Effectiveness of Neural Mobilization on Pain, Range of motion, and Disability in Cervical Radiculopathy: a Randomized Controlled Trial

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Abstract

Background: Cervical Radiculopathy (CR) is a disorder of the spinal nerve roots that is largely caused by space occupying lesion which can lead to nerve root inflammation and patient usually presents with radiating pain in his/her upper extremity known as cervical radiculopathy. The objective of the study was to compare the effectiveness of neural mobilization technique with conservative treatment on pain intensity, range of motion and disability.

Methods: It was a double blinded randomized clinical trial; data was collected from Mayo Hospital, Lahore through convenience sampling technique. After taking consent from the patients, the patients fulfilling the inclusion and exclusion criteria were selected and randomized blindly and assigned through computer generated random number into two groups i.e. group 1 (neural mobilization), group 2 (conventional treatment). Pain intensity was measured on Numeric pain rating scale, range of motion measured with inclinometer and functional status with neck disability index (NDI). Data was analyzed using SPSS and difference in improvement before, after 02 and 04 weeks was noted and compared.

Results: There was significant improvement in pain relief, neck disability and cervical ranges after the treatment in both groups compared to the pre-treatment status ($p < 0.00$) and when neural mobilization was compared , it was more effective technique than conventional treatment in reducing pain and neck disability ($p < 0.00$). But there was not statistical difference in mean score of cervical range of motion ($p>0.05$)

Conclusions: The present study concluded that both neural mobilization and conservative treatment were effective as an exercise program for patient with cervical radiculopathy, however neural mobilization was more effective in reducing pain and neck disability in cervical radiculopathy.

Trial registration: RCT20190325043109N1

Introduction

Cervical Radiculopathy (CR) is a disorder of the spinal nerve roots that is largely caused by space occupying lesion, disc herniation compression and bony spur typically osteophytes in degenerating cervical spine which can lead to nerve root inflammation, impingement even both. These lesions can trigger pain receptors in the soft tissues and joints of cervical spine that can lead to both sensory or the motor changes in upper extremity along with loss of sensation, numbness, tingling, fragility in upper end point, motor defects in neck and few times in scapula, and pain along the nerves pathway into the hand and arm, relying on where the affected roots are located.[1, 2] The radiation of pain can be unilateral or bilateral, although bilateral cases occurred only in 5-36%of patients with cervical radiculopathy.[1]

The incidence of cervical radiculopathy annually is about 107.3 per 100,000 for males and 63.5 per 100, 000 for females. This incidence increases in the fifth decade of life that reaches to 203 per 100 000.[3]

Among Pakistani population irregular physical activity is common, intensifying stress levels and deficiency of exercise are causing tremendous problems in daily routine. These factors result in bone, immune system and muscles feebleness as well as deteriorate body mechanics. Due to these factors, instability of the spine and related structures aggravate the underlying musculoskeletal problems[4].

For establishing criteria for the diagnosis of cervical radiculopathy different diagnostic tests are devised. MRI and EMG are considered the gold standard for diagnosing cervical radiculopathy. But these techniques are not readily available in most of clinical settings so other manual diagnostic tests are used.[1]

Cervical radiculopathy can be treated surgically but there is large number of evidence suggesting conservative management to be more effective than surgical treatment, suggesting multimodal treatment strategies that include cervical traction, manual therapy techniques and strengthening exercises. Although there is little high-quality evidence on the best non-operative therapy for cervical radiculopathy but these are used to relieve discomfort and pain.[5, 6]

Neural mobilizations have been studied in various populations such as low back pain, carpal tunnel syndrome, lateral epicondalalgia and cervico-brachial pain. Neural mobilization techniques studied include cervical lateral glides for cervico-brachial pain in which lateral translatory movement of c-spinal segment to be treated is done with an aim to move the structures surrounding the nerve, nerve gliding exercises which are sequence of positioning of fingers to elongate median nerve used in the treatment of carpal tunnel syndrome. However further researches are required for validation of this neural mobilization concept.[7] In the present study this approach was used to evaluate its effects on patients with cervical radiculopathy.

Many studies have been done on treatment of cervical radiculopathy. But most of them are inconclusive in terms of defining appropriate treatment options that would be efficacious for the treatment of this pathology. As they lack in quality of study, number of subjects, treatment methods used, duration of sessions, measurements of outcomes, including patients with neck pain of multiple or unspecified origin or conditions masquerading as cervical radiculopathy and comparison of different treatments.[6]

The purpose of this study was to assess the neural mobilization technique as an effective treatment to improve neck mobility, reduce pain intensity and disability for cervical radiculopathy through appropriate randomized controlled trial, taking the factors and outcome measures under consideration that are not addressed properly in previous literature. As it is a cost effective technique, this study will help many people with cervical radiculopathy, because of non-availability of different expensive modalities, these manual techniques can enhance the scope of rehabilitation in these subjects.

Methods

This randomized trial was conducted according to consolidated standards of reporting trial CONSORT guidelines (2010) [8] from July 2019 to July 2020. Ethical approval was gained from the University of Lahore (Ref#IRB-UOL-FAHS/373-VI/2018). Written informed contents in Urdu or English were taken from all the subjects before the study. The trial was prospectively registered through the Iranian Registry of Clinical Trials (IRCT20190325043109N1) on 30/6/2019.Total 88patients (44 in Group 1 and 44 in group 2) were included through convenience sampling technique in this study, using effect size 0.70, using (mean ±SD) in group 1(neural mobilization group) (3.35±1.49) and group 2 (exercise group) (4.45±1.63), at level of significance 0.05 and power 90% [9].

This was parallel group randomized controlled trial with 1:1 allocation ratio into two groups. Study was conducted at physical therapy department of Mayo Hospital Lahore. In order to recruit the patients in this study, patients between ages 35-50 years, both genders, having radiating symptoms of cervical radiculopathy (for the diagnosis of the patients with cervical radiculopathy clinical predictor rule was applied consisting of Spurling's test, Distraction test, upper limb nerve tension test ULNTT for median nerve and ipsilateral neck rotation), with no previous cervical surgeries, no loss of the upper limb movement and willing to participate were chosen. Subjects having traumatic history, osteoporosis, hypermobility, circulatory disturbances, with tumor causing cervical radiculopathy and who were not willing were excluded from the study. Patients were asked to sign a consent form and give their will regarding being enrolled in the study.

Randomization:

Randomization sequence was created by using Excel 2016 with a 1:1 allocation using simple randomization by an independent researcher who was not participating in treatment of patients.

Patients were allocated to two groups by concealment of allocation (sealed envelopes) through simple random sampling technique.

Concealment of allocation:

Allocation concealment was achieved with sequentially numbered, opaque, sealed, envelopes SNOSE. SNOSE was used according to guidelines of Doig and Simpson [10].

An independent researcher with no clinical involvement in the trial made the concealed envelopes. 88 Envelopes were made. Half envelops contained folded papers with Treatment A (group 1) written on them and the remaining half contained folded papers with Treatment B (group 2) written on them. A unique randomized number was allocated to these envelops and shuffled

vigorously. Then envelops were arranged sequentially and handed over to another independent researcher. Assessor pre-tested the participant and to eligible subjects, envelope was allocated to subject. Therapist recorded the information on the envelope and opened it afterwards to maintain the concealment. Assessor recorded the post treatment findings and another independent analyst analyzed the data.

Blinding:

In this study patient, assessors, data analysts were blinded to allocation of treatment groups in this study. Except for the therapist all other staff was kept blinded as they were not informed about the details of allocation. Trial adhered to established procedures to maintain separation between staff who was collecting outcome measurements and the therapist. Patients were blinded to treatment allocation as treatment was given in separate rooms for each group. Therapist who is not blinded did not take the outcome measurements. All the other assessors, investigators and analysts did not know the details of treatment.

Group 1:

In this group neural mobilization technique with sliding of median nerve was applied with 3 seconds hold in each repetition, Neural mobilization was done according to technique described by David Butler[11]. Subject was placed in supine position and slider neural mobilization of the median nerve was given. In this group conservative treatment which included cervical isometrics exercises with 10 repetitions in each direction with 5 seconds hold was also given. Isometric exercises were performed with the patient in sitting position.

Group 2:

In group 2 conservative treatment was given which included cervical isometrics exercises with 10 repetitions in each direction, with 5 seconds hold. Isometric exercises were performed with the patient in sitting position, 3 sets of these exercises were performed with the rest period of 30seconds.

All the subjects were given hot packs for 10 minutes prior to the treatment.

Subjects fulfilling the sample selection criteria were given treatment for 12 sessions (3 times per week for 4 weeks). Pre assessment was done at baseline, second assessment was done after 2 weeks and final post assessment was done at the end of 12th session in 4th week.

Outcome measures:

The main outcome was to measure the effectiveness of neural mobilization technique on pain intensity measured on NPRS, range of motion measured on inclinometer and measuring the effects of treatment on quality of life measured through Neck Disability Index (NDI).

Baseline measurements: Patient age, gender, baseline pain, ROM and quality of life were noted at the time of recruitment.

Data Analysis:

Data was analyzed using SPSS version 21. Descriptive analysis (mean, variance, standard deviation) were performed for quantitative data. Frequencies and percentages were calculated for categorical and nominal data of gender. Data was analyzed for normality by applying Shapiro-Wilk test. Independent samples t-test was used for cervical ranges and Man Whitney test was used for NPRS and NDI for between group comparisons. Repeated ANOVA was used for cervical ranges and Friedman test was used for NPRS and NDI for within group analysis. P-value ≤ 0.05 was considered as significant. Intention to treat analysis with the technique of last observation carried forward (LOCF) was used to handle the missing data due to loss of follow up.

Results

1: Patient characteristics

Total 88 subjects were included in this study, 5 patients (2 from group 1 and 3 from group 2) were loss to follow up, mostly due to the ongoing pandemic situation, and missing data was managed through intention to treat analysis with the technique of last observation carried forward. Mean age of subject in group 1 was 41.09± 6.05 and group 2 was 42.22 ± 5.62. According to the gender distribution in neural mobilization group, 15 (34.1%) were males and 29 (65.9%) were females and in conventional treatment group, 13 (29.5%) were males and 31 (70.5%) were females.

Shapiro-Wilk test of normality has shown that p values was more than 0.05 for mostly cervical ranges and less than 0.05 for NDI and NPRS, shown that data was normally distributed for cervical ranges and not normally distributed for other variables.

Pretreatment comparison of variables (NPRS, NDI and cervical ROM) showed that there was no statistically significant difference between both groups at the baseline as presented in table 1 and 2.

Variable	At Base line			
	Neural mobilization group Mean rank	Conservative treatment group Mean rank	Z score	p- value
NPRS	44.89	44.11	-0.14	0.88
NDI	42.84	46.16	-0.61	0.54

Table 1: Baseline measurement of Pain (NPRS) and Disability (NDI)

Variable	At Base line			
	Neural mobilization group Mean±S.D	Conservative treatment group Mean±S.D	Mean Change (95% CI)	p- value
Cervical flexion	39.09± 9.41	38.54± 11.48	0.55(-3.90,4.99)	0.80
Cervical extension	39.06± 12.26	42.04± 12.23	2.97(-8.16,2.21)	0.25
Cervical right side flexion	29.81± 8.46	30.81± 10.21	1.00(-4.97, 2.97)	0.61
Cervical left side flexion	29.88± 8.82	30.36± 8.55	0.47(-4.16, 3.20)	0.79
Cervical right rotation	36.45± 10.36	38.38± 9.58	1.93(-6.16, 2.29)	0.36
Cervical left rotation	40.09± 9.09	40.90± 10.50	0.81(-4.98, 3.34)	0.69

Table 2: Baseline measurement of cervical range of motion (ROM)

2: Comparison of variables with in Experimental group (group 1)

There was statistically significant difference between pre, mid and post treatment NPRS score. X^2 =82.14, p=0.00. Post hoc analysis with Wilcoxon signed rank was conducted with Bonferroni correction applied, resulting in significant level set at p < 0.017. Median (IQR) for pretreatment in experimental group NPRS score was 6(5 to 6), mid treatment was 4 (3 to 5) and post treatment was 3 (2 to 4). There was significant difference between pretreatment and mid treatment (Z= -5.76, p=0.00), mid treatment and post treatment (Z= -5.46, p=0.00), and pretreatment and post treatment (Z= -5.74, p=0.00), showing that NPRS score was significantly improved after 2 weeks and further improved after 4 weeks of treatment in experimental group as shown in table 3.

There was statistically significant difference between pre, mid and post treatment NDI score.X^2 =71.302, p=0.00. Post hoc analysis with Wilcoxon signed rank was conducted with Bonferroni correction applied, resulting in significant level set at p < 0.017. Median (IQR) for pretreatment Neck Disability Score (NDI) in experimental group was 38(30 to 46), mid treatment was 24 (20 to 28) and post treatment was 14 (8.5 to 20). There was significant difference between pretreatment and mid treatment (Z= -5.41, p=0.00), mid treatment and post treatment (Z= -5.68, p=0.00), and pretreatment and post treatment (Z= -5.58, p=0.00), showing that disability was significantly reduce after 2 weeks and further reduce after 4 weeks of treatment in experimental group.

Pre and post treatment comparison of cervical ranges of motion score in experimental has shown that post-treatment mean and standard deviation improved with p < 0.05, showing that neural mobilization is effective in improving cervical ranges in patients of cervical radiculopathy as shown in table 3.

Variable	Base line	2nd week follow up	At the end of 4th week	X^2 / F	p- Value
NPRS Median(IQR)	6(5 to 6)	4 (3 to 5)	3 (2 to 4)	X^2= 82.14	0.00*
NDI Median (IQR)	38(30 to 46)	24 (20 to 28)	14 (8.5 to 20)	X^2=71.30	0.00*
Cervical flexion Mean ± S.D	39.09± 9.41	44.65 ±8.30	48.22± 8.89	F=78.94	0.01**
Cervical extension Mean ± S.D	39.06± 12.26	45.65 ±12.74	49.56 ±13.09	F=66.69	0.00
Cervical right side flexion Mean ± S.D	29.81± 8.46	34.29 ±8.84	37.93 ±9.06	F=153.99	0.00
Cervical left side flexion Mean ± S.D	29.88± 8.82	35.18± 9.05	39.31± 9.10	F=132.76	0.00
Cervical right rotation Mean ± S.D	36.45± 10.36	43.02 ±10.12	46.88 ±10.21	F=75.52	0.00
Cervical left rotation Mean ± S.D	40.09± 9.09	45.38± 9.39	49.06 ±9.45	F=108.85	0.00

* Friedman test

** Repeated measure ANOVA (for all cervical ranges)

Table 3: Comparison of pain (NPRS), disability (NDI) and cervical mobility (ROM) with in experiemtal group

3: Comparison of variables with in control group (group 2)

There was statistically significant difference between pre, mid and post treatment NPRS score. X^2 =71.02, p=0.00. Post hoc analysis with Wilcoxon signed rank was conducted with Bonferroni correction applied, resulting in significant level set at p < 0.017. Median (IQR) for pretreatment in control group NPRS score was 6(5 to 6), mid treatment was 5 (3.25 to 6) and post treatment was 4 (2.25 to 5). There was significant difference between pretreatment and mid treatment (Z= -5.38, p=0.00), mid treatment and post

treatment (Z= -4.74, p=0.00), and pretreatment and post treatment (Z= -5.49, p=0.00), showing that NPRS score was significantly improved after 2 weeks and further improved after 4 weeks of treatment in control group.

There was statistically significant difference between pre, mid and post treatment NDI score, X^2 =72.11, p=0.00. Post hoc analysis with Wilcoxon signed rank was conducted with Bonferroni correction applied, resulting in significant level set at p < 0.017. Median (IQR) for pretreatment Neck Disability Score (NDI) in control group was 40(30 to 49), mid treatment was 30 (22 to 38) and post treatment was 22 (16 to 30). There was significant difference between pretreatment and mid treatment (Z= -5.23, p=0.00), mid treatment and post treatment (Z= -5.26, p=0.00), and pretreatment and post treatment (Z= -5.51, p=0.00), showing that disability was significantly reduce after 2 weeks and further reduce after 4 weeks of treatment in control group.

Pre and post treatment comparison of cervical ranges of motion score in group 2 has shown that post-treatment mean and standard deviation improved with p < 0.05, showing that conventional treatment is effective in improving cervical ranges in patients of cervical radiculopathy as shown in table 4.

Variable	Base line	2nd week follow up	At the end of 4th week	X^2 / F	p- Value
NPRS	6(5 to 6)	5 (3.25 to 6)	4 (2.25 to 5)	X^2= 71.02	0.00*
NDI	40 (30 to 49)	30 (22 to 38)	22 (16 to 30)	X^2=72.11	0.00*
Cervical flexion	38.54± 11.48	44.06 ±8.74	47.63± 7.62	F=54.28	0.00**
Cervical extension	42.04± 12.23	48.09 ±9.20	50.27 ±8.79	F=32.17	0.00
Cervical right side flexion	30.81± 10.21	33.77 ±8.04	36.31 ±7.69	F=25.78	0.00
Cervical left side flexion	30.36± 8.55	34.09± 6.65	36.38± 6.92	F=33.60	0.00
Cervical right rotation	38.38± 9.58	42.70 ±9.64	45.54 ±9.97	F=54.97	0.00
Cervical left rotation	40.90± 10.50	43.86± 9.61	45.88 ±9.44	F=33.55	0.00

*Friedman test

** Repeated measure ANOVA

Table 4: Comparison of pain (NPRS), disability (NDI) and cervical mobility (ROM) with in control group

4: Comparison of variables between experimental and control group

Comparison of mean and standard deviation of NPRS between group 1 and group 2 has shown that there was no significant difference in NPRS score at baseline, , as value p>.05, but there was significant difference after 2nd and further improved after 4th week, as value p<.05, showing that neural mobilization is more effective in reducing pain.

Comparison of NDI between group 1 and group 2 has shown that there was no significant difference in NDI score at base line and even after 2 weeks of treatment, as value p>.05, but there was significant difference after 4 weeks in neural mobilization group as mean rank was 35.30 with p<0.05 as shown in table 5.

Comparison of mean and standard deviation of cervical range of motion between group 1 and group 2 has shown, that there was no significant difference in cervical ranges at base line, after 2nd and 4th weeks of treatment, as p value >.05, so experimental and control groups showed equal improvement as shown in table 6.

Variable	At Base line				At the end of 4th week			
	Neural mobilization group Mean rank	Conservative treatment group Mean rank	Z score	p-value	Neural mobilization group Mean rank	Conservative treatment group Mean rank	Z score	p-value
NPRS	44.89	44.11	-0.14	0.88	37.45	51.55	-2.63	0.008
NDI	42.84	46.16	-0.61	0.54	35.30	53.70	-3.38	0.001

Table 5: Comparison of NPRS and NDI between experimental and control group

Variable	At Base line				At the end of 4th week			
	Neural mobilization group Mean±S.D	Conservative treatment group Mean±S.D	Mean Change (95% CI)	p-value	Neural mobilization group Mean±S.D	Conservative treatment group Mean±S.D	Mean Change (95%CI)	p-value
Cervical flexion	39.09± 9.41	38.54± 11.48	0.55(-3.90,4.99)	0.80	48.22± 8.89	47.63± 7.62	0.59 (-2.92, 4.10)	0.73
Cervical extension	39.06± 12.26	42.04± 12.23	2.97(-8.16,2.21)	0.25	49.56 ±13.09	50.27 ±8.79	0.70(-5.43, 4.02)	0.76
Cervical right side flexion	29.81± 8.46	30.81± 10.21	1.00(-4.97, 2.97)	0.61	37.93 ±9.06	36.31 ±7.69	1.61(-1.95 to 5.17)	0.37
Cervical left side flexion	29.88± 8.82	30.36± 8.55	0.47(-4.16, 3.20)	0.79	39.31± 9.10	36.38± 6.92	2.93(-0.46 to 6.35)	0.93
Cervical right rotation	36.45± 10.36	38.38± 9.58	1.93(-6.16, 2.29)	0.36	46.88 ±10.21	45.54 ±9.97	1.34(-2.93 to 5.61)	0.53
Cervical left rotation	40.09± 9.09	40.90± 10.50	0.81(-4.98, 3.34)	0.69	49.06 ±9.45	45.88 ±9.44	3.18(-0.82 to 7.18)	0.11

Table 6: Comparison of cervical range of motion between experimental and control group

Discussion

Cervical radiculopathy as a clinical syndrome manifests itself as by compressing spinal nerve root in the neck. Typical characteristics of this syndrome are defined as pain and weakness in the upper extremity, pain in neck and sensorimotor deficits in the area of distribution of affected nerve in the upper extremity. Often debilitated persons are unable to perform their social obligations, do physical tasks pertinently, show improper emotional behavior, and lose working hours[12].

In this study neural mobilization was used along with strengthening exercises of cervical muscles and hot pack as baseline treatment. Exercise regimen varies in different studies in intensity and duration, in present study isometric exercises were used in both groups. Past studies show moderate benefit of these exercises in reducing pain and improving strength in patients with cervical radiculopathy. Careful interpretation is required as physical therapy treatment uses other conservative modality that might interfere with accuracy of results[1]. Exercise intervention containing isometric exercise of deep neck flexor muscles showed alleviation in levels of pain and disability, measured on outcome scale of numeric pain rating scale NPRS and neck disability index NDI respectively[13],[14].

In present study, comparison of NDI score between group 1 and group 2 has shown that there was significant improvement ($p<0.05$) in NDI score in group 1 with neuro-mobilization while comparison of NPRS between group 1 and group 2 has also shown there was significant difference after 2nd and further improved after 4th week, as value $p<.05$, showing that neural mobilization is more effective in reducing pain and improving functional status in cervical radiculopathy.

The results are in consistent with the literature that showed improvement with isometric exercises[15]. Cervical radiculopathy often associated with inactivity, further increasing deconditioning of muscles, so this form of treatment may be helpful for the patient with cervical radiculopathy but should be carefully considered in accordance with different patients situations[16].

Physical activity even in form of exercise has supporting evidence of improving sleep, emotional and physical functioning, cognitive functioning, overall health of individual, and reducing depression or anxiety[17]. In return this impacts quality of life positively, enhancing independence and reducing disability[18]. The mechanism of action of this form of treatment is by reducing pain perception. This exercise induced hypoalgesia or analgesia predicts greater pain relief and improvement in cervical functioning by restoring muscular balance through strengthening cervical exercises[19].

This exercise program when combined with heating modalities shows decreased pain in patients with cervical radiculopathy as shown in randomized controlled trial of Diaab et al [20].

In a systematic review and meta-analysis of studies showed effects of exercises on pain, disability and quality of life of patients, using outcome tools of NPRS and NDI respectively. Method used to evaluate the quality of this meta-analysis was, the grade of recommendations assessment, development, and evaluation. Results showed reduction in pain and disability but studies had limitations of potential heterogeneity(16).

In a systematic review by Boyle's et al, effects of manual physical therapy were assessed on cervical radiculopathy. This included manipulation, soft tissue mobilization and neural mobilization. In his study manual therapy was either used as standalone approach or along with other treatment methods including strengthening exercises. Results were promising in increasing range of cervical motion, decreasing cervical pain, disability and increasing function of the patients. Significant improvements were shown on NDI and NPRS [21], which are consistent with the present study as pre and post treatment comparison of NDI score in group 1 has shown that that neural mobilization is effective in improving functional status in patients of cervical radiculopathy.

In a quasi-experimental study of Beniciuk et al investigated the effects of neural mobilization technique. The study concluded that mechanistic effects of neural mobilization differs from sham treatment, it resulted in neurophysiological effect and hypoalgesia of C-mediated fibres and there was reduction in sensory descriptors[22]. In a similar randomized trial of Kim et al, patient showed improvement in NPRS,NDI and ROM and endurance of deep flexor cervical muscles in patients with cervical radiculopathy(23).

Results of the presents study has showed that cervical ranges were significantly improve in both groups ($p<0.05$) but comparison of cervical range of motion between group 1 and group 2 has shown, that there was no significant difference in cervical ranges after 4 weeks of treatment, as p value >.05, so experimental and control groups showed equal improvement.

From the literature it seems that multimodal management interventions are more effective than uni-modal strategies. Multimodal management which comprises of neurodynamic mobilization and exercises is more effective as conservative treatment in participants with cervical radiculopathy[(24),(25)].

It is difficult to infer the characteristics of patients that correspond with outcomes Further researches are required focusing on reducing the variability in patients selection in clinical trials, that will further optimize clinical practice. There are few limitation in this study that may affects th results and should be considered in future studies such as in combined treatment it is difficult to interpret result of single intervention, there was difference in sex distribution in two groups, While interpreting strength related results; emotional components, physical components of both genders should be considered. Women tend to give up physical activity to greater extent than men. Sample was collected from single setting so results cannot be generalized.

Conclusion

The present study concluded that both neural mobilization and conservative treatment were effective as an exercise program for patient with cervical radiculopathy, however neural mobilization was more effective in reducing pain, neck disability, improving endurance and health related quality of life in cervical radiculopathy.

Declarations

Ethics approval

Ethical approval was obtained from the University of Lahore (Ref# IRB-UOL-FAHS/373-VI/2018).

Consent to participate:

Written informed contents in Urdu or English were taken from all the subjects to participate in the study.

Consent for publication: Not Applicable

Availability of data and materials:

The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request.

Competing interests: None

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Authors' Contributions:

1: Conceived Idea, Designed Research by Shazia Rafiq and Hamayun Zafar

2: Literature Search, Data Collection, Literature Review: by Sidrah Liaqat and Shazia Rafiq

3: Methodology, Data interpretation, Statistical Analysis by Amna Zia

4: Manuscript Writing by Amna Zia and Sidrah Liaqat

5:Manuscript final reading, Manuscript Approval by Syed Amir Gillani, Hamayun Zafar, Muhammad Waqas Sharif, Yasir Rafiq

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References

1. Iyer S, Kim HJ. Cervical radiculopathy. Curr Rev Musculoskelet Med. 2016;9(3):272–80.
2. Schmid AB, Fundaun J, Tampin B. Entrapment neuropathies: a contemporary approach to pathophysiology, clinical assessment, and management. Pain Rep. 2020;5(4):e829-e.
3. Kim HJ, Nemani VM, Piyaskulkaew C, Vargas SR, Riew KD. Cervical Radiculopathy: Incidence and Treatment of 1,420 Consecutive Cases. Asian Spine J. 2016;10(2):231–7.
4. Umar M, Naeem A, Badshah M, Amjad I. Effectiveness of cervical traction combined with core muscle strengthening exercises in cervical radiculopathy: a randomized control trial. J Public Health Biol Sci. 2012;1:115–20.
5. Thoomes EJ. Effectiveness of manual therapy for cervical radiculopathy, a review. Chiropractic & Manual Therapies. 2016;24(1):45.
6. Liang L, Feng M, Cui X, Zhou S, Yin X, Wang X, et al. The effect of exercise on cervical radiculopathy: A systematic review and meta-analysis. Medicine (Baltimore). 2019;98(45):e17733-e.
7. Basson A, Olivier B, Ellis R, Coppieters M, Stewart A, Mudzi W. The effectiveness of neural mobilizations in the treatment of musculoskeletal conditions: a systematic review protocol. JBI database of systematic reviews and implementation reports. 2015;13(1):65–75.
8. Schulz KF, Altman DG, Moher D. CONSORT 2010 statement: updated guidelines for reporting parallel group randomised trials. BMC medicine. 2010;8(1):18.
9. Faul F, Erdfelder E, Lang A-G, Buchner A. G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behavior research methods. 2007;39(2):175–91.
10. Doig GS, Simpson F. Randomization and allocation concealment: a practical guide for researchers. Journal of critical care. 2005;20(2):187–91.
11. Butler DS. The neurodynamic techniques: a definitive guide from the Noigroup team: Noigroup publications; 2005.
12. Caridi JM, Pumberger M, Hughes AP. Cervical radiculopathy: a review. HSS Journal®. 2011;7(3):265–72.

13. Cheng C-H, Tsai L-C, Chung H-C, Hsu W-L, Wang S-F, Wang J-L, et al. Exercise training for non-operative and post-operative patient with cervical radiculopathy: a literature review. Journal of physical therapy science. 2015;27(9):3011–8.
14. Cleland JA, Whitman JM, Fritz JM, Palmer JA. Manual physical therapy, cervical traction, and strengthening exercises in patients with cervical radiculopathy: a case series. Journal of Orthopaedic & Sports Physical Therapy. 2005;35(12):802–11.
15. Kjaer P, Kongsted A, Hartvigsen J, Isenberg-Jørgensen A, Schiøttz-Christensen B, Søborg B, et al. National clinical guidelines for non-surgical treatment of patients with recent onset neck pain or cervical radiculopathy. European Spine Journal. 2017;26(9):2242–57.
16. Liang L, Feng M, Cui X, Zhou S, Yin X, Wang X, et al. The effect of exercise on cervical radiculopathy: A systematic review and meta-analysis. Medicine. 2019;98(45).
17. Ambrose KR, Golightly YM. Physical exercise as non-pharmacological treatment of chronic pain: why and when. Best practice & research Clinical rheumatology. 2015;29(1):120–30.
18. Busch AJ, Webber SC, Richards RS, Bidonde J, Schachter CL, Schafer LA, et al. Resistance exercise training for fibromyalgia. Cochrane database of systematic reviews. 2013(12).
19. Lima LV, Abner TS, Sluka KA. Does exercise increase or decrease pain? Central mechanisms underlying these two phenomena. The Journal of physiology. 2017;595(13):4141–50.
20. Diab AA, Moustafa IM. The efficacy of forward head correction on nerve root function and pain in cervical spondylotic radiculopathy: a randomized trial. Clinical rehabilitation. 2012;26(4):351–61.
21. Boyles R, Toy P, Mellon J, Hayes M, Hammer B. Effectiveness of manual physical therapy in the treatment of cervical radiculopathy: a systematic review. Journal of Manual & Manipulative Therapy. 2011;19(3):135–42.
22. Beneciuk JM, Bishop MD, George SZ. Effects of upper extremity neural mobilization on thermal pain sensitivity: a sham-controlled study in asymptomatic participants. journal of orthopaedic & sports physical therapy. 2009;39(6):428–38.
23. Kim D-G, Chung SH, Jung HB. The effects of neural mobilization on cervical radiculopathy patients' pain, disability, ROM, and deep flexor endurance. Journal of Back and Musculoskeletal Rehabilitation. 2017;30(5):951–9.
24. De Pauw R, Kregel J, De Blaiser C, Van Akeleyen J, Logghe T, Danneels L, et al. Identifying prognostic factors predicting outcome in patients with chronic neck pain after multimodal treatment: A retrospective study. Manual Therapy. 2015;20(4):592–7.
25. Thoomes E. Effectiveness of manual therapy for cervical radiculopathy, a review. Chiropractic & Manual Therapies. 2016;24(1):45.

Figures

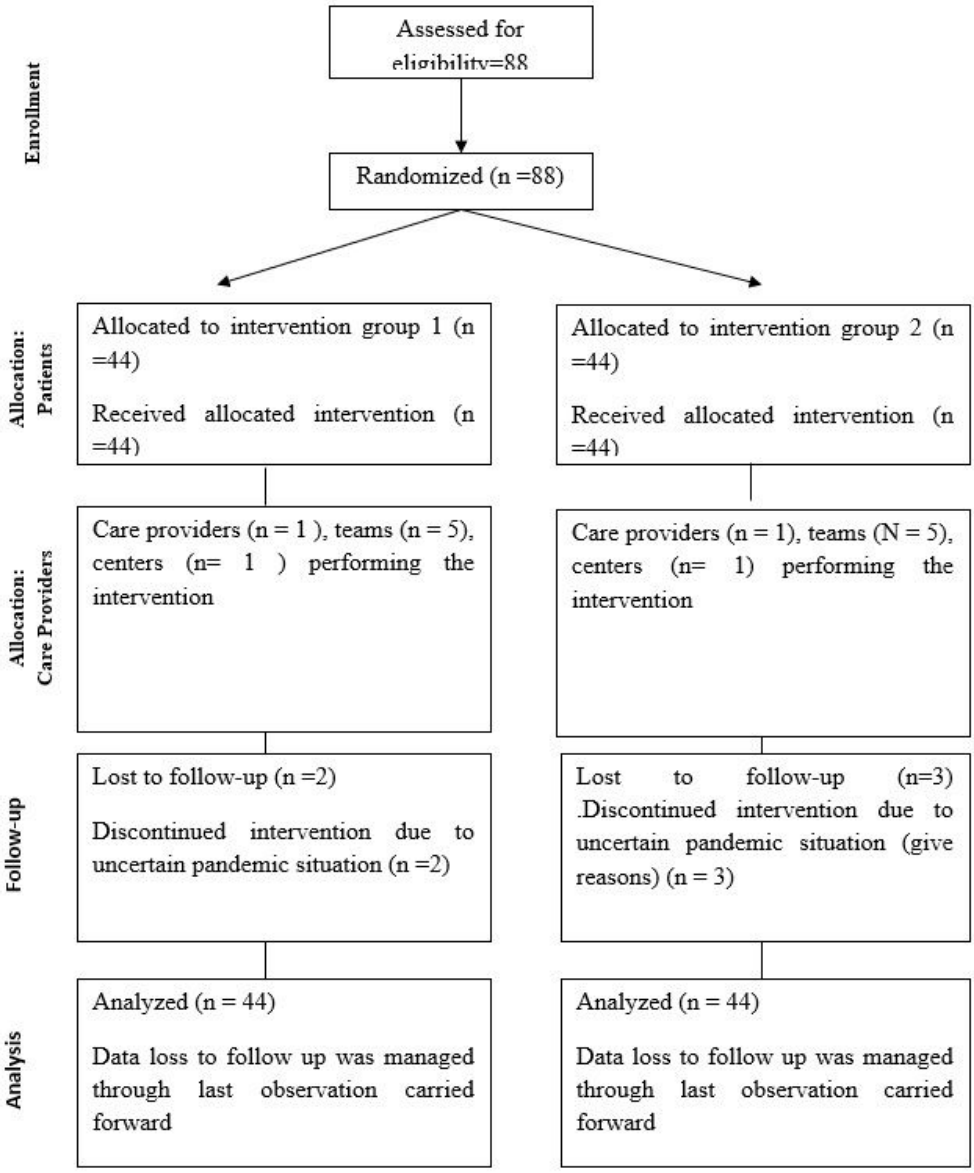

Figure 1

Consort Flow diagram