

# The effect of manual techniques on maximum muscle activity electromyography, functional disability, and pain in women with non-specific chronic low back pain

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Article Info	Abstract
<p>Original Article</p> <p><b>Article history:</b>            Received: 19 August 2021            Revised: 25 August 2021            Accepted: 04 October 2021            Published online: 05 December 2021</p> <p><b>Keywords:</b>            chiropractic manual techniques, electromyography activity, functional disability, pain, non-specific chronic low back pain.</p>	<p><b>Background:</b> Low back pain (LBP) can cause changes in muscle activity in affected individuals, making it difficult for them to contract their muscles effectively and engage in physical activities. Manual chiropractic techniques have been proposed as a potential solution to improve muscle orientation and function in individuals with LBP.</p> <p><b>Aim:</b> The purpose of this study was to investigate the effect of manual techniques on maximum muscle activity electromyography, functional disability, and pain in women with non-specific chronic low back pain.</p> <p><b>Materials and Methods:</b> Twenty women between the ages of 30 and 50, who had been experiencing NSCLBP for over three months with no history of spinal surgery or postural abnormalities, and were able to perform daily activities after providing consent, were recruited from a sports medicine clinic to participate in the study. In the pre-test, the Oswestry Disability Index (ODI) was used to assess functional disability, and the Visual Analogue Scale (VAS) was used to assess pain levels. Additionally, the maximum muscle activity of the multifidus and lumbar quadratus lumborum (QL) was measured using EMG. Chiropractic manipulation techniques were then implemented in the experimental group, with three sessions per week for six weeks, within the clinic. The same tests were repeated in the post-test. The ANOVA test was used to compare the chiropractic and control groups, with a significance level of <math>\alpha \leq 0.05</math>.</p> <p><b>Results:</b> The study results indicate that chiropractic manual techniques were effective in reducing lumbar EMG activity (<math>P= 0.0001</math>), reducing pain index (<math>P= 0.002</math>), and improving functional disability (<math>P= 0.001</math>) significantly.</p> <p><b>Conclusion:</b> The study findings suggest that six weeks of chiropractic manipulation techniques can induce a feeling of relaxation, reduce pain, and passively strengthen the lumbar muscles. These improvements in muscle condition and functional disability may lead to a reduction in pain experienced by individuals with NSCLBP.</p>

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## 1. Introduction

Low back pain (LBP) is one of the leading causes of disability globally [1]. In addition, it causes many problems for patients and communities. In industrialized countries, LBP imposes high medical costs, as well as job loss [2]. The LBP usually resolves within 8 to 12 weeks, and if it lasts more than three months, it can become chronic pain in 15% of patients. Hence, chronic LBP (CLBP) may lead to lower productivity, lower quality of life, and a higher financial burden on society [3]. Some LBP occurs with a specific cause, such as a disease that needs to be treated, but non-specific LBP occurs for no particular reason. This means that the body is not injured, nor the working conditions have caused pressure on the body and caused pain, and no damage or pathology change is observed in medical imaging or radiology [4].

Repetitive and erosive pressure on the lumbar region can cause pain and discomfort in this area, which reduces the tissue's tolerance to stress. In addition, there is a likelihood of LBP. Mechanical stresses, both continuously and cyclically, cause changes in the viscoelastic properties of the muscles, leading to inflammation and abnormal muscle activity [5]. The quadratus lumborum (QL) muscle plays a significant role in LBP. Although this muscle is significantly smaller than the dorsal extensors, it plays a crucial role in lumbar-pelvic movements, specifically in spinal stability, due to the way it is connected [6]. Lumbar instability is an essential factor in the occurrence of LBP, significantly reducing the maintenance of the neutral zone (NZ) in the body's physiology. Controlling the size of the NZ resulting from the interaction of passive, active, and

neural control systems is an essential criterion for lumbar spine stability, providing lumbar stability and vertebrae support by muscles [7]. Lumbar multifidus muscle, which is thought to be essential for spinal stability, has been addressed in various studies that multifidus leads to atrophy with the fat infiltration in patients with CLBP. Previous studies have indicated that QL asymmetry function can lead to compression fractures in the dorsal vertebrae [8]. Muscle weakness increases the risk of LBP. Pain is an unpleasant feeling that informs a person of undesirable and unwanted disorders and changes in the body. In addition, pain is one of the human body's defense mechanisms that determines a person to face a problem. Although some researchers have identified CLBP as the cause of physical disability, the disability includes the terms impairments, activity limitations, and participation restrictions [9]. Some patients with CLBP are terrified of sudden movements of the spine that are accompanied by pain impulses, which may lead to adaptive withdrawal from social activities [10]. According to Ferreira (2006), patients with the CLBP are more likely than those with the acute LBP to benefit from stabilization exercises regarding pain relief and disability [11]. Effective rehabilitation of these patients should be such as to prevent their onset of pain and disability.

Chiropractic means the application of manual maneuvers to establish a maximum movement of skeletal and muscular organs in the normal and balanced body positions [12]. Chiropractic has been shown to have similar benefits to physiotherapy. Previous studies have also shown significant statistical and clinical benefits for those receiving chiropractic therapy in addition to medical treatment compared to those

receiving only medical standards of care. Besides, the effectiveness of chiropractic care is similar to that of medical care for non-specific CLBP after six months of follow-up. Chiropractic has also been partially more effective than medical care alone in reducing disability in some patients [13].

Cherkin et al. (1998) stated that physical therapy and chiropractic care are both commonly used treatment options for low back pain, and they play important roles in helping patients manage their pain and improve their function [14].

Herman et al. (2021) suggested that more frequent chiropractic care may lead to better clinical outcomes for patients with chronic low-back and neck pain [15].

Herman, Hurwitz and Coulter (2020) also evaluated the results of chiropractic treatment for patients receiving ongoing care for CLBP and neck pain. By increasing the frequency of chiropractic therapy, the models indicated that only patients who received treatment more than once a week had a more significant improvement [16].

Bussièrès et al. (2017) reviewed treating the spinal manipulative therapy (SMT) along with a daily work guide under the auspices of the Canadian Chiropractic Association (CCA). The results revealed that SMT is a multifaceted approach, including routine active interventions, self-management recommendations, and exercise as an effective treatment strategy for acute and CLBP [17].

LBP impairs the control of the lumbopelvic region, leading to fatigue and decreased strength, endurance, and flexibility of the trunk muscles. The multifidus muscle is vital as a controller and stabilizer of the spine among the trunk muscles, and the QL is a crucial muscle as a distributor of external force and functional

load transfer between the pelvis and the spine. No study is available that examines these two muscles simultaneously. Additionally, LBP can decrease physical activity and quality of life and consequently impose social and economic problems on the individual and society; therefore, treatment and prevention of this occurrence are much more appropriate and cost-effective for society [18].

Studies shows that muscle activity changes in people with low back pain (LBP). They need right orientation to contract their muscles effectively, to improve life style and take part in physical activity. Manual chiropractic techniques claims to improve orientations. Other Studies performed with chiropractic techniques in patients with non-specific CLBP have yielded different results regarding pain and disability and the effectiveness of chiropractic techniques. However, no study has been conducted that examines the effect of chiropractic techniques on changes in lumbar muscle electrical activity in patients with LBP. The question is whether a course of chiropractic manipulation techniques affects the EMG activity of the lumbar muscles and the functional disability of women with non-specific CLBP.

## 2. Methods

The present study is quasi-experimental with pre-test and post-test designs. The statistical population included women with non-specific CLBP in Karaj, Alborz Province, Iran, referring to a sports medicine clinic, who were selected from 30 patients (Determining sample size by Morgan Table) based on inclusion and exclusion criteria whose LBP lasted more than three months and happened for no apparent reason but after completing the

course, 20 samples remained. People 30 to 50 years old have general health, do not have any specific pathology in the spine such as disc herniation, have no history of spinal fracture surgery, have the ability to sit, stand, and walk without assistance; ability to perform daily activities, having healthy legs, and no postural abnormalities [19] were included in the study after obtaining consent form and approval from a physician for exercise. People with acute LBP, spinal surgery, sciatica and specific spinal pathology, symptoms or history of spinal nerve root pain, painful arthritis, osteoporosis, rheumatic inflammatory diseases, acute disc herniation, spinal stenosis, congenital abnormalities, new fractures in the spine, failure to complete tests, absence from exercise (two consecutive or five non-consecutive absences during the course), or with the advice of a physician [20] were excluded from the study. Twenty subjects were randomly divided into two groups of ten based on the pain level estimated by VAS test (VAS=4.5). Group 1: Chiropractic manual techniques (CP) and Group 2: Control (C).

The Visual Analogue Scale (VAS) was used to assess the intensity of pain, reported with a validity of 0.70 and a reliability of 0.97 [21]. The ODI questionnaire in ten sections assessed functional disability: pain intensity, personal work, lifting, walking, sitting, standing, sleeping, sexual activity, social relationships, and travel. Each part of this questionnaire includes six options that, in the worst case of disability, a score of 5 is given to each section, equal to 50 points for ten sections. Based on this, the total disability is calculated by multiplying the sum of the scores of each section by two. In previous studies, the validity and reliability

of the ODI questionnaire in measuring LBP and disability in daily activities have been confirmed, and the reliability has been reported as 0.84 [22].

At first, the subjects warmed up the upper back muscles for 15 min. After that, to reduce the electrical impedance at the junction of the leads, the excess hair was first removed, and the skin was rubbed with fine sandpaper with soft, controlled pressure and then cleaned with an alcohol swab. The criterion for achieving the desired level of skin impedance (low resistance), light red skin color was considered. Then, SKINTACT Ag and AgCl wet gel leads were used to connect to the multifidus muscles between L1 and L2 at the level of the L5 shock appendage (about 2-3 cm from the midline) and QL (2 cm outside the spiny appendage of the L4 vertebra). The distance between the electrodes was 2 cm, and the active positions of the electrode on the skin were identified according to SENIAM instructions, and the electrodes were installed [23]. The Noraxon electromyography device (made in the USA), the Desktop DTS Receiver model, was used to record the electrical activity of the multifidus and QL muscles. This device has 16 channels with a frequency of 1500HZ, the ability to record the electrical activity of 16 muscles simultaneously. Subjects were asked to exert their maximum effort.

Then subjects placed on an isokinetic device that has been calibrated before the tests so, it was ready to begin testing. Subject placed on the bed in prone position. She applied maximum force to the strap on the inclined plate. Also, Manual resistance added to the strap to ensure that individuals reached their maximum effort. After testing the maximum voluntary contraction to

record the most isometric contraction of the multifidus and QL muscle. The electrodes were then installed in the desired place. While the hip was fixed, the individual performed the isometric contraction of the lumbar region with the most resistance [24].

It is repeated in cases where an error accompanies the movements at the beginning or in the absence of synchronization between the individuals and the examiner or metronome. Five repetitions were performed for each movement. For each exercise, concentric and eccentric phases were performed with one metronome beat in which one metronome beat was considered to rest between each repetition. All tests were performed continuously, and at least two minutes of rest were considered between each exercise. The subjects performed the selected exercises (Cat Pose, balasana, childs pose, Supine Plank), during which the electrical activity of the muscles was recorded at a frequency of 1000 Hz. Then, in order for the stimuli and activations to be recorded correctly, they performed the movements with their maximum effort for five seconds to record the MVC information after the operator's command [23].

Chiropractic manual techniques performed in the clinic by chiropractor (six weeks, three sessions per week). Pre-test and post-test before and after the treatment period. The day before the treatment period, and the day after the last treatment session, patients' functional disability measured using the ODI questionnaire. The electrical activity of the QL and multifidus muscles was also measured by an EMG (Noraxon model made in the USA) at Kharazmi University.

Chiropractic techniques performed in the study include Side (Chiropractic Adjustment Side) [25], Drope (Lumbar

Thompson Drop) [26], Shock wave [27], and Gun massage [28].

In the Side technique, the patient is placed on their side. The upper leg is bent into the abdomen. The lower five vertebrae and lumbar muscles are rotated by a chiropractor, which releases and stretches the lower back. This technique is applied once on the right side and once on the patient's left side. Drope technique, the patient sleeps on the abdomen, and the chiropractor presses the bed pedal to raise the patient's back and puts pressure on the vertebrae with the palm. Gun massage releases and relaxes muscle cramps for 5-6 minutes on the target muscles. Shockwave is finally applied to the target muscles and around the L1-L5 vertebrae with a few strokes, and finally, the sessions end.

This research has been registered in the Ethics Committee of the Physical Education Research Institute under the number SSRI.REC-2109-1268.

SPSS software version 20 was used to analyze the collected data. Shapiro-Wilk test was used to evaluate the normality of the distribution of the variables. Also, a T-test was used to compare the data for chiropractic and control groups. The significance level was considered 0.5 in the test. After recording the data in the device memory for EMG data, this data was transferred to Noraxon MR 3.10.64 software and analyzed. First, the EMG data were filtered with a transient Butterworth filter at a low frequency of 500 and a frequency above 15 Hz, and then the highest data was calculated as MVC data.

### 3. Results

The mean height, weight, age, and BMI of chiropractic and control groups were 28.2, which was not significantly different in any of the factors (Table 1).

**Table 1.** The mean height, weight, age, and BMI of people in chiropractic and control groups

Variable/ Group	Height (cm)	Weight (kg)	Age (year)	BMI
Chiropractic group	159 ± 4.44	73.88 ± 8.32	40.39± 4.58	28.9 ± 2.58
Control group	162.63± 4.01	74.54 ± 9.96	43.87± 6.35	28.2 ±3.99
Sig.	0.765	0.532	0.744	<b>0.403</b>

The present study examined the level of EMG activity of muscles, pain measurement, and functional disability of individuals, summarized in Table 2.

EMG activity was used to measure multifidus and QL muscle in the present study. There was a significant difference between the MVC of the QL muscle in the chiropractic and control groups ( $P \leq 0.001$ ). Also, in the study of EMG activity in the QL, a significant difference was observed between the MVC of the two groups of chiropractic and control ( $P \leq 0.001$ ). The

null hypothesis was rejected in these cases.

Also, in the present study, the VAS was used to measure pain. There was a significant difference between the amount of chiropractic and control groups ( $P \leq 0.002$ ) in the amount of pain, and the null hypothesis was rejected. Similarly, the ODI questionnaire was used to assess the functional disability of individuals, indicating a significant difference between the two groups of chiropractic and control ( $P \leq 0.001$ ) and rejecting the null hypothesis in this case (Table 2).

**Table 2.** Results obtained from the research

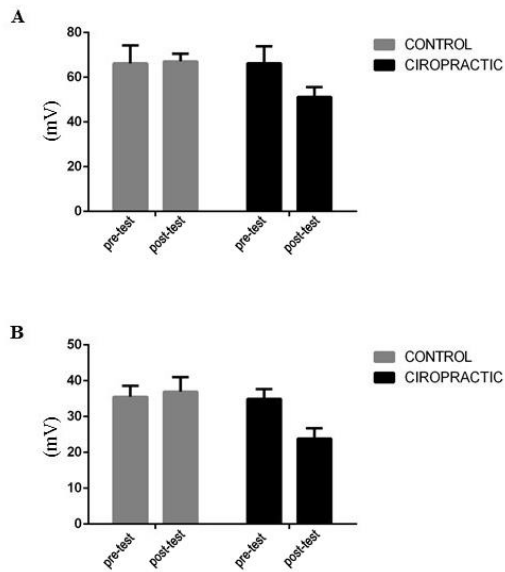
Muscle	Group	Pre-test	Post-test	Sig. within the group	Sig. between groups
Quadratus Lumborum (QL) (mV)	Chiropractic	66.25 ± 7.67	51.18 ± 4.26	0.000	<b>0.000</b>
	Control	66.26 ± 8.06	67.11 ± 3.48	0.769	
Multifidus (mV)	Chiropractic	34.90 ± 2.74	23.84 ± 2.90	0.000	<b>0.000</b>
	Control	35.52 ± 3.09	26.93 ± 4.11	0.348	
Pain measurement	Chiropractic	7.2 ± 1.81	3.2 ± 1.61	0.000	<b>0.002</b>
	Control	6.8 ± 2.2	7.3 ± 1.88	0.586	
Functional disability	Chiropractic	39.80 ± 6.90	25.10 ± 4.53	0.000	<b>0.001</b>
	Control	39.30 ± 7.87	40.20 ± 7.61	0.780	

#### 4. Discussion

The present study aimed to investigate the effect of a course of chiropractic manual techniques on EMG activity of lumbar muscles, functional disability, and pain in women with non-specific CLBP. The results revealed that chiropractic manual techniques on the test related to the activity of lumbar EMG, including multifidus muscle ( $P \leq 11111$ ) LL ( $P \leq 11111$ ) aain index ( $P \leq \text{iiiii}$ ), which aa s alle oocause a significant decrease in the results related to functional disability ( $P . \dots$ ).

Regarding the effect of manual maneuvers on reducing pain, it should be

noted that fear of pain and performing compensatory movements due to pain cause asymmetrical stresses on different joints, mainly in the lumbar region. In some studies, patients with chronic CLBP tend to lean more toward the center of gravity while standing. This position is caused by lumbar lordosis, resulting in asymmetric forces on the articulating surfaces of adjacent vertebrae and pressure on the nerve roots [29]. Also, without any restriction on their lumbar movements, there are abnormalities in the movements of these people, which may indicate a disorder in the control of their lumbar movements.

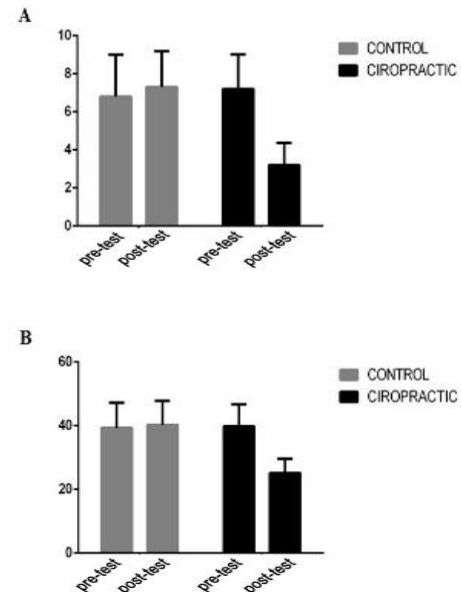


**Figure 1.** The effect of chiropractic techniques on the EMG activity of multifidus (A) and QL muscles (B)

Accordingly, this is another reason for asymmetric pressure on the lumbar spine that causes or exacerbates LBP [29].

Pain in the lumbar muscles, including the multifidus and lumbar spine, is considered to be the primary source of LBP. Myofascial pain in these muscles causes abnormal muscle contraction due to excessive accumulation of acetylcholine. Such abnormal contraction causes local ischemia and increases the metabolism of the contracted areas, causing an energy crisis that leads to local pain with hypersensitivity of the muscles involved [30].

Chiropractic therapy is expected to reduce muscle tension and improve local ischemia in areas of abnormal muscle contraction, which in turn prevents an increase in metabolism and an energy crisis. In addition, it prevents the induction of referral pain by reducing the synthesis of substance P in the dorsal root ganglia and, at the same time, inhibiting pain in the peripheral muscles, preventing central sensitization [31]. Chiropractic improves



**Figure 2.** The effect of chiropractic techniques on pain (A) and functional disability (B)

pain in the nervous and muscular system, reduces pain, and improves nerve delivery to the muscles, ultimately reducing the patient's functional disability. Chiropractic affects the neuromuscular system, which relaxes the muscle and reduces pain. Healing restores normal limb movement and reduces pain.

The mechanism of successful treatment resulted in reducing the nerve impulses, reducing gamma valve entry, involving the lymph return in the lymphatic vessels, and improving blood flow to the tissues. Some of these therapies effectively reduce the pain transmission into the spinal cord and release endorphins, which increase the pain threshold and reduce the severity of pain [32]. The research results of Lee et al. (2014) [33] and Herman et al. (2021) [15] were consistent with the present study's findings, but the research of Renkawitz and Grifka (2006) [34] was inconsistent. This could be due to the mismatch of the study population, whose study population was athletes with CLBP. However, the population studied in this research was non-

athlete women.

Weakness in the trunk muscles that are close to the center of the body reduces the spine's stability, causes sensory receptors disorder, impaired neuromuscular coordination, impaired motor control of the lumbar spine, and ultimately back pain. Therefore, to manage pain in patients with LBP, methods should reduce all LBP disorders [35].

Since this study focuses on the treatment of lumbar muscles showing the results of a significant improvement in muscle activity, it can be concluded that improvement in all factors studied may have reduced pain in patients with CLBP.

The onset of pain causes the patient to enter a vicious cycle. Patients with CLBP have limited mobility due to long-term pain (more than three months), and their physical activity is severely limited. Restricted daily activities also cause more muscle weakness. Therefore, it seems normal for patients with low back pain to have weaker muscles than healthy people [36]. In the present study, side and drop techniques performed by a specialist physician were used. Due to the releases done in the muscles and the specialized movements, the muscles were in a more comfortable position and had better flexibility. In addition, these movements manipulated the vertebrae and placed them in a better position, which ultimately led to reduced pain and better performance. The use of the Shockwave technique along with chiropractic also reduces pain in patients with CLBP [15]. In a study using shockwaves along with corrective exercises, they were able to reduce pain in patients with CLBP. The strength of the body's lumbar muscles reduces CLBP and achieves this improvement in strength, and this study seeks to find the best treatment and

chiropractic [26].

In the study conducted by Dorosti et al. (2017) which examined muscle thickness, no significant differences were observed. Additionally, they found that the multifidus muscle did not undergo any changes [24].

The present study used Side, Drop, Shock wave, and Gun massage for chiropractic techniques. The two Shockwave and Gun massage devices worked explicitly on the lumbar muscles. The main focus was on the multifidus and QL muscles so that passive activities could strengthen the lumbar muscles. The electrical activity of the muscles was used to accurately measure the changes in the studied muscles, which was quite indicative of the effectiveness of the chiropractic method on muscle strengthening [27].

According to the present study results, chiropractic is helpful for people with CLBP. Conceivably, by increasing the number of visits more than once a week, there is an improvement in performance, which occurs with more improvement in patients with severe pain and poor initial function, who may have more potential for improvement. Chiropractic, through the technique of massaging and dropping on the spine, causes the shock appendages that rotate on the spine and cause pressure on the disc and muscles to return to their place. And by means of the gun massage and shock wave device, the muscles involved in the back are directly worked on, which will help to eliminate the trigger points and muscle disorders and will improve the back pain. Chiropractic uses the drop technique on the spine to return the shock appendages that rotate on the spine and cause pressure to the disc and muscles to their place. u i eett eyý s s resmnyñ ) le re consistent with the current study [37].



## 5. Conclusion

Individuals with LBP suffer from pain and functional disability, which seriously disrupts a person's daily functional activities and sometimes even pain at rest, reducing the quality of their sleep and rest. The present study results indicated that the physician performed chiropractic manual techniques in a specialized manner on the vertebrae. Accordingly, Shockwave and Gun massage techniques improve lumbar EMG activity (multifidus muscle and QL), pain perception, and functional disability in patients with non-specific CLBP. It can be concluded that chiropractic manipulation techniques can effectively treat the non-specific CLBP. Therefore, it is recommended that physiotherapists, movement disorder specialists, and chiropractors pay special attention to compensating for or treating LBP using chiropractic.

## Conflict of interest

The authors declared no conflicts of interest.

## Authors' contributions

All authors contributed to the original idea, study design.

## Ethical considerations

The author has completely considered ethical issues, including informed consent, plagiarism, data fabrication, misconduct, and/or falsification, double publication and/or redundancy, submission, etc.

## Data availability

The dataset generated and analyzed during the current study is available from the corresponding author on reasonable request.

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## Practical and key points

Chiropractic can be an excellent help for physiotherapists in choosing treatments for people with LBP. Chiropractic can also be used with caution in patients with non-specific C LBP to improve their physical and functional condition under the supervision of a specialist.

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