (Mean±SD)	*p*
Visual Analog Scale	9.32 ± 0.84	7.78 ± 1.65	0.003
Beck Depression Inventory	37.64 ± 4.56	29.41 ± 4.73	0.001
Oswestry Disability Index	64.84 ± 8.61	52.73 ± 1.07	0.004

Mann Whitney U Test

At the end of the treatment, pain intensity, depression, and disability levels significantly improved in both groups ($p = 0.001$) (Table 3).

Table 3. Baseline characteristics of the participants.

	Group	Before (Mean±SD)	After (Mean±SD)	*p*
Visual Analog Scale	Experimental	9.32 ± 0.84	1.92 ± 0.83	0.001
	Control	7.70 ± 1.65	3.47 ± 1.64	0.001
Beck Depression Inventory	Experimental	37.64 ± 4.56	8.12 ± 2.73	0.001
	Control	29.41 ± 4.73	15.60 ± 2.41	0.001
Oswestry Disability Index	Experimental	64.84 ± 8.61	13.06 ± 4.42	0.001
	Control	52.73 ± 1.07	27.44 ± 7.56	0.001

Wilcoxon Rank Signed Test

Between-group comparison of the mean change score revealed significantly greater improvements regarding VAS (7.40 vs 4.23), BDI (29.52 vs 13.81), and ODI score (51.78 vs 25.29) for the experimental group compared to the control group ($p = 0.001$) (Table 4). For VAS and BDI all patients in both groups met the MCID. For ODI, only one patient stayed below 10 in the control group.

Table 4. Between-group comparison of mean change score.

	Group	Mean Change Score	*p*	Cohen's *d*	Effect Size *r*
Visual Analog Scale	Experimental	-7.40 ± 1.12	0.001	3.327	0.857
	Control	-4.23 ± 0.84			
Beck Depression Inventory	Experimental	-29.52 ± 3.32	0.001	4.903	0.925
	Control	-13.81 ± 3.21			
Oswestry Disability Index	Experimental	-51.78 ± 7.16	0.001	2.500	0.780
	Control	-25.29 ± 13.27			

4. Discussion

Despite the widespread use of the Huber® Motion Lab, there has been a limited number of related studies [9, 17–19]. In this study, the effects of core stabilization exercises with the Huber® Motion Lab and conventional core stabilization exercises in patients with

non-specific LBP were compared. At the end of the study, meaningful changes were obtained in both groups thus supporting the literature indicating the beneficial effects of core stabilization exercises in addition to the physiotherapy program. However, the benefits were in favor of the Huber® Motion Lab.

Akhtar et al. [22] compared two treatment groups which were treated with core stabilization exercises or routine physical therapy exercises. They found core stabilization exercises to be more effective with a 3.08 points reduction in pain severity [22]. Similarly, in our study the control group reached 4.23 points of pain reduction with core stabilization exercise. Amir et al. [23] studied the efficiency of the Huber® Motion Lab with non-specific low back pain. Their Cohen's d value for pain reduction was 2.9, which is lower than our study [23]. This difference may be related to additional pain relief effects of other physiotherapy modalities in our study.

Pain, muscle weakness, loss of endurance, motor control problems, and decreased spinal stability and flexibility result in disability in non-specific LBP patients. For this reason, it should be necessary to evaluate disability in determining the effectiveness of exercise programs and interventions. For this purpose, the ODI results that we used in our study revealed the beneficial effects of exercise programs. In the study by Kapetanovic et al. [24], there were three different patient groups. One of them was a control group which was only assessed, but the remaining two groups were experimental groups that performed core stabilization exercises at different frequencies and times. They found significantly reduced ODI scores after the exercise program, but the control group's ODI score was similar [24]. In a meta-analysis study by Wang et al. [6] that compared the effects of core stabilization and general exercises on LBP, five randomized control trials were included. The mean change scores of pain and disability were between [-2.47 – -0.11], and [-11.64 – -2.65], respectively [6]. In our study, higher mean change scores were obtained in both groups, but the difference was higher in the experimental group. In our study, all exercises were supervised by a physiotherapist, and this may be the main reason for both higher scores. Also, there is an additional positive effect of the Huber technology that gives motivation and feedback to patients.

Psychological problems like depression in non-specific LBP patients are common symptoms in disability. In the literature, the psychological status was not taken into consideration in most studies evaluating the effectiveness of core stabilization exercises. A study that investigated the effects of core stabilization exercises on sleep disturbance, pain-related disability, depression, and anxiety determined a decreased level of depression symptoms after 8 weeks of core stabilization exercises [25]. Similarly, in our study, depression decreased in both groups.

The interest in the use of technology in rehabilitation practices is gradually increasing. Many technological rehabilitation tools are preferred due to their advantages such as increasing patient motivation, providing feedback to patients, and instant evaluation. In our study, the Huber® Motion Lab proved to be a safe and effective exercise option for non-specific low back pain.

The findings of this study indicated that in patients with non-specific LBP, Huber® Motion Lab exercises in combination with conventional physiotherapy were more efficient in reducing pain, depression level, and functional inactivity concerning core stability exercises in combination with conventional physiotherapy. Of course, the effects of conventional physiotherapy methods applied to both groups cannot be neglected in intra-group outcome measures. However, since the aim of this study was to compare Huber® Motion Lab core stabilization exercises and traditional core stabilization exercises in addition to conventional physiotherapy, the effect of conventional physiotherapy was ignored. As a limitation, despite randomization, the severity of all assessed parameters was milder in the control group than in the experimental group which is a disadvantage for the experimental group.

5. Conclusions

In our group of patients with non-specific LBP, core stabilization exercises with and without the Huber® Motion Lab in addition to a physiotherapy program were beneficial in terms of pain severity, depression, and disability level. However, the benefits were in favor of the Huber® Motion Lab. The Huber® Motion Lab can be taken into account as an effective application while choosing the exercise environment, depending on the patient's disability and pain status, the patient's choice, the clinician's choice, or the facility's resources.

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