Effect of Forward Head Posture on Cervicocephalic kinesthetic Sense in College Students without neck pain

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Abstract:
Background: FHP is defined when the head is anterior to a vertical line passing through center of gravity. Changes in muscle length caused by poor posture for a sustained period of time results in musculoskeletal problems like FHP. FHP leads to hyperextension at upper cervical spine (C1-C3) and flexion at lower cervical spine (C4-C7)[4]. Forward head posture increases load on upper cervical joints, which disturbs periphery to central transmission of kinesthetic and proprioceptive signals. Kinesthesia is the ability to judge joint position, which is helpful in coordinated movements of head, trunk and extremities. Proprioception provides sensory feedback from body to nervous system; therefore contributes to the maintenance of optimal body alignment. Cervicocephalic kinesthetic sense has shown to be affected in several musculoskeletal disorders like FHP and multifactorial problems like fatigue injury, pain, effusion, disability.
Objectives: To determine the change in cervicocephalic kinesthetic sense in college students due to forward head posture.
Materials and Methodology: 197 healthy, asymptomatic college students participated in this study. Tragus to wall distance of all the subjects was measured to determine forward head posture. Out of 197 students, 45 students were included for further test. Kinesthetic sensibility test of the students was performed in erect sitting and habitual sitting while performing Right rotation, Left rotation, Flexion and Extension.
Result: There was no significant change in cervicocephalic kinesthetic sense while erect sitting and habitual sitting during right rotation, left rotation, flexion and extension.
Conclusion: To the best of our knowledge, this is the first study to determine the effect of effect of forward head posture on cervicocephalic kinesthetic sense in subjects without neck pain. However, there was no significant difference in in cervicocephalic kinesthetic sense.

Keywords: Forward Head Posture, Neck Proprioception, Cerviovephalic Kinesthetic Sense**.**

Introduction:

FHP is defined when the head is anterior to a vertical line passing through center of gravity[1]. Changes in muscle length caused by poor posture for a sustained period of time results in musculoskeletal problems like FHP[2,3]. Due to alteration in the relative position of head with respect to line of gravity, FHP leads to hyperextension at upper cervical spine (C1-C3) and flexion at lower cervical spine (C4-C7)[4]. FHP has been found to be a potential risk factor for shoulder pain[5], myofacial pain syndrome[6], proprioceptive dysfunction[7], coordination problems[8], altered balance[9], lateral inclination of pelvis[10]. It causes muscular imbalances in affecting various muscles of neck, such as upper cervical flexors, scapular retractors, suboccipitals, scalenus anterior, upper trapezius and sternocleidomastoid, levator scapulae and spinalis capitis posterior major[11-15]. Forward head posture increases load on upper cervical joints, which disturbs periphery to central transmission of kinesthetic and proprioceptive signals[16,17]. It seems to have greater impact on sensorimotor function which might cause balance problems and disturbed cervical

DOI: 10.9756/INTJECSE/V14I4.201

proprioception[18]. Excessive use of computers and smart phones in offices and homes, leads to musculoskeletal dysfunction through changes in the length of cervical muscles causing a forward head posture[19]. Maintaining poor head position for long duration leads to musculoskeletal dysfunction through changes in length of anterior and posterior neck muscles and sustained loading of cervical spine[20]. FHP is also characterized by decrease in the length of deep neck flexors and increase in surface neck flexion[21].

Kinesthesia is the ability to judge joint position, which is helpful in coordinated movements of head, trunk and extremities[22]. It is attributed to proprioceptors, which include consciously experienced sensations that give peripheral input for unconscious, autonomic modifications during posture and movement, primarily from muscle spindles and tendon organs[23]. Proprioception provides sensory feedback from body to nervous system; therefore contributes to the maintenance of optimal body alignment[24].

Proprioceptive input is the quickest and most accurate input that plays an integral role in preparing, maintaining and restoring stability of the entire body[25]. Proprioceptive function is more precise in neck than in lower back, owing to more mechanoreceptors and muscle spindles in suboccipital muscles[26]. Cervical proprioception contributes to correct head-in-space and trunk orientation in addition in body orientation and balance control[27].

Though there is a significant amount of research correlating forward head posture, cervicocephalic kinesthetic sense and cervical joint pain, there is not much literature available correlating the above two in population without cervical joint pain[28]. Thus, this study aims to investigate the effect of forward head posture on cervicocephalic kinesthetic sense in college students without neck pain. We hypothesized that they would show disturbed cervicocephalic kinesthetic sense. (by using kinesthetic sensibility test)

Materials and Methods:

1. Subjects:

Total of one ninety seven(197) healthy adult college students aged between seventeen to twenty-five (17-25) were included in the study.

This study was approved by institutional research committee of our university for ethical consideration involving human subjects.

TABLE 1:

Inclusion criteria:	
1.	Age: 17-25.
2.	Undergraduate students.
3.	Students who were ready to participate.
4.	No history of neck pain in the previous month.
5.	Forward head posture.

TABLE 2:

Exclusion criteria:	
1.	Postgraduate students.
2.	Teaching and non teaching staff of the university.
3.	Students who were not ready to participate.
4.	Neck trauma.
5.	Received physiotherapy treatment previously.
6.	Acute / chronic neck pain.
7.	Arthrodesis in foot or ankle.
8.	Evidence of impaired function in foot or ankle.
9.	Aid for walking or standing.
10.	Known disease that affects nervous system.(e.g.: Multiple sclerosis, stroke)
11.	Known disease that affects vestibular system. (e.g.: vertigo)

2. Procedure:

a. Forward head posture:

A very common method for assessment of forward head posture is to measure the distance between tragus of ear to wall. This study used this method. Subjects were asked to stand with their back supported to the wall, head in neutral position, shoulders relaxed, and hips touching the wall, heels of both the legs touching the wall. Subjects were asked to remove their footwear before taking the assessment. For female subjects, they were asked to untie their hair

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before assessment. The procedure was explained to all the subjects. After standing in a desired position, distance between tragus and wall was measured of each subject. Measurement was taken with help of a 30cm long scale. (Fig. 1)

Figure 1

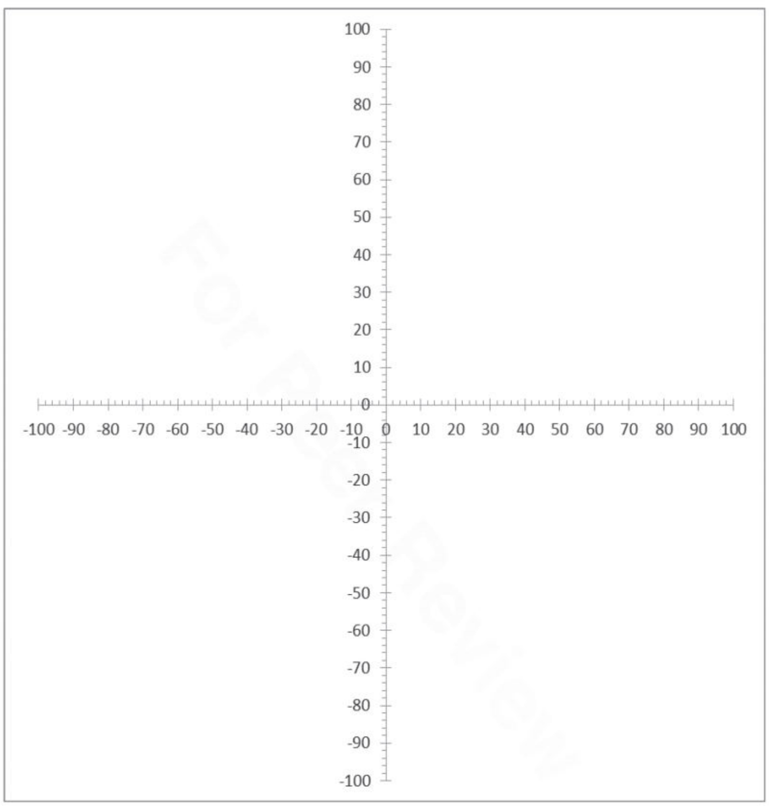

Figure 2

b. Kinesthetic sensibility test:

A 100cm x 100cm adjustable target was hanged on the wall. Mid-point of the target was marked as zero. Axis was marked on both the sides in centimeters. Subjects were made to sit without back support, 90cm away from the

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target, facing it. Eyes were closed using a sleeping eye mask. They were made to wear a cap with a fixed lazer pointer on it.

Head-neck relocation error was measured during different induced postures: standing, sitting, habitual sitting, incorporated with different cervical movements: flexion, extension and rotation (left and right), in sitting, habitual sitting.

Before starting the test, procedure was explained to the subjects individually. After covering their eyes they were asked to keep their head at point which they considered as neutral position and remember it to relocate their head as accurately as possible after each trial. Position of the target was adjustd according to the height and neutral point as suggested by the subject, such that the laser pointer corresponded to zero (0) on it.

After concentrating to keep the head in neutral position for 30sec., they were asked to perform maximum right rotation and then try to relocate the neutral position at their normal speed. The point at which the pointer corresponded on the traget after the trial was noted and its distance from zero was measured as relocation error. It was given a positive(+) or negative(-) sign. Threee trails were performed and their mean was ued for analyses.

Same procedure was repeated for maximum left rotation, flexion and extension. Before starting with the new movement, a 2 minutes rest was given and a new neutral position was established. (figure 2 & 3)

Test movements were performed in a random order and all readings were recorded in one session in the same recording area.

3. Material: Physical assessment.
4. Study design: Cross-sectional study.
5. Study type: Survey method.
6. Study duration: 6 months.
7. Smaple size: 197. (To measure Forward Head Posture)
8. Smaple size: 45. (For cervicocephalic kinesthetic sensibility test)
9. Data Analysis: Forward head posture was measured in centimeters using a 30cm scale. Values above 9.5cm were accepted and rest were rejected. Mean head-neck relocation error (± standard deviation)was measured in centimeter using kinesthetic sensibility test.It was given a positive or negative sign depending on whether subject over or under shoots the neutral position. However, to compare the difference in error during different induced postures, absolute error was calculated. Our hypothesis was tested by Friedman test (Nonparametric repeated measures ANOVA) using Graph-Pad Instat 3.0. It was rejected if the p-value was greaterthan 0.05.

Result:

1. Forward head posture was measured in centimeters using a 30cm scale. Values above 9.5cm were accepted and rest were rejected.
2. Meanvalue of forward head posture was 10.49(SD 0.73).
3. Mean age of subjects was 19.5 (SD 1.70). Mean and absolute head-neck relocation error during right rotation, left rotation, flexion and extension while sitting and habitual sitting has been shown in tables 3 and 4 respectively. Total average head neck relocation error while sitting was 1.35, SD 3.57, habitual sitting was 2.56, SD 4.77.
4. There was no significant change in cervicocephalic kinesthetic sense while erect sitting and habitual sitting during right rotation, left rotation, flexion and extension.

1\. Age-wise distribution

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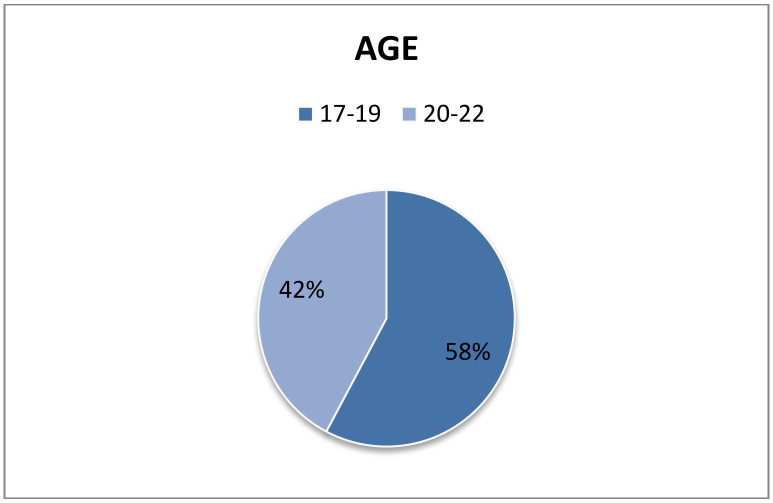
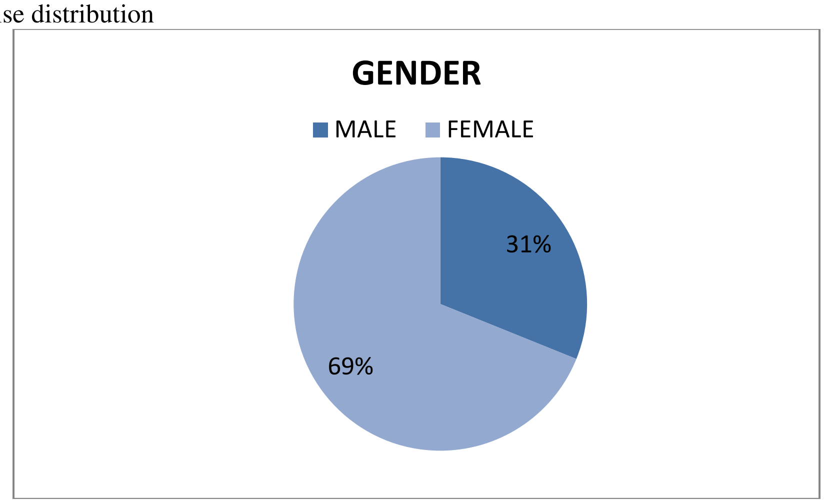
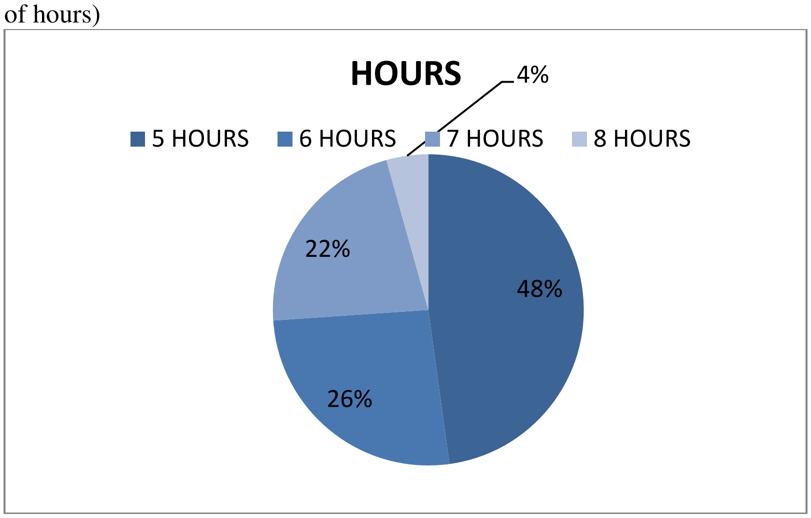


2. Gender-wise distribution



3. Sitting (no. of hours)



4. Posture

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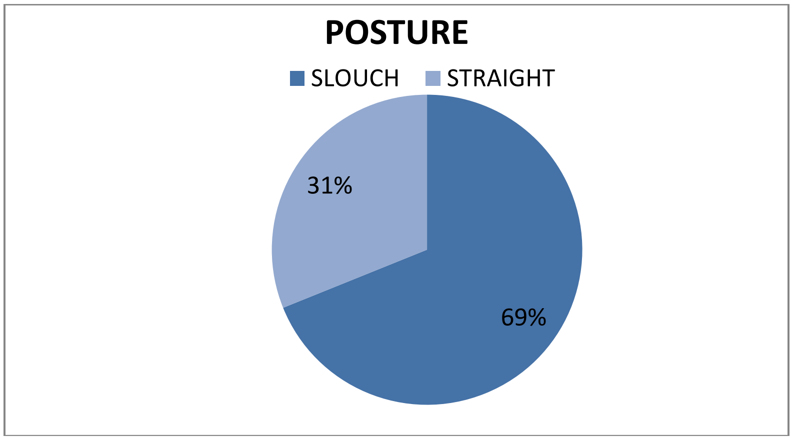
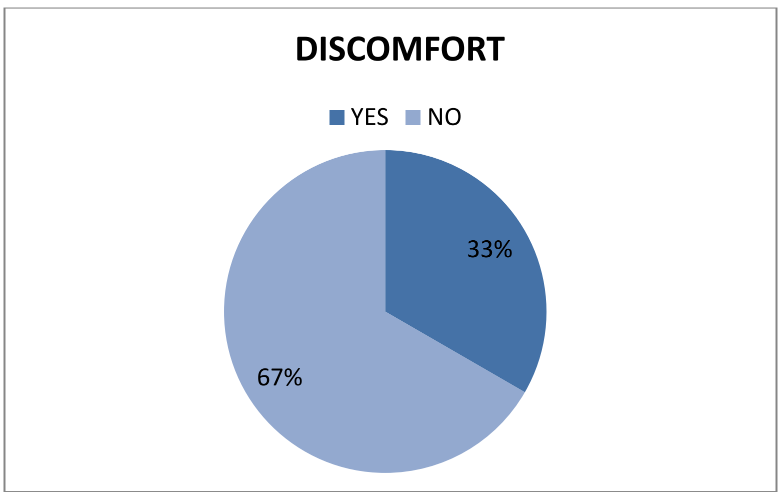
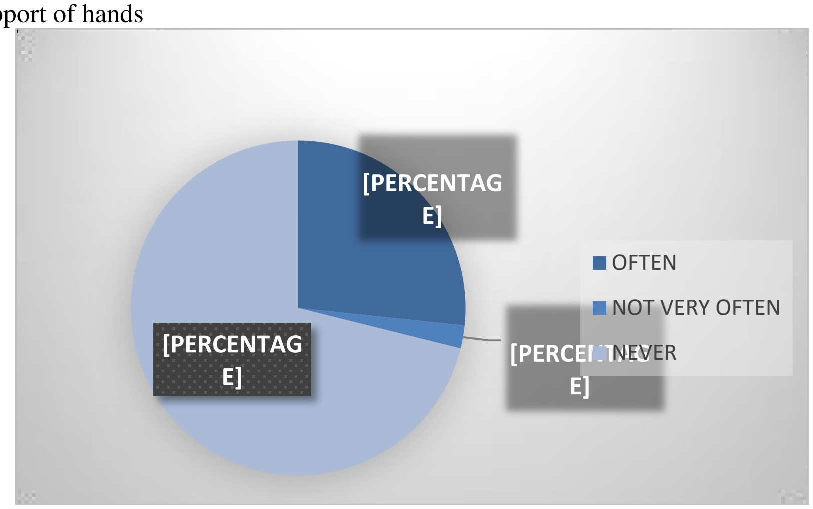


5. Discomfort



6. Taking support of hands



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7. Kinesthetic sensibility test

a. Head-neck relocation error:

Movement	Erect Sitting	Habitual Sitting
Right Rotation(RR)	0.96±6.08	1.53±6.31
Left Rotation(LR)	0.96±4.28	1.10±5.72
Flexion(F)	0.07±4.57	1.25±5.21
Extension(E)	3.40±9.41	6.35±8.61
Average error	1.35±3.57	2.56±4.77
All values in cm.		

Table 3: Head-neck relocation error (mean ±SD) during maximum right rotation (RR), left rotation (LR), flexion (F) and extension (E)movements while erect sitting (S), habitual sitting (HS). (n=45)

b. Absolute Head-neck relocation error:

Movement	Erect Sitting	Habitual Sitting
Right Rotation(RR)	4.78±3.89	4.55±4.78
Left Rotation(LR)	3.92±2.53	4.36±4.07
Flexion(F)	3.51±3.52	4.38±4.51
Extension(E)	7.86±6.08	8.17±6.87
Average error	5.02±2.55	5.37±4.01
All values in cm.		

Table 4: Absolute head-neck relocation error (mean ±SD) during right rotation (RR), left rotation (LR), flexion (F) and extension (E) movements while erect sitting (S), habitual sitting (HS). (n=45)

Discussion:

The purpose of this study was to investigate the effect of forward head posture on cervicocephalic kinesthetic sense. An article by Arzoo Khan[29] et al. suggested that cervicocephalic kinesthesia seems to be associated with the craniovertebralangle (CVA) in individuals with chronic neck pain; however, this association remains unexplored in individuals with FHP without neck pain[28]. Hence to the best of our knowledge this is the first study to find out the estimation of Forward head posture in asymptomatic students and its effect on cervicocephalic kinesthetic sense.Age of the subjects included in the study was between 17 to 25 years. The present study included only undergraduate students who did not have any history of neck pain, trauma to the neck in the past month. Students with congenital abnormalities, functional impairments, and any known disease of vestibular and nervous system were excluded.Maintenance of an induced posture for a considerable duration of time, as in our study during data collection, could lead to local fatigue and deteriorate joint position error[30]. Poor posture exploits body structures beyond their capacity and any change in one segment of the body affects its overall posture[31]. Results of the current study also show that compared to standing and habitual sitting, head-neck relocation error was higher when subjects assumed FHP. However, there was no significant difference among the studied postures which could be due to the fact that it was conducted on normal healthy subjects who were instructed to assume these positions at the time of data collection only.

Conclusion:

Although there was a great variation in the mean headneck relocation error between subjects during different movements in various head-neck-jaw postures, there was no significant difference in the absolute error. Assuming a posture for a short duration of time doesn't affect head-neck relocation error in normal healthy subjects.

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