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EFFECTS OF NEURAL MOBILIZATION VERSUS EFFECTS OF CORE STABILIZATION EXERCISES ON PAIN AND FUNCTIONAL DISABILITY IN SUBJECTS WITH LUMBAR RADICULOPATHY

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ABSTRACT

Background: Lumbar radiculopathy is a condition characterised by irritation, inflammation, or compression of nerve roots in the lower back, causing pain, numbness, or weakness that radiates down the leg. Both men and women are affected and its prevalence has been estimated between 3% and 5% of the population. Age is the main risk factor. Men are usually impacted in their 40s while women are affected in their 50s and 60s. Symptoms usually start in midlife. Neural mobilization is a therapeutic technique that involves applying mechanical forces to nerves in the body to promote healthy movement and function. Core stabilization exercises strengthen the muscle in core which includes lower back, abdomen, hips and pelvis. These exercises help to maintain balance and stability.

Aim: This study is aimed to investigate the effects of neural mobilization versus effects of core stabilization exercises on pain and functional disability in subjects with lumbar radiculopathy.

Methodology: The subjects were selected based on the selection criteria. The inclusion criteria were: individuals diagnosed with lumbar radiculopathy, both men and women, aged between 40 and 65 years, radiological findings of lumbar disc herniation or degeneration, back pain radiating into the lower extremity, reproduction of symptoms with passive straight leg raise (PSLR) or slump test, either one or both legs affected by radiating pain, and an NPRS score between 5 and 10. The exclusion criteria were: individuals above 65 years of age, any post-surgical cases, trauma, pregnancy, serious spinal conditions (e.g., infection, tumor, osteoporosis), severe cognitive impairment, uncooperative patients, and NPRS score less than 5. Thirty subjects were selected and randomly divided into two groups, with 15 subjects in Group A and 15 subjects in Group B. Group A received neural mobilization, while Group B received core stabilization exercises, along with conventional physiotherapy for both groups. Each group received training for five sessions per week for two weeks.

Result: Both neural mobilization and core stabilization exercises significantly reduced pain and disability in lumbar radiculopathy patients. However, core stabilization exercises produced far greater improvements, with a mean Numerical pain rating scale (NPRS) reduction of 4.80 versus 1.00 in neural mobilization and Modified Oswestry disability index (MODI) reduction of 34.53 versus 3.47 in core stabilization. Between-group comparisons confirmed these differences were highly significant ($p < 0.001$), with core stabilization group leading.

Conclusion: The study concludes that while both neural mobilization and core stabilization exercises are effective in managing lumbar radiculopathy, core stabilization exercises demonstrate superior outcomes. They

provide greater pain reduction, functional improvement, and long-term benefits compared to the short-term relief offered by neural mobilization.
Keywords: Lumbar radiculopathy, neural mobilization, core stabilization exercises, Numerical Pain Rating Scale, Modified Oswestry Disability Index.

INTRODUCTION:

Lumbar radiculopathy is a condition characterized by irritation, inflammation, or compression of nerve roots in the lower back, causing pain, numbness or weakness that radiates down the leg[1]. Both men and women are affected and its prevalence has been estimated between 3% to 5% of the population. Age is the main risk factor. Men are usually impacted in their 40s, while women are affected in their 50s and 60s. Symptoms usually start in midlife[1]. In the 21st century, life has become more sedentary and technology-driven, leading to less physical activity and more desk jobs. Among the working population, 12.9% experience radicular lower back pain, with 11% attributed to lumbar radiculopathy[2]. In the case of lumbar radiculopathy, this compressive force may occur within the dural sac, as the nerve root exit the dural sac within the lateral recess, as the nerve root transverses the neural foramina or even after the nerve root as exited the foramina. It may be related to disc bulging or herniation, ligamentous hypertrophy, spondylolisthesis, or even neoplastic and infectious processes[1].

Neural mobilization refers to the therapeutic practice of applying mechanical forces to nerves in the body, with the goal of restoring healthy movement[2]. The nervous system functions as a continuous structure, moving and sliding within the body as the person move, with this motion closely linked to essential physiological processes. Neural mobilization involves moving the nerve through the surrounding tissue both proximally and distally to its fullest extent by mobilizing each joint and body part the nerve passes through. The process resembles stretching a cord at one end while keeping the other end loose, then reversing the direction. Neural mobilization puts tension on the tissue, actively lengthens it and breaks scar tissue bonds, release tension in the nerve[4]. The difference between slider and tensioner exercise in the method of application may result in different responses. Sliders help reduce pain and improve nerve movement, while tensioners enhance the viscoelastic and physiological function of neural structures[2].

Core stabilization exercises are type of exercise that strengthens the muscles in core, which includes lower back, abdomen, hips, and pelvis. These exercises help to maintain balance and stability, which are important for many physical activities[5]. It strengthens and coordinates muscles to enhance spinal support and reduce pain. Strengthening the core muscles can relieve strain on damaged nerve roots, reducing pain and discomfort associated with lumbar radiculopathy[3].

NEED OF THE STUDY

Although both neural mobilization and core stabilization exercises have been shown to individually affect subjects with lumbar radiculopathy, no study has directly compared these two treatment approaches. Therefore, this study aims to compare neural mobilization and core stabilization exercises, exploring their impact on pain reduction and functional disability. This will provide the physical therapists with a better choice of treatment to be incorporated in patients with lumbar radiculopathy.

METHODOLOGY

Study Design: Comparative study
Sampling Technique: Convenient Sampling method
Sample Size: 30 samples
Sample Settings: OPD, Department of Physiotherapy, Dr. B. R. Ambedkar Medical College and Hospital

• Inclusion criteria:

1. Individuals diagnosed with lumbar radiculopathy.
2. Both men and women.
3. Age group around 40 to 65 years.

4. Radiological findings of lumbar disc herniation or degeneration, back pain radiating down into lower extremity, reproduction of symptoms with passive straight leg raise (PSLR) or slump test.
5. Either one or both legs affected by radiating pain.
6. NPRS Score between 5-10.

• Exclusion criteria:

1. Above 65 years old.
2. Any post- surgery, trauma, pregnancy.
3. Serious spinal conditions e.g infection, tumor, osteoporosis.
4. Severe cognitive impairment.
5. Uncooperative patients.
6. NPRS Score less than 5.

Outcome Measures:

Numerical Pain Rating Scale- NPRS
Modified Oswestry Disability Index- MODI

Procedure:

The subjects were selected based on the selection criteria. Then, 30 subject were selected and they were randomly divided into two group. 15 subjects were under Group A and other 15 subjects were under Group B. The group A received Neural mobilization and the group B received Core stabilization exercises along with conventional physiotherapy for both group A and group B. Each group received the training for 5 sessions per week for 2 weeks.

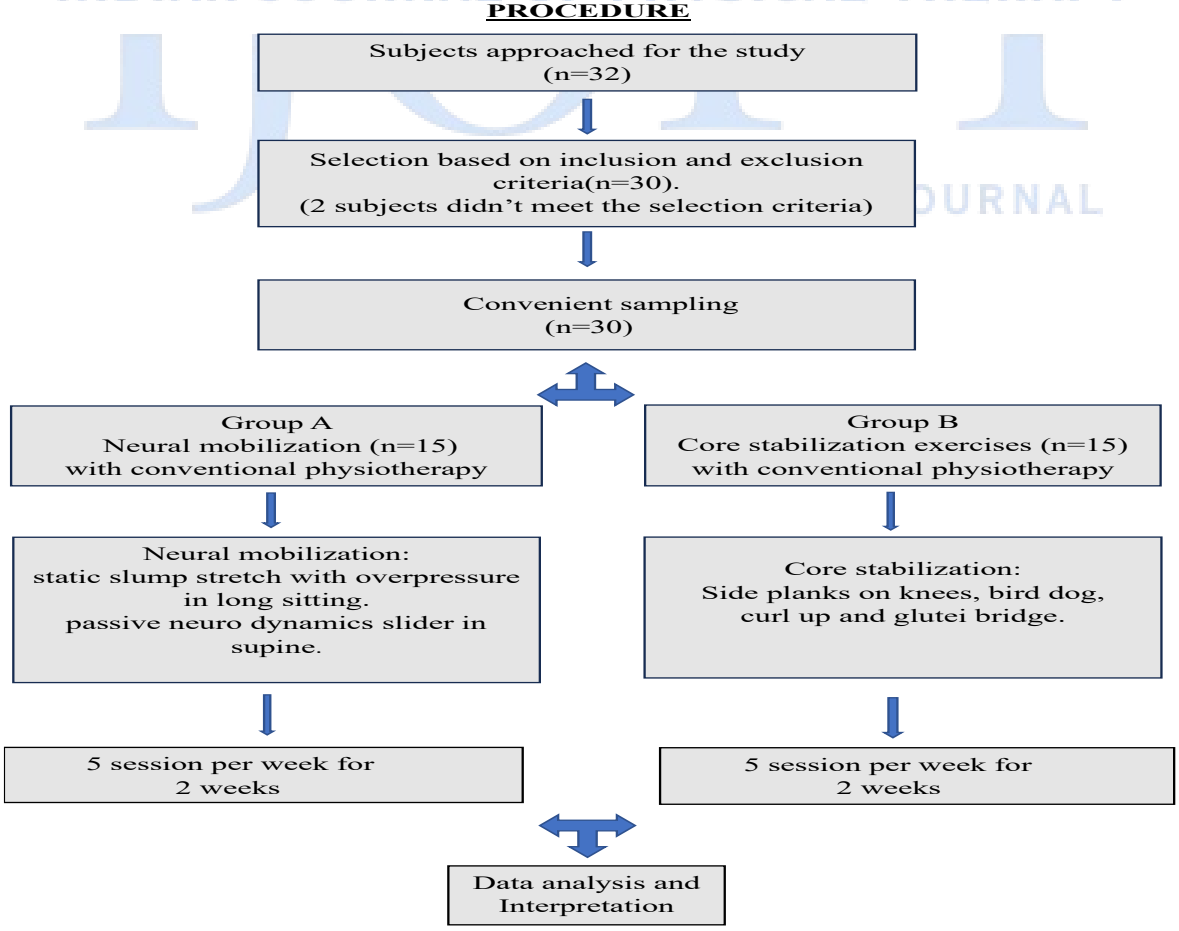
Neural mobilization:

TECHNIQUE 1	**TECHNIQUE 2**
Subject positioned in supine lying	Subject positioned sitting on chair or plinth
Therapist maintains cervical and thoracic spine in flexion	Subjects actively performs movements.
Begin alternating movements: hip flexion, knee flexion, ankle dorsiflexion.	Phase1: Knee bent backward under the plinth and head flexed downward. Phase2: Knee straightened on affected side and head extended backward
Movements performed in a controlled manner.	Movements continued until pain is felt. (do not push beyond pain limit).
Applied- 30 second hold 1minute rest	Applied- 5 sets x 15 repetitions with 1 minute rest between sets.
Repeat cycles. Total treatment time: 10 minutes per session	Repeat cycles. Total treatment time: 10 minutes per session

Core stabilization exercises:

Side plank on knees	Bird dog	Curl up	Gluteal bridge
The subject is instructed to sit on one hip, leaning on the side, and stacking the legs. The forearm is kept on the surface of the floor, when bend the elbow. Exhale to push the forearm into the floor and lift the hips into the air Inhale to lower the hips halfway. Exhale to lift the hips up again. Repeat 8-10 times, then inhale as the lower hips all the way down with control.	Begin on all four with the hands beneath the shoulders and the knees precisely beneath the hips. Aim for a neutral position in the spine. Exhale to draw the abdominal in and out. Without shifting the weight or arching the back, lift one leg behind and lift opposite arm in front. Breathe and hold the position for 3 slow counts. Inhale with control to return the leg and hand to the mat. Complete 6-8 repetitions and then repeat on the other side.	In a relaxed arm crossing. While keeping the head in line with the shoulder, instruct the subjects to contract the abdominal muscles and curl halfway up. 5 seconds of holding, roll out lie down. Repetition of 3 sets of 5.	The subject lie on the back on a stable bed with the legs straight and the hands by the sides. The subject lift the hips off the surface while keeping the back straight, then hold for 3 seconds. Then back to the beginning position. Until the set is finished, repeat the movement. Repeat 3 sets of 4 holding per set.

PROCEDURE



NEURAL MOBILIZATION

CORE STABILIZATION EXERCISES

DATA ANALYSIS

The statistical analysis was done using SPSS 23.0. The categorical variables were represented in frequency and percentage. Numerical variables were presented using mean and standard deviation. Pre post comparison was done using Paired sample t test. Comparison between groups was done using unpaired sample t test. A p value <0.05 was considered statistically significant.

Table 1: Showing mean and standard deviation of age in years in Group A(Neural mobilization) and Group B(Core stabilization exercise).

		N	Mean	Std. Deviation	t value	p value
Age	Group A	15	49.733	8.379	1.159	0.256
	Group B	15	46.733	5.509		

The mean age of participants in Group A was **49.73 ± 8.38 years**, while in Group B it was **46.73 ± 5.51 years**. The difference in mean age between the groups (**t = 1.159, p = 0.256**) was not statistically significant, indicating that the two groups were comparable in terms of age distribution.

Figure1: Representation of age in years in Group A (Neural mobilization) and Group B(Core stabilization exercise).

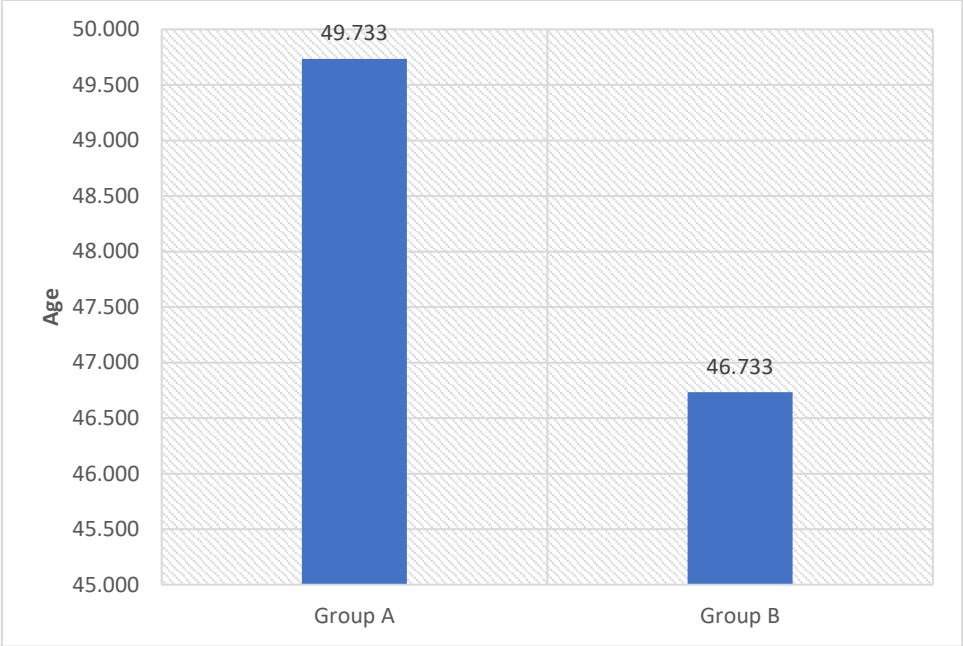


Table 2: Showing distribution of Gender in Group A(Neural mobilization) and Group B(Core stabilization exercise).

	Group	
Gender	Group A	Group B
Female	14	14
	93.3%	93.3%
Male	1	1
	6.7%	6.7%
Total	15	15
	100.0%	100.0%

In both Group A and Group B, the majority of participants were female (93.3%), while males constituted 6.7% in each group. The gender distribution was identical across the two groups.

Figure 2: Representing gender distribution in Group A(Neural mobilization) and Group B(Core stabilization exercise).

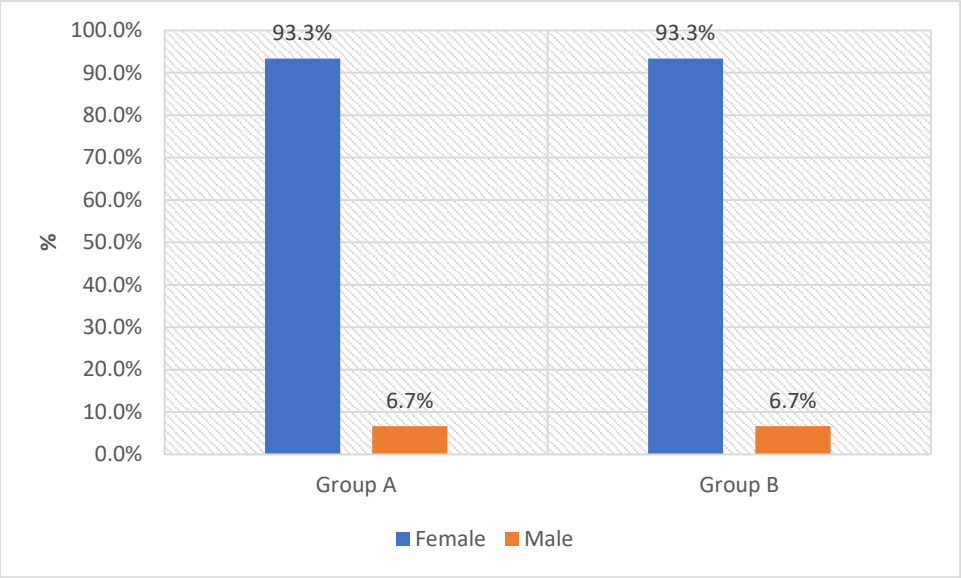


Table 3: Showing pre post comparison of NPRS in Group A (Neural mobilization).

Numerical Pain Rating Scale		Mean	Std. Deviation	Mean difference	t value	p value
Group A	Pre	7.667	1.113			
	Post	6.667	1.345	1.000	3.24	0.006

In Group A, the mean Numerical Pain Rating Scale score decreased from 7.67 ± 1.11 before the intervention to 6.67 ± 1.35 after the intervention, with a mean difference of 1.00. This reduction was statistically significant (t = 3.24, p = 0.006).

Figure 3: Representation of Pre and Post NPRS in Group A (Neural mobilization).

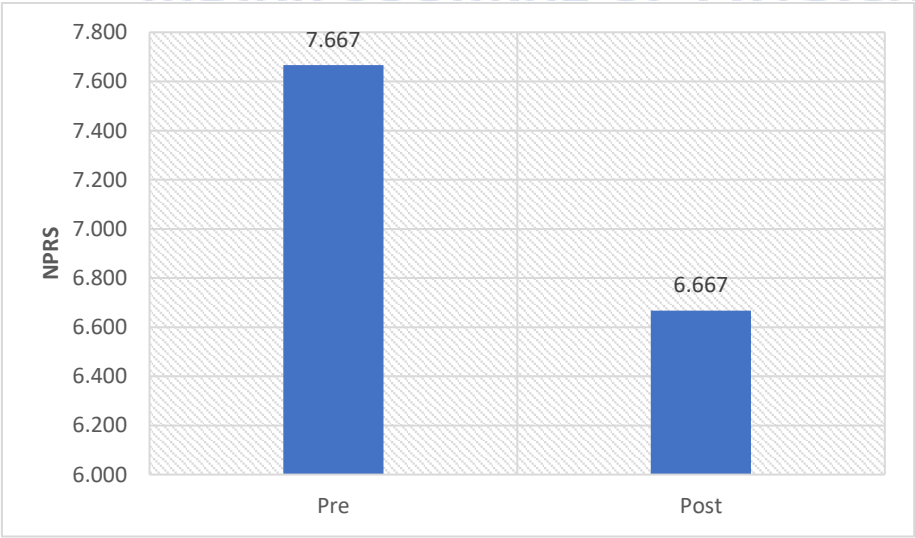


Table 4: Showing pre post comparison of NPRS in Group B (Core stabilization exercise).

Numerical Pain Rating Scale		Mean	Std. Deviation	Mean difference	t value	p value
Group B	Pre	7.600	1.298			
	Post	2.800	1.146	4.8	13.538	p<0.001

In Group B, the mean Numerical Pain Rating Scale score decreased from 7.60 ± 1.30 before the intervention to 2.80 ± 1.15 after the intervention, with a mean difference of 4.80. This reduction was highly significant (t = 13.538, p < 0.001).

Figure 4: Representation of Pre and Post NPRS in Group B (Core stabilization exercise).

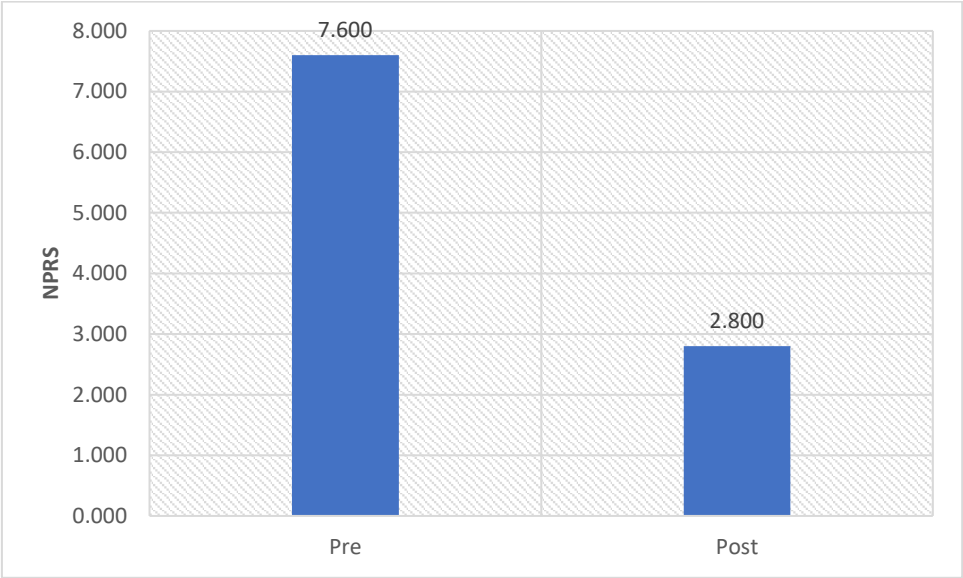


Table 5: Showing pre post comparison of MODI in Group A (Neural mobilization).

Modified Oswestry Disability Index		Mean	Std. Deviation	Mean difference	t value	p value
Group A	Pre	70.40	14.207			
	Post	66.93	16.833	3.467	2.547	0.043

In Group A, the mean Modified Oswestry Disability Index score decreased from 70.40 ± 14.21 before the intervention to 66.93 ± 16.83 after the intervention, with a mean difference of 3.47. This reduction was statistically significant (t = 2.547, p = 0.043).

Figure5: Representation of pre and post MODI score in Group A(Neural mobilization).

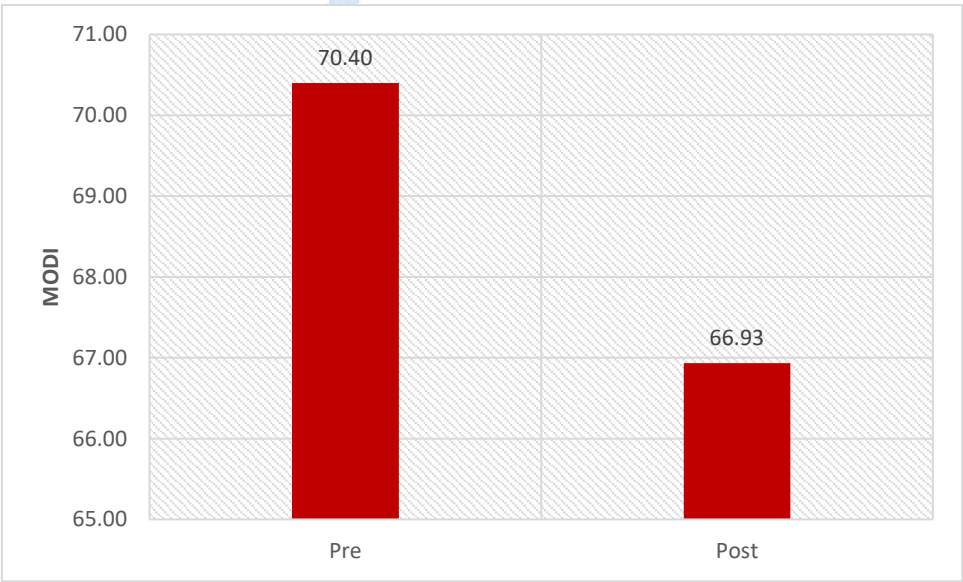


Table 6: Showing pre post comparison of MODI in Group B (Core stabilization exercise).

Modified Oswestry Disability Index		Mean	Std. Deviation	Mean difference	t value	p value
Group B	Pre	61.73	12.256			
	Post	27.20	3.278	34.533	12.992	p<0.001

In Group B, the mean Modified Oswestry Disability Index score decreased from 61.73 ± 12.26 before the intervention to 27.20 ± 3.28 after the intervention, with a mean difference of 34.53. This reduction was highly significant ($t = 12.992$, $p < 0.001$).

Figure6: Representation of pre and post MODI score in Group B(Core stabilization exercise).

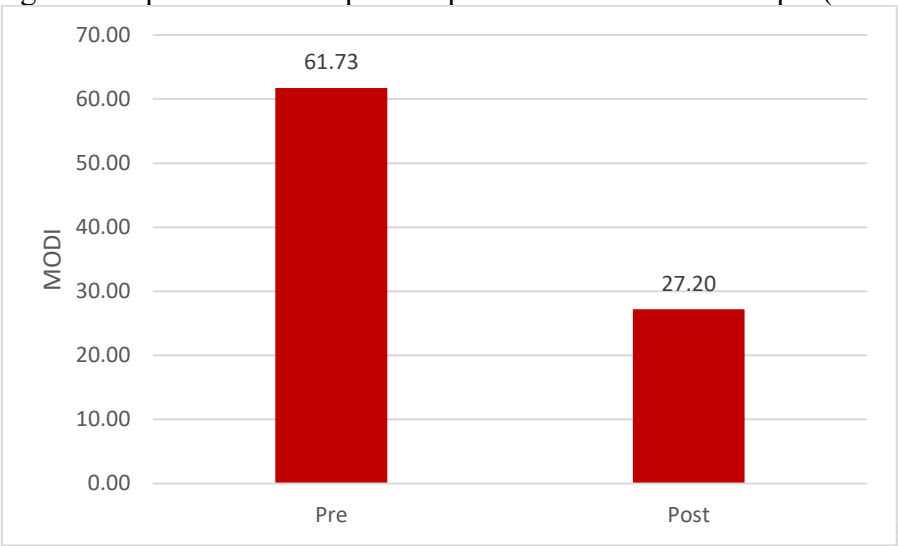


Table 7: Comparison of NPRS between Group A(Neural mobilization) and Group B(Core stabilization exercise).

Group		N	Mean(Improvement)	Std. Deviation	t value	p value
NPRS	Group A	15	1.000	1.195		
	Group B	15	4.800	1.373	8.084	p<0.001

The mean improvement in NPRS score was 1.00 ± 1.20 in Group A and 4.80 ± 1.37 in Group B. This difference was statistically significant ($t = 8.084$, $p < 0.001$), indicating greater pain reduction in Group B compared to Group A.

Figure7: Representation of NPRS between Group A(Neural mobilization) and Group B(Core stabilization exercise).

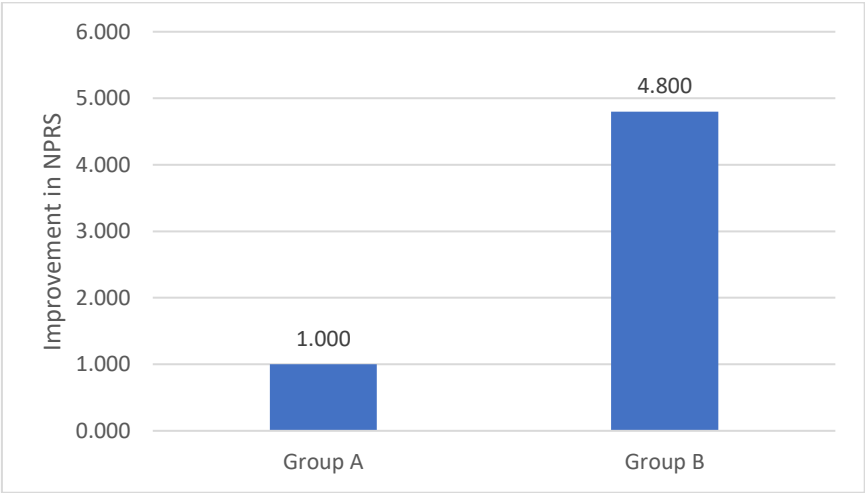
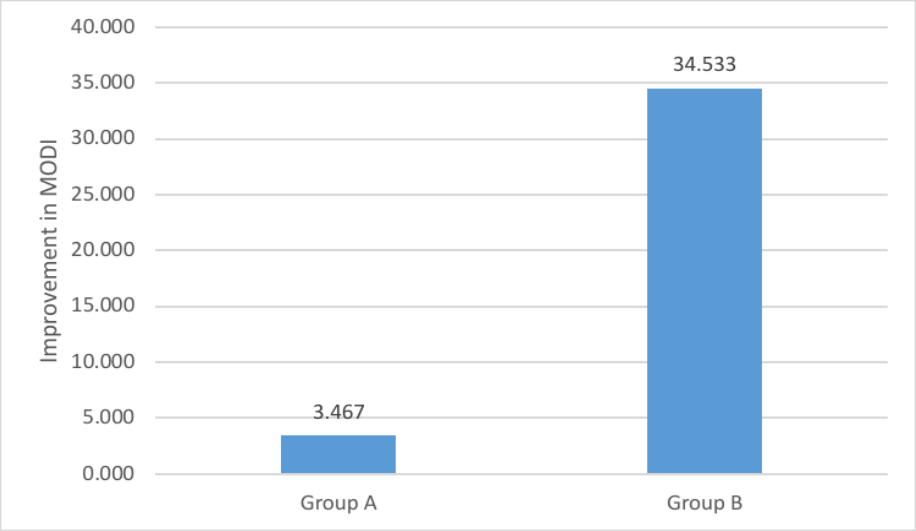


Table 8: Comparison of MODI between Group A(Neural mobilization) and Group B(Core stabilization exercise).

		N	Mean(Improvement)	Std. Deviation	t value	p value
MODI	Group A	15	3.467	6.255	9.988	p<0.001
	Group B	15	34.533	10.295		

The mean improvement in MODI score was 3.47 ± 6.26 in Group A and 34.53 ± 10.30 in Group B. This difference was statistically significant (t = 9.988, p < 0.001), showing markedly greater functional improvement in Group B compared to Group A.

Figure8: Representation of MODI between Group A(Neural mobilization) and Group B(Core stabilization exercise).



RESULT

The study aimed to investigate the effects of neural mobilization versus effects of core stabilization exercises on pain and functional disability in subjects with lumbar radiculopathy.
A total of 30 participants were included in the study, with 15 participants in Group A (Neural Mobilization) and 15 in Group B (Core Stabilization Exercise).
The mean age in Group A was 49.73 ± 8.38 years, while in Group B it was 46.73 ± 5.51 years. The difference was not statistically significant (t = 1.159, p = 0.256), indicating comparable age distribution between the groups. Gender distribution was identical in both groups, with 93.3% females and 6.7% males in each group.

Pre and Post Intervention Outcomes

Numerical Pain Rating Scale (NPRS):
In Group A, the mean NPRS decreased from 7.67 ± 1.11 pre-intervention to 6.67 ± 1.35 post-intervention, showing a statistically significant improvement (mean difference = 1.00, t = 3.24, p = 0.006).
In Group B, the mean NPRS decreased from 7.60 ± 1.30 pre-intervention to 2.80 ± 1.15 post-intervention, showing a highly significant improvement (mean difference = 4.80, t = 13.538, p < 0.001).

Modified Oswestry Disability Index (MODI):
In Group A, the mean MODI decreased from 70.40 ± 14.21 pre-intervention to 66.93 ± 16.83 post-intervention, with a statistically significant improvement (mean difference = 3.47, t = 2.547, p = 0.043).
In Group B, the mean MODI decreased from 61.73 ± 12.26 pre-intervention to 27.20 ± 3.28 post-intervention, showing a highly significant improvement (mean difference = 34.53, t = 12.992, p < 0.001).

Comparison Between Groups

NPRS Improvement: Group A showed a mean NPRS improvement of 1.00 ± 1.20, whereas Group B showed 4.80 ± 1.37.
The difference between groups was highly significant ($t = 8.084$, $p < 0.001$), indicating greater pain reduction in Group B.

MODI Improvement: Group A showed a mean MODI improvement of 3.47 ± 6.26, while Group B improved by 34.53 ± 10.30.
This difference was highly significant ($t = 9.988$, $p < 0.001$), reflecting markedly greater functional improvement in Group B.

DISCUSSION

This study compared the effects of neural mobilization versus core stabilization exercises on pain and functional disability in subjects with lumbar radiculopathy. Both interventions, alongside conventional physiotherapy, were effective in reducing pain and improving functional outcomes. However, core stabilization exercises appeared to be more effective than neural mobilization by enhancing trunk strength and spinal stability, core stabilization contributed to better pain reduction, functional recovery, and long-term quality of life, whereas neural mobilization provided only limited short-term relief from radicular pain.
In this study, the subjects with lumbar radiculopathy were taken into consideration based on proper inclusion and exclusion criteria. Thirty patients were selected. Later they were divided into group A and group B. The patients were treated for 5 session for 2 weeks, both groups treated with conventional physiotherapy in addition with neural mobilization for group A and core stabilization exercises for group B.
In the present study, the results show the ages of lumbar radiculopathy patients in both groups. The mean age of participants in Group A was 49.73 ± 8.38 years, while in Group B it was 46.73 ± 5.51 years. The study conducted by Samuelly-Leichtag G et.al also shows similar findings, aged 44.8 ± 16.3 years[9]. Yet another study done by Ningthoujam et.al also reported similar findings[14]. Yet another study done by Andrew J Schoenfeld et al shows similar results[15]. Yet another study done by CesarA. Hincapiè et.al also shows significant results[16]. Yet another study done by Ksenija Boškovic et.al shows results corresponding to age[7].
In the present study, In both Group A and Group B, the majority of participants were female (93.3%), while males constituted 6.7% in each group. The gender distribution was identical across the two groups. The study conducted by Alshami AM et al shows similar results that lumbar radicular pain were more prevalent in women than in men[17]. Yet another study done by Ningthoujams et.al shows similar results[14]. This findings are in line with another study done by CesarA. Hinacapiè et.al[16]. Yet another study done by Samuelly-Leichtag G et.al shows similar results[9].

In the present study, In Group A, the mean Modified Oswestry Disability Index score decreased from 70.40 ± 14.21 before the intervention to 66.93 ± 16.83 after the intervention, with a mean difference of 3.47. This reduction was statistically significant ($t = 2.547$, $p = 0.043$). A study done by Iqbal Z et.al shows similar results that there is a statistically significant improvement in Modified Oswestry Disability Index (MODI) scores, indicating greater functional recovery ($p < 0.05$)[18]. Yet another study done by Moussa A Sharaf et.al shows similar results[19]. Yet another study done by Kiran Satpute et.al shows similar results[20].
In the present study, In Group A, the mean Numerical Pain Rating Scale score decreased from 7.67 ± 1.11 before the intervention to 6.67 ± 1.35 after the intervention, with a mean difference of 1.00. A study done by Gehring et.al shows similar result that reduction was statistically significant ($t = 3.24$, $p = 0.006$). Significant NPRS score improvements were found between baseline and the 7th visit ($p = 0.027$)[21]. Yet another study done by Long- huei lin et.al shows similar results[22]. This findings are in line with another study done by Mica peacock et.al[2].

In the present study, In Group B, the mean Modified Oswestry Disability Index score decreased from 61.73 ± 12.26 before the intervention to 27.20 ± 3.28 after the intervention, with a mean difference of 34.53. This reduction was highly significant ($t = 12.992$, $p < 0.001$). The study conducted by Jamil et.al shows similar

results, reporting a statistically significant reduction in disability with the experimental group (ODI 16.1 ± 6.65)[23]. Yet another study done by Ye C et.al shows similar results[24]. Yet another study done by Jeong et.al shows similar results that there is significant improvement in Modified Oswestry Disability Index score[25].
In the present study, In Group B, the mean Numerical Pain Rating Scale score decreased from 7.60 ± 1.30 before the intervention to 2.80 ± 1.15 after the intervention, with a mean difference of 4.80. This reduction was highly significant ($t = 13.538$, $p < 0.001$). In the Core Stabilization Group, the pre-test mean NPRS score was 7.13 ± 1.2, while the post-test mean value decreased to 4.3 ± 1.0, indicating a mean reduction of 2.83. This reduction was found to be statistically significant ($p < 0.05$) A study done by Karthick D et.al shows similar results[5]. Yet another study done by Steiger si et.al shows similar results[26]. Yet another study done by Patil SS et.al shows similar results[27].

In the present study, core stabilization exercises shows greater improvement than neural mobilization. The motor control exercises group (e.g., planks, bridges, and sit-ups) demonstrated a mean reduction of approximately 2.8 points (from baseline 6.0 ± 1.4 to 3.2 ± 0.8), while the neural mobilization + motor control exercises group shows a slightly greater reduction of 3.3 points (from baseline 5.9 ± 1.4 to 2.6 ± 0.8), as observed in a study by Plaza-Manzano et al. on disc herniation patients[28]. Furthermore, a study by Mohsen Mohamed Elsayyad et al. on lumbar spine fusion patients shows similar results[29].

CONCLUSION

This study was done to compare neural mobilization versus core stabilization exercises on pain and functional disability in subjects with lumbar radiculopathy. Thirty participants were selected based on inclusion and exclusion criteria and divided into two groups, group A and group B. Group A received neural mobilization and Group B received core stabilization exercises in addition to conventional physiotherapy. Each group underwent 5 sessions for 2 weeks. Both interventions effectively reduced pain and improved function. However, core stabilization exercises appeared to be more effective than neural mobilization, offering greater pain relief, functional recovery, and long-term quality of life benefits, whereas neural mobilization provided only short-term symptom relief.

LIMITATIONS

•The study sample size was small and included only 30 patients.
•Age criteria was limited (40-65 years).
• Duration of study was less.

RECOMMENDATIONS

• Patients with a larger sample size can be undertaken in the future to achieve better results as this was conducted with a small sample size.
• The study duration can be extended.

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