Available Online at https://www.nepjol.info/index.php/IJOSH
International Journal of Occupational Safety and Health, Vol. 12 No. 4 (2022), 276 – 283

Correlation between the Guyon Canal Syndrome and the Forward Head Posture in Prolonged Smartphone Users

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ABSTRACT

Introduction: From youth to the eldest, smartphones have become an essential gadget in life. Neutral head posture plays an important role in our day-to-day activities as it is responsible for stability. Although smartphones have made our lives easier, they tend to increase the number of complaints related to the cervical spine, hand complex, wrist, and elbow pain as a result of their excessive use. This might result in various faulty postural adaptations, which can greatly contribute to the increased risk of musculoskeletal disorders. Also, its prolonged use can lead to forward head posture (FHP), which can be accompanied by Guyon Canal Syndrome (GCS). This study aimed to find and determine the correlation between Guyon canal syndrome and forward head posture in prolonged smartphone users.

Methods: This was a cross-sectional study that consisted of 80 respondents from a college who were selected based on the criterion for selection. The data that was collected included, demographic details, smartphone usage characteristics, the severity of pain, presence of FHP, and mechano-sensitivity of the ulnar nerve. Statistical analysis was done using a non-parametric test. Spearman's correlation coefficient test was used.

Results: The results of this study among the 80 prolonged smartphone users showed that 42 users (52.5%) were in the age group of 18–21, and 38 users (47.5%) were found to be in the age group of 22–25. Most of them were right-handed i.e., 61 (76%), while 19 (24%) were left-handed. In BMI, normal-weighing subjects (18.5-24.9) were 48 (60%) and overweight subjects were 32 (40%). Mean + SD of Smartphone Addiction Scale, Visual Analogue Scale, Upper Limb Tension Test and Occiput to Wall Distance was 29.99 + 6.50, 1.48 + 0.86, 0.73 + 0.45, and 2.78 + 0.96, respectively. Spearman's correlation coefficient was shown to have a moderately positive correlation between both SAS and VAS ($r = 0.36$, $p = 0.0010$), SAS and ULTT ($r = 0.14$, $p = 0.022$), and SAS and OWD ($r = 0.17$, $p = 0.013$). Linear regression was used to check the correlation and significance between FHP and GCS, where the r value was (0.27) and the p-value was 0.0177, which was found to be statistically significant.

Conclusion: Based on the findings of this study, we found that there was a positive correlation between forwarding head posture and Guyon canal syndrome in prolonged smartphone users. FHP can give rise to moderate pressure on the ulnar nerve, which mainly supplies the fifth finger of the hand, causing Guyon Canal Syndrome. Hence, we can conclude that in subjects with prolonged usage of smartphones, FHP can further progress and these subjects may have the tendency to develop GCS.

Key words: Forward Head Posture, Guyon Canal Syndrome, Musculoskeletal Disorders, Mechano-sensitivity, Upper Limb Tension Test

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DOI: https://doi.org/10.3126/ijosh.v12i4.42537

Conflicts of interest: None
Supporting agencies: Krishna Institute of Medical Sciences Deemed to be University, Karad.

Date of submission: 21.01.2022
Date of acceptance: 10.06.2022
Date of publication: 01.10.2022

Introduction

Our way of life has now been transformed by technological innovations, particularly the development of cell phones. A smartphone works on the same principle as a machine with an operating system, which includes a wide range of software applications.[1] It could be used for a wide range of purposes, like communication, leisure, messages, music, multimedia, internet access, photographs, and games.[2,3]

Smartphones encourage people to stare at their phones' small screens and perform repeated activities in an unnatural position for long periods, which can lead to musculoskeletal problems.[4,5] Cervical pain and dysfunction can be associated with poor head, neck, and shoulder postures.[6] Later, these can further lead to muscular imbalances that can also weaken the core muscles and excessively load the lumbar spine.[7]

Even though smartphones have made our lives easier, they tend to increase the number of complaints related to hand complex, wrist, and elbow pain as a result of their excessive use.[8] This results in various faulty postural adaptations that greatly contribute to the increased risk of musculoskeletal disorders.[9,10] Also, its prolonged use can lead to Forward Head Posture (FHP).

FHP is characterized by increased flexion of the lower cervical spine (C4-C7) and most of the thoracic region, increased extension of the upper cervical spine (C1-C3), and also changes in the thoracic spine (kyphosis). FHP can also be seen in prolonged smartphone users.[11] Most smartphone tasks users require to stare sharply downwards or to carry their arms out in front of them to read the screen which makes their head move forward and causes an excessive anterior curve within the lower cervical vertebrae and an excessive posterior curve in the upper thoracic vertebrae to take care of balance, placing stresses on the cervical spine and the neck muscles. FHP is one of the most commonly recognized poor postures in the sagittal plane.[12] It can occur due to anterior translation of the head, lower cervical flexion, or both, and it's claimed to be related to a rise in upper cervical extension.[13] It is associated with the shortening of the upper trapezius, the posterior cervical extensor muscles, the sternocleidomastoid muscle, and the levator scapulae muscle.[14]

Thus, FHP may contribute to neck and shoulder pain. Inadequate posture consists of poor relationships between parts of the body. Muscle tension and shortening are caused by these incorrect interrelations, making it more difficult to conduct proper joint motions and sometimes producing discomfort.[14] FHP that raises the top bending moment applies pressure on extensor muscles such as the semispinalis capitis and levator scapulae muscles on its own, without the use of an inducer.[15]

Fatigue and stress in the neck and shoulders occur more easily with the use of touch-screen computers than with desktops because small-monitor devices such as smartphones and tablet PCs cause people to look down and slouch more than with desktops.[16] With the growing penetration of smartphones, the time spent using them has also rapidly increased. Using visual display terminals such as smartphones for a long time can cause neck and back pain.[17] Neutral head posture plays an important role in our day-to-day activities as it's responsible for stability.

We are currently living in an industrial world where we are becoming more and more dependent on smartphone use for everyday work, which is causing increasing musculoskeletal problems. Chances are, FHP will be accompanied by Guyon canal syndrome. Moreover, the authors found very few studies correlating Guyon Canal Syndrome and FHP. This study was hence conducted to assess the correlation between Guyon canal syndrome and forward head posture in prolonged smartphone users.

Guyon Canal Syndrome may be a relatively rare peripheral ulnar neuropathy that involves injury to the distal portion of the cubital nerve because it travels through a narrow anatomic corridor at the wrist.[15] Haughie et al. have mentioned that the Guyon canal may be a unique location where the cubital nerve is susceptible to compressive injury, although the more common location of the cubital nerve injury occurs at the elbow, which is understood as cubital tunnel syndrome. Mushroor et al have described in their study that, each part of the ulnar nerve that gets affected in the Guyon canal region is represented by different symptoms. The distal section of the ulnar nerve before it splits into the superficial sensory and deep motor trunk is known as Zone 1. Injury to Zone 1 causes motor and sensory problems. Zone 2 is the most usually affected in Guyon canal syndrome, located distal to the motor and sensory bifurcation and radial to zone 3. Zone 3, which is ulnar to zone 2 and distal to the motor/sensory bifurcation, causes exclusively sensory complaints.[18] Long-term smartphone use has several harmful consequences

for the body, including an increase in muscle tension, which can lead to hand pain, tendinitis, and other issues. There is a need to discover improved usage practices and rules for managing the smartphone as the duration and frequency of phone usage increases, and unergonomic phone handling poses harm to the user's body.[19]

Improper smartphone gripping, such as keeping the little finger under the phone for support, causes strain in the little finger because the entire weight of the phone passes through the Distal Interphalangeal (DIP) area of the little finger, stretching the soft tissue in that area.

The incorrect posture of holding smartphones as a result of a sedentary lifestyle significantly increases the risk of musculoskeletal diseases. The dent over the PIP is most likely the result of repeated exposure to the phone's load compressing the soft tissues of the finger. Hand and wrist weakness is one of the main complications associated with the increased use of smartphones. This weakness occurs due to the repetitive flexion and extension of the wrist, thumb, and fingers, leading to significant musculoskeletal pathology.[20] When using a smartphone; the elbow is forced into a flexed position. Postures and work-related hobbies may play a role in the onset and progression of ulnar neuropathy at the elbow (UNE), which is becoming more common. The nerve may be damaged due to compression from prolonged periods of elbow flexion during sleep, exercise, driving, typing, or talking on the phone. In recent decades, the amount of time spent on a mobile phone has increased, resulting in more time spent with a flexed elbow (prolonged-phone-posture, or PPP).[21] This forward-leaning head posture is coupled with flexed elbows.

Methods

This was a cross-sectional study. It was conducted from March 2021 to May 2021. The study population considered was 80 participants, who had a history of prolonged smartphone usage.

The sample size was calculated by using the prevalence of prolonged smartphone users in India which is presently 54%.[22] Simple random sampling method was used as the sampling method.

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The inclusion criteria were both male and female smartphone users within the age group of 18–25 years who have been using smartphones for more than 3 hours per day for 2 years, the phone's display size was more than 4 inches, and the weight of the smartphone was more than 130 gm. Subjects using their phones in odd or abnormal positions, e. g., using smartphones in bed, etc., and those willing to participate were considered.

All subjects with any recent forearm/clavicle/shoulder fractures, cervical pain, rotator cuff lesion disorder, or any known deformity of the spine and hand were excluded from the study. The data that was collected included demographic details, smartphone usage characteristics, the severity of pain, the presence of FHP, and mechano-sensitivity of the ulnar nerve. The subjects were informed and written consent was obtained from them. Each one of them was assessed for pain, smartphone addiction, ulnar nerve involvement, and forward head posture.

Visual Analogue Scale (VAS) was used to assess pain[14], the Smartphone Addiction Scale (SAS) was used to examine addiction levels[23], the Occiput to Wall Distance (OWD) was used to check for forward head posture[24], and the Upper Limb Tension Test (ULTT) was used to assess ulnar nerve involvement. [19]

The collected data were statistically analyzed using the SPSS version 20 software. For each outcome measure, the arithmetic mean and standard deviation were determined. MS Excel was used to create various graphs based on the frequencies and percentages determined using the software. Spearman's correlation coefficient test was used.

Results

Among all the 80 subjects in this study, the female subjects (n = 44) were more than the male subjects (n = 36). The mean + SD of SAS, VAS, ULTT, and OWD was 29.99 + 6.50, 1.48 + 0.86, 0.73 + 0.45, and 2.78 + 0.96, respectively. Spearman's correlation coefficient showed a moderately positive correlation between both SAS and VAS (r = 0.36, p = 0.0010), SAS and ULTT (r = 0.14, p = 0.022), and SAS and OWD (r = 0.17, p = 0.013).

The total number of male users were 36 (45%), and female users were 44 (55%). The subjects within

the age groups, 18–21 years were 42 (52.5%) and 22–25 years were 38 (47.5%). Most of these users had right-hand dominance i.e., 61 (76%). In reference to BMI, normal-weighing subjects (BMI:18.5-24.9) were 48 (60%) and overweight subjects were 32 (40%). Based on the duration of smartphone usage, the usage between 1-2 hours was found in 36 (45%) users, from 2-4 hours in 29 (36%) users, and more than 4 hours in 15 (19%) users. (Table 2)

The correlation between SAS and VAS was significant with (r=0.36, p=<0.0010; the correlation between SAS and ULTT was significant with r = 0.14, p = 0.022; and the correlation between SAS and OWD was significant with r = 0.17, p<0.013. (Table 3)

Table 4 shows the correlation and statistical significance between forward head posture and Guyon Canal Syndrome. The correlation coefficient (r) was found to be (0.27) and the p-value was 0.0177, which is statistically significant.

Table 1: Outcome Measures used for Data Collection

Outcome Measure	Details
1) VAS	It is a scale that consists of a line numbering from 0 (no pain) to 10 (severe pain). The patient was asked to mark a point on the line according to the amount of pain they were experiencing.[14]
2) SAS	Kwon et al. have developed and validated the Smartphone Addiction Assessment (SAS) which is a self-reporting scale for smartphone addiction that includes six criteria and 33 items on a six-point Likert scale (1: "strongly disagree" and 6: "strongly agree").[23] Daily-life disruption, pleasant anticipation, withdrawal, cyberspace-oriented connection, overuse, and tolerance 12 were the six criteria for SAS-SV scores. [4,12]
3) OWD	In epidemiologic research, the occiput-to-wall distance test (OWD) is often used to screen and monitor thoracic hyperkyphosis. The results of OWD have a strong relationship with radiologic data (Cobb angles, r = 0.683, p = 0.001). When employed by a healthcare practitioner, the results of OWD demonstrated higher reliability. The best diagnostic features for determining the existence of thoracic hyperkyphosis were an OWD of at least 6.5 cm.[24]
4) ULTT for Ulnar Nerve	The Brachial Plexus Tension or Elvey Test is another name for the Upper Limb Tension Tests (ULTTs). These tests are designed to impose a strain on the upper limb's neurological structures. The shoulder, elbow, forearm, wrist, and fingers are all held in a certain position to stress a single nerve (nerve bias).[19] These tension tests are used to see if there is any peripheral nerve compression or if it is part of a larger problem. These tension tests are used to determine whether a peripheral nerve is compressed or as part of a neurodynamic evaluation. The primary purpose of the ULTT is to assess cervical radiculopathy.[21] According to Apelby-Albrecht (2013), specificity for ULTT was found to be 87% and sensitivity was found to be 71%.[25]

Table 2: Demographic Variables of the prolonged smartphone users

Demographic Variables		Mean + SD	Frequency (n)	No. of Participants (%)
Gender	Males	-	36	45%
	Females	-	44	55%
Age	18-21	19.36 + 0.68	42	52.5%
	22-25	22.97 + 1.53	38	47.5%
BMI	18.5-24.9	23.31 + 1.5	48	60%
	25-29.9	25.86 + 0.51	32	40%
Dominance	Right	-	61	76%
	Left	-	19	24%
Phone usage/ day (hours)	1-2 hours	-	36	45%
	2-4 hours	-	29	36%
	>4 hours	-	15	19%

Table 3: Correlation Between findings of SAS and VAS; ULTT and OWD

Correlation	r- value	p-value
SAS with VAS	0.36	0.0010
SAS with ULTT	0.14	0.022
SAS with OWD	0.17	0.013

Table 4: Correlation and Significance between FHP and GCS:

	No. of participants	Correlation Coefficient	p-Value
FHP	80		
FHP with GCS	58	0.27	0.0177

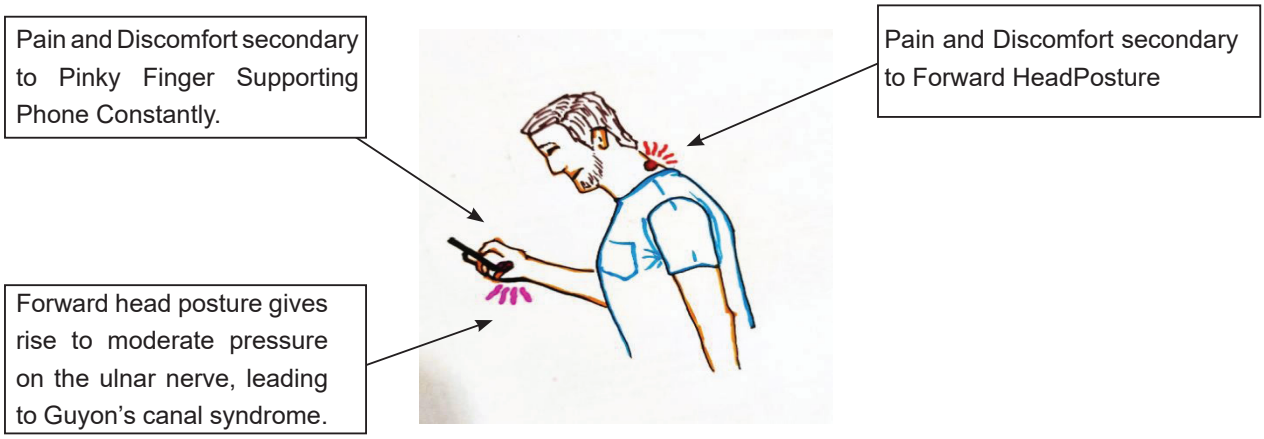

Figure 1: Relationship Between Forward Head Posture and Guyon Canal Syndrome.

Discussion

Anatomical and biomechanical pressures cause symptoms when an awkward posture is maintained for a long time.[26] Frequent neck flexion posture, which affects the natural curve of the cervical spine and increases the amount of stress on the cervical spine, leading to irritation and spasm in the surrounding skeletal structures and ligaments, may be linked to neck impairment among smartphone users.[12] Excessive smartphone use might result in repetitive and persistent head and neck movements toward the screen throughout the day. Such movements have been linked to an increased risk of chronic neck pain.[25]

The study respondents in this study were 80 regular smartphone users. We discovered that the majority of them were females; one reason for this could be that females have a higher cervical lordosis curve due to their proclivity for slouched posture. And the majority of them were between the ages of 18 and 21. The right hand was found to be dominant in 61 people. The maximum period of smartphone use was determined to be between 1 and 2 hours, with the lowest being more than 4 hours.

The maximum SAS score was discovered to be between 20 and 30 points, which was termed "mild addiction," and the minimum score was determined to be between 10 and 20 points. After prolonged smartphone use, the maximum pain intensity on the visual analog scale (VAS) was between 1 and 2, and the minimum score was 4-5. According to this study, the maximum patient-rated ulnar nerve examination score was zero, and the minimum score was two. The chosen 80 subjects were made to stand erect against a wall and the distance between their occiput and the wall was measured to assess their forward head posture.

The improper posture acquired during the use of smartphones highly contributes to the FHP. Prolonged smartphone use can also give rise to the Guyon Canal syndrome. Postural Correction and proper ergonomic advice on holding a smartphone are necessary to prevent further complications and improve the quality of life. In this study, among 80 subjects who were assessed for FHP, 58 subjects were found to have GCS. Another study was done to check for the prevalence of peripheral neuropathies in musculoskeletal oedematous conditions, which

showed that later on, these individuals can develop peripheral neuropathies.[27]

The recurrent movement of the upper extremities in an unnatural position, as well as prolonged and frequent usage of smartphones, has been demonstrated to be the key contributing factors to the occurrence of musculoskeletal problems.[28-30] The musculoskeletal complaints in smartphone userssuch as discomfort and pain, occur not only in the neck but also in the shoulders, elbows, arms, wrists, hands, thumbs, and fingers.[7,8,23,31-33] The findings of this study suggest that subjects should make an effort to reduce the amount of time they spend using a smartphone continuously, as well as implement other preventive measures such as maintaining proper posture while using it, taking frequent short breaks, and using voice-to-text software.[8]

Usage of smartphones offers a wide range of purposes, like communication as well as leisure, which can be messages, music, multimedia, internet access, photographs, and games.[2,3] During prolonged usage of the smartphone, individuals tend to bend forward, which increases the load on the cervical spine at the C7 level, and the fourth and fifth fingers tend to stay in an awkward position for prolonged hours. (Fig. 1) As the ulnar nerve (nerve roots-C8, T1) supplies the pinky finger and fifth finger, it can further progress to Guyon canal syndrome.

A study done by Samaan M. showed significant differences in conduction velocity of the ulnar nerve, forward head angle, and visual analog scale for pain in individuals using smartphones for more than 4 hours per day. They demonstrated that prolonged use of a smartphone can decrease the ulnar nerve conduction velocity due to sustained neck flexion due to looking downward at the smartphone screen. This effect that occurs on the ulnar nerve conduction velocity can be due to the ulnar nerve being derived from the medial cord of the brachial plexus and as it contains fibers from spinal roots C8 and T1, which are compressed by prolonged static flexion during smartphone use.[34, 35]

The FHP was used to measure the distance, so the greater the distance, the more severe the FHP. ULTT-4 was used to assess the involvement of the ulnar nerve, which tends to affect these users due to the awkward posture of the pinky finger.

Due to the limited duration and geographical area as this study was only done in one college at a university, we suggest that further studies should be done in the future with the consideration of other users to understand this condition better.

Conclusion

Based on the findings of this study, we found that there was a positive correlation between forward head posture and Guyon canal syndrome in subjects using prolonged smartphones. FHP can give rise to moderate pressure on the ulnar nerve, which mainly supplies the fifth finger of the hand, causing Guyon Canal Syndrome. Hence, we can conclude that in subjects with prolonged usage of smartphones, FHP can further progress and these study participants may have the tendency to develop GCS.

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