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COMPARATIVE ASSESSMENT OF NEURAL GLIDING AND NEURAL TENSIONING TECHNIQUES COMBINED WITH CERVICAL TRACTION ON PAIN AND NECK DISABILITY AMONG PATIENTS WITH CERVICAL RADICULOPATHY

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Abstract

Background: *Cervical radiculopathy is diagnosed when pain and sensory disturbances originating from a compressed or irritated cervical nerve root radiate into the arm, often with associated disability. Most conservative treatments involve neural mobilization or neural tensioning (at times in conjunction with cervical traction); and there have been few trials to compare neural gliding with neural tensioning where both are used in combination with traction.*

Objective: *To compare the effects of neural gliding plus cervical traction and neural tensioning plus cervical traction on pain intensity and neck disability.*

Methods: *This randomized controlled trial was conducted in a tertiary care hospital in Multan, Pakistan involving 36 adults (35–55 years) that were allocated by sealed opaque envelopes in two groups each (Group A – neural gliding and mechanical cervical traction, n = 18 and Group B – neural tensioning and mechanical cervical traction, n = 18). Four times a week, treatment was provided for four weeks. The Visual Analogue Scale (VAS) for pain and disability questionnaires (Neck Disability Index [NDI]) were completed prior and following the program. Nonparametric tests were used.*

Results: *All those participating in the trial finished the trial. Both groups showed significant reductions in pain and disability scores compared to baseline ($p < 0.001$). Mean VAS reduction was respectively 3.35 points in Group A vs. 2.52 points in Group B and posttreatment VAS scores were different between the two groups (U*

= 80.000, p = 0.009, d = 1.00). There were no significant between group differences in post-treatment NDI scores (U = 134.500, p = 0.383, d = 0.44), and mean NDI reductions were 11.94 points in Group A and 7.11 points in Group B.

Conclusion: *Both the groupings were effective. Hence, neural gliding and traction resulted in greater pain relief, but there were no significant differences in disability outcomes, thus gliding should be incorporated for pain reduction as primary clinical objectivity.*

1. INTRODUCTION

Cervical radiculopathy is a neurological condition that presents when a cervical nerve root becomes compressed or irritated and causes pain down the dermatomal distribution of the affected nerve root (C4, C5, C6, C7 etc.) into the upper limb (Kang et al., 2020). It is one of the more commons of the nerve-related conditions seen in clinical practice, and has a significant morbidity burden for patients and health care providers (Iyer & Kim, 2016). Most arise secondary to disc herniation or due to narrowing of the foramina that the roots pass into & through (Magnus et al, 2024) and the disability created reduces work productivity & quality of life (Apaydın et al 2024).

However, mechanical compression is not the only source of symptoms. When a herniated disc spills inflammatory chemicals like interleukins and tumor necrosis factor alpha, these chemicals inflate the nerve and make it more vulnerable to pain (Li et al., 2023). Compression may also interfere with the axial flow, with a decrease in blood supply within the nerve, and the increased vulnerability of the nerve to movement (Malik et al., 2023). Because of these findings, normal movement of nerves has been added as a therapeutic goal when decompressing. (Basson et al., 2017)

When there is no neurological deficit or when symptoms are mild (Plener et al., 2023), the first approach is conservative care. Mekonnen et al. (2011) found that manual therapy decreased pain and improved function, especially when it is supplemented by exercise. Cervical Traction has a longitudinal distraction effect that stretches the spine, widens the intervertebral foramina and reduces pressure on the neural elements (Abi-Aad & Derian, 2017). Patients with cervicogenic pain who received mechanical traction in addition to conventional treatment showed increased pain and disability outcomes compared to those receiving exercise for conventional treatment (Ahmad et al. 2025). Meta-analyses suggest that both short- and medium-term improvements in traction are statistically significant (Romeo et al., 2018) but lack clinical relevance (Colombo et al., 2020). Even if there is no decrease in nerve motion, or less sensitivity, there may be a need for extra procedures.

Neural mobilization is based on the premise that during limb and spinal motion, peripheral nerves should glide and elongate freely and if this movement is limited it can lead to pain and dysfunction (Waldhelm et al., 2019). This method is believed to help in the improvement of intraneural blood flow and reduce swelling, as well as improve axonal transport (Azharuddin et al., 2023). In patients with cervical disc herniation and cervical radiculopathy, the addition of neural mobilization to the conventional physiotherapy produced greater improvement in terms of pain, disability and mobility (Kayiran & Turhan, 2021; Rafiq et al., 2022).

The technique of neural mobilization is usually broken down into two methods, which comprise gliding or sliding techniques, and tensioning techniques (Alharmoodi et al., 2022). When the gliding occurs, the nerve bed is longer in one joint and shorter in another, allowing the nerve to glide relative to the other parts of the surrounding tissue in directions where there is limited lengthening to be applied, while the tensioning causes the nerve bed to be longer in several different locations at the same time and to increase in tensile length. There are thus clinical differences between the two. It was noted that tensioning correlated with decreased amplitude of dermatomal SSEPs in healthy volunteers, and the authors recommend with caution when applying tension to any nerve highly sensitized (Alharmoodi et al., 2022). However, tension has also been described as being a stress factor in aggravating symptoms of sensitive nerves (Basson et al., 2017). Nonetheless, tensioning of the brachial plexus was more effective for reducing

pain and improving function compared to conventional treatment in chronic cervical radiculopathy (Ibrahim et al., 2021).

A controlled trial combining neural mobilization with traction was more effective compared to either alone for improvement in pain and disability (Pallewar et al., 2021; Savva et al., 2021) and a meta-analysis study showed that when neural mobilization is applied with traction, it yields additional pain and disability reduction compared to traction alone, neural mobilization alone, or a control condition (Wu et al., 2026). The presentation time also can make a difference as in one trial, simultaneous delivery was better than consecutive delivery (Masood et al., 2024). However, most studies handle neural mobilization as one type without differentiating gliding and tensioning, and those studies that directly compare both are lacking in high quality trials when it accompanied with traction. The present trial was thus devised for filling this void. The hypothesis was that, when combined with cervical traction, neural gliding and neural tensioning have different pain reducing and neck disability efficacy in cervical radiculopathy.

2. METHODS

This was a two-arm parallel-group randomized controlled trial performed after approval of synopsis over a four months period at a tertiary care hospital of Multan, Pakistan. The ethics committee guidelines and rules for TIMES University Multan have been adhered to while conducting the study. All participants signed a written informed consent form after receiving a written explanation of the procedures, potential risks and participants' ability to drop out at any time without penalty. Identities were anonymized and data were stored securely with password protection and restricted access.

The inclusion criteria were: patients aged 35 to 55 years had unilateral cervical radiculopathy, arm pain that persisted for more than three weeks, and a positive Spurling test. Patients who had received a previous cervical spine surgery, cervical myelopathy, severe neurological impairment and a requirement for surgical intervention, cervical fracture, tumor or infection, and systemic inflammatory disease (rheumatoid arthritis), pregnancy or use of opioid analgesics or other pain medications were excluded. The recruitment for physiotherapy outpatient department was done by nonprobability purposive sampling technique. Out of 45 patients who were assessed, nine were not included in the sample, and 36 were enrolled (Figure 1).

In order to determine the sample size, G*Power 3.1.9.7 software for independent samples t test with two-sided α of 0.05, power of 80%, and a ratio of allocation of 1:1 was used. Based on Kim et al. (2017), a means of 10.60 and 14.27 with a standard deviation of 2.82 and 3.83, respectively, the effect size (Cohen's d) was 1.09, and a sample size of 15 for each group was obtained. If 10% of this was lost the total would be 33, rounded up to 36 for two equal numbers of 18.

Sealed opaque envelopes were used to allocate participants to Group A or Group B after the baseline assessment in order to hide allocation. Due to the difference in technique motion between the two; blinding the participants and therapist was impossible.

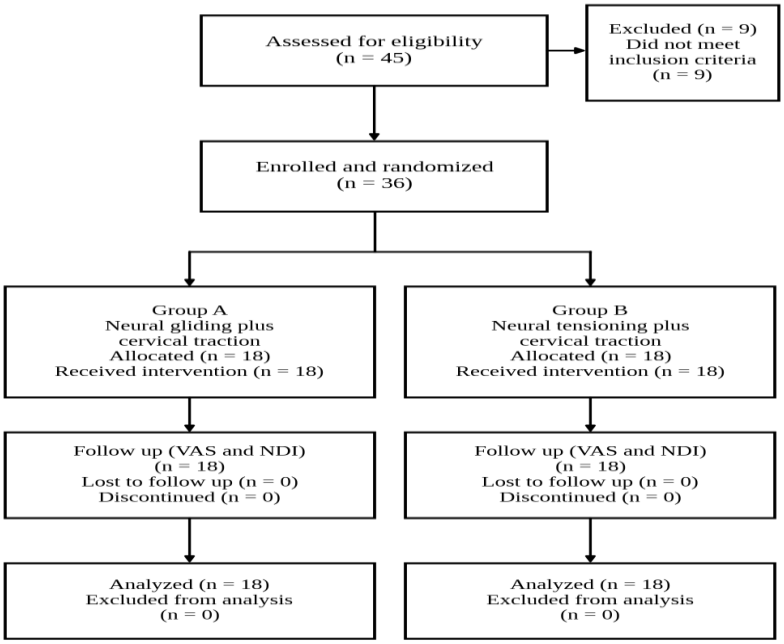


Figure 1. Flow of participants through the trial.

2.5 Interventions

Both groups received the same preparation and the same mechanical cervical traction, and each group then received a different median nerve technique. Moist heat and transcutaneous electrical nerve stimulation (TENS) were administered to all participants before the specific treatment. Treatment was provided four times per week for four weeks. Mechanical cervical traction was applied with the participant lying supine and the neck slightly flexed (20 to 25 degrees), using intermittent cycles of 15 seconds of hold followed by 5 seconds of rest, for 15 minutes per session (Abi-Aad & Derian, 2017).

Median nerve mobilization was performed with the participant supine, the shoulder abducted to 90°, the elbow extended and the forearm supinated (Ibrahim et al., 2024). Each session consisted of 3 sets of 10 repetitions and was designed to last 45 minutes.

In Group A (neural gliding), wrist extension was applied while the neck was laterally flexed toward the involved side, which lengthens the nerve bed at the wrist and shortens it at the neck. The nerve was slid rhythmically with minimal tensile stress, so that the focus was on nerve excursion rather than on tension.

In Group B (neural tensioning), the wrist and fingers were held in extension and the neck was laterally flexed away from the involved side, which lengthens the nerve bed at both ends and increases tension on the nerve. The position was held at the point of mild to moderate tension for 10 seconds, with the focus on controlled tensile loading of the neural tissue.

2.6 Outcome measures

The following baseline data were recorded: age, sex, occupation, symptom duration, dominant hand, height, body weight and body mass index (BMI). To compare the intensity of the pain, the VAS was used—there was no pain on one end of the line and the worst pain that you could imagine on the other end, and the patient identified the location of the pain inside this line for a specific period of time. Any score above 6 was considered severe, those of 4 to 6 were considered moderate, and those below 4 were regarded as mild. VAS scores have been shown to relate well to those of the numerical rating scale, although the two scales did not reach acceptable agreement (Goudman et al., 2024).

An estimate of neck related disability was assessed using the NDI which consists of 10 items pertaining to personal care, lifting, reading, headaches, concentration, work, driving, sleep habits, recreation. They will be marked out of 5 points for each item up to a maximum of 50, and also presented as a percentage total or raw scores. Mild: 5-14, Moderate: 15-24, Severe: 25-34, and Complete disability: 35-50. The NDI

has proven reliability and validity (Apaydın et al., 2024). All measures were administered at pre- and post-tests (after the fourth week).

2.7 Statistical analysis

All the data were analyzed in IBM SPSS Statistics 26. All variables were given their mean and standard deviations. The Shapiro Wilk test was used to test for the normality of change scores (post minus pre), and the Kolmogorov Smirnov test with Lilliefors correction was used as a supplement as the time of each group had fewer than 50 participants. With this there was a violation of normality in at least one group for each outcome; this is why the within group changes were assessed using a Wilcoxon signed rank test and post-treatment scores were compared between groups using a Mann Whitney U test. The Cohen's d was presented as the effect size, and effect sizes of < 0.5 were considered small.

3. RESULTS

3.1 Normality

VAS change in Group A and change in NDI in Group B failed normal distribution (Shapiro Wilk test), with the NDI change in Group A very close to not being normal (Table 1). For all comparisons that were made, the nonparametric analysis was performed.

Table 1. Tests of normality for change scores.

Variable	Group	KS statistic (p)	SW statistic (p)
VAS change	A	0.196 (0.067)	0.872 (0.019)*
VAS change	B	0.107 (0.200)	0.975 (0.888)
NDI change	A	0.191 (0.082)	0.898 (0.053)
NDI change	B	0.206 (0.043)*	0.874 (0.020)*

KS, Kolmogorov Smirnov with Lilliefors correction; SW, Shapiro Wilk. An asterisk marks p < 0.05.

3.2 Participant characteristics

All the 36 participants finished the program and none was lost to follow up or withdrawn due to no reason (Figure 1). There was no significant difference between the groups regarding age, duration of symptoms, sex or hand dominance (Table 2). Overall, the sample included 23 men (63.9%) and 13 women (36.1%), and 29 participants (80.6%) were right-handed. There were eleven occupations represented most of which were found in Group B (16.7% were office workers) with highest numbers of tailors in Group A (22.2%). There were also similar baseline scores across the groups (Table 3).

Table 2. Baseline characteristics of participants.

Characteristic	Group A (n = 18)	Group B (n = 18)
Age, years	44.28 ± 6.07	45.06 ± 5.43
Age range, years	35 to 54	37 to 53
Symptom duration, weeks	12.11 ± 3.66	12.11 ± 4.70
Duration range, weeks	5 to 20	5 to 20
Height, cm	168.50 ± 7.20	169.20 ± 6.80
Body weight, kg	72.40 ± 9.60	74.10 ± 10.20
BMI, kg/m²	25.45 ± 2.85	25.82 ± 3.10
Male, n (%)	12 (66.7)	11 (61.1)
Female, n (%)	6 (33.3)	7 (38.9)
Right handed, n (%)	15 (83.3)	14 (77.8)
Left-handed, n (%)	3 (16.7)	4 (22.2)

Continuous values are mean ± standard deviation.

3.3 Pain and disability scores

Mean VAS fell from 6.86 to 3.51 in Group A and from 6.95 to 4.43 in Group B, while mean NDI fell from 29.06 to 17.11 and from 27.28 to 20.17, respectively (Table 3, Figures 2 and 3). Both the measures gained larger numbers on the Group A.

Table 3. VAS and NDI scores before and after treatment.

Outcome	Group	Pretreatment	Posttreatment	Mean reduction
VAS	A	6.86 ± 1.14	3.51 ± 0.95	3.35
VAS	B	6.95 ± 1.06	4.43 ± 0.89	2.52
NDI	A	29.06 ± 6.86	17.11 ± 7.43	11.94
NDI	B	27.28 ± 6.31	20.17 ± 6.45	7.11

Values are mean ± standard deviation. VAS, Visual Analogue Scale; NDI, Neck Disability Index.

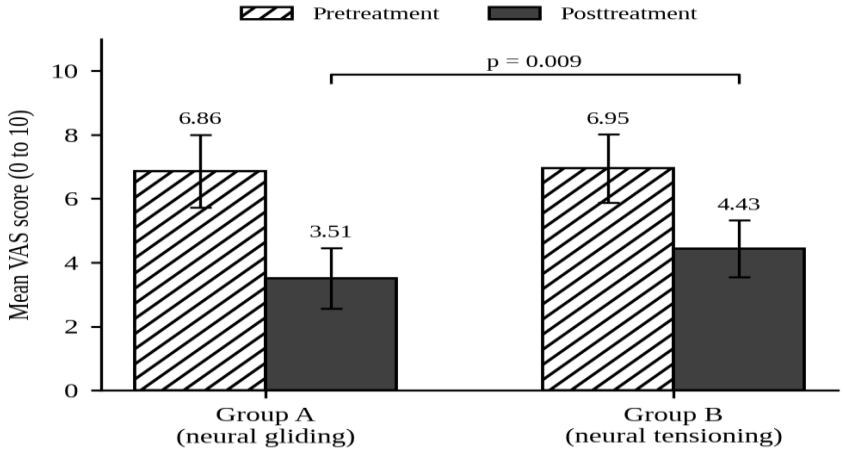


Figure 2. Mean VAS scores before and after treatment. Error bars show one standard deviation, and the bracket marks the between group comparison of posttreatment scores.

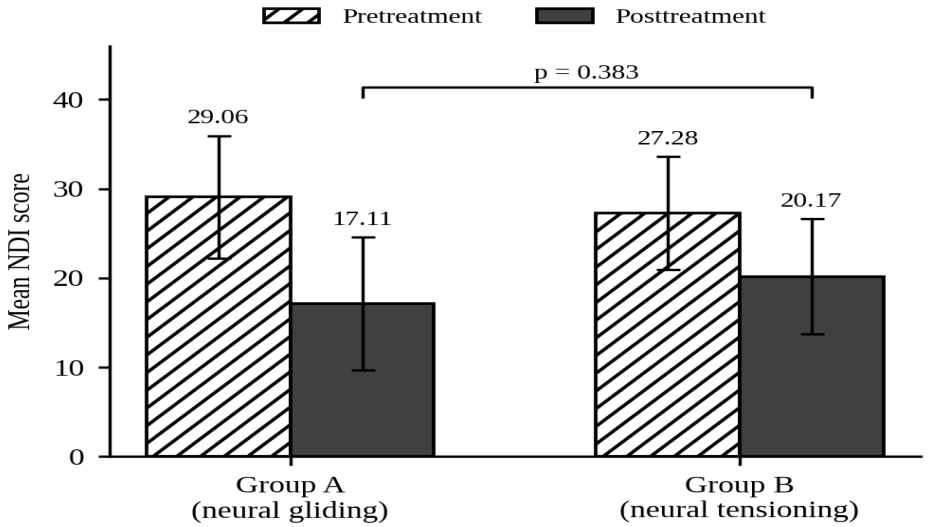


Figure 3. Mean NDI scores before and after treatment. Error bars show one standard deviation, and the bracket marks the between group comparison of posttreatment scores.

3.4 Within group changes

The VAS and NDI scores for both groups were reduced after the treatment. For each of the four Wilcoxon analyses the number of negative ranks was 18, there were no positive ranks and no ties with a mean rank

of 9.50 and a rank sum of 171.00. All changes were large, $p < 0.001$ and with very large effect sizes (Table 4). The mean NDI decreases for both group A (11.94 points) and group B (7.11 points) were above the 5-point cut that was considered as clinically meaningful in this study.

Table 4. Wilcoxon signed rank test for pretreatment to posttreatment change.

Outcome	Group	Z	p	Cohen's d
VAS	A	3.733	< 0.001	5.05
VAS	B	3.726	< 0.001	4.84
NDI	A	3.738	< 0.001	4.34
NDI	B	3.740	< 0.001	3.46

Absolute values of Z are shown; all changes reflected lower posttreatment scores.

3.5 Between group comparison

The posttreatment VAS scores were significantly different between the two groups with a large effect size (Table 5). There was no significant difference in post-treatment NDI scores and no matter how big or small the difference was the effect was small. For the pain intensity, null hypothesis was rejected and for the neck disability, null hypothesis was retained.

Table 5. Mann Whitney U test for posttreatment scores.

Outcome	Rank A	Rank B	U	Z	p	d
VAS	13.94	23.06	80.000	2.598	0.009	1.00
NDI	16.97	20.03	134.500	0.872	0.383	0.44

Rank A and Rank B are mean ranks (rank sums: VAS 251.00 and 415.00; NDI 305.50 and 360.50). Absolute values of Z are shown.

4. DISCUSSION

In this trial, two neural mobilization techniques (NM1: gliding and NM2: holding) were provided with mechanical cervical traction and concluded that the NM1 (gliding) method was associated with a lower pain rating at four weeks while the NM2 (holding) technique resulted in a similar disability reduction.

The improvements found in the two groups support previous research demonstrating greater improvement with traction combined with neural mobilization than with either alone (Pallewar et al., 2021; Savva et al., 2021; Wu et al., 2026), and that neural mobilization is beneficial when added to conventional therapy (Rafiq et al., 2022; Kayiran & Turhan, 2021). Neural mobilization has also exceeded Mulligan's mobilization in regard to nerve function, pain threshold and pain (Karkousha et al., 2023). The players in the tensioning group were similar to those in the report of brachial plexus tensioning increasing pain and function in CR (Ibrahim et al., 2021). Similarly, a network meta-analysis also showed that the combination of neural mobilization + articular mobilization was also best for short-term pain and disability, but with low certainty due to risk of bias and heterogeneity (García-Juez et al., 2025). None of the participants in either arm got worse on either parameter.

This pain difference between gliding positions is consistent with the mechanical difference between the different positions. When the nerve glides, there is always minimal added stress; when the nerve is tensioned it tends to put more stress on the nerve and can trigger an irritated nerve, thereby delaying the relief (Alharmoodi et al., 2022; Basson et al., 2017; Ellis et al., 2022). Clearly, neural mobilization has been touted as a potential approach for general reduced swelling, blood flow to improve, and enhancing axonal transport (Azharuddin, et al. 2023). Here there was no measurement of nerve function, blood flow or swelling, which support the mechanisms outlined above but have not been proven.

The fact that there is no difference between any of the groups in terms of disability may be attributed to the component that is common for both arms. It is believed that traction can create space between the discs and relieve pain from the root. Previous research found that combining traction with conventional treatment helped to reduce disability (Abi-Aad & Derian, 2017; Ahmad et al., 2025). The NDI was also

in favor of the Group A, and with a small to medium effect. Our size of the sample was based upon the results produced by Kim and others (2017) and a difference closer to 0.44 may have been missed. With a larger sample or a longer time period it may be possible to answer this question. These results might indicate that neural gliding along with traction is the better option for clinicians in the setting of pain relief. If functional recovery is the goal, either procedure is quite reasonable and selection can be reasonably based upon patient tolerance, severity of nerve compression, and timing of nerve involvement. Several limitations apply. The number of participants were modest (N = 18 per group). I was not able to find any follow up, therefore this program has an unknown durability. Blinding was not feasible and therefore there was potential for performance and expectation bias. Data were obtained from only one centre and so the findings may not be generalizable.

The entire cohort had root involvement, although of varying severity and this may have affected the responses. Furthermore, the study did not include an arm without treatment nor an arm with only neural mobilization, which made it difficult to delineate the contributions of each. An improvement could also be an improvement in symptoms and represent spontaneous recovery, which can range from faster recovery to no or even longer symptom duration (Sleijser-Koehorst et al., 2018).

5. CONCLUSION

To sum up, neural gliding with cervical traction was associated with greater reduction in pain than neural tensioning with cervical traction and both techniques resulted in clinically meaningful statistically comparable reductions in neck disability. Larger multicultural studies with follow up, comparison of dosing parameters for each technique, and testing of both techniques with strengthening exercises, postural correction and manual techniques could be helpful in future trials.

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