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[ORIGINAL ARTICLE]

Comparison of Pulmonary Functions in Young Adults with Normal Versus Forward Head Posture

Zawar Pranoti Rajgopal[1], Kolse Reshma[2] Prof. Dr. Abhijit Diwate[3]
[1]Intern student, Assistant Professor [2], Professor and HOD[3], Dept. of PT in cardiovascular and respiratory sciences, DVVPF, College of Physiotherapy, Ahmednagar, Maharashtra, India.

ABSTRACT :

Background: Body posture refers to the position of a person's body in space, the alignment of body parts in relationship to one another and to the environment at one point in time. Different postures such as forward head posture and kyphosis have been shown to alter breathing mechanism. Pulmonary function test is an important tool in the investigation of patients with respiratory pathology.

Methods: A comparative study was conducted at vikhe patil memorial hospital and college, Ahmednagar. The craniovertebral angle and Pulmonary function test was taken on 40 adults.

Results: The study show that Forced vital capacity, forced expiratory volume in 1 second and Peak Expiratory Flow Rate were significantly lower in the forward head posture group than in the normal group. The FEV1/FVC ratio was more in the forward head posture group than in the normal group. A positive correlation was observed between the Craniovertebral angle and the forced Expiratory Volume in 1 sec (r=0.058). while a negative correlation was observed between the Craniovertebral angle and Forced Vital Capacity (r=–0.012) and also observed between the Craniovertebral angle and Peak Expiratory Flow Rate (r= -0.189).

Conclusion: The pulmonary functions showed significant reduction in Young adults with Forward head posture as compared to normal craniovertebral angle. There is positive correlation was observed between the Craniovertebral angle and the forced Expiratory Volume in 1 sec. while a negative correlation was observed between the Craniovertebral angle and Forced Vital Capacity and between craniovertebral angle and Peak Expiratory Floe Rate.

Keywords: Craniovertebral angle, Pulmonary Function Test, Forward Head Posture, Force Vital Capacity, Force Expiratory Volume in 1 sec, Peak Expiratory Flow Rate.

Introduction

Body posture refers to the position of a person's body in space, the alignment of body parts in relationship to one another and to the environment at one point in time, and is influenced by each of the body's joints. [1]

Posture is alignment of body parts whether upright, sitting, or recumbent.it is describe by the positions of the joints and body segment and also in terms of the balance between the muscles crossing the joints. The alteration of the head-neck position had an immediate effect on respiratory function characterized by reduced diaphragm strength. This indicated the huge impact the head position can have on physio-mechanical function of the respiratory system. Sustaining poor ergonomic posture while using computers, TV, video games, mobile technologies, etc. for a prolonged period of time can lead to development of FHP. [2] It is often unnoticed at early stages until symptoms appear. Continuous repetitive adaptation of these positions turns into a deformity causing neck and upper back pain, stiffness, shallow breathing, and breathing dysfunction. Individuals with FHP showed reduced diaphragmatic strength as a result of its reduced activity. [2]

*Corresponding author
Zawar Pranoti Rajgopal
Email : zpranoti2016@gmail.com.
Dr. Vithalrao Vikhe Patil Foundations, College of Physiotherapy, Ahmednagar, Maharashtra, India

In recent times in some occupations work in static sedentary postures (Computer operators) for long hours in order to perform the tasks required of them. This can cause continuous muscle contraction in the neck and shoulders, which subsequently leads most people to adopt a forward head posture (FHP) in which their chins stick out. [3]

Different postures such as forward head posture (FHP) and kyphosis have been shown to alter breathing mechanism including diaphragm mobility. [2] Abnormal posture can have a negative effect on respiratory function. [4]

When Forward Head Posture (FHP) is maintained for prolonged periods the neck flexors and the erector spinae (ES) muscles in the upper thoracic region are weakened due to their lengthening, and the scapula is elevated due to tension in the levator scapula, sternocleidomastoid (SCM), splenius muscles, and the sub occipitalis, which also causes tension in the upper trapezius (UT). Therefore, because of an imbalance in the muscles, such as the shortening or lengthening, or straining or loosening of the muscles around the neck, a rounded shoulder posture is exhibited, in which the upper thoracic region is slightly bent while in a sitting posture, and chronic neck pain results due to mechanical stress. [3]

Pulmonary function test (PFT) is an important tool in the investigation and monitoring of patients with respiratory pathology. They provide important information relating to the large and small airways, the pulmonary parenchyma and the size and integrity of the pulmonary capillary bed. Although they do not provide a diagnosis per se, different patterns of abnormalities are seen in various respiratory diseases which helps to establish a diagnosis. [5]

The standard spirometry maneuver is a maximal forced exhalation (greatest effort possible) after a maximum deep inspiration (completely full lungs). Several indices can be derived from this blow. • FVC – Forced Vital Capacity – the total volume of air that the patient can forcibly exhale in one breath. • FEV1 – Forced Expiratory Volume in One Second – the volume of air that the patient is able to exhale in the first second of forced expiration. • FEV1 /FVC – the ratio of FEV1 to FVC expressed as a fraction (previously this was expressed as a percentage. [5]

The patient is instructed to inhale as much as possible and then exhale rapidly and forcefully for as long as flow can be maintained. The patient should exhale until one of the criteria defining the end of a forced exhalation has been reached. At the end of forced exhalation, the patient should again inhale fully as rapidly as possible.[6] The results of the PFTs are affected by the effort of the patient.[7]

Various software and application are available to measure the craniovertebral angle. The ON Protractor (version 6.0- developed by potatotree soft) smartphone application was used to measure the craniovertebral angle. The ON Protractor application is available for free in the play store android smartphone. Jinal mamania et al 2017, proved the reliability (0.979) and validity (0.99) of the ON protractor application to measure the craniovertebral angle in the Indian population. In addition to being reliable and valid for measuring the craniovertebral angle, the ON Protractor application is easily available. It is easy and non-invasive method of measuring the craniovertebral angle. The application is free and is cost effective. [8] The need of study is the majority of research have used PFT procedure recommendations. Age, weight, height, BMI, smoking history, and testing position are among the basic data needed. However, no studies have discussed posture evaluation. If forward head posture has an effect on pulmonary function, it will be necessary to evaluate posture in the preliminary data before the test. Since forced expiration is most important during PFT, forward head posture can have an impact on the outcome. As a result, if we correct FHP before performing the PFT, we would be able to perceive pathological cardiorespiratory diseases correctly.

As a result, the need of study is to evaluate forward head posture prior to the Pulmonary Function Test in order to ensure accurate results and interpretation. As a result, improving respiratory function by correcting posture and strengthening damaged accessory respiratory muscles may be clinically necessary when treating patients with FHP.

The aim of the study is to Compare Pulmonary Functions in Young Adults with Normal Versus Forward Head Posture and objectives are to compare FEV1 in young adult with normal vs forward head posture, to compare FVC in young adult with normal vs forward head posture, to compare FEV1/FVC ratio in young adult with normal vs forward head posture, to compare PEFR in young adult with

normal vs forward head posture.

Material And Methods

Methodology

A comparative study was conducted at vikhe patil memorial hospital and college, Ahmednagar. The craniovertebral angle and Pulmonary function test was taken on 40 adults within duration of six months. Purposive sampling method was used.

Material Used are Computer with RMS Helio 401 Spirometer, Chair without arm support, Nose clip, Pen &Pencil, ON Protractor smartphone application, Markers, Tripod stand, Weighing Machine & Measuring Tape

Inclusion Criteria are Age group 18-30 years, Both the genders, Normal BMI, Normal chest x-ray, Individual with Normal and Forward head posture and Exclusion criteria are Patients with any other musculoskeletal deformity, Respiratory & cardiovascular diseases, Un co-operative young adults, any neuromusculoskeletal impairments related to neck, Cervical radiculopathy, unwilling to participate, Hemodynamically unstable.

Procedure

We have taken an approval from the institutional ethics committee. According to the selection criteria, we screened 40 samples and included 40 of them in the report.

The patient record sheet included basic demographic information such as name, age, gender, and occupation. The subjects had explained about the procedure, benefits and the need of the study in a language best understood by them. Informed consent is taken for all the subjects in a language understood by them.

Procedure for Measuring Craniovertebral Angle:

- The participants were asked to sit in a chair with no armrests while the craniovertebral angle was calculated and they were divided into two groups: normal and forward head posture.
- The angle is determined with the ON Protractor smartphone app by placing appropriate markers on the C7 vertebra and the tragus of the ear.
- The smartphone is then propped up on a tripod stand and matched with the C7 spinous phase and tragus markers. The value of the craniovertebral angle had noted.
- The subjects with normal values of the craniovertebral angle were placed in the normal craniovertebral angle group, which is group A. (41.5 to 55.7 degrees). Whereas, subjects with abnormal values, the values not included in the above criteria had put in the abnormal angle group is the group B.

Procedure for Pulmonary Function Test:

- Students were told not to smoke or drink alcohol for 24 hours before the test, and not to drink caffeinated beverages or energy drinks for 2 to 4 hours before the test because they can impair the bronchial tree's reactivity.
- During the exam, the student recommended wearing loose, comfortable clothes. Tight clothing can limit the movement of the chest wall, resulting in erroneous results.
- The pulmonary function examination was performed while the patient was seated. The young adults sit in a chair that does not have armrests. To prevent air from escaping from the nose, a soft clip is put on the adult nose.
- Before the actual exam, the young adult is given a few practise attempts to ensure that they can execute the manoeuvre perfectly. The young adult is then instructed to take a deep breath through his nose while closing his lips around the mouthpiece. The adult was then instructed to forcibly exhale through the mouthpiece for six seconds before inhaling forcefully into the mouthpiece.
- The young adult requested that the manoeuvre be performed three times, with the best reading being included in the analysis.
- The best performed manoeuvre's FVC, FEV1, FEV1/FVC, and PEFR values are noted.

Outcome Measures

1) Pulmonary function testing-

- **Forced vital capacity (FVC)-** The maximum volume of air that can be forcefully expired after maximal inspiration
- **Forced Expiratory Volume In 1 second (FEV1) -** The maximum volume of air that can be forcefully expired (forced expiratory volume) within 1 second after maximal inspiration.
- **FEV1/FVC** – Ratio of FEV1 to forced vita capacity expressed as a percentage.

- **PEFR -** The maximum airflow rate attained during forced expiration (in L/s)

2) Craniovertebral angle –

- The normal value for the craniovertebral angle lies in the range of 41.5 to 55.7 degrees.
- The smaller the angle the greater is the forward head posture indicating an anterior shift of head in the sagittal plane.

Statistical Analysis

All data was analyzed using Graphpad InStat. Mean and standard deviation was calculated for all the outcome measures. The data was entered into an excel spread sheet. Unpaired t-test was used for the analysis.

Normality distribution testing of data was done for all baseline parameters using Kolmogorov Smirnov test. It was found that the data was normally distributed. Hence, parametric tests were used for analysis. Demographic analysis was done for age and gender in young adults.

The pulmonary functions FEV1, FVC, FEV1/FVC and PEFR of both groups i.e., group A with normal craniovertebral angle and group B with Forward Head Posture were compared. The correlation between PFT and craniovertebral angle was tested by comparing FVC, FEV1, FEV1/FVC and PEFR values with the values of craniovertebral angle by using Pearson correlation test. P value of <0.05 was consider significant.

Results

Demographic Analysis

Table No 1: Distribution of Age and Gender and Bmi in Group A and B

Groups	Male	Female	Age	BMI
	Mean ±SD			
Group A (Normal Craniovertebral Angel)	1(5%)	19(95%)	22.45±1.66	20.91±1.79
Group B (Forward Head Posture)	3(15%)	17(85%)	22.3±1.03	21.30±2.14

Inference:

The above table demonstrate the gender distribution of subjects in both the groups. In total, the sample has 4 males and 36 females, with Group A having 1 male and 19 females and Group B having 3 males and 17 females.

The above table demonstrate mean values of age in group A and group B i.e. group A has 22.45 and group B has 22.3

Comparison of Pulmonary Functions Fev1, Fvc And Fev1/Fvc In Group A And Group B

Table No 2 Shows: Comparison of FVC of Both Groups A And B

PULMONARY FUNCTIONS (volume)	MEAN±SD (volume)	t-VALUE	P VALUE	SIGNIFICANT
FVC (Group A)	2.97±0.54	2.642	0.0060	Extremely significant
FVC (Group B)	2.49±0.59			

Inference:

The above table shows mean valve of FVC in both groups i.e., 2.97 in group A and 2.49 in group B, with a p value of 0.0060. we conclude that the values are statistical difference. We can say that the values of the craniovertebral angle influence FVC values because group B has lower FVC values.

Table No 3 Shows: Comparison of FEV1 of Both Groups A And B

PULMONARY FUNCTIONS	MEAN±SD (volume)	t-value	P VALUE	SIGNIFICANT
FEV1 (Group A)	2.57±0.45	2.456	0.0094	Extremely significant
FEV1 (Group B)	2.22±0.44			

Inference:

The above table shows mean valve of FEV1 in both groups i.e., 2.57 in group A and 2.22 in group B, with a p value of 0.0094. we conclude that the values are statistical difference. We can say that the values of the craniovertebral angle influence FEV1 values because group B has lower FEV1 values.

Table No 4 Shows: Comparison Of FEV1/FVC of Both Groups A And B

PULMONARY FUNCTIONS	MEAN±SD (volume)	t-value	P VALUE	SIGNIFICANT
FEV1/FVC (Group A)	86.85±3.16	0.4325	0.4324	Not significant
FEV1/FVC (Group B)	87.65±20.79			

Inference:

The above table show mean valve of FEV1/FVC in both groups i.e., 86.85 in group A and 87.65 in group B, with a p value of 0.4324, which is not significant. we conclude that the values are statistically difference. Group B has higher value than group A thus it is not significant.

Table No 5 Shows: Comparison of PEFR of Both Groups A And B

PULMONARY FUNCTIONS	MEAN±SD (L/min)	t-value	P VALUE	SIGNIFICANT
PEFR (Group A)	5.90±1.07	1.202	0.1183	Not significant
PEFR (Group B)	5.36±1.68			

Inference:

The above table shows mean valve of PEFR in both groups i.e., 5.90 in group A and 5.36 in group B, with a p value of 0.1183. we conclude that the values are statistical difference. We can say that the values of the craniovertebral angle influence PEFR values because group B has lower PEFR values.

Table No 6 Show: Correlation between Craniovertebral Angle and Pulmonary Function Test Within Group B

	CRANIOVERTBRAL ANGLE (CVA)	
	r value	95% confidence interval
FVC	-0.01206	-0.4523 to 0.4329
FEV1	0.05880	-0.3941 to 0.4887
PEFR	-0.1892	-0.5830 to 0.2766

Inference:

The above table shows A positive correlation was observed between the CVA and the forced Expiratory Volume in 1 sec (FEV1) (r=0.058). while a negative correlation was observed between the CVA and Forced Vital Capacity (FVC) (r=–0.012). There is negative correlation was observed between the CVA and Peak Expiratory Flow Rate (r= -0.189).

Discussion

In this study, we have studied the effect of craniovertebral angle on the pulmonary functions in young adults. Accordingly, two groups were made i.e., group A, with normal craniovertebral angle and group B, with Forward Head posture. The differences in FEV1, FVC, FEV1/FVC and PEFR were studied in both the groups of 20 people each i.e., 40 patients. The aim of the study is comparison of pulmonary function test with normal versus forward head posture.

Jintae Han, conducted study in 2016 Jan on 'Effects of forward head posture on forced vital capacity and respiratory muscles activity' They conclude that the

results indicate that forward head posture could reduce vital capacity, possibly because of weakness or disharmony of the accessory respiratory muscles. [3] Jeong-Il Kang, conducted study in sept 2016 on 'Correlation between pulmonary functions and respiratory muscle activity in patients with forward head posture' They conclude that Severe forward head posture increased the activities of the sternocleidomastoid muscles and the anterior scalene muscles, and decreased the forced vital capacity. Thus, it is necessary to develop more efficient interventions for managing forward head posture based on pulmonary function and the activity of the respiratory synergist muscles. [9]

Forced expiratory volume in 1 second or FEV1 is the volume of air the patient can exhale in the first second of forced expiration. The normal values of FEV1 is >70 percent.[10] In this study, it was found that the FEV1 values of young adults with forward head posture was significantly less as compared to those with normal craniovertebral angle.

Forced Vital Capacity is the total volume of air the patient can forcibly exhale in one breath. The normal values of FVC is >80%. (10) In this study, it was found that there is a statistically significant difference in FVC between the two groups. FVC of group B was reduced as compared to group A.

A ratio of FEV1/FVC represents the percent of lung volume that can be exhaled in one second. The normal values for the ratio lie between 0.7 to 0.8. [10] The results of our study found that there is a statistically not significant. There is increase in the FEV1/FVC values of group B when compared to group A.

Peak Expiratory Flow Rate is the maximum flow rate generated during a forceful exhalation, starting from full lung inflation. [11] The normal values of PEFR is 85-100 L/min. In this study, it was found that this is not statistically significant in difference in PEFR between the two groups. PEFR of group B was reduced as compared to group A.

A positive correlation was observed between the CVA and the forced Expiratory Volume in 1 sec (FEV1) (r=0.058). while a negative correlation was observed between the CVA and Forced Vital Capacity (FVC) (r=–0.012). There is negative correlation was observed between the CVA and Peak Expiratory Flow Rate (r= -0.189).

Also, there is a change in the shape of thoracic cavity in forward head posture. It causes expansion of the upper thorax and contraction of the lower thorax. These changes in thoracic shape restrict the movement of the chest wall and causes a decline of respiratory functions such as FEV1, FVC, etc. The expansion of upper thorax restricts the reduction in size of upper thorax during expiration which leads to reduced FEV1. The contraction of 57 lower thorax due to forward head posture inhibits the expansion of lower thorax during inspiration and hence, FVC decrease can be seen. [12]

As positive correlation is seen we can say that as the value of craniovertebral angle decreases the value of FEV1 will also decrease. Thus, an increase in the forward head posture will cause Affection in the pulmonary function test which may leads to abnormal results in PFT and show some pulmonary condition or lung pathology that patients may not have.

There is, significant results in FEV1, FVC and PEFR in Forward Head Posture as compare with normal young adults. It shows that there is decreased in value of PFT in Forward Head Posture as compare to normal young adults. This can lead us to abnormal results of PFT and show some lung pathology or pulmonary condition that patients may not have.

Conclusion

The results indicates that forward head posture could reduce the vital capacities and peak expiratory flow rate. When compared to a normal craniovertebral angle, the pulmonary functions FEV1, FVC, and PEFR were significantly lower in young adults with forward head posture. The CVA and the forced Expiratory Volume in 1 Second were found to have a positive correlation (FEV1). while a negative correlation was found between the CVA and Forced Vital Capacity (FVC). There is negative correlation was observed between the CVA and Peak Expiratory Flow Rate (PEFR). The researchers came to the conclusion that when the craniovertebral angle is reduced, the FEV1 values decrease. Implying that disease severity increases with increase in the forward head posture.

It clinically signifies, the study found that young adults with Forward head posture have lower pulmonary functions than those with a normal craniovertebral angle. As a result, before conducting a pulmonary function test and a respiratory assessment, the craniovertebral angle should be

assessed. Changes in the craniovertebral angle may provide insight into pulmonary changes.

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