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Effect of Core Stability Exercises on Pain in Chronic Non-Specific Low Back Pain

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Abstract

Background: Nearly everyone will at some point in their lifetime have low back pain, which is a relatively common ailment. A condition referred to as "nonspecific low back pain" lacks a recognized underlying anatomical etiology. According to several publications, it has been widely reported that core stability exercises, particularly those focusing on the transverse abdominis and multifidus muscles, have the potential to reduce chronic low back pain, both with and without radiculopathy, while also enhancing general functionality.

Aim of Study: To examine the effect of core stability exerciseson chronic non-specific low back pain sufferers.

Subjects and Methods: Fifty women with non-specific low back pain were recruited, and participants were divided into two equal groups at random. Study group (A) 25 patients who received core stability exercises and transcutaneous electrical nerve stimulation (TENS). Control group (B) 25 patients who received TENS only. The treatment was conducted for 40min, three sessions per week for twelve successive weeks. Outcome measures were Visual Analogue Scale (VAS) score to measure pain. The measurements were done before and after the 4 weeks of intervention.

Results: Within groups comparisons, there was a statistically significant reduction in pain when comparing pre- and post-treatment conditions within study group A, (p=0.001*). While the control group (B), showed a statistically significant reduction in pain when comparing pre- and post-treatment conditions (p=0.001*). Between groups comparisons showed a statistical significant reduction in pain for the study group compared to the control group after treatment (p=0.001*).

Conclusion: Core stability exercises is a beneficial therapeutic program in reducing pain in patients with chronic non-specific low back pain.

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Key Words: *Core stability exercise – Pain – Chronic nonspecific low back pain.*

Introduction

IT was found that nonspecific low back pain is the present manifestation of the condition commonly referred to as low back pain.

Nonspecific low back pain frequently occurs in cases where a specific pathoanatomical cause cannot beidentified **[1].**

However, in cases where a healthcare practitioner identifies a specific disease process that necessitates a unique management approach separate from non-specific low back pain, the utilization of diagnostic tests assumes a critical role. To diagnose nonspecific low back pain accurately, it is crucial to rule out various conditions that specifically affect the lumbar spine. These conditions may include but are not limited to, epidural abscess, compression fracture, spondyloarthropathy, malignancy, cauda equine syndrome, radicular pain, radiculopathy, or spinal canal stenosis **[1,2].**

The remaining participants demonstrate non-specific low back pain. Although the intervertebral disc and facet joints are considered potential sources of lumbar pain, current clinical testing methods do not offer conclusive evidence establishing a direct correlation between these structures and the sensation of pain **[2].**

The multifidus and transverse abdominis muscles contract during spinal loading or limb movement **[3].** Therefore, in instances where the multifidus muscle fails to contract right away, the superficial muscles, such as the erector spinae, engage in compensatory contraction. This compensatory mechanism leads to muscle spasms, pain, andincreased compressive tension on the spine **[3-5].**

Certain factors have been identified as contributors to the development of low back pain [3].

The addition of stabilizing exercise has been shown to yield significant benefits in the treatment of pain related disability depression, and anxiety among individuals with nonspecific chronic low back pain, regardless of the presence or absence of radiculopathy. Research suggests that exercise is a highly effective intervention for reducing non-specific low back pain [6].

Chronic nonspecific low back pain should be treated with exercise therapy. Regard less of the form, exercise can help with secondary prevention and recurrence prevention [7].

For the primary management of chronic nonspecific low back pain, muscle strengthening, and stabilization programs appear to be more effective than cardiovascular programs [7,8].

According to this study, exercise therapies can help people with chronic back pain improve trunk muscle motor function [9].

The deep core muscles exhibit synchronous contraction and serve as a stable foundation upon which the global muscles can effectively operate [10].

Moreover, they exhibit a consistent level of activity throughout the day. Core stability refers to the ability of the lumbopelvic hip complex to withstand collapse and restore its original position following a disturbance [10,11].

The deep core or local core muscles include the transverse abdominis, multifidus, diaphragm, and pelvic floor muscles [11].

The anatomical structure in question exhibits a box-like shape, wherein the diaphragm functions as the uppermost component, the pelvic floor diaphragm serves as the lowermost component, and the multifidus and transverse abdominis muscles serve as the anteroposterior components [12-14].

Subjects and Methods

Study design:

A randomized controlled study was conducted to investigate the effect of core stability exercises on pain in non-specific chronic low back pain.

Data were collected from August 2022 to August 2023, and all patients signed aninformed consent form.

Participants:

Fifty chronic nonspecific low back pain patients were recruited in this study from the outpatient clinic of the faculty of physical therapy at Cairo University and the outpatient clinic of El Qanater El Khaireya Hospital.

The patients were diagnosed and referred by an orthopedic surgeon based on inclusion and exclusion criteria.

The selected patients were randomly assigned into two equal groups: The intervention group (a) and the control group (b). The intervention group (GA) of 25 patients was treated with core stability exercises in addition to transcutaneous electrical nerve stimulation (TENS), and the control group (GB) of 25 patients was treated only by transcutaneous electrical nerve stimulation (TENS).

The treatment was conducted for 40 minutes, with three sessions per week for four weeks. The whole procedure was explained to every patient. All patients were informed with written consent before participation.

Randomization:

The recruited patients were randomly assigned, after signing a consent form, into two groups. A randomized control trial was carried out by using theenvelope allocated.

Inclusion criteria:

1- Females with chronic nonspecific low back pain [7].
2- With a history of at least a three-month duration.
3- The individual's age was between 22 and 45 years old.
4- Pain score on a visual analogue scale from 3 to 6.

Exclusion criteria:

- Patients with medical red flags (fracture, trauma, osteoporosis, and infection).
- Patients with a history of rheumatologic conditions.
- Patients with a history of systemic cardiovascular, respiratory, neurological, gastrointestinal, urogenital, or related conditions.
- Patients with a history of back-related conditionsor degenerative vertebral disease.
- Patients with a history of extra vertebral cause-visceral.
- Patients with a history of sensory or motor defects.
- Patients with a history of disc lesions.

Assessment instrumentation:

Visual Analogue Scale (VAS):

The scale has values ranging from 0 to 10.

The pain scale ranges from 0 to 3, indicating the absence of pain or mild pain. A range of 4 to 6 signifies the presence of severe pain, while a range of 7 to 10 represents the experience of very strong to the most intense pain imaginable [15-18].

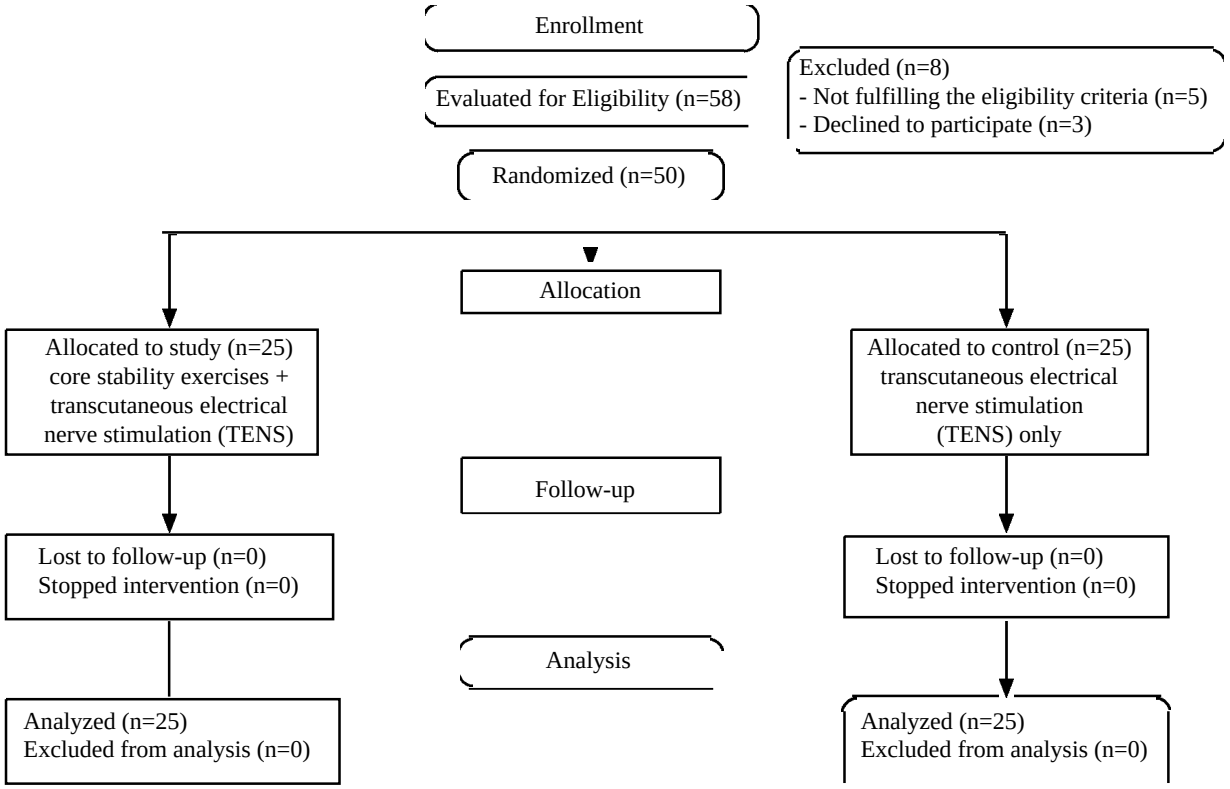

Fig. (1): The flowchart of recruiting patients.

Treatment instrumentation:

Transcutaneous electrical nerve stimulation (TENS):

The patient lay prone, and two electrodes on the lumbar spine were utilized. Regarding TENS parameters, using burst mode (5 Hz, intensity of 20-50 mA), the application duration is 40 minutes.

Intervention protocol:

Study group (A): Patients were given forty minutesper session involving the TENS current. And during the application of current they did a program that involves selecting core stability exercises.

Control group (B): Patients were given the TENS current only for forty minutesper session, three sessions/week, for four successive weeks.

Ethical considerations:

Consent number: P.T.REC/012/003938 was reviewed for ethical consideration and authorized for the current investigation. The privacy and anonymity of every patient were ensured Participants.

Sample Size Calculation:

Sample size has been calculated using G power software, using effect size (0.5), power (0.95), one-tailed, and $p>0.05$ giving a sample size of (50), 25 in each group.

Control group (B):

The patients had TENS current only.

TENS current for 40 minutes. The patient was lying prone, and two electrodes on the lumbar spine were utilized. Regarding TENS parameters, using burst mode, 5 Hz, intensity of 20-50mA, application duration of 40 minutes.

Study group (A):

The TENS current was applied to the patients with the same parameters asthe control group and during the application of TENS current they developed a program that involves selecting core stability exercises:

a- Breathing exercise program:

Patients performed deep diaphragmatic exercises, holding breath for five seconds, exhaling through pursed lips, and producing hissing sounds, followed by a weekly three-respiratory training session for four weeks *[19]*.

b- The pelvic floor muscle training program:

The patient engaged in pelvic floor muscle contraction training, performing 10 contractions per set for three sets, maintaining diaphragmatic breathing and pursed lips *[20]*.

c- The transverse abdominis muscle training [21]:

The patients from supine lying were instructed to activate the transverse abdominis using a manual palpatory approach *[22]*.

1- Participants were instructed to draw their abdomen using pressure biofeedback, hold it for 5 seconds, and repeat it 10 times in a supine lying position.
2- Subjects were instructed to draw in their belly, hold them for 10 seconds, and repeat them 10 times with each heel sliding for 4 seconds.
3- Participants were instructed to draw their abdomen while supine, raising their buttocks off a surface and holding for 5 seconds, with 10 repetitions.
4- Participants were instructed to perform 10 repetitions of the abdominal drawing-in movement while standing, and then attempt to maintain this movement while moving **[21].**

d- *The lumbar multifidus muscles contraction:*

Subjects were instructed to perform isometric back exercises in supine or prone lying positions, swelling muscles against a hand and maintaining transverse abdominis drawing-in maneuvers **[22].**

Statistical analysis:

Results are expressed as the mean ± standard deviation. A test of normality, the Kolmogorov-Smirnova test, was performed to measure the distribution of the data measured at pre-treatment.

A comparison between normally distributed data (variables) in the two groups was performed using an unpaired *t*-test. An analysis of covariance (ANCOVA) test was used to compare the pre-treatment values of the two groups, and at the same time, between post-treatment values to control the effect of pre-treatment values. A comparison between pre- and post-treatment data in the same group was performed using a paired *t*-test.

A comparison between the data (variables) in the two groups was performed using the Mann-Whitney test. Comparison between pre-and post-treatment data in the same group was performed using the Wilcoxon Signed Ranks test.

Statistical Package for Social Sciences (SPSS) computer program (version 19 Windows) was used for data analysis. *p*-value ≤0.05 was considered significant.

Results

There was no statistically significant difference between the two groups as regards age (*t*=–1.111, *p*=0.272), weight (*t*=–1.042, *p*=0.303), height (*t*= 0.166, *p*=0.869), and BMI (*t*=–1.142, *p*=0.260), respectively (Table 1).

At pre-treatment, in groups A and B, the mean values (± SD) of pain level were 5.16±1.40 and 5.24±1.48, respectively. There was no statistically significant difference between the two groups (F value=0.038, *p*=0.845) (Table 2).

Table (1): Demographic characteristics of the two studied groups.

	Study group A (n=25)	Control group B (n=25)	*t*-value	*p*-value
Age (yrs.)	26.68±4.72	28.40±6.13	–1.111	0.272 (NS)
Weight (kg.)	68.23±12.04	72.78±18.24	–1.042	0.303 (NS)
Height (cm)	160.96±7.70	160.66±4.71	0.166	0.869 (NS)
BMI (kg/m^2)	26.33±4.37	28.07±6.26	–1.142	0.260 (NS)

Data are expressed as mean ± SD.
t = Unpaired *t*-test. NS = *p*> 0.05 = Not significant.

Table (2): Inter- and intra-group comparison between values of pain level in the two groups measured at pre- and post-treatment

	Study group A (n=25)	Control group B (n=25)	*t*-value	*p*-value
Pre-treatment	5.16±1.40	5.24±1.48	0.038	0.845 (NS)
Post-treatment	2.24±0.97	3.76±1.36	30.187	0.001 (S)
Mean difference	2.92	1.48		
% change	56.59 ↓↓	↓↓		
t-value	12.676	6.022		
p-value	0.001 (S)	0.001 (S)		

Data are expressed as mean ± SD. NS = *p*>0.05 = Not significant.
F value = ANCOVA test. S = *p*≤0.05 = Significant.
t-value = paired *t*-test.

In group A, there was a statistically significant decrease in the mean value of pain level measured at post-treatment (2.24±0.97) when compared with its corresponding value measured at pre-treatment (5.16±1.40) with *t*-value=12.676 & *p*-value= 0.001.

Also in group B, there was a statistically significant decrease in the mean value of pain level measured at post-treatment (3.76±1.36) when compared with its corresponding value measured at pre-treatment (5.24±1.48) with *t*-value=6.022 and *p*-value= 0.001.

The percent decrease in pain level in both groups A and B were 56.59% and 28.24%, respectively.

Post-treatment, the ANCOVA test revealed that there was a statistically significant decrease in the mean value of pain level in group A (2.24±0.97) when compared with its corresponding value in group B (3.76±1.36) with F value=30.187 & *p*= 0.001.

Discussion

The current study was conducted to examine the effect of core stability exercises on pain in patients with nonspecific chronic lower back pain.

Fifty women participated in this study. Participants were assigned to two groups (the study group and the control group). The study group (GA) in-

cluded twenty-five patients. The control group (GB) included twenty-five patients.

The result of this research indicated that the use of core stability exercises that include a breathing program, pelvic floor training, transverses abdominis, and multifidus training is effective in reducing pain in nonspecific chronic low back pain patients.

For the management of chronic nonspecific low back pain, Dangmei et al. recommended combining deep breathing exercises and pelvic floor muscle exercises into physical therapy interventions. Their results supported ours, showing that increasing trunk stabilizers' activity through pelvic floor muscle training and deep breathing exercises improved stability and decreased pain ***[21-25]***.

In the primary therapy of chronic non-specific low back pain, it was found that programs for strengthening and stabilizing the musculature appear to cure low back pain more effectively than programs with a cardiopulmonary emphasis ***[7]***.

According to Frizziero et al., core stability may have significant therapeutic benefits for those with non-specific chronic low back pain by lowering pain levels,and reducing disability, activation, and thickness of the core muscles ***[25]***.

On the other hand, the best way to treat patients with low back pain for their core muscles is a topic of debate. Physicians can choose between two different rehabilitation approaches: Global muscular function assessment using a general exercise approach or local muscle assessment combined with motor control exercise ***[26]***.

No noticeable variations in pain relief were noted during the intermediate- and long-term follow-up periods, according to a 2012 meta-analysis ***[27]***.

Conclusions:

Core stability exercises is a beneficial therapeutic program in reducing pain in patients with chronic non-specific low back pain.

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تأثير تمارين الثبات المحورى على الألم فى آلام أسفل الظهر المزمنة غير محددة السبب

الخلفيه: آلام أسفل الظهرالغير محددة السبب هى شائعه نسبيا لا تحتاج الى مسببات تشريحيه أساسيه معروفه.وفقا للعديد من المنشورات،أن تمارين الثبات المحورى لديها القدره على تقليل آلام أسفل الظهر المزمنه مع تعزيز الوظائف العامة أيضا.

الهدف من الدراسة: دراسة تأثير تمارين الثبات المحورى على المصابين بآلام أسفل الظهر المزمنه الغير محددة السبب.

طرق البحث: تمت مشاركة خمسين امرأة تعانى من آلام أسفل الظهر غير محددة السبب، وتم تقسيم المشاركين إلى مجموعتين متساويتين بشكل عشوائى. مجموعة الدراسة (أ) ٢٥ مريضاً تلقوا تمارين الثبات المحورى بالاضافه لاستخدام التيارالكهربائى عبر سطح الجلد الكهربائى عبر الجلد فقط المجموعة (ب) ٢٥ مريضاً تلقواالتيارالعلاج لمدة اربعين دقيقة، ثلاث جلسات أسبوعيًا لمدة أربع أسابيع متتاليه.

النتائج: ضمن مقارنات المجموعات، كان هناك انخفاض ذو دلالة احصائيه فى الألم فى المجموعه (أ) مقارنة ظروف ماقبل وبعد العلاج . كما أظهرت المقارنات بين المجموعه (أ) والمجموعه (ب) انخفاضا ملحوظا فى المجموعه (أ) بالنسبه للالمقارنة بالمجموعه (ب).

الاستنتاج: تمارين الثبات المحورى هى برنامج علاجى مفيد فى تقليل الألم لدى المرضى الذين يعانون من آلام أسفل الظهر المزمنة الغير محددة السبب.