Effect of Duration of Smartphone Use on Cervical Repositioning Error in Forward Head Posture and Normal Posture

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Abstract

Introduction: The purpose of this study was to assess the influence of the duration of smartphone usage on repositioning error in the cervical spine in forward head posture and normal posture. **Materials and Methods:** Thirty subjects (normal group: mean age 22.2±.90 years, mean height 161.00±.87 cm, mean weight 56.46±1.40 kg; and FHP group: mean age 24.26±.98 years, mean height 165.80±1.69 cm, mean weight 61.66±1.52 kg) were classified into two groups (15 forward head posture and 15 normal subjects) whose used their own smartphone for 20 minutes. Cervical repositioning error (for flexion, extension, right and left rotation) was calculated for all subjects before and after use of smartphone. All statistical analyses were conducted using IBM SPSS Statistics 24. **Results***:* Position sense error for flexion in normal group had a significant difference before and after using the smartphone. However, there was no significant difference in FHP groups and between the two groups. There was no significant difference either in extension and left rotation before and after use of smartphone and between two groups. Position sense error for the right rotation before and after using the smartphone in two groups had no significant difference, but after using the smartphone there was significant difference between the two groups. **Conclusion:** There were no significant differences in cervical repositioning error before and after use of smartphone in the normal group and FHP group as well as between the two groups.

Keywords: Cervical, Forward Head Posture, Repositioning Error, Smart Phone

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Introduction

Smartphones are a class of mobile phones whose usage is progressively growing because of the various applications installed on them and the ability to connect to the internet (1, 2). Long-term use of the smartphones results in repeated use of certain muscles and consequently damage to muscle fibers; cumulative damage from acute trauma which often occurs in the neck and shoulders (3). When using a computer with a touch screen, fatigue and stress in the neck and shoulder occur more easily than with desktops (4). When people use small-monitor devices such as smartphones and tablets, they look down and slouch more than with desktop (5). Using the smartphone in a fixed position without the support of the shoulder causes abnormal alignment in the neck shoulder. Further, smartphones have a small display and are usually close to the lap; as such users must bend their head to see the screens. In this way, the activity in the neck extensor muscles increases, thus increasing load on the neck and shoulder. This, in turn, promotes muscle fatigue and affects the musculoskeletal system (6, 7).

Muscle receptors are thought to be most important in providing information for proprioception (8, 9). Abnormal posture such as forward head posture (FHP) can change the length of the anterior and posterior muscles of neck whereby most of the superficial muscle becomes short while the deep muscle becomes long and weak (10, 11). Therefore, it seems that FHP affects the position sense in cervical region with FHP being the most common abnormal posture in the neck area (12, 13). Several methods are used to evaluate deep sense, one of which is assessing the joint position sense which is measurement of repositioning error in a limb in an active or passive form (9, 14, 15). In previous studies, there was a relationship between FHP and reposition

Table 1. General characteristic of the subjects (Mean±SD)

	FHP group	Normal group
Age (year)	0.98±24.26	0.90±22.20
Weight (kg)	1.52±61.66	1.40±56.46
Height (cm)	1.69±165.80	0.87±161.00
Flex before (cm)	15.87±2.36	17.59±1.36
Flex after (cm)	16.84±1.86	23.86±2.45
Ext before (cm)	15.29±1.76	18.62±2.33
Ext after (cm)	14.59±2.09	17.09±2.18
Right rotation before (cm)	12.94±2.30	16.96±3.01
Right rotation after (cm)	11.58±2.26	19.94±3.2
Left rotation before (cm)	16.81±2.17	18.19±2.40
Left rotation after (cm)	16.31±2.01	17.31±2.49

Table 2. Position sense error (N=15)

		(Mean±SD)
Normal group before use of smartphone	Flexion	17.59±1.36
	Extension	18.62±9.05
	Right rotation	16.96±11.66
	Left rotation	18.19±9.33
Normal group after use of smartphone	Flexion	23.84±2.45
	Extension	17.09±8.46
	Right rotation	19.94±12.50
	Left rotation	17.31±9.67
FHP group before use of smartphone	Flexion	15.87±9.14
	extension	15.29±6.84
	Right rotation	12.94±8.91
	Left rotation	16.81±8.41
FHP group after use of smartphone	Flexion	16.84±7.20
	extension	14.59±8.12
	Right rotation	11.58±8.75
	Left rotation	16.31±7.79

sense error in cervical region (16, 17). In this regard, the effect of smartphone use on head, cervical region, and repositioning error as well as a cervical repositioning error in FHP and normal subjects has been investigated. On the other hand, since no has addressed the effect of using smartphones on forward head posture, this study aimed to investigate the effect of duration of smartphone use on cervical repositioning error in forward head posture and normal posture. There are a close relationship between forward head posture and neck and shoulder pain (18). The purpose of this study was to assess the influence of the duration of smartphone usage on repositioning errors in the cervical spine in forward head posture and normal posture.

Materials and Methods

Subjects

A total of 30 young subjects (age: 18-30 years, BMI: 20-24 kg/m2) who had no physical difficulties in using smartphone were divided into two groups; 15 FHP subjects (Cranio vertebral Angle (CVA) < 49) and 15 normal subjects (CVA> 49) who had at least one year of experience with smartphone. The exclusion criteria consisted of a history of traumatic injuries or surgical interventions, neurological and orthopedic disorders, and chronic diseases affecting the musculoskeletal system.

Experimental Procedures

The subjects sat on a chair with their feet on the floor**,** knees, and hips at right angles whose trunk were upright. The tragus of the ear and spinouts process of the C7 vertebra were marked and the base of the camera was set at the height of the subject´s shoulder with a distance of 150 cm. A lateral view digital photograph of each subject was taken. Note that the CV angle is defined as the angle between a horizontal line passing through C7 and a line extending from the tragus of the ear to C7; we measured this angle by MB_Ruller software. For measuring cervical repositioning error sense, a laser pointer was firmly placed on the subjects' heads and they seated on chair while the shoulder, elbow, and waist were fixed by straps. They were instructed to

Table 3. Position sense error in each group (N=15)

	Statistical test	Sig (2-tailed)
Flexion a-b in normal group	Wilcoxon	0.033
Flexion a-b in normal group	Paired t test	0.707
Extension a-b in normal group	Paired t test	0.58
Extension a-b in FHP group	Paired t test	0.80
Right rotation a-b in normal group	Paired t test	0.06
Right rotation a-b in FHP group	Paired t test	0.50
Left rotation a-b in normal group	Paired t test	0.73
Left rotation a-b in FHP group	Paired t test	0.86

P<0.05. b: before use of smartphone, a: after use of smart phone

Table 4. Position sense error between the two groups (N=30)

	Statistical test	Sig(2-tailed)
Flexion before use of smartphone	Mann Whitney u	.49
Flexion after use of smartphone	Mann Whitney u	.05
Extension before use of smartphone	Independent samples test	.26
Extension after use of smartphone	Independent samples test	.41
Right rotation before use of smartphone	Mann whitney u	.15
Right rotation after use of smartphone	Mann Whitney u	.008
left rotation before use of smartphone	Independent samples test	.67
left rotation after use of smartphone	Independent samples test	.75

sit in their normal upright head and neck position and return to this initial upright head and neck. In order to reduce the error, the subjects were asked to practice the test three times before recording. They were also asked to move their head and neck through their entire range of flexion or extension and return to the initial upright position while the eyes were closed. They performed a full neck flexion and held this position for 5 s. Then, they were asked to return to the initial position while holding this position for 5 s with the stopping point of the laser beam being marked. This movement was done three times and the interval between the two points was calculated and the average was taken. The sequence of movements (flexion/extension/right rotation and left rotation) was done randomly. Each subject performed text-messaging, web-browsing, and video-watching tasks for 20 minutes in a fixed order using his/her own smartphone. They were asked to do some activity with a handy (dominant hand) and regardless of their own position. When the 20 minutes were completed, the cervical reposition sense error was measured again after using the smartphone.

All statistical analyses were performed suing IBM SPSS Statistics 24. Descriptive statistics for all variables were calculated. The K_S test was used to check the normality of the data. If the data were normal, to check the CVA and cervical repositioning error before and after use of smartphone in both groups (forward head posture and normal posture), Paired t-test was used, while to compare this effect between the two groups, independent T-Test was employed. If the data were not normal, to check the CVA and cervical repositioning error before and after use of smartphone in both groups, Wilcoxon test was utilized. Finally, to compare this effect between the two groups, Mann-Whitney U test was used.

Results

The demographic data as well as Mean and SD of variables are listed in Table 1. According to K-S test results, in some variables with no normal distribution, we used non-parametric statistics.

Position sense error for flexion in the normal group had a significant difference before and after using the smartphone (P=0.033), but in FHP group, there was no significant difference (P=0.707); there was no significant difference either between the two groups (flex before P=0.494 and flex after P=0.54) (Table 2, 3, 4).

Position sense error for extension in the normal and FHP groups had no significant difference before and after using the smartphone (normal: P=0.587) (FHP: P=0.707). There was no significant difference either between the two groups (extension before P=0.267 and extension after p=0.418) (Table 2, 3, 4).

Position sense error for left rotation in the normal and FHP groups had no significant difference before and after using the smartphone (normal: P=0.732), (FHP: P=0.862). No significant difference existed either between the two groups

(left rotation before P=0.674 and left rotation after P=0.758). Furthermore, position sense error for right rotation in the normal and FHP group had no significant difference before and after using the smartphone (normal: P=0.068), (FHP: P=0.504) and there was no significant difference either between the two groups before using the smartphone (P=0.152). However, after use there was a significant difference between the two groups (P=0.008) (Table 2, 3, 4).

Discussion

The smartphone is used frequently in every life; the long and continuous use of the smartphone causes incorrect posture (19). Smartphone users usually hold the device using one or two hands below their eye height. Excessive use of smartphones causes musculoskeletal disorder such as FHP (16) where patients with FHP usually complain about neck and shoulder pain (20). Pain reduces joint sensation which influences abnormal proprioception and poor postural balance (21) and the loss of position sense causes movement limitation (22).

The present study examined the effect of duration of smartphone use on cervical repositioning error in forward head posture and normal posture in order to investigate whether 20 minutes use of smartphone affects joint position sense in subjects (normal and FHP) and to determine if there is a difference between the two groups. Position sense error for flexion in the normal group had a significant difference before and after using the smartphone, but in FHP groups there was no significant difference possibly due to the lower cervical in the flexion and upper cervical in the extension in the FHP group; so, it is far away from the neutral position; reduces muscle dependence, and increases the role of ligaments. Consequently, this time (20 minute) was not enough to affect ligaments. There was no significant difference before and after use of smartphone and between the two groups for extension and left rotation. There was no significant difference regarding the position sense error for right rotation before and after using the smartphone in the two groups. However, after using the smartphone there was a significant difference between the two groups; possibly this is not long enough (20 minutes) to tire the rotator muscle and perhaps this muscle is more resistant to fatigue and probably the reason for the different error in rotation to the right, because of the greater number of right-handed individuals.

Conclusion

This study found no significant difference in the sense of position between normal and FHP groups as well as in each group, before and after using the smartphone (20 minutes). The purpose of this study was to provide information to help reduce musculoskeletal damage in smartphone users. Since defect in the position sense may lead to instability and degenerative diseases, so attention should be paid to the position of individuals when using the smartphone. It seems that some differences were not significant due to the limited trial time (20 minutes). Therefore, it is recommended that the present study be conducted with different time periods.

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