

## ORIGINAL ARTICLE

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## EFFECTIVENESS OF CERVICAL STABILIZATION EXERCISES WITH FEEDBACK ON RESPIRATORY STATUS IN CHRONIC NECK PAIN PATIENTS WITH FORWARD HEAD POSTURE

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## ABSTRACT

**Background:** Chronic neck pain is observed to be commonly kindred with forward head posture (FHP). Rib cage mechanics is found to be altered that decreases thoracic mobility. This reduced mobility of thorax reduces the effectiveness of diaphragm, intercostals, and abdominal muscles in terms of ventilation. Therefore this study was done to evaluate the effectiveness of exercises meant for enhancing the stability of the neck with feedback on neck stabilization exercises with feedback in improving the respiratory status.

**Methods:** This was an experimental study. Based on inclusion & exclusion criteria, 100 subjects (54 males and 46 females) enrolled for the study, which was further allotted into Experimental and Control groups. The experimental group was given Cervical Stabilization Exercise with feedback in addition to routine Physiotherapy treatment. Control group was given only regular Physiotherapy treatment for six weeks. The digital camera assessed the FHP by measuring of Craniovertebral Angle (CVA). Spirometry assessed pulmonary function (FEV1) and Micro RPM assessed inspiratory muscle strength (PImax). All measurements were taken on the day of study, on 3rd and 6th week.

**Results:** Significant reduction in forward head posture measured by improvement in Craniovertebral angle, improvement in Inspiratory muscle strength (PIMax) and pulmonary functions (FEV1) were found in the group that received cervical stabilization exercises with feedback along with the conventional Physiotherapy ( $p < 0.05$ ). Therefore it is suggested that cervical stabilization exercises correct the head posture and helps to improve the biomechanics of respiratory muscles.

**Conclusion:** Cervical stabilization exercise is an effective approach to correct the forward head posture, and it should be included in the intervention measures of patients with forward head posture.

**Keywords:** Cervical Stabilization exercises, Chronic Neck Pain, Craniovertebral angle, FHP, FEV1, PImax.

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## BACKGROUND

Chronic pain at the nape of the neck is one of the most common musculoskeletal problems. It has been believed that 70%-80% of people are bothered with neck pain at some times during their life course, and up to 60% of the population may experience persistent and recurrent pain. Because of increased advancement, increased use of information technology, and use of motor vehicles led the last twenty years for growing research & interest in the treatment of neck pain [1].

The abnormal posture of head is claimed to be identified with the development and tenacious of Neck Pain, and few therapists focus its value at the time of evaluation [2]. A poke chin posture or forward head posture is one of the most common deformities identified in the patients having pain in the neck. This is interpreted as the anterior translation of the head in the median plane in which the head is laid anterior to the trunk [3]. FHP was demolishing of lower cervical spine curve with rounding of the upper back and raised and abduction of scapulas [2].

It has been observed that patients with FHP are presented with weakness in some muscles like middle and lower trapezius, serratus anterior, rhomboids and shortening or tightening of the cervical extensors or the pectoralis muscles [4].

Chronic pain at the nape of the neck is an orthopedics condition which affects the person in different ways. It has been found that there occurs decrease in hand grip strength in the patients having chronic pain at the nape of the neck [5]. Such Patients having neck pain are treated mainly as orthopedics patients. Neck pain patients are connected with a decrease in strength and fatigue of cervical muscles, reduction in cervical mobility, and altered position sense, posture abnormalities, and behavioral compromise. All these factors have been asserted to be kindred with a decrease in pulmonary functions in subjects having chronic neck pain [6].

This Forward head posture leads to increase the cervical lordosis and thoracic kyphosis, thereby impairing the activity of primary muscle of respiration, i.e. diaphragm. FHP is found to be associated with a reduction of motion of lower ribs during respiration in sagittal, frontal and transverse planes. The altered mechanics associated with FHP results into the weakness of inspiratory muscles, poor respiratory strength, reduced chest expansion and hence increased work of breathing which results into impaired pulmonary functions such as vital capacity, maximum inspiratory and expiratory pressures [7].

To attain the correct posture incorporation of stretching and strengthening exercises and behavioral or biofeedback training program which represent crucial module of the physical therapy treatment given to the subjects having pain at the nape of the neck and thoracic musculoskeletal conditions. Improvement in a posture that occurs due to exercise would be suggested due to recovery in muscle length and strength [8].

Kendall F et al. (2005) explained the rehabilitation program

for FHP directed by stretching and strengthening principle that emphasis underlying soft tissue imbalances would include cervical extensor and pectoral muscle stretching and deep cervical flexor and shoulder retractor strengthening. To attain correct postural alignment, the treatment approach has been advocated is strengthening of the weak postural muscles and stretching of tightened muscles [9].

Researchers have emphasized that cervical stabilization exercises should be incorporated in the management of the patients having chronic neck pain as exercises improve muscle strength, endurance, and coordination of spinal stabilizer muscles and hence help reduce in neck pain and enhance cervical functions [10].

Chan Woo Nam et al.(2015) studied the role of cervical stabilization exercises and breathing training on improving respiratory functions in stroke patients. They found that the patient with cervical stabilization exercises in adjunct with breathing retraining showed more significant improvement in respiratory functions [11]. Therefore the objective of the present study was to assess the effect of cervical stabilization exercises with feedback along with conventional Physiotherapy treatment on forward head posture and respiratory status in terms of pulmonary functions and strength of respiratory muscles in patients having chronic pain over the neck.

## METHODS

This was an experimental study design. The study was conducted in Physiotherapy OPD & testing of pulmonary functions was done in the laboratory of Pulmonary Medicine department of SGT Hospital, SGT University, Budhera, Gurugram.

The sample size was calculated by G-Power software, using the power of study 0.95, with effect size 0.65 and probability error 0.05. The calculated sample size was 104, and there was a dropout of four subjects

Subjects with chronic neck pain in the Age Group 20-40 Years with mild neck disability (NDI score 5-15) who had less than optimal performance (unable to attain 24 mm of Hg on Sphygmomanometer) on Craniocervical flexion test were included in the study [12].

Subjects who were excluded from the study were those who reported of neck pain secondary to trauma, abnormalities/deformities of a thoracic region or vertebral column, previous history of any thoracic or vertebral column surgery, subjects in the category of overweight as measured by BMI > 30, history of smoking.

100 Subjects were included in the study based on inclusion criteria. They were randomly divided into two groups- Group A (Experimental Group) and Group B (Control Group) with 50 subjects in both the groups. Group A received Cervical stabilization exercise with the feedback alongwith the Conventional Physiotherapy, and Group B received Conventional Physiotherapy only. All the subjects underwent baseline assessment for Inspiratory muscle strength (Pimax) with the Micro Respiratory Pressure meter (Care Fusion), pulmonary function (FEV<sub>1</sub>) with Spirometer, (Spiro Excel, Medicaid, International Electro

Medical Co.) and forward head posture by estimating the Craniovertebral angle. Written consent was taken with prior information regarding the study.

### PROCEDURE

Subjects in Control Group received the Conventional Physiotherapy treatment for six weeks, which included cervical isometric exercises, transcutaneous electrical nerve stimulation (TENS) and hot packs. TENS was given for 30 min, at the intensity of 10-30 mA with a frequency of 80 Hz. All the subjects accomplished Cervical isometric exercises in the sitting position by applying resistance at the forehead (cervical flexion, extension, rotation, and side bending) maintained for 10 sec having 15-sec breaks between holds with 10-15 repetitions increasingly [10].

Subjects in Experimental Group received the Cervical Stabilization exercise with feedback on sphygmomanometer for six weeks in addition to Conventional Physiotherapy treatment. The exercise was executed in supine position; the cuff of sphygmomanometer was put sub-occipitally to observe the flattening of cervical lordosis that accompanies with longus colli's contraction. Subjects were guided by feedback to sequentially reach 5mm Hg pressure target with increments of 2 mm Hg from a baseline of 20mm Hg to the ultimate level of 30mm Hg. Subjects were directed to quietly nod their head as though they said 'yes.' The target pressure that the subject could hold undeviatingly for 10 seconds was identified. Duration of contraction was increased to 10 seconds for each target level. Subjects performed ten repetitions before progressing to the next target level.

The measurements at baseline, 3<sup>rd</sup> and 6<sup>th</sup> week were compared by using the IBM SPSS 21 Multilingual software.

### RESULTS

The data analysis was done by using the SPSS software package 21 for window version. Mean, and standard deviation of all the outcomes measures were calculated. The significance level was set at  $p < 0.05$ . To compare the outcomes measures in both the Groups, independent sample t-test was used. There were non-significant differences between both the groups at baseline measurement (Table I). One way ANOVA followed by post hoc analysis was used for within-group analysis (Table II & III). Comparison of Mean  $\pm$  SD between groups showed significant differences in the measurements taken at 3<sup>rd</sup> and 6<sup>th</sup> week (Table IV).

**Table I:** Comparison of baseline measurements in both the groups

Variables	Group A (Mean $\pm$ SD)	Group B (Mean $\pm$ SD)	t-value	p-value
Age	33.52 $\pm$ 1.91	33.34 $\pm$ 1.85	0.479	0.63 <sup>NS</sup>
BMI	23.52 $\pm$ 5.01	23.34 $\pm$ 5.03	0.179	0.86 <sup>NS</sup>
CVA	39.20 $\pm$ 1.69	39.02 $\pm$ 1.61	0.545	0.59 <sup>NS</sup>
FEV1	2.07 $\pm$ 0.42	2.01 $\pm$ 0.47	0.660	0.51 <sup>NS</sup>
PImax	61.14 $\pm$ 3.16	61.06 $\pm$ 3.13	0.124	0.90 <sup>NS</sup>

BMI- Body mass index, CVA-Craniovertebral angle, FEV<sub>1</sub>- Forced expiratory volume in 1<sup>st</sup> second, PImax- Maximal inspiratory pressure

NS- Non Significant ( $p > 0.05$ )

**Table II:** Comparison of measurements within the groups on baseline, 3<sup>rd</sup> and 6<sup>th</sup> week

Group A				
Outcomes measure	Sum of Squares	Mean Square	F-value	p-value
CVA	516.253	258.127	114.942	0.000**
FEV <sub>1</sub>	1.309	0.654	3.499	0.033*
PImax	666.653	333.327	30.775	0.000**
Group B				
Outcomes measures	Sum of Squares	Mean Square	F-value	p-value
CVA	6.813	3.407	1.438	0.241 <sup>NS</sup>
FEV <sub>1</sub>	0.171	0.86	0.384	0.681 <sup>NS</sup>
PImax	39.960	19.980	1.789	0.171 <sup>NS</sup>

CVA-Craniovertebral angle, FEV<sub>1</sub>- Forced expiratory volume in 1<sup>st</sup> second, PImax- Maximal inspiratory pressure

NS- Non Significant ( $p > 0.05$ )

\*- Significant ( $p < 0.05$ )

\*\* - Highly Significant ( $p < 0.001$ )

**Table III:** Mean Differences of measurements within the groups on baseline, 3<sup>rd</sup> & 6<sup>th</sup> Week

Group A				
Outcomes measures	Week		Mean difference	p-value
		1st Week		
CVA	1st Week	3rd Week	2.10	0.000**
	3rd Week	6th Week	2.44	0.000**
	1st Week	6th Week	4.54	0.000**
FEV1	1st Week	3rd Week	0.117	0.18 <sup>NS</sup>
	3rd Week	6th Week	0.11	0.20 <sup>NS</sup>
	1st Week	6th Week	0.228	0.009*
PImax	1st Week	3rd Week	2.14	0.001*
	3rd Week	6th Week	3.00	0.000**
	1st Week	6th Week	5.14	0.000**
Group B				
Outcomes measures	Week	Mean difference	p-value	
CVA	1st Week	3rd Week	0.30	0.33 <sup>NS</sup>
	3rd Week	6th Week	0.22	0.48 <sup>NS</sup>
	1st Week	6th Week	0.52	0.09 <sup>NS</sup>
FEV1	1st Week	3rd Week	0.029	0.75 <sup>NS</sup>
	3rd Week	6th Week	0.052	0.58 <sup>NS</sup>
	1st Week	6th Week	0.081	0.39 <sup>NS</sup>
PImax	1st Week	3rd Week	0.540	0.420 <sup>NS</sup>
	3rd Week	6th Week	0.720	0.283 <sup>NS</sup>
	1st Week	6th Week	1.260	0.061 <sup>NS</sup>

CVA-Craniovertebral angle, FEV<sub>1</sub>- Forced expiratory volume in 1<sup>st</sup> second, PImax- Maximal inspiratory pressure

NS- Non Significant ( $p > 0.05$ )

\*- Significant ( $p < 0.05$ )

\*\* - Highly Significant ( $p < 0.001$ )

**Table IV:** Comparison of measurements between groups at 3<sup>rd</sup> and 6<sup>th</sup> week

Comparison at 3 <sup>rd</sup> Week				
Outcomes measures	Group A Mean ± SD	Group B Mean ± SD	t-value	p-value
CVA	41.30 ± 1.56	39.32 ± 1.57	6.33	0.000**
FEV <sub>1</sub>	2.18 ± 0.43	2.04 ± 0.60	1.60	0.11 <sup>NS</sup>
PImax	63.28 ± 3.06	61.60 ± 3.34	2.622	0.010*
Comparison at 6 <sup>th</sup> Week				
Variables	Group A Mean ± SD	Group B Mean ± SD	t-value	p-value
CVA	43.74 ± 1.21	39.54 ± 1.43	15.85	0.000**
FEV <sub>1</sub>	2.30 ± 0.44	2.09 ± 0.25	2.25	0.03*
PImax	66.28 ± 3.63	62.32 ± 3.37	5.656	0.000**

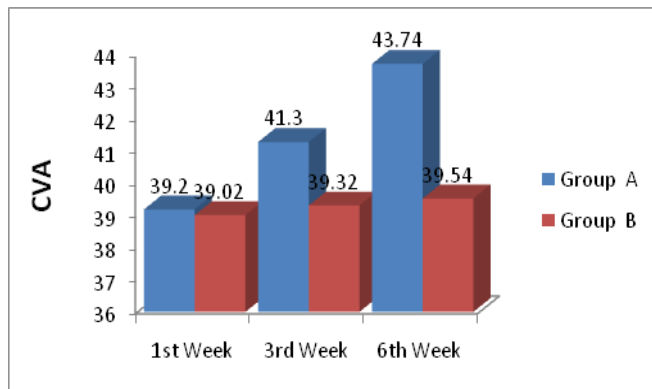
CVA-Craniovertebral angle, FEV<sub>1</sub>- Forced expiratory volume in 1<sup>st</sup> second, PImax- Maximal inspiratory pressure

NS- Non Significant (p > 0.05)

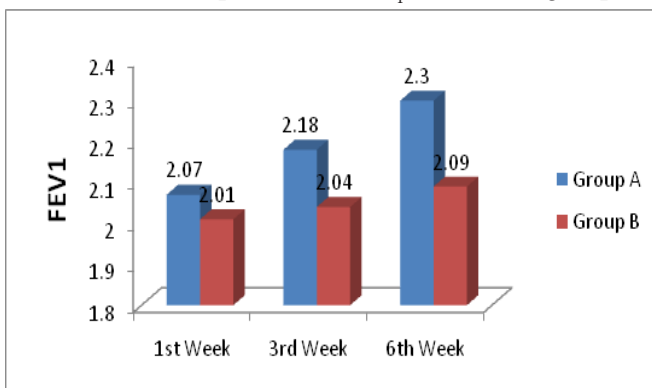
\*- Significant (p < 0.05)

\*\*.- Highly Significant (p < 0.001)

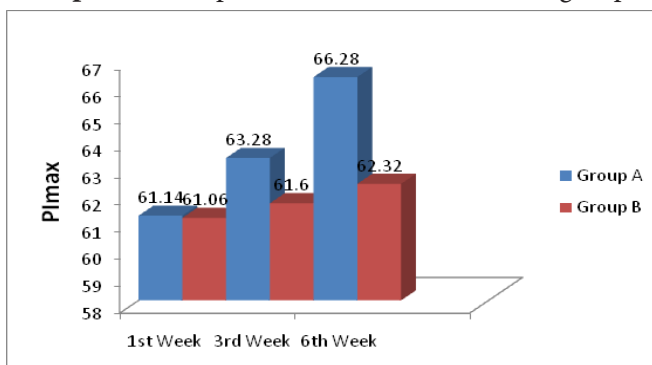
**Graph I:** Comparison of CVA in between groups



**Graph II:** Comparison of FEV<sub>1</sub> in between groups



**Graph III:** Comparison of PImax in between groups



## DISCUSSION

This study intended to find the beneficial effects of Cervical Stabilization exercises guided by feedback through sphygmomanometer along with conventional Physiotherapy treatment on the pulmonary functions in patients having chronic pain over the nape of the neck with forward head posture. Forward head posture is that posture where the head is positioned anteriorly from the line of gravity. This anterior shifting of the head caused by forward head posture causes increased compression on the posterior structures of the spine viz zygoapophyseal facet joints and intervertebral disks. It also leads to shortening of zygoapophyseal joint capsule and narrowing of the intervertebral foramina causing to nerve root compression. Muscles of lower cervical spine and upper back are overloaded and continuously work to counterbalance the pull of gravity which may cause them to become ischemic over some time in an attempt to counteract the normal external flexion moment.

Also, in the FHP, the scapulae may rotate medially, and a thoracic kyphosis may develop and leads to diminished thoracic capacity because of closed kinematics chain that causes a reduction in vital capacity [13]. It has been observed that that forward head posture is kindred with reduction of respiratory movements of lower ribs which alters the mechanics of breathing and thereby reducing the ventilator efficacy of diaphragm and leads to decrease in strength of the muscles of respiration and pulmonary functions [14]. Han J et al.(2016), in their study, found the decreased activity of accessory muscles of respiration when compared the subjects with forward head posture to normal subjects [15]. It was observed that cervical lordosis caused by forward head posture also have an impact on vital capacity [16].

It has been found that exercises that target to correct the posture and strength of deep neck muscles increase the cervical angle and improves pulmonary function [17]. A Study by Kim SY et al. (2015) found that sustained natural apophyseal glides (SNAGS) to help correct neck posture and pulmonary functions in patients having forward head posture [18]. Cervical Stabilization exercise has been found to control the forward head posture [19].

Dusunceli Y et al. (2009) found the neck stabilization exercises superior in terms of reducing pain and disability outcomes as compared to isometric and stretching exercises when given along with the physical therapy agents for the treatment of neck pain [10].

A study by Akodu AK et al. (2018) found neck stabilization exercises to be effective for reducing neck pain, forward head posture, depression, and anxiety in individuals with nonspecific chronic neck pain. Mechanism of pain reduction is suggested to be increased activation of motor pathways which suppresses the pain center in the brain. There was also an improvement in the functional status of the patients [20].

In this study, significant improvement has been found in the forward head posture in the group that received the

Cervical Stabilization exercise with the feedback along with Conventional Physiotherapy program. The reduction of forward head posture also leads to improvement in inspiratory muscle strength and pulmonary function when compared to the subjects who received the only conventional Physiotherapy intervention. In a pilot study, it has been observed that cervical stabilization improved the respiratory strength and craniovertebral angle in chronic neck pain patients with forward head posture [21]. Results of the present study revealed that reduction of forward head posture with cervical stabilization exercises improve the pulmonary functions by correcting the altered biomechanics of cervical and thoracic spine which in turns improve the thoracoabdominal mobility and efficacy of diaphragm can be improved.

## CONCLUSION

Cervical Stabilization exercise can be incorporated in the management of patients suffering from FHP to correct the faulty mechanics, which leads to impaired respiration.

## Conflict of interest

In this study, no potential conflict of interest concerning authorship or publication was reported.

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