IMPACT OF STRAIN-COUNTERSTRAIN ON TREATMENT OF ACUTE NONSPECIFIC LOW BACK PAIN: A SINGLE-BLIND RANDOMIZED CONTROLLED TRIAL

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ABSTRACT

Purpose. The study was to assess the effectiveness of strain-counterstrain (SCS) techniques, after treatment and after a 6-week follow-up, on pain, range of motion (ROM), and disability in patients with acute nonspecific low back pain with mobility deficits.
Methods. Overall, 84 patients diagnosed with nonspecific low back pain with mobility deficits were divided into 2 groups; 42 received SCS techniques (group A) and 42 (group B, control group) were advised to be active. The pressure pain threshold (PPT), lumbar flexion ROM, and Oswestry Disability Index (ODI) were used for assessment. All patients were assessed before treatment, after treatment, and after a 6-week follow-up. The treatment program was applied for 2 weeks, 2 sessions per week.
Results. Statistical analysis revealed that there were significant increases in PPT on both sides of L5 and lumbar flexion ROM. In addition, a significant reduction in ODI scores was observed ($p < 0.05$) in the pre- vs. post-treatment evaluation, in the pre-treatment vs. post-6-week evaluation, and in the post-treatment vs. post-6-week evaluation with regard to both groups. As for between-group effects, multiple pairwise comparisons revealed significant increases in PPT on both sides of L5 and lumbar flexion ROM, in addition to a significant reduction in ODI scores ($p < 0.05$) in favour of group A as compared with group B after treatment and after the 6-week follow-up.
Conclusions. SCS is preferable to be advised in the treatment of acute nonspecific low back pain with mobility deficits.
Key words: strain-counterstrain, acute nonspecific low back pain, Oswestry Disability Index

Introduction

Low back pain (LBP) is defined as pain and discomfort in the area between the costal margin and the inferior gluteal folds, with or without referred leg pain [1]. It is the commonest musculoskeletal condition in the adult population and its prevalence amounts to 84% [2]. Furthermore, it limits the activity of the affected population by 30.8% monthly and 38% every year [3]. Additionally, LBP restricts occupational activities and is among the main causes of absenteeism. So, it leads to high costs of health care and decreases productivity [4]. Guidelines for the treatment of patients with acute non-specific LBP (that is defined as LBP not attributable to a recognizable, known specific pathology) with mobility deficits involve beneficial modalities such as advice to be active [5, 6].

Recently, various forms of manual therapy have been applied to manage LBP [7]. The strain-counterstrain (SCS) technique is one of the effective osteopathic treatment methods [8]. It is a passive positional intervention aimed at relieving musculoskeletal dysfunc-

tion and pain [9]. This positioning has been shown to reduce tender point sensitivity and somatic pain [10, 11]. Osteopathic techniques including SCS have been addressed in peer-reviewed literature showing success [12]. The SCS technique is found to be effective in acute LBP treatment [13], but few researches have followed up its impact in a longer period. The purpose of the study was to assess the effect of the SCS technique, after 2 weeks of treatment and after 6 weeks of follow-up, on pain, range of motion (ROM), and functional disabilities in treating nonspecific LBP patients with mobility deficits. It was hypothesized that SCS would have a positive impact on these factors in the population with nonspecific LBP and mobility deficits.

Material and methods

Study design

A randomized, controlled, parallel, assessor-blinded clinical trial was designed to assess the effectiveness of SCS techniques, after treatment and after a 6-week follow-up, on pain, ROM, and disability in patients with acute nonspecific LBP with mobility deficits. The study was conducted between June 2017 and August 2018.

Participants

A convenient sample of 84 patients (age: 24.07 ± 1.55 years) referred from an orthopaedic surgeon and diagnosed with acute nonspecific LBP with mobility deficits were enrolled and assessed for their eligibility to participate in the study. The examining physician used inspection, palpation, motion assessment, and standard tests such as Kemp's, Yeoman's, straight leg raise, Milgram's, and Valsalva manoeuvre to verify the inclusion and exclusion criteria. The inclusion criteria were the following: (1) acute low back, buttock, or thigh pain lasting for a maximum of 1 month, in addition to limited segmental mobility; (2) more pain-free days than days with LBP in the previous year; (3) age of 20–30 years; (4) body mass index of 20–30 kg/m^2 [14, 15]; (5) extension lesion of L4 and L5, called a type 2 lesion by Fryette [16]: rotation occurs before the side bending and the two motions are in the same direction, which is determined by: (a) a limitation in lumbar spine ROM (less than 3 cm in forward bending in Schober test), (b) positive segmental mobility assessment and positive pain provocation with segmental mobility testing at the level of L4 and L5 on one side [17]. The participants were excluded if they had: (1) symptoms of cauda equina such as perianal numbness, loss of bowel and/or bladder control; (2) a deformity in the spine; (3) radiculopathy; (4) history of severe osteoporosis or spinal fractures; (5) spinal infections or tumours; (6) prior lumbar spine surgery; (7) pregnancy [18, 19].

Randomization

With the sealed envelope method of randomization, the patients were randomly assigned into 2 matched groups. Group A consisted of 42 individuals who received SCS and group B (control group) involved 42 participants who were advised to be active. Both groups were assessed before treatment, after treatment, and after a 6-week follow-up. All evaluations were performed by the same researcher to maintain standardization. No subjects dropped out of the study after randomization (Figure 1). All participants were explained the nature, purpose, and benefits of the study; also, they were informed on their right to refuse or withdraw at any time and about the confidentiality of any obtained data. Anonymity was assured through the coding of all data.

Outcome measures

Pressure pain threshold

The patient lay prone on an examination plinth. Pressure pain threshold (PPT) was measured with an electronic pressure algometer (Fischer pressure algometer) at both sides of the L5 spinous process, 4 cm lateral to it [20]. The pressure measured to the nearest 0.1 kg/cm^2 and with a stimulation surface area of 1 cm^2 ranged from 0 to 11 kg/cm^2. A constant pressure increase rate was maintained of 1 kg/cm^2/s. When the examiner applied the algometer to a measuring point, the patient said 'yes' when pain was experienced. Three short consecutive PPT measurements with 10 seconds in between were performed at each of the 2 selected measuring points [21].

Oswestry Disability Index

The Oswestry Disability Index (ODI) is a commonly utilized outcome measure to capture perceived disability in patients with LBP [22]. This is a 10-item index: 8 of them are related to activities of daily living and 2 refer to pain. The score of each item ranges from 0 to 5, with higher scores indicating greater disability. The total score is expressed as percentage [23].
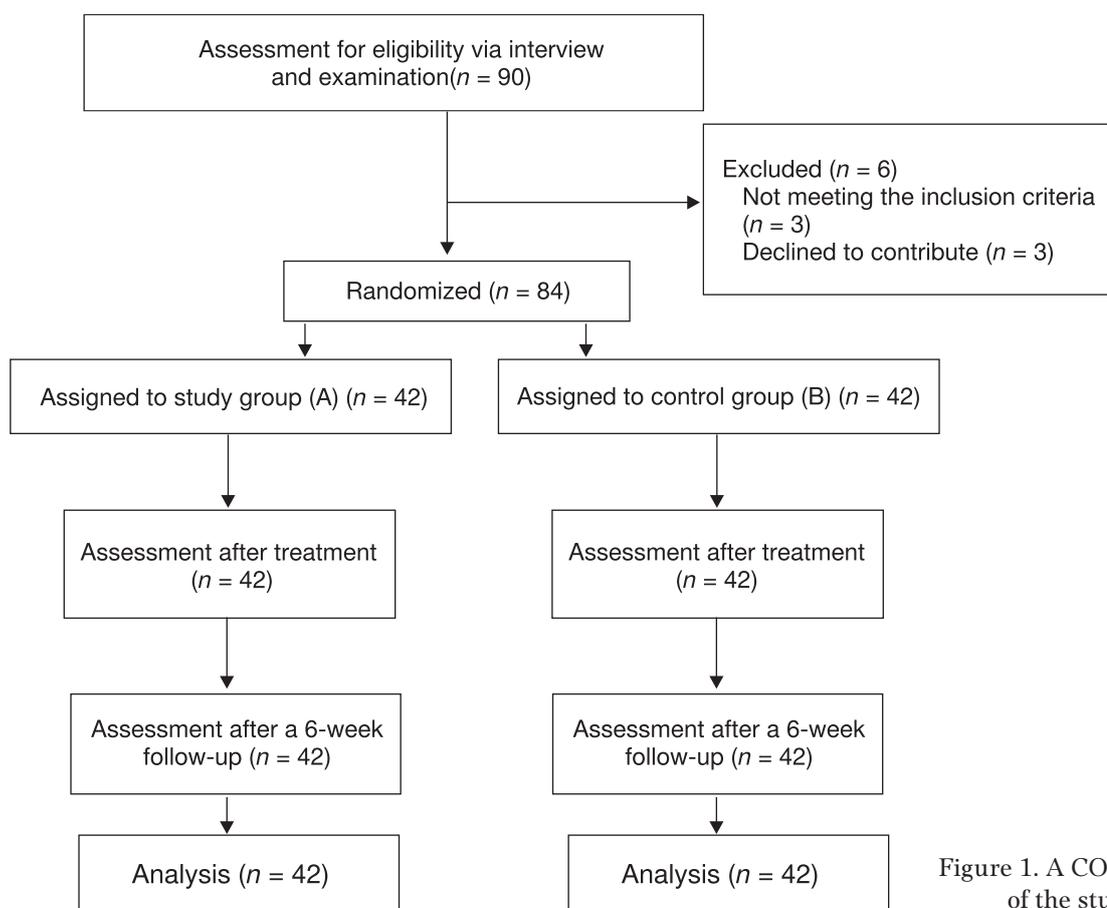
Figure 1. A CONSORT flow diagram of the study participants

Dual digital inclinometer

Evaluation of physical impairment is important for LBP management as it helps clinicians to determine the effect of an intervention. The level of impairment in individuals with LBP was determined by measuring the limitation in lumbar ROM [24]. A dual inclinometer can extract extraneous motion so it is considered more valid than a single inclinometer, and it is preferred when documenting spinal ROM. An inclinometer was placed on the T12–L1 and L5–S1 spinal interspaces and zeroed with the patient in neutral standing position. The examiner asked the patient to bend forward maximally and then recorded the motion. Lumbar flexion was represented by the difference in motion between the upper and lower inclinometers [25].

Interventions

Group A

The patients in this group were treated with 2 different SCS techniques for 2 weeks, 2 sessions per week [26]. In accordance with the technique principles and guidelines provided by Jones [26], the therapist located a tender point and then found a position of comfort or a mobile point (at least 70% decreases in tenderness), monitored the tender point as holding the position of comfort for 90 s, and repeated the technique until an at least 50% improvement in the visual analogue scale score.

Extension lesion of L4 and L5. Position: patient in pronelying, therapist's left hand on the tender points: L4 – dorsal from the tensor fascia lata, 2–3 cm caudally from the iliac crest (gluteus maximus); L5 – on the superomedial surface of the posterior superior iliac spine (iliocostalis lumborum). Correction: therapist's right hand under the anterior aspect of thigh and taking hip into extension, slight adduction, till reaching to 70% decreases in tenderness in the tender point; more extension is required for L4 than for L5.

Atypical lesion of L5. Position: patient in pronelying at the edge of the bed, hip and knee joints flexed at 90° out of the bed, therapist's left hand on the tender points at the inferior of the 2 trigger points of L5 is situated 2 cm caudally to the posterior superior iliac spine (iliocostalis lumborum). Correction: therapist's right hand under the knee and anterior aspect of leg,

hip and knee joints flexed at 90°; light abduction or adduction is added till reaching to 70% decreases in tenderness in the tender point.

Group B

The patients in the control group received advice to be active [5, 6].

Statistical analysis and sample size calculation

A preliminary power analysis [power (1–α error P) = 0.85, α = 0.05, effect size = 0.67, with a 2-tailed test for a comparison of 2 independent groups] determined a sample size of 41 for each group in this study to avoid a type II error. The effect size was calculated in accordance with a pilot study in 12 participants (6 in each group) considering ODI as a primary outcome. All statistical measurements were performed by using the Statistical Package for the Social Sciences (SPSS) software, version 20 for Windows. Descriptive analyses showed that the data were normally distributed and did not violate the parametric assumption for all measured dependent variables (PPT for the right and left L5, lumbar flexion ROM, and ODI scores). Additionally, the Box's test applied to verify the homogeneity of covariance revealed that there was no significant difference with p values of > 0.05. The outliers were detected by box and whisker plots of the tested variables. The Shapiro-Wilk data normality test was used, reflecting that the data were normally distributed for all dependent variables. All these findings allowed the researchers to conduct parametric analysis. So, to compare the tested variables of interest in different tested groups and measuring periods, a 2 × 3 mixed design MANOVA was applied. The alpha level was set at 0.05.

Ethical approval

The research related to human use has complied with all the relevant national regulations and institutional policies, has followed the tenets of the Declaration of Helsinki, and has been approved by the institutional review board at the Faculty of Physical Therapy, Cairo University (approval number: P.T.REC/012/00976).

Informed consent

Informed consent has been obtained from all individuals included in this study.

Results

As indicated by the independent *t*-test, there were no statistically significant differences (p > 0.05) be-

Table 1. Demographic characteristics of patients in both groups

	Group A (n = 42)	Group B (n = 42)	*t*	*p*
Age (mean ± *SD*) (years)	24.04 ± 1.82	24.07 ± 1.55	–0.064	0.949
BMI (mean ± *SD*) (kg/m²)	24.19 ± 2.13	24.36 ± 1.58	–0.429	0.669

SD – standard deviation, BMI – body mass index

tween subjects in both groups concerning age or body mass index (Table 1). Overall, 84 patients assigned to 2 equal groups were analysed by using mixed design MANOVA. It revealed a significant within-subject effect (F = 1402.974, p = 0.0001) and treatment*time effect (F = 300.893, p = 0.0001). A significant between-subject effect was also observed (F = 1063.414, p = 0.0001). Table 2 presents the descriptive statistics (mean ± *SD*) and multiple pairwise comparison tests (post-hoc tests) for the PPT for the left and right L5, lumbar flexion ROM, and ODI scores. Additionally, multiple pairwise comparison tests were used for the within-subject effect and revealed a significant increase in PPT for the left and right L5 and lumbar flexion ROM, in addition to a significant reduction in ODI scores (p < 0.05) in the pre- vs. post-treatment evaluation, in the pre-treatment vs. post-6-week evaluation, and in the post-treatment vs. post-6-week evaluation with regard to both groups. As for the between-subject effects, there was a significant increase in PPT for the right and left L5 and lumbar flexion ROM, in addition to a significant reduction in ODI scores (p < 0.05) in favour of the SCS group as compared with the control group after treatment and after the 6-week follow-up.

Discussion

The purpose of this study was to find out the effects of SCS techniques, after treatment and after a 6-week follow-up, on the outcome measures in nonspecific LBP patients with mobility deficits. The inclusion criteria referred only to nonspecific LBP with mobility deficits (limitation in flexion direction) and controlled that by using modified Schober test in forward bending less than 3 cm and 2 objective valid tests for quality, not for quantity (positive segmental mobility assessment and positive pain provocation with segmental mobility testing at the level of L4 and L5). This inclusion criterion was based on findings by Fritz

Table 2. Descriptive statistics (mean ± *SD*) and comparison between patients with nonspecific low back pain before treatment (1), after treatment (2), and after the 6-week follow-up (3) for both groups

Parameter	Group A (*n* = 42)			Group B (*n* = 42)		
	1	2	3	1	2	3
PPT for left L5 (kg)	2.98 ± 0.59	5.91 ± 0.44	8.75 ± 0.75	3.07 ± 0.62	3.58 ± 0.99	5.54 ± 0.8
PPT for right L5 (kg)	3.28 ± 0.61	5.91 ± 0.68	8.67 ± 0.78	3.08 ± 0.81	3.72 ± 0.97	5.76 ± 0.90
Flexion ROM (°)	32.42 ± 1.45	47.23 ± 2.06	48.09 ± 1.85	32.28 ± 1.51	37.16 ± 1.57	39.4 ± 1.84
Oswestry scale	37.76 ± 1.6	9.66 ± 1.64	4.71 ± 2.06	37.76 ± 1.54	34.61 ± 2.47	20.38 ± 3.09

	Within groups					
	Group A			Group B		
Parameter	1 vs. 2	1 vs. 3	2 vs. 3	1 vs. 2	1 vs. 3	2 vs. 3
PPT for left L5	0.0001*	0.0001*	0.0001*	0.004*	0.0001*	0.0001*
PPT for right L5	0.0001*	0.0001*	0.0001*	0.003*	0.0001*	0.0001*
Flexion ROM	0.0001*	0.0001*	0.032*	0.0001*	0.0001*	0.0001*
Oswestry scale	0.0001*	0.0001*	0.0001*	0.0001*	0.0001*	0.0001*

	Between groups		
Parameter	1	2	3
PPT for left L5	0.536	0.0001*	0.0001*
PPT for right L5	0.204	0.0001*	0.0001*
Flexion ROM	0.661	0.0001*	0.0001*
Oswestry scale	0.999	0.0001*	0.0001*

SD – standard deviation, PPT – pressure pain threshold, ROM – range of motion
* significant (*p* < 0.05)

et al. [17], which imply that patients without joint stiffness do not need manipulation. The selection of the SCS technique itself for treating patients with nonspecific LBP was to determine an effective and easy method with fewer contraindications to use in those patients [27, 28].

The results of the study revealed that there were significant increases in PPT for left and right L5 and lumbar flexion ROM and a significant reduction in ODI scores (*p* < 0.05) in the pre- vs. post-treatment evaluation, in the pre-treatment vs. post-6-week evaluation, and in the post-treatment vs. post-6-week evaluation in both groups. The improvement observed in the control group corroborated previous studies [5, 6], confirming the role of advice to regain normal activity as much as possible. Patients with such serious medical conditions as LBP need to diminish the psychological distress from living with the disorder by disease self-management programs [6]. The improvement reported in the SCS group was in line with the results of previous studies [11, 29].

The results of the current study were in agreement with Meseguer et al. [11], who compared the immediate effect of a modified application of the SCS technique and a classical method on pain threshold following 1 treatment session of tender points in the upper trapezius muscle with control group outcomes. The pain level evaluation with a visual analogue scale decreased significantly after the SCS technique application; there was not any change in the control group. So, Meseguer et al. [11] suggested that SCS was effective in reducing tenderness of the tender points in the upper trapezius muscle. However, the article studied only the immediate effect of the SCS technique and did not consider the follow-up effect.

In a systematic review conducted by Wong et al. [29], 5 randomized control trials were included in a qualitative and quantitative analysis. The collective effect of SCS was a reduction of tender point palpation pain. Low-quality evidence found in this systematic review suggests that SCS may reduce tender point palpation pain. But future studies were recommended with larger samples that would assess impairment and dysfunction outcomes in addition to long-term pain.

Concerning between-subject effects, multiple pairwise comparisons revealed that PPT for the right and left L5 and lumbar flexion ROM increased significantly and ODI scores were significantly reduced (*p* < 0.05)

in favour of group A compared with group B after treatment and after the 6-week follow-up. This proves that SCS techniques increase the ability of the body for self-healing and regulation through improving ROM, reducing pain, and decreasing the disability index; this is in line with the results of previous studies [26, 28].

Lewis et al. [30] conducted a randomized controlled trial that compared SCS combined with exercise therapy with exercise alone in a population with LBP. Four treatment sessions over a 2-week period were given to the patients. Assessments of pain and function were performed before the intervention and at 2, 6, and 28 weeks after the intervention. The only significant difference between groups was observed at 2 weeks; the patients in the SCS group showed a significant perception of general improvement compared with the control group. Therefore, the long-term effect of combined SCS and exercise therapy vs. exercise therapy alone was reported to be equal in treating acute LBP. This previous study corroborated our study in the results after 2 weeks and differed in the results at follow-up. Still, the comparison in our study was between the SCS technique and the sole advice to be active.

The current study is in agreement with a previous one which assessed the immediate effects of SCS on pain intensity and functional outcome in LBP patients with quadratus lumborum myofascial trigger points. The control group (20 patients) received moist heat only, and the management in the experimental group (20 subjects) involved the SCS technique in addition to the moist heat. Immediately after the treatment, the examiner applied the patient-specific functional scale and the visual analogue scale. There was a statistically significant decrease in pain score within the groups. A clinically significant improvement was seen in the experimental group only, and the functional scale also reported a significant improvement in the experimental group only. But this study was limited by evaluating solely the immediate effect of treatment, and a long-term follow-up was not carried out [28].

Studies comparing the effect of a muscle energy technique with SCS or comparing a muscle energy technique alone with adding the SCS technique to a muscle energy technique revealed no statistically significant differences between groups [13, 31]. However, both studies are in agreement with the current study as for the positive effect of SCS on pain, function, and lumbar ROM.

One can say that SCS is the treatment of choice for the acute patient because it is so gentle and atraumatic. The examiner moved the patient's body slowly in non-painful directions to positions that were non-threaten-

ing and readily within their limited ROM. The investigator was guided by relief of palpatory tenderness and local decrease in tissue tension to find the optimal position of release. Remarkable changes can be achieved in decreased pain intensity, muscle guarding spasms, and congested inflammatory fluid. Treating the neuromuscular component of the acute condition facilitates circulation and promotes the ability of the body to heal the injured or damaged tissue [32].

SCS effectiveness may be explained by the proprioceptive theory. It states that SCS corrects the abnormal neuromuscular activity caused by muscle spindles and local circulation. Additionally, the inflammatory reactions mediated by the sympathetic nervous system may improve with SCS. In accordance with the proprioceptive theory, by passively shortening the dysfunctional muscle, one can reduce the neuromuscular imbalance that occurs owing to continuous stimulation of the muscle spindles. So the normal muscle spindle activity may be returned in the agonist muscle as a result of SCS, leading to a restoration of the antagonist muscle spindle activity to the normal state. These changes relieve abnormal neuromuscular activity and restore normal function [33].

An in vitro SCS model has shown an induction of fibroblast proliferation and secretion of pro- and anti-inflammatory interleukins, which may contribute to the clinical value of SCS. The technique also reduces pain and improves the functional outcome by decreasing tissue tension and allowing for the resolution of the inflammatory response [34].

The only way to deal with chronic nonspecific LBP is a multidisciplinary approach. Recent studies used creative methods; aerobic exercises of walking/running at moderate intensity in both the aquatic environment and on land may be indicated for chronic back pain patients [35]. A back extension-glide virtual reality game turns out comparable with the McKenzie extension therapy in its effect on pain and pain-related characteristics, disability, movement impairments, and quality of life. Using a virtual reality game in rehabilitation makes the intervention process more attractive [36].

Conclusions

It is preferable to use SCS in the treatment of acute nonspecific LBP with mobility deficits as it may increase lumbar ROM, relieve back pain, and improve joint function. In addition to restoring the normal neuromuscular reflexes, it balances the muscular forces that affect joint function.

Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest.

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