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Effect of Sustained Use of Smartphone on the Craniovertebral Angle and Hand Dexterity in Young Adults

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Abstract: ***Introduction: The advancement in technology has led to an increase in the use of smartphones. So much so that the young generation is getting addicted to it. But, the use of smart phones in a static posture may lead to various postural faults that can cause neck pain. The use of smartphone requires coordinated movement with strength and dexterity of the fingers together with sensory capability and motor control and hence its sustained use may have an effect on its function.Aims and Objectives: The aim of the study was to find the effect of sustained use of smartphone on the Craniovertebral Angle(CVA) and hand dexterity in young adults. The objective was to measure the cranio-vertebral angle and hand dexterity pre and post the smartphone use. Also to assess if a relation exists between the CVA and hand dexterity post smartphone use. Materials and Methodology: A prospective study was performed among 60 young adults using smartphones in the age group of 18-28 years to assess the cranio-vertebral angle in sitting and hand dexterity after sustained use of smartphone using the photogrammetric method using Kinovea software and Purdue pegboard respectively. Results: It was observed that the CVA decreased at the 15th minute of sustained smartphone use. It was seen that the mean of hand dexterity post smartphone use was reduced than the pre hand dexterity. A significant difference was found between the post and pre hand dexterity for all the components of the Perdue peg board test. Conclusion: Our study showed that sustained smartphone use result in a significant decrease in the Craniovertebral angle and also has a negative effect on the hand dexterity.***

Keywords: Smartphone, Cervical posture, Cranio-vertebral angle, Hand dexterity

1. Introduction

The usage of smartphone is in an increasing trend worldwide.[1]Smartphone integrates several technologies which makes an extensive usage of this device as a computer, calculator, camera, video player, web browser, social media and video games other than as a mobile phone.[2]It brings remarkable changes over personal relationships and also in both mental and physical health status.[3]Nowadays, addiction is not only applicable to drug or substance abuse, but it also refers to smartphones which falls under the category of behavioural addiction. It is mostly noticed in adolescent age groups.[4]The percentage of smartphone addiction was 8.4%, which was higher than the internet addiction of 7.7% based on a survey of smartphone addiction completed by the National Information Society Agency in 2012.[5]

Cervical posture of an erect human body provides an external approximation of the positions that the cervical structures adopt when supporting the head against gravity. The most common objective measurement of cervical posture in sagittal plane is to see the alignment of the head and the neck. One objective measure of assessing head posture is through measuring the craniovertebral angle (CVA).

The CVA normally ranges from 150° in flexion to 180° in extension.[6] Ventral spinal cord compression may occur when the angle is less than 150°.[6] A CVA less than 48-50 indicated a greater forward head posture.[7]It has been associated with neck pain and dysfunction,[8-10]cervicogenic headache,[11],[12] carpal tunnel syndrome[13] and even an increased falling risk in the elderly.[14] Thus, quantifying the severity of forward head posturehas been recommended for routine examination of the head and neck as well as the upper quadrant of the body.[15],[16]Text-neck posture leads to significant changes in cervical spine biomechanics. Increased compressive load, antero-posterior shear load, and high cervical extensor muscles activity were associated with forward flexed neck posture adapted by smartphones users.[17]

Most small electronic products require physical manipulation of controls and manual handling. The hands are used to grasp, move and exert forces to operate various products. Assembly objects can be grasped, pushed and pulled. The human hand is composed of four fingers and an opposable thumb, which is a key to many dexterity tasks.[18],[19] Users often use both hands at the same time to manipulate objects. This coordinated movement requires strength and dexterity of the fingers together with sensory capability and motor control. The use of smartphone requires and utilizes most of these functions and hence its sustained use may have an effect on its function.

Thus this study aimed at determining if the sustained use of smartphone had any effect on the CV angle and hand dexterity in young adults.

2. Materials and Methodology

A prospective study was performed among 60 young adults using smartphones in the age group of 18-28 years to assess the cranio-vertebral angle in sitting and hand dexterity after sustained use of smartphone using the photogrammetric

method using Kinovea software and purdue pegboard respectively.

The CVA was measured as the angle between an imaginary line extending from C7 vertebrae through the tragus of the ear, and the horizontal line. The values for CVA are indicative of the position of the head relative to the trunk. The smaller the CVA, the greater the Forward head posture.

3. Method

60 young adults were selected according to the inclusion criteria, Purdue Pegboard test was performed. They were then made to sit on a chair and given a smartphone in hand and were allowed to play Tap Black- Black Piano Tiles (Superior Crazy Games Studio; Version 1.2) for 15mins with the side of the trunk facing the camera and the camera was placed on the tripod at a distance of 100meters from the subject. A photograph was clicked to measure the CVA at the first minute of playing the game. Another photograph is clicked at the 15th minute of the game. Purdue Pegboard test was performed again after the 15th minute of the game.

The cranio vertebral angle was calculated with the photographs using the Kinovea softwarewhich has a validity of 0.79 and reliability of 0.99.[20] The photogrammetric method has a high interrater (ICC=0.75-0.89) and intrarater (ICC=0.91-0.99) reliability in assessingforward head posture.[20]

The hand dexterity is measured using Purdue pegboard with a validity of 0.78 and a reliability of 0.89.[21]It is made up of wooden board. Its length is 23 inches and breadth is 15 inches. It contains 4 cups which contains pins, washers and collars. There are two centre rows having 25 small holes drilled in them.The person to be tested should be seated comfortably at a normal height table (at approximately 30"). This test battery consists of 4 components:

1) Right Hand (30 sec)
2) Left Hand (30 sec)
3) Both Hands (30 sec)
4) Assembly (60 sec)

Scoring:

1) For right & left hand, each properly inserted pin is equal to 1 point.
2) For both hands, each pair of pin properly inserted is equal to 1 point.
3) Each assembly is 4 points.

The data thus obtained was analysed using appropriate statistical tests**.**

Data Analysis

Table 1: Represents effect of Sustained Use of Smartphone on the Cranio-vertebral Angle

Pre-Post

		Mean	N	Std. Deviation
Pair 1	CVA 1MIN	36.3167	60	7.40245
	CVA 15MIN	23.4167	60	14.35659

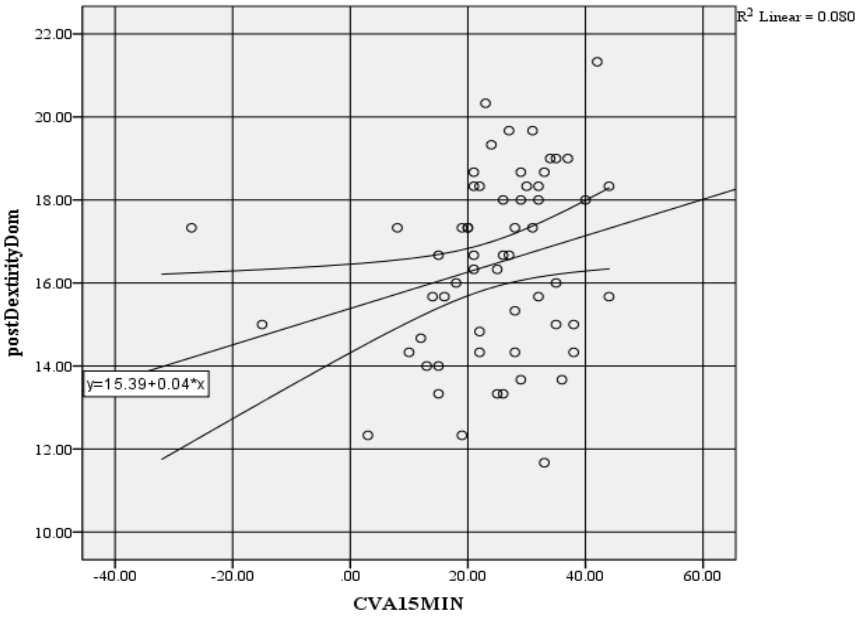
- Cranio-vertebral angle at 1 min is 36.31+7.40
- Cranio-vertebral angle at 15min is 23.41+14.35

Table 2: Represents comparison of Pre and Post measure of Hand Dexterity using Purdue Pegboard with sustained use of smartphone

	N	Mean	Std. Deviation
PreDexterityDom	60	17.8217	2.03881
postDexterityDom	60	16.4133	2.21856
preDexterityNonDom	60	16.1612	2.03622
postDexterityNonDom	60	14.8193	2.16389
preDexterityBoth	60	28.5303	2.69967
postDexterityBoth	60	25.7863	3.37345
preDexterityAssembly	60	36.6083	4.5161
postDexterityAssembly	60	33.9398	4.49366

Thus it is found that the mean of post hand dexterity is reduced than the pre hand dexterity for all the components.

Table 3: Represents correlation between the Cranio-vertebral angle at the 15minute and the post dexterity



A poor or weak correlation exists between CVA at 15min and post dexterity of dominant hand.

4. Discussion

This study was undertaken to determine the effect of smartphone use on the cranio-vertebral angle and hand dexterity.This study included 60 young adults, with 36 females and 24 males. The mean age of males was 20.62±2.22 and that of females was 22.13±1.22. In this study, the craniovertebral angle was measured using photogrammetric method using Kinovea software.

As observed from the results of this study, it was observed that the craniovertebral angle at 15minute is reduced than the craniovertebral angle at 1minute. Smaller CVA angles mean greater protraction and Forward head posture, while larger angles reflect good head and neck alignment in the sagittal plane.[22]Forward head posture has been shown to be a common postural displacement, with an estimate of 66% of the patient population.[23] It was found that the mean of the difference between the CVA at 1min and 15min is 12.90±10.40. It was observed that the subjects were initially sitting upright at the start of 1st minute and later developed a Forward head posture as were engrossed in playing the mobile game. The primary cause for Forward head posture (low CVA) may be the muscle imbalance due to weakness of short deep cervical flexors, rhomboids, serratus anterior, middle and lower trapezius and tightness of the cervical extensors and pectorals.[24],[25] In many instances, decrease in CVA is associated with headache, neck pain, rounded shoulders, thoracic kyphosis, myofacial pain syndrome and TMJ disorders.[26],[27] The difference between the craniovertebral angle at 1 min and 15min was found to be statistically significant with a p value of 0.00. This may be attributed to the fact that many people use smartphones with the head shifted forward and thesmartphone placed near the waist or lap while in a sitting position.[28]Most smartphone tasks require users to stare sharply downward or to hold their arms out in front to read the screen, which makes the head move forward. Moreover, the maintenance of this head shifted forward position decreases the lordosis of the lower cervical vertebrae and creates a posterior curve in the upper thoracic vertebrae to maintain balance, which decreases the CVA.[29]

In this study, the Purdue Pegboard was utilized as an assessment tool to measure a factor called hand dexterity that was defined as the ability to make rapid, skillful controlled movement of small objects where fingers were primarily involved. Hand dexterity was assessed using purdue pegboard in 36 males and 24 females aged 18-28 years. As observed in the results, it is seen that the mean of post hand dexterity is reduced than the pre hand dexterity. A significant difference is found between the post and pre hand dexterity for all the components .i.e. dominant, non-dominant, both and assembly. This may be due to muscle fatigability or pain due to static hand posture. A previous study was done to compare the hand function between smartphone non-users, high smartphone users and low smartphone users. It was found that significantly higher VAS (visual analog scale) pain in movement in high smartphone users than in low smartphone users. The data suggest that frequent smartphone users may be more prone to experience pain in their thumbs. The low level of physical activity is presumablyexplained by the habit of avoiding aggravation of pain and fatigue,[30] which consequently results in sedentariness and deconditioned muscles.[31] Low level of physical activity may also be correlated with poor motor control and lower movementvelocity.[32] Low level of physical activity is furthermoreshown to negatively influence manual discrete aiming. Eventhough age matters for performance, younger participantswith a low level of physical activity displayed worse performancein manual dexterity.

Thus, this study concludes that sustained use of smartphone has a negative effect on the craniovertebral angle and hand dexterity.

5. Conclusion

This study shows that sustained smartphone use can result in a decrease in craniovertebral angle, which, in turn, leads to a forward head posture in young adults. Therefore, smartphone addiction has an impact on the neck posture of male and female young adults, which, in the long run, may result in musculoskeletal disorders.It also shows the hand dexterity can also be affected after sustained smartphone use.

6. Limitations

The limitations of this study is small sample size. Exclusion criteria does not include subjects with any predisposing factors to poor head posture or any previous cervical condition.

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