Effects of the suboccipital muscle inhibition technique on pain intensity, range of motion, and functional disability in patients with chronic mechanical low back pain

Basma H. Hasaneen[a], Reda S.A. Eweda[b], Alaa E.A. Hakim Balbaa[b]

[a]Physical Therapy, Misr University for Science and Technology, Giza, [b]Physical Therapy for Musculoskeletal Disorders and its Surgeries, Faculty of Physical Therapy, Cairo University, Cairo, Egypt

Correspondence to Reda Sayed Ahmed Eweda, Physical Therapy for Musculoskeletal Disorders and its Surgeries, Faculty of Physical Therapy, Cairo University, Cairo, Egypt. Tel: 01005413229;
e-mail: redaawada@yahoo.com

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Background
Chronic mechanical low back pain is a common clinical condition encountered by physical therapists. It has a mechanical origin that lasts more than 3 months.
Aim
The aim of this study was to investigate the effects of the suboccipital muscle inhibition technique on pain intensity, range of motion (ROM), and functional disability in patients with chronic mechanical low back pain.
Patients and methods
Thirty female patients with a mean age of 23.8±0.86 years who had chronic mechanical low back pain were randomly assigned to two equal groups. Group A received exercise training (stretching and strengthening) and the suboccipital muscle inhibition treatment for five consecutive sessions. Group B received only exercise training (stretching and strengthening) for five consecutive sessions. Both groups were assessed using the visual analog scale for pain intensity, Modified–Modified Schober's test for ROM of lumbar flexion and extension, and the Oswestary functional disability questionnaire for functional disability. Patients were assessed before and after treatment.
Results
The results of this study showed that there were significant improvements in pain, ROM in the lumbar region (flexion and extension), and functional disability in both groups A and B ($P<0.05$). There was no statistical significant difference between the two groups; however, there was a clinical difference in favor of group A.
Conclusion
It was concluded that the suboccipital muscle inhibition technique combined with exercises have better clinical effects than exercises alone in patients with chronic mechanical low back pain.

Keywords:
chronic, mechanical low back pain, suboccipital muscle inhibition

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Introduction

Low back pain refers to pain in the lumbosacral area of the spine including the distance from the first lumbar vertebra to the first sacral vertebra. The fourth and fifth lumbar segments are the most commonly affected sites [1]. Low back pain is a leading cause of occupational disability all over the world and the most common reason of missed workdays [2]. It is the second most common reason for individuals to seek treatment from a physician [3], and the most affected individuals have high levels of physical activity at work [4].

As low back pain results from the association of many factors, it is very difficult to determine the exact cause [5]. Risk factors include genetic factors, back pain history, age, obesity, smoking status, and work-related factors. Work-related factors include physical aspects such as heavy manual work, twisting, lifting, and postural stress or psychosocial factors such as monotonous work and low job satisfaction. Physiological factors include inadequate trunk strength and low physical fitness [6].

Chronic mechanical low back pain can be of mechanical origin (the spine and its supporting structures), including muscle strain, disc disorders, and sacroiliac joint problems [2]. It refers to functional abnormality without underlying malignant diseases [7]. The patients usually describe it as throbbing or aching pain, and the pain may also present in the buttocks and thighs [2]. Mechanical low back pain often increases with activity and decreases with rest. Physical findings such as tightness of hamstrings, paravertebral muscle spasm, and restriction in motion of the spine may be present [5].

The incidence of mechanical low back pain is more common in young adults due to bad postures and intense physical efforts [8]. Nonspecific low back pain is believed to have high prevalence in females as risks are higher in women than in men. These higher risks may be attributed to anatomical and functional factors. Women tend to have less muscle mass and bone density, greater joint fragility, and lower adaptation to physical exertion [9]. High prevalence of obesity in women, especially abdominal obesity, increases the mechanical load on the lumbar spine. This is a risk factor for mechanical low back pain. In addition, low-grade systemic inflammation may be caused by obesity as the adipose tissue produces proinflammatory cytokines as well as adipokines that increase pain intensity [10].

It has been reported that menstruation is strongly associated with low back pain that might be attributed to hormonal fluctuations during the menstrual cycle leading to reduction of the pressure pain threshold at the lumbosacral area [11]. Psychological problems such as depression are more prevalent in young women than in men [12]. Many studies have reported that depression might be a risk factor for low back pain due to high pain severity [13].

Flexibility of the hamstrings is very important for normal mechanics of the lumbar spine. Tightness of the hamstrings reduces the lordotic curve, affects pelvic mobility, causes strain on the lumbar spine, and alters the lumbopelvic rhythm, which generates more strain on the lumbar segments, giving rise to low back pain [14].

There is a myofascial bridge between the suboccipital muscles, especially the rectus capitus posterior minor muscle and the dura and also between the ligamentum nuchae and the dura. In addition, there is an attachment between the dura and the posterior aspect of the bodies of the lumbar, thoracic vertebrae and the posterior longitudinal ligament; therefore, changes in dural tension can affect spinal mechanics and mobility and lead to low back pain [15].

The suboccipital muscle inhibition technique might decrease the tone of the hamstrings as the suboccipital muscles are connected to the hamstring by one neural system – which is the dura [16].

The suboccipital muscle inhibition technique is a manual technique that aims to relax the tension in the suboccipital muscles by decreasing the myofascial restriction in the suboccipital region [17].

The main objective of treatment of chronic mechanical low back pain is to return the patient to the desired level of activities and participation as well as the prevention of chronic complaints and recurrences [18]. Physical therapy, especially exercise therapy, is very important in the management of chronic mechanical low back pain [19]. Physical exercises tend to decrease pain and stabilize the spine and improve posture [2].

Although there are many interventions used for the treatment of chronic low back pain, the studies do not show a clear advantage of one method over the other, including exercises, massages, manipulation, mobilization, and low-impact aerobic exercises [20].

According to our limited knowledge, there are no previous studies that have investigated the effects of suboccipital muscle inhibition on chronic mechanical low back pain. Therefore, this study was conducted to investigate the effect of this technique on pain, range of motion (ROM), and functional disability in patients with chronic mechanical back pain, aiming to improve their ability to perform activities of daily living and shorten the rehabilitation period.

Patients and methods

Patients

Thirty female patients diagnosed with chronic mechanical back pain, with a mean age of 23.8±0.86 years and mean BMI of 25.03 kg/cm^2, were enrolled into this randomized pilot trial. After they signed a consent form which showed that they were freely and voluntary participated in the study and that they might withdraw and discontinue at any time.

This study was conducted at the Bolak El-Dakror Outpatient Physical Therapy Clinic, to which patients were referred by the orthopedic doctor of the hospital. Each patient was interviewed, and the aim of the study was explained. Patients who agreed to participate in the study were asked to fill a consent form. This study was approved by the ethical committee for scientific research of the Faculty of Physical Therapy, Cairo University. All ethical rules were followed according to the Helsinki declaration. Patients were randomly assigned into two matched groups A and B using a sealed envelope; each group consisted of 15 patients. Group A received exercise training (stretching exercises and strengthening exercises) and the suboccipital muscle inhibition treatment. Group B received only exercise training (stretching and strengthening exercises) for five consecutive daily sessions.

The following inclusion criteria were used for patient selection: female patients (because they have a higher risk for low back pain), aged 20–38 years [5], presence of chronic mechanical low back pain, which is the chief complaint, without leg pain [7], pain for more than 3 months [21], and a positive slump test. The patients were excluded if they had any of following conditions: tumor, infection, fractures in the spine, and cauda equina syndrome that requires urgent surgery [5], pregnant patients [19], and patients with previous lumbar surgery [7].

Outcome measures

Initially, demographic data and patient characteristics were collected. These data included height (measured to the nearest 0.1 cm) and weight (kg) (measured to the nearest 0.1 kg using a standard weight scale).

Pain intensity was assessed using the visual analog scale. It is a valid and reliable tool for the assessment of pain intensity. The visual analog scale consists of a 10-cm line, with the left extremity indicating 'no pain' and the right extremity indicating 'severe pain' [22,23]. Patients were asked to indicate their current level of pain on this scale.

ROM assessment was carried out by Modified–Modified Schober's test. It is a valid and reliable test used for assessing lumbar flexion, extension, and ROM. During lumbar flexion assessment, patients are in the standing position, whereas the examiner is in a kneeling position behind patients. The posterior superior iliac spines were identified. A horizontal line was made between both posterior superior iliac spines. One ink mark was made at the level of the S2 vertebra, and another ink mark was made 15 cm above this mark. The examiner then fixed a tape measure between those marks. Next, the examiner instructed the patient to bend forward. The new distance between the two marks was measured. The change in the difference between the measurement marks in standing and in flexion was used to indicate the amount of lumbar flexion [24].

Assessment of lumbar extension was performed as lumbar flexion with the exception that the examiner instructed the patient to bend backward. Then the new distance between the two marks was measured, and the change in the difference between the measurement marks in standing and in extension was used to indicate the amount of lumbar extension [24].

Functional disability was assessed using the Oswestary disability questionnaire. It is as a clinical assessment tool that provides an estimate of disability expressed as a percentage score. High scores indicated great pain; it is a valid and a reliable tool. The Arabic version of the questionnaire was used, and the questions were explained to the patients. For illiterate patients, the examiner read and explained the questions. Scores from 0 to 20% indicated minimal disability, from 20 to 40% indicated moderate disability, from 40 to 60% indicated severe disability, from 60 to 80% indicated crippled disability, and from 80 to 100% indicated complete disability (confined to bed) [25].

Treatment procedures

Stretching exercises

Hamstring stretches were performed as follows: the patient rested in the supine position, and the therapist brought the leg passively into a 90° hip flexion and then extended the knee passively till the patient felt a tolerable stretch; this position was held for 30 s and then relaxed. The procedure was repeated three times [26].

Lower back stretch was performed as follows: the patient was in the crook position, and the therapist brought both knees toward the chest and held the position for 30 s and then relaxed; this was repeated three times [27].

Strengthening exercises

Abdominal curl up was performed as follows: the patient was in the crook position and both hands were extended beside the body. Active sit ups were performed followed by relaxation; this was repeated five times [28].

Trunk extension was performed as follows: the patient was in the prone position and performed active trunk extension and extended the elbows and then relaxed; this was repeated five times [27].

The suboccipital muscle inhibition technique was performed as follows: the patient was in the supine position and the therapist sat behind the patient's head and placed both hands under the patient's head making contact with the suboccipital muscles in the region of the posterior arch of the atlas, and the pressure applied was upward toward the ceiling for nearly 4 min until the tissues and muscles were relaxed. During the procedure, patients were asked to keep their eyes closed to avoid eye movements that affect the suboccipital muscle tone [17].

In group A, each patient received five consecutive sessions in the form of exercises (stretching and strengthening) in addition to the suboccipital muscle inhibition technique; each session lasted for nearly 30 min. In group B, each patient received five consecutive sessions in the form of exercises (stretching and strengthening); each session lasted nearly 25 min.

Data analyses

All statistical measures were performed using the statistical package for social science (SPSS) program, version 20 for windows (IBM, Armonk, NY, United States of America). Before the final analysis, data were screened for normality assumption and presence of extreme scores. This exploration was performed as a prerequisite for parametric calculation of the analysis of difference and analysis of relationship measures. The box and whisker plots of the tested variables were analyzed to detect outliers. For normality testing of data, the Shapiro–Wilk test was used. All these findings allowed the researchers to conduct parametric analysis. Therefore, 2×2 mixed design multivariate analysis of variance was used to compare the tested variables of interest in different tested groups and measuring periods. The α level was set at 0.05.

Results

Descriptive analysis using histograms with the normal distribution curve showed that the data were normally distributed and did not violate the parametric assumption for the all measured dependent variables. In addition, testing for homogeneity of covariance using Box's test revealed that there was no significant difference with *P* values less than 0.05.

Thirty patients were included in the final data analysis. They were divided into two groups. Each group included 15 patients. There were no statistically significant differences ($P>0.05$) between patients in both groups concerning age, body weight, height, and BMI (Table 1). There were also no statistically significant differences between groups for any outcome variables at baseline (preintervention).

Pain, range of motion of the lumbar spine, and functional disability

Statistical analysis using mixed design multivariate analysis of variance was applied. It revealed that there were significant within-subject effects ($P=0.0001$) and treatment×time effect ($F=4.257$, $P=0.01$). However, there was no significant between-subject effect ($F=0.032$, $P=0.988$). Table 2 presents the descriptive statistics (mean±SD) of all the detected variables, whereas Table 3 represents multiple pairwise comparison tests (post-hoc tests) for the all dependent variables.

Table 1 Descriptive statistics and unpaired *t*-tests for mean age, body weight, height, and BMI of patients with chronic mechanical low back pain of both groups

	Age (years)	Body weight (kg)	Height (cm)	BMI (kg/cm^2)
Group A	23.8±0.86	63.93±8.75	158.66±3.55	25.03±2.57
Group B	23.8±0.86	63.96±8.42	162.26±7.16	24.35±2.27
t-Value	0.000*	−1.743*	−0.011*	0.763
P-value	1.00	0.092	0.958	0.452

*Significant at the α level ($P<0.05$).

Table 2 Descriptive statistics of all the dependent variables in patients with chronic mechanical low back pain of both groups

Dependent variables	Group A		Group B	
	Pretreatment	Post-treatment	Pretreatment	Post-treatment
Pain level	5.15±1.65	2.73±1.2	4.36±1.8	3.1±2.3
Lumbar flexion	6.3±1.71	7.34±1.65	6.6±1.19	7.23±0.88
Lumbar extension	3.23±0.92	3.96±1.05	3.26±1.16	3.8±1.04
Functional disability	21.69±8.32	11.3±4.6	19±8.32	13.06±7.3

*Significant at the α level ($P<0.05$).

Table 3 Multiple pairwise comparison tests (post-hoc tests) for all the dependent variables in patients with chronic mechanical low back pain of both groups

Within groups (pre vs. post)				
P-value	Pain level	Lumbar flexion	Lumbar extension	Functional disability
Group A	0.0001*	0.0001*	0.0001*	0.0001*
Group B	0.0001*	0.002*	0.003*	0.001*
Between groups (group A vs. group B)				
Pretreatment	0.248	0.602	0.93	0.401
Post-treatment	0.619	0.82	0.688	0.462

*Significant at the α level ($P<0.05$).

In the same context, regarding within-subject effect, multiple pairwise comparison tests revealed that there were significant decreases ($P<0.05$) in pain level and functional disability in the post-treatment condition compared with the pretreatment condition in both groups. There was a significant increase ($P<0.05$) in ROM of the lumbar flexion and extension in the post-treatment condition compared with the pretreatment condition in both groups. Regarding between-subject effect, multiple pairwise comparisons revealed that there were no significant differences in all dependent variables between both groups ($P>0.05$).

Discussion

Chronic mechanical low back pain is a common condition in outpatient physical therapy practice settings, and treatment of this disorder is characterized by large variations in practice patterns.

To the best of our knowledge, this is the first study that investigated the effects of the suboccipital muscle inhibition technique on pain intensity, ROM, and functional disability in patients with chronic mechanical low back pain.

The results of this study showed that in both groups there were significant increases in ROM of the lumbar region (flexion and extension) and significant reduction in pain intensity and functional disability after treatment in comparison with before treatment. However, there was no statistically significant difference between both groups. There was only a clinical difference and a high percentage of improvement in favor of group A compared with group B in all the parameters (pain intensity, ROM, and functional disability).

As the lumbar spine has an anatomical attachment with the dura, changes in the mechanics of the lumbar spine may affect dural tension, which in turn may be a source of pain to the lower back. Application of the suboccipital muscle inhibition technique may decrease this dural tension, and thus more mobility in the lumbar spine may occur leading to reduction in low back pain [15,16].

Regarding the effects of the suboccipital muscle inhibition technique, our results are supported by a similar study, which found that suboccipital muscle inhibition decreased pain intensity in patients with tension headache through its inhibitory effect that released the suboccipital muscles spasm [29].

Aparicio *et al.* [16] found that suboccipital muscle inhibition technique modified elasticity of hamstring muscles and increased the ROM of straight leg raising in patients with short hamstring syndrome. The participants in their study were young adults and were nearly of the same age as the patients of our study [16]. In addition, Jagtap and Pandale [30] found that five consecutive sessions of suboccipital muscle inhibition technique reduced the hamstring tightness in normal healthy population, which would reduce patients' disability and improve their well-being. On other hand, Antolinos-Campillo *et al.* [31] found that suboccipital muscle inhibition had no effect on neck pain in patients with cervical whiplash. Their results may be attributed to the short treatment duration, as the technique was applied only for one session [31].

Improvement of pain in group A may be attributed to many reasons. First, suboccipital muscle inhibition technique induces muscles relaxation through stimulation of the autonomic nervous system (parasympathetic system) [32]. The second reason is that suboccipital muscle inhibition technique increases the release of β-endorphins, which decrease the perception of pain [33]. Improvement in the ROM of the lumbar spine in group A may be a result of an increase in hamstring flexibility caused by application of the suboccipital muscle inhibition technique [16]. Good hamstring flexibility allowed greater motion to occur at the hips and pelvis, which in turn reduced the stress on the lumbar spine [26]. Improvement in functional disability in group A might be caused by the reduction in hamstring muscles tone due to application of the suboccipital muscle inhibition technique, which allowed a greater range during the straight leg raising exercise. This greater range of straight leg raising decreases the functional limitation of the patients and allows easier performance of different activities due to pain reduction [16].

With regard to the effect of exercises, our results are supported by other studies. Moon *et al.* [34] found that lumbar strengthening exercises significantly decreased low back pain. The sample size of this study was 24 patients, which is nearly similar to our study [34]. In addition, Seif *et al.* [21] found that stretching exercises for hamstrings and back muscles and strengthening exercises for abdominal muscles led to improvement in lumbar ROM in patients with chronic low back pain. On other hand, another study by Smith and Mell [35] found that lumbar extension exercises did not improve the lumbar ROM; however, they used different assessment methods for measuring the lumbar ROM.

In another study, the treatment program for patients with chronic low back pain, which included stretching exercises followed by progressive strengthening exercises, showed a decrease in patients' functional disability and an increase in patients' confidence [36]. On the other hand, in another randomized controlled trial, there was no short-term effect of exercises on functional disability in patients with chronic low back pain, and this study had a different sample size compared with our study [37].

Improvement in pain in group B might be interpreted in the light of physiological changes induced by exercises in form of improvement of tissue blood flow. This might facilitate the healing process by supplying more nutrients and oxygen to the affected area, while at the same time aid in removal of irritant substances and waste products from the sensitive tissues leading to reduction of low back pain [38]. Whereas improvement in the ROM of the lumbar spine in group B might be attributed to the effect of stretching exercises, which decreased the excessive lumbar lordosis, and the compressive force on the lumbar discs [39].

Improvement of the functional disability in group B might be attributed to the effect of the abdominal muscle strengthening exercise, which increased intra-abdominal pressure, and thus decreased the load on the lumbar spine and protected it from injury [28]. It also reduced lumbar lordosis and improved stability of the spine by creating a self-made corset, which in turn reduced the fear of movement, a predictor for functional limitation [39].

In addition, stretching exercises increased levels of insulin-like growth factor, which stimulated protein synthesis, and thus increased muscle mass. This increase in muscle mass improved muscle strength, which reduced patients' functional disability and improved patients' ability to perform activities of daily living [40]. It was observed that patients with low back pain showed longer latency in muscle responses during sudden loading of the trunk. Exercises facilitated the feed forward postural mechanism, which results in improvement of lumbopelvic stability and the patient's overall functional status [34].

Limitations of the present study include the following: only female patients were included, the sample size was small, and the treatment duration was short.

According to the results of this study, the following recommendations are made: future studies with larger sample size, with longer treatment periods, and on both sexes (male and female) are required.

Conclusion

On the basis of the obtained results, it was concluded that suboccipital muscle inhibition technique combined with exercises (stretching and strengthening) had better clinical effects than exercises alone in patients with chronic mechanical low back pain.

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Conflicts of interest

There are no conflicts of interest.

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