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Effect of Postural Awareness Exercises using Smartphone Application on Craniovertebral Angle and Jaw Opening in Subjects with High Smartphone Addiction

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Abstract: ***Background: For many people in today's society, a Smartphone is one of life's essential goods. Forward head which is commonly seen in smartphone addicts leads to cervical dysfunction. The study aims at finding out the effects of using smartphone application itself as a reminder to perform postural correction exercise after every half hour on Craniovertebral angle and Jaw opening in subject with High Smartphone Addiction. Methodology: This was an experimental study design, included 32 individuals both males and females, between the age group of 18-25 years of age, which were further allotted into experimental and control group through Random Sampling. Subjects were taught postural correction exercise. Experimental Group was given a reminder after every half hour in the form of mobile phone application. Control Group was educated regarding postural correction exercise to be performed after every half hour. Exercise was performed for the duration of one month. Conclusion: Postural correction exercise using Mobile phone Application in terms of reminder lead to improvement in Craniovertebral angle & Jaw opening in subjects with High Smartphone Addiction.***

Keywords: Smartphone Addiction, Craniovertebral angle, Jaw Opening

1. Introduction

Humans have given birth to new technology and gadgets to make life easy, smartphone are one of them. Smartphones have made internet access possible, with no bounds on time or place, for wide range of activities [1].

According to the statistics, in 2019 number of Smartphone users as almost reached to 800 million. The studied have shown that smartphone addiction among the teenagers is more than other age groups [2].The increasing use of smartphone from necessity to addiction is the matter of concern. Overuse of Smartphone is increasing, leading to lot of physical and psychological effects [3].

"A good posture is defined as keeping one's ear aligned with the shoulder and having angel wings or shoulder blades retracted." Ideal posture is considered to be the most effective position for the spine, since it reduces stresses on the spine [4].

People usually flex their neck downwards to stare at the mobile phone and maintain the head in a forward position for long periods of time, which may lead to musculoskeletal disorders. According to Dragon et.al the whole body works on compensation, disturbances like increases in muscle tension in the upper quadrant leads to compensatory changes within the spine so as to adapt correct posture [5]. There are many studies which proves that smartphone addiction can lead to altered posture [6][8].

In FHP, supramandibular muscles create a pull on the mandible, causing mandible to move towards maxilla leading to reduction in mouth opening [7].Thus altered cervical posture can give rise to Temporomandibular disorders.

Lot of literature search is found on high smartphone addiction and its deleterious effect on posture and psychological status [8][9].Very little research work is done on intervention in these subjects. It is known fact that postural correction exercises eg. Chin tucks, turtle tucks exercises have positive effect on posture.[10][11] Hence, in view of paucity of literature on intervention in smartphone addicts, this study is done to evaluate effect of postural correction exercises with multiple reminder using smartphone application on craniovertebral angle and jaw opening.

2. Methodology

Ethics committee approval for the study was taken from the Institution Research Committee (Ref No. KJSCOPT/784/19-20). An Experimental study design was conducted on 32subjects over a period of 6 months.

Young adults both males and females from 18-25 years of age pursuing their graduation or post-graduation and who had studied in English medium schools were included. All were included who were under High Smartphone Addiction category using Mobile Phone Addiction Scale (MPAS) and were using Android Smartphone since atleast 12 months.

Individuals with a history of pain in TM joint due to dental problems are excluded. Also individuals with any congenital, traumatic, pathological or degenerative disorders of musculoskeletal system, Neurological system and Cardio-Respiratory system were not included in the study.

Computer generated Random sampling was used to divide the subjects into Experimental group and Control group.

After explaining the study procedure, written consent was taken from the subjects. The Craniovertebral Angle [12] and the Jaw opening [13] was measured in subjects with High Smartphone Addiction according to the Mobile Phone Addiction Scale (MPAS) [14] by the Therapist.

Group A- Case Group subjects were taught to correct their posture by the Therapist as the app reminded them after every half an hour. Posture Reminder Application was downloaded in subject's smartphone with a reminder set every Half an hour and its functioning was explained. The app consists of reminder to correct posture in terms of beep and message flash on the screen. Postural correction that was taught by the therapist included-

Cervical Retraction - Sitting with arm relaxed by the side. Lightly touch above the lips under the nose and subjects were asked to lift their head up and away as if a sling was pulling their head upward. Verbally reinforcement was also given to correct the posture, and attention was drawn to the way it feels so that the subject got the feel of correct posture and could perform it whenever the alarm beeped.

Scapular Retraction-Sitting/ Standing, Gently resisted movement of inferior angle of scapula and subject were asked to pinch them together. Extension and elevation the shoulders were avoided. Attention was drawn to the way it feels so that the subject got the feel of correct posture and could perform it whenever the alarm beeps.

Subjects could continue their daily routine. (Case Group).

Group B- Control Group was also taught about the postural correction and ergonomic advice was given by the therapist.
Both the groups were explained to perform exercise daily. The duration of the study programme was 4 weeks. After four weeks assessment of Craniovertebral Angle and Jaw opening was performed for both the groups by the therapist. Data Analysis was done.

The study subjects were explained about the procedure and a written consent was taken. Assessment of Mobile Phone Addiction is done use Mobile Phone Addiction Scale by Dr. A. Velayudhan and Dr. S. Srividya. Males with a score higher than or equal to 128 and females with a score higher than or equal to 109 were considered to fall under the category of High Smart phone addiction.The Outcome measures of the research study are as follows- Craniovertebral Angle and Vertical Mouth Opening.

Craniovertebral Angle- Craniovertebral angle was assessed to find out forward head posture. Lateral view photograph was clicked using a digitized camera in his/her usual standing posture. Subjects were asked to stand relaxed with their arms resting on the side of the body. Subjects were instruction to virtually focus on a point on the wall directly ahead of them. The camera was arranged on a tripod, 60cm farther from the side of the subject .The height of the tripod was modified to frame the head from the top to the base of the clavicle. Tragus of the ear was marked, and a marker was placed on the skin overlying the C7 vertebra. The image was then uploaded to a computer software MB-ruler and the angle will be calculated. The angle was calculated between a line extending from the tragus of the ear to C7and the horizontal line passing from C7.

Vertical Mouth Opening
The subjects were asked to open their mouth maximally as wide as possible.A calibrated fiber ruler was used to measure the distance between the incisal edge of the maxillary incisor and the mandibular incisor. The mean maximal mouth opening for males was 51.3 mm (SD 8.3) (Range 39–70 mm) and that for females was 44.3 mm (SD 6.7) (Range 36-56mm)


Measurement of Craniovertebral Angle


Measurement of Jaw Opening

Posture Reminder Application

3. Result

Statistical analysis was done using Graph Pad Prism 8 version of the data collected from 32 subjects who passed Kolmogorav Smirnov Test of normality. Paired t test was used to compare pre post finding within the group. Unpaired t test was done for comparison between the groups. The level of significance of the study was at $p<0.05$

Table 1: Age Distribution

Age	18	19	20	21	22	23	24
Frequency	10	5	4	7	3	2	4

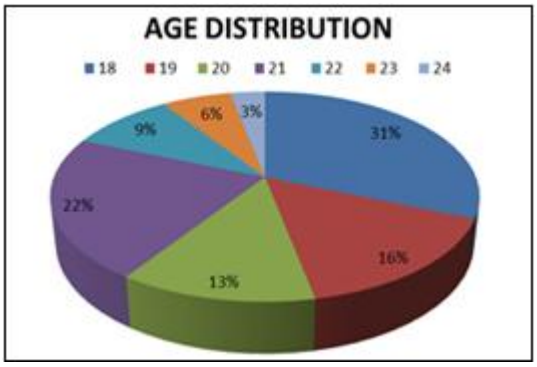


Table 2: Gender Distribution

	Frequency	Percentage
Female	26	81
Male	6	19

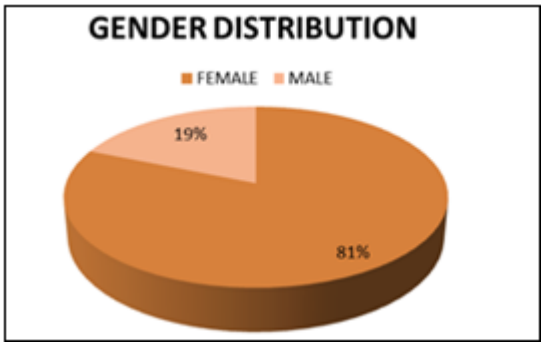


Table 3: Craniovertebral Angle of the Experimental Group

	Mean	SD	t value	p value
Pre	41.948	±4.176	5.358	<0.0001 (Significant)
Post	46.428	±4.190		

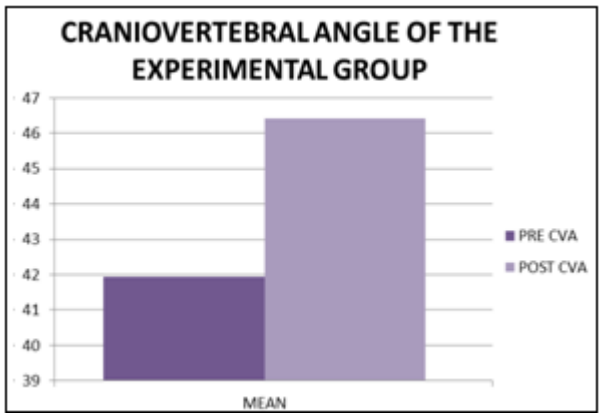


Table 4: Craniovertebral Angle of the Control Group

	Mean	SD	t value	p value
Pre	44.288	±3.6404	2.005	0.0633 (Not Significant)
Post	45.1975	±4.2129		

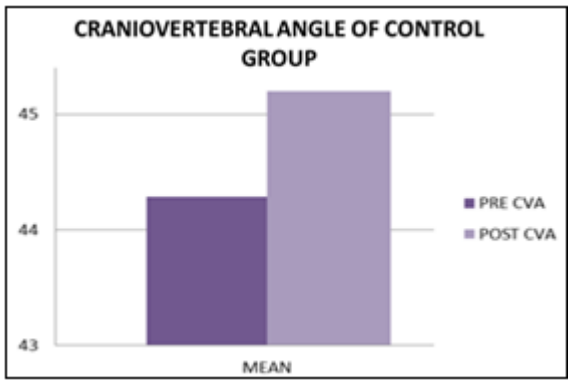


Table 4: Comparison between the groups

	Mean of Difference	SD of Difference	P Value
CVA (EXP GRP)	5.358	±3.870	<0.0001 (Significant)
CVA (CNTL GRP)	0.9088	±1.813	

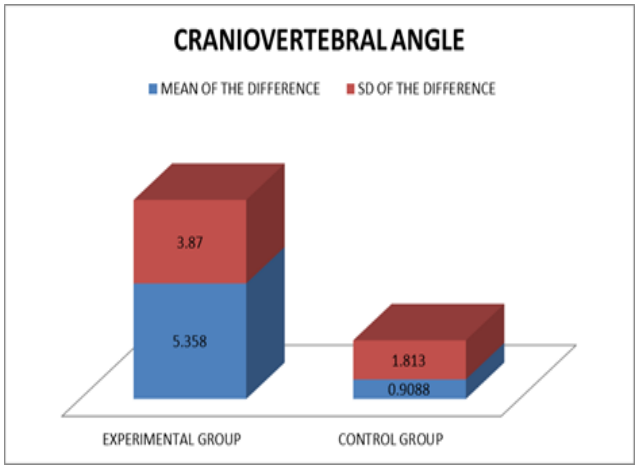


Table 5: Jaw Opening of the Experimental Group

	Mean	SD	t value	p value
Pre	40.946	±6.833	10.02	<0.0001 (Significant)
Post	46.428	±4.190		

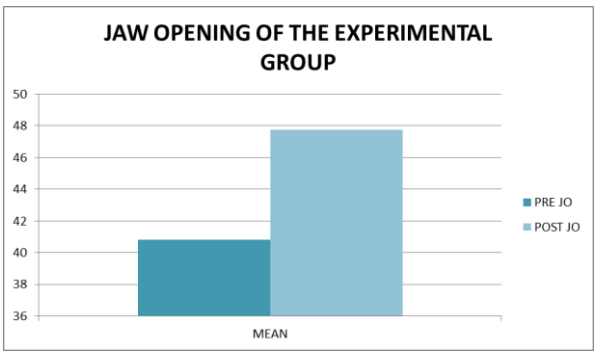


Table 6: Jaw Opening of the Control Group

	Mean	SD	t value	p value
Pre	44.8125	±5.1538	5.344	<0.0001 (Significant)
Post	47.25	±5.000		

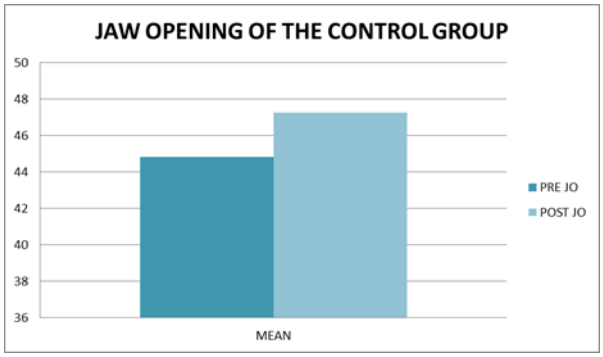
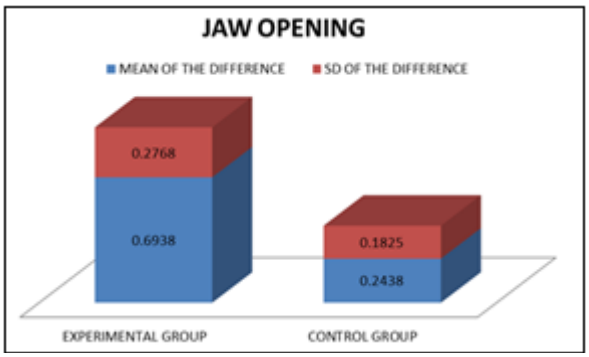


Table 8: Comparison between the Groups

	Mean of the Difference	SD of the Difference	p value
Jaw Opening (EXP GRP)	0.6938	±0.2768	<0.0001 (Significant)
Jaw Opening (CNTL GRP)	0.2438	±0.1825	



4. Discussion

The study aims at studying the effect of postural awareness exercise after every half hour in the form of Mobile phone application as a reminder on Craniovertebral angle and Jaw Opening in subjects with High Smartphone Addiction. It included young adults (N =32) both males (N=6) and females (N=26) between the age group of 18-25 years of age (Mean±20). Craniovertebral angle and Jaw Opening measurement was done to study the effect of intervention after one month.

The study showed significant improvement in Craniovertebral angle in the Experimental group ($p<0.0001$). Improvement in Craniovertebral angle is attributed to the following reasons- "Motor learning is a complex set of internal processes that involves the acquisition and relatively permanent retention of a skilled movement or task through practice." [15]. Motor learning probably modifies the way sensory information in the central nervous system is organized and processed and affects motor actions produced. The task of postural correction was taught, which lead to acquisition and relative retention of movement.

"Motor Learning occurs as a direct result of Practice- that is repeatedly performing a movement or series of movements in a task." [15]. More the practice, better is the task learnt. Practice was given every half an hour to perform the task of postural awareness exercise.

Next important component is a Feedback. In this case Feedback was provided in the form of Beep and a Flash message to fix the posture.

Postural correction exercise that is Chin Tuck might have helped to stretch the short posterior neck muscles and strengthen the upper cervical flexors and lower cervical extensors. These exercises function as strengthening exercise by increasing the size of muscle fibre thus increasing the deep anterior muscle fibre force and torque. The study done by Goosheh et.al showed chin tuck and turtle exercises had improved short neck extensor strength which supports results of our study. [10]

Above discussed component cumulatively helped in improving the posture and maintain the corrected posture all the day round.

The study performed by Lee et.al showed a strong correlation between forward head posture and Temporomandibular Disorder [16].

Our study showed significant improvement in Jaw Opening in both Experimental Group ($p<0.0001$) and Control Group ($p<0.0001$). But when both the groups were compared Experimental group ($p<0.0001$) was found to be better than control group.

Improvement in Jaw Opening in Experimental Group is attributed to improvement in Craniovertebral Angle. Due to postural Correction exercises, corrected neck alignment may have helped to reduced pull on mandible towards the maxilla by the supramandibular muscles. Normal Length tension relationships of the suprahyoid, posterior cervical muscles and infrahyoid muscles may be established. This may also help to reduce the Tension on the muscles of mastication and improved the jaw opening [17].

Also, the Control group showed significant improvement in jaw opening. This result can be attributed to little improvement in craniovertebral angle, though it was statistically insignificant.

Hence, from the above discussion it can be concluded that Postural Awareness exercise after every half hour using mobile phone application as a reminder has positive effect on Craniovertebral angle and Jaw opening in subjects with High Smart phone addiction.

5. Conclusion

The results suggested that-

- There was a significant improvement in both Experimental and Control Group with respect to Jaw Opening and in Experimental Group with respect to Craniovertebral Angle.
- When both the groups were compared Experimental Group showed significant improvement with respect to Craniovertebral Angle and Jaw Opening.

6. Limitation

Long Term effect was not studied.

7. Acknowledgement

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