Effect of Elastic Therapeutic Taping on Abdominal Muscle Endurance in Patients With Chronic Nonspecific Low Back Pain: A Randomized, Controlled, Single-Blind, Crossover Trial

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Abstract

Objective: The purpose of this study was to determine the immediate effect of elastic therapeutic taping and sham taping of the abdominal musculature on maximum hold time of endurance tests in patients with chronic nonspecific low back pain (CNLBP).

Methods: Twenty-six people with CNLBP and 26 asymptomatic individuals were included in this study. The CNLBP participants were allocated to an elastic therapeutic tape group or a sham tape group. Standard adhesive elastic therapeutic tape was utilized for facilitatory application in the elastic therapeutic tape group. The elastic therapeutic tape group received real elastic therapeutic taping on the transversus abdominis and internal obliques, and the sham tape group received sham elastic therapeutic taping application. For the sham group, the elastic therapeutic tape was positioned horizontally above the navel and applied without tension. After a wash-out period, each CNLBP participant was switched to the other group. Outcome measures included maximum hold time of supine isometric chest raise, supine double straight-leg raise, and abdominal drawing in maneuver.

Results: The CNLBP participants had lower maximum hold time compared to the asymptomatic individuals ($P \leq .01$). Following taping, both groups showed an increase in the maximum hold time (mean difference = 4.43 – 50.69 seconds; $P \leq .02$). Although there was no difference between the results of both groups ($P \geq .12$), effect sizes were large for the elastic therapeutic tape group (Cohen's $d = -1.93$ to -1.00).

Conclusions: The results suggest that the maximum hold time of endurance tests was decreased in CNLBP patients compared to healthy participants. The application of both elastic therapeutic tape and sham tape to the transversus abdominis and internal obliques produced short-term improvement in abdominal endurance. There was no statistically significant difference between the results of elastic therapeutic tape and sham tape. (J Manipulative Physiol Ther 2018;41:609-620)

Key Indexing Terms: *Low Back Pain; Physical Endurance; Abdominal Muscles; Athletic Tape*

Introduction

Chronic nonspecific low back pain (CNLBP) can be defined as pain persisting for a period of greater than 3 months, localized between the costal margin and the inferior gluteal folds, without referred leg pain and that is not caused by a known specific pathology.[1] The lifetime prevalence of CNLBP is estimated approximately to 23%.[1] It is an important socioeconomic public health challenge worldwide, and, despite the volume of literature published on the subject, it is still a difficult-to-treat condition.[2] Although the main causes of CNLBP are widely unknown, several factors seem to be associated with the development of CNLBP symptoms, including psychological factors, occupational factors, habits, and individual characteristics.[3,4]

Control of the spine is complex and depends on well-coordinated, deep-trunk musculature.[5] It has been demonstrated that decreased muscle activity and altered motor control of kinesiologic monitor muscles, such as paraspinal (multifidus) and deep abdominal musculature (transversus abdominis and internal oblique) can be found in patients with CNLBP.[6] Therefore, the control and stability of the lumbar spine may be

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challenged due to the changes in activity of the deep-trunk musculature. Muscle endurance is defined as the ability of a muscle or group to maintain a fixed contraction or repeatedly execute consecutive contractions over a prolonged period of time.[7] Endurance levels can be determined by observing changes in the performance of the functional activity being examined.[7] Many studies have demonstrated that decreased muscle endurance can be found in patients with low back pain (LBP).[8-12] Various factors have been suggested for this decline in the muscle endurance, such as higher muscle metabolite level resulting from prolonged muscle contraction or spasm,[8] muscle deconditioning,[12] higher proportion of type II muscle fibers in the paraspinal[11] and abdominal musculature, impaired muscle coordination and unequal distribution of force,[12] and atrophy and inhibition of the paraspinal musculature,[9,12] especially the lumbar multifidus muscles,[9,10] in response to pain and decreased activity.

Elastic therapeutic tape (kinesiology tape) is made of tightly woven elasticized cotton fibers with acrylic, waterproof, and highly durable glue on the back so it can be worn for up to a week, during which time the tape will resist vigorous movements, sweat, and total immersion in water.[13,14] This popular technique may increase range of motion, promote postural alignment and stability, facilitate muscle function, restore functional movement, enhance blood circulation, decrease oedema, normalize muscle length and tension ratios creating optimal force, reduce pain due to neurologic suppression, and prevent sports-related injuries.[15-22]

To date, several studies have looked at the effects of elastic therapeutic taping of the abdominal musculature. In 2008, Cepeda et al indicated that elastic therapeutic tape application to abdominal musculature in children with hypotonia may be a therapeutic approach to facilitate the transition from supine to sitting.[23] In another study, Gürşen et al reported that the application of elastic therapeutic tape with abdominal exercises resulted in significant benefit for abdominal recovery in women with cesarean section compared to abdominal exercises alone.[24] However, to the best of authors' knowledge, there is no clinical study that has evaluated the immediate effects of elastic therapeutic taping of the abdominal musculature on endurance tests in patients with CNLBP. Therefore, the purpose of the present study was to determine the immediate effect of elastic therapeutic taping of the abdominal musculature on the maximum hold time of 3 endurance tests (ie, supine isometric chest raise [SICR] test, supine double straight-leg raise [SDSLR] test, and abdominal drawing in maneuver) in CNLBP patients.

Methods

Study Design

The experimental design was a randomized, sham-controlled, single-blind, crossover trial design with a level of evidence Ib according to a classification system modified from the Oxford Centre for Evidence-based Medicine (https://www.cebm.net/2009/06/oxford-centre-evidence-based-medicine-levels-evidence-march-2009/). This investigation was conducted in the physiotherapy clinic located at the School of Rehabilitation Sciences, Iran University of Medical Sciences, Tehran, Iran. An official letter was obtained from the Ethical Review Board to perform this research. Moreover, the present study was registered at the Iranian Registry of Clinical Trials (IRCT2016110829264N2). Figure 1 illustrates the process of the study.

Participants

The sample size of this investigation was calculated based on a pilot study (initial $n = 12$, 6 patients with CNLBP and 6 asymptomatic individuals) using the G*Power Statistical Package (version 3.0.10)[25] with an α value of 0.05 to achieve a statistical power of 0.80 and an effect size of 0.80. The following options were also selected: test family, t test; statistical test, means difference between 2 dependent means; and type of power analysis, a priori. The mean ± standard deviation values of the SICR test for participants with and without LBP were 30.99 ± 17.38 seconds and 57.15 ± 12.26 seconds, respectively. The result of the difference between 2 groups revealed that a minimum of 26 participants with CNLBP and 26 asymptomatic participants were needed. Therefore, 26 patients with CNLBP (13 male, 13 female) and 26 demographically matched asymptomatic (healthy) participants (13 male, 13 female) were recruited for this study. It was the largest sample size that was determined during the pilot study. Selection of the study sample was conducted using a nonprobability convenience purposive sampling method. Accessible population of the present study composed of CNLBP patients aged between 18 to 45 years who were referred to the physiotherapy clinic located at the School of Rehabilitation Sciences, Iran University of Medical Sciences Tehran. All of the participants were identified and recruited by posters and word-of-mouth from the University and the surrounding locality. Study enrollment took place between March 2016 and December 2016. The inclusion and exclusion criteria of this investigation are listed in Table 1. These criteria were selected to obtain a homogeneous study group and as an attempt to control the variables influencing the study outcomes (Table 2). In addition, the asymptomatic and CNLBP participants were balanced for 3 prognostic factors. An explanation on the study procedure was given to each participant both verbally and using a written form. Finally, all eligible participants signed a written informed consent before entering the study.

Randomization

All eligible CNLBP participants were randomized to a real elastic therapeutic tape group or a sham elastic therapeutic tape group with a ratio of 1:1. Randomization was conducted by a computer generated random number table (Research Randomizer, version 4.0). However, this type of randomization does not control confounding variables and covariates. In

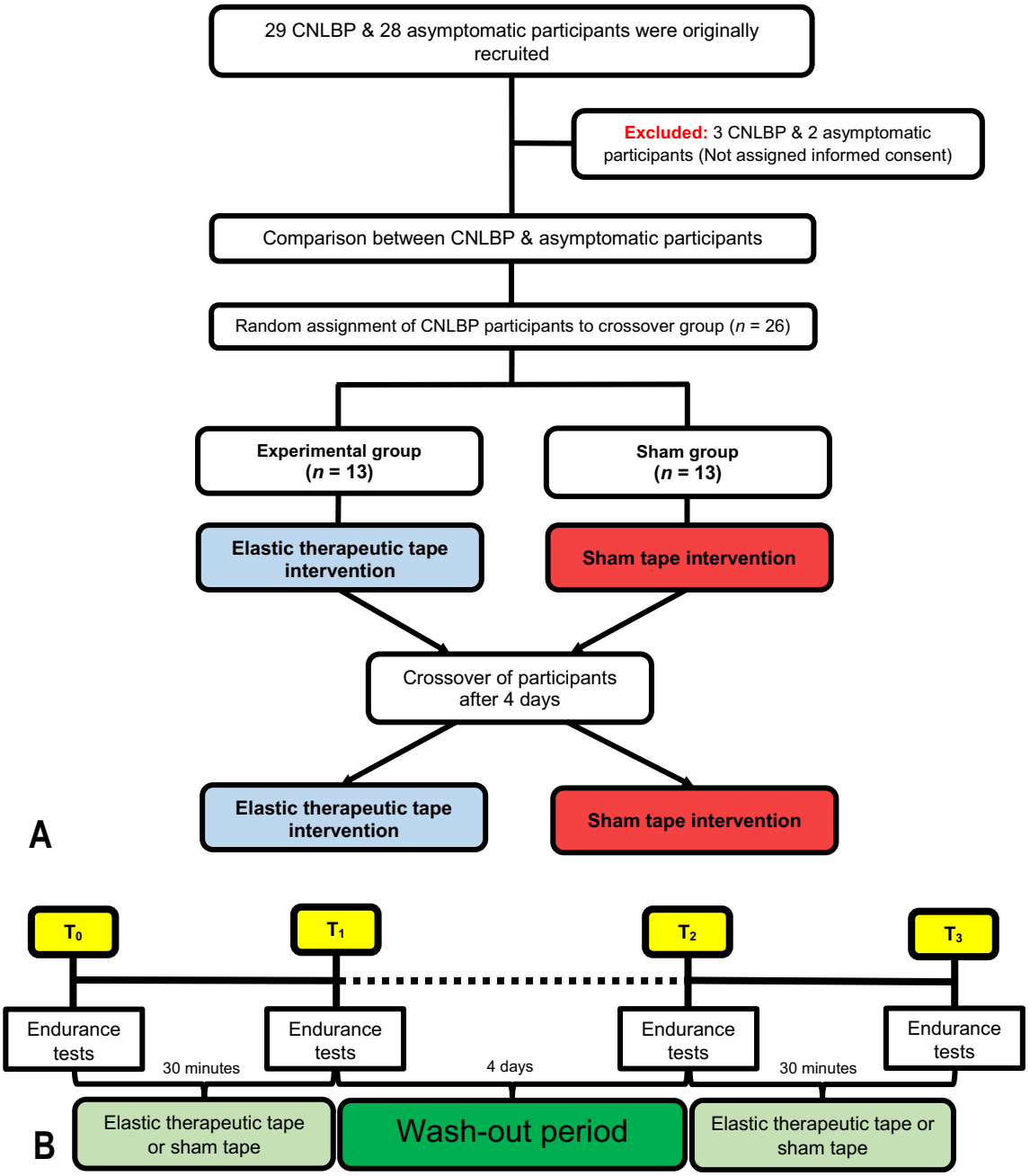

Fig 1. *Flow chart of recruitment and randomization of study participants (A). Timeline of the experimental protocol (B).* CNLBP, chronic nonspecific low back pain; T_0, *first assessment (at this assessment, CNLBP participants and asymptomatic participants were evaluated);* T_1, *second assessment;* T_2, *third assessment;* T_3, *fourth assessment.*

the current study, confounding variables and covariates were controlled by the crossover design. After randomization, the randomization schedule was transferred into written instructions (elastic therapeutic tape or sham tape) and placed in sequentially numbered opaque sealed envelopes. The randomization was performed by an investigator who was not involved with participant assessment and taping. Therefore, CNLBP participants were blinded to which group they were in until the end of the study. There was no formal attempt made to assess the success of blinding.

Procedure

In this study, we tried to use the template for intervention description and replication checklist[29] as a guideline to improve the completeness of reporting of our intervention

Table 1. *Inclusion and Exclusion Criteria for CNLBP Participants*

Inclusion Criteria	Exclusion Criteria
1- CNLBP (low back pain persisting for more than 3 months in the absence of an underlying pathology)[26] 2- Age between 18 and 45 y 3- Moderate pain at rest (pain scores between 3 and 6 on a 0-10-point pain VAS, where 0 represents no pain and 10 is the worst pain imaginable)	1- Pain radiating past the knee[27] 2- History of abdominal surgery 3- Abdominal hernia 4- Pregnancy[28] 5- Contraindicated to elastic therapeutic taping (eg, skin allergy or intolerance to tape, dermatitis, or pre-existing skin lesion and infection)[28]

CNLBP, chronic nonspecific low back pain; *VAS*, visual analogue scale.

procedure. After the recruitment phase, the participants were brought to the physiotherapy clinic located at the School of Rehabilitation Sciences, Iran University of Medical Sciences. Afterward, the participants were asked to lie on a treatment table, and the maximum hold time of endurance tests was recorded by a chronometer application installed on an iPhone 5 device. The procedure was conducted by 2 examiners (M.R.P. and R.B.) who were PhD candidates in physiotherapy, and they were not blinded to testing conditions because they were involved in the intervention program (taping).

Endurance Tests

SICR Test. The participant's position was supine on the treatment table with the hands crossed on the chest. The hips and knees were flexed at 45°, and the feet were placed flat on the table. The participant was requested to lift the neck and upper trunk from the table until the inferior angles of scapulae had risen clear of the table and hold this position as long as possible (Fig 2A).[30-32] The maximum hold time was then recorded in seconds, and the test was terminated when the participant was unable to maintain the test position.

SDSLR Test. The participant was asked to lie in a supine position with the hips and knees extended. The hands were also placed in a relaxed position near the body. The participant was then instructed to raise both legs from the table to approximately 20° and hold them as long as possible without any tilting in the pelvis (Fig 2B).[31] During the test, pelvic tilt was monitored by an experienced physiotherapist (M.R.P.). The maximum hold time was recorded in seconds, and the test was terminated when the participant was unable to maintain knee clearance.[33]

Abdominal Drawing in Maneuver. This was done with the participant lying supine on the treatment table with the hands placed in a relaxed position near the body. The hips and knees were flexed at 45° and the feet were placed flat on the table. In addition, a pressure biofeedback monitor (sphygmomanometer) was placed below the lumbar lordosis between the L_1 and S_1 vertebrae. The cuff of the sphygmomanometer was inflated to 20 mmHg using an air pump to fill the space between the lumbar spine and treatment table. The participant was then requested to contract his or her deep abdominal musculature by drawing the navel up in a cephalad direction and in toward the spine, so as to draw in the lower abdomen.[34] The participant was instructed to push his or her back against the cuff and maintain the pressure at 40 (±10) mmHg as long as possible (Fig 2C). The maximum hold time was recorded in seconds, and the test was terminated when the participant was unable to maintain the pressure at 40 (±10) mmHg.

All procedures were repeated 3 times, and the mean value of each measurement was used for analysis. In addition, approximately 90 seconds of rest were given to the participants between each of the 3 repetitions, and a 3-minute rest was provided between the 3 endurance tests. Verbal encouragements were offered by the 2 examiners during the tests, and no visual feedbacks were authorized. All asymptomatic participants served as a control group in the first assessment to detect differences in the maximum hold times of the 3 endurance tests between the CNLBP patients and asymptomatic participants. Hence, they did not participate in the intervention phase and the second assessment (Fig 1).

Taping Techniques

Elastic therapeutic taping is a technique that utilizes an elastic therapeutic tape developed by Dr Kenzo Kase (a chiropractor) in Japan more than 25 years ago, and it was introduced into the United States in the 1990s.[35] It has been reported that to facilitate muscle function, the tape should be applied with moderate (25%-50% of the available) tension in the direction from origin to insertion.[36] In addition, depending on the muscle being taped, elastic therapeutic tape can be applied using "I" or "Y" cuts. In the present study, every taping application was performed by an experienced physiotherapist (M.R.P.) with more than 6 years of clinical experience in taping techniques. Standard 5-cm wide, 0.5-mm thick, and water resistant elastic adhesive therapeutic tape (BB Tape, WETAPE Inc, Seoul, Korea) was used for facilitatory application in the elastic therapeutic tape group. The CNLBP participants

Table 2. *Baseline Characteristics of Participants*

Participants	Sex	*n* (%)	Age (y) [a]	Height (cm) [a]	Body Mass (kg) [a]	BMI (kg/m^2) [a]	VAS Score at Rest [a]	Smoker *n* (%)	Working Status, *n* (%)			Education, *n* (%)		
									Working Full Time	Working Part Time	Not Working	Lower Than Diploma, Diploma, and Advanced Diploma	Bachelor's Degree	Higher Than Bachelor's Degree
Asymptomatic	Male	13 (50)	28.15 ± 6.56	174.61 ± 7.65	72.85 ± 8.83	23.82 ± 1.68	—	5 (19)	6 (23)	5 (19)	2 (8)	3 (11)	6 (23)	3 (11)
	Female	13 (50)	29.60 ± 6.21	168.57 ± 4.67	64.00 ± 7.02	22.47 ± 1.74	—	3 (11)	3 (11)	6 (23)	4 (15)	3 (11)	8 (31)	3 (11)
	Total	26 (100)	28.57 ± 6.48	171.59 ± 6.97	68.42 ± 9.06	23.15 ± 1.82	—	8 (31)	9 (35)	11 (42)	6 (23)	6 (23)	14 (54)	6 (23)
CNLBP	Male	13 (50)	28.20 ± 6.87	173.95 ± 5.99	71.95 ± 8.37	23.71 ± 1.78	4.69 ± 1.10	4 (15)	7 (27)	5 (19)	2 (8)	2 (8)	8 (31)	3 (11)
	Female	13 (50)	28.45 ± 5.11	167.66 ± 3.83	63.38 ± 6.46	22.50 ± 1.58	4.38 ± 0.96	3 (11)	2 (8)	5 (19)	5 (19)	3 (11)	6 (23)	4 (15)
	Total	26 (100)	28.32 ± 5.98	170.80 ± 5.90	67.66 ± 8.56	23.11 ± 1.77	4.54 ± 1.03	7 (27)	9 (35)	10 (38)	7 (27)	5 (19)	14 (54)	7 (27)

BMI, body mass index; *CNLBP*, chronic nonspecific low-back pain; *VAS*, visual analogue scale.
[a] Values are reported as mean ± standard deviation.

were asked to lie in a supine position, and their hips and knees were flexed at 45°. In male CNLBP participants, the abdomen area, in which the tape was applied to, was shaved and cleaned as well. Depending on the CNLBP participant's morphology, the length of 3 pieces of I-shaped strip elastic therapeutic tape was determined by measuring the distance between 2 anterior superior iliac spines and measuring the distance between the middle one-third of the intermediate line of the iliac crest to the inferior border of the 10th rib.[23,37] Afterward, the elastic therapeutic tapes were applied to the internal oblique muscles in the direction of the fibers (obliquely, medially, and upward) from the origin to insertion with approximately 50% of their maximal length tension (Fig 3A). For the transversus abdominis muscle, the elastic therapeutic tape was applied horizontally between the 2 anterior superior iliac spines, with approximately 50% of maximal length tension (Fig 3A). For elastic therapeutic taping of the internal oblique and transversus abdominis muscles, the first and last 2 cm of the elastic therapeutic tapes were applied with no tension (anchoring).

For the sham taping, a single I-shaped strip of elastic therapeutic tape, 25 cm in length, was positioned horizontally 2 cm above the navel and applied without any tape tension in the crook-lying position (Fig 3B). Then, all of the measurements were repeated again in the same manner as they had been performed before taping. After a wash-out period of 4 days, each CNLBP participant was switched to the other group. All participants were advised to maintain their daily life activities during the wash-out period and not perform vigorous activities. This matter was clearly explained and also double-checked with each patient. No attrition (dropout) was observed in the CNLBP participants during the wash-out period and when the condition was reversed.

Statistical Analysis

All the statistical analyses were conducted on a personal laptop using SPSS version 20.0 (IBM Corp, Armonk, New York) and Stata version 13.0 (StataCorp, College Station, Texas). Prior to the statistical analyses, the Shapiro-Wilk test was used to check for normality of data. The Shapiro-Wilk test revealed that the distribution of the maximum hold time of the endurance tests followed the normal distribution. The comparison between CNLBP patients and asymptomatic participants before intervention was performed using the independent Student's t test. We performed uncorrected, planned pairwise comparisons with analysis of variance to assess for differences between the testing conditions in patients with CNLBP. The independent variable was taping application with 2 conditions (elastic therapeutic tape and sham tape), and the dependent variables were the 3 endurance tests measured in seconds. In addition, the comparison between the 2 conditions and asymptomatic participants was conducted using the 1-way analysis of variance test (Bonferroni multiple comparison test). Cohen's d[38] effect

Fig 2. *Abdominal musculature endurance tests. Supine isometric chest raise test (A); supine double straight-leg raise test (B); and abdominal drawing in maneuver (C).*

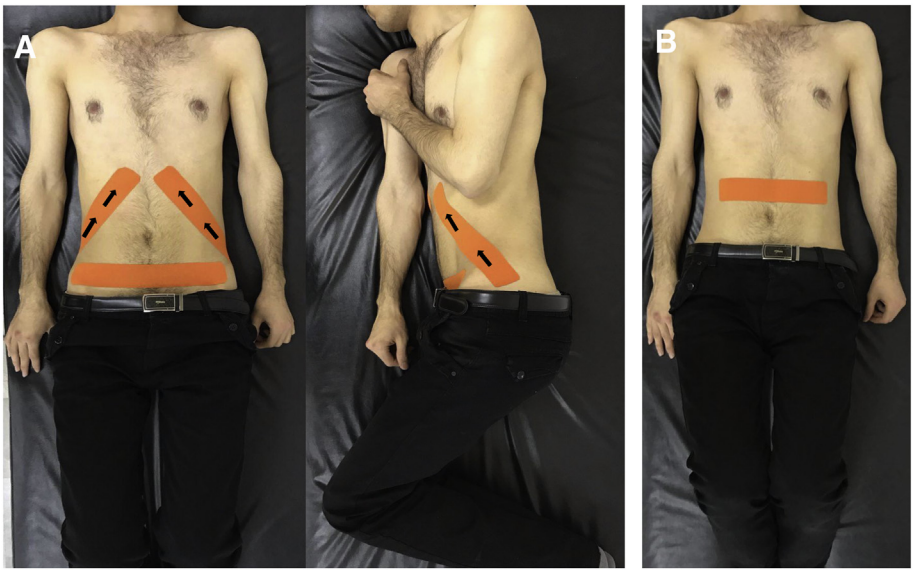

Fig 3. *Elastic therapeutic taping of the transversus abdominis and internal oblique muscles. For the transversus abdominis muscle, the elastic therapeutic tape was applied horizontally between the 2 ASISs with approximately 50% of maximal length tension. For the internal oblique muscles, the elastic therapeutic tape was applied with approximately 50% of maximal length tension in an oblique, medial, and upward direction from the middle one-third of the intermediate line of the iliac crest to the inferior border of the 10th rib (A). Sham tape was positioned horizontally 2 cm above the navel and applied without any tape tension (B).* ASISs*, anterior superior iliac spines.*

sizes were calculated to quantify and to examine predifferences and postdifferences in the elastic therapeutic and sham tape groups. By convention, effect sizes of 0.20, 0.50, and 0.80 were considered as small, medium, and large differences, respectively.[38] Finally, all probability values (*P* values) were set at significance levels of .05.

Results

Among the 29 CNLBP participants originally recruited, based on the inclusion criteria, 3 patients were excluded because they did not sign the informed consent (Fig 1). Thus, 26 CNLBP and 26 demographically matched asymptomatic participants were included in the current investigation. The baseline demographic characteristics of eligible participants are presented in Table 2.

The results of this study indicated that there was a significant difference in the maximum hold time of the endurances tests among CNLBP patients and asymptomatic participants ($P < .05$) (Table 3). All 26 CNLBP participants were able to complete the 2 testing conditions. The majority of the CNLBP participants stopped the tests primarily because of abdominal fatigue, leg fatigue during the SDSLR tests, or pain in the lumbar spine. Some CNLBP participants stopped for different reasons at each tape condition.

In this investigation, the maximum hold time of the endurance tests was increased significantly after the application of elastic therapeutic tape and sham tape (Table 4 and Fig 4). However, there was no statistically significant difference in the maximum hold time of the endurance tests between the results

Table 3. *Differences in Maximum Hold Time Between CNLBP and Asymptomatic Participants During the 3 Endurance Tests Before Intervention*

	Participants [a]			
Endurance Tests	Asymptomatic (Minimum Value, Maximum Value)	CNLBP (Minimum Value, Maximum Value)	Mean Difference (95% CI)	Level of Significance
SICR (s)	63.41 ± 19.73 (23.50, 99.80)	15.84 ± 6.28 (8.83, 32.61)	47.57 (45.41-60.64)	.000 [b]
SDSLR (s)	65.20 ± 22.40 (17.00, 89.70)	26. 97 ± 15.66 (8.01, 57.72)	38.22 (29.57-54.35)	.000 [b]
Abdominal drawing in maneuver (s)	81.89 ± 31.16 (44.48, 123.90)	52.17 ± 28.00 (12.30, 111.96)	29.71 (9.64-54.49)	.013 [b]

CNLBP, chronic nonspecific low-back pain; *CI,* confidence interval; *SDSLR,* supine double straight-leg raise; *SICR,* supine isometric chest raise.
[a] Values are reported as mean ± standard deviation.
[b] Statistically significant: $P < .05$.

of elastic therapeutic tape and sham tape (Table 5 and Fig 4). After intervention, there was still significant difference between the asymptomatic participants and CNLBP patients in the maximum hold time of the endurance tests (Table 6). The effect size measures in Table 5 report the predifference and postdifference in the maximum hold time of the endurance tests in the elastic therapeutic tape and sham tape groups. The present study demonstrated that although there are no statistically significant differences between the results of elastic therapeutic tape and sham tape, the effect size measures were large in the elastic therapeutic tape group compared to the sham tape group.

Discussion

The main purpose of the present study was to evaluate the immediate effect of elastic therapeutic taping of the abdominal musculature on the SICR test, SDSLR test, and abdominal drawing in maneuver in patients with CNLBP. The results indicated that elastic therapeutic taping of the abdominal musculature would improve the maximum hold time of the endurance tests.

Chronic nonspecific low back pain is a common pathology that limits function at different ages and causes economical costs for individuals and society.[39] Persistent (chronic) pain may alter abdominal musculature activation pattern, and it has been shown that dysfunction of the deep abdominal musculature is an important functional problem in patients with LBP.[40,41] The deep abdominal musculature is considered to be postural musculature and primary stabilizer of the trunk and the lumbar spine during activities.[11] The results of this study indicated that there is a significant difference between the maximum hold time of the endurance tests in patients with CNLBP and asymptomatic participants. The concept of chronicity of pain, as presented in the fear avoidance model[42] stated that LBP influences total physical performance.[43] Therefore, if a person's daily activity level is decreased because of LBP, this will result in disuse-related changes in the whole body, especially influencing antigravity musculature, such as the transversus abdominis and internal oblique, which is the controller of upright posture in humans.[43] Deconditioning or inhibition of the deep abdominal musculature may reduce the stability of the spine in CNLBP patients[44] and, as a vicious cycle, reduced stability contributes to uncontrolled movement of the spine; this may result in perpetuating pain and disability among adults who experience LBP. Hence, facilitating abdominal musculature via various methods could help stabilize the spine and decrease pain in CNLBP patients.

In the current investigation, elastic therapeutic tape was applied to the transversus abdominis and internal oblique muscles to facilitate them. The results of our study revealed that the maximum hold time of the endurance tests was significantly improved immediately after the application of elastic therapeutic tape. It has been reported that the blood and lymph circulations may be increased at the areas where elastic therapeutic tape is applied; thus, the muscular and myofascial functions at those sites may be affected.[45,46] Previous studies stipulated that improved blood circulation of the muscle can result in increased muscle volume.[47,48] Pearson et al indicated a correlation between increased muscle volume and improved muscle function in elite master weightlifters.[49] In addition, the application of elastic therapeutic tape to the skin is theorized to stimulate cutaneous mechanoreceptors, facilitate the inhibited muscles, and assist postural alignment.[37,50] Cutaneous mechanoreceptors activate nerve impulses when mechanical loads (eg, touch, pressure, stretch, vibration, and itch) cause deformation of the skin.[46] The activation of cutaneous mechanoreceptors via an adequate stimulus can generate local depolarizations that trigger nerve impulses (sensory inputs) along the afferent fibers traveling toward the central nervous system.[46,51] The central nervous system integrates the sensory inputs, and modulates gamma-motor firing, which results in facilitation of inhibited muscles.[52] Reduction of motor neuron threshold induced by cutaneous stimulation may result in easier recruitment of the motor units,[53-55] and in turn, improves functional performance

Table 4. *The Mean of Maximum Hold Time of the 3 Endurance Tests Before and After Intervention and Comparison Among Them*

	Condition [a]							
	Elastic Therapeutic Tape				Sham Tape			
Endurance Tests	Pretape (Minimum Value, Maximum Value)	Posttape (Minimum Value, Maximum Value)	Mean Difference (95% CI)	Level of Significance	Pretape (Minimum Value, Maximum Value)	Posttape (Minimum Value, Maximum Value)	Mean Difference (95% CI)	Level of Significance
SICR (s)	13.40 ± 3.80 (8.83, 19.50)	32.83 ± 13.68 (15.26, 52.27)	19.43 (11.76-27.09)	.000 [b]	18.28 ± 7.45 (10.50, 32.61)	22.71 ± 10.07 (13.20, 45.68)	4.43 (1.79-7.07)	.004 [b]
SDSLR (s)	27.99 ± 12.79 (12, 47.27)	40.68 ± 12.48 (22.21, 58.40)	12.69 (8.75-16.62)	.000 [b]	25.96 ± 18.75 (8.01, 57.72)	33.87 ± 15.99 (15.90, 57.37)	7.90 (4.77-11.03)	.000 [b]
Abdominal drawing in maneuver (s)	38.41 ± 16.84 (12.30, 63.98)	89.10 ± 45.48 (20.98, 159.87)	50.69 (24.38-77.00)	.002 [b]	42.93 ± 15.99 (19.96, 65.46)	51.89 ± 18.56 (20.14, 87.68)	8.96 (1.71-16.21)	.02 [b]

CI, confidence interval; *SDSLR,* supine double straight-leg raise; *SICR,* supine isometric chest raise.
[a] Values are reported as mean ± standard deviation.
[b] Statistically significant: $P < 0.05$.

and muscle strength.[54-56] Possibly, all aforementioned mechanisms may facilitate muscle activity following the application of elastic therapeutic tape and, as a result, may impact abdominal musculature endurance tests.

Another factor worth mentioning is that Slupik et al believed that even without applying stretch to the skin, strapping may have a facilitating effect on cutaneous mechanoreceptors with subsequent reflex motor stimulation.[57] This reflex effect may consist in an increase in the number of motor units recruited during muscle contraction.[57] This mechanism may be the explanation for insignificant difference observed between real elastic therapeutic tape and sham tape in the Álvarez-Álvarez et al study.[58] They evaluated the immediate effect of elastic therapeutic taping on back musculature endurance in 99 asymptomatic adults. Participants received elastic therapeutic tape applied longitudinally over the lumbar paraspinal musculature, a sham procedure consisting of short cuts of elastic therapeutic tape applied horizontally to the skin over the lumbar spine area, or no tape. The results of their study indicated that there was no statistical difference between elastic therapeutic tape group vs the sham group during the Biering-Sørensen test.[58] Similarly, Hagen et al also reported that there was no statistical difference in back musculature endurance when using elastic or rigid therapeutic tape in 16 patients with CNLBP.[27] The results of our study were in agreement with the previous studies, and no significant differences have been found between the results of elastic therapeutic tape and sham tape in patients with CNLBP during the endurance tests.

The effect size is defined as the standardized mean difference between preintervention and postintervention. Cohen described the effect size as “the degree to which the phenomenon is present in the population.”[38] The major benefit of determining effect size is that unlike test statistics, the effect size is not greatly influenced by sample size, thus reducing problems of power associated with large and small samples.[59] The effect sizes of the elastic therapeutic tape group were large, whereas the sham tape group showed medium effect sizes. Large effect sizes indicated that the real elastic therapeutic tape resulted in a substantial change in the maximum hold time of the endurance tests. However, the sham tape did not show the same magnitude of effects because of the medium effect sizes.

In recent years, the use of elastic therapeutic tape has become increasingly popular in the field of rehabilitation, and many studies have investigated the effect of the tape in various pathologies for different purposes.[60,61] A meta-analysis conducted by Csapo and Alegre reported that there are no adverse effects associated with elastic therapeutic taping.[62] Hence, this intervention is now widely used in physiotherapy clinics throughout the world. This study, for the first time, examined the effect of elastic therapeutic taping on abdominal musculature endurance tests. The results of this study can provide clinical implications about the use of elastic therapeutic tape over the abdominal

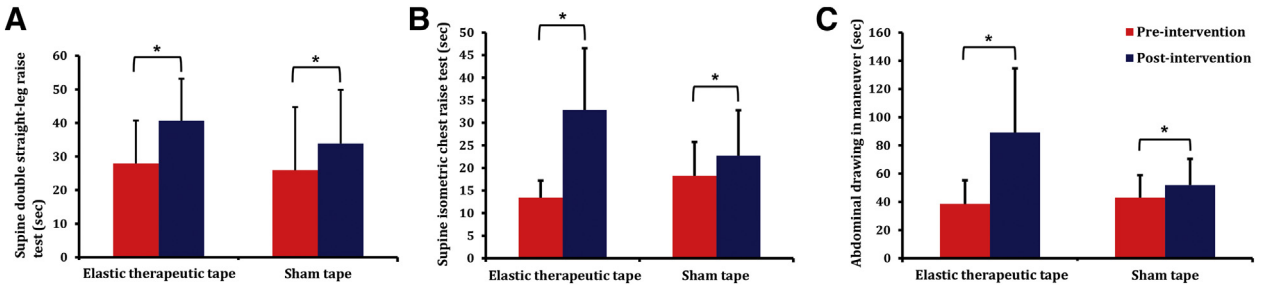

Fig 4. *Comparison of pretaping and post-taping maximum hold time in 2 conditions (elastic therapeutic tape and sham tape) during supine isometric chest raise test (A); supine double straight-leg raise test (B); and abdominal drawing in maneuver (C). The graphs represent that the maximum hold time of the endurance tests increased significantly immediately after the application of elastic therapeutic tape and sham tape. However, there was no statistically significant difference (*P < .05*) between the results of elastic therapeutic tape and sham tape during the endurance tests.*

Table 5. *Comparison Between the 2 Conditions After Intervention and Asymptomatic Participants*

	Comparison [a]					
Endurance Tests	Asymptomatic Group vs Elastic Therapeutic Tape Group	Level of Significance	Asymptomatic Group vs Sham Tape Group	Level of Significance	Elastic Therapeutic Tape Group vs Sham Tape Group	Level of Significance
SICR (s)	30.58 (13.90-47.25)	.000 [b]	40.69 (24.02-57.37)	.000 [b]	2.62 (–4.85 to 10.09)	.40
SDSLR (s)	24.52 (5.16-43.87)	.011 [b]	31.33 (11.98-50.68)	.001 [b]	4.42 (-1.45-10.31)	.12
Abdominal drawing in maneuver (s)	43.48 (18.59-68.36)	.001 [b]	38.95 (14.07-63.83)	.002 [b]	16.34 (12.93-45.61)	.20

SDSLR, supine double straight-leg raise; *SICR,* supine isometric chest raise.
[a] Values are mean difference (95% confidence intervals).
[b] Statistically significant: $P < .05$.

musculature in patients with CNLBP. This work showed that the activity of the abdominal musculature improved immediately after the application of elastic therapeutic tape and sham tape in CNLBP patients; however, the results were still significant between the asymptomatic and CNLBP groups in the maximum hold time of the endurance tests. This may indicate that more sessions are needed for taping to be considered effective, or the tape should be used in combination with other physiotherapy programs (eg, manual therapy or therapeutic exercises) to help improve performance in CNLBP patients. Therefore, further research is encouraged to assess the effect of elastic therapeutic tape in combination with other physiotherapy programs on abdominal musculature endurance tests in patients with LBP.

Limitations

We investigated only the immediate effect of elastic therapeutic tape and sham tape, and further research is warranted to evaluate the effect of prolonged or repeated applications of elastic therapeutic tape vs sham tape to the abdominal musculature in individuals with CNLBP. Another limitation of our study was that only young and middle-aged CNLBP participants were included; therefore, the generalizability of results is limited and the data from the CNLBP patients is not representative of other population with LBP.

Conclusion

The results of the current study indicated that the maximum hold time of endurance tests was decreased in CNLBP patients compared to healthy participants. The application of both elastic therapeutic tape and sham tape to the transversus abdominis and internal obliques produced short-term improvement in abdominal endurance, and there was no statistically significant difference between the results of elastic therapeutic tape and sham tape. Although further investigation is warranted, our results can give an insight into the application of elastic therapeutic tape over the abdominal musculature in the treatment of CNLBP individuals.

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Table 6. *Effect Sizes for Predifferences and Postdifferences in Maximum Hold Time of the 3 Endurance Tests in Elastic Therapeutic Tape and Sham Tape Groups*

	Condition			
	Elastic Therapeutic Tape		Sham Tape	
Endurance Tests	Cohen's *d*	95% CI	Cohen's *d*	95% CI
SICR (s)	-1.93	-2.99 to -0.84	-0.50	-1.38 to 0.40
SDSLR(s)	-1.00	-1.93 to -0.06	-0.45	-1.34 to 0.44
Abdominal Drawing in Maneuver (s)	-1.48	-2.46 to -0.46	-0.52	-1.40 to 0.38

CI, confidence interval; *SDSLR,* supine double straight-leg raise; *SICR,* supine isometric chest raise.

Contributorship Information

Concept development (provided idea for the research): M.R.P., R.B.

Design (planned the methods to generate the results): M.R.P., R.B., E.J.

Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): I.E.T., J.S., H.M.

Data collection/processing (responsible for experiments, patient management, organization, or reporting data): M.R.P., R.B.

Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): M.R.P., R.B., E.J., H.M.

Literature search (performed the literature search): M.R.P., R.B.

Writing (responsible for writing a substantive part of the manuscript): M.R.P.

Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): M.R.P., R.B., E.J., I.E.T., J.S., H.M.

Practical Applications

- The results indicated that there were significant differences in abdominal muscle endurance tests between CNLBP patients and asymptomatic people.
- Both elastic therapeutic and sham tapes improved the maximum hold time of endurance tests in CNLBP.
- Although there were no differences between the results of elastic therapeutic and sham tape groups, effect sizes were large for elastic therapeutic tape group.

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