Short Communication

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The Correlation between Craniovertebral Angle and Scapular Dyskinesis in Adults

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ABSTRACT

BACKGROUND AND OBJECTIVE: Faulty neck posture causes many musculoskeletal disorders in the neck and shoulders. Considering the shared muscle attachments of the neck and the scapula, identifying the correlation between neck posture and scapular position can be effective in preventing shoulder pain. Therefore, the present study was conducted to determine the relationship between neck posture and static and dynamic scapular position.

METHODS: In this cross-sectional study, 38 female students from the University of Social Welfare and Rehabilitation Sciences without history of dysfunction in the shoulder and neck were selected and examined through nonprobability convenience sampling. Neck posture was examined by measuring the craniovertebral angle using diagnostic imaging techniques. The scapula – spine distance was measured using the ruler and the scapular winging was measured in hanging position of hand and during the flexion and scaption, and then the relationship between them and the craniovertebral angle was investigated.

FINDINGS: Subjects with an average age of 24.71±3.02 participated in the study. There was a significant correlation between craniovertebral angle (51.09±5.73) and the scapular winging in flexion (r=0.38, p=0.01) and scaption (r=0.44, p=0.005). There was no significant relationship between the craniovertebral angle and the distance between the fourth thoracic vertebra (T4) and the inferior angle of the scapula (6.29±0.96) and the distance between inferior angle and the corresponding vertebral levels (7.80±0.93).

CONCLUSION: The results of this study showed that neck posture is correlated with scapular dyskinesis in a dynamic scapular position.

KEY WORDS: *Neck, Scapula, Spine, Craniovertebral Angle.*

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Introduction

In contemporary societies, with the spread of sedentary lifestyle and the increasing use of technology, faulty postures have become widespread, especially in the head and neck region (1, 2). According to researchers, in most cases, dysfunctions in the region of the neck, thorax and shoulders are correlated with each other, and they are observed together, which may affect the muscles of these regions and disrupt their activity (3, 4). It seems that the muscles that may be affected by the neck posture are the scapulothoracic muscles, which provide scapular stability as the basis for the dynamic actions of the upper extremity (5). The head and neck posture may affect some of these muscles such as levator scapulae and upper trapezius due to their attachments with cervical vertebrae (6).

In a study, McLean et al. observed that the activity of the levator scapulae muscle in forward head posture (FHP) was higher than the normal posture of the head and neck (7). Since scapular stability is low on the chest, the muscles attached to scapula control its posture (8), and changes in the activity of these muscles disrupt the natural posture and movement of scapula (8, 9). In a study, Thigpen et al. found that in patients with forward head posture with rounded shoulders, the internal rotation of the scapula was significantly higher (3). Considering the relationship between neck posture and shoulder pain (10, 11), better understanding of its effect on the scapula is necessary, which can be effective in finding strategies to prevent or reduce the development of shoulder pain.

Despite the importance of this issue, the independent correlation between head and neck posture and scapular position has not been investigated so far. Therefore, the present study was conducted to investigate the possible correlation between craniovertebral angle as a criterion for head and neck posture and the distance of the scapula from the thoracic spine, as well as the scapular winging in static and dynamic scapular position.

Methods

This cross-sectional study was approved by the Ethics Committee of the University of Social Welfare and Rehabilitation Sciences with the Code of Ethics IR.USWR.REC.1393.306, and was conducted among 38 female students of the University of Social Welfare and Rehabilitation Sciences who were selected through nonprobability convenience sampling. People in the age range of 18 to 35 years whose dominant extremity was the right upper extremity, and had full and painless range of motion in the shoulder joint were included in the study. People with history of trauma or surgery in the regions of neck, shoulder or chest, scoliosis, increased kyphosis, neurological diseases in the neck or shoulders, rheumatoid arthritis, and continuous participation in physical activities were excluded. In case of having the necessary inclusion criteria, the participants signed an informed consent form after being informed of the course of the research.

In order to examine the head and neck posture, the digital imaging method was used to measure the craniovertebral angle, which is the angle between the ala-tragus line and the spinous process of the seventh cervical vertebra (C7) with a horizontal line. First, the participant was asked to perform the flexion and extension of the neck three times while standing to relax the neck muscles, and then put the head in neutral position. The camera was fixed on a base at a distance of 1.5 meters from the subject and its height was adjusted to match the level of the subject's shoulder. Then, the image was taken from the right view of the subject and the Photoshop software measured the angle between the two mentioned lines (12, 13).

Evaluation of the scapular position of dominant extremity was done in two ways. First, the scapula – spine distance was measured in anatomical position using a flexible ruler in millimeters (14, 15). For this purpose, the subjects were asked to stand in a comfortable position, while the hands were close to the body and they looked straight ahead. Then, the spinous process of the fourth thoracic vertebra (T4), the inferior angle of the scapula, and the spinous process of the corresponding vertebral levels were specified with superficial touch and were marked with a marker. While the examiner was standing behind the subject, the distance between the fourth thoracic vertebra and the inferior angle of the scapula and the distance between the inferior angle of the scapula and the corresponding vertebral levels were measured (14, 15).

In the second method, the scapular winging was examined in both static and dynamic positions. The subject was standing at resting position while the hands were close to the body and the subject looked straight ahead. The scapular winging was then measured from the level of chest using a ruler. The severity of the scapular winging was divided into three modes of normal (lack of scapular winging), mild (scapular winging less than 2.54 centimeters), and noticeable (scapular winging greater than 2.54 centimeters). In the next step, the scapular winging was examined in two positions of raised arms in sagittal plane (flexion) and scapular plane (scaption). The patient was asked to raise the arm in a standing position in the sagittal plane and then in the scapular plane (30 degrees to the frontal plane) for 5 seconds while holding a one-kilogram weight. During the test, the examiner was standing behind the participant to avoid any displacement of the trunk and spine in the anterior-posterior plane and lateral plane. Each of the movements was performed three times and the examiner measured the severity of scapular winging. Depending on the severity of scapular winging during arm flexion and scaption, it was assigned to one of the normal, mild, or noticeable categories (16). Data were analyzed by SPSS software version 21, Shapiro-Wilk statistical tests were used to examine the distribution of quantitative data, and Spearman correlation coefficient was used to investigate the relationship between craniovertebral angle and scapular position. P<0.05 was considered significant.

Results

Subjects with mean age of 24.71±3.02 years, mean BMI of 21.08±2.79 and mean craniovertebral angle of 51.09±5.73 (Table 1) participated in the study. There was a significant correlation between craniovertebral angle and scapular winging in flexion (r=0.38, p=0.01) and scaption (r=0.44, p=0.005); with the increase of the craniovertebral angle, the scapular winging increased, indicating that head and neck posture is correlated with the scapular winging in the dynamic position. No significant correlation was observed between craniovertebral angle and scapular winging in the static position. In addition, there was no significant correlation between the craniovertebral angle and the distance between the fourth thoracic vertebra and the inferior angle of the scapula (6.29±0.96) and the distance between the inferior angle of the scapula and the corresponding vertebral levels (7.80±0.93) (Table 2). It should be noted that all the studied variables followed the normal distribution (p<0.05).

Table 1. Information about the underlying variables of the subjects

Variable	Mean±SD	Min	Max
Age	24.71±3.02	19	31
Height	162.47±5.05	150	173
weight	55.84±9.00	40	75
Body mass index	21.08±2.79	15.63	27.89
Craniovertebral angle	51.09±5.73	39.60	63.20

Table 2. Investigating the relationship between the craniovertebral angle and scapular position

Variable		Correlation (r)	P–value
Scapular winging	In resting position	0.31	0.058
	In flexion position	0.38	0.01
	In scaption position	0.44	0.005
Distance between the fourth thoracic vertebra (T4) and the inferior angle of the scapula		- 0.18	0.28
Distance between the inferior angle of the scapula and the spine		0.03	0.84

Discussion

In the present study, a significant correlation was observed between the scapular winging and craniovertebral angle during arm flexion and scaption; with the increase of the craniovertebral angle, the scapular winging increased. The results indicate that the scapular winging may affect the neck posture, which may be due to the shared muscle attachments of the neck and the scapula. In a study, Thigpen et al. found that in patients with forward head posture and rounded shoulders, the internal rotation of the scapula was significantly higher (3). Therefore, the levator scapula was tighten. Consequently, in order to compensate this tension, the muscle elongated eccentrically. Therefore, it has been able to gain better control over the movement of the scapula while raising the arm. It is also likely that the elongation of the levator scapulae muscle through holding the anterior angle of scapula prevents the scapular winging during the movement of the arm. In this study, there was no correlation between scapula – spine distance and neck posture. The results of Kibler et al. showed that there is a correlation between the strength of the middle trapezius muscles and rhomboids and scapula – spine distance (17), in the way that weakness of these muscles increases scapula – spine distance and causes rounded shoulders (9, 18). It seems that because of the fact that the subjects in the present study did not have noticeable rounded shoulder abnormality, the scapula – spine distance did not increase; therefore, there was no significant correlation between craniovertebral angle and scapula – spine distance. In a study, Lee et al. reported a decrease in the activity of middle trapezius muscles during neck movements in patients with forward head posture, but the scapula – spine distance was not investigated (19). Therefore, further studies are needed to examine the relationship between neck posture and the scapula – spine distance. In this study, there was no significant relationship between neck posture and scapular winging in resting position, though it was very close to being significant. Since correlation analysis is closely related to the number of subjects, it is likely that there would be a significant correlation with the increase in the number of subjects. It is suggested that future studies consider this issue with larger sample size. All measurements were performed on the dominant extremity due to differences in peripheral nervous system between the two extremities, including nerve conduction velocity and differences in muscle strength. Participants were between the ages of 18 and 35 years old and considering the increase in the risk of spinal abnormalities with age, the results may not be directly applicable to other age groups, and similar studies are recommended to be conducted among older people. The results of the present study indicate that scapular winging in the dynamic state may affect the head and neck posture, which increases the importance of evaluating the scapular movement in neck posture disorders. The results of this study can be used as a background for future studies.

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