ORIGINAL ARTICLE

IJPHY

# EFFECTIVENESS OF NEURAL MOBILIZATION IN THE MANAGEMENT OF CHRONIC LOW BACK PAIN WITH RADICULOPATHY: A RANDOMIZED CONTROLLED TRIAL

[*1]Dr. Salem F. Alatawi


## ABSTRACT

***Background:*** Neural mobilization (NM) constitutes the most effective, common method for assessing and treating several neuromuscular disorders. The study at hand aims to determine the effectiveness of the NM technique compared to lumbar stabilization exercise (LSE) and Radial Extracorporeal Shock Wave Therapy (rESWT) in the physical therapy management of chronic low back pain (CLBP) with radiculopathy.

***Methods:*** Two groups comprising 30 participants and randomly chosen formed the basis of this investigation: Group A (NM, LSE, and rESWT) and Group B (LSE and rESWT). The period of three to six weeks constituted the time it took to measure the results herein reached baseline. The results of the observations focused on pain assessed by numerical pain rating scale (NPRS), Lumbar flexion range of motion (Lumbar FROM) by Schober's method, and disability level as measured by the Modified Oswestry Disability Questionnaire (MODQ).

***Results:*** In the control group, the mean scores of pain, lumbar FROM, and MODQ at baselines showed a high level of similarity (6.47, 2.87, and 43.71 respectively in the intervention group, and 6.20, 2.93 and 44.66. Both groups showed improvement in their pain scores at three weeks ($P<0.05$). However, only lumbar FROM and MODQ showed statistically significant improvement in favor of the intervention group at three weeks ($P<0.05$). By week 6, both groups achieved a statistically significant difference in the values of all variables.

***Conclusion:*** NM with LSE and rESWT is more effective than LSE and rESWT in the third week, and was similarly effective in the sixth week of the treatment. NM with LSE and rESWT may be an alternative treatment option in the treatment of CLBP.



***Keywords:*** Chronic low back pain, radiculopathy, neural mobilization, lumbar stabilization exercise, Radial extracorporeal shock wave therapy.

Received 26th July 2019, accepted 01st October 2019, published 09th October 2019

www.ijphy.org

10.15621/ijphy/2019/v6i5/186844



## CORRESPONDING AUTHOR

**[*1]Dr. Salem F. Alatawi**

Assistant Professor of Neurorehabilitation,
Vice-dean of the deanship of graduate studies
University of Tabouk
Faculty of Applied Medical Sciences,
Department of Physical Therapy,
Tabuk- Kingdome of Saudi Arabia
e-mail: sfalatawi@ut.edu.sa

## INTRODUCTION

It has been stated that 80% of people suffering from low back pain (LBP) at least once in their lifetime. One of the common symptoms of LBP is radiating pain [1]. This symptom may be associated with a decrease in flexibility and strength of the muscles of the lumbar and lower extremities [2]. Chronic lower back pain (CLBP) is determined by the persistence of back pain for more than three months of symptoms[3]. The intervertebral disc usually causes back pain and radicular symptoms[4]. Radiculopathy is a common condition in which the pain radiates towards the lower extremity, and follows symptoms in the dermatome and myotome patterns due to the irritability of the nerve roots at the lumbosacral spine[5].

Around 90% of the radiculopathy condition is caused by disc herniation associated with nerve root compression, lumbar canal stenosis and less occurrence of tumors[6]. Radiculopathy symptoms may vary depending on the level of the root affected in the spine[7]. Among all the radiculopathies, the two most commonly affected areas in the lumbar regions are L4-5 or L5-S1 [8]. The symptoms include numbness, paraesthesia and weakness, or a combination of all the above symptoms, which frequently cause functional limitations and disability[9,10]. Several interventions, such as neural mobilization, extracorporeal shock wave therapy, exercise therapy, massage, or lumbar stabilization techniques are used to treat LBP, but with limited evidence regarding its combined treatment efficiency[11-15].

Neural mobilization (NM) has a specific role in the treatment of LBP with radiculopathy[16]. NM plays asignificant role in evaluating and in improving the mechanical and neurophysiological integrity of the peripheral nerves in populations studies[17,18]. NM techniques include the combinations of joint movements that promote either sliding, or neural tensioning[19]. Further, these techniques are used in disc disease, in order to adjust radiating pain and specifically, mobilization techniques for sciatic nerve compression and the decrease of mechanosensitivity of the nervous system, as well as improving the compliance of nerve tissues, relieving low back pain[20]. Further, these mobilization techniques relieve the damaged sciatic nerve structure and improve range of motion in the joint structure. Applying tension to the nervous system during sciatic nerve mobilization techniques leads to a decrease of the cross-section of the nerves, which in turn causes obstruction at the level of the small blood vessels that cross the epineurium. This process leads to the volume of blood adjusting to the nerve fibers. These processes in turn affect the axonal transport system. Moreover, by increasing the flexibility of the shortened nerves and by surrounding the joint structures, we end up with increased muscle strength. Under these conditions,the main aim of improving flexibility of sciatic nerves is to decrease the mechanosensitivity of the nervous system, which in turn amplifies compliance of the nerve tissues[21].

New treatment approaches, including extracorporeal shockwave therapy (ESWT), have recently been implemented in the management of CLBP with radiculopathy[12]. Minimal evidence in the use of radial extracorporeal shock wave therapy in CLBP with radiculopathy is available. In ESWT, extracorporeal shockwaves are applied to particular lesions to activate revascularization and stimulate the process of connective tissue generation and healing of the bone. The pain is removed, and the function is improved.

ESWT plays an important role in pain relief and muscle strength improvement through appropriate motor simulation of the muscles and tendons with extracorporeal shockwaves. Although Radial Extracorporeal Shock Wave Therapy (rESWT) is presently used to treat diseases of the musculoskeletal system, few studies have examined the effect of rESWT on CLBP.

Therapeutic exercise for LBP has changed over time. It has to date focused on exercises that plan to keep stability in the lumbar area (Dagenais et al, 10). In the literature, this approach has been termed *segmental stabilization*, *lumbar stabilization*, or *core stabilization* exercises. However, the definition of lumbar stabilization exercises (LSE) is still unclear.

The purpose of LSE is to improve the neural and muscular control of the central musculature while maintaining stability in and around the spine and trunk. The muscles that are usually targeted are transversus abdominis (TrA), lumbar multifidus, and other paraspinal, abdominal, diaphragmatic, and pelvic musculature.

LSE is commonly used in clinical practice. Consequently, it is necessary to critically investigate the evidence of their efficacy in patients with CLBP with radiculopathy. Thus, this paper aims to find out the combined effectiveness of neural mobilization with lumbar stabilization exercise and radial extracorporeal shock wave therapy with lumbar stabilization exercise in the management of chronic low back pain with radiculopathy.

## METHODOLOGY

### Design

A randomized clinical control trial was conducted in the North West area of Saudi Arabia (Figure 1).

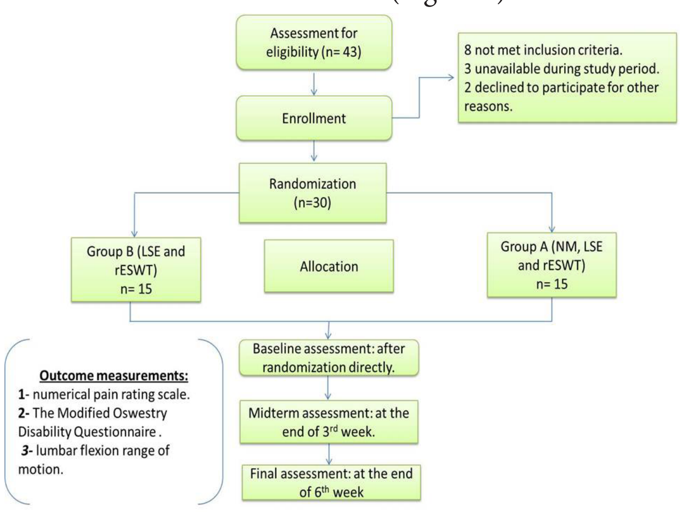


**Figure 1:** Flow chart of study and participant recruitment.

**Sample:**

Thirteen patients diagnosed to have CLBP with radiculopathy at three different hospitals in Saudi Arabia were recruited for this study. Exclusion criteria comprised: 1) subjects who had continuous pain with a score above 5 on the Visual Analogue Scale (VAS), 2) age ≤ 18 years, 3) those who had already received physical therapy treatment in the past 6 months, and 4) subjects who had undergone previous surgery, and suffer from structural anomalies, spinal cord compressions, severe instabilities, severe osteoporosis, acute infections, severe cardiovascular or metabolic diseases, expecting mothers, and those with a body mass index above 30kg/m2. All participants provided an informed written consent, as approved by the ethical codes of research of the University of Tabuk-Saudi Arabia.

**Interventions:**

Participants were randomly assigned into treatment (n=15), or control group (n=15). All participants were outpatients. Before starting the study, the author designed the treatment and control group treatment programs and instructed the treating physiotherapists in their implementation. Ethical approval was approved by the University of Tabuk-Saudi Arabia. Participants in each group received 12 treatment sessions of 45 minutes each, two days a week, for six consecutive weeks.

For each group, a menu of lumbar stabilization programs was designed. This program included eight levels of exercise (single-leg knee-to-chest stretch, double-leg knee-to-chest, supine piriformis stretch, supine hamstring stretch, lower trunk rotation stretch, lumbar rotation stretch, pelvic tilt, pelvic tilt with alternating legs). Exercises were tailored for each ability and, if possible, progressed at each session, which lasted approximately 30 minutes. Every single exercise was repeated many times based on the patient's clinical condition. All sessions were provided by physiotherapists. After finishing a session of lumbar stabilization, shock wave therapy was applied to each participant in a prone position over the region of low back pain (Figure 2).

**Figure 2:** Duolith SD1 was used to administer the treatment for LBP with the patient in a prone position, 2000 (7 times per sec) shock wave impulses (5Hz) at an energy flux density of 0.10 mJ/mm2 were delivered using a 17-mm head.

Only participants in the treatment group received a neural mobilization technique. This includes the following: sciatic neural mobilization technique (Figure 3), slump neural mobilization technique (Figure 4) and self neural mobilization (Figure 5 ).

**Figure 3:** Sciatic neural mobilization. In a supine position, the leg was raised passively with knee extended with toes up (ankle dorsiflexion). This is performed by therapist.


**Figure 4:** Slump neural mobilization technique: A) Patient was asked to place his hand behind his back while neck flexion and chin to chest. Then B) Both knees are fully extended with toes up (ankle dorsiflexion).

**Figure 5:** Self neural mobilization: Participant was asked to place his hand behind his back. Then asked to extend his knee with toes up (ankle dorsiflexion).

**OUTCOME MEASUREMENT TOOLS:**

The three following outcome measures were used: pain, disability and lumbar spine range of motion. Subjects were tested three times, following this timeframe: at the baseline (0 weeks), at mid-treatment (3 weeks), and finally, at the end of treatment (6 weeks).

- ***Pain***

The pain was assessed by using NPRS, where 0 represents no pain, and 10 represents the worst pain possible, to indicate the intensity of pain in the lower back[22].

- ***Disability***

Disability was measured by using the Modified Oswestry Disability Questionnaire (MODQ), which is a self-rating questionnaire used to evaluate functional physical disability [23].

- ***Lumbar flexion range of motion***

The lumbar flexion range of motionwas measured by using modified Schober method[24].

## DATA ANALYSIS

A simple descriptive statistical analysis was adopted to describe the patient-specific demographic characteristics with respect to outcome parameters. Within-group and between-group comparisons were done with ANOVA and Scheffes' post-hoc tests by using SPSS 20.0.

## RESULTS

All 30 subjects completed the study protocol. Fifteen subjects completed the study in Group A (NM, LSE, and rESWT), and the other 15 subjects completed the study in Group B (LSE and rESWT). Group characteristics for patients at baseline are displayed in Tables 1 and 2.

Table 1: Subject characteristics ofthe group.

| Variable | Group A Mean±SD | Group B Mean±SD |
|---|---|---|
| Age | 52.27±14.30 | 54.87±14.53 |
| Marital status | 1.33±0.48 | 1.20±0.41 |
| Height | 1.82±0.07 | 1.78±0.09 |
| Weight | 75.93±11.25 | 76.07±14.23 |
| BMI | 22.89±3.84 | 23.86±3.26 |

**Table 2:** Frequency distribution of selected demographic variables.

| Variables | | Group A | Group B |
|---|---|---|---|
| Marital status | Married | 10 (66.7) | 12(80) |
| | Single | 5 (33.3) | 3(20) |
| Smoking | Yes | 7 (46.7) | 8(53.3) |
| | No | 8 (53.3) | 7(46.7) |
| Causative | Inflammation | 4 (26.7) | 2(13.3) |
| | Degeneration | 2 (13.3) | 1(6.7) |
| | Traumatic | 2 (13.3) | 5(33.3) |
| | Strain | 5 (33.3) | 7(46.7) |
| | Post lumbar surgery | 2(13.3) | 0(0) |
| Duration | 3-6 months | 9 (60) | 9(60) |
| | 6-12 months | 4 (26.7) | 3(20) |
| | < 12 months | 2 (13.3) | 3(20) |
| Past 12 months | 1 time | 5 (33.3) | 3(20) |
| | 2 times | 5 (33.3) | 5(33.3) |
| | < 2 times | 5 (33.3) | 7(46.7) |
| Pain radiating | Right | 3 (20) | 4 (26.7) |
| | Left | 4 (26.7) | 6 (40) |
| | Both | 5 (33.3) | 4 (26.7) |
| | None | 3 (20) | 1 (6.7) |
| Sleep pain | Yes | 11 (73.3) | 11 (73.3) |
| | No | 4 (26.7) | 4 (26.7) |

Table 3 presents data of the different outcome measures reported in each group for each data collection period (baseline, three weeks and six weeks) as mean and standard deviation (SD).

**Table 3:** Groups scores across all tested time points.

| Variables | Group A | | | Group B | | |
|---|---|---|---|---|---|---|
| | 0 Week Mean± SD | 3 Weeks Mean± SD | 6 Weeks Mean± SD | 0 Week Mean± SD | 3 Weeks Mean± SD | 6 Weeks Mean± SD |
| Pain score | 6.47± 1.06 | 4.87± 0.74 | 1.80± 0.67 | 6.20± 0.78 | 5.13± 0.74 | 2.87± 0.83 |
| Lumbar FROM | 2.87± 1.13 | 4.28 ± 1.21 | 7.12± 1.51 | 2.93± 0.99 | 3.67± 1.23 | 4.19± 1.05 |
| MODQ | 43.71± 3.16 | 31.12± 2.25 | 26.67± 3.30 | 44.66± 4.58 | 41.46± 3.99 | 39.20± 2.82 |

Results showed that the mean pain score, lumbar flexion range of motion (Lumbar FROM), and Modified Oswestry Disability Questionnaire (MODQ) were similar at baseline. The mean for pain score at the baseline period ranged from 6.47 to 6.20, for Lumbar ROM ranged from 2.87 to 2.93, whereas the mean for MODQ range from 43.71 to 44.66. However, during week three and week six collection periods, the mean values were 4.87 and 1.80 for the Group A, and 5.13 and 2.87 for the Group B. The mean values for the Lumbar ROM during week three and week 6 were 4.28 and 7.12 for Group A and 3.67 and 4.19 for Group B, while the mean values for MODQ during week three and week 6 were 31.12 and 26.67 for Group A and 41.46 and 39.20 for Group B.

The ANOVA table indicated that there was a significant difference between groups (Table 4). Significant differences occurred post-test compared to the pre-test for Group A for pain score (P=0.000). Lumbar FROM (P=0.000) and MODQ (P=0.000) at three different time points (0 weeks, three weeks and six weeks). Furthermore, Group B also showed significant differences between all variables (pain score P=0.000, Lumbar FROM P=0.012 and MODQ P=0.002).

**Table 4:** ANOVA showing the difference between time intervals in variables in Group A and B.

| Variables Sum of squares | | Group A | | | | Group B | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | df | Mean square | F (P value) | Sum of squares | df | Mean square | F (P value) | |
| Pain score | Between group | 168.711 | 2 | 84.356 | 118.625* P=.000 | 86.933 | 2 | 43.467 | 70.577* P=0.000 |
| | Within group | 29.867 | 42 | 0.711 | | 25.867 | 42 | 0.616 | |
| Lumbar FROM | Between group | 140.712 | 2 | 70.356 | 98.405* P=0.000 | 11.895 | 2 | 5.955 | 4.955* P=0.012 |
| | Within group | 69.897 | 42 | 1.664 | | 50.417 | 42 | 1.200 | |
| MODQ | Between group | 2344.993 | 2 | 1172.496 | 135.871* P=0.000 | 226.132 | 2 | 113.066 | 7.567* P=0.002 |
| | Within group | 362.438 | 42 | 8.629 | | 627.568 | 42 | 14.942 | |

Furthermore, a Scheffes' posthoc test was used in this study to find out whether this significant difference exists within the groups, by comparing the values of all variables at the different time intervals (Table 5).

**Table 5:** Scheffes' posthoc test revealing the mean differences of variables between time intervals in both groups.

| Variables | Mean Mean difference | | Group A | | Group B | |
|---|---|---|---|---|---|---|
| | | | Significant (P value) | Mean difference | Significant (P value) | |
| Pain score | Pre (0 week) | Mid (3 weeks) | 1.6000* | 0.000 | 1.0666* | 0.003 |
| | Pre (0 week) | Post (6 weeks) | 4.6666* | 0.000 | 3.3333* | 0.000 |
| | Mid (3 weeks) | Post (6 weeks) | 3.0666* | 0.000 | 2.2666* | 0.000 |
| Lumbar FROM | Pre (0 week) | Mid (3 weeks) | 1.4144* | 0.017 | 0.7333 | 0.199 |
| | Pre (0 week) | Post (6 weeks) | 4.2527* | 0.000 | 1.2533* | 0.012 |
| | Mid (3 weeks) | Post (6 weeks) | 2.838* | 0.000 | 0.52000 | 0.437 |
| MODQ | Pre (0 week) | Mid (3 weeks) | 12.589* | 0.000 | 3.2001 | 0.089 |
| | Pre (0 week) | Post (6 weeks) | 14.047* | 0.000 | 5.4633* | 0.002 |
| | Mid (3 weeks) | Post (6 weeks) | 4.4579* | 0.001 | 2.2641 | 0.287 |

Results showed that the mean difference in values of all variables in Group A, which was measured between the 0 week and 3 weeks, is found as significant (P<0.05). Furthermore, the mean difference measured between 3 weeks and 6 weeks, as well as 0 weeks and 6 weeks, is also significant (P<0.05) with respect to all variables in Group A. In Group B, the results revealed that the mean difference in the pain scale values between 0 week and 3 weeks is found as significant (P<0.05); also, the mean difference measured between 3 weeks and 6 weeks, as well as 0 weeks and 6 weeks is also significant (P<0.05). However, the mean difference of values taken only between 0 week and 6 weeks is found to be significant (P<0.05) with respect to Lumbar FROM and MODQ (Figure 6).

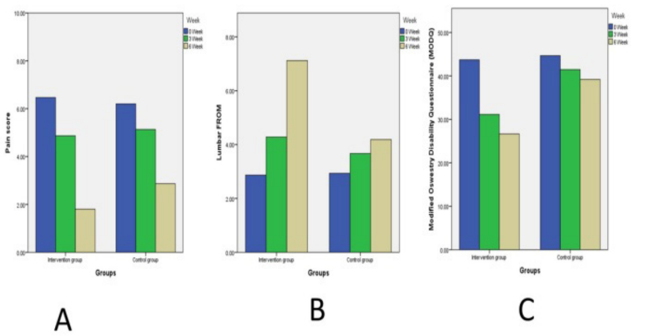


**Figure 6:** Pre (0 week), mid (3 weeks), post (6 weeks) treatment of outcome measurement tools (A: pain, B: lumbar ROM and C: disability) between control and intervention groups at different time intervals.

## DISCUSSION

In this study, two combination types of therapeutic interventions (NM, LSE with rESWT and LSE with rESWT) were chosen for the management of CLBP with radiculopathy within the framework of these principles. The analysis highlighted no statistically significant differences found between the two study groups in pre-treatment assessments. This indicates that the patients in the two groups were homogenous. Evidence shows that NM interventions, whether or not used in combination with other treatments, successfully decreased pain level and disability in people with CLBP [25]. The author intended to study the combination of therapeutic modalities and exercises in the management of CLBP with radiculopathy.

The authors gave explanations for the improvement of pain level, and functional disability once using neural mobilization and referred this to the alteration of mechanical properties of peripheral nerves and the direct effect of this alteration on nerve physiology[25,26]. Because of disc herniations, compression of the nerve root hindered the blood flow of the nerve root. This alteration of the microcirculation of the nerve leads to pain and release of inflammatory mediators[27,28]. In this study, NM techniques play a vital role in the management of CLBP with radiculopathy. The study results are consistent with those that mention that compromised compression and microcirculation of the nerve root, and pressure on the nerve will affect oedema and demyelination[29]. Neural mobilization techniques of short oscillatory movements were enough to disperse oedema, thereby alleviating hypoxia and reducing associated symptoms. The study suggested that N.M. techniques would be useful in treating low back and lower extremity pain and associated neural tension dysfunction[30].

One study[31] that suggested lumbar radiculopathy (L.R.) showed a favorable outcome after N.M.was not consistent with this study. The authors explain that N.M is not the best choice for L.R., as it would further aggravate an already compressed, hypoxic and oedematous nerve root. However, they don't comment on the positive effects of N.M. on compressed, hypoxic and oedematous peripheral nerves. It is difficult to determine whether the difference can be explained by a lack of perineurium.

In the present study, radial extracorporeal shockwave therapy (rESWT) likely reduced CLBP with radiculopathy. This result was consistent with what other studies specified that ESWT reduced its' interference with the signals coming from the muscles and the sensory organs. This process consequently improves the active ranges of joint motion. As a result, the ranges of joint motion showed improvement, while the weight shift distances increased[32,33].

In this study, the Lumbar Stabilization exercises (LSE) added additional benefits in the treatment of CLBP with radiculopathy in both Group A and Group B. The study results were consistent with other findings [34]. The current evidence stated that LSE was an effective way to reducing pain in people suffering from CLBP. However, other findings suggested that LSE is not more effective than manual therapy in the treatment of CLBP [34].

It should be noted that in both Group A and Group B, there is a considerable improvement in the outcome measurement such as pain scale, disability and lumbar flexion range of motion in CLBP with radiculopathy. When comparing baseline, three weeks and six weeks, there is a significant improvement in back pain in all time periods and within the groups in Group A, whereas, in Group B, there is no significant difference in baseline, three weeks and six weeks. However, when comparing the baseline with the six-week mark, there is a significant improvement in CLBP with radiculopathy. Several interventions, such as neural mobilization, extracorporeal shock wave therapy and lumbar stabilization techniques are used to treat people with CLBP, but with limited evidence regarding its combined treatment effectiveness. This is the first study to compare the combined efficiency of NM and rESWT with LSE. However, the effect of these measures is to be tested in a large sample study.

## CONCLUSION

This study was conducted to investigate the effects of the application of neural mobilization techniques and radial extracorporeal shock wave therapy with lumbar stabilization exercise for six weeks in chronic low back pain with radiculopathy. Based on the results of this paper, application of neural mobilization techniques and radial extracorporeal shock wave therapy with lumbar stabilization exercise have a strong effect on chronic low back pain with radiculopathy concerning pain intensity, lumbar flexion range of motion, and back disability.

Conflicts of interest

The author declared no potential conflicts of interest to the research, authorship, and publication of this article.

Acknowledgment

The author would like to thank the physiotherapists at the neurorehabilitation units in Saudi Arabia, for their participation in this study. Also, I would like to thank the University of Tabuk –Saudi Arabia- for its generous support.

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