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RESEARCH ARTICLE

Evaluation of Neural Mobilization for Functional Recovery in Patients with Sciatica

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ABSTRACT

Objective: Sciatica, marked by lower-limb neuralgic pain, significantly affects many individuals. Traditional treatments, such as medication or surgery, often have limitations. This study aimed to compare the effectiveness of Neural Mobilization (NM) and Core Muscle Stabilization (CMS) in reducing pain, improving function, and enhancing outcomes for sciatica patients. **Methods:** A randomized controlled trial was conducted with 90 software professionals aged 30-55 years diagnosed with sciatica. Participants were randomly assigned to three groups: Neural Mobilization (Group A), Core Muscle Stabilization (Group B), and Control (Group C), with a 3-month intervention period. The inclusion criteria were sciatic pain confirmed by Straight Leg Raise (SLR) and Slump tests, along with core muscle weakness. Exclusion criteria included neurological or structural conditions. Outcome measures included pain (Numeric Pain Rating Scale [NPRS]), Sciatica Bothersome Index (SBI), pressure biofeedback (mmHg), and hip range of motion (ROM). Pre- and post-intervention assessments were also performed. Statistical analysis included paired t-tests and ANOVA. **Findings:** Both NM and CMS significantly reduced pain, improved SBI, and enhanced hip ROM and pressure biofeedback compared with the Control group. NM showed superior effectiveness, particularly in terms of pain reduction, SBI, and pressure biofeedback. Significant post-test differences were observed between groups for all outcomes ($p < 0.001$). **Novelty:** This study is one of the few to directly compare NM and CMS interventions in sciatica, demonstrating NM's potential superiority in both symptom relief and functional improvements.

Keywords: Sciatica; Neural Mobilization; Core Muscle Strengthening; Pain Reduction; Hip Range of Motion; Rehabilitation

1 INTRODUCTION

Sciatica is a common condition characterized by lower limb neuralgic pain, with an estimated overall incidence between 13% and 40%.[1] It can be persistent and chronic, leading to significant socioeconomic consequences. The standard treatment approach for sciatica typically involves medication, surgery, or a combination of both.[1] However, these conventional treatments may have negative impacts, high costs, and a disease-centric approach, prompting the need for efficient evidence-based alternatives.

Neural mobilization and core muscle strengthening are the two therapeutic approaches used in the management of sciatica. Recent studies suggest that both techniques can be effective in alleviating symptoms and improving function in patients with sciatica. Neural mobilization techniques aim to restore the normal mechanics and physiology of the nervous system, potentially reducing pain and improving function in sciatica patients. A study investigating the effects of sciatic nerve stimulation (SNS) neuromodulation found that it could alleviate neuropathic pain and reduce neuroinflammation by suppressing satellite glial cell hyper-activation and inducing M2 macrophage polarization in the dorsal root ganglia.[2] This suggests that neural mobilization techniques may have beneficial effects on the underlying pathophysiology of sciatica. On the other hand, core muscle strengthening exercises focus on improving the stability and function of the muscles supporting the spine and pelvis. While not directly addressing sciatica, a study on forward shoulder posture in COPD patients demonstrated that a combination of pectoral stretching and scapular stabilizer strengthening exercises could improve respiratory function and reduce postural abnormalities.[3] This suggests that core strengthening exercises may have indirect benefits for sciatica patients by improving overall posture and reducing strain on the lower back. Although both approaches are individually recognized in the management of sciatica, there is limited comparative research evaluating their relative effectiveness. The current study sought to address this gap by investigating the effectiveness of neural mobilization versus core muscle strengthening in reducing pain, improving function, and enhancing overall outcomes in patients with sciatica.

2 MATERIALS AND METHODS

A randomized controlled trial was conducted across software companies in Bengaluru, with a sample size of 90 software professionals aged 30-55 years who were diagnosed with sciatica. The study duration was three months, during which the participants underwent different interventions. Ethical clearance was obtained from the ethics committee and informed consent was obtained from all participants prior to inclusion. The inclusion criteria for participation in the study were individuals aged between 30 and 55 years of both genders, who exhibited both core muscle weakness and a positive result for sciatica (determined by both Straight Leg Raise and Slump tests). Exclusion criteria were sciatica due to tumours, osteoporotic fractures, radiculitis, cauda equina syndrome, recent lumbar spine surgery, sciatica with vascular disorders, diabetic neuropathy, or acute ligament injuries.

Upon enrolment, baseline assessments were performed to evaluate hip active range of motion (AROM), core muscle strength, and Sciatica Bothersome Index (SBI) for each participant. Following the pre-intervention assessments, the participants were randomly allocated into three groups: Experimental Group A (Core Muscle Strengthening), Experimental Group B (Neural Mobilization) and Control Group C (Conventional Method). Each group followed a specific intervention protocol for 3 months. The outcomes were measured again post-intervention, using the same pre-intervention assessments. The Straight Leg Raise (SLR) test is used as a key diagnostic tool to assess sciatica. A positive SLR was defined as the reproduction of sciatic pain during hip flexion, which indicated nerve root involvement and sciatica. The SLR test was performed to measure the degree of pain and identify the presence of sciatic nerve irritation. Statistical analysis was conducted to compare the pre- and post-intervention data for each group to evaluate the effectiveness of the interventions in improving core muscle strength, reducing sciatic symptoms, and enhancing overall functional outcomes.

3 RESULTS

There were no significant differences between the groups with respect to the gender distribution. In Group A (Neural Mobilization), 43.3% of the participants were male and 56.7% were female. In Group B (Core Muscle Stabilization), 53.3% were male and 46.7% were female, while in Group C (Control), 53.3% were male and 46.7% were female. A chi-square test revealed that the distribution of gender across the groups was not statistically significant (Chi-Square value = 0.806, df = 2, $p > 0.05$, NS). Furthermore, the ANOVA test confirmed that there was no significant difference in gender distribution between the groups ($F = 0.548$, $p > 0.05$, NS). Regarding age distribution, the age range in all groups was 30–47 years. The mean age in Group A (Neural Mobilization) was 36.80 ± 5.05 years, in Group B (Core Muscle Stabilization) it was 35.50 ± 5.20 years, and in Group C (Control), it was 36.47 ± 5.43 years. ANOVA indicated that there were no significant differences in the mean age between the groups ($p > 0.05$, NS). Both gender and age distributions were comparable across the three groups, with no statistically significant differences observed (Table 1).

The outcome measures for pain (NPRS) and Sciatica Bothersome Index (SBI) were compared between the three groups at both the pre-test and post-test assessments. For the Pain (NPRS) scores, the range of pain intensity at baseline (pre-test) varied between 6 and 10 across all groups. Group A (Neural Mobilization) had a mean pain score of 8.17 ± 1.05, Group B (Core Muscle Stabilization) had a mean score of 8.13 ± 1.21, and Group C (Control) had a mean score of 8.37 ± 0.89. After the intervention (post-test), the pain intensity was reduced across all groups. Group A showed a significant reduction, with the mean pain score decreasing to 2.93 ± 1.23, Group B's mean pain score reduced to 3.33 ± 1.24, and Group C's mean score decreased to 5.17 ± 0.98. Wilcoxon test indicated that all groups experienced statistically significant reductions in pain ($p < 0.001$).However, the between-group comparison using the Kruskal-Wallis test showed no significant difference in the pre-test pain scores (Chi-square value = 1.098, $p > 0.05$), but a significant difference in the post-test pain scores (Chi-square value = 8.428, $p < 0.001$), suggesting a greater reduction in pain in the experimental groups (Neural Mobilization and Core Muscle Stabilization) compared to the Control group.

Regarding the SBI, the pre-test scores ranged from 15 to 24 in all groups, with Group A having a mean of 19.47 ± 2.31, Group B having a mean of 19.67 ± 2.60, and Group C having a mean of 19.70 ± 2.64. Following the intervention, all groups showed improvements, with Group A, SBI reducing to 9.70 ± 2.04, Group B, to 11.20 ± 3.32, and Group C, to 14.30 ± 2.40. The Wilcoxon test revealed significant reductions in SBI in all groups ($p < 0.001$). The between-group comparison using the Kruskal-Walli's test showed no significant difference in the pre-test SBI scores (Chi-square value = 0.453, $p > 0.05$), but a significant difference in the post-test scores (Chi-square value = 9.463, $p < 0.001$), indicating that the Neural Mobilization and Core Muscle Stabilization groups

Table 1: Distribution of patients with sciatica according to gender and age among the groups

Variables		Group A (Neural mobilization)	Group B (Core muscle stabilization)	Group C (Control)	Chi-Square Test	ANOVA
Gender	Male	13 (43.3%)	16 (53.3%)	16 (5.3%)	Chi-Square value= 0.806, Df= 2, p > 0.05, NS	F= 0.548, p>0.05, NS
	Female	17 (56.7%)	14 (46.7%)	14 (46.7%)		
Age (years)	Range	30 - 47	30 - 45	30 - 47		
	Mean ± SD	36.80 ± 5.05	35.50 ± 5.20	36.47 ± 5.43		

NS – Non significant (p>0.05)

experienced greater improvements in SBI compared to the Control group. Significant improvements were observed in both pain and SBI across all groups, and the post-test results indicated that the Neural Mobilization and Core Muscle Stabilization groups showed more substantial reductions in pain and SBI than the Control group (Table 2).

Pressure Biofeedback and Hip Range of Motion (ROM) were compared between the three groups at both the pre-test and post-test assessments. For Pressure Biofeedback, the pre-test measurements ranged from 28 to 45 mmHg in Group A (Neural Mobilization), with a mean of 37 ± 4.55 mmHg, from 25 to 45 mmHg in Group B (Core Muscle Stabilization), with a mean of 35.63 ± 5.28 mmHg, and from 25 to 43 mmHg in Group C (Control), with a mean of 36.40 ± 4.59 mmHg. After the intervention, all groups showed significant improvements. mmHg; Group A, post-test range was 40-62 mmHg, with a mean of 52.40 ± 5.13 mmHg; Group B, range–35-56 mmHg, with a mean of 48.93 ± 5.54 mmHg; and Group C, range–30-55 mmHg, with a mean of 46.33 ± 4.59 mmHg. The paired t-test indicated significant improvements in all groups ($p < 0.001$). However, the between-group comparison using the F-test for ANOVA showed no significant difference in the pre-test pressure biofeedback values ($F = 0.629$, $p > 0.05$), but a significant difference in the post-test values ($F = 8.686$, $p < 0.001$), suggesting that the Neural Mobilization and Core Muscle Stabilization groups showed greater improvement than the Control group.

Regarding Hip Range of Motion, the pre-test measurements in Group A (Neural Mobilization) ranged from 21 to 32°, with a mean of 27.17 ± 3.34°; in Group B (Core Muscle Stabilization), the range was 20 to 40°, with a mean of 27.53 ± 3.71 °; and in Group C (Control), the range was 22 to 32°, with a mean of 27.13 ± 2.93°. Post-intervention, Group A showed a significant increase in hip ROM, with a range of 37-46° and a mean of 42.17 ± 3.34°; Group B, range was 30-42°, with a mean of 27.53 ± 3.71°; and Group C, range of 31-41°, with a mean of 36.63 ± 2.32°. The paired t-test confirmed significant improvements in hip ROM in all groups ($p < 0.001$). The between-group comparison using the F-test for ANOVA revealed no significant difference in the pre-test hip ROM values ($F = 0.132$, $p > 0.05$), but a significant difference in the post-test values ($F = 28.678$, $p < 0.001$), indicating that Group A (Neural Mobilization) showed the greatest improvement in hip ROM, followed by Group C (Control), with Group B showing less improvement than the other two groups. All groups demonstrated significant improvements in both pressure biofeedback and hip ROM; however, the Neural Mobilization group showed the greatest improvements, especially in pressure biofeedback. There was a significant difference in the post-test measurements of both outcome measures between groups (Table 3).

4 DISCUSSION

The present study compared the effectiveness of Neural Mobilization and Core Muscle Strengthening in treating patients with sciatica, with a focus on pain reduction, disability improvement, and functional outcomes. The results demonstrated significant improvements in all outcome measures across both experimental groups (NM and CMS), highlighting the efficacy of these interventions in managing sciatica symptoms. The study comparing neural mobilization and core muscle strengthening in patients with sciatica found no significant differences in gender and age distribution across the groups, ensuring that these variables did not confound the results. The significant pain reduction observed in both the NM and CMS groups aligns with previous studies supporting the role of physical therapy in the management of sciatic pain. Neural mobilization alleviates nerve root tension and effectively reduces pain, while core muscle strengthening improves spinal stability, thereby reducing strain on the lumbar spine. Neural mobilization has been shown to be effective in reducing pain and improving function in patients with lower back pain, as supported by multiple systematic reviews and meta-analyses. A systematic review indicated that NM effectively decreases mechanical sensitivity and enhances functional ability in patients with lower back pain and sciatica.[4,5] A meta-analysis revealed that NM interventions led to improved Visual Analog Scale and Oswestry Disability Index scores, indicating better pain management and functional outcomes.[6] In contrast, some studies suggest that NM may not be universally effective, with varying results across different populations and conditions.[6] This indicates that, while NM is promising, further research is needed to establish its efficacy relative to core strengthening in diverse patient groups.

Table 2: Comparison of pain (NPRS) and Sciatica Bothersome Index (SBI) scores in patients with sciatica across the three groups

Pain (NPRS)					
Groups	**Pre-test**		**Post-test**		**Wilcoxon test, p value**
	Range	**Mean ± SD**	**Range**	**Mean ± SD**	
Group A (Neural mobilization)	6-10	8.17 ± 1.05	0-5	2.93 ± 1.23	Z=4.817, p < 0.001*
Group B (Core muscle stabilization)	6-10	8.13 ± 1.21	1-6	3.33 ± 1.24	Z=4.826, p < 0.001*
Group C (Control)	7-10	8.37 ± 0.89	4-7	5.17 ± 0.98	Z=3.249, p < 0.001*
Between groups comparison / Krushkal Wallis test	Chi-square value=1.098, p > 0.05		Chi-square value=8.428, p < 0.001*		
Sciatica Bothersome Index (SBI)					
Groups	**Pre-test**		**Post-test**		**Wilcoxon test, p value**
	Range	**Mean ± SD**	**Range**	**Mean ± SD**	
Group A (Neural mobilization)	15-24	19.47 ± 2.31	6-13	9.70 ± 2.04	Z=4.987, p < 0.001*
Group B (Core muscle stabilization)	15-24	19.67 ± 2.60	7-17	11.20 ±3.32	Z=4.286, p < 0.001*
Group C (Control)	15-24	19.70 ± 2.64	9-19	14.30 ± 2.40	Z=3.792, p < 0.001*
Between groups comparison / Krushkal Wallis test	Chi-square value=0.453, p > 0.05		Chi-square value=9.463, p < 0.001*		

*Significant

Table 3: Comparison of Pressure Biofeedback and Hip Range of Motion (ROM) in patients with sciatica across the three groups

Pressure biofeedback (mmhg)					
Groups	**Pre-test**		**Post-test**		**Paired t-test, p value**
	Range	**Mean ± SD**	**Range**	**Mean ± SD**	
Group A (Neural mobilization)	28-45	37 ± 4.55	40-62	52.40 ± 5.13	t=17.481, p < 0.001*
Group B (Core muscle stabilization)	25-45	35.63 ± 5.28	35-56	48.93 ± 5.54	t=11.323, p < 0.001*
Group C (Control)	25-43	36.40 ± 4.59	30-55	46.33 ± 4.59	t=8.292, p < 0.001*
Between groups comparison / F-test for ANOVA	Fe=0.629, p > 0.05		F=8.686, p < 0.001*		
Hip (ROM)					
Group A (Neural mobilization)	21-32	27.17 ± 3.34	37-46	42.17 ± 3.34	t=34.340, p < 0.001*
Group B (Core muscle stabilization)	20-40	27.53 ± 3.71	30-42	27.53 ± 3.71	t=18.780, p < 0.001*
Group C (Control)	22-32	27.13 ± 2.93	31-41	36.63 ± 2.32	t=14.397, p < 0.001*
Between groups comparison / F-test for ANOVA	F = 0.132, p > 0.05		F = 28.678, p < 0.001*		

*Significant

Core muscle strengthening is another common intervention for sciatica that focuses on stabilising the spine and improving posture. Core strengthening exercises, particularly McGill-type exercises, have been shown to enhance stability and reduce pain in patients with conditions like piriformis syndrome, suggesting potential benefits for sciatica as well.[7] While core strengthening is beneficial, it may not provide immediate pain relief that NM offers, highlighting the need for a combined approach in treatment protocols. The current study's results align with literature suggesting that both interventions can be beneficial, but neural mobilization may offer more direct relief for nerve-related symptoms.[8]

In the present study, both interventions demonstrated substantial reductions in pain intensity and the Sciatica Bothersome Index (SBI) post-treatment, outperforming the control group. This aligns with recent literature that supports NM as an effective treatment for low back and radicular pain, highlighting its immediate hypoalgesic effects.[9,10] Pain reduction was observed in all groups. At baseline, pain scores ranged from 6 to 10 in all groups. After the intervention, the NM group showed the greatest reduction, followed by the CMS group (3.33 $\pm$ 1.24) and the Control group (5.17 $\pm$ 0.98). All groups showed significant pain reduction ($p < 0.001$), with the NM and CMS groups showing significantly greater improvements than the Control group. Disability improvement, as measured by SBI, was observed in all groups. The pre-test SBI scores were similarly high across all groups, ranging from 15 to 24. Post-test scores revealed a significant reduction: the NM group had a mean of 9.70 $\pm$ 2.04, the CMS group had 11.20 $\pm$ 3.32, and the Control group had 14.30 $\pm$ 2.40. Statistical analysis showed significant improvements, with the NM and CMS groups showing greater reductions than the Control group.

The present study revealed significant improvements in both pressure biofeedback and hip range of motion (ROM) across all groups, with NM showing the most pronounced benefits. Improvements in Pressure Biofeedback were observed in all the groups. In the pre-test, Group A (NM) had a mean of 37 mmHg, Group B (CMS) had 35.63 mmHg, and Group C (Control) had 36.40 mmHg. After the intervention, Group A showed the greatest improvement, with a post-test mean of 52.40 mmHg, followed by Group B with 48.93 mmHg, and Group C with 46.33 mmHg. ANOVA indicated significant differences in post-test values ($F = 8.686$, $p < 0.001$), highlighting the superior effectiveness of the Neural Mobilization (NM) group as demonstrated by Peacock et al and Chen et al.[6,9] Hip Range of Motion (ROM) improvements were also observed in all groups. At the pre-test, Group A had a mean of 27.17°, Group B had 27.53°, and Group C had 27.13°. The post-test measurements showed significant improvements, with Group A increasing to 42.17°, Group B to 37.53°, and Group C to 36.63°.ANOVA revealed significant differences in post-test values ($F = 28.678$, $p < 0.001$), with the Neural Mobilization group demonstrating the greatest improvement, as was evident in the studies conducted by Anwar et al. and Walia.[11–13] NM showed superior outcomes in the current study, some literature suggests variability in effectiveness, indicating that individual responses to treatment can differ significantly.[14] This highlights the need for personalised treatment approaches in managing sciatica, and some studies have suggested that other physiotherapy strategies may also yield comparable results.[15,16] Future research should focus on the long-term effects and compare neural mobilization with other interventions, including core muscle strengthening, to establish comprehensive treatment protocols.

5 CONCLUSION

Both Neural Mobilization and Core Muscle Stabilization were individually effective in reducing pain, improving the Sciatica Bothersome Index, enhancing pressure biofeedback, and increasing hip range of motion in patients with sciatica. However, Neural Mobilization demonstrated significantly greater improvements in all these outcomes than Core Muscle Stabilization and the Control group. Specifically, neural mobilization was found to be more effective in reducing pain, alleviating sciatica-related discomfort, enhancing pressure biofeedback, and improving hip ROM. Based on these findings, it can be concluded that Neural Mobilization is a superior and beneficial therapeutic approach for treating patients with sciatica, offering a promising alternative to conventional therapy and core muscle strengthening interventions.

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