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Effects of ELDOA Exercises versus Neural Mobilization on Cervical Pain, Range of Motion, and Functional Disability in Patients with Cervical Radiculopathy: A Randomized Controlled Trial

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Abstract :

Background:Cervical radiculopathy is a common neuromusculoskeletal disorder characterized by neck pain, radiating upper-limb symptoms, restricted cervical mobility, and functional disability. ELDOA exercises and neural mobilization are commonly used physiotherapy interventions; however, comparative evidence remains limited.

Objective: To compare the effectiveness of ELDOA exercises and neural mobilization on pain, cervical range of motion, and functional disability in patients with cervical radiculopathy.

Methodology :A randomized controlled trial was conducted on 60 participants aged 25–45 years diagnosed with cervical radiculopathy. Participants were randomly allocated into two groups of 30 each. Group A received ELDOA exercises with conventional physiotherapy, while Group B received neural mobilization with conventional physiotherapy for six weeks. Outcome measures included Numeric Pain Rating Scale (NPRS), Neck Disability Index (NDI), and cervical range of motion. Statistical analysis was performed using SPSS version 26.0 with significance set at $p < 0.05$.

Results :Both groups showed significant improvement following intervention. However, Group A demonstrated greater improvement in pain reduction, cervical mobility, and functional disability. Post-treatment NPRS scores were significantly lower in Group A (1.93 ± 0.78) compared with Group B (2.57 ± 0.77; $p = 0.002$). NDI scores also improved significantly more in Group A (10.73 ± 2.88) than Group B (14.23 ± 3.14; $p < 0.001$).

Conclusion :Both ELDOA exercises and neural mobilization were effective interventions for cervical radiculopathy; however, ELDOA exercises combined with conventional physiotherapy demonstrated superior clinical outcomes.

Keywords: Cervical radiculopathy, ELDOA, neural mobilization, neck pain, cervical range of motion, physiotherapy rehabilitation

INTRODUCTION

Cervical radiculopathy is a neurological condition resulting from compression or irritation of cervical nerve roots and is commonly associated with neck pain radiating into the upper extremity, paresthesia, muscular weakness, altered sensation, restricted cervical range of motion, and functional disability. The condition frequently develops secondary to cervical disc herniation, degenerative cervical spondylosis, osteophyte formation, and narrowing of the intervertebral foramina. Modern occupational demands, prolonged computer use, sustained forward-head posture, poor ergonomic habits, and sedentary lifestyle patterns have contributed to the increasing prevalence of cervical spine disorders. Cervical radiculopathy often interferes with activities of daily living, occupational performance, sleep quality, and overall quality of life. Conservative physiotherapy is considered the first-line management approach and primarily focuses on pain reduction, restoration of mobility, postural correction, neural tissue mobility, and functional improvement. Neural mobilization is commonly used to restore normal neural excursion, reduce mechanosensitivity, and improve neural tissue dynamics. ELDOA (Étirements Longitudinaux avec Décoaptation Ostéo-Articulaire) is a relatively newer physiotherapeutic approach designed to achieve segment-specific spinal decompression, fascial elongation, and postural correction. Although both interventions are widely used clinically, direct comparative evidence regarding their effectiveness in cervical radiculopathy remains limited. Therefore, the present study was undertaken to compare the effectiveness of ELDOA exercises and neural mobilization on pain intensity, cervical range of motion, and functional disability in individuals with cervical radiculopathy.

NEED OF THE STUDY.

Cervical radiculopathy is frequently encountered in physiotherapy practice and often results in persistent pain, movement restriction, and functional disability.

Although various conservative interventions are available, uncertainty remains regarding the relative effectiveness of ELDOA exercises and neural mobilization.

Most previous studies have evaluated isolated interventions rather than direct comparative effectiveness. Therefore, this study was undertaken to determine which intervention may offer greater clinical benefit.

3.1Population and Sample

The population of the present study consisted of patients diagnosed with cervical radiculopathy attending the Department of Physiotherapy OPD, Jagannath University, Jaipur. Participants presenting with symptoms such as neck pain radiating to the upper limb, restricted cervical range of motion, sensory disturbances, and functional limitation were considered for inclusion in the study. A total of 60 participants were selected using purposive sampling technique based on the inclusion and exclusion criteria. Participants aged between 25–45 years with clinically diagnosed cervical radiculopathy were included in the study. Individuals with previous cervical spine surgery, fractures, myelopathy, severe neurological deficits, or recent traumatic injuries were excluded.
The selected participants were randomly allocated into two groups comprising 30 participants each:

- **Group A:** ELDOA exercises with
- **Group A:** ELDOA exercises with conventional physiotherapy
- **Group B:** Neural mobilization with conventional physiotherapy

Both groups received intervention for a duration of six weeks under supervised physiotherapy sessions. The study aimed to compare the effectiveness of both interventions on pain intensity, cervical range of motion, and functional disability in patients with cervical radiculopathy.
Random allocation was performed to minimize selection bias and ensure equal distribution of participants between the two groups. Baseline demographic characteristics including age, duration of symptoms, and clinical presentation were assessed prior to intervention to maintain homogeneity of the sample.
The outcome measures used in the study included:

- Numeric Pain Rating Scale (NPRS) for assessment of pain intensity
- Neck Disability Index (NDI) for assessment of functional disability
- Universal goniometer for assessment of cervical range of motion

Pre-intervention and post-intervention assessments were conducted for all participants to evaluate the effectiveness of ELDOA exercises and neural mobilization.
The intervention protocol was carried out in accordance with ethical considerations, and informed consent was obtained from all participants prior to inclusion in the study.

3.2 Data and Sources of Data

For the present study, primary data were collected from participants diagnosed with cervical radiculopathy attending the Department of Physiotherapy OPD, Jagannath University, Jaipur. Data collection was carried out over the intervention period following ethical approval and participant consent.

A total of 60 participants fulfilling the inclusion criteria were recruited for the study. Baseline assessment was conducted prior to intervention, and post-intervention assessment was conducted after completion of the six-week treatment protocol.
The study collected clinical data related to pain intensity, cervical range of motion, and functional disability using standardized assessment tools. The following outcome measures were used:

- **Numeric Pain Rating Scale (NPRS):** to assess pain intensity
- **Neck Disability Index (NDI):** to assess functional disability
- **Universal Goniometer:** to measure cervical range of motion including flexion, extension, and rotation movements

Participants were randomly allocated into two groups:

- **Group A:** Received ELDOA exercises with conventional physiotherapy
- **Group B:** Received neural mobilization with conventional physiotherapy

Treatment sessions were conducted under supervision for six weeks according to the intervention protocol. Pre-treatment and post-treatment values of all outcome measures were recorded systematically for statistical analysis.
The collected data were organized, tabulated, and analyzed using SPSS version 26.0 to determine the effectiveness of ELDOA exercises and neural mobilization in patients with cervical radiculopathy.
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3.3 Theoretical framework

The variables used in the present study consisted of dependent variables and independent variables. A pre-specified methodology was adopted for the selection and assessment of variables.
The independent variables of the study were the physiotherapy interventions administered to the participants:

- ELDOA exercises with conventional physiotherapy
- Neural mobilization with conventional physiotherapy

The dependent variables included pain intensity, cervical range of motion, and functional disability in patients with cervical radiculopathy.

Pain intensity was assessed using the **Numeric Pain Rating Scale (NPRS)**, which is a reliable and valid tool used to measure the severity of pain experienced by the participant.
Functional disability was assessed using the **Neck Disability Index (NDI)**, which evaluates the impact of neck pain on activities of daily living and functional performance.
Cervical range of motion was measured using a **universal goniometer** to assess movements including cervical flexion, extension, right rotation, and left rotation.
The study evaluated changes in these dependent variables before and after intervention in order to determine the effectiveness of ELDOA exercises and neural mobilization in patients with cervical radiculopathy.

RESEARCH METHODOLOGY

The methodology section describes the research plan and procedures used to conduct the study. It includes the population and sample, data collection procedure, variables of the study, and analytical framework.

3.1 Population and Sample

The study population consisted of patients diagnosed with cervical radiculopathy attending the Department of Physiotherapy OPD, Jagannath University, Jaipur. A total of 60 participants aged 25–45 years were selected using purposive sampling based on the inclusion and exclusion criteria.
The participants were randomly divided into two groups of 30 each:

- **Group A:** ELDOA exercises with conventional physiotherapy
- **Group B:** Neural mobilization with conventional physiotherapy

The intervention was conducted for six weeks to compare the effectiveness of both treatment approaches on pain intensity, cervical range of motion, and functional disability.

3.2 Data and Sources of Data

Primary data were collected from all participants before and after the intervention period. Data collection was carried out in the Department of Physiotherapy OPD using standardized assessment tools.
The following outcome measures were used:

- Numeric Pain Rating Scale (NPRS) for pain intensity
- Neck Disability Index (NDI) for functional disability
- Universal goniometer for cervical range of motion assessment

Pre-treatment and post-treatment values were recorded systematically for statistical analysis. The collected data were analyzed using SPSS version 26.0.

3.3 Theoretical Framework

The study included independent and dependent variables. The independent variables were the physiotherapy interventions:

- ELDOA exercises
- Neural mobilization

The dependent variables included:

- Pain intensity
- Cervical range of motion
- Functional disability

Pain intensity was measured using NPRS, functional disability was assessed using NDI, and cervical range of motion was measured using a universal goniometer.
ELDOA exercises are designed to produce segmental spinal decompression, improve posture, reduce fascial restriction, and enhance neuromuscular control. Neural mobilization aims to improve neural tissue mobility, reduce mechanosensitivity, and restore neural excursion.
The study assumed that improvement in these variables would indicate the effectiveness of the respective intervention in patients with cervical radiculopathy.

3.4Statistical tools and econometric models

This section describes the statistical methods used to analyze the collected data and determine the effectiveness of ELDOA exercises and neural mobilization in patients with cervical radiculopathy.

3.4.1 Descriptive Statistics

Descriptive statistics were used to summarize the demographic and clinical characteristics of the participants. Mean and standard deviation were calculated for variables including age, pain intensity, cervical range of motion, and functional disability scores. The data collected before and after intervention were tabulated and analyzed to observe changes in outcome measures between the two groups.

3.4.2 Inferential Statistics

Statistical analysis was performed using SPSS version 26.0. Both within-group and between-group analyses were conducted.

- **Paired t-test** was used to compare pre-treatment and post-treatment values within each group.
- **Independent t-test** was used to compare post-treatment outcomes between Group A and Group B.

The level of statistical significance was set at **$p < 0.05$**.

3.4.3 Outcome Measures

The following outcome measures were used for statistical analysis:

Outcome Measure	Purpose
Numeric Pain Rating Scale (NPRS)	Assessment of pain intensity
Neck Disability Index (NDI)	Assessment of functional disability
Universal Goniometer	Measurement of cervical range of motion

3.4.4 Group Comparison

Participants were divided into two groups for comparison:

Group	Intervention
Group A	ELDOA exercises + conventional physiotherapy
Group B	Neural mobilization + conventional physiotherapy

Post-treatment scores of both groups were compared to determine which intervention demonstrated greater effectiveness in reducing pain, improving cervical mobility, and enhancing functional ability.

3.4.5 Interpretation of Data

Improvement in NPRS scores indicated reduction in pain intensity, improvement in NDI scores indicated reduced functional disability, and increased cervical range of motion values indicated improvement in cervical mobility.
The intervention producing greater statistical improvement was considered more effective in the management of cervical radiculopathy.

IV. RESULTS AND DISCUSSION

4.1 Results of Descriptive Statistics

Table 4.1 Descriptive Statistics of Outcome Measures

Variable	Minimum	Maximum	Mean	Std. Deviation
NPRS	1.00	8.00	4.25	1.84
NDI	8.00	34.00	20.18	5.42
Cervical Flexion	28.00	50.00	39.76	5.31
Cervical Extension	32.00	58.00	45.82	5.74
Right Rotation	45.00	75.00	61.37	6.43

Variable	Minimum	Maximum	Mean	Std. Deviation
Left Rotation	44.00	76.00	60.94	6.28

Table 4.1 presents the descriptive statistics of the study variables including minimum value, maximum value, mean, and standard deviation. The findings indicate the overall distribution and variability of pain intensity, cervical range of motion, and functional disability among participants with cervical radiculopathy.

The mean NPRS score indicated moderate pain intensity among participants before intervention. Similarly, the mean NDI score demonstrated the presence of functional limitation associated with cervical radiculopathy. Cervical flexion, extension, and rotational movements showed restricted mobility among the study participants prior to intervention.

The standard deviation values indicated moderate variability of data around the mean values, suggesting an acceptable distribution of participant responses within both groups.

The descriptive statistics demonstrated that participants included in the study presented with comparable baseline characteristics related to pain, cervical mobility, and functional disability.

4.2 Comparison of Pre- and Post-Intervention Outcomes

Table 4.2 Comparison of Post-intervention Outcome Measures

Variable	Group A (ELDOA) Mean ± SD	Group B (Neural Mobilization) Mean ± SD	p-value
NPRS	1.93 ± 0.78	2.57 ± 0.77	0.002
NDI	10.73 ± 2.88	14.23 ± 3.14	<0.001
Cervical Flexion	46.87 ± 3.18	43.90 ± 3.56	0.001
Cervical Extension	53.47 ± 3.67	50.53 ± 3.82	0.004
Right Rotation	72.13 ± 4.61	67.80 ± 4.84	0.001
Left Rotation	72.80 ± 4.44	68.23 ± 4.73	<0.001

Table 4.2 demonstrates the comparison of post-treatment outcome measures between Group A and Group B following six weeks of intervention.

Both groups showed statistically significant improvement in pain intensity, cervical range of motion, and functional disability after intervention. However, Group A treated with ELDOA exercises demonstrated greater improvement compared with Group B treated with neural mobilization.

The post-treatment NPRS scores were significantly lower in Group A than Group B, indicating superior pain reduction in participants receiving ELDOA exercises. Similarly, NDI scores showed greater reduction in functional disability in the ELDOA group.

Cervical flexion, extension, right rotation, and left rotation also improved significantly more in Group A compared with Group B, demonstrating better restoration of cervical mobility following ELDOA intervention.

DISCUSSION

The present study was conducted to compare the effectiveness of ELDOA exercises and neural mobilization on pain intensity, cervical range of motion, and functional disability in patients with cervical radiculopathy.

The findings of the study demonstrated that both interventions were effective in improving clinical outcomes following six weeks of treatment. However, participants treated with ELDOA exercises showed significantly greater improvement compared with those receiving neural mobilization.

The reduction in pain intensity observed in the ELDOA group may be attributed to the segment-specific spinal decompression effect produced by the intervention. ELDOA exercises are designed to create vertebral decoaptation and fascial elongation, thereby reducing mechanical stress on cervical nerve roots and surrounding structures. Improvement in spinal alignment and reduction in compressive forces may contribute to decreased nociceptive stimulation and pain perception.

The improvement in cervical range of motion observed in the ELDOA group may be explained by enhanced fascial flexibility, reduced muscular tightness, improved postural alignment, and restoration of segmental mobility. The active postural positions used during ELDOA exercises may also improve neuromuscular control and cervical biomechanics, leading to improved functional movement patterns.

Neural mobilization also demonstrated beneficial effects in reducing pain and improving function. The mechanism of neural mobilization is believed to involve restoration of neural tissue mobility, reduction of intraneural edema, improvement of axoplasmic flow, enhancement of neural vascularity, and reduction of mechanosensitivity. These physiological effects may reduce adverse neural tension and contribute to symptom relief.

Despite improvement in both groups, the ELDOA group demonstrated greater improvement in Neck Disability Index scores, suggesting superior enhancement in functional ability. This may be because ELDOA addresses multiple biomechanical and postural impairments simultaneously, including spinal compression, fascial restriction, muscular imbalance, and movement dysfunction.

The findings of the present study are consistent with previous literature supporting the role of conservative physiotherapy interventions in cervical radiculopathy management. Earlier studies have reported positive effects of neural mobilization in reducing pain and improving cervical function. Similarly, recent evidence regarding ELDOA exercises suggests beneficial effects on spinal decompression, posture correction, flexibility, and pain reduction.

The present study contributes additional evidence by directly comparing ELDOA exercises and neural mobilization using a randomized controlled design. The findings indicate that ELDOA exercises combined with conventional physiotherapy may provide superior clinical benefits in patients with cervical radiculopathy.

However, certain limitations should be considered. The study included a relatively small sample size and short intervention duration. Long-term follow-up was not conducted, and therefore the long-term sustainability of treatment effects remains unclear. Future studies with larger sample sizes and extended follow-up periods are recommended.

Overall, the findings suggest that ELDOA exercises combined with conventional physiotherapy are more effective than neural mobilization in reducing pain, improving cervical mobility, and enhancing functional ability in patients with cervical radiculopathy.

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