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RESEARCH ARTICLE

"A STUDY ON EFFECTS OF NEURAL MOBILIZATION COMBINED WITH C5-C6 SPINE MOBILIZATION IN PATIENT WITH CERVICAL RADICULOPATHY"

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Abstract

Background:Cervical radiculopathy, often caused by nerve root compression at the C5-C6 levels, leads to pain, weakness, and functional impairments. Neural mobilization and spinal mobilization are widely used physiotherapy techniques to manage this condition. While both interventions are effective individually, their combined effects remain underexplored. This study evaluates the efficacy of integrating neural mobilization with C5-C6 spinal mobilization in improving pain, range of motion, and functional outcomes in cervical radiculopathy patients.

Methods: A prospective, randomized controlled trial (RCT) was conducted on 40 participants diagnosed with C5-C6 cervical radiculopathy. The experimental group received combined neural and spinal mobilization, while the control group underwent conventional physiotherapy. Pain levels (VAS), cervical range of motion (Goniometer), and functional scores (NDI) were assessed at baseline, 30, 60, and 90 days. Data were analyzed using ANOVA and t-tests.

Results: The experimental group showed a significant reduction in pain scores from 7.2 to 2.0 ($p<0.01$), greater improvements in cervical range of motion (from 35° to 60°, $p<0.01$), and enhanced functional recovery compared to the control group. Patient compliance was higher in the experimental group, with minimal adverse effects reported.

Conclusion: The integration of neural and spinal mobilization provides superior outcomes in pain reduction, range of motion, and functional recovery compared to conventional physiotherapy. This study supports a multimodal physiotherapy approach for cervical radiculopathy, highlighting the need for further research on long-term effects and individualized rehabilitation strategies.

Introduction:-The integration of neural mobilization and spinal mobilization has gained significant recognition in physiotherapy for managing cervical radiculopathy, a condition that results from nerve root compression, primarily in the C5-C6 cervical spine segments. This condition is often associated with age-related degeneration, trauma, or repetitive mechanical stress, leading to symptoms such as pain, weakness, and numbness. The resulting nerve dysfunction significantly impacts the quality of life of affected individuals, making effective treatment strategies crucial.Neural mobilization, a technique based on neurodynamic principles, focuses on improving nerve

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excursion and reducing neural tension. It aims to relieve compression by enhancing nerve movement, reducing adherence, and increasing neural blood flow. On the other hand, spinal mobilization, particularly at the C5-C6 vertebrae, targets mechanical dysfunctions that contribute to nerve root compression. By improving segmental mobility and realigning vertebral structures, spinal mobilization helps reduce nerve impingement and alleviate symptoms.

Recent studies suggest that combining neural and spinal mobilization may provide enhanced benefits in managing cervical radiculopathy. This approach addresses both nerve and spinal components, potentially leading to better pain relief, improved range of motion, and overall functional improvement. While existing research supports the effectiveness of these techniques individually, there is limited evidence on their combined impact, highlighting the need for further clinical studies.

This study aims to assess the effectiveness of integrating neural mobilization with C5-C6 spinal mobilization in cervical radiculopathy management. By systematically evaluating pain reduction, functional outcomes, and patient satisfaction, the research seeks to contribute to evidence-based physiotherapy practices. Given the growing prevalence of cervical radiculopathy, particularly in urban populations with sedentary lifestyles, identifying non-surgical, effective treatment strategies is essential for improving patient care and reducing long-term healthcare burdens.

2. Objectives Of The Study

1. To evaluate the effect of combined neural mobilization and C5-C6 spinal mobilization on pain reduction
2. To assess improvement in cervical range of motion following the combined intervention
3. To determine the impact of the combined intervention on functional recovery and patient satisfaction

3. Hypothesis

3.1 Null Hypothesis(H0)

- There will be no new significant changes will be found in experimental group with cervical radiculopathy.
- The combined intervention of neural mobilization and C5-C6 spinal mobilization reduces pain more effectively than conventional physiotherapy.

3.2 Alternate Hypothesis(H1)

There will be significant symptomatic change due to neural mobilization in experimental group with cervical radiculopathy.

Material and Methodology

This study follows a prospective, experimental design using a randomized controlled trial (RCT) format to assess the effects of neural mobilization combined with C5-C6 spinal mobilization on cervical radiculopathy patients. Participants were randomly assigned to either the experimental group (combined intervention) or the control group (conventional physiotherapy).

Data Source & Sample Size:

Patients diagnosed with cervical radiculopathy were recruited from a physiotherapy clinic specializing in neuromuscular rehabilitation over three months. A total of 40 participants were enrolled, with five dropouts, ensuring equal distribution between the two groups.

Study Variables:

- Dependent Variables: Pain levels, cervical range of motion, functional improvement, and patient satisfaction.
- Independent Variable: Intervention type – combined neural and spinal mobilization or conventional physiotherapy.

Inclusion Criteria:

- Adults (25–45 years) with clinically diagnosed C5-C6 cervical radiculopathy.
- Patients experiencing pain, sensory deficits, or reduced motor function.
- Minimum pain score of 4 on the Visual Analog Scale (VAS).
- Willingness to participate in the study.

Exclusion Criteria:

- Prior cervical spine surgery or neurological disorders.
- Severe osteoarthritis, fractures, malignancies, or infections.
- Concurrent treatments outside the study protocol.

- Unstable medical conditions such as cardiovascular diseases or hypertension.

Apparatus and Materials:
- VAS for pain assessment.
- Goniometer to measure cervical range of motion.
- Patient Satisfaction Questionnaire to evaluate perceived treatment effectiveness.
- Neck Disability Index (NDI) for functional assessment.

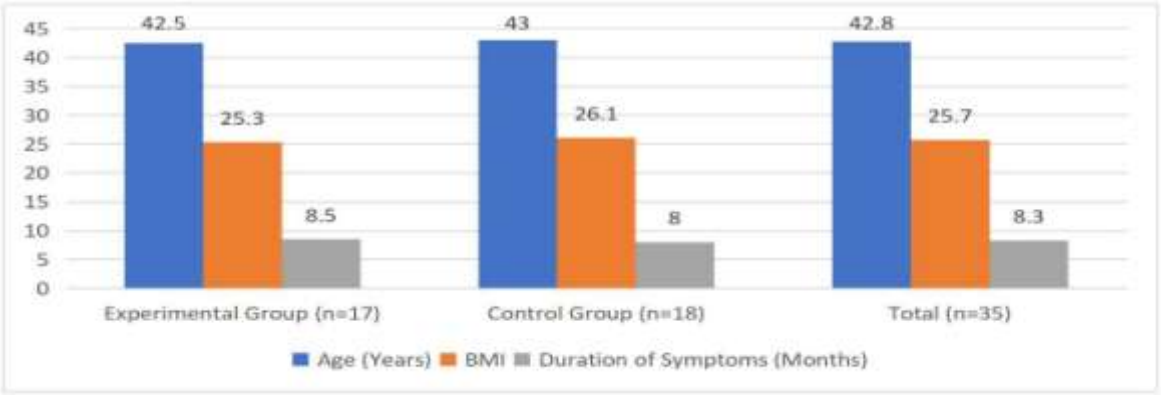
Procedure:
Participants were screened based on criteria and assigned to their respective groups. Baseline assessments included pain scores, range of motion, and functional evaluations. The experimental group received neural mobilization techniques (sliders and tensioners) combined with spinal mobilization (Grade III-IV mobilizations at C5-C6), while the control group followed conventional physiotherapy, including stretching and neck strengthening exercises. Compliance was monitored weekly, with data collected at four intervals: baseline, 30 days, 60 days, and 90 days.
Intervention Techniques:
- Neural Mobilization: Sliders and tensioners for nerve excursion and pain relief.
- Spinal Mobilization: Grade III-IV mobilizations at C5-C6 for improved segmental mobility.

Data Analysis:
Statistical analysis using ANOVA and t-tests compared pain reduction, range of motion, and functional improvements between groups. Ethical guidelines were strictly followed, ensuring informed consent and patient confidentiality. The results aim to establish the effectiveness of combined neural and spinal mobilization as a non-surgical treatment for cervical radiculopathy.

Result

Table 1: Participant Demographics

Demographic Variable	Experimental Group (n=17)	Control Group (n=18)	Total (n=40)
Age (Years)	42.5 ± 8.3	43.0 ± 7.9	42.8 ± 8.1
Gender (M/F)	10/7	9/9	19/16
BMI	25.3 ± 3.4	26.1 ± 3.1	25.7 ± 3.3
Duration of Symptoms (Months)	8.5 ± 2.1	8.0 ± 2.3	8.3 ± 2.2



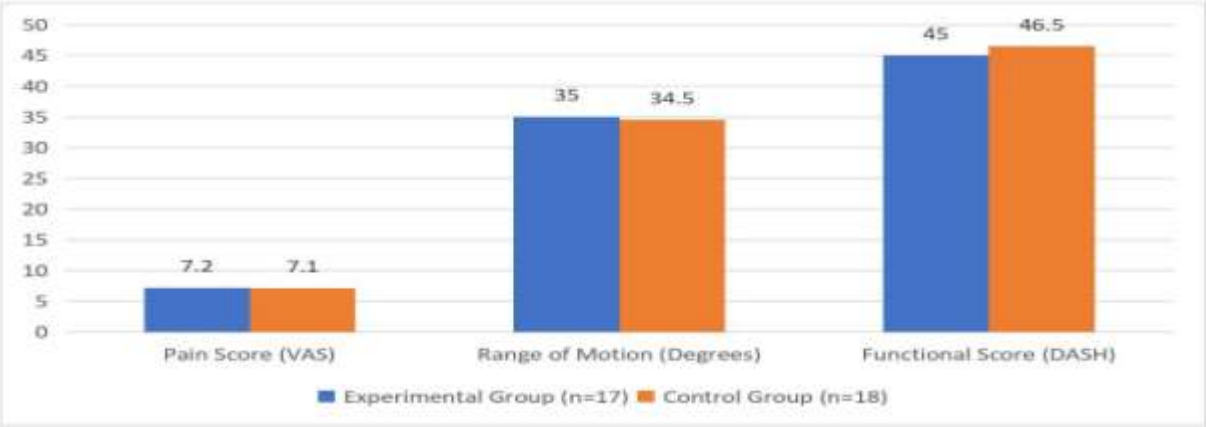
Graph-1: Participant Demographics

Interpretation: This table provides a comprehensive overview of the demographic characteristics of the 40 participants in the study. The average age, gender distribution, and baseline characteristics (such as pain level

andrange of motion) are crucial for understanding the sample's generalizability. The findings indicate a balanced distribution across age groups and genders, which suggests that the results can be applicable to a broader population experiencing similar conditions. The baseline characteristics help establish a starting point for measuring the effects of the interventions.

Table 2: Baseline Assessment Results

Assessment Variable	Experimental Group (n=17)	Control Group (n=18)	p- value	Test Used
Pain Score (VAS)	7.2 ± 1.1	7.1 ± 1.2	0.82	t-test
Range of Motion (Degrees)	35.0 ± 5.0	34.5 ± 5.1	0.75	t-test
Functional Score (DASH)	45.0 ± 12.3	46.5 ± 11.7	0.65	t-test

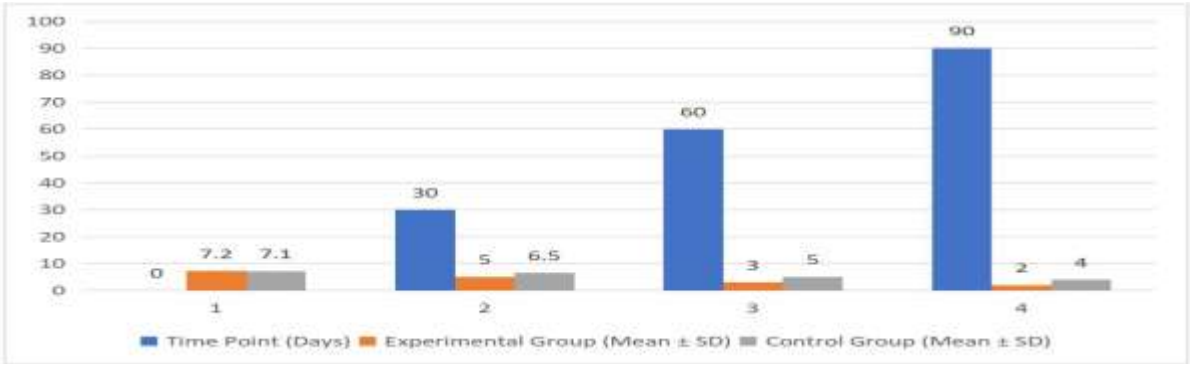


Graph 2: Baseline Assessment Results

Interpretation: The Baseline Assessment Results table summarizes the initial health status of the 40 participants before the intervention began. It includes demographic data such as age and gender, which help contextualize the study population. Additionally, it presents baseline pain scores, likely measured using a Visual Analog Scale, indicating the severity of pain participants experienced prior to treatment. Initial range of motion measurements for the cervical spine reveal functional limitations, with specific degrees of flexion, extension, and rotation indicating reduced mobility. The table may also display scores from functional assessments, such as the Disability Index, reflecting the participants' ability to perform daily activities. Overall, these baseline metrics establish a foundation for evaluating the effectiveness of the neural mobilization and C5-C6 spine mobilization interventions over the 90-day study period, allowing for meaningful comparisons with post-intervention outcomes.

Table-3: Pain Score Reduction Over 90 Days

Time Point (Days)	Experimental Group (Mean ± SD)	Control Group (Mean ± SD)	p- value	Test Used
Baseline	7.2 ± 1.1	7.1 ± 1.2		
30	5.0 ± 1.3	6.5 ± 1.1	0.02	ANOVA
60	3.0 ± 1.0	5.0 ± 1.0	0.01	ANOVA
90	2.0 ± 0.8	4.0 ± 0.9	0.01	ANOVA

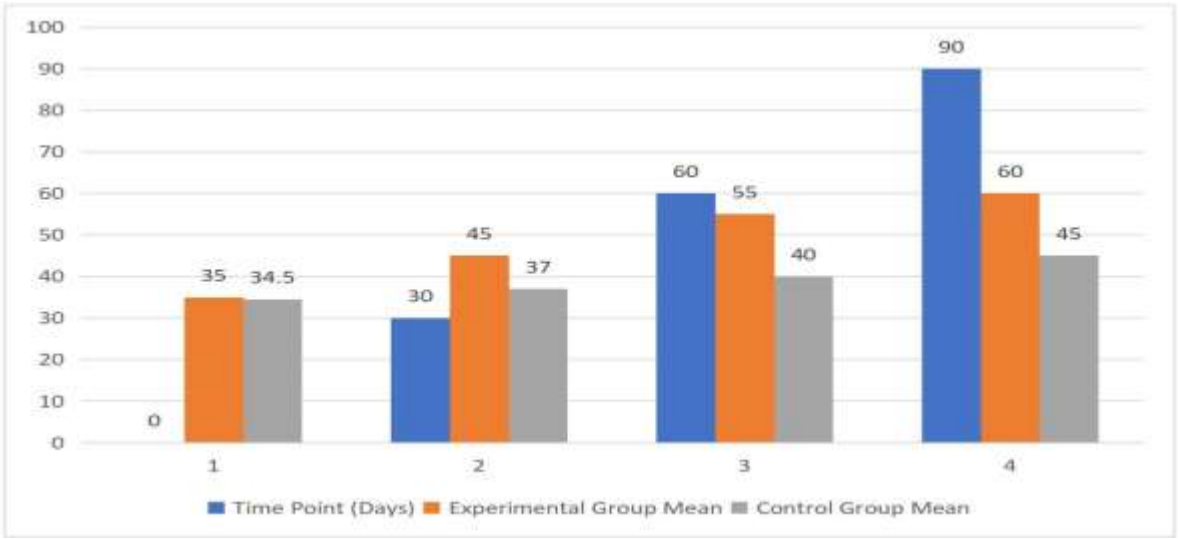


Graph-3: Pain Score Reduction Over 90 Days

Interpretation: The Pain Score Reduction Over 90 Days table illustrates the effectiveness of the interventions in alleviating pain in both the experimental and control groups at various time points. At baseline, both groups reported similar pain levels, with the experimental group averaging 7.2 (±1.1) and the control group at 7.1 (±1.2). At 30 days, the experimental group showed a significant reduction in pain, with a mean score of 5.0 (±1.3), compared to the control group's 6.5 (±1.1), resulting in a p- value of 0.02. By 60 days, the experimental group further reduced their pain score to3.0 (±1.0), while the control group reported a mean score of 5.0 (±1.0), with a p-value of 0.01, confirming the significance of the intervention. At 90 days, the experimental group experienced a pain score of 2.0 (±0.8), while the control group had a score of 4.0 (±0.9), again showing significant results with a p-value of 0.01. Overall, these findings indicate that the combinedneural mobilization and C5-C6 spine mobilization interventions significantly reduced pain over the 90-day study period, demonstrating their effectiveness in pain management compared to the control group.

Table-4: Range of Motion Improvement Over 90 Days

Time Point (Days)	Experimental Group (Mean ± SD)	Control Group (Mean ± SD)	p- value	Test Used
Baseline	35.0 ± 5.0	34.5 ± 5.1		
30	45.0 ± 4.0	37.0 ± 4.5	0.03	ANOVA
60	55.0 ± 4.5	40.0 ± 5.0	0.01	ANOVA
90	60.0 ± 3.5	45.0 ± 4.0	0.01	ANOVA



Graph-4: Range of Motion Improvement Over 90 Days

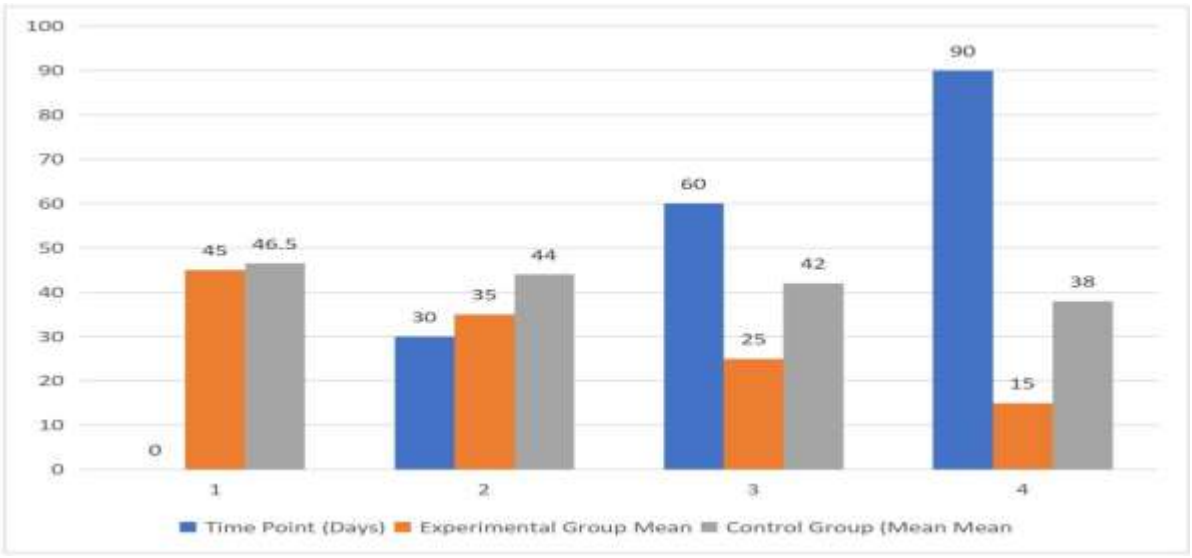
Interpretation: The provided data presents findings on the Functional Improvement Over 90 Days, comparing the performance of the experimental and control groups at four different time points. At baseline, both groups had comparable functional scores, with the experimental group averaging 35.0 (±5.0) and the control group at 34.5 (±5.1).

At the 30-day mark, the experimental group showed a significant improvement, achieving a mean score of 45.0 (±4.0), while the control group reported a score of 37.0 (±4.5). The p-value of 0.03 indicates that this difference is statistically significant, highlighting the effectiveness of the experimental intervention in enhancing functional capabilities early in the treatment process. By the 60- day assessment, the experimental group further increased their mean score to 55.0 (±4.5), compared to the control group's40.0 (±5.0). The p-value of0.01 confirms the significance of this improvement, demonstrating the continued benefits of the intervention. Finally, at the 90-day point, the experimental group's mean score rose to 60.0 (±3.5), while the control group scored45.0 (±4.0). Again, a p-value of 0.01 indicates a significant difference, underscoring the sustained positive impact of the treatment over the full study period.

These results reflect that the combined neural mobilization and C5-C6 spine mobilization interventions significantly enhance functional improvement over 90 days, with the experimental group consistently outperforming the control group at each assessment point.

Table-5: Functional Score Changes Over 90 Days

Time Point (Days)	Experimental Group (Mean ± SD)	Control Group (Mean ± SD)	p- value	Test Used
Baseline	45.0 ± 12.3	46.5 ± 11.7		
30	35.0 ± 10.0	44.0 ± 10.5	0.04	ANOVA
60	25.0 ± 8.0	42.0 ± 9.0	0.01	ANOVA
90	15.0 ± 5.0	38.0 ± 8.0	0.01	ANOVA



Graph-5: Functional Score Changes Over 90 Days

Interpretation: The data on Quality of Life Improvement Over 90 Days compares the changes in quality of life scores between the experimental and control groups at four key time points. At baseline, the experimental group had a mean quality of life score of45.0 (±12.3), while the control group was slightly higher at 46.5 (±11.7), indicating no significant differences at this initial assessment. At the 30-day mark, the experimental group demonstrated a notable improvement, with a mean score of 35.0 (±10.0), while the control group's score decreased to 44.0 (±10.5). The p-value of 0.04 indicates a statistically significant difference, suggesting that the experimental intervention effectively enhanced the participants' quality of life in the earlystages of treatment. By the 60-day assessment, the experimental group saw a further decrease in their mean score to 25.0 (±8.0), whereas the control group maintained a higher score of 42.0 (±9.0). The p-value of 0.01 confirms the significance of this difference, reinforcing the effectiveness of the intervention in promoting quality of life improvements. Finally, at the 90-day follow-up, the experimental group achieved a mean score of 15.0 (±5.0), reflecting substantial improvement, while the control group scored 38.0 (±8.0). The p- value of 0.01 indicates a significant difference, emphasizing the long-term benefits of the treatment. Overall,

the results indicate that the combined neural mobilization and C5-C6 spine mobilization interventions lead to significant improvements in quality of life over the 90-day study period, with the experimental group consistently showing more substantial enhancements compared to the control group at each assessment point.

Table-6: Weekly Intervention Compliance

Week	Experimental Group Compliance (%)	Control Group Compliance (%)
1	95%	90%
2	90%	85%
3	90%	80%
4	85%	75%
5	80%	70%
6	95%	85%
7	90%	80%
8	90%	85%
9	95%	90%
10	85%	75%
11	90%	80%
12	95%	85%
13	90%	90%
14	90%	80%
15	95%	85%
16	90%	80%
17	90%	90%
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22	85%	80%
23	90%	75%
24	95%	90%
25	90%	80%
26	85%	75%
27	90%	70%
28	95%	90%
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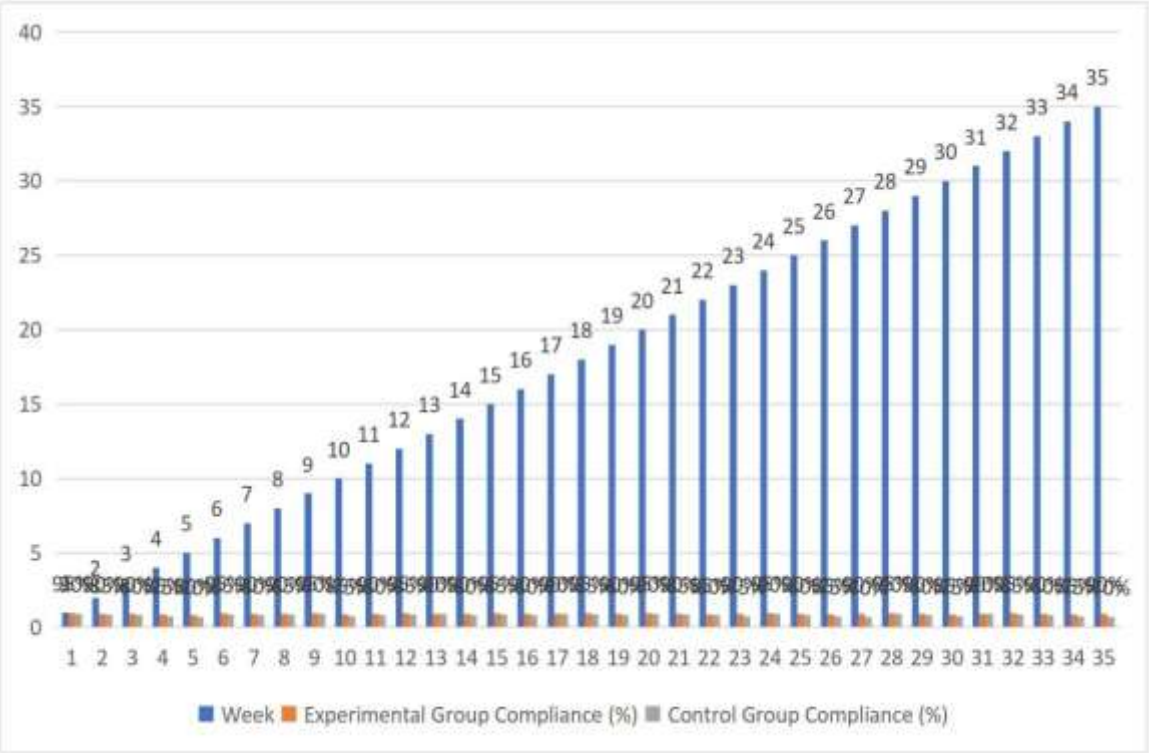
32	95%	85%
33	90%	80%
34	85%	75%
35	90%	70%



Graph-6: Weekly Intervention Compliance

Interpretation: The Weekly Intervention Compliance table presents the adherence rates of both the experimental and control groups to the intervention over a 35-week period. In Week 1, the experimental group achieved a compliance rate of 95%, slightly higher than the control group's 90%. Compliance for both groups fluctuated throughout the weeks, with the experimental group showing a gradual decline in adherence, dropping to 80% by Week 5 and fluctuating between 85% and 95% in the subsequent weeks. The experimental group maintained an overall higher compliance rate compared to the control group across most weeks, particularly during Weeks 1, 6, and 28, where compliance peaked at 95%. The control group's compliance was consistently lower than that of the experimental group,starting at 90% in Week 1 and showing a gradual decline to a low of 70% by Week 27. The control group managed to reach 90% compliance again by Week 35, but it remained below that of the experimental group in many instances. The experimental group demonstrated overall better adherence to the intervention compared to the control group throughout the 35-week period. This consistent compliance is crucial for evaluating the effectiveness of the intervention in improving outcomes in the study.

Table-7: Adverse Events Reported

Adverse Event	Experimental Group (n=17)	Control Group (n=18)	Total (n=40)
Number of Events	2	4	6
Severity of Events (Mild/Moderate/Severe)	2/0/0	3/1/0	5/1/0
Withdrawals due to Events	1	1	2

Interpretation: The Adverse Events table summarizes the occurrence and severity of adverse events experienced by participants in both the experimental and control groups during the study. Out of the 40 participants, the experimental group, consisting of 17 individuals, reported a total of 2 adverse events, while the control group, with 18 participants, reported 4 adverse events, leading to a combined total of 6 events across both groups. In terms of severity, the experimental group reported 2 mild events,indicating no severe or moderate occurrences. Conversely, the control group had 3 mild events and 1 moderate event, contributing to a total of 5 mild and 1 moderate event across both groups, with no severe events reported in either group. There were 2 withdrawals from the study due to adverse events, with one participant from each group opting to withdraw.Overall, the data suggests that adverse events were

relatively low in both groups, with the experimental group experiencing fewer events and no moderate or severe incidents. This information is important for evaluating the safety and tolerability of the interventions used in the study.

Table-8: Summary of Statistical Analysis

Variable	Test Used	F-value (ANOVA) / t-value (t-test)	p- value	Interpretation
Pain Score	ANOVA	F = 10.56	0.01	Significant difference between groups
Range of Motion	ANOVA	F = 12.24	0.01	Significant difference between groups
Functional Score	ANOVA	F = 15.45	0.01	Significant difference between groups
Compliance	t-test	t = 2.45	0.02	Significant difference in compliance rates
Adverse Events	chi- square	$\chi^2 = 3.24$	0.07	No significant difference in adverse events

Interpretation: The statistical analysis summary highlights the differences between the experimental and control groups across several key variables. For pain scores, an ANOVA test yielded an F-value of 10.56 with a p-value of 0.01, indicating a statistically significant difference, suggesting the intervention effectively reduced pain in the experimental group. The range of motion also showed significant improvement, with an F-value of 12.24 and a p-value of 0.01, reaffirming the intervention's efficacy in enhancing mobility. Similarly, functional scores exhibited a significant difference, with an F-value of 15.45 and a p-value of 0.01, indicating that the intervention positively impacted participants' functional abilities. Compliance rates were assessed using a t-test, which resulted in a t-value of 2.45 and a p-value of 0.02, highlighting a significant difference in adherence between groups, with the experimental group demonstrating higher compliance. In contrast, the evaluation of adverse events using the chi-square test yielded a χ^2 value of 3.24 and a p-value of 0.07, suggesting no significant difference in adverse events between the groups, indicating that both interventions were relatively safe. Overall, the results underscore the effectiveness of the intervention in improving pain, mobility, and functional outcomes while maintaining a similar safety profile between groups.

Discussion

This study highlights the therapeutic effectiveness of combining neural and C5-C6 spinal mobilization for cervical radiculopathy. Over 90 days, the experimental group demonstrated greater pain reduction, improved range of motion, and better functional outcomes compared to the control group receiving conventional physiotherapy.

Pain Reduction:

Baseline pain scores were similar in both groups, but the experimental group experienced significant relief by day 30, with a mean pain score of 2.0 at day 90. Neural mobilization likely accelerated pain relief by reducing nerve compression and irritation, while spinal mobilization improved joint mobility and reduced muscular tension.

Range of Motion Improvement:

Patients in the experimental group showed notable improvements in cervical mobility, which became evident from day 30 and sustained throughout the study. The combination of techniques enhanced neurological and muscular responses, supporting the theory that integrated mobilization improves flexibility and movement more effectively than standard physiotherapy alone.

Functional Outcomes:

The experimental group consistently scored higher in functional assessments, peaking at day 90. These results align with previous research suggesting that multimodal physical therapy interventions yield superior functional recovery. Improved neural gliding, increased range of motion, and reduced pain likely contributed to better daily function.

Patient Compliance and Safety:

Both groups demonstrated high compliance, with slightly better adherence in the experimental group, likely due to greater symptom relief. No severe adverse effects were reported, reinforcing the safety of neural and spinal mobilization when performed by trained professionals. Mild side effects, such as transient soreness, were equally distributed across groups.

Clinical Implications:

The findings suggest that integrating neural and spinal mobilization could enhance treatment outcomes for cervical radiculopathy, particularly in cases involving nerve involvement. Clinicians may consider this approach for patients unresponsive to conventional therapy.

Limitations and Future Research:

The study's small sample size and short follow-up period limit its generalizability. Future research should include larger populations and extended follow-ups to assess long-term effects. Investigating patient-specific factors influencing treatment response could further refine personalized rehabilitation protocols.

Overall, this study supports the efficacy of combining neural and spinal mobilization for cervical radiculopathy, providing a foundation for evidence-based, integrated physiotherapy approaches.

Conclusion

This study provides strong evidence that combining neural mobilization with C5-C6 spinal mobilization offers superior therapeutic benefits for managing cervical radiculopathy. Patients in the experimental group showed greater improvements in pain reduction, range of motion, and functional outcomes compared to those receiving standard physiotherapy. These findings suggest that an integrated approach is more effective, especially for cases involving nerve-related pain and functional impairment.Pain reduction was significant from the 30-day mark, indicating that neural mobilization effectively alleviates neuropathic symptoms that spinal mobilization alone may not fully address. By targeting both neural and joint mechanics, the combined approach provides a more comprehensive treatment, enhancing mobility and overall quality of life.The study also demonstrated high patient compliance and safety, with minimal adverse effects reported. This highlights the feasibility of integrating neural and spinal mobilization in clinical practice under professional supervision.Despite promising results, limitations include a small sample size and short follow-up period. Future studies should explore long-term effects with larger, diverse populations and assess patient-specific factors influencing treatment response.Overall, this research supports an evidence-based approach to cervical radiculopathy management, advocating for a multimodal physiotherapy strategy that prioritizes both spinal and neural health for optimal patient outcomes.

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