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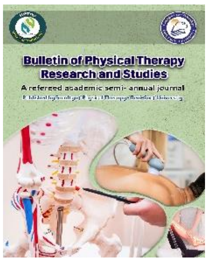

Effect of Core Stabilization Exercises on Muscle Tenderness in Patients with Chronic Non-Specific Low Back Pain: A Randomized Controlled Trial

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Running Title: Effect of Core Stabilization Exercises on Chronic Non-Specific Low Back Pain.

Abstract:

Background: Core stability exercises seek to restore normal muscle function to enhance spinal stability and neuromuscular control in the lumbopelvic area.**Purpose:** To investigate the impact of core stabilization exercises on muscle tenderness among patients having chronic nonspecific low back pain. **Methods:** Fifty patients of both sexes suffering from chronic nonspecific low back pain were recruited and distributed randomly into the control (group A) and experimental group (group B). Group B was given regulated traditional therapy as well as core stabilization exercises. Only conventional treatment was administered to Group A. Both groups received the same treatment for six weeks. Assessment was conducted before and after 6 weeks for both groups. Group B included 25 subjects who received conventional treatment in the form of transcutaneous electrical nerve stimulation, continuous ultrasound, and core stabilizing exercises. Group A included 25 subjects who were given only conventional treatment. Both groups received the intervention for six weeks, three sessions per week. The pain pressure threshold of paraspinal muscles was assessed using a manual pressure algometer before and following a six-week intervention for both groups.**Results:** As compared to the control group (Group A), paraspinal muscle tenderness at the lumbar region in the experimental group (Group B) Unpaired t-test revealed a substantial difference among two groups with p-value < 0.05.**Conclusion:** Core stabilization exercises are effective in the improvement of muscle tenderness among patients suffering from chronic non-specific low back pain.

Keywords: Low back pain, Core stabilization, Tenderness.

Introduction

Core stability has gained significant prominence in recent years, described as the restoration or enhancement of the neuromuscular system's capacity to control as well as protect the spine from damage or re-injury. The goal of core stability exercises is to restore normal muscle function. These exercises aim to strengthen the spine, improve lumbopelvic neuromuscular control, stiffen the intersegmental joints, and protect the lumbar spine from shear forces (1). Core stability exercises represent an evolving process, necessitating the improvement of clinical rehabilitation procedures. Core stability programs focus on two primary strategies: motor control strategy and muscle capacity strategy to enhance lumbopelvic control. The motor control strategy seeks to reestablish coordination and regulation of the trunk muscles to enhance control of the lumbar spine and pelvis. The muscle capacity strategy aims to restore endurance as well as strength of the trunk muscles to fulfill control demands (2). The core is defined as a muscular structure that includes the abdominal at the anterior surface, the paraspinal and gluteal muscles at the posterior surface, the diaphragm above, and the pelvic floor along with the hip girdle muscles below. The trunk muscles have been categorized into two systems: a local system and a global system, both involved in maintaining the stability of the lumbar spine (3). The local system consists of muscles with their insertion or origin, or both, within the lumbar vertebrae, whereas the global system encompasses muscles that originate from the pelvis and insert into the thoracic cage (3). Muscles can be classified into two categories based on their anatomical, biomechanical, and physiological characteristics: stabilizers as well as mobilizers. The stabilizers are designed for posture maintenance using an 'antigravity' feature. The mobilizers are optimally constructed for swift ballistic actions and are frequently designated as 'task muscles.' The abdominal muscles that help with trunk movement include the rectus abdominis, which helps with flexion, and the erector spinae, which helps with extension. The internal oblique, multifidus, as well as transversus abdominis, are the main muscles that stabilize trunk movement (3,4). Additional classification may be conducted into both primary and secondary stabilizers. The principal stabilizers are muscles that do not produce substantial joint movements, including the lumbar multifidus as well as transversus abdominis. The primary function of these muscles is to make lumbar stabilization. The secondary stabilizers, such as the internal oblique, medial fibers of the external oblique, and quadratus lumborum, exhibit large stabilizing functions while also facilitating the mobilization of spinal joints (3). Low back pain (LBP) has emerged as a significant public health issue globally. About 23% of people have chronic LBP, whereas 84% of people have lifelong LBP. Eleven to twelve percent of the population is disabled because of LBP (5). Chronic nonspecific low back pain (CLBP) is described by lumbosacral spine pain for at least three successive months without a discernible anatomical or neurophysiological etiology, potentially arising from mechanical, musculoskeletal, or multifactorial sources. Obesity, age, sex, low educational attainment, as well as smoking, may correlate with an elevated chance of getting LBP (6). Patients experiencing chronic low back pain exhibit delayed activation of the lumbar multifidus and transversus abdominis, as well as a diminished physiological tonic activation of the transversus abdominis during ambulation and limb movement. Dysfunction of these muscles may result in diminished support for the lumbar spine and lead to increased stress and pressure on the joints and ligaments of the lumbar region (7). Pressure pain thresholds are commonly assessed by manual pressure algometry at both primary pain sites and distant areas, an indication of local as well as generalized hyperalgesia (8). Pressure algometry has proven to be efficient as well as reliable in investigating the physio-pathological mechanisms associated with muscular pain disorders (9).

Methods

Ethical considerations

Approval of this study was obtained from the Research Ethics Committee of the Faculty of Physiotherapy at Cairo University (approval number: P.T.REC/012/ 005227).

Study design and Setting

This study employed a randomized controlled design with pre-test and post-test assessments. Participants were randomly assigned to one of two groups: group A, which served as the control, and group B, which served as the experimental group, and were enrolled from the outpatient clinic of Cairo University's physical therapy faculty between May 8, 2024, and three months later. The sample size was fifty subjects who were measured utilizing G-Power 3.0.10 software by hypothesizing a 5% degree of freedom along with a 5% attrition rate using a 0.80 power. Fifty patients suffering from chronic non-specific LBP of both genders were employed from the external clinic of the faculty of physical therapy at Cairo University. They were randomized into the control (group A) as well as the experimental group (group B). Participants from both groups provided informed consent before their recruitment in the study.

Group A included 25 subjects who were given only conventional treatment. Group B included 25 subjects who received conventional treatment in the form of transcutaneous electrical nerve stimulation, continuous ultrasound in addition to core stabilization exercises. Both groups were given the intervention for six weeks, 3 sessions per week. The pain pressure threshold of paraspinal muscles was assessed using a manual pressure algometer before and following a six-week intervention for both groups.

Inclusion criteria

They were aged from 30 to 50 years, they have been in pain for at least three months to two years, and they have been diagnosed with CLBP. The pain intensity ranged from moderate to severe, measured on a visual analog scale (VAS) of four or higher.

Exclusion criteria

The current study's subjects did not show any symptoms of sciatica. Other conditions included neurological impairment, peripheral neuropathy, cauda equina syndrome, previous spinal trauma, spinal surgery in the lumbar region, pelvic pain, pregnancy, serious mental health problems, neuromuscular diseases that are degenerative, metabolic problems (that include diabetes and thyroid conditions), coagulopathies (which involves hemophilia and anticoagulant usage), or fever.

Procedures

Evaluative Procedures:

Participants who satisfied the inclusion criteria and were devoid of any exclusion criteria were incorporated into the study. To prevent any interference with the assessment process, subjects were told to dress comfortably for the procedure. Participants were assessed with a manual pressure algometer (Baseline Dolorimeters, NY) equipped using a 1 cm^2 rubber disk at the termination of the apparatus. The patient was instructed to alert the assessor when they experienced mild discomfort when pressure was exerted perpendicular to the skin. PPT was described in kg/cm2.Individuals were asked to lie down in a prone position on the evaluation table. Measurements were performed on the bilateral paraspinal muscles of the lumbopelvic area 2.5 cm from the midline of the spinal segments L1 to S3 (16 points of measurement) (6).

Intervention procedures

Group A (the control group) was given traditional treatment, whereas Group B (the experimental group) received traditional therapy in addition to core stabilization exercises .Conventional therapy included ultrasound therapy (Gymna-Due 200) in continuous mode, having a frequency of 1 MHz with an intensity of 1.0 W/cm, for 5 minutes. A moist heat pack was used for 20 minutes in conjunction with TENS. The Gymna Due 200 electrotherapy TENS device was utilized with the following parameters: burst mode, frequency of 5 Hz, pulse width of 150 µs, and output intensity ranging from 20 to 40 milliamperes or as acceptable by the participant .Conventional TENS used 4 electrodes at a distance of 3 cm distance on either side of the spinal process, two electrodes were applied over paraspinal muscles at the level of L1-L3, and 2 electrodes were applied over paraspinal muscles at the level of L5-S1. The core stabilization regimen comprised both stretching and strengthening activities. Stretching exercises encompassed quadriceps, hip flexors, adductors, as well as hamstrings in a standing position. Strengthening exercises comprised abdominal pulls, abdominal pulls with knee flexion towards the chest, abdominal pulls during heel slide on the table in the supine position, prone cobra posture, superman position, and planks. Treatment was administered three times each week for thirty minutes. 18 sessions, 3 sessions per week, for 6 weeks, 30 min per session; a day of rest was allowed between each 2 sessions to avoid fatigue (10).

Statistical analysis

Data were presented as mean ± standard deviation (SD). The study was conducted utilizing SPSS software version 20 (SPSS Inc., Chicago, IL, USA). The significance level was established at $P < 0.05$.

Results

Demographic data of the subjects

Fifty participants in the present study were randomized into two equivalent groups, as illustrated in Table 1. The mean ± SD of the age of groups A and B were (35.53±6.68 years and 36.00± 6.94) years respectively with a p-value is 0.76. The mean ± SD of height in both groups were (170.2±8.9) and (170.4±8.3) cm respectively, and for weight in both groups were (73.5±9.5) and (71.2±10.8) Kg respectively (Table 1). There were no substantial differences among both groups regarding age, height, as well as weight ($p>0.05$). The gender distribution of groups A and B revealed that there were 11 male patients (44%) and 14 females (56%) in group (A), and 12 males (48%) patients, and 13 females (52%) patients in group (B) respectively. No substantial difference was observed in gender distribution among the two groups ($p = 0.759$).

Results of Pain Pressure Threshold of paraspinal muscles in both groups

The mean ± SD of pre-treatment PPT values of paraspinal muscle in groups A and B were 5.1 ± 0.7 and 4.8 ± 0.9 kg/ respectively, while post-treatment values were 5.6 ± 0.7 and 8.4 ± 1 kg/ respectively. No statistically substantial difference was noted in pre-treatment mean PPT values of paraspinal among both groups (P=0.633). There was a statistically substantial difference among post-treatment values of both groups A and B (P=0.001) favoring group B. There was a statistically substantial difference among before as well as following treatment PPT mean values of paraspinal within both groups as the p-value was (0.005) and (0.001) respectively. The percentage of changes among before and following treatment values in groups A and B were 12.3% and 67.4% respectively.

Table 1. Subjects' characteristics of both groups

	Group A	Group B	p-value
Age (years)	35.53±6.68	36.00± 6.94	0.76
Height (cm)	170.2±8.9	170.4±8.3	0.971
Weight (kg)	73.5±9.5	71.2±10.8	0.475
Sex distribution	No (%)	No (%)	**p-value**
Males	11 (44%)	12 (48%)	0.759
Females	14 (56%)	13 (52%)	

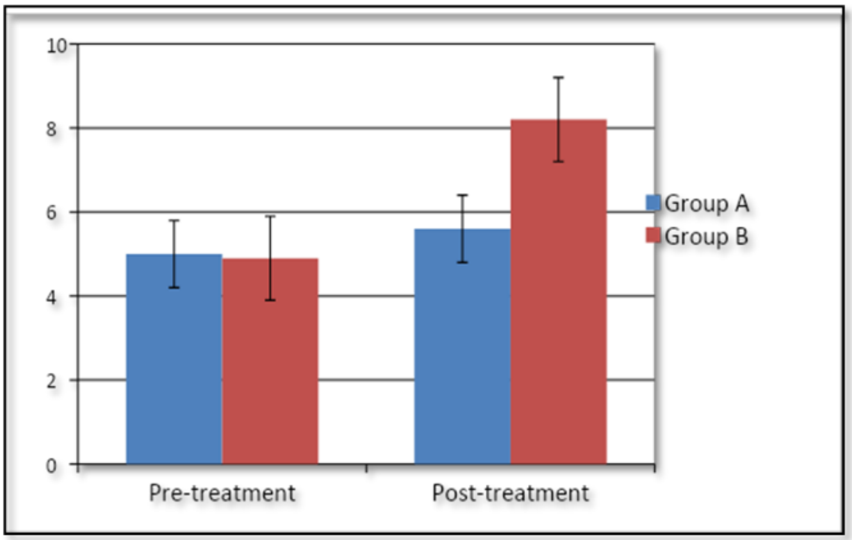
Data represented as mean ±SD, χ^2 : Qi square

Table 2: Comparison of PPT between the control group and the experimental group

Pain threshold (kg/cm^2)	**Group A**	**Group B**	**MD (95% CI)**	**P value**	**ηp2**
Pre-treatment	5.1 ± 0.7	4.8 ± 0.9	0.117 (-0.382, 0.620)	0.633	0.006
Post-treatment	5.6± 0.7	8.4 ± 1	-2.70 (-3.0, -2.08)	0.001*	0.706
(P-value)	0.005*	0.001*			
% of change	12.3%	67.4%			

Data was expresses as mean ± SD, probability; η2, partial eta square; MD, mean difference; CI, confidence interval; *, significant

Fig.1 Mean values of pain pressure threshold of paraspinal muscles in the two groups



Discussion:

This study was done to examine the influence of core stability exercises on patients with CLBP. The study was done by over 50 subjects suffering from chronic nonspecific LBP, randomly allocated into two equal groups, the control group (group A) and the experimental group (group B). Group B included 25 participants who were treated with conventional treatment in the form of transcutaneous electrical nerve stimulation, continuous ultrasound, and core stabilizing exercises. Group A included 25 participants who received only conventional treatment. Both groups were given the intervention for six weeks, 3 sessions per week. Assessment of the pain pressure threshold of paraspinal muscles using a manual pressure algometer was done before and after six weeks of intervention for both groups. The findings of this study revealed that there was a statistically substantial difference among post-treatment values for both groups A and B (P = 0.001) in favor of group B. The results of the present study agree with Hodges., 2003 who supported and augmented the findings of the current study, Participants in his study were randomized into either a motor-relearning program or a control group receiving no therapy. The training duration was 10 weeks. Upon the conclusion of training and at the 30-month follow-up, a notable decrease in pain as well as disability was observed in the motor-relearning group (2).Also, the present results agree with those of Jamil et al., 2023 who demonstrated that core stability exercises effectively improved function, alleviated pain, diminished disability, as well as enhanced endurance among patients with lumbar disc herniation as well as low back pain (11).The current study concludes that individuals having CLBP may benefit greatly from having their pain levels assessed. This agrees with the results of Özdolap., 2014 that patients having CLBP had much lower pain pressure thresholds in several sites that are either directly or indirectly connected to the lumbar spine compared to healthy controls (12).In the same line as the present study, Coulombe., 2017 stated that core stability exercises are more helpful than general exercises in decreasing pain and enhancing back-specific functional status among patients suffering LBP (13).The current study's results agree with those of Zachary S, et al.,2022 who examined the impact of core stability exercises in treating NSLBP among adult patients. They determined that core stability exercises are an effective approach for alleviating pain among patients experiencing non-specific low back pain (14).The valuable and significant effect of core stability revealed by the present study was also examined by Su S., 2021 who concluded that, although both core stability and strengthening activities alleviate pain, core stability exercises are more effective than strengthening exercises. It effectively enhances proprioception, and balance, as well as the percentage change in muscle thickness of the transversus abdominis along with lumbar multifidus, while diminishing functional disorders and fear of motion among patients with subacute LBP (15).

Limitations

There were just 50 participants in the study, which might have limited how far the results can be applied. Results would be more solid and trustworthy with a bigger sample size. The six-week duration of the intervention might not have been enough to see the long-term benefits of core stability exercises. Increasing the time might show late-emerging impacts or long-lasting advantages. Only people between the ages of 30 and 50 met the inclusion requirements; people in other age groups who might also benefit from or react differently to core stabilization exercises were not included. Conventional therapy, which does not completely isolate the effects of core stability exercises, was administered to the control group. A sham intervention or placebo might be used in a more thorough control design. Psychological and sociological problems, such stress or depression, were not considered in this study.

Conclusion

Core stabilization exercises are effective in the improvement of muscle tenderness among patients suffering from chronic non-specific low back pain.

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