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Original Research Article

EFFECTIVENESS OF MOTOR CONTROL THERAPEUTIC EXERCISE VS. PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION IN SUBJECTS WITH CERVICAL SPONDYLOSIS ON PAIN AND FUNCTIONAL DISABILITY

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ABSTRACT

Background: Cervical spondylosis is the degeneration of the structures in the cervical region of the spin often associated and advances with the age, commence earlier in males, owing to osteophytes or bone spurs on vertebra. Earlier Motor Control Therapeutic Exercise and Proprioceptive Neuromuscular Facilitation have been studied to improve the condition of subjects with cervical spondylosis. Present study is aimed to investigate and compare the effectiveness of MCTE and PNF on pain and functional disability of subjects with cervical spondylosis.

Methodology: Sample of 60 subjects with cervical spondylosis was randomly divided into two groups (Group A consists of 30 subjects who were given exercise according to MCTE and Group B consists of 30 subjects who were given exercise according to PNF protocol). Cervical spine assessed according to physical assessment protocol, subject's pain and functional disability were measured with VAS and NDI.

Result: Intra-group significant differences were obtained between pre-post and post -follow-up interventions for all evaluated variables *($P < 0.01$)* in both groups. Intergroup significant differences only in muscular strength were found after 4 weeks of intervention *($P < 0.01$)*. PNF showed significantly more improvement at follow-up.

Conclusion: The study indicates both interventions are effective in improving the pain and functional status of patients and PNF shows improvement at follow up.

KEY WORDS: Cervical Spondylosis, Motor Control Therapeutic Exercise, Proprioceptive Neuromuscular Facilitation, Cervical Pain, Cervical Spine Disability.

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INTRODUCTION

Cervical spondylosis is a denomination for the degeneration (osteoarthritis) of the structures in the cervical/ neck region of the spine. Cervical spondylosis is often associated and advances with the age, affecting equally both men and women but problems commence earlier in males with the gradual advancement of age, owing to osteophytes or bone spurs, on vertebral [1]. Hard work, injury of the neck, genetic background and bad diet habits with abnormal fat, etc. are considered as the major factors behind condition. Neck stiffness increasing with time, numbness or abnormal sensations in the shoulders, arms, or legs, headache usually on the backside of the head are the major symptoms *[2]*. Cervical spondylosis can be triggered by a traumatic experience such as a whiplash injury, old fractures, muscle tension, or a herniated disc or blood disease. Often, spondylosis specifically affects the facet joints in the spine [3]. It occurs mostly in the fourth and fifth decades of life. Cervical spondylosis is primarily an age-related condition and by the age of 70 nearly 100% of men, 96% of women will have cervical spondylosis. The average age for cervical radiculopathy is 50 to 54 years [4]. Degeneration of the intervertebral discs, which fragment, loses water content, and collapse has a detrimental effect on proprioceptive input to the cervical spine *[5]*.

The prevalence of cervical spondylosis in the general population globally ranges between 0.4% and 86.8% (mean: 23.1%); point prevalence is 41.5% and 1-year prevalence is 59.5%. The prevalence rate is generally higher in women, higher in high-income countries compared with low- and middle-income countries and higher in urban areas compared with rural areas [6]. Cervical spondylosis most often diagnosed by clinical ground, pain is predominately in neck region and can be radiated to various locations. Cervical root segments from 5th to 8th, resulting in well-recognized clinical syndromes. However, each dermatome overlaps widely with adjacent dermatomes, so further evaluation is usually required *[3]*.

Proprioceptive or sensorimotor functions are related to the control of posture and movements. The contribution of cervical muscles to sensorimotor function has been emphasized with regards to the density of muscle spindles that reflect a well-developed proprioceptive system, and cervical muscles play a major role in motor control of the head and neck, eye movements and bipedal posture during quiet standing *[7]*.

In cervical spondylosis, if non-specific cervical pathology is paired with an alteration in kinesthetic sensibility, it is likely that proprioception is affected primarily by a lesion or functional impairment of muscular and articular receptors, or secondarily by an alteration in afferent's integration and tuning. It may impair functioning of the cervical mechanoreceptors, which interferes with precise continuous input necessary for coordinated multisegmental reflexes, which are required for normal patterns of motion, balance, coordination and equilibrium [8].

Motor control is the capacity of how the central nervous system produces useful movements that are coordinated and integrated with the rest of the body and the environment. Thus, MCTE is relevant to improve the status of patients with neck pain. Changes in motor control that could cause pain or dysfunction require practitioners to work on the components of motor learning for a successful intervention capable of producing satisfactory motor learning and retention. Such intervention requires repetitive training. Motor control exercises have been purported to improve sensorimotor control and improve stability. Patients with recurrent cervical pain often exhibit a loss of muscular strength and motor control *[9]*.

PNF involves stretching, resisted movement, traction and approximation to manage muscle disharmony, atrophy and joint movement limitation. PNF Technique is based on movement patterns to facilitate and correct sensory-motor function it has been suggested that PNF correct the impaired impulses emerging from proprioceptive receptors in the muscle. Therefore, it decreases pain and desires to improve the strength of muscles. PNF position renders a greater amount of sensory input coming from the periphery than that in the neutral position [10].

For that reason, the purpose of the study was to compare the effects of MCTE versus PNF exercises in subjects with cervical spondylosis on pain and functional disability.

METHODOLOGY

The present study was experimental in nature; parallel randomized, pre-post test with 15 days follow-up, wherein two therapeutic interventions were compared for their efficacy in improving pain and functional ability in patients with cervical spondylosis. The study was done in the Department of Physiotherapy, Guru Nanak Dev University, Amritsar; over a period of one and a half years.

Ethical Approval and Consent: Before the study began, ethical approval was obtained from the institutional ethical committee (vide letter No. (225/HG) dated 27/09/2018). Prior to the commencement of the study, each participant was explained the purpose, aims, objectives and risks associated with the study and thereafter their written consent was obtained. They were also ensured that their identity will be kept confidential.

Participants: A sample of 60 subjects with cervical spondylosis, aged between 45 to 65 years, constituted a sample of the present study *(figure 1)*. Participants were equally assigned into two groups i.e., Group A (MCTE) and Group B (PNF).

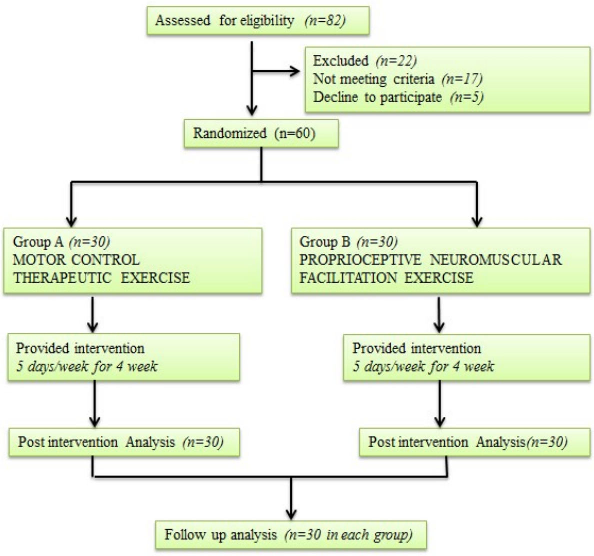

Fig. 1: Participants recruitment – flow chart.

Sampling Method: The sample size was estimated by using G*Power 3.1.7 for Windows (G*Power©, University of Dusseldorf, Germany). The sample size calculation was considered a power calculation to detect the difference between two independent. To obtain 80% statistical power (1- βerror probability) with an á error level probability of 0.05, we used a medium effect size of 0.08 to consider two groups and two measurements for primary outcomes, generating a sample size of 26 participants per group (total sample size of 52 subjects). Allowing a dropout rate of 15% and aiming to increase the statistical power of the results, the researcher planned to recruit at least 30 participants to provide sufficient power to detect significant group differences.

Recruitment of subjects: The subjects in this study were selected on the basis of the following:

Inclusion criteria:

a. Subject willing to be a part of a research study,

b. Age 45 -65 years,

c. Both male and female,

d. Patient with pain and functional disability of neck for at least 7 weeks,

e. Subject physically and radiological diagnosed with cervical spondylosis (With or without Radiculopathy)

Exclusion criteria:

a. Any recent trauma (fracture, tendon injury),

b. Severe osteoporosis,

c. Cervical myelopathy & Cervical canal stenosis,

d. Malignancy,

e. Non-cooperative subject (with any psychological condition or unable to understand and follow treatment procedure).

Procedure: All the subjects were assessed for the cervical spine according to physical assessment protocol; the subject's pain and functional disability were measured with visual analogue scale and neck disability index respectively.

Subjects were randomly divided into two groups. Subjects in both groups were treated with a moist heat pack and TENS. Group A consists of 30 subjects who were given exercise according to the Motor control Therapeutic Exercise protocol. Group B consists of 30 subjects who were given exercise according to the PNF Pattern Exercise protocol. In both groups, exercises were given for 4 weeks (5 sessions per week) in each group; each treatment session lasted around 40-45 minutes.

Anthropometric Variables: Three anthropometric variables (height, weight, and BMI) were measured from all the subjects using the techniques provided by Lohmann et al., (1988) and were measured in triplicate with the median value used as the criterion. Stadiometer (Holtain Ltd. Crymych, Dyfed, UK) was used in measuring standing height. Subjects were weighed in minimal light-weight clothing, barefoot, using a standard weighing machine (Model DS-410, Seiko, Tokyo, Japan) to the nearest 0.1 kg. Body mass index (BMI) was calculated from height and weight as BMI=weight/height^2 (kg/m^2).

Interventions: In both groups, subjects were given common treatment by moist heat pack and transcutaneous electrical nerve stimulation.

In Group A (MCTE), the MCTE used for this research is based on retraining the cervical muscles and included the following exercises:

a. Craniocervical flexor exercise,

b. Craniocervical extensor exercise,

c. Co-contraction of flexors and extensors,

d. A synergy exercise of the deep neck flexors [11].

In Group B (PNF), the PNF techniques used for this research were a combination of isotonic, rhythmic stabilization, stabilizing reversals, rhythmic initiation, dynamic reversals, and hold-relax. The following movement patterns were performed.

Neck pattern includes:

• Head and neck flexion with rotation to right and head and neck extension with rotation to left

•Head and neck flexion with rotation to left and head and neck extension with rotation to right.

Scapular pattern includes:

• Anterior Elevation and Posterior Depression

• Anterior Depression and Posterior Elevation [10].

Outcome measures:

Primary outcome measures:

a. Pain assessment using the Visual Analogue Scale: The Visual Analogue Scale is used method for assessing pain severity (valid, reliable, simple and frequently). The scale consists of a straight line typically 100 millimeters long Patients were asked to mark along the line to indicate their level of pain: zero means no pain, whereas 10 mean severe intolerable pain *[12].*

b. Disability assessment using the Neck Disability Index: The Neck disability index (NDI) is a condition-specific disability measure. The NDI contains 10 items (7 related to activities of daily living, 2 related to pain, and 1 item related to concentration). Score of each item is ranges 0 to 5 and the total score is expressed as a percentage, with higher scores represents the greater disability. The NDI has shown to be reliable and valid for patients with neck pain. It was devised in an outpatient physiotherapy department by Vernon and Mior in 1991 and is based on the Oswestry disability index *[13].*

Secondary outcome measures:

a. Muscle strength: Manual Muscle Testing was used for assessing the strength of cervical flexor, extensor, right and left lateral flexor and rotator muscles. Testing was conducted with the patient at prone (for extension), supine (for flexion and rotations), and side-lying (for lateral flexion) *[14]*.

b.Range of motion: Neck Range of motion was measured in a sitting position to remove errors and movement compensation. The subjects were asked for sitting with their back straight and strapped to the back of the wooden chair. Subject's ankles, knees, and hips were positioned at the right angle, and arms were folded across the chest to minimize thoracic movement. A large Universal goniometer was used for measuring the range of motion. The range of motion in all six directions was measured *[15].*

Data Analysis: The data collected was entered in the Microsoft excel (© Microsoft cooperation) sheet and statistical analysis were done using SPSS (Statistical Package for Social Science 20.0) package (© SPSS Inc. Chicago, USA). Repeated ANOVA was applied in group A and group B for pre, post, and follow up in the comparison of all variables. The intergroup comparison was done by applying the unpaired t-test. The level for statistical significance was set at *P<0.05.*

RESULTS

Table 1: Descriptive statistics of selected anthropometric variables.

Variables	Group A		Group B		t- value	P-value
	Mean	SD	Mean	SD		
Age (years)	53.03	4.951	54.67	5.79	1.173	0.245*
Height (cm)	162.57	5.46	165.58	5.81	2.059	0.044**
Weight(Kg)	72.4	7.59	70.13	14.24	0.769	0.444*
BMI (Kg/m^2)	27.47	3.24	25.68	4.18	1.849	0.069*

*Non-significant **significant

A total of 60 subjects with cervical spondylosis based on inclusion criteria involved in the study and randomly divided into two groups.

Table 1 showed the Descriptive statistics of anthropometric variables (Age, Height, Weight, and BMI) in subjects with cervical spondylosis, a significant difference in height was noted.

Table 2 showed baseline values (Pre-intervention) of the two groups. According to this table; there is no significant difference between ranges of motion, muscle strength, pain, and functional disability except side flexion LT.

Table 3 and Table 4 showed within-group (inter-group) analysis of Group A and Group B respectively, in which both interventions show significant difference at post-intervention and follow-up *(P<0.05).*

Table 5 showed intragroup analysis (*Group A vs. Group B*) with respect to variables at post-intervention measurement. Subjects treated with Motor Control Therapeutic Exercise have higher mean values in all variables except side flexion left range and significant difference is shown in side flexion left *(P=0.039)*, muscle strength of flexors *(P=0.0002)*, extensors *(P=0.001)*, side flexors RT *(P=0.005)* side flexors LT *(P=0.001)* rotators RT *(P=0.006)*, rotators LT *(P=0.001).*

Table 6 showed intragroup analysis (*Group A vs. Group B*) with respect to variables at follow-up measurement. The subject treated with Motor Control Therapeutic Exercise has higher mean values in range of motion (Flexion, Side Flexion RT and Side Flexion LT) and muscle strength (flexors and extensors). The subject treated with PNF exercise have higher mean values in VAS, NDI score, muscle strength (side flexion RT, side flexion LT, rotation RT and rotation LT) and range of motion (extension, rotation RT and rotation LT). Significant difference is shown in NDI score *(P=0.008),* range of motion flexion *(P=0.001),* extension *(P=0.035);* muscle strength flexors *(P=0.0004)* extensors *(P=0.001)* and rotators LT *(P=0.005)*.

Table 2: Descriptive statistics of all variables at pre -treatment between Group A and Group B.

Variables	Group A		Group B		t - value	P-value
	Mean	SD	Mean	SD		
VAS	7.23	0.67	7.1	0.72	0.742	0.460*
NDI	56.13	5.35	58.6	6.85	1.554	0.125*
Flexion	27.27	2.75	27.28	3.42	1.001	1.001*
Extension	27.47	3.8	26.9	3.62	0.596	0.556*
Side flexion RT.	22.5	3.71	22.93	2.42	0.536	0.594*
Side flexion LT.	23.37	3.42	23.13	2.11	0.317	0.752*
Rotation RT.	41.83	2.26	41.67	2.35	0.28	0.780*
Rotation LT.	42.41	2.57	41.9	2.04	0.722	0.473*
Flexors	2.03	0.49	2.17	0.53	1.011	0.316*
Extensors	2.03	0.41	1.87	0.43	1.522	0.133*
Side flexors RT.	1.97	0.32	2.07	0.36	1.128	0.263*
Side flexors LT.	2.03	0.32	2.27	0.52	2.091	0.040**
Rotators RT	2.2	0.4	2.17	0.46	0.297	0.767*
Rotators LT	2.2	0.42	2.21	0.4	0.001	1.001*

*Non-Significant ** Significant

SD: standard deviation; P-value: probability value; Significant at level (P<0.05

RT. = Right, LT. = Left, VAS= Visual Analogue Scale, NDI= Neck Disability Index

Table 3: Descriptive Statistics of Different Variables between Pre-Treatment, Post Treatment and Follow- up of Group A.

Variables	Pre	Post	Follow up	F value	P-value
	Mean ± SD	Mean ± SD	Mean ± SD		
VAS	7.23±0.67	2.43±0.72	1.30±0.46	1075.97	0.001***
NDI	56.13±5.35	24.87±5.21	12.35±4.29	1098.74	0.001***
Flexion	27.27±2.7	39.27±2.51	47.93±2.06	649.71	0.001***
Extension	27.47±3.80	42.67±2.48	51.03±2.32	909.61	0.001***
Side Flexion RT.	22.50±3.71	32.60±2.64	38.00±2.91	610.38	0.001***
Side Flexion LT.	23.37±3.42	33.20±3.24	39.00±3.35	582.25	0.001***
Rotation RT.	41.83±2.26	54.43±2.06	59.80±1.84	736.18	0.001***
Rotation LT.	44.33±2.57	54.77±1.88	60.43±2.34	471.63	0.001***
Flexors	2.03±0.49	3.67±0.47	3.87±0.68	132.22	0.001***
Extensors	2.03±0.41	3.97±0.32	4.17±0.53	257.56	0.001***
Side flexors RT.	1.97±0.32	3.50±0.50	3.53±0.50	211.2	0.001***
Side flexors LT.	2.03±0.32	3.80±0.48	3.83±0.53	261.92	0.001***
Rotators RT	2.20±0.40	3.83±0.53	3.87±0.57	145.36	0.001***
Rotators LT	2.20±0.42	3.87±0.34	3.93±0.36	306.98	0.001***

*** highly significant p<0.001 (high significant)

SD: standard deviation; P-value: probability value; Significant at level (P<0.05

RT. = Right, LT. = Left, VAS= Visual Analogue Scale, NDI= Neck Disability Index

Table 4: Descriptive Statistics of Different Variables between Pre-Treatment, Post- Treatment and Follow-up of Group B.

Variables	Pre	Post	Follow UP	f - value	P–value
	Mean ± SD	Mean ± SD	Mean ± SD		
VAS	7.10±0.71	2.80±0.88	1.40±0.62	536.8	0.001***
NDI	58.60±6.85	25.60±4.62	15.67±4.64	554.01	0.001***
Flexion	27.27± 3.42	38.90±2.91	43.73±2.21	277.71	0.001***
Extension	26.90±3.62	43.30±2.69	52.27±2.10	520.61	0.001***
Side flexion RT.	22.93±2.42	31.53±2.14	37.83±2.99	369.56	0.001***
Side flexion LT.	23.13±2.11	31.57±2.75	38.67±3.23	229.81	0.001***
Rotation RT.	41.67±2.35	55.23±4.28	60.97±4.49	241.03	0.001***
Rotation LT.	41.90±2.04	55.77±4.04	61.53±2.56	350.23	0.001***
Flexors	2.17±0.53	3.13±0.57	3.30±0.46	94.88	0.001***
Extensors	1.87±0.43	3.13±0.57	3.43±0.50	114.47	0.001***
Side flexors RT.	2.07±0.365	3.10±030	3.57±0.50	128.52	0.001***
Side flexors LT.	2.27±0.52	3.23±0.43	3.87±0.50	91.27	0.001***
Rotators RT	2.17±0.46	3.43±0.56	3.90±0.54	97.2	0.001***
Rotators LT	2.20±0.40	3.30±0.46	4.23±0.43	183.1	0.001***

***highly significant p<0.001 (high significant)

SD: standard deviation; P-value: probability value; Significant at level (P<0.05
RT. = Right, LT. = Left, VAS= Visual Analogue Scale, NDI= Neck Disability Index

Table 5: Descriptive statistics of all variables at post -treatment between Group A and Group B.

Variables	Group A		Group B		t – value	P-value
	Mean	SD	Mean	SD		
VAS	2.43	0.72	2.8	0.88	1.751	0.085*
NDI	24.87	5.21	25.6	4.62	0.576	0.566*
Flexion	39.27	2.51	38.9	2.9	0.521	0.604*
Extension	27.47	3.8	26.9	2.69	0.947	0.347*
Side flexion RT.	32.6	2.64	31.53	2.14	1.715	0.091*
Side flexion LT.	33.2	3.24	31.57	2.75	2.104	0.039**
Rotation RT.	54.43	2.06	52.23	4.28	0.922	0.360*
Rotation LT.	54.77	1.88	55.77	4.04	1.226	0.225*
Flexors	3.67	0.47	3.13	0.57	3.916	0.0002**
Extensors	3.97	0.32	3.16	0.58	6.971	0.001**
Side flexors RT.	3.5	0.32	3.1	0.3	3.694	0.005**
Side flexors LT.	3.8	0.48	3.23	0.43	4.792	0.001**
Rotators RT	3.83	0.53	3.43	0.56	2.818	0.006**
Rotators LT	3.87	0.34	3.3	0.46	5.348	0.001**

*non-significant **significant

SD: standard deviation; P-value: probability value; Significant at level (P<0.05
RT. = Right, LT. = Left, VAS= Visual Analogue Scale, NDI= Neck Disability Index

Table 6: Descriptive statistics of all variables at follow-up between Group A and Group B.

Variables	Group A		Group B		t - value	P–value
	Mean	SD	Mean	SD		
VAS	1.3	0.46	1.4	0.62	0.705	0.483*
NDI	12.53	4.29	15.67	4.64	2.713	0.008**
Flexion	47.93	2.06	43.73	2.21	7.6	0.001**
Extension	51.03	2.32	52.27	2.1	2.155	0.035**
Side flexion RT.	38	2.91	37.83	2.99	0.219	0.827*
Side flexion LT.	39	3.35	38.67	3.23	0.392	0.696*
Rotation RT.	59.8	1.84	60.97	4.49	1.316	0.193*
Rotation LT.	60.43	2.34	61.53	2.56	1.732	0.088*
Flexors	3.87	0.68	3.3	0.46	3.759	0.0004**
Extensors	4.17	0.53	3.43	0.504	5.488	0.001**
Side flexors RT.	3.53	0.5	3.57	0.5	0.255	0.799*
Side flexors LT.	3.83	0.53	3.87	0.51	0.249	0.804*
Rotators RT	3.87	0.57	3.9	0.54	0.231	0.818*
Rotators LT	3.93	0.36	4.23	0.43	2.912	0.005**

*non-significant **significant

SD: standard deviation; P-value: probability value; Significant at level (P<0.05
RT. = Right, LT. = Left, VAS= Visual Analogue Scale, NDI= Neck Disability Index

DISCUSSION

This current study was carried out to compare the efficacy of two interventional approaches for improving the pain and functional ability status in subjects with cervical spondylosis. The first approach comprising of Motor Control Therapeutic Exercise was administered to Group A whereas, the second approach comprised of PNF pattern exercises was given to the participants of Group B. For this study, 60 subjects were selected with a mean age of 53.03±4.59 for Group A and 54.67±5.79 for Group B as per the inclusion and exclusion criteria. The mean BMI for Group A was 27.47±3.24 and Group B was 25.68±4.18. (Tab.1)

Result of this study focused on improvement of neck pain and disability status in patients with cervical spondylosis. Results of the present study showed significant improvement *(PÂ0.001)* in Group A (Motor Control Therapeutic Exercise) after a 4 week intervention program and 15 days follow up. Treatment with MCTE comparable to *Ask et al. (2009),* in which the motor control group completed a motor relearning program with an emphasis on coordinating holding capabilities of specific neck flexor and extensors as well as the shoulder girdle musculature. The changes within both groups are significant at six weeks but not at one year follow up. For most pain-related variables clinical significant improvement was demonstrated at six weeks but not at one year follow up [9]. *Peréz et al. (2016),* determine the effect of motor imagery combined with motor control therapeutic exercises program on the cervical region in asymptomatic subjects. This study provides new evidence of the effects of MI and MCTE on sensorimotor variables measured in the cervical region in asymptomatic subjects. An intervention of MCTE combined with MI was effective in improving craniocervical neuromotor control and the subjective perception of fatigue after effort, while MCTE in isolation did not produce changes for these same variables [11].

Results of the present study demonstrate a very highly significant improvement *(P < 0.001)* in Group B (PNF pattern exercise) after a 4 week intervention program and 15 days follow up. Maichi et al. (2017), Shows the differences in outcome measurements at the baseline in favor of the PNF group when it comes to the Functional Rating Index (personal care, frequency of pain, walking) and McGill Questionnaire but no statistically significant changes were observed in relation to the type of occupation, age and BMI index. The fact that patients from PNF group initially had fewer symptoms might have influenced the results and therapeutic effects [10]. *Jung L et al (2012),* Discussed a study, in which the experimental group, which received PNF techniques, showed statistically significant differences in VAS, from 7.13±0.81 before treatment to 5.00±1.26 after treatment, and in PPT, from 35.64±9.51 before treatment to 39.35±8.46 after treatment (p<0.005) [16]. *Rezasoltani et al, (2010),* suggested that the performance of the craniocervical flexion test, Spine, neck pain decreased and neck muscle strength increased in PNF group than TET group who performed isometric exercise. Load moment and extension plus shoulder girdle exercise in one group and myoelectric activity when cervical spine is and only resisted exercise of head and neck in the other held in full flexion and extension [17]. The result of present study is supported by abovementioned articles.

This study was limited by many factors like the inability to ensure maximum exertion level of the subject during performance of some exercise such as exercise in which neck is unsupported and need to maintain in an extended position, painful end range movement in PNF pattern exercise and symptoms of radiculopathy. Further study can be performed with large sample size and assess the long term effects that can be seen by prolonged follow-up. Moreover, future studies can be done specifically on players and even various effects of techniques on various age groups can be assessed.

Limitations of this study: A limited number of subjects in the study. The duration of intervention was four weeks only. There was no control group in the study.

CONCLUSION

The present study evince that both treatment programs are effective in improving range of motion, muscle strength, pain, and functional ability status in patients with cervical spondylosis. MCTE and PNF pattern exercise program in comparison with each other shows no significant difference in improving the range of motion in post-treatment assessment after 4 weeks of intervention and PNF pattern exercise group shows significant improvement at follow-up assessment after 15 days. Motor control therapeutic exercise program shows a significant difference in improving the muscle strength in post-treatment assessment after 4 weeks of intervention and no significant difference at follow-up assessment after 15 days comparing with PNF pattern exercise program.

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Conflicts of interest: None

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