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Effect Of Neurodynamic Moblization On Pain And Functional Abilities In Patients With Chronic Discogenic Sciatica

Shimaa Mohamed Abdelmageed[1], Asmaa Ahmed Ibrahim[2], Wael Mahmoud Ezzat[3], Mohamed Helayel Marzouk[4]

[1] Assistant professor of Physical Therapy for Neurology and Neurosurgery, Faculty of Physical Therapy, Cairo University.
[2] Teaching assistant, Department of Neurology and Neurosurgery, Faculty of Physical Therapy, Sinai University.
[3] Lecturer of Neurology Faculty of Medicine, Cairo University.
[4] Lecturer of Physical Therapy for Neurology and Neurosurgery, Faculty of Physical Therapy, Cairo University.
EMAIL: asmaaah259@gmail.com

Abstract:

Background: Sciatica is a medical term that describes a sensation of burning, tingling and numbness experienced in the buttock, thigh, leg as well as foot.

Objective: The purpose of this study was to examine the impact of adding neurodynamic mobilization to a conventional therapy program on leg pain intensity, hip range of motion (ROM) as well as functional abilities in patients suffering from chronic unilateral discogenic sciatica.

Methods: Forty-four male lumber radiculopathy patients were randomized into two equivalent groups. Control group (G1) was treated by conventional physical therapy program that includes therapeutic strengthening exercises (back extension exercise and prone hip extension exercise) and electrotherapy (transcutaneous electrical nerve stimulation and ultrasound). The study group (G2) was treated by conventional physical therapy program in addition to neurodynamic mobilization from different positions (sliding and tensioning techniques). The duration of each session was 45 minutes, three times per weeks (day after day) for four weeks. Pre and post treatment evaluation was done for all Variables in both groups. Sciatic Pain intensity was measured by Sciatica Bothersomeness Index, hip range of motion was measured by straight leg raising and functional abilities were assessed by Roland- Morris Disability Questionnaire.

Results: Post treatment, a statistically significant difference was observed in the study group (G2) compared to the control group (G1), in the following variables (hip ROM , sciatic pain intensity and functional abilities) with a p-value of less than 0.05.

Conclusion: This study showed that the neurodynamic mobilization has a better effect on decreasing discogenic pain intensity, improving hip range of motion and function abilities in patients with chronic unilateral discogenic sciatica.

Keywords: Sciatica, Neurodynamic, Lumber radiculopathy.

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INTRODUCTION:

Lumbar radiculopathy is a discomfort in the lower back and hips that travels down the back of the leg. Disc protrusion presses on the spinal roots

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and raise the compression inside the intervertebral foramen. This causes tingling, radiating pain, numbness and paresthesia in the back and legs [(1)].

Radiculopathy may develops anywhere along the spine, the lower back (lumbar-sacral radiculopathy) is the most common site that develops manifestations. Fifty seven percent of patients who have low back pain develop sciatica. On average, lumbar radiculopathy is highly prevalent. In their lifetime, three to five percent of individuals will have symptoms [(2)].

Sciatica has a lifetime incidence ranging from 13% to 40%, making it a relatively common disorder. Its symptoms are described by a wide range of populations from 1.6% of the overall population to 43% of a specific working group. Men are more frequently affected than women [(3)]. Smoking, being obese, being physically active at work and heavy lifting and other forms of occupational stress are modifiable risk factors for sciatica. Additional risk factors for sciatica include lifting objects for non-occupational-related purposes, particularly with a bent back and straight knees [(4)].

Radiological evaluation (CT or MRI) in addition to a neurological evaluation and physical examination have confirmed the diagnosis of sciatica. When diagnosing sciatica or lumbar disc herniation, the most typical physical examination tool is the straight leg raising test (SLR). When the SLR causes pain that travels down the sciatic nerve beneath the knee at a hip flexion range of 30–70 degrees with the ankle dorsiflexed at the end of the test, it is regarded as positive test [(5)]. Ankle dorsiflexion can help distinguish between neurologic and musculoskeletal symptoms by lowering the SLR angle until the test becomes positive [(6)].

A neural tissue provocation test for evaluating patients with lower extremity and spinal pain, the Slump test has gained broad acceptance. It depends on reducing the anatomical distance over the body by taking slumped posture with the thoracolumbar spine and flexion of the cervical spine. Presence of neurological symptoms or positive indicators of sciatic pain means that the sciatic nerve, spinal cord or nerve roots are compressed [(7)].

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Treatment of discogenic sciatica by physical therapists encompasses a broad spectrum of techniques. Electrotherapy, directed exercises**,** spinal manipulation and lumbar stabilization exercises are the main stays of discogenic sciatica treatment [(8).] As a manual therapy approach, neural mobilization (NM) is recommended for relief of pain and improvement of disability in these patients. Neural mobilization improves nerve gliding and reduces neural mechanosensitivity by using a specific sequence of joint motions that mobilize the peripheral nerve affected [(9)].

But in our study, we focused on investigating the outcomes of adding NM to the conventional physical therapy on pain, hip ROM and functional abilities among patients suffering from chronic unilateral discogenic sciatica.

MATERIAL and METHODS

Study design:

A pre and post-test randomized control trial. It was conducted in the physical therapy out-patient clinic of AL-AHRAR Teaching Hospital and El-Zigzag hospitals From **(September/2023 to March/2024).** The study got approval by the Egyptian university's ethical review board for the physical therapy program at Cairo University (registration approval number: **P.T.REC/012/004903)**. To take part in this study, patients were asked to fill out a written consent form.

Sample size:

Using the following equation $\mathbf{N} = \frac{(Z_\alpha)^2 * (S)^2}{(d)^2}$ according to (Charan and Biswas, 2013).N= total sample size.Z_α= Is Standard normal variation and it is equal 1.96 at P<0.05 .SD= standard of variables and it is equal 3.6. d= Absolute error or precision. Total sample size N= $\frac{(1.96)^2 x (3.6)^2}{(2.5)^2}$ =19.9 ≈ 20 patients. We expected a considerable difference between the groups, and the results showed that N=40. 20 patients for each group with total sample size for all groups equals 40 patients. Following this to compensate for potential incidences of individuals dropping out during follow-up, the

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sample size was raised to 44. With twenty-two people divided equally among the two groups.

Participants: Forty-four male patients were diagnosed with lumber radiculopathy by neurologist and referred to physiotherapy out patient's clinic of AL-AHRAR hospital and El-Zigzag hospitals**.** Participants in the current study had lumber disc prolapse (L5, S1) and were between the ages of 35 and 45. Results from the Slump test and the SLR were all positive, suggesting that symptoms deteriorated during these tests.

The inclusion criteria for this study:

All the patients diagnosed as lumbar radiculopathy (L5-S1) for at least six months. Radiography (CT or MRI) as well as a physical examination (including tests of motor and sensory abilities and reflexes) confirmed the diagnosis. All patients had second grade of disc bulge which was detected from T2 axial view of MRI [(10)]**.** All patients had unilateral radiculopathy and pain in the distribution of sciatic nerve. Their age ranged from 35 to 45 years [(11)]. Their body mass index ranged from (22-25 kg/m2 [(12)].

The Exclusion criteria:

This study excluded the patients who had disc prolapse on both sides or at several levels, radiating discomfort on both sides, pain that lasts shorter than three months was considered acute pain, an active infection was present in the lumbar spine, any additional abnormalities of the spine. The patients who had cauda equine syndrome, neoplastic and narrowing of the spinal canal were also excluded.

Procedures:

1- Assessment**:**

1- pain assessment :

A-1 Pain pressure threshold Algometer: All the patients' Pain were assessed by using pressure pain threshold with the help of this algometer which provides visual feedback in real-time. While set and monitor the applied pressure rates at the beginning and the end of treatment sessions. The pressure was maintained and progressively raised until the patient felt pain and asked to "STOP".

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B-1 Sciatica Bothersomeness Index: The patient's reported symptoms to indicate the difficulty of living with sciatica. The patient's perception of the severity of sciatica symptoms [(13)].

2-Hip ROM assessment: By unilevel inclinometer a fluid type was use for measuring angle of hip flexion during straight leg raisin**.**

3-Functional abilities assessment: Functional abilities was assessed by Roland-Morris Disability Questionnaire, 136-item Sickness Impact Profile (SIP) which evaluates mental and physical health in its whole disability due to pain. In the 24-item RMQ, a patient-reported outcome measure .The RMQ may take a total score between 0 and 24; higher scores indicate more severe pain-related impairment. Items are scored 0 when left blank and 1 when approved [(14)]**.**

Outcome measures:

The 1st measurement was taken before the intervention began and the 2nd was taken four weeks later. The primary outcome measures are pain, hip ROM and functional abilities.

2-Interventions:

The patients in the control group (G1) were treated by conventional physical therapy program that includes therapeutic strengthening exercises (back extension exercise and prone hip extension exercise) and electrotherapy (transcutaneous electrical nerve stimulation and ultrasound)

Ultrasound therapy application: It was applied for five minutes with continuous mode on low back area. Frequency is 1 MHz and power was 1.5 watt/cm². Acoustic gel was used as occupying medium. It was applied for three times per week for one month. Phyaction 190 serial number 2745, 230 v / 300MA / 50-60 Hz [(15)].

Transcutaneous electrical nerve stimulation (TENS): It was applied for 20 minutes, three times per week for one month. The patient laid prone and electrodes were placed, one electrode on each side of low back area. Apparatus phyaction 787 made in Netherland 230 v / 300MA / 50-60 Hz [(16)]**.**

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The patients in study group (G2) were treated by conventional physical therapy program in addition to sciatic nerve neural mobilization, sliding technique followed by tension technique. The time of sliding technique for each movement performed three sets, each set form of 10 repetitions with rest approximately 10 seconds in between them. And the time of tension technique hold for 15secs, each movement was performed three sets, each set consisted of 10 repetitions with rest approximately 10 seconds between sets [17].

Treatment session was done for both groups three sessions per week, day after day for one month. The time of each session was 45 minutes. Pre and post treatment evaluation was done for all the patients in all the following variables pain intensity, hip ROM during SLR and functional abilities.

Results:

We used IBM SPSS software package version 20.0 (IBM Corp. Released 2017) to analyze the data that was fed into the computer. IBM Corp., Armonk, New York, USA: IBM SPSS Statistics for Windows, Version 25.0. Numbers and percentages were used to describe the qualitative data. The distribution was checked for normality using the Shapiro-Wilk test. Range (including minimum and maximum), mean, standard deviation, median as well as interquartile range (IQR) were used to represent quantitative data. The results were considered statistically significant at the 5% level.

For categorical variables, the chi-square test was applied for group comparisons. When over 20% of cells have predicted more than 5 chi-square values, the Monte Carlo method corrects for it. To determine whether the difference between the two groups' means was statistically significant, the Student T Test was employed. To determine if there was a statistically significant difference in a non-parametric variable between the two groups of participants, the Mann Whitney U test was utilized.

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For comparing related samples, the dependent student t-test is utilized. Two matched samples were compared using the Wilcoxon Rank test. A model that predicts the value of a dependent variable using two or more independent variables is known as multiple linear regression. When comparing related samples, matched samples or a single sample with repeated measurements to see if their population means differ, the Wilcoxon Rank test was utilized.

Table 1. Demographic and clinical characteristics of the study groups

		Group (1) Control group (N= 22)		Group (2) Neurodynamic group (N= 22)		p- value
		N	**%**	**N**	**%**	
Age (years)	**Mean± SD**	40.95± 5.40		41.0± 5.57		0.978
BMI (Kg/m2)	**Median (IQR)**	24 (23.5- 25)		24 (23.4- 25)		0.962
Duration of illness (months)	**Median (IQR)**	7 (6- 8)		7 (6- 8)		0.128
Affected side	**Right side**	3	13.6%	5	22.7%	0.698
	Left side	19	86.4%	17	77.3%	

*p≤0.05 is significant, **p≤0.01 is highly significant, SD: standard deviation, IQR: Inter-quartile range analysis done by Independent Samples T test, Mann-Whitney U test and Chi-Square test.

Table (2): Range of motion assessment of straight leg raise (SLR) among the studied groups before and after the treatment sessions.

SLR (hip joint)		**Group (1) Control (N= 22)**	**Group (2) Neurodynamic (N= 22)**	**Test value**	**P-value[a]**
Before 1st session	**Mean± SD**	55.86± 4.94	54.27± 6.42	t= 0.922	0.362
	Range	48- 66	45- 63		
After 4 weeks (12 sessions)	**Mean± SD**	64.14± 5.84	82.64± 3.39	t= 12.85	**<0.001****
	Range	55- 75	75- 88		
Test value (t)		15.57	29.6		
P-value[b]		**<0.001****	**<0.001****		

*p≤0.05 is significant, **p≤0.01 is highly significant, SD: standard deviation, [a]Analysis done by Independent Samples T test, [b]Analysis done by Paired t Test

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By comparing the two groups we found that there was no significant difference regarding straight leg raise (SLR) before the 1st session ($p>0.05$) whereas a significant difference between them was found after 4 weeks (12 sessions) ($p<0.001$) as range of motion by SLR was significantly higher in Neurodynamic group compared to control group. In addition, when the effect of time was compared in each group, the results showed significant improvement (increase) in range of motion by SLR after 4 weeks (12 sessions) than before the 1st session in both Neurodynamic and control groups ($p<0.001$).

Table (3): Assessment of Sciatica Bothersomeness Index (SBI) score *among the studied groups before and after the treatment sessions*

SBI Score		**Group (1) Control group (N= 22)**	**Group (2) Neurodynamic group (N= 22)**	**Test value**	**P-value[a]**
Before 1st session	**Median (IQR)**	20 (15- 22)	21 (17- 23)	Z_{MWU}= 1.189	0.235
	Range	9- 22	14- 23		
After 4 weeks (12 sessions)	**Median (IQR)**	16 (13- 20)	4 (3- 9).	Z_{MWU}= 5.588	**<0.001****
	Range	10- 20	2- 10		
Test value (z)		4.013	4.114		
P-value[b]		**<0.001****	**<0.001****		

*p≤0.05 is significant, **p≤0.01 is highly significant, SD: standard deviation, [a]Analysis done by Mann-Whitney U test, [b]Analysis done by Wilcoxon signed rank Test

By comparing the two groups we found that there was no significant difference regarding SBI total score before the 1st session ($p>0.05$) whereas a significant difference between them was noticed after 4 weeks (12 sessions) ($p<0.001$) as neurodynamic group showed significant decrease in SBI total score (improvement sciatica symptoms) in comparison to control group.

Furthermore, when the effect of time was compared in each group, the results showed significant decrease in SBI total score (improvement of sciatica symptoms) after 4 weeks (12 sessions) than before the 1st session in the two groups ($p<0.001$).

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Table (4): Roland- Morris Disability Questionnaire (RMQ) score among the studied groups before and after the treatment sessions

Roland- Morris Disability Questionnaire		Group (1) Control group (N= 22)	Group (2) Neurodynamic group (N= 22)	Test value	P-value[a]
Before 1st session	**Median (IQR)**	13 (10- 15)	12 (11- 16)	Z_{MWU}= 1.106	0.309
	Range	9- 19	6- 20		
After 4 weeks (12 sessions)	**Median (IQR)**	12 (7- 14)	2 (1- 3)	Z_{MWU}= 5.715	**<0.001****
	Range	7- 15	0- 5		
Test value (z)		4.164	4.121		
P-value[b]		**<0.001****	**<0.001****		

*p≤0.05 is significant, **p≤0.01 is highly significant, SD: standard deviation, [a]Analysis done by Mann-Whitney U test, [b]Analysis done by Wilcoxon signed rank Test.

By comparing the two groups we found that there was no significant difference regarding RMQ score before the 1st session (p>0.05) whereas a significant difference between them was noticed after 4 weeks (12 sessions) (p<0.001) as RMQ score was significantly lower (means lower rate of pain-related disability) in neurodynamic group compared to control group.

Furthermore, when the effect of time was compared in each group, the results showed significant decrease in RMQ score (means lower rate of pain-related disability) after 4 weeks (12 sessions) than before the 1st session in the two groups (p<0.001).

Discussion:

The purpose of this research was to determine the impact of NM to improve pain levels, functional abilities as well as ROM in patients suffering from chronic unilateral discogenic sciatica. All variables were assessed as follows; hip range of motion by straight leg raising test, pain intensity by Sciatica Bothersomeness Index and functional abilities by Roland-Morris Disability Questionnaire. Post treatment, there was a statistically significant difference between the two groups in all assessed variables (p< 0.05) .

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Both the control group (G1) and the study group (G2) showed statistically significant differences in all variables between the pre- and post-treatment, favoring the study group (G2). Neurodynamic group (G2) revealed significant decrease in the sciatica symptoms and lower rate of pain-related disability and increased the total hip ROM.

When treating patients with chronic unilateral discogenic sciatica, NM have been shown to improve dermatomal somatosensory evoked potential greater than a conventional physiotherapy program alone [(18)]. Additionally, it was discovered that the slider approach improved mobility of the hips, knees and back more than the tensioner technique in ROM [(19)].

A major goal of neural mobilization in hip ROM is restoring the dynamic balance between movements of neural tissues and surrounding mechanical interfaces. Passive mobilization of limb nerve structures also aims to achieve this goal [(20)]. Neural tensioner is to promote the smooth motion of neural structures throughout the surrounding tissues.It uses the simultaneous lengthening and shortening of nerves at two joints (hip and knee joints) to increase flexibility [(21)].

By returning the nervous system to its normal physiological state, neurodynamic techniques have shown promising clinical benefits in the treatment of a wide range of diseases, removing inflammatory exudates and facilitation of tissue oxygenation. Contrarily, tensioner approaches are utilized to cause viscoelastic, movement-related as well as physiological responses inside different brain tissues. The neural tissues are subjected to tension by extending the distance between the nerve's terminals [(22)].

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According to this study's findings that the neurodynamic group showed significant decrease in SBI total score (improvement sciatica symptoms) compared to control group. Neurodynamic mobilization showed that it was efficient in alleviating pain and restoring sciatic nerve mobility in the treatment of chronic unilateral discogenic sciatica [(23)].

Prolonged movements of Neurodynamic mobilization strategies decrease edema by diffusing fluid within the nerve axon and alleviated hypoxia. This leads to reduction in symptoms when the pain is the primary symptom of a neurological disorder [(24)]. Slider procedures (by applying pressure to the proximal attachment and releasing it at the distal root) cause less pressure than the tensioner methods (mobilizing the nerve across both its proximal and distal attachments) [(25)].

The study's findings that RMQ score was significantly lower (lower rate of pain-related disability) in neurodynamic group compared to control group. Neurodynamic increased ROM in subjects with and without pathology lead to systemic alterations including enhanced strength, endurance and fatigue recovery. Additionally, it has demonstrated beneficial effects on a functional level by enhancing postural control and decreasing impairment in the affected extremities [(26)].

The impact of stretching exercises, neurodynamic mobilization techniques (both slider and tensioner) treatment for chronic unilateral discogenic sciatica were demonstrated in a comparative study. Neurodynamic mobilization was found to be beneficial in relieving pain and restoring sciatic nerve mobility in cases of discogenic sciatica [(27)]. The symptoms and dysfunctions were further decreased by the use of

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neurodynamics mobilization strategies that effectively reduced edema and alleviated hypoxia [28].

Moksha et al, compared the effectiveness of the slider and tensioner neurodynamic mobilization techniques combined with home exercise program on 60 patients with Non-specific LBP associated with radicular lower limb symptoms. He founded that both techniques have better positive effects on reducing pain intensity, increasing hip flexion ROM, and improving functional disability with more significant effect for the slider neurodynamic mobilization technique in all outcomes measured. Mok [29].

Seven studies reported a statistically significant improvement by using neurodynamics mobilization in pain and other outcome measures ($p \leq 0.05$), while one study did not report a p-value [11]. Moreover, two studies compared two techniques of NM, slider and tensioner NM techniques and reported statistically significant results [30].

Limitations OF the study:

This Study was limited by some patients may not able to understand the instructions due to the difference of cognitive and mental function between each other. Some patients were not well educated and this made some difficult while filling the scales. An effort was made to minimize the effect of the possible error. Neurodynamic is not appropriate for all patients with complex nerve symptoms.

Conclusion:

This study showed evidence that neurodynamics mobilization has a better effect on improving patient's symptoms, including hip range of

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motion, pain and function abilities on patients with chronic unilateral discogenic sciatic.

Conflict of interest:

There were no conflicting interests.

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