



Effect of Neural Mobilization Combined with Conventional Physiotherapy on Disability and Cervical Mobility in Patients with Cervical Radiculopathy: A Comparative Study

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ABSTRACT:

Cervical radiculopathy is a condition associated with neck and upper-limb pain, restricted cervical mobility, sensory symptoms, and functional disability. Nerve flossing is a neural mobilization technique that may improve neural mobility and reduce symptoms; however, limited evidence is available regarding its additional effects when combined with conventional physiotherapy in individuals with cervical radiculopathy. This study aimed to determine the efficacy of nerve flossing added to conventional therapy in patients with cervical radiculopathy. An experimental study was conducted among 32 patients aged 30–70 years who were randomly allocated into two groups of 16 participants each. Group A received nerve flossing combined with conventional therapy, while Group B received conventional therapy alone. Both groups underwent treatment for four weeks, with three sessions per week. Outcomes were assessed using the Neck Disability Index (NDI) and cervical range of motion (ROM), measured using a universal goniometer before and after the intervention. Within-group changes were analysed using paired-samples t-tests, while between-group changes were compared using the Mann–Whitney U test. Both groups demonstrated statistically significant improvements in NDI and all measured cervical ROM parameters following the intervention ($p < 0.001$). Group A showed a greater reduction in NDI (26.63 points) than Group B (20.00 points). Between-group analysis revealed statistically significant differences in NDI improvement ($p = 0.021$) and all cervical ROM parameters ($p < 0.001$), with effect sizes ranging from moderate to very large. These findings indicate that both treatment approaches were associated with significant improvements in disability and cervical range of motion; however, adding nerve flossing to conventional therapy resulted in greater improvements than conventional therapy alone.

Keywords: Cervical Radiculopathy, Cervical Range of Motion, Conventional Therapy, Neck Disability Index, Nerve Flossing, Neural Mobilization.

INTRODUCTION:

Pain in one or both upper extremities, frequently accompanied by neck pain is referred to as cervical radiculopathy. This condition is caused by compression or irritation of nerve roots in the cervical spine. A motor or sensory or reflex impairment may accompany it.⁽¹⁾ Cervical radiculopathy can present with a variety of signs and symptoms, including neck and unilateral arm pain accompanied by numbness, paralysis, or altered reflexes, depending on the segments affected and the extent of neurological dysfunction.⁽²⁾ Other common presentations include occipital headaches, inter-scapular discomfort, and more widespread non-dermatological arm aches.⁽³⁾ Over half of all instances involve the C7 nerve root, which is the most commonly affected. In about 25% of instances, the C6 nerve root is affected. C1 through C5 and C8 nerve roots are less affected. Radicular disease risk factors include driving, using vibrating machinery, and performing physical labour including heavy lifting, smokers.⁽⁴⁾ Disc herniation, spondylitic spurs or cervical osteophytes caused by inflammation of cervical nerve root result in the narrowing of the intervertebral foramen this condition impacts 85 individuals per 100,000 annually.⁽⁵⁾ Cervical radiculopathy refers to the pathological condition resulting from compression and inflammation of the cervical spinal nerve or nerve root. The leading causes of this condition are cervical disc herniation and cervical spondylosis.⁽²⁾ Radicular symptoms can arise from any condition that compresses or irritates a spinal nerve root. In younger individuals, particularly those in their third and fourth decade, disc trauma and herniation are the primary reasons for nerve impingement. As people tend to age, the causes shift to degenerative issues, with disc degeneration being the leading factor for those in their fifth and sixth decade. By the seventh decade, foraminal narrowing due to arthritis becomes the main cause. In most cases of cervical radiculopathy, inflammation serves as the primary pathophysiologic mechanism. This inflammatory response maybe triggered by an acute herniation of a nearby cervical, which impinges upon the nerve root. Additionally, inflammation can worsen pre-existing degenerative changes, allowing disc degeneration-related alterations to further compress then nerve root. This mechanical compression, coupled with inflammation leads to clinical manifestations such as pain, numbness, tingling, and muscle weakness.⁽⁴⁾ Other factors leading to nerve root compression frequently exhibit a distinct set of symptoms. Spinal tumours are primarily responsible for myelopathy but conditions like osteochondromas and schwannomas can lead to radiculopathy. Since these tumours usually develop within the dura mater, symptoms can worsen with the Valsalva Maneuver. Tumours originating from the thyroid, oesophagus, pharynx, and lung tissues have been noted to compress specific cervical nerves beyond the neural foramen, along with sarcoidosis and arteriovenous malformations.⁽¹⁾ The Spurling test is a well-validated Maneuver known for its high specificity and sensitivity. It consists

of passively moving the patient's neck into lateral flexion and extension, followed by gentle downward axial compression. The aim of this Maneuver is to narrow the neural foramen, with a positive result indicated by the recreation of radicular symptoms.⁽¹⁾ The upper limb tension test, although more complex and less frequently used, is the most sensitive method for excluding cervical radiculopathy. It is analogous to the straight leg raise test used for the lumbar spine in assessing cervical nerve tension. This test begins with the patient lying supine, with the shoulder in a neutral position and the elbow and wrist flexed. The examiner then abducts the shoulder to 90 degrees, extends the elbow and fingers, and extends and supinates the wrist while the patient tilts their neck to both the opposite and same sides. A positive outcome is indicated by the reproduction of pain at any stage of the maneuver.⁽¹⁾ The most common basis for diagnosing cervical radiculopathy is clinical indications and symptoms that are consistent with nerve root compression seen by medical imaging (such as computer tomography or magnetic resonance imaging, or MRI).⁽⁶⁾ Cervical radiculopathy is often associated with neck stiffness and restricted mobility, leading to symptoms such as neck and arm pain, tingling, and muscle weakness, which can interfere with daily activities. Physiotherapy interventions like nerve flossing works on central neuromodulator mechanisms, improving neural mobility. Therefore, as there is limited evidence on using nerve flossing in cervical radiculopathy and the potential benefits it may offer this intervention have been selected for study.

AIM:

To determine the efficacy of nerve flossing added with conventional therapy in patients with cervical radiculopathy.

OBJECTIVES:

1. To evaluate the effectiveness of conventional therapy in patients with cervical radiculopathy.
2. To evaluate the effectiveness of nerve flossing added with conventional therapy in patients with cervical radiculopathy.
3. To compare the effect of conventional therapy and nerve flossing added with conventional therapy in patients with cervical radiculopathy.

REVIEW OF LITERATURE:

1. Dr. A. K. Vijay Krisha Kumar, Lakshmi Bharia, and Chetana R. (2024) conducted a pre-post experimental study on 40 participants aged 35–65 years with cervical radiculopathy. The experimental group received neural flossing with conventional therapy, while the control group received conventional therapy alone. Outcomes assessed using NPRS, NDI, cervical ROM, and shoulder ROM showed greater improvement in pain reduction, functional ability, and mobility in the neural flossing group.⁽⁷⁾
2. Rafiq et al. (2022) conducted a randomized controlled trial involving 88 patients aged 35–50 years with cervical radiculopathy. Participants were divided into neural mobilization and conventional treatment groups for 4 weeks. Outcomes were assessed using NPRS, cervical ROM, and NDI. Both groups showed significant improvement, with neural mobilization producing greater improvement in pain and disability.⁽⁸⁾
3. Ali M. Alshami and Duaa A. Bamhair [2021] conducted a double-blind RCT on 28 chronic cervical radiculopathy patients, comparing cervical mobilization + exercise to minimal pressure + exercise over 6 sessions. Outcomes (NPRS, NDI, PPT, HPT/CPT, ROM) showed significant pain, disability, ROM, and mechanical hypersensitivity improvements in the experimental group, with no thermal sensitivity change. They concluded cervical mobilization with exercises showed significant effect.⁽⁹⁾
4. Varsha Gore, Harshada Patil, and Akshay Chogule [2020] conducted an experimental study on 28 patients with unilateral cervical radiculopathy (aged 30–50 years) comparing cervical manual traction and TENS alone with the same plus neural tissue mobilization. Over 2 weeks (5 sessions per week), both groups improved in pain (NPRS) and function (PSFS), but the combination therapy group had significantly greater reductions in pain and disability ($p \leq 0.05$). The study concluded that adding neural tissue mobilization to conventional therapy enhances clinical outcomes.⁽¹⁰⁾
5. Cheatham, Morey J Kolber, Monique Mokha, William J Hanney [2018] conducted a study to examine the concurrent validity of the Numeric Pain Rating Scale (NPRS) with the Visual Analog Scale (VAS) in individuals with myofascial pain syndrome (MPS) and fibromyalgia. The study included 60 participants (30 MPS, 30 FM) assessed using 18 tender points according to the American College of Rheumatology criteria. Pain intensity was measured using both NPRS and VAS in a single session. Results showed an excellent correlation between NPRS and VAS for MPS ($\rho \geq 0.81$) and FM ($\rho \geq 0.96$). The study concluded that NPRS is a valid, reliable, and practical alternative to VAS for chronic pain assessment in clinical settings.⁽¹¹⁾
6. Vijay Kage and Gayatri Gurav [2017] conducted a pre-post experimental study on 30 patients with acute or sub-acute trapezitis, treated with neural flossing for four days. Pain (VAS), cervical ROM, and function (NDI) were measured before and after intervention. Results showed 96% pain reduction, significant ROM gains, and 78.19% improvement in NDI ($p=0.0001$). Neural flossing proved effective in decreasing pain, improving neck mobility, and enhancing function, though follow-up and blinding were lacking.⁽¹²⁾
7. Sanjiv Kumar and Lama [2014] studied 30 cervical radiculopathy patients using self-neural flossing. The pre-post design showed a significant immediate reduction in pain, slight functional improvement, but no significant change in cervical ROM. The authors concluded that self-flossing is helpful for immediate pain relief and recommended further studies with larger samples.⁽¹³⁾

8. Yee Won, Hadafi Fitri Mohd Latip, and Mohd Sharizal Abdul Aziz [2014] conducted a review to evaluate the reliability and validity of cervical range of motion measuring tools. The study analysed commonly used instruments such as motion analysis systems, smartphones, goniometers, and tape measurements. Assessment methods were compared across different cervical conditions, age groups, and testing positions. The authors concluded that CROM devices, inclinometers, and smartphone-based tools are reliable and cost-effective for clinical. ⁽¹⁴⁾

METHODOLOGY:

The study was an experimental study conducted over six months in the Musculoskeletal Physiotherapy OPD among patients with cervical radiculopathy, using simple random sampling with a sample size of 32 participants. The study included male and female patients aged 30–70 years presenting with unilateral radiating upper-limb pain, reduced cervical range of motion, and positive Spurling's test and ULTT 1. Patients unwilling to participate, those with recent neck injuries or fractures, previous neck surgery, neurological disorders such as myelopathy or multiple sclerosis, and pain intensity greater than 6/10 on the Numeric Pain Rating Scale (NPRS) were excluded. The outcome measures included the Neck Disability Index (NDI) and shoulder joint range of motion, assessed using a universal goniometer. Following ethical approval and informed consent, eligible participants were assessed at baseline and randomly allocated into two groups. Group A received nerve flossing exercises along with conventional therapy, including moist heat, transcutaneous electrical nerve stimulation (TENS), cervical isometric exercises, and active cervical range of motion exercises, while Group B received conventional therapy alone. Nerve flossing was performed for one set of 10 repetitions, three sessions per week for four weeks, within a pain-free range. Post-intervention assessments were conducted using the specified outcome measures, and statistical analysis was performed to compare the effects of both treatment approaches.

RESULTS:

The data were collected and entered in the master sheet and the findings are presented under the following headings.

SECTION 1:

1. Description of personal variables of the samples.
2. Description of mean NDI and cervical range of motion scores before and after intervention among patients with cervical radiculopathy.

SECTION 2:

1. Findings related to the effect of nerve flossing added with conventional therapy in patients with cervical radiculopathy.
2. Findings related to the effect of conventional therapy in patients with cervical radiculopathy.

SECTION 3:

1. Findings related to comparison between nerve flossing added with conventional therapy and conventional therapy alone.

SECTION 1: 1. DESCRIPTION OF PERSONAL VARIABLES OF THE SAMPLES:

A total of 32 patients with cervical radiculopathy were included in the study and were divided into two groups. Group A consisted of 16 participants who received nerve flossing added with conventional therapy, whereas Group B consisted of 16 participants who received conventional therapy alone.

Demographic Variable - Age	Group A n (%)	Group B n (%)
30 to 39 years	4 (25.0%)	5 (31.3%)
40 to 49 years	6 (37.5%)	6 (37.5%)
50 to 59 years	4 (25.0%)	3 (18.8%)
60 to 69 years	2 (12.5%)	2 (12.5%)

Table 1: Distribution of samples according to age

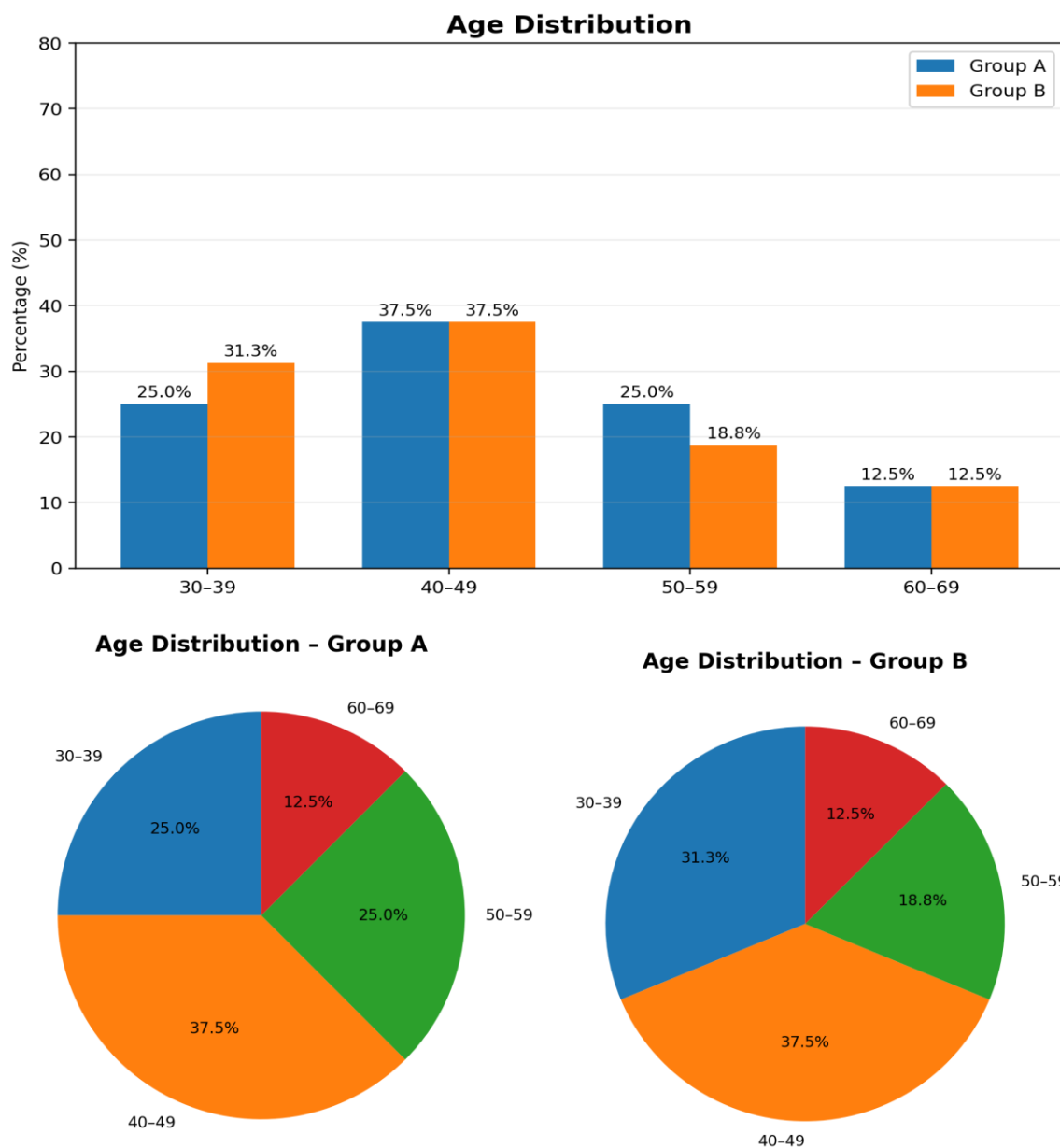


Figure 1. Age distribution of participants in Group A and Group B.

Age: The age of the participants ranged from 30 to 65 years in Group A and from 30 to 66 years in Group B. The mean age was 44.75 ± 10.59 years in Group A and 44.25 ± 10.05 years in Group B.

Demographic Variable - Gender	Group A n (%)	Group B n (%)
Male	8 (50.0%)	10 (62.5%)
Female	8 (50.0%)	6 (37.5%)

Table 2: Distribution of samples according to Gender



Figure 2. Gender distribution of participants in Group A and Group B.

Gender: In Group A, 8 (50.0%) participants were male and 8 (50.0%) were female. In Group B, 10 (62.5%) were male and 6 (37.5%) were female.

Demographic Variable - Affected Side	Group A n (%)	Group B n (%)
Right	9 (56.3%)	10 (62.5%)
Left	7 (43.8%)	6 (37.5%)

Table 3: Distribution of samples according to Affected side

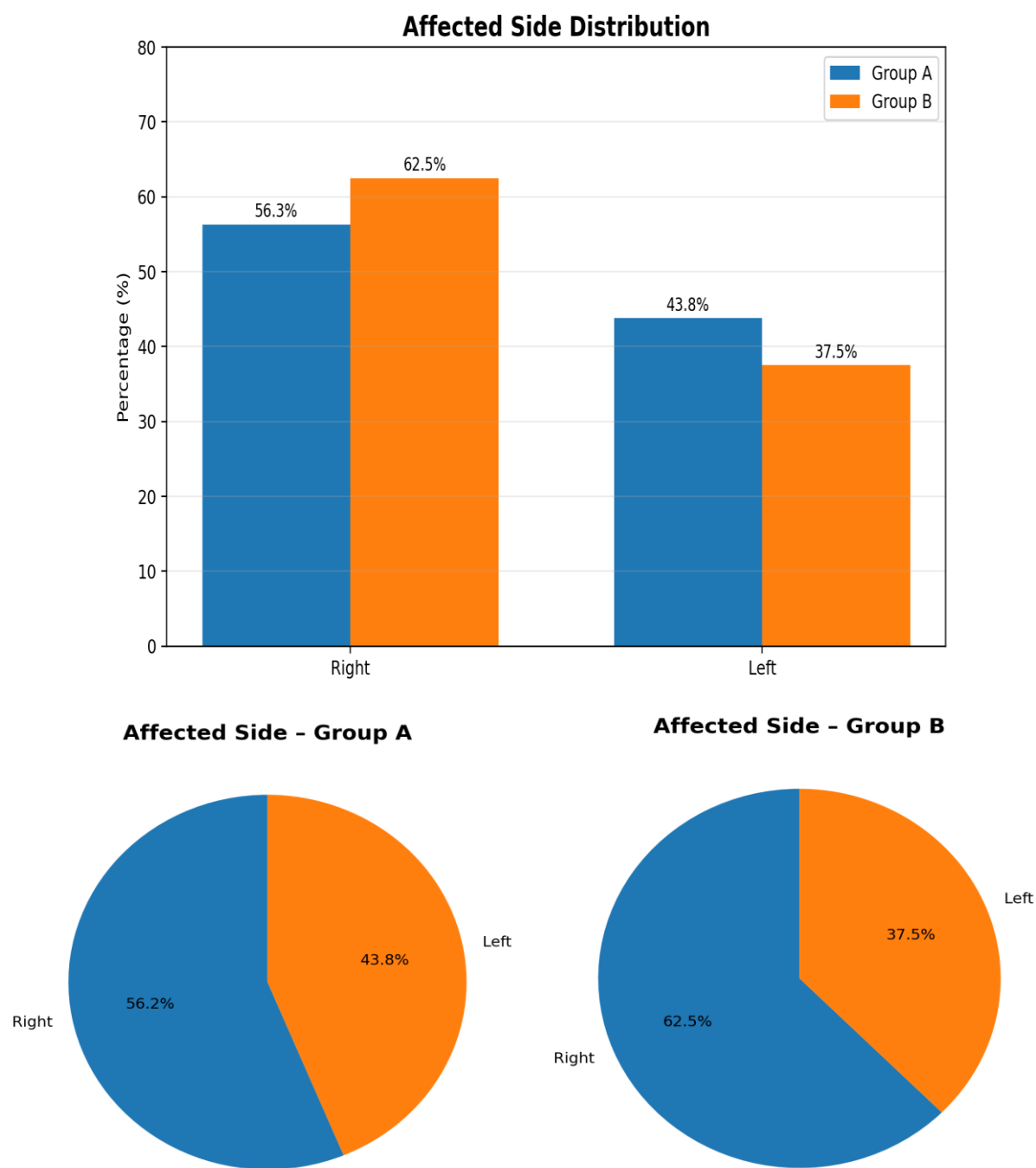


Figure 3. Affected Side distribution of participants in Group A and Group B.

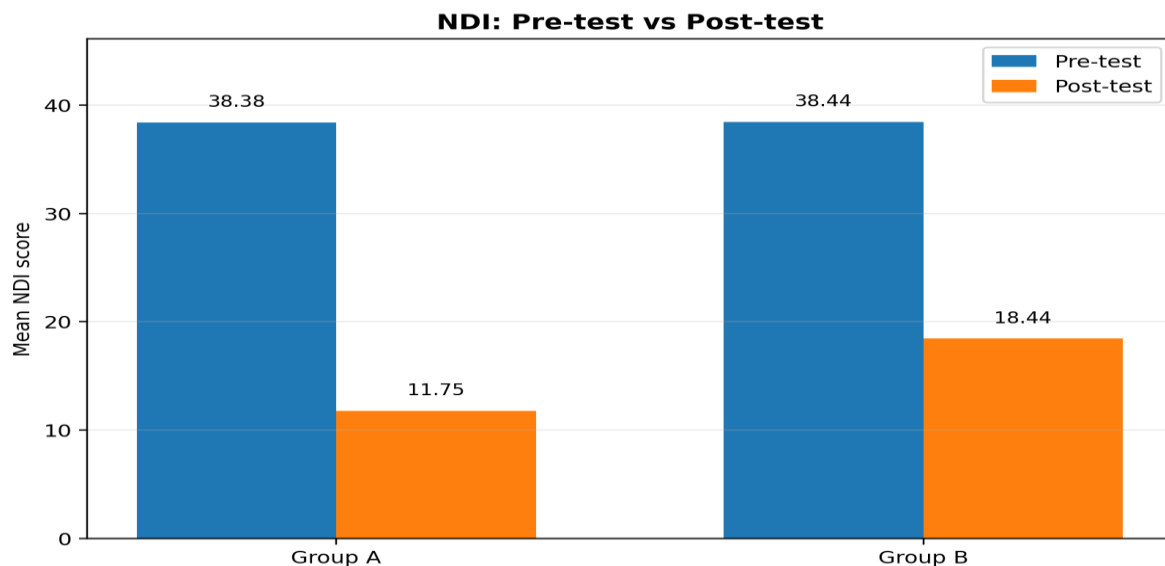
Affected side: In Group A, 9 (56.3%) participants had right-sided involvement and 7 (43.8%) had left-sided involvement. In Group B, 10 (62.5%) had right-sided involvement and 6 (37.5%) had left-sided involvement.

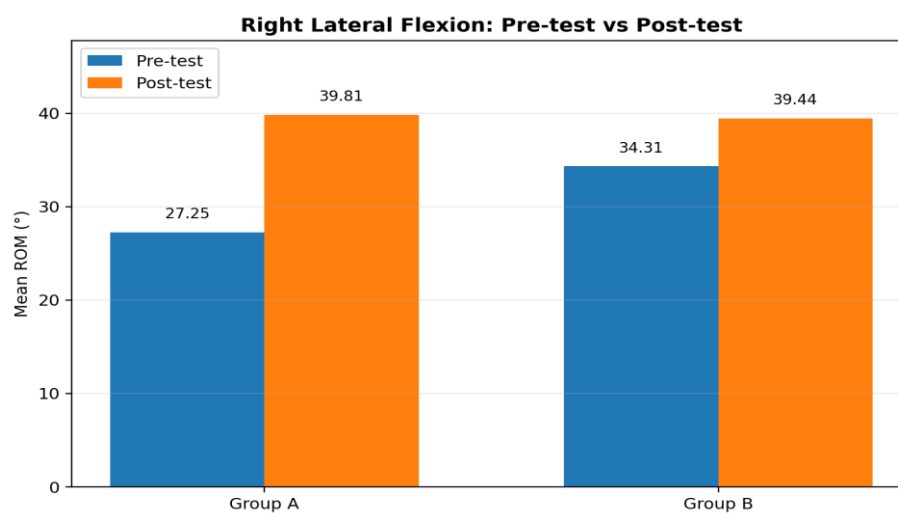
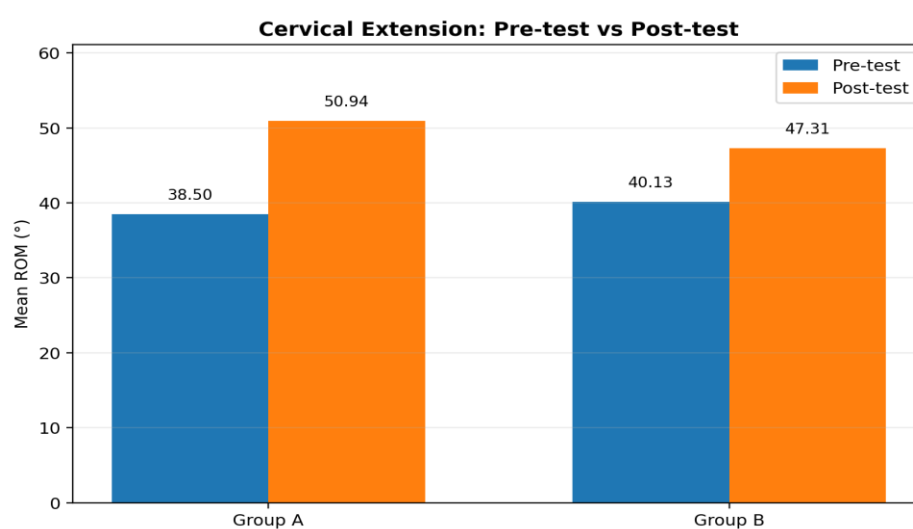
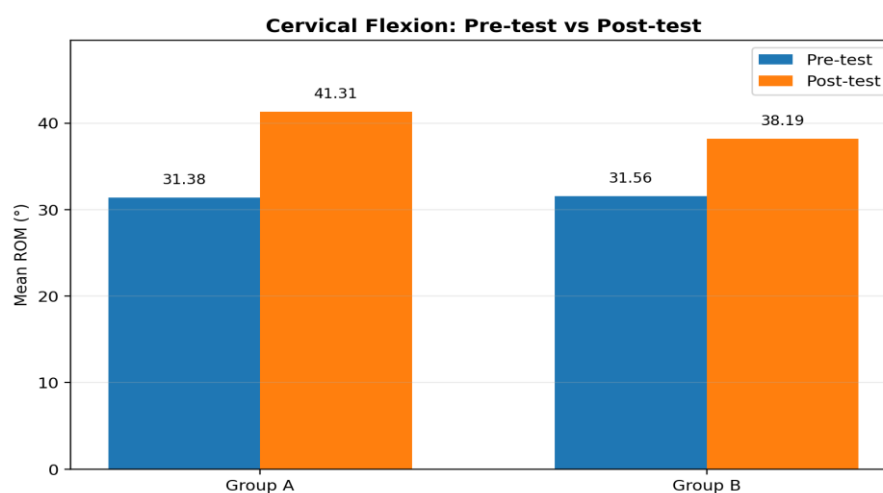
1. DESCRIPTION OF MEAN NDI AND CERVICAL RANGE OF MOTION SCORES BEFORE AND AFTER INTERVENTIONS

Table 4: Mean and standard deviation of NDI and cervical ROM scores before and after interventions

Parameter	Group A Pre-test Mean ± SD	Group A Post-test Mean ± SD	Group B Pre-test Mean ± SD	Group B Post-test Mean ± SD
NDI	38.38 ± 11.53	11.75 ± 4.33	38.44 ± 11.71	18.44 ± 5.34
Cervical flexion	31.38 ± 3.34°	41.31 ± 2.12°	31.56 ± 4.34°	38.19 ± 4.95°
Cervical extension	38.50 ± 3.72°	50.94 ± 1.61°	40.13 ± 3.84°	47.31 ± 3.63°
Right lateral flexion	27.25 ± 4.37°	39.81 ± 3.64°	34.31 ± 6.80°	39.44 ± 5.36°
Left lateral flexion	30.00 ± 5.93°	39.88 ± 4.38°	32.25 ± 6.11°	37.69 ± 5.34°
Right lateral rotation	47.19 ± 4.40°	61.19 ± 3.53°	46.00 ± 4.40°	51.88 ± 3.65°
Left lateral rotation	50.44 ± 3.12°	63.38 ± 3.59°	48.69 ± 4.53°	54.50 ± 4.24°

The data presented in Table 4 reveal improvement in NDI and cervical range of motion following intervention in both groups. In Group A, the mean NDI score decreased from 38.38 ± 11.53 to 11.75 ± 4.33. Cervical flexion increased from 31.38 ± 3.34° to 41.31 ± 2.12°, while cervical extension increased from 38.50 ± 3.72° to 50.94 ± 1.61°. Similarly, right and left lateral flexion and bilateral cervical rotation demonstrated improvement following intervention. In Group B, the mean NDI score decreased from 38.44 ± 11.71 to 18.44 ± 5.34. Improvements were also observed in all cervical ROM parameters following conventional therapy.





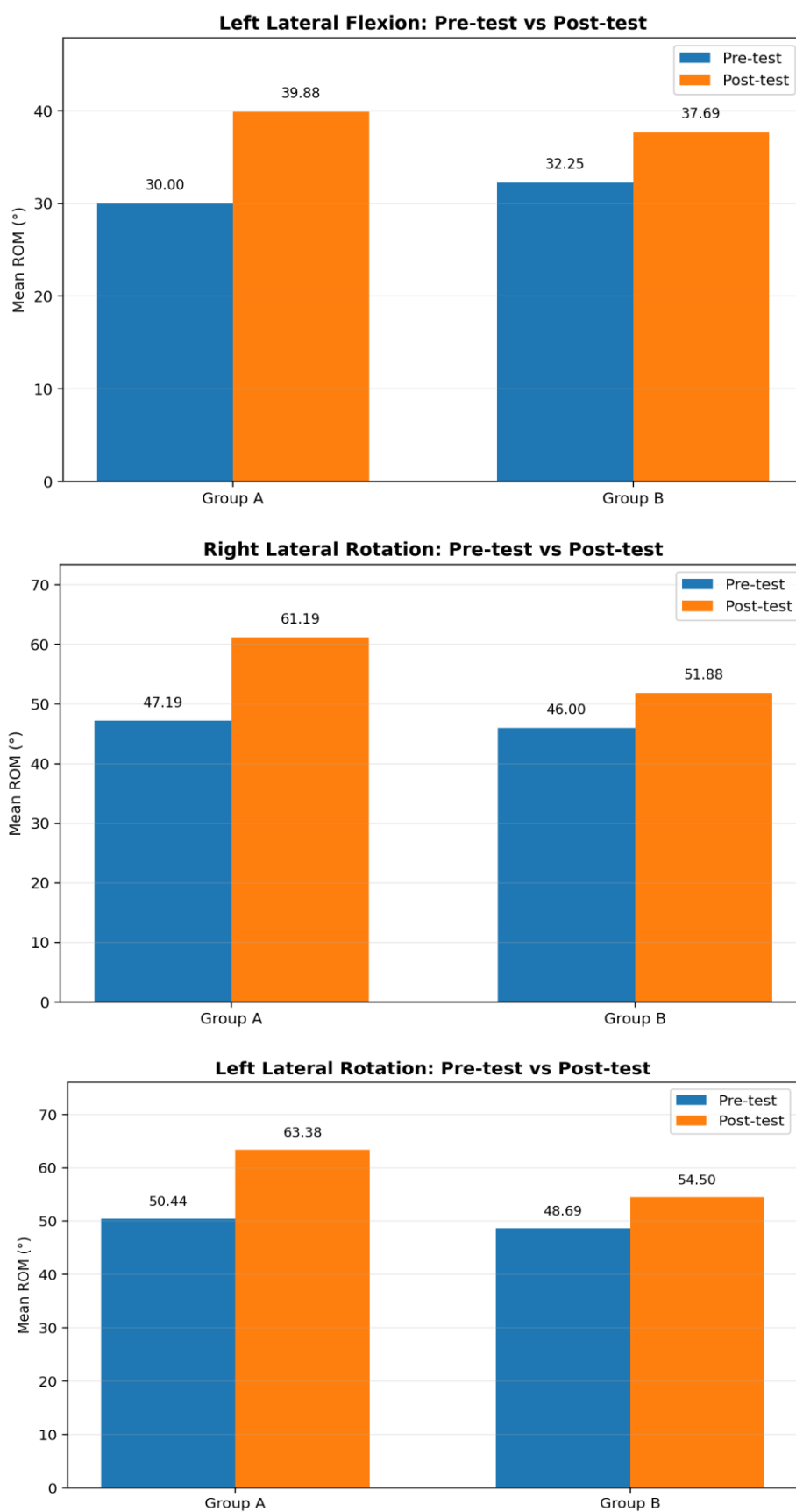


Figure 4. Comparison of outcome measures before and after intervention in Group A and Group B.

SECTION 2 –

1. FINDINGS RELATED TO THE EFFECT OF NERVE FLOSSING ADDED WITH CONVENTIONAL THERAPY

Parameter	Mean change	SD of change	SE	t	df	p-value	95% CI of mean change
NDI	-26.63	7.88	1.97	13.513	15	<0.001	-30.82 to -22.43
Cervical flexion	+9.94°	2.41	0.60	16.511	15	<0.001	8.65 to 11.22
Cervical extension	+12.44°	4.52	1.13	11.016	15	<0.001	10.03 to 14.84
Right lateral flexion	+12.56°	2.90	0.72	17.342	15	<0.001	11.02 to 14.11
Left lateral flexion	+9.88°	3.16	0.79	12.501	15	<0.001	8.19 to 11.56
Right lateral rotation	+14.00°	4.62	1.15	12.124	15	<0.001	11.54 to 16.46
Left lateral rotation	+12.94°	2.91	0.73	17.789	15	<0.001	11.39 to 14.49

Table 5: Paired-samples t-test for NDI and cervical ROM in Group A

The data presented in Table 5 show the effect of nerve flossing added with conventional therapy in patients with cervical radiculopathy. A paired-samples t-test demonstrated statistically significant improvement in NDI and all cervical ROM parameters following intervention. The mean NDI reduction was 26.63 points, with $t(15) = 13.513$, $p < 0.001$. Cervical flexion improved by 9.94°, with $t(15) = 16.511$, $p < 0.001$, while cervical extension improved by 12.44°, with $t(15) = 11.016$, $p < 0.001$. Right lateral flexion, left lateral flexion, right lateral rotation and left lateral rotation also demonstrated statistically significant improvements ($p < 0.001$ for all). Thus, Group A demonstrated statistically significant pre- to post-treatment improvement in all measured outcome variables.

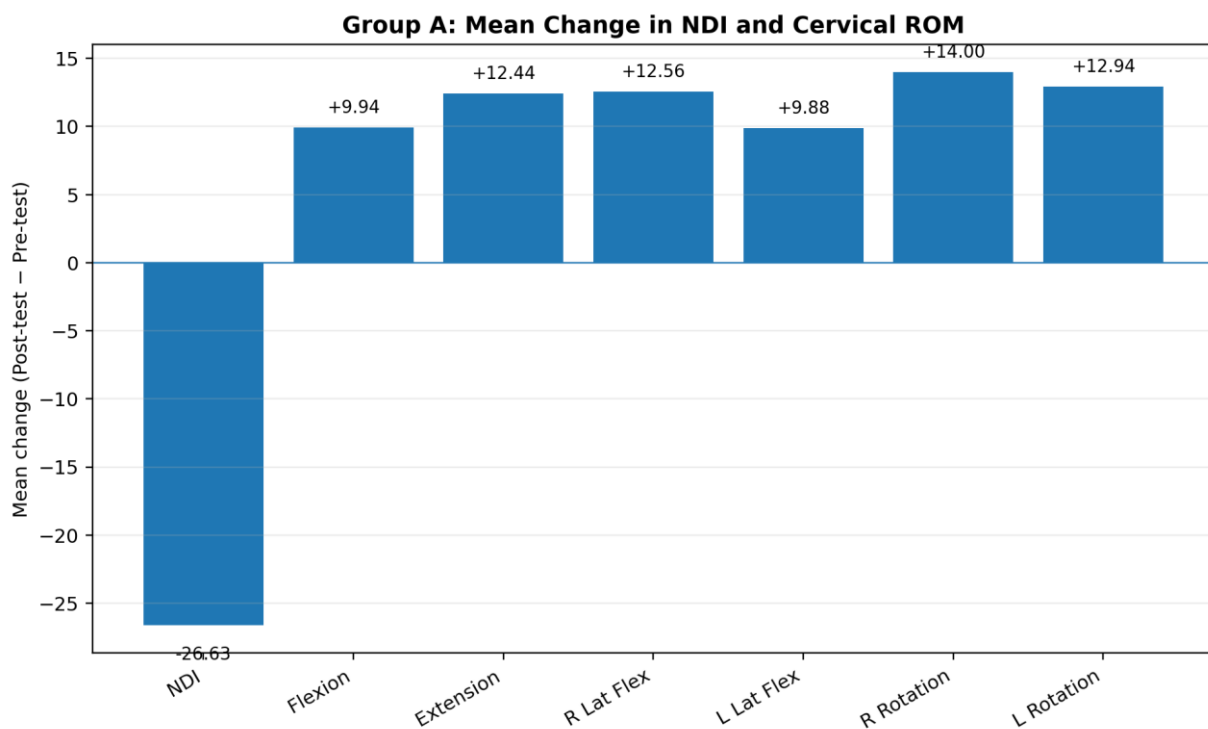


Figure 5. Mean change in NDI and cervical ROM scores in Group A following intervention.

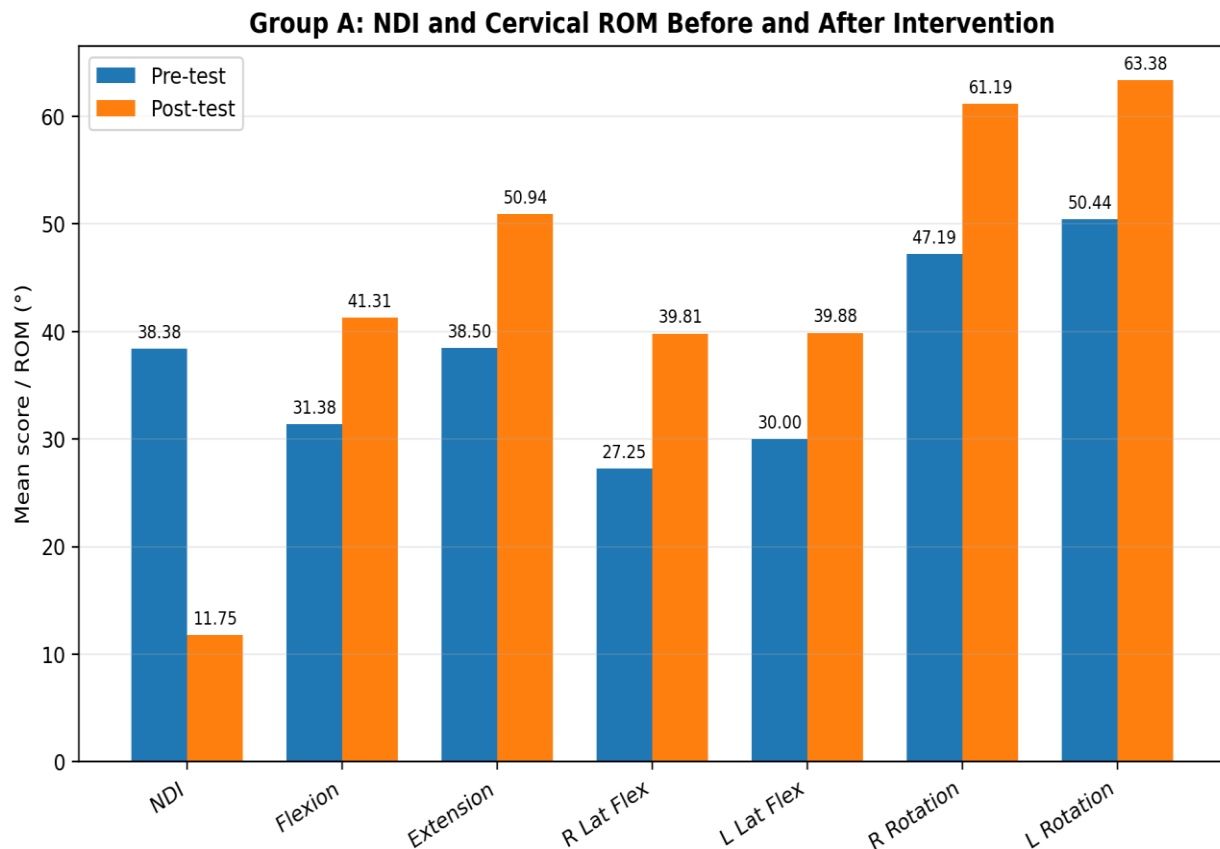


Figure 6. Comparison of mean pre-test and post-test NDI and cervical ROM scores in Group A.

2. FINDINGS RELATED TO THE EFFECT OF CONVENTIONAL THERAPY:

Parameter	Mean change	SD of change	SE	t	Df	p-value	95% CI of mean change
NDI	-20.00	7.80	1.95	10.260	15	<0.001	-24.15 to -15.85
Cervical flexion	+6.63°	2.25	0.56	11.792	15	<0.001	5.43 to 7.82
Cervical extension	+7.19°	2.32	0.58	12.415	15	<0.001	5.95 to 8.42
Right lateral flexion	+5.69°	2.82	0.71	8.062	15	<0.001	4.18 to 7.19
Left lateral flexion	+5.44°	1.50	0.38	14.460	15	<0.001	4.64 to 6.24
Right lateral rotation	+5.88°	1.75	0.44	13.456	15	<0.001	4.94 to 6.81
Left lateral rotation	+5.81°	2.37	0.59	9.799	15	<0.001	4.55 to 7.08

Table 6: Paired-samples t-test for NDI and cervical ROM in Group B

The data presented in Table 6 show the effect of conventional therapy among patients with cervical radiculopathy. A paired-samples t-test demonstrated statistically significant improvement in NDI and all cervical ROM parameters following intervention. The mean NDI reduction was 20.00 points, with $t(15) = 10.260$, $p < 0.001$. Cervical flexion improved by 6.63° and cervical extension by 7.19°, with both demonstrating statistically significant improvement ($p < 0.001$). Significant improvement was also observed in right and left lateral flexion and bilateral cervical rotation ($p < 0.001$). Thus, conventional therapy also produced statistically significant improvement in all measured outcome variables.

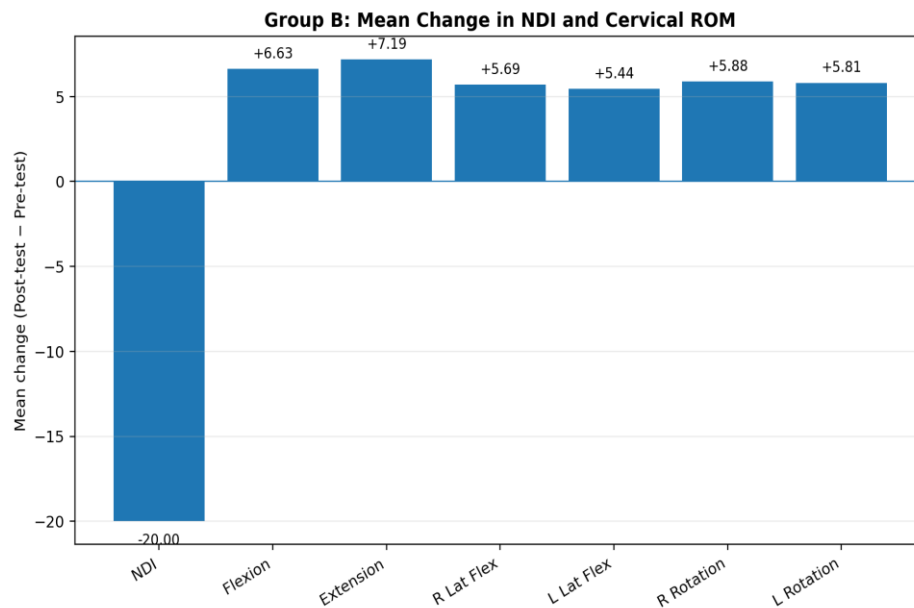


Figure 7. Mean change in NDI and cervical ROM scores in Group B following conventional therapy.

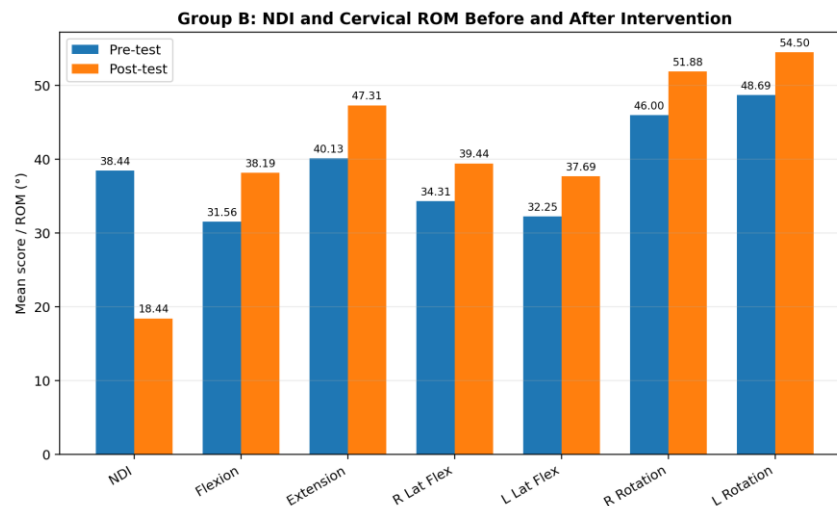


Figure 8. Comparison of mean pre-test and post-test NDI and cervical ROM scores in Group B.

SECTION 3:

1.FINDINGS RELATED TO COMPARISON BETWEEN NERVE FLOSSING ADDED WITH CONVENTIONAL THERAPY AND CONVENTIONAL THERAPY ALONE:

Parameter	Group A Mean Change	Group B Mean Change	U	Z	p-value	Effect size r
NDI	-26.63	-20.00	66.50	-2.324	0.021	0.411
Cervical flexion	+9.94°	+6.63°	221.00	3.561	<0.001	0.629
Cervical extension	+12.44°	+7.19°	218.00	3.427	<0.001	0.606
Right lateral flexion	+12.56°	+5.69°	243.50	4.426	<0.001	0.782
Left lateral flexion	+9.88°	+5.44°	228.50	3.859	<0.001	0.682
Right lateral rotation	+14.00°	+5.88°	251.50	4.688	<0.001	0.829
Left lateral rotation	+12.94°	+5.81°	246.50	4.504	<0.001	0.796

Table 7. Mann-Whitney U test comparing change scores between Group A and Group B

The data presented in Table 7 demonstrate a statistically significant difference in the magnitude of improvement between Group A and Group B. For NDI, Group A demonstrated a greater reduction in disability (26.63 points) compared with Group B (20.00 points), and this difference was statistically significant ($U = 66.50$, $Z = -2.324$, $p = 0.021$). For cervical flexion, Group A demonstrated a mean improvement of 9.94° , compared with 6.63° in Group B ($U = 221.00$, $Z = 3.561$, $p < 0.001$). Similarly, statistically significant between-group differences were observed for cervical extension, right lateral flexion, left lateral flexion, right lateral rotation and left lateral rotation ($p < 0.001$ for all). The effect sizes ranged from $r = 0.411$ to $r = 0.829$, indicating moderate to very large between-group effects.

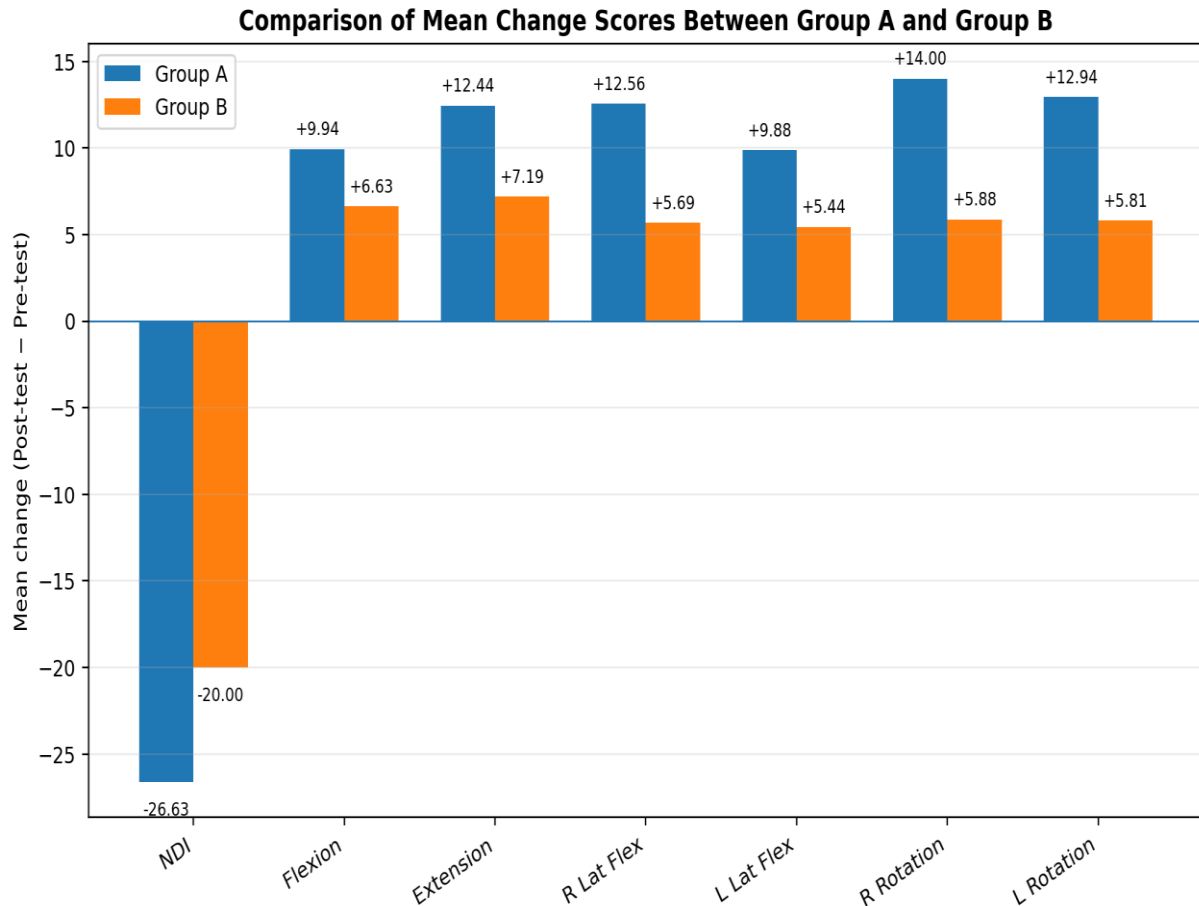


Figure 9. Comparison of mean change scores between Group A and Group B.

Parameter	Difference in change A to B	95% CI	Cohen's d
NDI	-6.63	-12.29 to -0.96	0.85
Cervical flexion	+3.31°	1.63 to 4.99°	1.42
Cervical extension	+5.25°	2.66 to 7.84°	1.46
Right lateral flexion	+6.88°	4.81 to 8.94°	2.40
Left lateral flexion	+4.44°	2.65 to 6.22°	1.79
Right lateral rotation	+8.13°	5.60 to 10.65°	2.33
Left lateral rotation	+7.13°	5.21 to 9.04°	2.68

TABLE 8: Between-group mean difference, 95% CI and Cohen's d

The results presented in Table 8 demonstrate that the difference in improvement between the two groups was substantial for the cervical ROM variables. Cohen's d ranged from 0.85 to 2.68, indicating large between-group effect sizes. The largest standardized differences were observed for left lateral rotation ($d = 2.68$), right lateral flexion ($d = 2.40$) and right lateral rotation ($d = 2.33$).

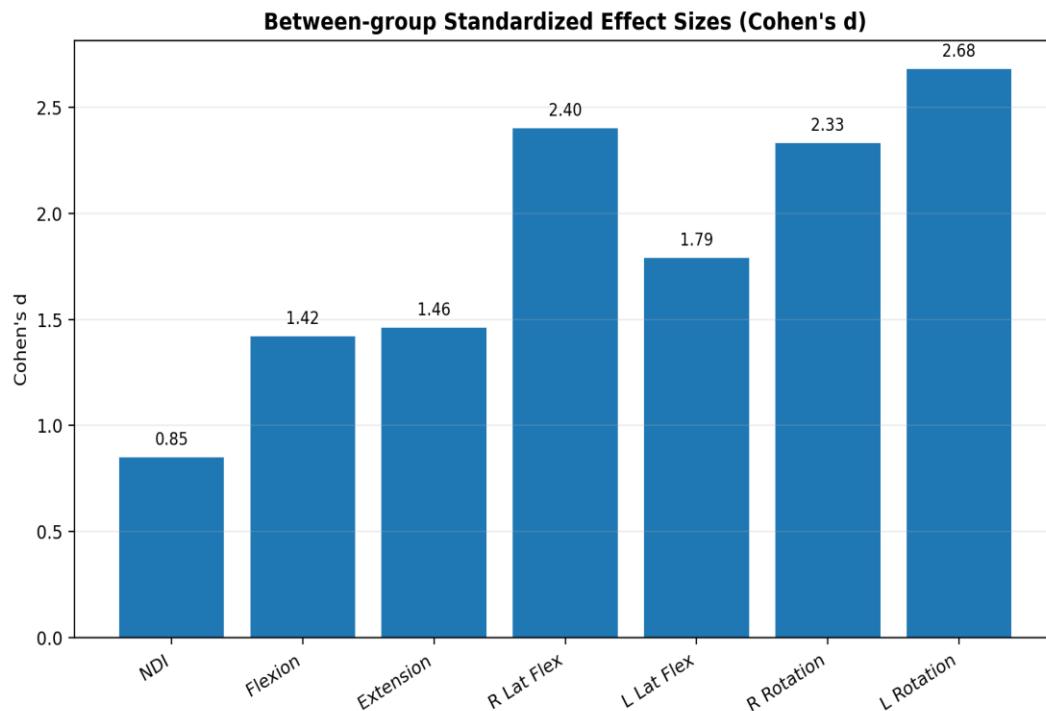


Figure 10. Between-group standardized effect sizes (Cohen's d).

DISCUSSION:

The present study was conducted to determine the efficacy of nerve flossing added with conventional therapy in patients with cervical radiculopathy. A total of 32 participants were included in the study and randomly allocated into two groups, with 16 participants in each group. Group A received nerve flossing added with conventional therapy, whereas Group B received conventional therapy alone. The outcomes were assessed using the Neck Disability Index (NDI) and cervical range of motion (ROM) before and after the intervention. The intervention was administered for 4 weeks, with three sessions per week. In the present study, both groups demonstrated statistically significant improvement in NDI and all measured cervical ROM parameters following the intervention. Group A showed a reduction in mean NDI score from 38.38 ± 11.53 to 11.75 ± 4.33 , whereas Group B showed a reduction from 38.44 ± 11.71 to 18.44 ± 5.34 . The mean reduction in NDI was 26.63 points in Group A and 20.00 points in Group B. These findings indicate that both conventional therapy and nerve flossing added with conventional therapy were associated with improvement in functional disability. The significant improvement in NDI observed in both groups may be attributed to the effects of conventional physiotherapy interventions used in the present study, including moist heat, TENS, cervical active ROM exercises, and cervical isometric exercises. These interventions may help in reducing symptoms and improving cervical movement, thereby facilitating improvement in functional activities. The findings are consistent with Rafiq et al. (2022), who reported significant improvement in pain, cervical ROM, and disability following neural mobilization as well as conservative treatment in patients with cervical radiculopathy.⁽⁸⁾ The greater reduction in NDI observed in Group A suggests that the addition of nerve flossing may provide an additional benefit over conventional therapy alone. The between-group analysis showed a statistically significant difference in the change in NDI scores, with Group A demonstrating a mean reduction of 26.63 points compared with 20.00 points in Group B ($U = 66.50$, $Z = -2.324$, $p = 0.021$). The effect size was $r = 0.411$, indicating a moderate between-group effect. This finding is supported by Kumar et al. (2024), who studied the effectiveness of neural flossing in individuals with cervical radiculopathy and reported improvement in pain, functional ability, and cervical mobility following neural flossing combined with conventional therapy.⁽⁹⁾ Similarly, Gore et al. (2020) reported that the addition of neural tissue mobilization to cervical manual traction and TENS produced greater improvement in pain and functional disability compared with conventional treatment alone.⁽⁹⁾ The findings of these studies are consistent with the present study, in which the addition of nerve flossing resulted in greater improvement in functional disability. The present study also demonstrated significant improvement in cervical ROM following intervention. In Group A, cervical flexion improved by 9.94° , extension by 12.44° , right lateral flexion by 12.56° , left lateral flexion by 9.88° , right lateral rotation by 14.00° , and left lateral rotation by 12.94° . All improvements were statistically significant with $p < 0.001$. Group B also demonstrated significant improvement in all cervical ROM parameters, although the magnitude of improvement was lower than that observed in Group A. The improvement in cervical ROM in Group A may be related to the neural mobilization component of the intervention. Nerve flossing involves alternating movements of proximal and distal joints to facilitate neural gliding while avoiding prolonged neural tension. In the present study, nerve flossing was performed through coordinated movements of the shoulder, elbow, wrist, fingers, and cervical spine within a small, pain-free range. The findings are comparable with Kage and Gurav (2017), who reported significant improvements in cervical ROM and functional ability following neural flossing in subjects with acute and subacute trapezititis.⁽¹²⁾ Although their study population differed from the present study, the improvement in cervical mobility following neural flossing is consistent with the present findings. Similarly, Kumar and Lama (2014) investigated the immediate effects of self-neural flossing in patients with cervical radiculopathy and reported a significant immediate reduction in pain

and improvement in function, although the change in cervical ROM was not statistically significant.⁽¹³⁾ The difference between their findings and the present study may be related to differences in intervention duration and study design, as the present study evaluated the effects of a 4-week treatment programme rather than an immediate response. The present study demonstrated statistically significant between-group differences in all cervical ROM parameters. Cervical flexion showed a mean difference of 3.31° between groups, extension 5.25°, right lateral flexion 6.88°, left lateral flexion 4.44°, right lateral rotation 8.13°, and left lateral rotation 7.13°. The corresponding Cohen's d values ranged from 1.42 to 2.68, indicating large between-group effect sizes.

The greater improvement in cervical ROM in Group A is also supported by Rafiq et al. (2022), who investigated neural mobilization in cervical radiculopathy and reported greater improvement in clinical outcomes in the neural mobilization group.⁽⁸⁾ In addition, Gore et al. (2020) reported significant improvements following the addition of neural tissue mobilization to conventional treatment.⁽¹⁰⁾ These findings, together with the present results, suggest that incorporating neural mobilization into a conventional physiotherapy programme may contribute to improvements in cervical mobility. Alshami and Bamhair (2021) investigated manual therapy combined with exercise in patients with chronic cervical radiculopathy and reported significant improvements in pain, disability, cervical ROM, and mechanical hypersensitivity following treatment.⁽⁹⁾ Although the intervention differed from the nerve flossing protocol used in the present study, the improvement in cervical mobility and disability is comparable with the findings of the present study and supports the use of manual and exercise-based physiotherapy approaches in cervical radiculopathy. The improvement observed in Group B is also important because it demonstrates that conventional therapy alone produced significant changes in both NDI and cervical ROM. The mean NDI reduction was 20.00 points, while significant improvements were observed in cervical flexion, extension, bilateral lateral flexion, and bilateral rotation ($p < 0.001$). This finding is consistent with Rafiq et al. (2022), who reported significant improvement following conservative treatment in individuals with cervical radiculopathy.⁽⁸⁾ The mechanism underlying the additional benefit of nerve flossing may be related to the effect of neural mobilization on neural tissue mobility and mechanosensitivity. Nee and Butler (2006) discussed the integration of neurobiology and neurodynamics in the management of peripheral neuropathic pain and highlighted the clinical relevance of neurodynamic approaches.⁽¹⁸⁾ Basson et al. (2017), in a systematic review and meta-analysis, also examined the effectiveness of neural mobilization for musculoskeletal conditions and reported beneficial effects across several musculoskeletal conditions, although effects varied according to the condition and intervention characteristics.⁽¹⁷⁾ The present findings therefore provide clinical support for incorporating nerve flossing as an adjunct to conventional physiotherapy in patients with cervical radiculopathy. The findings are particularly relevant because both treatment groups improved, but the magnitude of improvement was significantly greater in the group receiving nerve flossing. The between-group analysis demonstrated significant differences in NDI as well as all cervical ROM parameters, with effect sizes ranging from moderate to very large. A recent systematic review with network meta-analysis by García-Juez et al. (2025) evaluated articular and neural mobilization for cervical radicular pain and provided further evidence regarding the role of neural mobilization in the management of cervical radicular symptoms.⁽¹⁹⁾ This recent evidence complements the findings of the present study, although differences in intervention protocols and study populations should be considered when interpreting the results.

Overall, the present study demonstrated that both conventional therapy and nerve flossing added with conventional therapy resulted in significant improvements in neck disability and cervical range of motion after four weeks of treatment. However, the addition of nerve flossing resulted in significantly greater improvement in NDI and all measured cervical ROM parameters compared with conventional therapy alone. Therefore, nerve flossing may be considered as an adjunct to conventional physiotherapy for improving functional disability and cervical mobility in patients with cervical radiculopathy.

CONCLUSION:

The present study concluded that both nerve flossing added with conventional therapy and conventional therapy alone produced statistically significant improvements in neck disability and cervical range of motion in patients with cervical radiculopathy after 4 weeks of intervention. However, the group receiving nerve flossing in addition to conventional therapy demonstrated significantly greater improvement in NDI and all measured cervical range of motion parameters compared with conventional therapy alone. Therefore, nerve flossing, when added to conventional physiotherapy, may provide additional benefits in improving functional disability and cervical mobility in patients with cervical radiculopathy.

ACKNOWLEDGEMENT: The authors express their sincere gratitude to all participants who voluntarily participated in this study. The authors also acknowledge all individuals who contributed directly or indirectly to the successful completion of this research.

ETHICAL CONSIDERATIONS: Ethical Approval was obtained from the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to participation. Participation was voluntary, and confidentiality of participant information was maintained throughout the study.

CONFLICT OF INTEREST - The authors declare that there is no conflict of interest regarding the publication of this manuscript.

FUNDING - No external funding was received for this study.

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