

Comparative Effect of Core Muscle Strengthening and Neural Tissue Mobilization With Conventional Back Care Exercises on Pain, Disability, and Straight Leg Raise Range of Motion in Patients With Low Back Pain With Sciatica: A Comparative Study

Devendra Singh Shekhawat¹, Madhusudan Tiwari², Hemendra Kumar Sharma³, Parth Bhardwaj⁴, Aryan Pachar⁵, Gaurav Soni⁶, Rudmal Choudhary⁷

¹Associate Professor, Mahatma Gandhi Physiotherapy College, Mahatma Gandhi University of Medical Sciences and Technology, Jaipur, Rajasthan, India. Email: physiodevendra@gmail.com ORCID ID: <https://orcid.org/0009-0005-1862-4027>.

²Principal, Mahatma Gandhi Physiotherapy College, Mahatma Gandhi University of Medical Sciences and Technology, Jaipur, Rajasthan, India. Email: Principal.physiotherapy@mgumst.org

³Associate Professor, Mahatma Gandhi Physiotherapy College, Mahatma Gandhi University of Medical Sciences and Technology, Jaipur, Rajasthan, India. Email: Hemendra.physio@gmail.com

⁴Assistant Professor, Symbiosis college of Physiotherapy Jaipur, Rajasthan, India. Parthbhardwaj00@gmail.com

⁵Tutor, Mahatma Gandhi Physiotherapy College, Mahatma Gandhi University of Medical Sciences and Technology, Jaipur, Rajasthan, India. Email: Aarupachar516@gmail.com

⁶Lecturer, Mahatma Gandhi Physiotherapy College, Mahatma Gandhi University of Medical Sciences and Technology, Jaipur, Rajasthan, India. Email: Gauravsoni2609@gmail.com

⁷Assistant Professor, Maharshi Arvind University Mundiya Ramsar, Jaipur, Rajasthan, India. Email: Rudmalchoudhary0@gmail.com ORCID ID: <https://orcid.org/0009-0006-2940-1520>.

ABSTRACT

Background: Low back pain with sciatica is associated with pain, disability, and restricted straight leg raise range of motion. Core muscle strengthening and neural tissue mobilization are commonly used physiotherapy approaches for managing these problems.

Objective: To compare the effects of core muscle strengthening exercises with neural tissue mobilization combined with conventional back care exercises on pain, disability, and straight leg raise range of motion in patients with low back pain with sciatica.

Methods: Eighty individuals with sciatica and low back pain were enrolled, and they were split into two equal groups of forty people each at random. While Group B got neural tissue mobilization along with traditional back care exercises, Group A received activities that strengthened their core muscles. Outcome assessments were taken at baseline, the end of the third week, and the end of the sixth week. Treatment was administered for six weeks on alternate days. The Numerical Pain Rating Scale (NPRS), the Oswestry Disability Index (ODI), and a goniometer were used to measure pain intensity, disability, and straight leg raise range of motion (SROM). The two-sample t-test, which assumes equal variances, is used throughout the paper to report between-group comparisons.

Results: At baseline, no significant between-group differences were observed for NPRS, ODI, or SROM. At the 3rd week, significant between-group differences were observed for NPRS ($p=0.003509$), ODI ($p=0.037114$), and SROM ($p=0.000057$). At the 6th week, significant differences were observed for NPRS (Group A 2.10; Group B 1.65; $p=0.012994$), ODI (Group A 23.20; Group B 19.85; $p=0.000019$), and SROM (Group A 55.50; Group B 68.625; $p<0.001$), favoring Group B.

Conclusion: Both therapies were beneficial over 6 weeks; however, neural tissue mobilization combined with standard back care exercises revealed higher improvement than core muscle strengthening in pain, disability, and straight leg raise range of motion in the reported intergroup analysis.

Keywords: low back pain; sciatica; neural tissue mobilization; core muscle strengthening; pain.

INTRODUCTION

Low back pain (LBP) is defined as pain located below the lower rib margin and above the inferior gluteal crease, with or without associated leg pain ^[1]. S. Kinkade described LBP as discomfort arising posteriorly between the inferior rib margin and the proximal thighs ^[2]. Nonspecific LBP refers to pain in the lower back without an identifiable underlying pathology such as infection, tumor, osteoporosis, fracture, arthritis, or Cauda Equina syndrome. It may arise from minor abnormalities or strain involving muscles, ligaments, intervertebral discs, facet joints, or other lumbar structures ^[3].

Radicular pain is defined as pain perceived in a limb or trunk due to abnormal activation of pain-sensitive nerve fibres within the spinal nerve roots or other neuropathic pathways ^[4]. Lumbar radiculopathy is commonly associated with bulging or herniated lumbar intervertebral discs, which may compress the spinal nerve roots and produce neuromuscular symptoms. Patients may experience low back pain accompanied by tingling, numbness, or radiating pain into the leg and foot ^[5]. Lumbar radiating pain, commonly referred to as sciatica, is a severe and disabling condition that can adversely affect pain, disability, quality of life, and healthcare utilization ^[5]. Sciatica is characterized by pain radiating into the buttock, thigh, and below the knee toward the foot or toes, and may be accompanied by sensory loss, altered reflexes, and muscle weakness in the affected nerve-root distribution ^[6].

Sciatica is most commonly associated with lumbar disc herniation causing nerve-root compression ^[7]. Other less common causes include foraminal stenosis, lumbar spinal stenosis, spondylolisthesis, and cancer ^[8]. The underlying mechanism may involve a combination of mechanical compression, inflammatory, and immunological processes rather than nerve-root compression alone ^[9].

Core stability exercises (CSE) focus on the coactivation of the lumbar multifidus (LM) and transversus abdominis (TrA) muscles. These deep stabilizing muscles contribute to lumbar stability by increasing intra-abdominal pressure and enhancing neuromuscular control of the spine ^[10]. CSE may improve muscle activation patterns, postural control, pain, and disability in patients with LBP ^[11].

Neural mobilization (NM) is another physiotherapeutic approach commonly used for lumbosacral radiculopathy. It aims to improve the mechanical properties and mobility of peripheral neural tissues and their surrounding structures ^[12]. Evidence suggests that NM may reduce neural mechanosensitivity and produce a hypoalgesic effect ^[13,14].

OBJECTIVE

Although both core stability exercises and neural mobilization have been reported to improve pain and functional outcomes in patients with low back pain and radicular symptoms, evidence comparing their effectiveness in patients with radiating low back pain with sciatica remains limited. Recent systematic reviews suggest that neural mobilization may improve pain, function, and disability in patients with low back or radicular pain; however, further high-quality comparative studies are needed to establish its effectiveness relative to exercise-based interventions. ^[15,16] Therefore, the present study was undertaken to compare the effectiveness of neural tissue mobilization combined with back care exercises and core strengthening exercises in patients with radiating low back pain with sciatica, in terms of pain, disability, and SLR range of motion.

SUBJECTS AND METHODS

Evaluation of Study Subjects

A sample of 80 patients of low back ache with sciatica were included for this study. Each individual gave their informed permission before beginning this investigation. 80 patients were divided in 2 groups (40 each) (Group A- Patients received strengthening exercises of core muscles and The B Group - the patients gained neural mobilization with conventional back care exercises). Each group underwent testing procedures so that their performances on the various measurement variables of this study were carefully documented.

Inclusion criteria

1. Age range: between 30 to 60 years.
2. Both male and female.
3. According to the using of Numerical Pain Rating Scale (NPRS), leg pain severity of three or more and back pain with sciatica.
4. The development of pain within six months.
5. Ability to walk without any assistance.
6. The study comprised participants who were willing to finish all evaluations and give informed permission.

Exclusion criteria

1. Any individuals who get alternative therapy for sciatica and/or back pain (such as surgery, nerve blocks, or analgesic medication) are not included.
2. Person those have soft tissue or non-spine issues that may be linked to sciatica or back pain. (such as rheumatoid arthritis, pregnancy, or spinal tumours)
3. Patient have any history of vertebral fractures, dislocations, or spinal operations or extreme neurological deficiency or symptoms like cauda equina syndrome.

Outcome Measures

1. The pain intensity by NPRS scale
2. Use the Oswestry Disability Index to check functions
3. Goniometer for measuring Straight Leg Raise range of motion (SRM)

Procedure

Total 80 subjects were randomly divided in to two equal groups A and B i.e. 40 subjects in each group.

Group A subjects received core muscle strengthening (core stabilization) exercises only and Group B subjects received Neural Tissue Mobilization with conventional back care exercises. The treatment protocol was designated as one hour therapy sessions in a day on alternate day basis for 6 weeks. Data of all variables were collected on pretest (baseline) i.e. on day 0, at the end of 3rd week and at the end of 6th week.

Intervention of Core muscle strengthening group (Group A)

Patients received strengthening exercises for Core muscle 3 days in a week on alternate day basis for 6 weeks in compliance with home exercises program: -

Table 1. Treatment protocol of group A core strengthening (core stabilization) exercise.

Primary Muscle Group*	Exercises	Criteria for Progression	
		Till 2 weeks	3 rd – 6 th week
Transversus abdominus	Abdominal bracing.	10 reps with a hold of 8 seconds	
	Bracing with heel slides.	5 reps each leg while holding for 4 seconds	
	Bracing with leg lifts.	5 reps each leg using the 4-s hold	15 repetitions with 8-s hold, with 1 leg
	Bracing with bridging.	15 repetitions with 8-s hold,	
	Bracing in standing.		
	Bracing with standing row exercise. Bracing with walking.		30 reps with an 8-second hold

			30 reps, holding for 8 seconds. 30 m walk to and fro.
Erector spinae/multifidus	Quadruped arm lifts with bracing. Quadruped leg lifts with bracing.	10 repetitions with 8-sec hold 10 repetitions with 8-sec hold	
Erector spinae/multifidus	Quadruped alternate arm and leg lifts with bracing.		30 reps, holding each side for 8 seconds
Quadratus lumborum	Side support with knees flexed.	10 repetitions on each side with an 8-second hold	
	Side support with knees extended.		30 repetitions with 8-s hold on each side
Oblique abdominals	Side support with knees flexed.	10 repetitions with 8-s hold on each side	
	Side support with knees extended.		30 repetitions with 8-s hold on each side

Group B patients were received Neural tissue mobilization along with conventional back care exercises, one set in a day on alternate day basis for 6 weeks in compliance with home exercise program.

Neural mobilization allows mobility between neural tissues and their environments (interface) via manual therapies or exercise. It encompasses the following: slump neural mobilization technique, sciatic neural mobilization technique, and self-neural mobilization

The straight leg lifts neural mobilization approach was the method used. The physiotherapist used this approach while the participants were in a supine posture. The treated leg was raised in a typical straight leg raise until the discomfort in the leg or back prohibited it from moving any further. The afflicted leg was then lowered a few degrees. To activate the sciatic nerve, the therapist next used a series of oscillatory motions in the ankle's dorsiflexion direction. Each session of the straight leg lift technique, which involved 30-second oscillations followed by a 1-minute rest, lasted around ten minutes (Sarkari and Multani et al year). raised the neural mobilization's amplitude gradually based on the patient's reaction up to a point when discomfort or reluctance to movement was experienced. As the discomfort subsided, the ankle's plantar flexion, the foot's inversion, and the hip's medial rotation and adduction were added to create further strain on the sciatic nerve. The range of movement was increased by the therapist slowly until achieving the maximal range of straight leg raise.^[17]

Neural tissue mobilization was given one set in a day, thrice in a week for 6 weeks.

Patients performed following back care exercises 3 times a week for 6 weeks in compliance with home exercise program.

Conventional Back Care Exercises

Table 2. Conventional Back Care Exercise Protocol

Exercises	Criteria for Progression	
	Till 2 weeks	3 rd – 6 th week
Static Back Care Exercise	5 repetitions with 1 min hold	5 repetitions with 3 min hold
Pelvic Bridging	10 repetitions with 10 sec hold	15 repetitions with 30 sec hold
Bottom to heel stretch	10 repetitions with 10 sec hold	15 repetitions with 30 sec hold
Lumbar Spinal Rotation		15 repetitions with 10 sec hold
Single Knee to Chest		15 repetitions with 20 sec hold on each side
Double Knee to Chest		15 repetitions with 15 sec hold
Cat and Camel Exercise		15 repetitions with 10 sec hold on each position

Statistical Analysis

Data were analysed using SPSS software. The outcome measures, including Numerical Pain Rating Scale (NPRS), Oswestry Disability Index (ODI), and Straight Leg Raise Range of Motion (SROM), were assessed at baseline, at the end of the 3rd week, and at the end of the 6th week. Descriptive statistics were used to summarize the study variables. For comparison between Group A and Group B at each assessment point, an independent two-sample t-test assuming equal variances was used. The level of statistical significance was set at $p < 0.05$.

Results

A total of 80 participants were included in the study, with 40 participants in each group. Group A received core muscle strengthening exercises, whereas Group B received neural tissue mobilization with conventional back care exercises. NPRS, ODI, and SROM were assessed at baseline (0 day), 3rd week, and 6th week.

Table 3. Comparison of Gender in Group A and B

	Male	Female
Group A	16	24
Group B	22	18

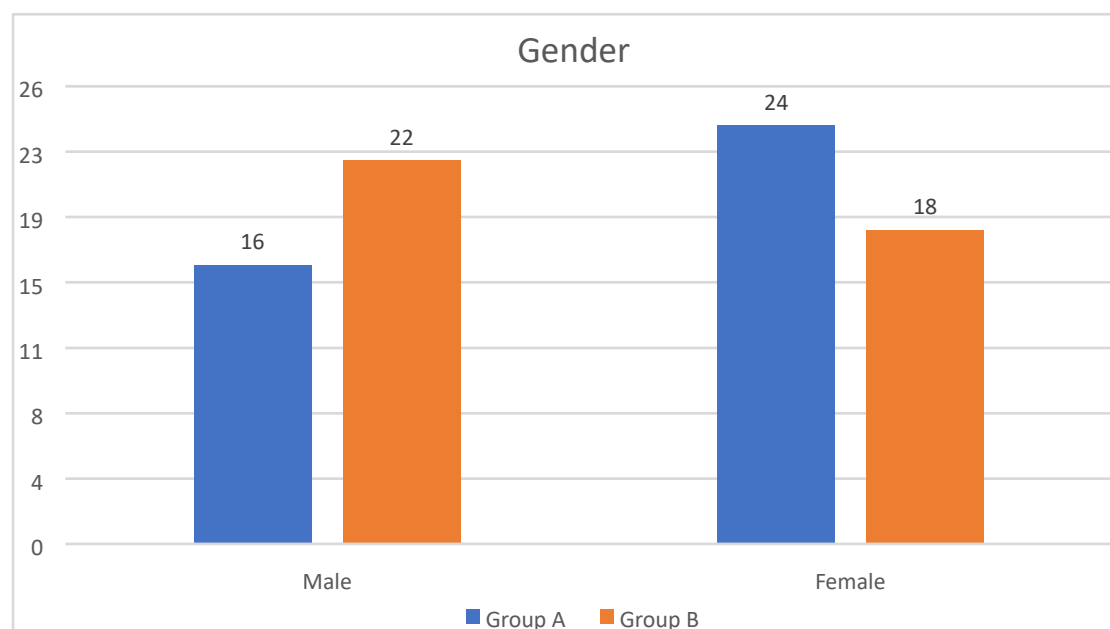


Fig. 1. Comparison of Gender in Group A and B

Numerical Pain Rating Scale

Table 4. Between-Group Comparison of NPRS Scores at Baseline, 3rd Week and 6th Week

Time point	Group A – Core muscle strengthening exercise	Group B: Neural tissue mobilization + conventional back care exercise	p-value
Baseline (0 day)	7.125 ± 0.714	7.125 ± 0.748	1.00000
3rd week	4.725 ± 0.670	4.225 ± 0.790	0.003509
6th week	2.100 ± 0.663	1.650 ± 0.882	0.012994

At baseline, the mean NPRS score was 7.125 ± 0.714 in Group A and 7.125 ± 0.748 in Group B, with no significant between-group difference (p = 1.00000). At the 3rd week, the mean NPRS score was 4.725 ± 0.670 in Group A and 4.225 ± 0.790 in Group B, showing a statistically significant between-group difference (p = 0.003509). At the

6th week, the mean NPRS score decreased to 2.100 ± 0.663 in Group A and 1.650 ± 0.882 in Group B, with a statistically significant difference ($p = 0.012994$). Thus, the reduction in pain was greater in Group B.



Fig.2 Inter Group Analysis of NPRS Scores

Graph represents that there is significant difference in mean of NPRS scores in both interventions. Oswestry Disability Index

Table 5. Between-Group Comparison of ODI Scores at Baseline, 3rd Week and 6th Week

Time point	Group A: Core strengthening exercise	Group B: Neural tissue mobilization + conventional back care exercise	p-value
Baseline (0 day)	56.325 ± 4.977	57.075 ± 5.241	0.518877
3rd week	39.275 ± 5.287	36.800 ± 5.016	0.037114
6th week	23.200 ± 3.487	19.850 ± 2.980	0.000019

At baseline, the mean ODI score was 56.325 ± 4.977 in Group A and 57.075 ± 5.241 in Group B, with no statistically significant difference ($p = 0.518877$). At the 3rd week, the mean ODI score was 39.275 ± 5.287 in Group A and 36.800 ± 5.016 in Group B, showing a statistically significant between-group difference ($p = 0.037114$). At the 6th

week, the mean ODI score was 23.200 ± 3.487 in Group A and 19.850 ± 2.980 in Group B, with a highly statistically significant difference ($p = 0.000019$). The reduction in disability was greater in Group B.

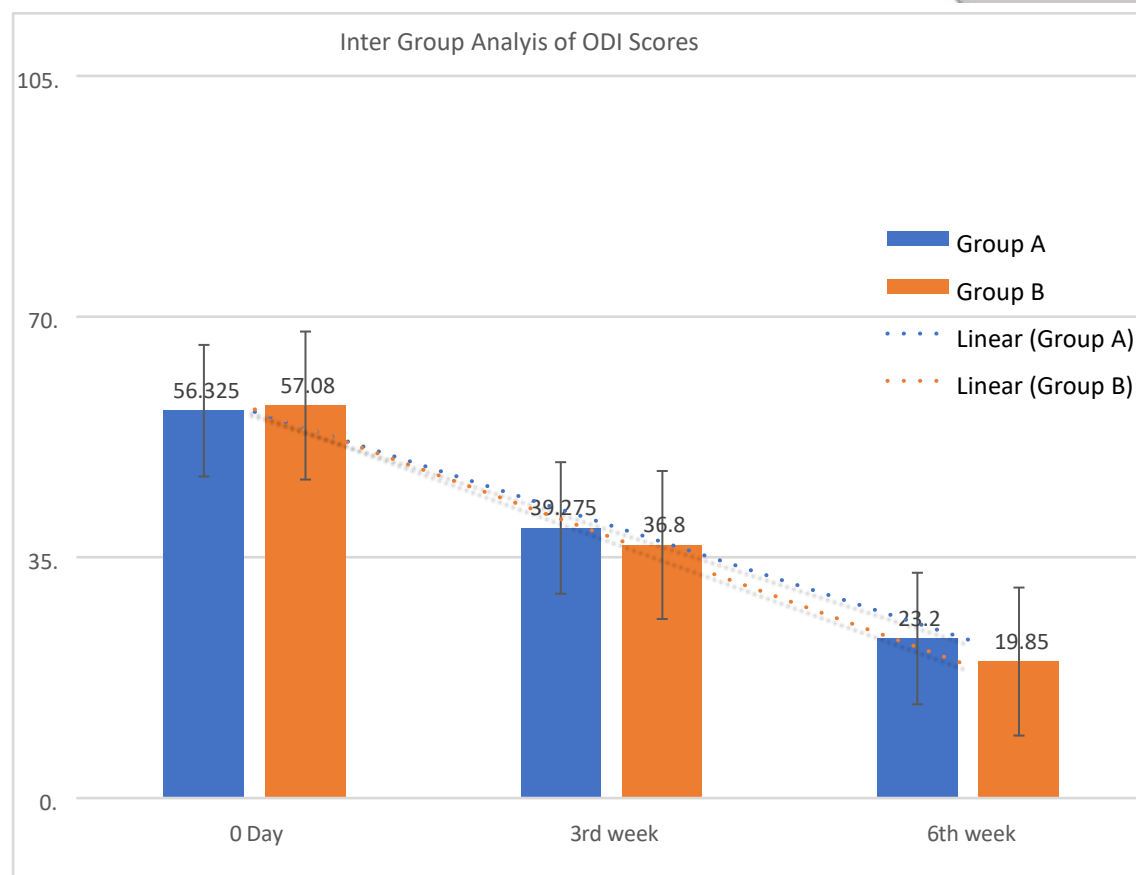


Fig.3 – Inter Group Analysis of ODI Scores

Graph represents that there is significant difference in mean of ODI scores in both interventions. Straight Leg Raise Range of Motion

Table 6. Between-Group Comparison of SROM Scores at Baseline, 3rd Week and 6th Week

Time point	Group A: Core strengthening exercise	Group B: Neural tissue mobilization + conventional back care exercise	p-value
Baseline (0 day)	42.375 ± 2.497	42.375 ± 2.736	1.00000
3rd week	50.500 ± 3.317	54.000 ± 3.905	0.000057
6th week	55.500 ± 3.122	68.625 ± 5.808	<0.001

At baseline, the mean SROM was $42.375 \pm 2.497^\circ$ in Group A and $42.375 \pm 2.736^\circ$ in Group B, with no significant between-group difference ($p = 1.00000$). At the 3rd week, SROM increased to $50.500 \pm 3.317^\circ$ in Group A and $54.000 \pm 3.905^\circ$ in Group B, with a statistically significant between-group difference ($p = 0.000057$). At the 6th week, the mean SROM increased to $55.500 \pm 3.122^\circ$ in Group A and $68.625 \pm 5.808^\circ$ in Group B, with a statistically significant difference ($p < 0.001$). Greater improvement in SROM was observed in Group B.

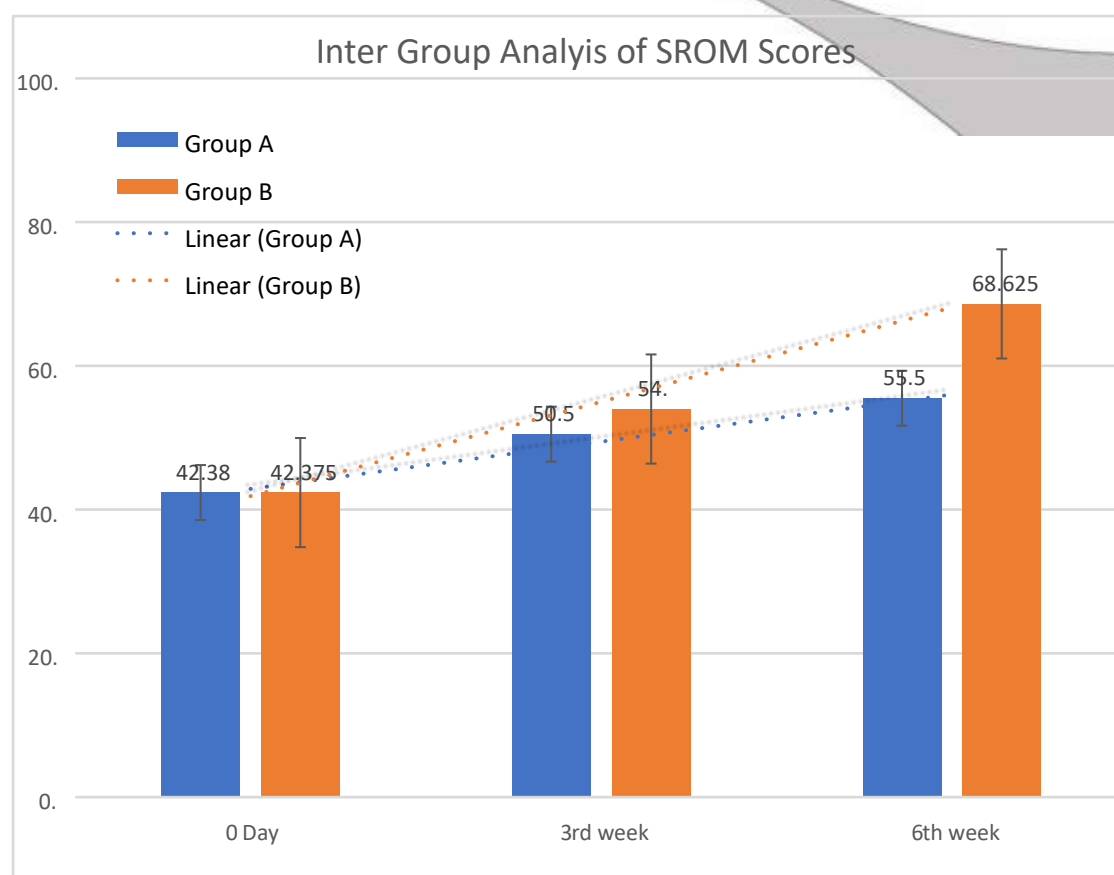


Fig.3 – Inter Group Analysis of SROM Scores

Graph represents that there is significant difference in mean values of SROM scores in both interventions.

Discussion

This study looked at the effects of strengthening the core muscles as compared with those obtained by combining neural tissue mobilization with conventional back-exercise programmes in patients suffering from low back pain and sciatica. During the 6-week period of intervention both groups showed improvements in terms of pain, disability and the range of motion for the straight leg raise. Yet the group which received neural tissue mobilization together with conventional exercise showed significantly greater improvements at both the third and sixth weeks.

The greater improvement observed in the neural mobilization group may be related to the specific effects of neural tissue mobilization on neural mechanosensitivity and neural tissue mobility. While core strengthening primarily aims to improve trunk stability, neuromuscular control, and tolerance to mechanical loading, neural mobilization may additionally facilitate movement of neural tissues relative to their surrounding structures. This may be particularly relevant in patients with radiating symptoms and restricted SLR.

The improvement in pain and disability observed in the present study is consistent with previous findings. de Almeida et al. (2019) reported greater short-term reductions in leg and lumbar pain following sciatic neural mobilization compared with advice to remain active or basic exercise interventions ^[18]. Similarly, Vijayalakshmi et al. (2022) reported significant improvements in pain and neural mobility following neural mobilization compared with control treatment ^[19].

The present findings are also in agreement with Geethika et al. ^[20], who reported greater improvements in pain-free passive SLR range of motion and functional disability following neural tissue mobilization compared with conventional physiotherapy in patients with low back ache and sciatica ^[20]. These findings provide support for incorporating neural mobilization into physiotherapy management of selected patients with radiating symptoms. The greater improvement in SLR range of motion may reflect improved tolerance to neural loading and movement following neural mobilization. The corresponding reduction in pain and disability may also have contributed to improved functional performance.

Evidence from systematic reviews further supports the findings of the present study. Peacock et al. ^[21], in a systematic review of randomized controlled trials involving adults with low back and radicular pain, reported that the addition of neural mobilization to conservative treatment generally improved pain, disability and functional outcomes. The authors concluded that neural mobilization may be useful for short-term improvement in pain, function and disability in patients with low back and radicular pain, although they also highlighted the need for higher-quality research ^[21]. More recently, Lin et al. ^[22] conducted a systematic review and meta-analysis of 20 randomized controlled trials involving 877 participants with lumbar radiculopathy. Their findings demonstrated significant reductions in pain and disability following neural mobilization, with beneficial effects observed both when neural mobilization was used alone and when combined with other interventions ^[22]. Nevertheless, the improvement observed in the core strengthening group indicates that strengthening-based exercise remains a beneficial component of management. Therefore, the present findings support the greater effectiveness of the combined neural mobilization and conventional exercise approach compared with core strengthening alone, rather than establishing the superiority of neural mobilization as an isolated intervention.

Conclusion

Both interventions were effective in reducing pain and disability and improving SLR range of motion after 6 weeks of intervention in patients with radiating low back pain with sciatica. However, neural tissue mobilization combined with conventional back-care exercises produced greater improvements than core muscle strengthening exercises alone. It may therefore be considered a simple, cost-effective, and home-based approach for the management of low back pain with sciatica.

Limitations of the Study

1. The study included a relatively small sample size of 80 participants (40 in each group), which may limit the generalizability of the findings. Future studies with larger sample sizes are recommended.
2. Only patients with unilateral radiating pain (either left or right leg) were included; therefore, the findings may not be applicable to patients with bilateral symptoms.
3. The follow-up period was limited to 6 weeks, so the long-term effectiveness and sustainability of the treatment outcomes could not be determined.
4. The study was restricted to participants aged 30–60 years, limiting the applicability of the findings to other age groups with sciatica.

Future Scope

Future studies should be conducted on larger sample sizes with longer follow-up periods to evaluate the long-term effectiveness of the interventions. Further research may also explore the effectiveness of these treatment approaches across different age groups and in combination with other physiotherapy interventions. Additionally, comparative studies between male and female participants may provide further insight into treatment outcomes.

Ethics approval

The study received approval from the Institutional Ethics Committee of Mahatma Gandhi Medical College & Hospital, Jaipur, under approval number MGMCMC & H/IEC/JPR/2023/1506.

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Conflict of Interest

The authors declare that they have no competing interests or conflicts of interest.

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