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Effect of Cervical and Shoulder Complex Exercises on Improvement of Forward Head Posture

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ABSTRACT

Background: Forward head posture is anterior positioning of the head with respect to neck in sagittal plane. Craniovertebral angle is used to measure forward head posture. Craniovertebral angle is formed at the junction of a line drawn from the tragus of the ear through the spinous process of the C7 vertebra and a horizontal line through the C7 vertebra. This study aimed to investigate the effects of cervical and shoulder complex exercises on improvement of forward head posture.

Objectives: To improve the forward head posture by- Cervical and shoulder complex exercises.

Method: 30 participants, whose craniovertebral angle (CVA) was less than 50° were selected and further divided into experimental group (Group-A) (15 participants) and control group (Group- B) (15 participants). Photos of participants in standing position were taken using mobile camera and craniovertebral angle was measured using autocad software. Experimental group performed exercises such as chin tucks, cervical posterior isometric, scapular retraction exercise, Y to W exercise, middle trapezius fibres muscle strengthening exercise for 6 week interval. Whereas the control group was asked to carry on with routine activities. Pre (0^{th} week), mid (4^{th} week), and post (6^{th} week) photos of participants of both groups were taken to see the effect of exercises along with numerical pain rating and neck disability score

Results: This study signified that craniovertebral angle (p value=0.001), numerical pain rating scale score (p value=0.001) and neck disability index scores (p value=0.001) were statistically significant.

Conclusion: This study proved that 6 week cervical and shoulder complex exercises protocol has significant effect in improving forward head posture and reducing neck pain and neck disability.

Keywords: Autocad software, Craniovertebral angle, chin tucks, forward head posture, neck pain, neck disability

INTRODUCTION

Forward head posture (FHP) denotes the anterior positioning of the head with respect to neck in sagittal plane.[1] FHP correlates with the tightening of the upper trapezius, levator scapulae and cervical extensor muscles (such as suboccipitals, semispinalis capitis and splenius capitis-cervicis).[2] Optimal posture is a state of musculoskeletal equilibrium, minimizing the strain on bodily structures.[2] Forward head posture is flexion of lower cervical

spine (C4-C7) and hyperextension of upper cervical spine (C1-C3).[2] Later consequences of forward head posture can cause decreased cervical proprioception, increased reaction times and movement, subacromial impingement.[2] Majority of patients suffering from neck pain have forward head posture.[3]This posture leads to uneven distribution of forces across the cervical spine causing structural changes and degeneration of neck muscles.[3]Forward head posture occurs due to habitual postural tendencies over time.[6] Variations in head, shoulder and thoracic posture have been observed between individuals with neck pain.[7]. Increase usage of computers, mobiles, electronic devices has also lead to forward head posture due to prolonged sitting in slouched posture.[8] Furthermore, incorrect use of chair, desk level predisposes forward head posture.[8]

Forward head posture, if not treated, in later stages can cause pathological conditions such as headaches, temporomandibular disorders and scapular dyskinesis.[9] Decrease in strength and endurance of deep cervical flexors is noted.[9] Forward head posture increases compressive loads on the zygapophysial joints of the cervical spine.[11] There is change in length and strength of connective tissues as there is stretching of anterior cervical structures.[11] Neck pain is a musculoskeletal disorder caused by this postural deviation as there is increase in load on muscles and connective tissues.[12] This constant load on muscles and noncontractile structures affects the biomechanical movement and leads to neck pain.[12]

Forward head posture can cause functional limitation in movement of head and neck area.[12] Forward head posture can lead to decrease in number of sarcomere and shortening of muscle fibers which in turn have an effect on muscular contraction.[12] There is lengthening of cervical flexors and weakening of scapular retractors such as rhomboids, middle and lower trapezius.[13] Patients with chronic neck pain have reduced cervical range of motion and fatigue of cervical muscles which leads to stiffness and other musculoskeletal problems in cervical region.[13]

Exercise regimes targeting the cervical and shoulder complex can address underlying soft tissue imbalances through muscle stretching and strengthening. [13] Therapeutic exercises aim to correct maladaptive body responses, enhance elasticity and mobility, muscular strength and endurance along the cervical spine and associated ligaments.[13] Proprioceptive reflexes are also weakened in people with forward head posture. [14] Forward head posture not only affect neck posture but also shoulder posture which leads to thoracic kyphosis which in turn decreases thoracic mobility.[14] Rounded shoulder is the posture in which there is cervical hyperextension, anterior scapular tilt, scapular downward rotation which affects scapular kinematics.[14] This posture also affects the rotator cuff muscles.[14]

Therapeutic exercises such as scapular stabilization exercises, cervical stabilization exercises will help in improving strength of weakened muscles, improving muscle-ligament flexibility, lengthening shortened muscles, restoring muscular imbalances.[14] The length tension relationship of muscle can be improved by performing strengthening exercises for cervical muscle.[15] Exercises will help in activating muscles in head, neck and thoracic region.[15] This study aimed to study the effects of cervical and shoulder complex exercises on improvement of forward head

posture. The objective of this study is to improve forward head posture by cervical and shoulder complex exercises.

MATERIALS & METHODS

Research design: This is an experimental study which aimed to investigate the effects of cervical and shoulder complex exercises on improvement of forward posture that involved measurements of craniovertebral angle (CVA), numerical pain rating scale (NPRS) and Oswestry neck disability index (NDI).

Subjects

The subjects for this study were 30 participants. Inclusion criteria was craniovertebral angle less than 50 degrees in the age group of 18 to 35. Exclusion criteria was subjects with previous cervical or shoulder surgeries. This study was conducted in Pune, Maharashtra. The subjects were further divided equally into two groups – 15 participants in the experimental group (Group – A) and 15 participants in the control group (Group -B). The experimental group followed a specific exercise protocol for 6 weeks, on the other hand the control group followed their routine activities for 6 weeks.

Subject orientation

The subjects were provided with orientation and explanation about the purpose of the study in addition to this, consent was taken from all the participants and assurance was provided that their information will remain confidential. Approval for this study was taken from ethical committee of college.

Materials: stickers, mobile camera, numerical pain rating scale, Oswestry neck disability index.

Assessment of Craniovertebral angle

Autocad software was used to measure the Craniovertebral Angle.[2] The angle formed at the junction of a line drawn from the tragus of the ear through the spinous process of the C7 vertebra and a horizontal line through the C7 vertebra is the Craniovertebral angle.

A 64-megapixel smartphone was set up on a tripod framework 150 cm away, with the height adjusted to the subject's shoulder level.[21]

The tragus of the ear and the C7 spinous process were located using stickers.[21]

The next instruction given to the subjects was to stand laterally with their left shoulder toward the camera.[21]

After that, the participants were told to stand comfortably with their weight evenly distributed over both feet and to look straight forward.[21]

The participants were then told to rest in a comfortable position after flexing and extending their heads three times.[21]

Using the autocad program, the angle was measured after capturing a picture with the smartphone camera.

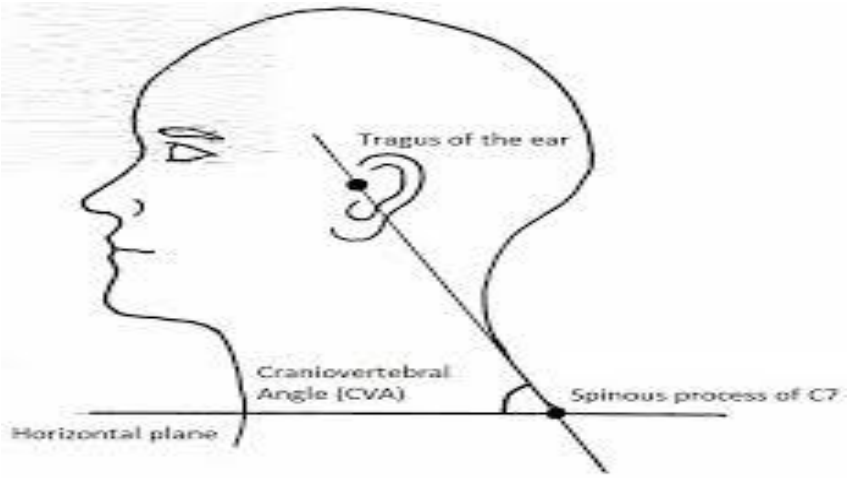

Fig 1: Representation of craniovertebral angle (CVA)

Evaluation of Neck Pain

Neck discomfort was measured using the Numerical pain rating scale.

After then, the participants were told to mark the number that represented the intensity of pain in their neck.

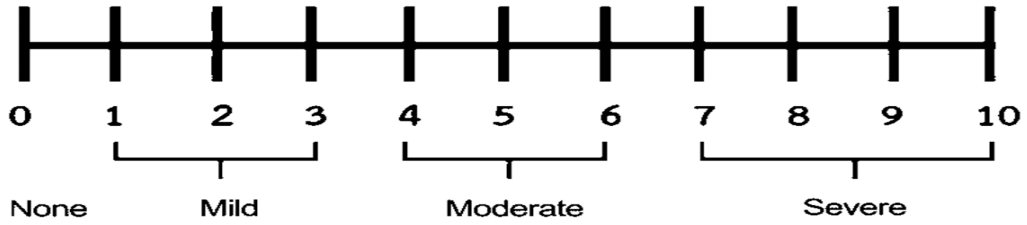

Fig 2: Numerical Pain Rating Scale (NPRS)

Evaluation of neck disability

Evaluation of neck disability was done using Oswestry neck disability index

Exercise protocol

A 6 week exercise protocol was designed. Experimental group (Group-A) followed the exercise protocol whereas control group was asked to carry out their routine activities for 6 weeks.

Pre (0^{th} week), mid (4^{th} week) and post (6^{th} week) photographs were taken and craniovertebral angle was measured.

Along with craniovertebral angle (CVA), numerical pain rating scale and neck disability index scores were also taken at 0^{th} week, 4^{th} week and 6^{th} week respectively.

Participants in experimental group were asked to perform exercises twice a day, 6 days a week for 6 weeks.

The exercises are demonstrated in the table I.

Table I: 6 Week Exercise protocol

	Exercise	Description	Dosage
1	CHIN TUCKS	The participants is asked to look straight ahead and then glide their chin straight back, avoiding tilting their head either up or down in standing position	10 repetitions with 6 seconds hold
2	SCAPULAR RETRACTION	In standing position the participants is asked to retract and pinch the scapulae together	10 repetitions with 6 seconds hold
3	NECK POSTERIOR ISOMETRICS	The participant is asked to clasp their fingers behind their head and press their head against their hand and hold it for few seconds	10 repetitions with 10 seconds hold
4	Y TO W	In prone lying position with shoulder is abducted to 120 degree, Arms are raised while keeping retraction of scapula in Y shape then elbows flexed and shoulders are extended and W Shape is made by arms.	10 repetitions
5	MIDDLE AND LOWER TRAPEZIUS STRENGHTGENING	Participant is in prone lying position with shoulders abducted to 90 degree with the thumbs pointing upwards and the arms are raised	10 repetitions

STATISTICAL ANALYSIS

The collected data was analyzed. One-way repeated measure ANOVA, Independent t test are parametric test which were used to compare means of normal data. SPSS and Minitab software were used for statistical analysis at a level of significance = 0.05. For within group comparison of mean of group A, Friedman test, a non-parametric test was used. For within group comparison of mean of group B, one way repeated measure ANOVA is used. An independent sample t test was a statistical method that was used to determine whether there existed a significant difference between the means of two independent groups of craniovertebral angle. For neck disability index, within group comparison of mean of group- A, paired t test, a parametric test is used. For within group comparison of mean of group -B, Friedman's test was used. An independent sample t test was a statistical method that was used to determine whether there existed a significant difference

between the means of two independent groups of neck disability index. For Numerical pain rating scale, within group comparison of mean of group A and B Friedman test a non-parametric test was used.

RESULTS

CVA and NDI

In table 2, the correlation between CVA at 0 weeks and NDI at 0 weeks exhibited a significant negative correlation, as indicated by Spearman's rho coefficient ($\rho = -0.657$, $p < 0.01$, 2-tailed). This means that there is a moderate negative relationship between CVA and NDI at the beginning of the study. In other words, as CVA increase, NDI scores tend to decrease. The correlation was statistically significant at the 0.01 level. The analysis was conducted with a sample size of 30 participants for both CVA and NDI assessments.

Table 2. Correlation coefficient -CVA and NDI

CVA 0 WEEK	NDI 0 WEEK	Correlation
41.40 ± 5.47	24.53 ± 5.81	-0.657 **

CVA and NPRS

In table 3, the correlation between CVA at 0 weeks and NPRS at 0 weeks exhibited a significant negative correlation, as indicated by Spearman's rho coefficient ($\rho = -0.634$, $p < 0.01$, 2-tailed). This means that there is a moderate negative relationship between CVA and NPRS at the beginning of the study. In other words, as CVA increase, NPRS scores tend to decrease. The correlation was statistically significant at the 0.01 level. The analysis was conducted with a sample size of 30 participants for both CVA and NPRS assessments.

Table 3. correlation coefficient- CVA and NPRS

CVA 0 WEEK	NPRS 0 WEEK	Correlation
41.4 ± 5.47	5.4 ± 1.35	-0.634 **

Craniovertebral angle

Table 4. demonstrates the mean and standard deviation of craniovertebral angle of Group-A is 42.33 ± 4.78 for 0^{th} week, 46.33 ± 4.13 for 4^{th} week and 52.07 ± 2.71 for 6^{th} week. The p value is 0.001 which implies the result is highly significant. The mean and standard deviation for Group-B is 40.47 ± 6.12 for 0^{th} week, 37.93 ± 5.79 for 4^{th} week and 35.73 ± 7.46 for 6^{th} week. The p value for Group-B is 0.001 which implies the result is highly significant. The p value for both groups for 0^{th} week (Group-A and Group-B) is 0.359 which implies that there were no significant differences in craniovertebral angle at the beginning of the study, but as the week progressed there were significant differences in both groups for 4^{th} week and 6^{th} week as the p value is 0.001. The two sample t-test was conducted to compare mean differences of craniovertebral angle preceded by Levene's test for variance equality.

Table 4. Craniovertebral angle

Group	0th week	4th week	6th week	P value	Post hock tests
Group A	42.33 ± 4.78	46.33 ± 4.13	52.07 ± 2.71	< 0.001 **	All significant
Group B	40.47 ± 6.12	37.93 ± 5.79	35.73 ± 7.46	< 0.001**	All significant
P value	0.359	<0.001 **	< 0.001 **		

Neck disability index

In table 5, we can see that the mean and standard deviation of neck disability index for group-A is 25.76 ± 5.22 for 0^{th} week, 14.89 ± 5.91 for 4^{th} week and 0 for 6^{th} week. The p value is 0.001 which implies the result is highly significant. The mean and standard deviation of neck disability index for group-B is 23.30 ± 6.28 for 0^{th} week, 28.04 ± 6.95 for 4^{th} week and 30.06 ± 7.53 for 6^{th} week. The p value is 0.001 which implies the result is highly significant. The p value for both groups (group-A and group-B) for 0^{th} week is 0.253 which implies there is no significant difference in both groups at the beginning of the study, but in 4^{th} week we can see there is significant difference in both groups as the p value is 0.001. The mean values for neck disability index for all weeks were calculated by paired t test.

Table 5.

Group	0th week	4th week	6th week	P value	Post hock tests
Group A	25.76 ± 5.22	14.89 ± 5.91	00	< 0.001 **	All significant
Group B	23.30 ± 6.28	28.04 ± 6.95	30.06 ± 7.53	< 0.001**	All significant
P value	0.253	<0.001 **	Not Required		

**** highly significant**

Numerical pain rating scale

In table 6, we can see that the mean and standard deviation of group-A is 5.47 ± 1.41 for 0^{th} week, 2.33 ± 1.40 for 4^{th} week and 0.13 ± 0.35 for 6^{th} week. The p value is 0.001 which implies that the result is highly significant. The mean and standard deviation of group-B is 5.33 ± 1.35 for 0^{th} week, 5.87 ± 1.30 for 4^{th} week and 6.07 ± 1.33 for 6^{th} week, the p value is 0.001 which implies the result is highly significant. The p value for both groups is 0.806 which implies there is no significant difference in both groups at the beginning of the study, but as the week progressed there is significant differences as the p value is 0.001.

Table 6.

Group	0th week	4th week	6th week	P value	Post hock tests
Group A	5.47 ± 1.41	2.33 ± 1.40	0.13 ± 0.35	< 0.001 **	All significant
Group B	5.33 ± 1.35	5.87 ± 1.30	6.07 ± 1.33	< 0.001**	4^{th} week and 6^{th} week are same
P value	0.806	<0.001 **	< 0.001 **		

**** highly significant**

DISCUSSION

This research study intended to reveal the effects of cervical and shoulder complex exercises on improvement of forward head posture. In this 6 week exercise protocol, subjects were asked to perform exercises twice a day. 6 days in week for 6 weeks. A forward head posture differs from the ideal posture in that the head is positioned anteriorly, the usual anterior cervical convexity is enlarged, and the peak of the lordotic cervical curve is located far from the line of gravity.[13] The forward head posture leads to an anterior slanting of the head, which abnormally compresses the zygapophyseal facet joints and intervertebral discs, the posterior structures of the spine.[13] In addition, the intervertebral foramina shrink and the zygapophyseal joint capsule shorten, which compresses the nerve roots.[13] The lower cervical spine and upper back muscles are overworked and constantly trying to counteract the pull of gravity, which might eventually lead to them becoming ischemic.[13] The scapulae may rotate medially in the forward head posture, which can result in a thoracic kyphosis and decreased thoracic capacity, both of which lower vital capacity.[13] Forward head posture lead to neck pain and neck disability as there is disturbance in function of contractile and non contractile structures in cervical region.[11] In this study we found that there is significant negative correlation between craniovertebral angle with neck pain and neck disability, means when the craniovertebral increases the neck pain and neck disability decreases and vice versa.

In this study we found that after 6 week exercise protocol there is significant improvement in craniovertebral angle of experimental group (Group - A) which lead to decrease in neck pain and neck disability index. Kim, Jin Young et al., in their study found that deep cervical flexors strengthening exercises has the effect of alleviation of neck pain and neck disability and improvement in forward head posture.[4] Therefore, it may be said that the degree of discomfort and disability in the neck region increases as the FHP magnitude increases.[11] This might be because these structures generate an even greater degree of disruption as the amount of forward movement rises. Therefore, those with a lower Craniovertebral angle will have more severe pain and incapacity.[11] Regarding the potential reason for the association between

forward head posture and a history of neck discomfort, it may also be claimed that individuals with a lower Craniovertebral angle are more likely to have more severe dysfunction of structures in cervical region.[11] Further, it made people aware of their faulty posture.

Numerous investigations into the relationship between forward head posture and neck discomfort have been conducted and the results indicate that severe neck discomfort is brought on by shorter muscle fibres and reduced ability of those fibres to produce tension when the head is positioned forward.[21] In addition to causing neck pain, forward head posture can also affect respiration, cause palpitations, disrupt sleep and cause limb numbness. Owing to these findings, it is critical to properly diagnose, treat and evaluate forward head posture.[21]

In this present study, in the initial week (0^{th} week), the mean craniovertebral angle of experimental group was 42.33 while after following 6-week exercise protocol the mean Craniovertebral angle was 52.07 with a p value of 0.001 which implies that there is significant improvement in craniovertebral angle hence improving the forward head posture.

In the experimental group, in the initial week (0^{th} week), the mean of Neck disability index was 25.76 while after following 6-week exercise protocol the mean neck disability index was 0 with a p value of 0.001 which suggests that there is decrease in the neck disability.

In the experimental group, in the initial week (0^{th} week), the mean of Numeric pain rating scale was 5.47 while after following 6-week exercise protocol the mean numerical pain rating scale was 0.13 with a p value of 0.001 which suggests that there is significant decrease in the neck pain.

In the initial week (0^{th} week), the mean craniovertebral angle of control group was 40.47 while, in the control group, who carried out their routine activities, mean craniovertebral angle after 6-weeks was 35.73 with a p value of 0.001 which implies that there is significant decrease in craniovertebral angle hence no improvement the forward head posture.

In the initial week (0^{th} week), the mean Neck disability index of control group was 23.30 while, after 6-weeks the mean Neck disability index was 30.06 with a p value of 0.001 which implies that there is significant increase in Neck disability.

In the initial week (0^{th} week), the mean Numerical pain rating scale of control group was 5.33 while, after 6-weeks the mean Numerical pain rating scale was 6.07 with a p value of 0.001 which implies that there is significant increase in Neck pain

From the readings mentioned above it is clear that, exercises such as chin tucks, scapular retraction, cervical posterior isometric, Y to W, middle trapezius strengthening helped in improving the forward head posture in group – A (Experimental group), because this exercise regimen stimulated the deep cervical muscles, causing activation and improving postures of the neck and shoulders. while there was no improvement in forward head posture in group – B (Control group) which did not perform this specific exercise protocol. Exercises improved the functionality of neck. This exercise protocol can be followed on regular basis. Thus 6 week interventional protocol was successful in improving forward head posture and thus reducing neck pain and neck disability. The muscular imbalance and was also corrected because of this exercise protocol. This study can effectively convey how the regular exercise protocol can significantly help to

improve posture and reduce pain in cervical region.

CONCLUSION

A 6 week cervical and shoulder complex exercise protocol is beneficial in improving forward head posture and thus reducing Numerical pain rating and Neck disability scores in individuals

Declaration by Authors

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