

Comparative Effectiveness of Neural Mobilization Combined with Cervical Dynamic Exercises Versus Cervical Isometric Exercises Combined with Intermittent Cervical Traction in Patients with Cervical Radiculopathy: A Comparative Clinical Study

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ABSTRACT

Background: Cervical radiculopathy is a clinical condition associated with neck and/or upper-limb pain, sensory symptoms, motor impairment and functional limitations resulting from involvement of a cervical nerve root. Physiotherapy management commonly includes exercise therapy, neural mobilization and cervical traction. However, comparative evidence regarding different combinations of these interventions remains limited.

Objective: To compare the effectiveness of neural mobilization combined with cervical dynamic exercises versus cervical isometric exercises combined with intermittent cervical traction on pain, neck disability and cervical range of motion (ROM) in patients with cervical radiculopathy.

Methods: A comparative interventional study was conducted in 50 patients with symptomatic cervical radiculopathy. Participants were randomly allocated into two groups of 25 participants each. Group A received neural mobilization combined with cervical dynamic exercises, whereas Group B received cervical isometric exercises combined with intermittent cervical traction. Both interventions were administered for 20 treatment sessions over 4 weeks, at a frequency of five sessions per week. Pain intensity, neck-related disability and cervical ROM were assessed using the Visual Analogue Scale (VAS), Neck Disability Index (NDI), and goniometric measurement, respectively. Assessments were performed before and after the intervention period.

Results: Both groups showed improvement after 4 weeks. Group B showed significantly greater reduction in VAS than Group A ($p < 0.001$). Improvement in NDI was comparable between groups ($p = 0.851$), while both groups showed an identical 15° improvement in ROM.

Conclusion: Both interventions were effective. Group B was more effective for pain reduction, whereas improvements in NDI and ROM were comparable between the groups.

Keywords: cervical radiculopathy; neural mobilization; cervical traction; cervical exercise; neck disability; range of motion; physiotherapy.

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1. INTRODUCTION

Cervical radiculopathy (CR) is a clinical syndrome characterized by neck and/or upper-extremity pain accompanied by sensory, motor or reflex abnormalities attributable to cervical nerve-root involvement. The condition may result from disc herniation, degenerative changes, foraminal narrowing or other pathological processes affecting the cervical nerve root.^[1,2]

Cervical radiculopathy patients may suffer discomfort radiating from the neck to the upper limb, paraesthesia, numbness, weakness, and restrictions in everyday activities. These symptoms might have a significant impact on functional ability and overall quality of life. In general, clinical diagnosis is based on the patient's history and physical examination findings. Recent research indicates that combining clinical tests may give more helpful diagnostic information than relying on a single test.^[3,4]

Physiotherapy is an important component of conservative management of cervical radiculopathy. Exercise therapy, manual therapy, neural mobilization and cervical traction are among the interventions commonly used to address pain, mobility restrictions and functional disability.

Neural mobilization aims to restore or improve the mechanical and physiological function of neural tissues by applying controlled movements to the nervous system and surrounding structures. Previous randomized studies have reported improvements in pain, disability and cervical ROM following neural mobilization-based interventions in patients with cervical radiculopathy.^[5]

Cervical traction is another popular technique. Its suggested effects include reduced mechanical stress and improved foraminal dimensions, which may reduce discomfort to impacted brain regions. However, the data for the increased advantage of traction is not entirely consistent. One randomized clinical research revealed no significant extra benefit from adding mechanical traction to manual treatment and exercise, but another randomized experiment found better long-term outcomes when mechanical traction was paired with exercise in some patients.^[6,7]

Similarly, a randomized controlled trial involving cervical traction and neural mobilization found that the combination improved pain, disability and some cervical mobility outcomes compared with control conditions.^[8]

The Neck Disability Index is widely used for assessing disability associated with neck disorders and has demonstrated acceptable reliability and validity in patients with cervical radiculopathy.^[9,10]

Although previous studies have investigated neural mobilization and traction independently or in combination with other interventions, there remains clinical interest in determining whether a neural-mobilization-plus-dynamic-exercise approach or an isometric-exercise-plus-intermittent-traction approach produces greater improvements in pain, disability and cervical mobility.

Therefore, the present study compared these two physiotherapy approaches in patients with cervical radiculopathy.

2. SUBJECTS AND METHODS

2.1 Evaluation of Study Subjects

A convenience sample of 50 male and female participants who were diagnosed with cervical radiculopathy by a neurologist and referred to the physiotherapy outpatient department of Mahatma Gandhi Hospital, Jaipur, were recruited for this study. The participants were divided into two groups, each with twenty-five members, at random. Participants' informed permission was obtained before to their involvement in this study. For this study, participants who met the inclusion criteria were chosen.

2.1.1 Inclusion Criteria

Participants were eligible if they fulfilled the following criteria:

- Age 18–65 years
- Cervical radiculopathy
- Arm pain $\geq 4/10$
- Paraesthesia and/or numbness and/or weakness and/or altered reflex
- Male or female participants
- At least two positive clinical tests, including Spurling's test, cervical distraction test and/or median neurodynamic test.

2.1.2 Exclusion criteria

Participants were excluded if they had:

- Signs of myelopathy
- Cervical arthritis
- Rapidly progressive paresis or paresis below Grade 4
- Generalized pain syndrome
- Previous cervical fracture or cervical spine surgery
- Inability/unwillingness to accept either treatment alternative
- Vertebrobasilar insufficiency.

2.2 Outcome Measures

2.2.1 Visual Analogue Scale

Pain intensity was assessed using the Visual Analogue Scale (VAS). The dissertation describes a 10-cm scale ranging from 0 to 10, with higher scores representing greater pain.

2.2.2 Neck Disability Index

Neck-related functional disability was assessed using the Neck Disability Index.

The NDI is a widely used measure for neck disability and has established psychometric support in cervical radiculopathy populations.^[9,10]

2.2.3 Cervical Range of Motion

Cervical ROM was measured using a universal goniometer.

2.2.4 Procedure

After thorough assessment, patients were divided into two groups.

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Group A (Neural mobilization combined with cervical dynamic exercises) subjects received Neural mobilization with cervical dynamic exercise. Patient position was during neural mobilization that patient's shoulder was abducted to 90° and laterally rotated then to slide the median nerve, alteration of elbow flexion (unloading the median nerve) with wrist and fingers extension (loading the median nerve) and elbow extension (loading the median nerve) with wrist and fingers flexion (unloading the median nerve) done for 6 sets of repetitions. Each set was performed in a slow, oscillatory manner with 10 seconds rest between the sets. Frequency: 5 sessions a week for 4 weeks.

DYNAMIC CERVICAL EXERCISE: Patient was performed 5 repetitions of each exercise.

- Dynamic neck flexion
- Dynamic neck extension
- Dynamic neck lateral flexion and rotation.

In group B, (Intermittent Cervical Traction with Cervical isometrics) Patients of this group received intermittent cervical traction plus conventional treatment. Patient was placed in supine position with cervical spine placed at 15° of flexion. The head halter was fitted under patient's occiput and chin. A safety switch was given to the patient and was instructed to press it, if any discomfort felt. Patients were told that they would feel a gentle pull on their head and neck when the traction was applied, and for that it was important that they should relax as much as possible.

Mode: Intermittent traction force:

10% of patient's body weight

Hold time: 20 seconds

Rest time: 10 seconds

Duration: 15 minutes

Frequency: 5 sessions a week for 4 weeks.

CERVICAL ISOMETRICS: Patient was performed 5 repetitions of each exercise.

- Isometric Neck Flexion
- Isometric Neck Extension
- Isometric Lateral Flexion

IFT and hot pack were common for both the groups. Patients were checked for all the contraindications for IFT before starting the treatment. Four carbon rubber Electrodes were placed in the Neck Region+ in Quadripolar Method.

Timing: 15-20 Minutes^[6] Intensity: As per Patient's Tolerance, Frequency: 90-120 Hz [Rhythmic]. Heat pack was given for 15 min.

2.3 Statistical Analysis

Both descriptive and inferential statistics were used to analyze the data. Whereas categorical data were displayed as frequency and percentage, continuous variables were reported as mean $\pm$ standard deviation (SD). The independent-samples t-test was used for between-group comparisons. The paired-samples t-test was used to evaluate differences within the group before and after the intervention. The mean change between the two groups was compared following baseline and four-week analyzes of VAS, NDI, and cervical ROM. Statistical significance was defined as a two-tailed p-value less than 0.05. The proper statistical software was used to conduct the statistical analysis.

3. RESULTS

Table 1. Demographic profile Group A & Group B

Demographic variable	Group A (n=25)	Group B (n=25)
Age (years), Mean $\pm$ SD	41.88 $\pm$ 5.18	41.64 $\pm$ 4.53
Age range (years)	33–52	35-52
Male	14 (56%)	11 (44%)
Female	11 (44%)	14 (56%)
Total	25 (100%)	25 (100%)

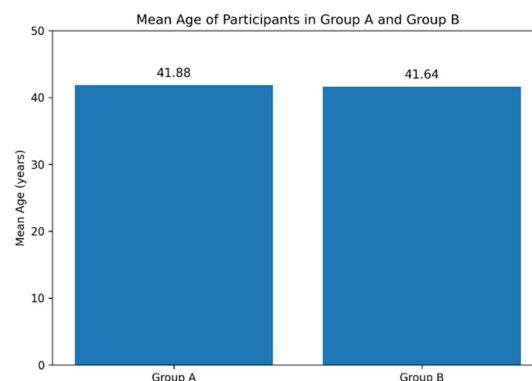


Fig.1. Comparison of Group A & B Group B age mean Value

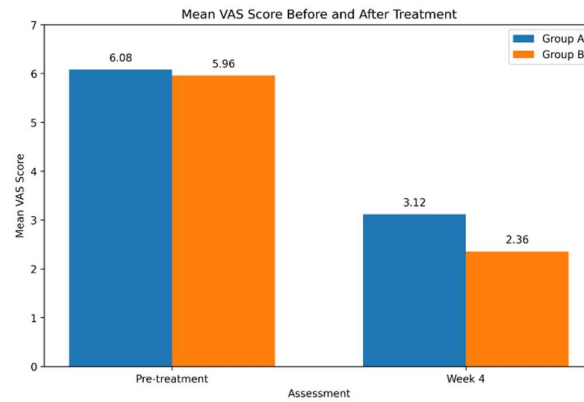


Fig.2. Inter-group analysis of VAS Score

Table 2. Comparison of mean value of visual Analog Scale with standard deviation, t- value and p- value for both groups

VAS Assessment	Group A (n=25) Mean ± SD	Group B (n=25) Mean ± SD	t-value	p-value
Baseline	6.08 ± 1.15	5.96 ± 1.37	0.33	0.739
Week 4	3.12 ± 1.09	2.36 ± 0.86	2.733	0.009
Mean Change	2.96 ± 0.20	3.60 ± 0.87	-3.600	<0.001

3.1 Intergroup Analysis of VAS Score

Intergroup analysis demonstrated no statistically significant difference in baseline VAS scores between Group A and Group B (6.08 ± 1.15 vs. 5.96 ± 1.37 ; $t = 0.335$, $p = 0.739$). Following the 4-week intervention, VAS scores were significantly lower in Group B compared with Group A (2.36 ± 0.86 vs. 3.12 ± 1.09 ; $t = 2.733$, $p = 0.009$). Furthermore, the reduction in VAS score was significantly greater in Group B than Group A (3.60 ± 0.87 vs. 2.96 ± 0.20 ; $t = -3.600$, $p < 0.001$).

Table.3 Comparison of mean value of NDI with standard deviation, t- value and p- value for both groups

NDI Assessment	Group A (n=25) Mean ± SD	Group B (n=25) Mean ± SD	t-value	p-value
Baseline	19.96 ± 2.51	12.76 ± 1.51	12.302	<0.001
Week 4	12.92 ± 2.40	5.68 ± 1.70	12.318	<0.001
Mean Change	7.04 ± 0.45	7.08 ± 0.95	-0.189	0.851

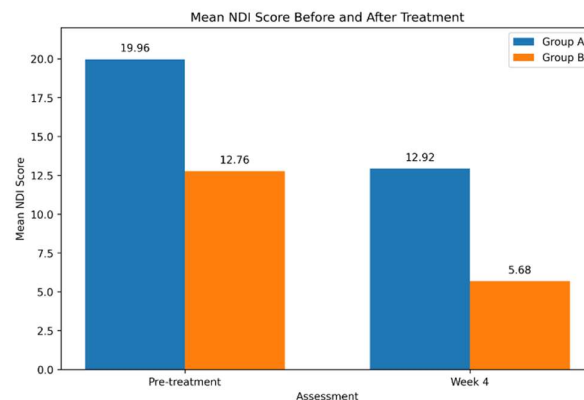


Fig.3. Inter-group analysis of NDI Score

3.2 Inter-group Analysis of NDI Score

Inter-group analysis revealed a significant baseline difference in NDI scores between Group A and Group B (19.96 ± 2.51 vs. 12.76 ± 1.51 ; $t = 12.302$, $p < 0.001$). At week 4, NDI scores remained significantly different between the groups (12.92 ± 2.40 vs. 5.68 ± 1.70 ; $t = 12.318$, $p < 0.001$). However, the magnitude of improvement in NDI was comparable between Group A and Group B (7.04 ± 0.45 vs. 7.08 ± 0.95 points), with no statistically significant between-group difference ($t = -0.189$, $p = 0.851$).

Table.4 Comparison of mean value of ROM with standard deviation, t- value and p- value for both groups

ROM Assessment	Group A (n=25) Mean $\pm$ SD	Group B (n=25) Mean $\pm$ SD	t-value	p-value
Baseline	$115.40 \pm 6.11^\circ$	$136.00 \pm 5.77^\circ$	-12.253	<0.001
Week 4	$130.40 \pm 6.11^\circ$	$151.00 \pm 5.77^\circ$	-12.253	<0.001

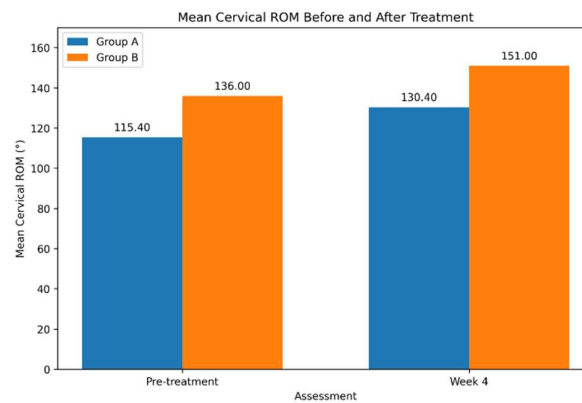


Fig.4. Inter-group analysis of ROM

3.3 Inter-group Analysis of ROM

Inter-group analysis demonstrated a significant difference in baseline cervical ROM between Group A and Group B ($115.40 \pm 6.11^\circ$ vs. $136.00 \pm 5.77^\circ$; $t = -12.253$, $p < 0.001$). A similar significant difference was observed at week 4 ($130.40 \pm 6.11^\circ$ vs. $151.00 \pm 5.77^\circ$; $t = -12.253$, $p < 0.001$). However, both groups demonstrated an identical mean improvement of 15° from baseline to week 4. Therefore, despite the higher absolute ROM values in Group B, the magnitude of ROM improvement was identical between the two groups.

4. DISCUSSION

The present study compared the effects of two multimodal physiotherapy interventions in patients with cervical radiculopathy. Group A received neural mobilization combined with cervical dynamic exercises, whereas Group B received cervical traction combined with cervical isometric exercises, IFT, and hot-pack application are common for both groups. The findings demonstrated that both treatment approaches were associated with improvements in pain, neck disability, and cervical range of motion after four weeks. However, the magnitude of pain reduction was significantly greater in Group B, while no

significant between-group difference was observed in the improvement of neck disability.

Effect of the interventions on pain

The most important finding of the present study was the significantly greater reduction in VAS scores in Group B. Mean VAS decreased from 5.96 ± 1.37 to 2.36 ± 0.86 in Group B, compared with 6.08 ± 1.15 to 3.12 ± 1.09 in Group A. The mean reduction was 3.60 ± 0.87 points in Group B versus 2.96 ± 0.20 points in Group A, with a statistically significant between-group difference ($p < 0.001$).

This outcome is consistent with existing data that cervical traction is a useful component of conservative therapy for cervical radiculopathy. A comprehensive review and meta-analysis of randomized controlled studies discovered that including mechanical traction into physical therapy resulted in considerable pain reduction, particularly at the short- and intermediate-term follow-up.^[11] More recent evidence also supports traction as one of the active rehabilitation components associated with pain reduction in cervical radiculopathy. A 2025 component network meta-analysis identified cervical traction, neurodynamic techniques, articular treatment, analgesic electrotherapy, and strengthening exercises as relevant components of effective rehabilitation, with multimodal combinations showing

promising results.^[12] The superior pain reduction observed in Group B may therefore be related to the mechanical and neurophysiological effects of cervical traction. Traction may reduce mechanical loading and irritation of cervical neural structures and may facilitate symptom modulation when combined with therapeutic exercise. The addition of cervical isometric exercises may further contribute to improved muscular support and controlled cervical movement.

However, the improvement shown in Group A is likewise clinically significant. Neural mobilization has been demonstrated to alleviate pain and enhance function in cervical radiculopathy patients. A comprehensive review and meta-analysis found moderate-quality evidence that neuromobilization can reduce pain, disability, cervical flexion, and extension when compared to control therapies.^[13] Thus, the significant improvement in Group A is consistent with the existing evidence supporting neural mobilization as part of a multimodal rehabilitation programme.

A 2025 network meta-analysis found that combinations of neural mobilization plus conventional treatment can provide considerable benefits in pain and pain-related disability, while the level of evidence varied between comparisons.^[14] Therefore, the present findings suggest that the traction-based combination used in Group B may provide an additional advantage specifically for pain reduction.

Effect on neck disability

Both groups demonstrated substantial improvement in NDI scores. Group A decreased from 19.96 ± 2.51 to 12.92 ± 2.40 , while Group B decreased from 12.76 ± 1.51 to 5.68 ± 1.70 . Although the absolute Week-4 NDI score was lower in Group B, the mean change was very similar between the groups (7.04 ± 0.45 vs. 7.08 ± 0.95) and the between-group difference was not statistically significant ($p = 0.851$).

This finding is important because the groups differed considerably at baseline in NDI. Therefore, the lower final NDI score in Group B should not automatically be interpreted as evidence that Group B was superior in improving disability. The more appropriate interpretation is that both interventions produced improvement in disability, with no statistically significant difference in the magnitude of improvement between the groups.

This outcome is generally in line with other research showing that functional impairment in cervical radiculopathy can be improved by exercise-based and multimodal physiotherapy therapies. Patients with cervical radiculopathy showed notable improvements in both pain and NDI, according to a meta-analysis of exercise therapies.^[15] Similarly, evidence concerning neural mobilization indicates improvements in function and disability compared with control interventions, although superiority over other active interventions is less consistent.^[13] A recent systematic review and meta-analysis examining simultaneous traction and neural mobilization also found improvements in pain and disability with multimodal interventions, but differences between active treatment

combinations were not consistently statistically significant.^[16] This supports the interpretation of the present study that both treatment protocols can be beneficial for functional disability.

Effect on cervical range of motion

Cervical ROM improved in both groups. Group A increased from $115.40 \pm 6.11^\circ$ to $130.40 \pm 6.11^\circ$, while Group B increased from $136.00 \pm 5.77^\circ$ to $151.00 \pm 5.77^\circ$. Importantly, the mean improvement was 15° in both groups.

Although Group B demonstrated higher absolute ROM values at both assessment points, the groups started with different baseline ROM values. Therefore, comparison of the absolute Week-4 values alone would be inappropriate for determining treatment superiority. The clinically relevant observation from the present dataset is that both interventions produced an identical 15° improvement in cervical ROM.

This result is consistent with other studies showing that cervical mobility can be enhanced by neural mobilization. In individuals with cervical radiculopathy and chronic musculoskeletal neck diseases, a 2024 comprehensive review and meta-analysis found that adding neural mobilization to standard physical treatment significantly improved mobility.^[17] Similarly, a systematic review of neuromobilization reported improvements in cervical flexion and extension compared with control interventions.^[13] Evidence regarding traction is also supportive of improvements in cervical mobility, although effects can vary depending on the traction technique and accompanying interventions. A recent 2026 systematic review of traction combined with neural mobilization found significant improvements in cervical flexion and extension compared with control interventions.^[16]

5. STRENGTHS AND LIMITATIONS

An important strength of this study is the direct comparison of two clinically relevant multimodal physiotherapy programmes using commonly used outcome measures—VAS, NDI, and cervical ROM. The four-week intervention period also allows assessment of short-term treatment response.

The present study has several limitations. First, the sample size was relatively small, with 25 participants in each group, which may limit the generalizability of the findings. Second, the intervention and follow-up period were limited to four weeks; therefore, the long-term sustainability of treatment effects could not be determined. Third, both groups received IFT and hot-pack therapy, making it difficult to determine the independent contribution of these modalities to the observed outcomes.

6. CONCLUSION

Overall, the current study indicates that individuals with cervical radiculopathy can benefit from both multimodal physiotherapy regimens in terms of pain, neck impairment, and cervical range of motion. Neural mobilization in conjunction with cervical dynamic exercises did not significantly reduce pain as much as traction-based treatments in conjunction with cervical isometric exercises.

Nonetheless, the groups' gains in cervical range of motion and NDI were similar. These results encourage the use of both strategies as part of multimodal rehabilitation, with traction-based therapy perhaps providing an extra benefit when the main clinical goal is pain relief.

Ethics approval

The dissertation identifies Ethics Committee approval/registration number: MGMC & H/IEC/JPR/2023/1268.

Informed consent

Written informed consent was obtained from participants before treatment started.

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Conflict of interest

Authors have declared that no competing interests exist.

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