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EFFECTIVENESS OF CONVENTIONAL EXERCISE PROGRAM AND OCULAR MUSCLE RETRAINING IN UG MEDICAL STUDENTS WITH TEXT NECK SYNDROME AND ASTHENOPIC SYMPTOMS DUE TO SMARTPHPONE ADVERSITY

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Abstract:

Background: Text neck syndrome is emerging as a public health threat globally because of our adjustment to a NEW NORMAL life due to COVID-19 pandemic. Long-term mobile use can lead to various musculoskeletal problems, especially neck pain associated with eye discomfort and vision disturbances. This is referred to as "smartphone adversity". Neck pain is frequently treated, but visual impairments are often overlooked.

Aim: To study the effects of conventional exercise program and ocular muscle retraining in UG medical students presenting symptoms related to neck and eye strain due to smartphone adversity.

Methodology: This study was a Pre-test Post-test experimental study which included UG medical students, both male and female, between age group 19-25 having neck pain and asthenopic symptoms (smartphone Adversity) since last 1 yr. The treatment protocol consisted of conventional treatment program and ocular muscle retraining for 4 weeks. Pre and post assessment was done using the outcome measure – Ocular Surface Disease Index (OSDI), Numerical Pain Rating Scale (NPRS) and Neck Disability Index (NDI).

Result: There was a significant difference in all the three outcome measures - pre and post intervention. The result was statistically significant with $p<0.001$ when Wilcoxon signed-rank test was applied.

Conclusion: The study concluded that the conventional exercise program and ocular muscle retraining were effective in reducing neck pain, disability and asthenopic symptoms in UG medical students with text neck syndrome and asthenopic symptoms due to smartphone adversity. Hence, this structured exercise regimen can be helpful to combat the effects of smartphone adversity.

Keywords: Text Neck, Neck Pain, Asthenopic, Smartphone adversity, prolonged neck flexion

INTRODUCTION

In 21st century, the advancement in mobile technology has brought more and more people together daily using smart phones. They spend more time using smart phone, tablets, laptops in call, text e-reading and using social media.This result in flexion of neck for prolonged time causing text neck.[1] When using a smartphone, people usually will flex their neck downwards to stare at the lowered object and maintain the head in forward position for long periods of time.[2] Maintenance of a non- neutral neck posture, such as a flexed posture, is a well-known cause of neck pain.[2]

The term of 'text neck', or another phrase 'turtle neck posture', can be described as a repeated stress injury and pain sustained from excessive watching or texting on handheld devices for long periods of time. Mobile device users frequently adopt prolonged forward head posture while looking down at the screens of mobile devices.[3] The term "Text neck" was coined by Dr. Dean L. Fishman, who is a US chiropractor. The term text neck is used to describe a repetitive stress injury or an overuse syndrome where a person has his/her head hung or flexed in a forward position and is bent down looking at his/her mobile or other electronic device for prolonged periods of time.[4]

Smartphone use results in more head and neck flexion due to its relatively small size[5]. The postural deviations cause alterations in muscle activities and an increase in cervical load. There occurs increased activity of neck extensor muscles and upper trapezius. Continuous use of a smartphone, when arms are unsupported, puts excess strain on the upper trapezius, reducing its pressure pain threshold. Besides, there occurs reduced activity in thoracic extensors and lower trapezius muscles.[5]

Most cell phone errand clients require to gaze pointedly downward or to hold their arms out before them to peruse the screen which makes their head push ahead and cause an over the top foremost bend in the lower cervical vertebrae and an unnecessary backbend in the upper thoracic vertebrae to look after balance, setting weights on the cervical spine and the neck muscles.[6] Text neck leads to harmful symptoms such as neck pain, upper back pain, shoulder pain, chronic headaches and increased curvature of the spine.[7]If text neck is not treated or corrected in right time it can lead to serious permanent damage and can result into overuse syndrome or repeated stress injury. Long term untreated text neck can result into inflammation of the neck ligaments, muscles and nerves leading to permanent arthritic changes.[7]

Asthenopia due to smartphone adversity- Eye Related Symptoms- The effects of texting with the neck in forward flexion can cause nearsightedness, eye strain, or dry eyes, because the focus on the object is nearby.[8] The physical dimensions of a smartphone visual display are smaller than other computer devices such as tablets and laptop computers. Although websites and other data displayed on smartphones may be rendered 'mobile-friendly' (that is, in a format compatible with the dimensions of the phone display), the font size displayed is small, prompting users to hold the smartphone at a close viewing distance when reading from the display.[9] Smartphone users have eye strain symptoms due to the brightness of the screen. Phones have negative effects on health in that case. By having a phone, one can stay in touch all over the world but the radiations emitted by phones are dangerous to health.[10]

Nonspecific symptoms of eye strain include headache, tiredness, and pain around the eyes, blurred vision, and double vision[10]Visualizing the smaller screens can accelerate a pattern of ophthalmic problem such as headaches, blurred vision, sore eyes, dry eye and muscle strain.[11]According to the American Optometric Association,[13] the most common symptoms associated with DES are eyestrain, headaches, blurred vision, dry eyes and pain in the neck and shoulders. **Asthenopia** is the formal term for eye strain, for which two distinct mechanisms and sets of symptoms were described by Sheedy et al.[13] External symptoms of burning, irritation and tearing and dryness were noted to be closely related to dry eye, while internal symptoms of strain, ache and headache behind the eyes were linked to accommodative and/or binocular vision stress.[13]

Common presentation of Text Neck syndrome -The most common presentation of Text Neck is neck pain, stiffness and soreness. The main symptoms include [12]

1. **Stiff neck:** Soreness and difficulty in moving the neck is usually present when trying to move the neck after long usages.
2. **Pain**: can be localized to one spot or may be diffused over an area, usually lower part of the neck. Can be described as dull aching or can also be sharp or stabbing in extreme cases. Text neck most commonly causes neck pain and soreness.
3. **Neurological symptoms**: There can often be radiation of pain into the shoulders and arms. If a cervical nerve becomes pinched, pain and possibly neurological symptoms can radiate down your arm and into your hand.
4. **Muscular weakness**: shoulders muscles namely, trapezius, rhomboids and shoulder external rotators are often weak.
5. **Headache**: Sub-occipital muscle tightness can lead to tension type headaches.

6. **Muscle Spasm**: Upper back pain ranging from a chronic, nagging pain to sharp, severe upper back muscle spasms. Shoulder pain and tightness, possibly resulting in painful shoulder muscle spasm.

Eye strain together with dryness and irritation of the eyes, headache, blurred vision, dry eyes, and neck and shoulder pain are characteristic of CVS symptoms.[14]Long-term mobile use can lead to various musculoskeletal problems, especially neck pain associated with eye discomfort and vision disturbances. This is referred to as "smartphone adversity"[15]

The combination of repetitive movements, poor posture, and over-use of phones for texting and playing games, studying without taking breaks, can cause injury to the nerves, muscles, and tendons in the fingers, hands, wrists, arms, elbows, shoulders, and neck too which if ignored, may lead to further problems.[16] "Texting neck" or "iNeck pain" syndrome is emerging as a public health threat globally because of our adjustment to a NEW NORMAL life due to COVID-19 pandemic.[19]With no specific guidelines, it is now a usual routine for employees to spend most of the time (nearly 8–12 h/day) attending webinars, meetings, and performing jobs in front of the computer or mobile screens.[19] So-called "text neck" is neck pain that results from tilting your head down to look at a smartphone, laptop, screen, And also if your work from home set up is not ergonomic that will facilitate the onset of musculoskeletal problem running from neck shoulder, back pain.[20]

Neck pain (NP), one of the most commonly reported musculoskeletal disorders, is a major cause of illness, reduced educational attainment, and absence from university lessons; NP may thus place students' career prospects in jeopardy[21]. In addition to the general factors that predispose people to experience NP, students spend long hours reading, writing, and using computers or tablets, making them a high-risk group for the development of NP[21]Far fewer studies were focused on NP and its association with factors pertinent to students, such as excessive exposure to screens, a maladaptive ergonomic environment, and psychological stress[21] Indeed, musculoskeletal pain in students manifests most often in the neck[21]. Yet, there is a lack of knowledge about the development of NP among students during the COVID-19 pandemic.[21]

Despite the fact that smartphone adversity can lead to such chronic complications if untreated, there is a lack of literature on a training program for both, neck pain and ocular symptoms. Hence this study was conducted to implement a conventional exercise program and ocular muscle retraining in individuals with text neck syndrome.

METHODOLOGY

1. **Sample size**: 36

   Sample size calculation –Sample size for equality of two means

   Minimum sample size (n) = $\frac{Z_1^2 S^2}{E^2}$

   $Z_1 = 1.96$ at $\alpha = 5$ % level of significance, S= 1.11, $\mu = 23.30$

   E = absolute precision = 0.4

   $$n = \frac{(1.96)^2 \times (1.11)^2}{(0.4)^2}$$

   n = 30
2. **Study design**: Pre test-Post test Experimental study
3. **Method of sampling**: Convenient Sampling
4. **Study setting** : Dr. Ulhas Patil College of Physiotherapy, Jalgaon
5. **Duration of study**: 6 month
6. **Selection criteria:**

   A. **Inclusion criteria** –

   Diagnostic Criteria for both Text neck and ocular symptoms -

- UG students having neck pain due to smartphone Adversity since last 1 yr.
- Both Male and female, between age group 19-25.
- Individuals using smartphone for an average 8 hr/day since 1 year and complaining about neck pain and visual discomfort.
- Subjects complaining of any below symptoms(mild to moderate) due to smartphone overuse: Headache

  Burning eye sensation

  Eye redness

  Blurred vision

  Dry eyes (tearing)

Neck and shoulder pain

(Mild: transient symptoms that persist for few minutes to hours;
Moderate: symptoms persist for few hours and subsides after rest or sleep;
Severe: needs medical attention)

B. Exclusion criteria –

- Any congenital deformity of the upper limb and neck
- Any recent fracture of the upper limb and neck
- Any recent surgery of the upper limb and neck
- Participants who have undergone ocular surgeries or having any diagnosed eye disease.
- Participants who wear spectacles.
- Individuals with any cervical disc disease or inflammatory or malignant type of pain.
- The subjects who had any pre-presenting musculoskeletal neck diseases such as PIVD, cervical spondylosis or any other congenital neurological condition like torticollis.

8) Materials

1) Pen
2) Paper
3) Patient evaluation sheet

OUTCOME MEASURES

1. Neck disability index(NDI)
2. Ocular surface disease index (OSDI)
3. Numerical Pain Rating Scale (NPRS)

PROCEDURE

To conduct the following study permission was taken from Principal of Dr. Ulhas Patil College of Physiotherapy, Jalgaon in UG students. Subjects were taken according to the Inclusion and Exclusion criteria. The procedure was explained and a written consent was obtained from the subjects.
The demographic information of each participant was taken, and the purpose of the study was explained to them. Evaluation sheet was used for including and excluding the subjects.
The evaluation sheet included the following questions: 1)Personal information and information related to their phone usage 2) Characteristics of the pain and 3) What does the individual do during pain etc.
Pre assessment was done using the outcome measure –
1. Ocular Surface Disease Index (OSDI)
2. Numerical Pain Rating Scale (NPRS)
3. Neck Disability Index (NDI)

Pre- assessment outcome measures was taken on the first day of the 1st week. The treatment protocol consisted of 5 sessions of conventional treatment program and ocular muscle retraining programme for 4 weeks and the following mentioned exercises were taught to them on the 1st day after assessment. On the first day of each week, the exercises were performed under supervision and the remaining 4 days subjects performed their exercises with regular followup. Duration for treatment was 25-30 min / day. 2 days in a week was given for rest.

Post assessment was taken on the last day i.e., after 4 weeks of treatment.

The conventional exercise program consists of-

1. Cervical muscle-strengthening exercises in the form of neck isometrics:[15]

a) **Neck flexion**: Place one hand on the forehead and press the forehead into the palms in a nodding fashion while not moving. Hold for 10 sec. Repeat it for five times.
b) **Neck extension**: Clasp fingers of both hands and put your hands on the back of your head. Try pushing your head backward with your hands going forward. Hold for 10 sec. and repeat it for five times.
c) **Rotation (left side)**: Place the left hand on the left side of the chin. Attempt to turn the head to look over the left shoulder but not allowing the motion. Hold for 10 sec. Repeat it for five times.

d) **Rotation (right side)**: Place the right hand on the right side of the chin. Attempt to turn the head to look over the right shoulder but not allowing the motion. Hold for 10 sec. Repeat for five times.

2. **Stretching for upper trapezius** – Position: Perform this stretch in sitting or in standing in a relaxed position. For left side stretching, right ear tries to touch the right shoulder. You will feel a gentle stretch on the left side.[17] Repeat the same for right side.
   (15 sec hold for 3 repetitions) [16]

3. **Lateral neck bending with chin tucked in (RIGHT AND LEFT)** – The patient was asked to perform chin tuck with the head bending towards the right side, as if trying to bring the right ear toward the right shoulder. Repeat the same procedure for left side.

4. **Chin tucks** - Chin tuck were taught by asking the participant to sit on a chair, tucking their chin posteriorly and inferiorly while touching it (manually guide the movement) and hold this position for 10 sec. Exercise was followed by a 10-sec break. It was supposed to be repeated 5 times.[18]

Following this, the ocular muscle training exercises were given[15] –

1. **Blinking**: The participants were asked to blink their eyes for 3–4 secs. for 2 mins. After that, relax eyes for 10 sec. Now try not to blink for 30 sec at a time for the next 2 mins.

2. **Palming:** Place your two hands over your eyes with the cup of your palm covering your eyes, your fingers on your forehead, and the heel of your hand will rest on your cheekbone. Make sure you can blink freely and you are not putting too much pressure on your eye. Do this for 30s.Repeat it for 5 times.

3. **Figure of 8:** Imagine a giant figure of 8 in front of you about 10 feet. Now close one eye and trace the figure of 8 with your eyes, slowly in the horizontal direction. Repeat it for five times and then relax. Now, perform the same exercise with the other eye closed.

4. **Finger-targeted near-and-far focusing**: Stretch out your arm with your thumb in the hitchhike position. Focus on your thumb as your arm is outstretched. Now bring your thumb closer to focusing all the time, until your thumb is about 3 inches in front of your face. Now, move your thumb away again until your arm is fully outstretched. Repeat this for five times at a time.

The outcome measures were repeated again to obtain the post intervention scores.

Cervical isometric for flexion

Cervical isometric for extension

Cervical isometric for rotation

Stretching for Trapezius

Chin Tucks

Lateral bending with Chin tucks

Palming

Finger targeted Near and far Focusing

Figure of 8

STATISTICAL ANALYSIS

The data was collected, analyzed and was entered in excel sheet and statistical analysis was done using SPSS Statistical package of social sciences version 28.0.0.1 software. Test of normality was applied to check for the normal distribution of data (Shapiro– Wilk test). Data were not normally distributed. Hence, nonparametric test of significance was used (Wilcoxon signed-rank test) to check for the difference before and after the intervention. Statistical significance was set at $p < 0.05$.

RESULTS

Baseline characteristics of the population –

- Figure 1 shows gender distribution. Out of 36 subjects, 14% of the population was male and 86 % of the samples was female.

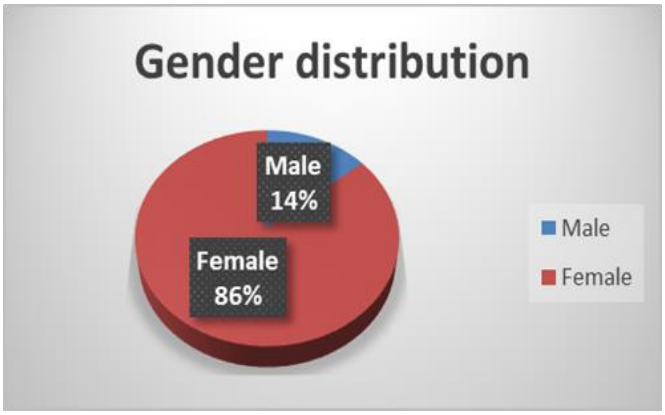


FIGURE 1

STATISTICS	
AGE	
N	36
MEAN	21.67
SD	1.242

TABLE 1

- Table 1 shows the mean and SD FOR age was 21.67 and 1.242 respectively.

- FIGURE 2 shows age distribution. 50 % subjects were of the age group 20-21, 42% SUBJECTS were of the age group 22-23 and the remaining 8 % were of the Age group 24 -25.

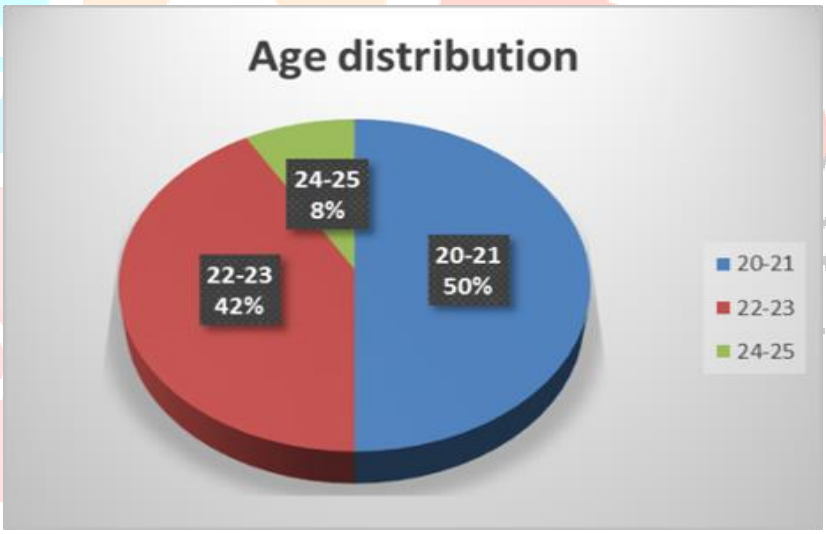
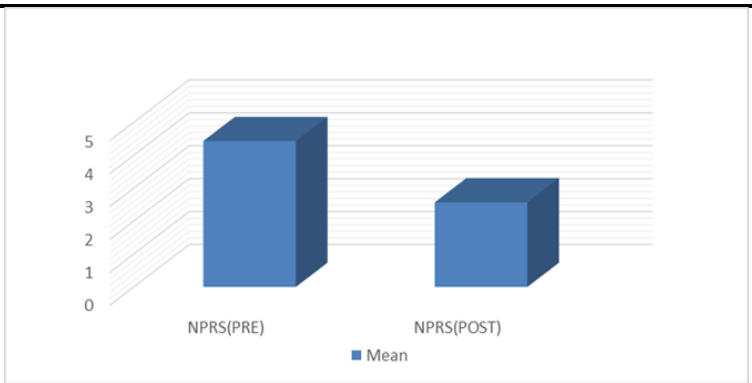


FIGURE 2

- The present study included 36 subjects with text neck syndrome who met the inclusion criteria. Table 2 shows pre and post intervention reading of NPRS. The Pre mean and SD for NPRS was 4.43 ± 1.29 and the post mean and SD was 2.57 ± 1.14. It signifies a decrease in symptoms of pain pre and post intervention. The result was statistically significant with p<0.001 when Wilcoxon signed-rank test was applied.

Column1	Mean	Std. Deviation	P value
NPRS(PRE)	4.43	1.29	<0.001
NPRS(POST)	2.57	1.145	

TABLE 2

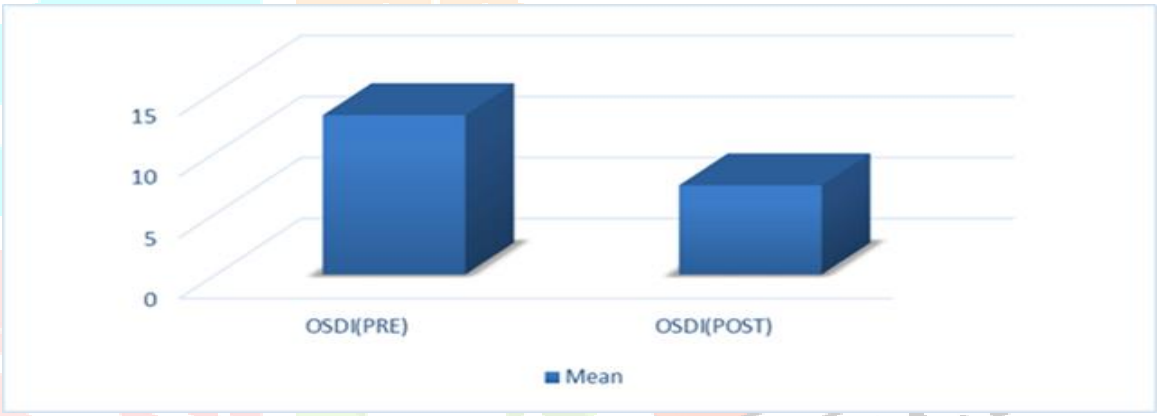


GRAPH 1

- Table 3 shows pre and post intervention reading of OSDI scores of the samples. The mean and SD of the participants pre intervention was 13.06 ± 4.51 which reduced to 7.31 ± 3.16 post intervention and the obtained p value is $p < 0.001$.

Column1	Mean	Std. Deviation	P value
OSDI(PRE)	13.06	4.516	
OSDI(POST)	7.31	3.161	<0.001

TABLE 3

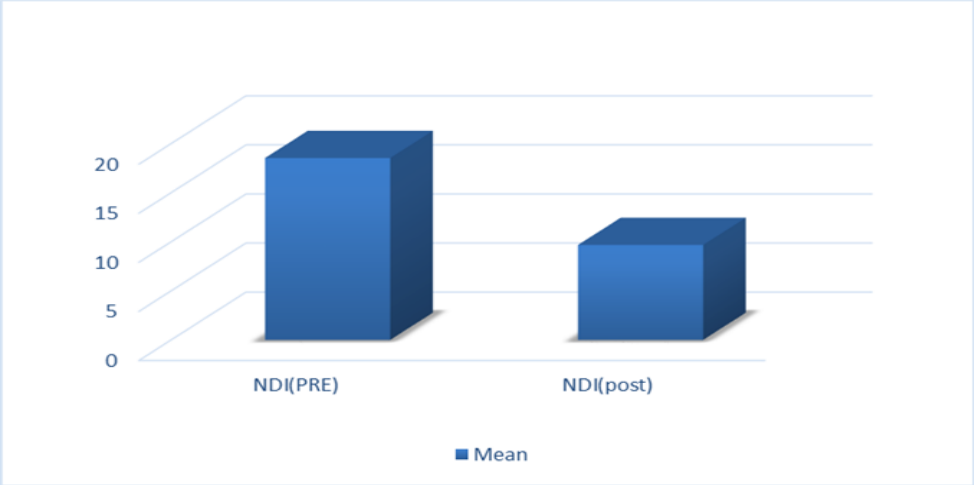


GRAPH 2

- TABLE 4 shows pre and post intervention reading of NDI. The Pre mean and SD for NDI was 18.53 ± 8.47 and the post mean and SD was 9.67 ± 4.18. The obtained p value was < 0.001.

Column1	Mean	Std. Deviation	P value
NDI(PRE)	18.53	8.477	<0.001
NDI(post)	9.67	4.182	

TABLE 4



GRAPH 3

DISCUSSION

The present study was designed to find out the effect of a structured exercise program including training for both ocular and neck related symptoms in UG medical Students with text neck syndrome and asthenopic symptoms due to smartphone adversity within the age group of 19- 25. In the present study, it was found that conventional exercise program and ocular muscle retraining resulted in significant decrease in neck pain, neck disability and asthenopic symptoms, after 4 weeks of intervention.

Statistical analysis proves that the conventional exercise program and ocular muscle retraining was significantly effective in reducing neck pain, neck disability and ocular symptoms with p value of < 0.001 for NPRS, p value of <0.001 for NDI, p value of <0.001 for OSDI. Hence, the study rejects null hypothesis.

In the present study, the pain intensity and neck disability has been reduced to $p < 0.001$. These values are in accordance with the study done by Jill Shah et al. (2021) on effectiveness of Pilates along with Conventional Exercise Program and Conventional Exercise Program Alone in Subjects with Text Neck Syndrome. Greater statistical improvement was seen in group B Than group A ($p < 0.05$).

The present study was conducted in UG students with Text Neck Syndrome and asthenopic symptoms due to smartphone adversity. In a previous study done by Mayura P. Deshmukh et al on the Effect of Cervical Muscle Strengthening and Ocular Muscle Training among Students with Smartphone Adversity in Physiotherapy students having neck pain, both male and female between the age group of 18–25 years. The study concluded that cervical muscle strengthening and ocular muscle training are effective for the students having smartphone adversity.

During the Covid – 19 pandemic, it was a shift from non-digital working to digital working. It became a usual routine for students to spend most of the time (nearly 8–12 h/day) attending online lectures, webinars, meetings, in front of the computer or mobile screens. Because of our adjustment to a NEW NORMAL life due to COVID-19 pandemic, continuous smartphone use lead to increased load on the cervical muscles and it was a major cause for digital eye strain. In the era of new normal, text neck syndrome is emerging as a public health threat globally. To combat the effects of smartphone overuse, during and post lockdown period, a structured exercise program is necessary.

Smartphone use results in more head and neck flexion due to its relatively small size[5]. The postural deviations cause alterations in muscle activities and an increase in cervical load. There occurs increased activity of neck extensor muscles and upper trapezius. Continuous use of a smartphone, when arms are unsupported, puts excess strain on the upper trapezius, reducing its pressure pain threshold. Besides, there occurs reduced activity in thoracic extensors and lower trapezius muscles.[5]

Sadagopan et al. reported that normal blinking rate about 15 times per minute, but this rate reduced when the person who was staring at smartphone. The person is quint to read the smaller screens, facial, neck and shoulder muscles are contracted, eyes become fatigued and vision can be blurred or strained. In her study, they added to their analysis that reading in bed can affect sleep cycle due to the blue light radiate from the screen and lead to decrease levels of melatonin and produce sleep disturbance.[11] The present study found that eye exercises helped to reduce the tendency to tire, blurring and strain found in the eyes due to smartphone adversity.

Two recent studies reported that an in increase in cervical flexion degree caused a significant increase in fatigue and pain in upper trapezius muscle.[22]The weight supported by the spine dramatically increases when the head is flexed forward at varying degrees.[23] A previous study done by Shreya Ahirrao et al found that fatigue in the cervical muscle is responsible for more flexed cervical posture and imbalanced tones between the cervical muscles after prolonged usage of a smartphone. This negative relationship between the time of smartphone use and neck flexion and extension could be due to the fact that the posture people adopt as they look at their smartphones raises the stress on the neck.[23]

In the present study, one of the component of the conventional exercise program consisted of neck isometrics. This study is in accordance with a previous study done by Bhuvan DeeP GuPta et al which suggests that Conventional isometric training (CIT) aims at improving isometric function of neck muscle, which counteracts the forces of gravity in order to maintain head and neck in upright position.[24] A study conducted by Having JL said that the chin tuck exercise to strengthen deep craniovertebral flexors and the head bending exercise improves the muscular endurance of cervical flexors and reduce the pain in patients with chronic cervical pain and improve their muscular functions.[25]

The present study is in accordance with the previous study done by Pradeep K Kurunhikattil in which the results suggested that these techniques gave significant reduction in eye strain, watering of eyes ,headache,dryness of eyes, neck pain etc. which helped the professionals to improve their workplace productivity. They added to their analysis that professionals working long hours with computers can practice this eye exercises and neck exercises to keep away from asthenopia which may help to improve their performance. These exercises helps in relaxing the ocular muscles, some exercises like palming give relaxation to all sensory nerves related with vision. These relaxing techniques can improve vision or helps in improving the accommodation.[26]

The results of the present study suggest that the conventional exercise program and ocular muscle retraining were effective in reducing neck pain, disability and asthenopic symptoms due to smartphone adversity.

CONCLUSION

The study concluded that the conventional exercise program and ocular muscle retraining were effective in reducing neck pain, disability and asthenopic symptoms in UG medical students with text neck syndrome and asthenopic symptoms due to smartphone adversity. In addition, results support that eye exercises helped to reduce the tendency to tire, blurring and strain found in the eyes due to smartphone overuse. Hence, this structured exercise regimen can be helpful to combat the effects of smartphone adversity.

LIMITATIONS:

1) Sample size of the study is small in number.
2) This study was conducted within age group 19-25 years only.
3) Long term follow up was not taken.
4) Ergonomic advice was not given.

SUGGESTIONS:

1) Future study should be done with a larger sample size.
2) Future studies should also be done on IT Professionals, dentists and surgeons.
3) Study can be done for longer duration.

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