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Effect of Poor Posture on Cervical Range of Motion in Young Subjects

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Abstract:

Purpose of the study: The present study was conducted to investigate the effect of poor posture on cervical range of motion (ROM) in young subjects.

Methods: 120 subjects were divided into four groups of both sex (males and females) ranged in age from 18 to 30 years were assigned into four groups (A, B, C and D) of equal number; 30 subjects for each group. Group (A) included 30 patients who had forward head posture (FHP) (with craniovertebral angle (CVA) less than 49 degrees), group (B) included 30 patients who had thoracic kyphosis (with flexicurve angle more than 45 degrees) and group (C) included 30 patients who had FHP (with CVA less than 49 degrees) and thoracic kyphosis (with flexicurve angle more than 45 degrees) and group (D) included 30 normal subjects.

Results: The obtained results of the present study indicated that a significant difference in ROM of flexion, extension, RT side bending, LT side bending, RT rotation and LT rotation when compared between groups (A and D), (B and D) and (C and D).

Key Words: Forward head posture, Thoracic kyphosis, Cervical range of motion (ROM).

1.Introduction

Forward head posture (FHP) is the cervical in superior to straight line gravity. It is postural disorder related to wrong actions in musculoskeletal balance (1). Deleting of kyphotic range and increasing kyphotic angle leading to increasing movement limitations in adults (2).

Thoracic hyper kyphosis (THK) occurring leads to many problems such as death, pain, altered gait, compression fractures and reduced age of life. When postural is seen in the adult, it is concerning as the normal abnormal prognosis is a worsening of spinal mal posture and associated with disease (3).

Few researchers have observed that individuals with head, and cervical pain usually have a smaller CVA indicative of an FHP than asymptomatic subjects. The degree of FHP reported by Raine, 1997 and colleagues for pain-free individuals over the age of 55 years was

higher than that reported for patients with neck pain within 38 years. This highlights the relevance of controlling for age when comparing FHP between adults with and without cervical pain **(5).**

The common popular postural deviations in the neck region are FHP, which is defined by **(5)** as follows:

"When the neck is in anteriorly, the line of vision will extend downward if the normal angle at which the neck and cervical meets is maintained.

The FHP and kyphotic upper thoracic region have compensatory hyperextension of the head. This can compress the facet joints, affecting the mechanics of the head/neck **(6)** and therefore the cervical motion. This may also lead to contraction of suboccipital muscles and stretch weakness of anterior neck muscles. Abnormally large compression force on the articular facets as the altered and sustained pull of the shortened muscles may lead to pain causing still further decreasing in neck movement in youth with Cervical spinal disease (CSD) **(7).**

In this research we combined both the FHP and thoracic hyper kyphosis and named them as "poor posture" and the significance of this work is to demonstrate the effect of bad posture "forward head and thoracic kyphosis" on the cervical ROM as non of the studies before this study discussed this as in (8, 9, 10) who discussed the effect of FHP on the cervical ROM and (10) who discussed the effect of thoracic kyphosis on cervical ROM in but we noticed that no one discussed the poor posture and its effect on cervical ROM in young subjects and we included young subjects as most of the studies focused on the old age as in (10). But none of them also focused on bad posture in the youth subjects as it is the beginning of the problem because of physiological and activity of daily living changes happen in this age that will cause differences in the spine as an adaptation to these changes. In this study we tried to make an early detection of the problem.

2.Patients and Methods

2.1. Participants:

120 subjects were divided into four groups of both sex (males and females) ranged in age from 18 to 30 years were assigned into four groups; 30 subjects for each group. Group (A) included 30 subjects who had FHP (with CVA less than 49 degrees), group (B) included 30 subjects who had thoracic kyphosis (with flexicurve angle more than 45 degrees) and group (C) included 30 subjects who had FHP (with CVA less than 49 degrees) and thoracic hyper kyphosis (with flexicurve angle more than 45 degrees) and group (D) included 30 normal subjects. The three groups (A, B and C) were selected from the out-patient clinic of Faculty of Physical therapy, Cairo University, and the Doctor Hisham Bakry out-patient clinic. The type of this work is a comparative one- and the-time length of this work was from December 2018 to October 2019. The participated subjects of this work were selected according to the following criteria:

Inclusion criteria:

1) Their ages ranged from 18 – 30 years (11).
2) They didn't practice sports or athletic activity.

Exclusion criteria:

Subject was excluded if he/she had the following criteria:
1) Subjects with any spinal fractures or congenital anomalies.
2) Previous history of any neural or cardiopulmonary disease.
3) Subjects with disc herniation or spinal stenosis.
4) Currently and knowingly pregnant females.
5) Subjects with any skin irritation or abrasion or allergy.
6) Moderate or severe scoliosis.
7) Visual impairment not corrected by perspective lenses.
8) Whiplash injury, diabetic neuropathy, unstable angina, vestibular disease, dizziness, foot deformities, history of falling over the past two years.
9) Subjects taking any muscle relaxants or sedatives.

2.2. Instrumentation:

2.2.1. Measurement equipment and tools:

2.2.1.1. Flexicurve:

It used for measuring thoracic kyphosis. It is the established technique used in a large prospective study (12). Moreover, the validity and reliability the flexicurve have been proved in many studies (13), with intra- and inter-rater reliability coefficients accuracy of 0.88 and higher (14).

2.2.1.2. Digitized camera:

It produced digital while there are still dedicated digital cameras. (15).

2.2.1.3. Cervical range of motion device (CROM):

It used CROM device and CROM measurements had established validity. The following measurements were obtained:
(i) Total active cervical flexion range in upright sitting.
(ii) Total active cervical rotation ROM (right and left) in upright sitting.
(iii) Total active cervical extension in upright sitting.
(iiii) Total active side pending ROM (right and left) in upright sitting.

2.3. Procedures of the study:

2.3.1. Measurement equipment and tools:

2.3.1.1. Flexicurve:

Subjects stand in their habitual posture while the therapist was placed the flexicurve over the upper and lower of the back of the spine.
The advantage of the image may be lengthened several times and measurement precision was conceivably greater than that associated with tracing curve on paper as employed in many studies (17).
Applications and instructions (18):
1) First examine the spine and mark relevant landmarks of C7 and L1.
2) Start with the person in sitting with shoes off. Show the subject the flexicurve and instruct him/her through the application as the following:
- Ask the subject to stand in a usual best posture; resting hands lightly on the chair or table in front and look straight ahead.
- Place the flexicurve on subject's spine and gently, press to mould it to the curves of spine.
- Once this is done ask the subject to take his/her hands away from the support and stand in as a usual best posture for him/her. Then check and make any final adjustments.
- Ask the subject if he/she needs at any point to rest saying and can sit down.

- This application is applied three times and the subject can sit and have a rest between each measure.

3) Ask the subject to stand then place the upper end of the flexicurve with the flat part against the spine on the C7 spinous process (marked) and suited the flexi-curve along the shape of the spine to L1 spinous process (marked) to provide a good shape of the spinal shape (Be sure there is no gap between the flexicurve and the subject and the location of L1 on the flexicurve with make-up marker).

4) Ask the subject to sit because he/she needs to hold about 30 seconds between measures.

5) Trace the flexicurve on skin onto the graph paper (Curve 1). Mark the points C7 and L1 on paper and put the flexicurve and remove the marks.

6) Repeat step 3-5 a further 2 times.

2.3.1.2. Digitized camera:

It was used to measure FHP; it was taken from lateral view to minimize image distortion (19).

2.3.1.3. Cervical range of motion device (CROM):

The CROM device placed on the subject's head while they seated and looking directly forwards. The therapist viewed the degree of change exhibited by the CROM device to reduce subjective error as the following (20):

i) To test for neck flexion and extension, ask the participant to move up and down of the chin and head. ii) To test for right and left neck flexion (side bending), ask the participant to flex the neck to the left and right sides.

iii) To test for right and left neck rotation, ask the participant to rotate the neck to the left and right sides.

3.Results

- General characteristics of the subjects:

The $\bar{X}\pm$ SD age of groups (A, B, C and D) were 23.8 ± 3.57, 24.36 ± 3.4 kg, 23.13 ± 2.76 and 24.9 ± 2.86 years, respectively. There was no significance change when compared the four groups in the $\bar{X}\pm$ age (p = 0.16) (table 1).

Table (1): Descriptive statistics and ANOVA test for the mean age of the four groups (group A, B, and C).

	Group (A)	Group (B)	Group (C)	Group (D)	F-value	p-value	Sig
	$\bar{X}\pm$ SD	$\bar{X}\pm$ SD	$\bar{X}\pm$ SD	$\bar{X}\pm$ SD			
Age (year)	23.8 ±3.57	24.36 ± 3.4	23.13 ±2.76	24.9 ±2.86	1.71	0.16	NS

$\bar{X}$: Mean. SD: Standard deviation.
P value: Probability value. NS: Non-Significant.

1- Comparison of flexion ROM between the groups (A, B, C and D):

There was a significant change in flexion ROM when compared the three groups (A, B and C) and group (D) as shown in (table 2) and (figure 1).

Table (2) Comparison of mean values of flexion ROM between the groups (A, B, C and D).

Flexion ROM (degrees)						
$\bar{X}\pm$ SD				F-value	p-value	Sig
Group (A)	Group (B)	Group (C)	Group (D)			
76.1 ±3.6	65.46 ±4.72	76.76 ±1.43	82.06 ± 3.75	112.86	0.0001	S

Multiple comparison (Tukey)

	MD	p- value	Sig
Group (A) Group (D)	-5.96	0.0001	S
Group (B) Group (D)	-16.6	0.0001	S
Group (C) Group (D)	-5.3	0.0001	S

$\bar{X}$: Mean. SD: Standard deviation.
P value: Probability value. S: Significant.

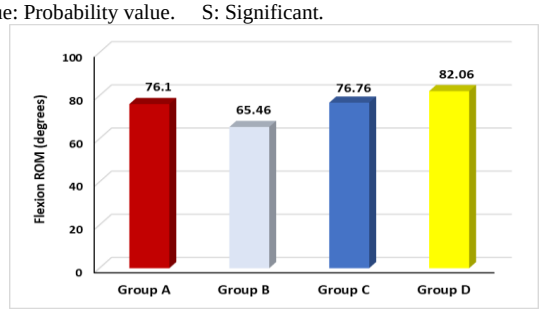

Figure (1): Mean flexion ROM of groups (A, B, C and D).

2- Comparison of extension ROM between the groups (A, B, C and D):

There was a significant change in extension ROM when compared the three groups (A, B and C) and group (D) as shown in (table 3) and (figure 2).

Table (3): Comparison of mean values of extension ROM between three groups (A, B and C) and group (D).

Extension ROM (degrees)						
$\bar{X}\pm$ SD				F-value	p-value	Sig
Group (A)	Group (B)	Group (C)	Group (D)			
52.36 ±4.02	49.3 ±4.19	43.16 ±1.6	58.86 ±6.2	68.38	0.0001	S

Multiple comparison (Tukey)

	MD	p- value	Sig
Group(A) Group(D)	-6.5	0.0001	S
Group(B) Group(D)	-9.56	0.0001	S
Group(C) Group(D)	-15.7	0.0001	S

$\bar{X}$: Mean. SD: Standard deviation.
P value: Probability value. S: Significant.

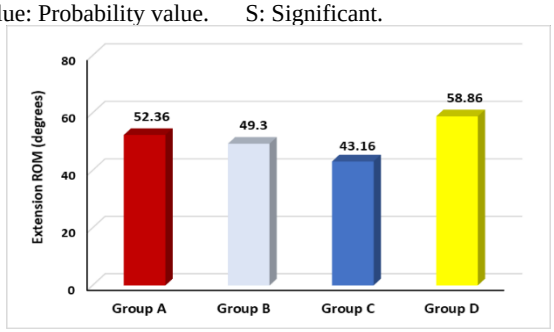

Figure (2): Mean extension ROM of groups (A, B, C and D).

3- Comparison of right bending ROM between the groups (A, B, C and D):

There was a significant change in right bending ROM when compared the three groups (A, B and C) and group (D) as shown in (table 4) and (figure 3)

Table (4) Comparison of mean values of right bending ROM between three groups (A, B and C) and group (D).

Right bending ROM (degrees)						
$\bar{X}\pm$ SD				F-value	p-value	Sig
Group (A)	Group (B)	Group (C)	Group (D)			
37.83 ±2.7	36 ±.42	33.9 ±2.21	40.06 ±2.5	33.97	0.0001	S

Multiple comparison (Tukey)

	MD	p-value	Sig
Group (A) Group (D)	-2.23	0.004	S
Group (B) Group (D)	-4.06	0.0001	S
Group (C) Group (D)	-6.16	0.0001	S

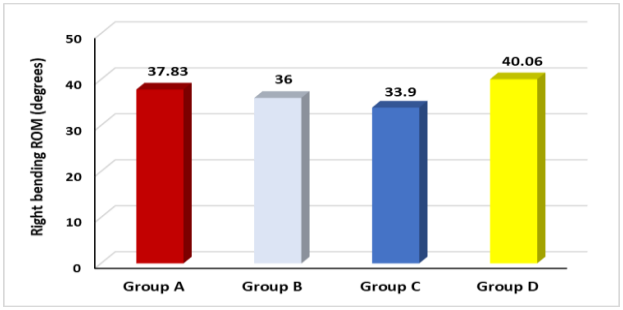

Figure (3): Mean right bending ROM of groups (A, B, C and D).

4- Comparison of left bending ROM between the groups (A, B, C and D):

There was a significant change in left bending ROM when compared the three groups (A, B and C) and group (D) as shown in (table 5) and (figure 4).

Table (5): Comparison of mean values of left bending ROM between three groups (A, B Cand D).

Left bending ROM (degrees)						
$\overline{X}$ ± SD				F-value	p-value	Sig
Group (A)	Group (B)	Group (C)	Group (D)			
37.2 ±2.05	35.33 ±1.18	33.86 ± 1.9	39.13 ±2.4	41.64	0.0001	S
Multiple comparison (Tukey)						
			MD	p- value	Sig	
Group (A) Group (D)			-1.93	0.001	S	
Group (B) Group (D)			-3.8	0.0001	S	
Group (C) Group (D)			-5.27	0.0001	S	

$\overline{X}$: Mean. SD: Standard deviation. P value: Probability value. S: Significant.

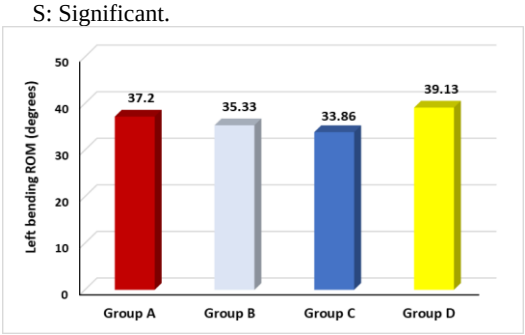

Figure (4): Mean left bending ROM of groups (A, B, C and D).

5- Comparison of right rotation ROM between the groups (A, B, C and D):

There was a significant difference in right rotation ROM when compared between the three groups (A, B and C) and group (D) as shown in (table 6) and (figure 5).

Table (6): Comparison of mean values of right rotation ROM between three groups (A, B and C and D).

Right rotation ROM (degrees)						
$\overline{X}$ ± SD				F-value	p-value	Sig
Group (A)	Group (B)	Group (C)	Group (D)			
78.16 ±3.01	71.93 ±2.71	69.96 ±2.63	81.86 ±2.55	121.52	0.0001	S
Multiple comparison (Tukey)						
			MD	p-value	Sig	
Group (A) Group (D)			-3.7	0.0001	S	
Group (B) Group (D)			-9.93	0.0001	S	
Group (C) Group (D)			-11.9	0.0001	S	

$\overline{X}$: Mean. SD: Standard deviation. P value: Probability value. S: Significant.

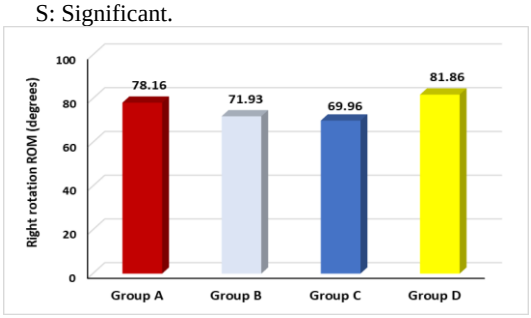

Figure (5): Mean right rotation ROM of groups (A, B, C and D).

6- Comparison of left rotation ROM between the groups (A, B, C and D):

There was a significant change in left rotation ROM when compared the three groups (A, B and C) and group (D) as shown in (table 7) and (figure 6).

Table (7): Comparison of mean values of left rotation ROM between three groups (A, B and C) and group (D).

Left rotation ROM (degrees)						
$\overline{X}$ ± SD				F-value	p-value	Sig
Group (A)	Group (B)	Group (C)	Group (D)			
73.9 ±3.13	71 ±2.31	68.73 ±2.25	80.03 ±3.76	83.31	0.0001	S
Multiple comparison (Tukey)						
			MD	p- value	Sig	
Group (A) Group (D)			-6.13	0.0001	S	
Group (B) Group (D)			-9.03	0.0001	S	
Group (C) Group (D)			-11.3	0.0001	S	

$\overline{X}$: Mean. SD: Standard deviation. P value: Probability value. S: Significant.

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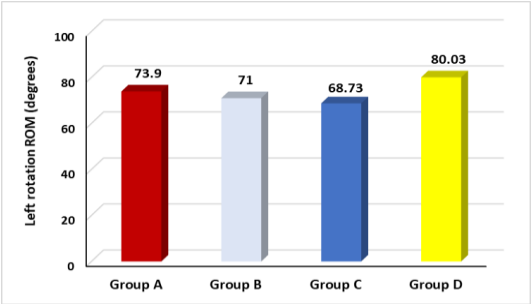

Figure (6): Mean left rotation ROM of groups (A, B, C and D).

Discussion

We choose this age between 18 to 30 years old because we found that most of researches stated that this age is the start of the symptoms because of the habitual and anatomical changes in this age such as breast enlargement in females that leads to increase thoracic kyphosis and rounded shoulder and studying habits that lead to increase rounded shoulder and thoracic kyphosis and forward head posture and its effect of cervical range of motion plus the modern technology and the increased use of mobile phone during the day hours that affect widely the cervical range of motion by increasing the thoracic kyphosis and rounded shoulder and FHP.

The selection of the age of this study could be accepted with (21) who applied cross-sectional study enrolled a convenience sample composed of 150 students between 18 and 21 years old.

The study was limited to the psychological condition of the subject that may affect the performance of the subject, hours spent in using mobile phone and there was no control to decrease hours of using of mobile phone. The different age also plays an important role in the limitation of this study because of the going on the universities and the different jobs.

Thoracic hyper kyphosis (THK) should be considered its own 'syndrome'. It refers to it being a 'geriatric syndrome' because of its association with a plethora of future dire health consequences (12). This is because posture tends to deteriorate over time, so it is very important make more researches on this age to help in minimizing the bad complications that can be fatal to help this large population of young age to live healthier life and minimize the fatal deterioration of this case cause prevention is better than cure (3).

In the current study selection of the subjects who had forward head and thoracic kyphosis could be accepted with (21) who added that since spinal pain and headache is associated with deviations of spinal posture, the preservation of upright posture and spine alignment should be the goal for patients having back pains and/or headache.

Deviations from ideal head posture are often associated with different disorders in the musculoskeletal system. The FHP may contribute to some disturbance of balance. Several reports confirmed the existence of a relationship between head posture and cervical spine pain which lead to cervical muscle guarding that lead to decrease cervical ROM in all direction (23).

The results of this study agreed with (24) who showed a positive correlation between FHP and cervical mobility. Increased angle of the head tilt in the sagittal plane was associated with decreased mobility of the cervical spine. Furthermore, the results obtained by (17) showed that FHP mediates the relationship between thoracic hyper kyphosis and cervical ROM, specifically general cervical rotation, and flexion.

It was reported that FHP results in decrease length of the cervical extensor muscles including the splenii and upper trapezius, but also the sternocleidomastoid muscle. When a muscle contracted or stretched compared to its resting position, its ability to form force is reduced (25).

In a rigid thoracic spine (as occurring with hyper kyphosis), increased weight is placed on the loaded muscles spanning the neck and the upper back, which considerably impair motor control (26). The stiffness increased not energetically efficient and hence increases the muscle co-contraction, thereby further enhancing the compressive load on the cervical spine there by affecting the mobility of cervical range of motion because of the poor proximal stabilization from the unstable thoracic spine (27).

Reduced mobility in the lower cervical segments leads to increased movement at the upper cervical levels. This occurrence caused impaired control and irritation of the nociceptive structures in the spine during the onset of neck pain. Nonetheless, the effect could also be the result of 'reverse causation,' as hyper thoracic kyphosis could not be conclusively established as a causative factor in neck pain development (17).

In summary, most of the articles considered in the review reported the presence of thoracic

dysfunction in the neck pain population. Two features, namely impaired thoracic mobility and relationship between FHP and thoracic kyphosis, were evident. Therefore, the review reinforces the inclusion of thoracic spine evaluation and treatment in the management of neck pain thus cervical range of motion consequently.

5. Conclusion:

The subjects who had FHP only or thoracic kyphosis only or who had FHP and thoracic kyphosis had a significant effect on cervical range of motion especially when compared with normal subjects.

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