



Original Article

Differences in Cervical Extensor Muscles Thickness on Subjects with Normal Head Posture and Forward Head Posture; an Ultrasonography Study

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ABSTRACT

Background: Forward head posture (FHP) is recognized as a common postural disorder of modern societies. Increase in anterior cervical convexity and anterior displacement of the line of gravity of head in individuals with FHP is assumed to result in altered moment arms and muscle activity on cervical spine. Measurement of muscle thickness seems to be an appropriate index for muscle activity. This study was aimed to compare cervical extensor muscle thickness in individuals with normal head posture with those suffering from FHP.

Methods: Twenty volunteers with FHP and 20 matched controls (11 females and 9 males in each group) participated in this cross-sectional study. The thickness of cervical extensor muscles including multifidus, semispinalis cervicis, semispinalis capitis, splenius capitis and upper trapezius were measured using ultrasonography at the level of fourth cervical vertebrae at rest.

Results: No significant differences of thickness of cervical extensor muscles were observed between the two groups ($P < 0.05$) at rest.

Conclusion: The results of this study showed that the thickness of cervical extensor muscles at the level of fourth cervical vertebrae in individuals with FHP did not change in comparison with normal head posture at rest. Further studies are recommended to evaluate extensor muscles at other levels of cervical spine.

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Introduction

Forward head posture (FHP) is one of the most common postural disorders [1]. Prolonged sitting conditions in front of computers might lead people to adapt this posture [2] and cause them a variety of complications. FHP is claimed to contribute to an increase in the compressive forces on posterior apophyseal joints, posterior capsule, ligaments and posterior neck structures [3, 4]. Narrowing of intervertebral foramen with the possibility of compressive stresses on nerve roots is another complication of

FHP as well [5]. In such conditions, FHP may induce degenerative changes on intervertebral discs and cervical facet joints [6, 7]. Shoulder impingement syndrome, temporomandibular joint dysfunction, myofascial pain and tension headache are other reported complications of postural deviations [8-12]. From a biomechanical point of view, there is an increment/flattening of cervical lordosis and an augmentation/decrease of the distance of the apex of its convexity from line of gravity. These changes impose an extra flexor torque to neck muscles in comparison with normal posture causing permanent contraction of dorsal neck muscles to balance the imposed load [5, 13].

A recently study by Peolsson et al. has reported changes in the pattern of the activity of dorsal neck muscles

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secondary to three different acquired head and neck positions including FHP, normal head posture (NHP) and backward head posture [14]. Reduced neck extensor contraction capacity has also been observed during acquired neck flexion and extension posture [15]. However, to the best of our knowledge no study has yet been conducted to evaluate morphometric changes of dorsal neck muscles in individuals with FHP. Ultrasonography was frequently reported as a reliable method to evaluate and measure such muscular morphometric changes [16-18]. Therefore, we aimed to examine and compare dorsal neck muscle thickness in individuals with FHP with those with NHP. We hypothesize that there would be differences in dorsal neck muscles' thickness in individuals with FHP compared to those with NHP.

Methods

Twenty students with FHP aged $21.302.36 \pm$ years old and twenty controls with NHP aged $21.852.87 \pm$ years old, all right handed were recruited for this cross-sectional study. Any history of neck pain in the last year, trauma, neck surgery, rheumatoid diseases and structural mal—alignment were considered as exclusion criteria. The study protocol was fully explained to the subjects and each participant signed the consent form prior to data collection.

A plumb line was placed on their lateral side of body in the sagittal plane to evaluate their head posture. The acromion process was used as a landmark to align the plumb line with. FHP was defined as the placement of the ear tragus in front of the plumb line. Then cranio—vertebral angle was measured as a confirmation method in order to determine the exact angle of the head forward lean. Cranio—Vertebral angle is defined by the angle of the line passing the C7 and the midpoint of the ear tragus with the horizontal line [19, 20].

Ultrasonography imaging of dorsal neck muscles was performed by using Ultrasonix ES500, with a 12 MHz and 4.5 Cm linear array probe at the level of C4 while participants sat relaxed on a chair and put their hands on their thighs. The fourth cervical (C4) spinous process was identified by palpation. Then, the transducer transversely was placed at the level of C4 spinous process, moving it slowly to the right and slightly upward and downward to clearly observe echogenic vertebral lamina. The thickness of the dorsal neck muscles including trapezius, splenius capitis, semispinalis capitis, semispinalis cervicic and multifidus muscles were measured at C4 as the largest distance between the anterior and posterior fasciae (Figure 1) (17, 18, 21, 22).

Statistical analysis was performed in SPSS software v20 on windows operating system. Independent T test was used to compare each muscle thicknesses between two groups. Muscles' thicknesses were normalized to participants' weight to make muscle thickness of men and women comparable. The level of significance was set at 0.05.

Results

Twenty students with NHP aged 19 to 25 years and 20 matched students with FHP aged 19 to 24 years old were participated in this study. Participants' demographic information is provided in Table 1.

Independent T test showed no significant thickness differences between the groups for none of the dorsal neck muscles. Mean and standard deviation of normalized muscle thickness were demonstrated in Table 2.

Discussion

The results of the present study showed no significant difference of dorsal neck muscles thickness at of rest

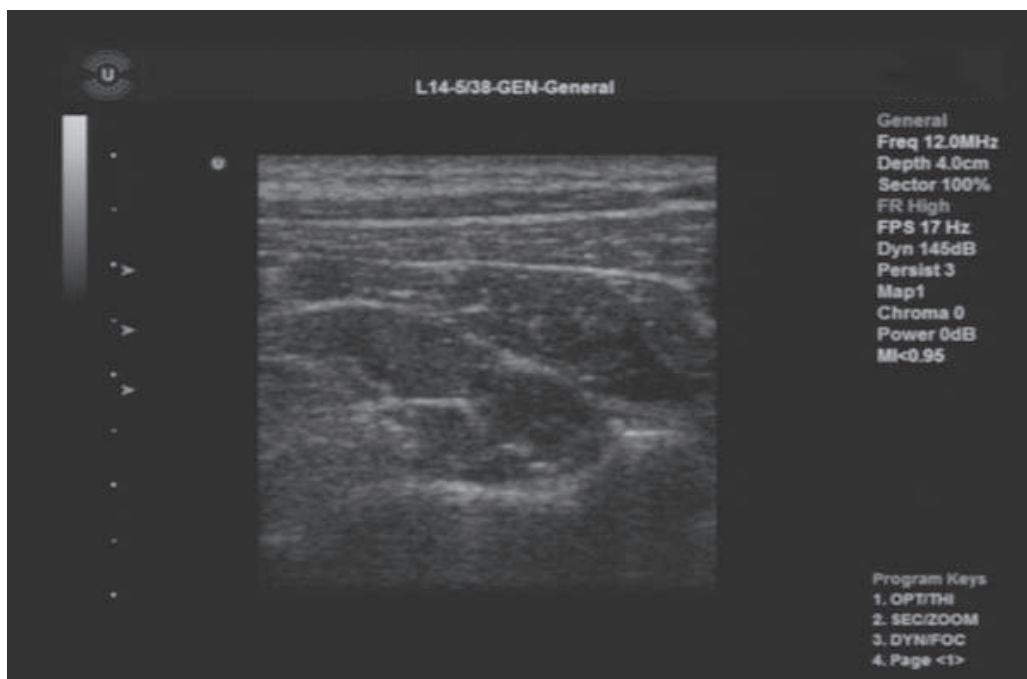


Figure 1: Ultrasonographic image of dorsal neck muscles

Table 1: Mean and standard deviations of participants' demographic data

Group	Age (yrs)	Height (cm)	Weight (kg)	BMI (kg/m ²)	CVA (degree)
NHP (n=20)	21.85±2.87	170.3±7.70	61.65±8.18	21.19±1.63	55.90 2.25
FHP (n=20)	21.30±2.36	171.15±7.08	61.12±9.76	20.77 ±2.38	43.43 2.58

BMI: Body mass Index; CVA: Craniovertebral angle

Table 2: Mean and standard deviation of normalized muscle thickness in mm/kg

Muscle	NHP	FHP	P value
Multifidus	0.15±0.02	0.15±0.01	0.74
Semispinalis Cervicis	0.08±0.01	0.08±0.02	0.99
Semispinalis Capitis	0.09±0.02	0.08±0.02	0.16
Spleniuscapitis	0.06±0.01	0.07±0.01	0.29
Upper Trapezius	0.02±0.00	0.02±0.00	0.83

between individuals with NHP and those with FHP.

Peolsson et al. demonstrated that there was a significant increase in the deformation rate of the dorsal neck muscles in intentional FHP in comparison with NHP. It was claimed that FHP would place the dorsal neck muscles in an antigravity position causing them to be more active compared with NHP [14]. These results are not in line with ours. This discrepancy between the results could be due to the following two reasons. First, Peolsson et al. examined muscles' deformation rate for the time span of 0.4 second. However, what we measured in the present study was muscles thicknesses. The second possible reason is the fact that ultrasound imaging was carried out on an intentional FHP while performing a lifting task in the Peolsson's study. On the contrary we recruited individuals who suffered from FHP and examined them at rest. It seems that the intentional FHP had an immediate effect on dorsal neck muscles activity shown during the lifting task. But, we could not see such an activity alteration at the state of the rest in individuals suffering from FHP.

To the best of our knowledge this is the first study to evaluate dorsal neck muscles in individuals with FHP. Therefore, we referred to the abovementioned study [14] to determine the cervical vertebral level for ultrasound imaging. Furthermore, it is argued that the best ultrasound image is taken when the ultrasound beam is perpendicular to the muscle fiber [17]. Since C4 is located in the middle of the cervical lordosis, it was assumed to be the best level for evaluating dorsal neck muscles. However, in FHP, the upper cervical vertebrae were placed in extension position and the lower vertebrae in flexion position. Consequently, it is expected that the upper muscles shortened and the lower ones stretched [23]. But, aforementioned morphometric changes are not detectable at the mid-level of C4. As a result we could not observe any difference between two groups of subjects.

Canerio et al. also reported an increase in electromyography activity of superficial dorsal neck muscles in slump sitting. It is believed that there is a forward lean of the head on the trunk following slump sitting. As a result, these muscles were placed in an antigravity position making them more activated compared with upright posture [24]. The results of the present study do not support these findings either. It

might be due to the fact that we measured the thickness of muscles at the state of rest and we did not record any basic or actual activity of the muscles.

Our observations from this research emphasize that atrophic changes were not found at level of C4 and therefore other cervical vertebral levels must be examined separately to see whether a morphometric alteration is presented. If thickness changes were found at other levels, then C4 is not a suitable level for FHP dorsal neck muscles evaluation. On the contrary, if no changes observed at other levels either, then strengthening exercises are not advised for FHP treatment.

There are some limitations to this study. First, only asymptomatic subjects were included. Therefore, we cannot extrapolate the results directly to a clinical population. Furthermore, we evaluated dorsal neck muscles at level of C4 only. A comprehensive evaluation of muscles at different cervical levels gives a better insight of dorsal neck muscles in individuals with FHP.

Conclusion

The results of this study showed no significant difference between the thicknesses of C4 dorsal neck muscles in individuals with FHP and NHP at the state of rest. Accordingly, no muscle atrophy was observed either. Thus, strengthening exercises for correction of FHP may not be advised. Additionally, C4 might not be the right level in evaluating dorsal neck muscles in subjects suffering from FHP.

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Conflict of Interest: None declared.

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