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COMPARATIVE STUDY BETWEEN NEURAL TISSUE MOBILIZATION AND MANUAL CERVICAL TRACTION COMBINED WITH STRENGTHENING EXERCISE ON FUNCTIONAL DISABILITY IN CERVICAL RADICULOPATHY

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KEYWORDS

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Abstract

Background: Cervical radiculopathy frequently causes patients to experience measurable functional disability limiting a patients ability to perform activities of daily living well beyond the resolution of pain alone. The effectiveness of a neurodynamic rehabilitation approach vs. a traction-based approach, combined with identical strengthening programmes, for greater functional recovery has not been well established.
Objective: i) To evaluate the effect of manual cervical traction combined with a specific strengthening programme on functional disability in cervical radiculopathy ; ii) To evaluate the effect of neural tissue mobilization combined with the same strengthening programme on functional disability; iii) To compare the two intervention for their effect on disability reduction at six weeks.
Methods: Sixty patients with cervical radiculopathy confirmed by MRI were randomly divided into two groups. Group A (n=30) patients who received manual cervical traction along with strengthening exercise, and Group B (n= 30) patients who received neural tissue mobilization with the same strengthening exercise five days/week for six weeks. The Neck Disability Index (NDI) was used to assess functional disability at baseline and 6 weeks.
Results: Both groups showed statistically significant within group reduction in NDI score ($p < 0.05$) .Group A improved from 43.97±2.28 to 37.13±1.95, and Group B improved from 43.97±2.28 to 31.73±1.90. At six weeks the mean difference between groups was 5.40 points in favour of Group B($t=3.62$, $df=58$, $p=0.005$)
Conclusion: Neural tissue mobilization combined with strengthening exercise produced significantly greater improvement in neck-related functional disability than manual cervical traction with strengthening exercise, but both approaches were clinically effective.

INTRODUCTION

Beyond pain, cervical radiculopathy imposes a distinct and often under addressed burden on a patient's ability to perform ordinary activities of daily living, such as: lifting, reading, sleeping, driving and substained deskwork are all commonly disrupted[1],[2]. Population-based surveillance from Rochester, Minnesota recorded an average age-adjusted incidence rate of 83.2 per 100,000 population over the past five years, with the highest rate of 202.9 per 100,000 population occurring among adults aged 50-54, a time where occupational and domestic demands are highest[26]. This is not a coincidence in the way patients present in physiotherapy clinics – the overlap between peak incidence and peak functional demand commonly occurs in patients who are still

working, frequently in jobs involving prolonged neck postures, repetitive use of the arms or driving, and when combined with an irritable nerve root from the compression, it becomes a disability rather than just a pain complaint.

Compression of the affected nerve root produces motor weakness and altered reflex activity in addition to sensory symptoms and this combination of weakness, guarded movement, and pain-avoidance behaviour that translates into measurable disability rather than pain intensity alone[3,4]. Motor weakness should be considered in isolation of pain, since it has a strong prognostic value for treatment decisions and outcomes of conservative treatment in cervical radiculopathy; a recent analysis of risk factors for suboptimal outcomes in patients with cervical radiculopathy showed that motor weakness may be a clinically significant marker to consider when making treatment decisions and predicting the likelihood of suboptimal functional outcomes with conservative treatment[18]. A widely cited clinical review also considers the functional implications of the condition – reduces grip strength, altered arm and hand coordination, and guarded neck movement – as a symptom that often persists beyond the acute pain phase and requires active rehabilitation rather than resolving spontaneously recovery with pain relief[27]. Disability in this population also extends into the upper limb, with patients commonly reporting difficulty with tasks well beyond the neck itself[5] and another good reason that a neck-focused pain score is inadequate for this population.

The Neck Disability Index (NDI) is most widely used and validated patient-reported measure for this purpose. It is a ten item, self-administered questionnaire which include activities of daily living, pain related items and concentration.that has been shown to have high levels of reliability and responsiveness to clinical change in mechanical neck disorders and radiculopathy [6,7] Its breadth adds to its clinical value: because the NDI samples across several functional domain rather than single activity, so that the NDI is sensitive to the type of diffuse, multi-domain disability that is typically produced by cervical radiculopathy, as opposed to just movement restriction in the neck. Neck pain outcome frameworks, such as the clinical practice guidelines that are associated with the International Classification of Functioning, Disability and Health, also consider functional recovery, rather than pain, as the criterion for evaluating conservative treatment of neck pain[8].

This reflects a broader and well established shift in the measurement of rehabilitation outcomes, which has recently moved from the measurement of symptom relief as an end point in itself, to the measurement of the patient's actual ability to function in the workplace, at home, and during self-care: is ultimately the outcome that determines whether a patients and their treating clinician consider the intervention to have succeeded.

Exercise-based rehabilitation can effectively enhance body function and participation in activities in patients with cervical radiculopathy, whether applied before and after surgical intervention, and strengthening, range of motion, and scapular stabilisation components each contributing to function gains[9],[10]. the rationale for strengthening specifically relates to the mechanisms by which motor control is disrupted with nerve root irritation: With nerve root irritation, strength and movement is lost, which leads to compensation, shifting of the dominant motor control patterns, and disuse of affected musculature, and the restoration of strength in the deep neck flexors and scapular stabilisers is known to reverse this pattern and rather than simply building muscle in isolation[16],[17]. Neck –specific strengthening programmes in particular have shown measurable reductions in disability, reinforcing the rationale for combining any manual or neurodynamic technique with an active strengthening components rather than relying on a passive treatment alone[11]. Case-level evidence supports this claim at the individual patient level: A case report of structured cervical corrective exercise in a patient with radiculopathy demonstrated not only improvement in pain but in posture and intersegmental motion as well, which suggests that functional change can be observed with exercise, even when not part of the overall trial analyses[19].Comparative trials between surgical and non surgical management have likewise found that structured physiotherapy achieves meaningful functional improvement without the risks associated with surgery, supporting conservative rehabilitation as a legitimate first line strategy in appropriately selected patients[12].A separate randomized trial comparing a manual therapy, therapeutic exercise and mechanical traction approach to exercise alone found greater functional improvement, supporting the notion that a multimodal (combined) conservative approach – not any single passive modality alone – is what maximizes improvement in disability status in this population[28].

Manual cervical traction is recommended as an indirect method of restoring function,

via decompression of the nerve root and reduction of mechanical irritation which inhibits motor function and results in guarded movement patterns[13]. The underlying principle is sequential rather than direct: mechanical compression will be relieved first and the protective guarding and motor inhibition the nervous system has taken up around the painful segment should, in principle, be released as the threat signal coming into the nervous system from the compressed root is diminishes. This is a plausible and clinically familiar chain of events, but it is also an indirect chain of events for the nerve, in that it does not act on the nerve's own mechanical behaviour, but rather acts on the joint space and soft tissue around the nerve, and the nerve recovers in function will depend upon this surrounding decompression being sufficient to result in a reduction in neural irritation over time.

However, Neural tissue mobilization is proposed to improve function more directly by enhancing the sliding capacity of the nerve at the interfaces of surrounding tissues, and thus normalise the inhibited neuromuscular recruitment patterns caused by nerve root irritation[14,15].

This mechanistic distinction originates from the foundational concept of neurodynamic, which integrated the biomechanics and physiology of neural tissue movement into a unified glide, adapt to tension and interact with surroundings musculoskeletal structures during spinal and limb movements. Recognizing the nervous system as an assessable and directly treatable mechanical structure rather than merely a passive contributor to joint or soft tissue pathology[29]. Within this framework, intervention that enhance a nerve ability to glide and tolerate mechanical stress are believed to restore motor function more directly and potentially more effectively than approaches that simply enlarge the surroundings joint space and rely on the gradual resolution of neural irritation as an indirect outcomes.

Evidence directly comparing these two mechanically distinct approaches with each other specifically for disability outcomes, and comparative data will be required for functional disability outcomes in cervical radiculopathy treated with either manual traction or neurodynamic mobilization, with the same strengthening program, to guide technique selection for restoring function rather than only reducing pain. This is a meaningful gap for practising clinicians as, while pain and disability are correlated, there's no guarantee that a treatment that significantly improves pain also significantly improves disability; an

intervention that succeeds in reducing pain significantly, but not in addressing the motor recruitment deficits and movement-avoidance behaviours that the NDI is specifically designed to capture, will not necessarily also be effective in improving disability. In principle, a technique might be superior to another technique on pain but inferior on function, or superior on function while inferior on pain, or simply different on function, and only a study that used a functional outcome as its primary measure would answer these questions directly, not by an analysis of pain data collected for a different purpose.

Establishing whether there is a specific functional advantage to any one technique in addition to the advantage it demonstrates in relation to pain is therefore different from the question addressed in pain-focused comparative studies and has not been well-defined in the existing literature on cervical radiculopathy. The present study was designed to address this gap directly. It compared manual cervical traction with strengthening exercise against neural tissue mobilization with strengthening exercise using the Neck Disability Index as a primary functional outcome measure in patients with cervical radiculopathy to determine which of these two mechanistically distinct manual treatments is more effective at translating into clinical improvement of functional capacity of the cervical spine when the other is held constant.

MATERIAL AND METHOD

Research Design: Comparative study.

Study Setting: Department of Physiotherapy, Pacific Medical College and Hospital, Bhilo Ka Bedla, Udaipur, Rajasthan.

Sample Design: Randomized sampling ;60 patients with cervical radiculopathy (both sexes) were enrolled and then randomly divided into two equal groups of 30 patients each group.

Study Duration :11 months of study; 45-60 minute per sessions 5 days a week for six weeks.

Selection Criteria

Inclusion criteria:

- Ages of 30 - 70 years
- Both male and female participants were included
- Complain of radiating pain down the neck to forearm or arm
- Positive special test (cervical distraction test, foraminal compression test)
- Diagnosis confirmed by MRI,
- Willing to give informed consent

Exclusion criteria:

- Age less than 30 or more than 70 years.
- coexisting neurological disease or disorder.
- brachial plexus injury.
- congenital spinal deformity.

The baseline age and sex distribution of the sample is reported in our companion paper on pain outcomes from the same sample and not included here, as the distribution was very similar across both groups. The following two baseline measures are relevant to functional capacity: body mass index and area of residence – are reported below

PROCEDURE

Ethical clearance from the institution was obtained prior to enrolment, and all participants written informed consent was obtained after explaining the procedures of this study. After baseline assessment, participants were randomly divided into two groups: Group A (manual cervical traction and strengthening exercise) and Group B (neural tissue mobilization and strengthening exercise).

Group A was manually traction in supine with the neck positioned in approximately 25° of flexion, applied as a 10 seconds pull followed by 5 seconds of rest and was repeated 10 times per session. Group B were given neurodynamic mobilization of median, radial and ulnar nerves. Both groups were also instructed to perform the same strengthening exercises: isometric strengthening of the deltoids against the wall (10 seconds × 10 repetitions); isometric strengthening of the scalene muscles against manual resistance at the occiput (10 seconds × 10 repetitions); strengthening of the trapezius, rhomboids, latissimus dorsi and serratus anterior with a resistance band (5 seconds × 10 repetitions); chin-tuck exercise (5 seconds × 10 repetitions); and shoulder shrugs (5 seconds × 10 repetitions), because there is a close relationship between the strength of the scapular and deep neck flexors and functional carry-over to activities of daily living[30,31].

Outcome Measure: Neck Disability Index (NDI)- a 10 –items , self- reported, disability questionnaire, 7 items are related to activities of daily living, 2 are related to pain and 1 is related to concentration, each item is scored 0 to 5, and the total score is expressed as a percentage; higher score represents greater disability. The NDI has been shown to have good reliability and responsiveness in populations of mechanical neck pain and radiculopathy[6,7].

Statistical Analysis: Data was presented as Mean ± Standard deviation. The paired t-

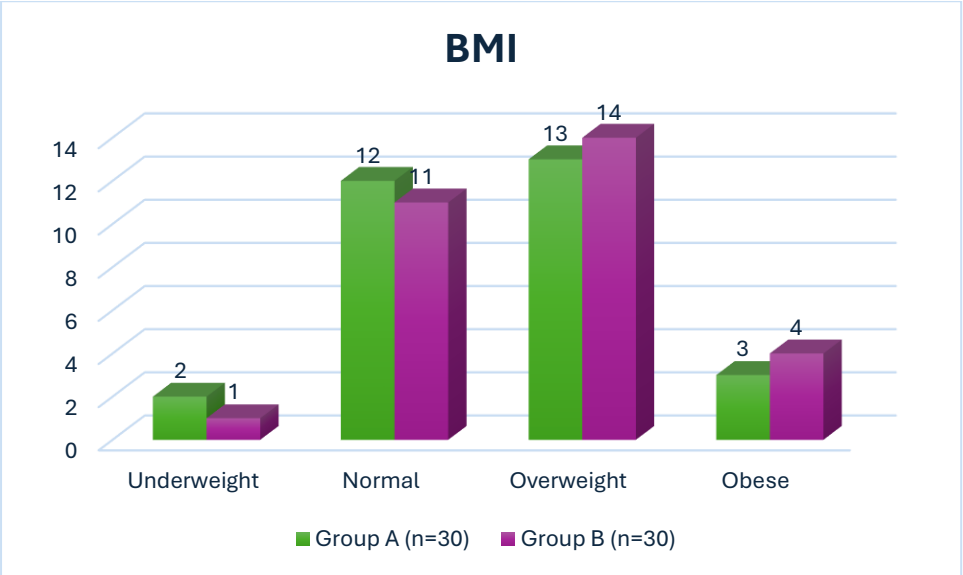
test was used for within-group change from baseline to six weeks and the independent samples t-test was used for the between-group comparison at six weeks. A p-value<0.05 was considered statistically significant.

RESULT

Table 1: BMI DISTRIBUTION OF PARTICIPANTS

BMI Category	Range (kg/m²)	Group A (n=30)	Group B (n=30)	Total (n=60)
Underweight	<18.5	2 (6.7%)	1 (3.3%)	3 (5.0%)
Normal	18.5–24.9	12 (40.0%)	11 (36.7%)	23 (38.3%)
Overweight	25–29.9	13 (43.3%)	14 (46.7%)	27 (45.0%)
Obese	≥30	3 (10.0%)	4 (13.3%)	7 (11.7%)

GRAPH 1: BMI DISTRIBUTION



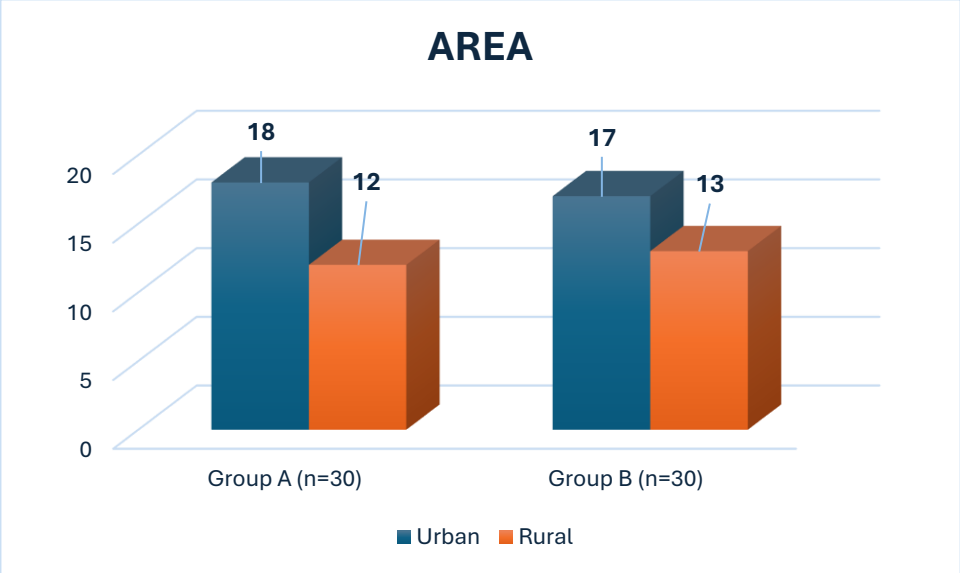
Nearly half of all participants (45.0%) fell in the overweight category, with a broadly similar BMI profile in both groups; the slightly higher proportion of obese participants in Group B

(13.3% vs 10.0%) was not considered clinically meaningful given the small absolute difference.

Table 2: AREA (DOMICILE) DISTRIBUTION OF PARTICIPANTS

Area	Group A (n=30)	Group B (n=30)	Total (n=60)
Urban	18 (60.0%)	17 (56.7%)	35 (58.3%)
Rural	12 (40.0%)	13 (43.3%)	25 (41.7%)

GRAPH 4: AREA DISTRIBUTION



A majority of participants (58.3%) resided in urban areas, with a near-identical urban–rural split across both groups.

Table 3: GROUP A (MANUAL CERVICAL TRACTION + STRENGTHENING) — NDI, 0 WEEK VS 6 WEEKS

Timepoint	N	Minimum	Maximum	Mean	Std. Deviation	t-value	p-value	Result
0 Week	30	40	48	43.97	2.28	3.48	0.005	Significant
6 Week	30	34	40	37.13	1.95			

Overall	60	34	48	40.55	4.01			

GRAPH 6: GROUP A – NDI (0 WEEK VS 6 WEEKS)

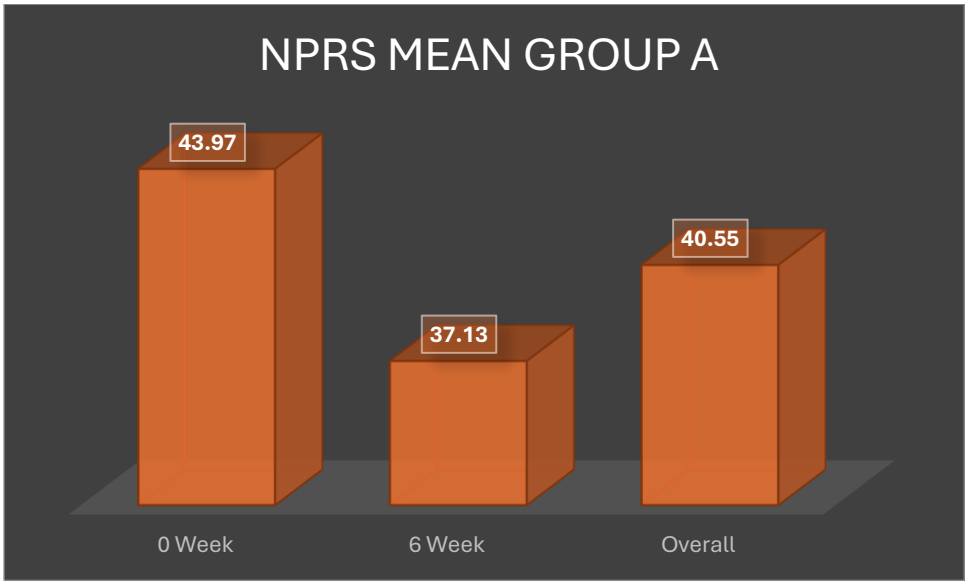
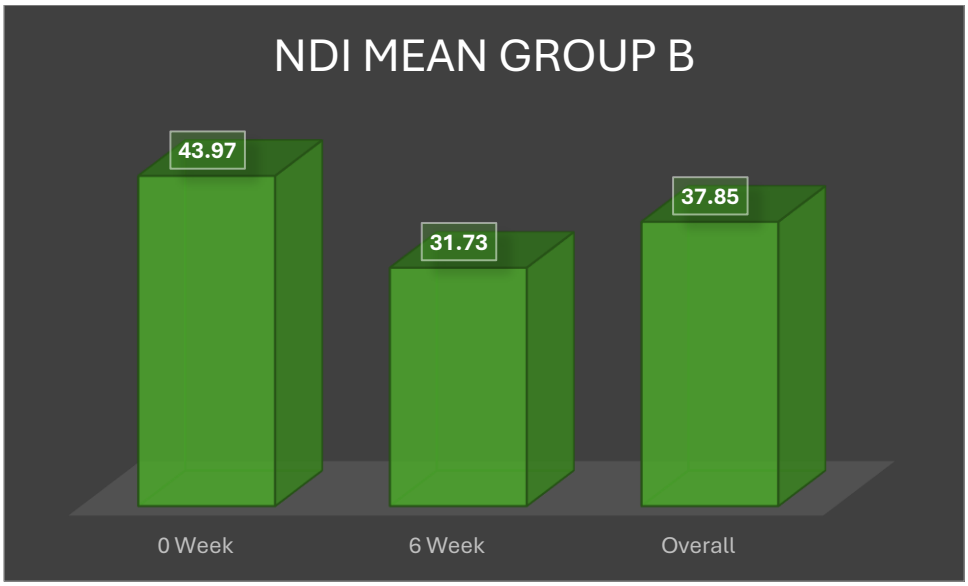


Table 4: GROUP B (NEURAL TISSUE MOBILIZATION + STRENGTHENING) — NDI, 0 WEEK VS 6 WEEKS

Timepoint	N	Minimum	Maximum	Mean	Std. Deviation	t-value	p-value	Result
0 Week	30	40	48	43.97	2.28	4.95	0.005	Significant
6 Week	30	28	34	31.73	1.90			
Overall	60	28	48	37.85	6.18			

GRAPH 8: GROUP B – NDI (0 WEEK VS 6 WEEKS)



Both groups showed a statistically significant reduction in disability score, but the improvement was considerably larger in Group B (mean fall of 12.24 points) than in Group A (mean fall of 6.84 points).

Table 5: BETWEEN-GROUP COMPARISON — NDI AT 6 WEEKS

Group	N	Mean	Std. Deviation	Std. Error Mean
Group A	30	37.13	1.95	0.36
Group B	30	31.73	1.90	0.35

Independent Samples Test

t-test for Equality of Means

t-value	df	p-value	Mean Difference	Result
3.62	58	0.005	5.40	Significant

At six weeks, Group B showed significantly lower disability scores than Group A, a mean difference of 5.40 points favouring neural tissue mobilization.

DISCUSSION

This study aimed to compare the effect of manual cervical traction and neural tissue mobilization, each combined with an identical strengthening programme, on neck-related functional disability in cervical radiculopathy, measured using the NDI. Both groups achieved statistically significant reduction in disability over six weeks, but the reduction was almost twice as large in the neural mobilization group, a difference that was confirmed on direct between group comparison.

The functional improvement observed within the traction group is similar to the proposed mechanism of action, by which decompression of the nerve root reduces motor inhibition and permits more normal movements pattern to re-establish , thereby allowing greater performance of activities of daily living (ADLs)[13],[18]. In previous studies, neck-specific exercises with conservative treatments resulted in similar functional improvements, supporting the notion that structured and supervised rehabilitation regardless of the type of manual technique, is effective in improving function in this patient population[9,19].

The greater functional gain with neural tissue mobilization is consistent with other studies showing that the restoration of neurodynamic mobility has an impact beyond reducing pain, to measurable functional recovery. However, Rafiq et al. reported that neural mobilization resulted in significantly more disability improvement, along with pain and ROM, than conservative therapy alone[20], and Savva et al. reported similar disability improvement with neural mobilization combined intermittent traction[21]. Dedering et al. Randomized trial also showed that a neck specific, structured training program resulted in significant improvements in disability compared to giving patients general physical activity advice, indicating that focused training on a specific mechanism is more effective for improving neck function.[22] The Cervical Radiculopathy Impact Scale literature also has demonstrated that disability in this population affects; extends across multiple domains of daily function, not pain alone

this is in alignment with the multi-item structure of the NDI that was used here and helps explain why a technique that acts directly at the nerve root has produced such disproportionately large response on a disability measure versus a pain score alone[23].

A plausible explanation for this pattern is that neurodynamic mobilization not only decreases the nociceptive drive, but also normalizes the altered motor recruitment and movement avoidance behavior that develops in response to nerve root irritation, and it is this behavioral and neuromuscular component that most directly affects a patient's NDI score, and not just pain alone. A strengthening exercise commonly performed by both groups may have had an effect of a common functional improvement, through the restoration of the strength of the deep neck flexor and scapular stabilisers strength[30,31] and the neurodynamic technique may have had a mechanism specific functional benefit that was not fully captured by manual traction.

Overall, the findings suggest that neural tissue mobilization, in addition to strengthening exercise, has a clinically significant advantage over manual cervical traction, combined the strengthening exercise, for treating patients with cervical radiculopathy, when the primary goal is restoring function and activities of daily living, rather than relieving pain alone.

CONCLUSION

The present study compared functional disability outcomes of 60 patients with cervical radiculopathy treated with either manual cervical traction or neural tissue mobilization, both with a 6-week strengthening program, using the Neck Disability Index as the primary outcome. Both treatments resulted in statistically significant improvements in disability scores, indicating that structured conservative treatment resulted in meaningful restoration of function in this group of patients, regardless of the manual technique used.

However his improvement was not the same between the groups. Patients treated with neural tissue mobilization and strengthening exercise achieved Close to two times reduction in NDI score was seen in patients treated with manual cervical traction and strengthening exercise and this advantage was confirmed on formal between group statistical comparison at six week. This implies that direct targeting of the neural interface may be more effectively translated into activity performance than targeting only the joint and surrounding soft tissue alone.

The clinical implications of the findings are to prioritize neural tissue mobilization in a strengthening-based rehabilitation program when the primary goal of the rehabilitation is to restore a patient's ability to perform activities of daily living and work tasks and restore functional independence, rather than pain reduction. Manual traction remains a valid and effective option, particularly where neurodynamic techniques are less well tolerated but the present comparative data suggests that neural mobilization is a better option.

Due to its small single centre trial of modest size and limited 6-week follow-up period without a no-treatment control arm, these findings need to be confirmed in larger, multi-centre trials with longer term functional follow-up before they are widely applicable. Further studies should explore to examine the functional benefit of neural tissue mobilization found in this study and if these benefits persist over months versus weeks as well as if these benefits relate to measurable return-to-work or return-to-sport timelines.

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