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THE CHANGE OF UPPER TRAPEZIUS AND SERRATUS ANTERIOR FOR VISUAL INFORMATION DURING SHOULDER FULL FLEXION IN FORWARD HEAD POSTURE: PRELIMINARY STUDY

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ABSTRACT

Purpose: The purpose of this study was to identify the effects of visual information for head posture on muscle activity of upper trapezius and serratus anterior and a ratio of serratus anterior to upper trapezius during shoulder full flexion test in subjects with forward head posture.

Methods: Fifteen subjects with forward head posture who volunteered were included in this study.

The subjects were measured muscle activity of upper trapezius and serratus anterior during the shoulder full flexion test. Subjects were asked to sit in a chair with a backrest and look straight ahead before performing the shoulder full flexion test up to a horizontal bar and holding the posture for 5 s. The subjects were asked to perform shoulder full flexion test while watching visual information monitor for their head posture. Two-way repeated analysis of variance was used to analyze about muscle and intervention. Paired t-test was used to analyze a ratio of serratus anterior to upper trapezius.

Results: There was significant difference pre and post-test for intervention ($p<0.05$), and there was significant difference interaction of muscle and intervention ($p<0.05$). In post-hoc analysis, the upper trapezius muscle activity significantly decreased, and the serratus anterior muscle activity significantly increased ($p<0.025$). A ratio of serratus anterior to upper trapezius significantly increased in pre and post-test.

Conclusion: This study recommends that the visual information of head posture that demonstrates a high ratio of serratus anterior to upper trapezius would be an important component of rehabilitation to enable correcting for forward head posture.

INTRODUCTION

The excessive using of computer can result in video display terminal syndrome, such as of musculoskeletal pains, headache, visual problem, and other symptoms , among which, musculoskeletal problems is the most common problem [1].

Forward head posture is defined as a combination of lower cervical flexion and upper cervical extension [2]. Forward head posture leads to lengthening and weakness of the anterior cervical muscles as well as shortening of the posterior cervical muscles [3]. Studies have shown that some postural orientations of the cervical spine, such as forward head posture, result in heightened gravitational load to some cervical motion segments [4] as well as increased extensor muscle activity [5]. At the atlantoccipital joint, forward head posture creates a long moment arm for the cervical extensor muscles counteracting the load of the head which arm results in a low muscular requirement of cervical extensor, while increasing the activities of the upper trapezius [6].

In addition to muscle imbalance, it is generally believed that forward head posture is a contributor to the development of chronic neck, shoulder, jaw pain, fatigue, and restricted movement of the neck as well as symptoms attributed to excessive joint and muscle loading. Every 2.5 cm the head moves forward, it gains 0.45 kg in weight, as far as the muscles in the upper back and neck are concerned, because they experience more strain to support the position of the head [7]. Maintain the head forward for long periods of time may cause musculoskeletal disorders such as 'upper crossed syndrome', which involves having reduced lordosis of the lower cervical, in conjunction with kyphosis of the upper thoracic vertebrae [8].

Lifting and overhead work in the sagittal plane are often performed in construction and assembly line workplaces for loading and unloading, and forward head posture is the typically assumed posture during much work in construction and on assembly lines [9]. Several variables have been identified as risk factors for the development of neck and shoulder pain, including highly abnormal sustained posture of the cervical spine, repetitive use of the arm, and work with the arm in an elevated position [10]. Although these factors can also be present without an elevated arm posture, their presence can put the upper extremity at higher risk. In particular, if someone is continuously working in an overhead position, he or she may experience strain and fatigue of the shoulder muscles. So that overhead work is highly correlated with upper extremity discomfort and disorders [11]. Although overhead work is closely related to musculoskeletal disorders, it is difficult to avoid and modify these postures in daily life as many occupational and athletic activities require repetitive overhead activity [12].

This study aimed to investigate the effects of visual information for head posture on muscle activity of upper trapezius and serratus anterior during shoulder full flexion test in forward head posture.

METHODS

Subjects

This study was conducted with 15 subjects (male 6, female 9) in the forward head posture. Subjects were recruited from Daegu University in Korea. The subjects were informed about the purpose and method of this study and asked to provide their consent to participate in the experiment. This study was approved by the Daegu University Institutional Review Board. The criteria for forward head posture was that the craniovertebral angle was less than 53º.16 Average age of subjects was 20.87±0.99 years, average height 165.67±8.20 cm, average weight 55.40±9.10 kg, and average craniovertebral angle was 56.43±2.27°.

PROCEDURE

Measurement

The subjects were measured muscle activity during the shoulder full flexion test were collected via a surface EMG system (TeleMyo DTS, Noraxon Inc., Scottsdale, AZ, USA) using silver–silver chloride surface electrodes. They had electrodes placed on the dominant side of their upper trapezius and serratus anterior. The subjects were asked to sit in a chair with a backrest and look straight ahead before performing the shoulder full flexion test up to a horizontal bar and holding the posture for 5 seconds. The subjects were asked to perform shoulder full flexion test while watching visual information monitor for their head posture. All measurements were repeated three times to produce average values.

The EMG data were normalized using the maximal voluntary isometric contractions (MVIC) of the upper trapezius, and serratus anterior separately. The measurement positions for the MVIC were chosen according to a study by Kendall [13]. MVIC values reflected the average RMS after three trials. EMG data were expressed as a percentage of MVIC (% MVIC).

Visual information

The subjects were then required to maintain this posture and perform end-range shoulder flexion for 5 seconds while their head posture was observed through a computer monitor. A video camera (DCR-SR68E, Sony, Dokyo) input into the computer monitor provided visual information for head posture. The video camera was set at the height of the subjects' acromia to expose the part of the head and the shoulders entirely. The monitor was set at the height of each subject's sightline.

Statistical analysis

Two-way repeated analysis of variance was used to analyze about muscle and intervention. The post-hoc analysis for interaction was performed to investigate significant differences between pre and post-test in each muscle by Bonferrori correction ($p<0.025$). Paired t-test was used to analyze a ratio of serratus anterior to upper trapezius. Statistical analyses were performed using SPSS for Windows (version 20.0), and the statistical significance level was set at $p < 0.05$.

Results

There was significant difference pre and post-test for intervention ($p<0.05$) (Table 1), and there was significant difference interaction of muscle and intervention ($p<0.05$) (Table 1). In post-hoc analysis, the upper trapezius muscle activity significantly decreased, and the serratus anterior muscle activity significantly increased ($p<0.025$) (Table 1). A ratio of serratus anterior to upper trapezius significantly increased in pre and post-test ($p<0.05$) (Table 2).

Table 1. Comparison of muscle activity in pre and post-test (unit: %MVIC)

	Pre	**Post**	**Muscle X Intervention**
UT	32.46±7.63	19.05±8.86**	0.00*
SA	26.64±6.14	34.16±10.04**	

Mean±SD, *p<0.05**: Bonferroni correction p<0.025
UT: Upper trapezius, SA: Serratus anterior

Table 2. Comparison of ratio of serratus anterior to upper trapezius muscle activity in pre and post-test (unit: ratio)

	Pre	**Post**	**Differ**	**t**	**p**
	0.88±0.33	2.56±2.29	1.68±2.28	-2.85	0.013*

Mean±SD, *p<0.05

DISCUSSION

The purpose of this study was to identify the effects of visual information for head posture on muscle activity of upper trapezius and serratus anterior and a ratio of serratus anterior to upper trapezius during shoulder full flexion test in subjects with forward head posture. The upper trapezius muscle activity significantly decreased, the serratus anterior muscle activity significantly increased, and a ratio of serratus anterior to upper trapezius significantly increased in visual information of post-test than pre-test.

The individuals with forward head posture were found that higher activity in the upper trapezius changes the angle of the cervical vertebra [14]. This study found that the upper trapezius compensates for the cervical extensor muscles and maintains the head position during shoulder full flexion in pre-test. During the 5 seconds of keeping shoulder full flexion, the muscle activity of upper trapezius under visual information is significantly lower than pre-test. A study reported that applied tapping on neck retractor muscles of individual with forward head posture during computer work [15]. In that study, the upper trapezius muscle activity was significantly decreased during computer work performed with tapping on neck retractor muscles, which is same to this study.

At the atlanto-occipital joint, upper trapezius plays the role of supporting the weight of head instead of the weaken cervical extensor muscles of individuals with forward head posture [6]. During the keeping shoulder full flexion, instead of cervical extensor muscles, upper trapezius will be over activity to maintain the position of head compared with normal individuals [3]. Forward head posture subjects displayed overuse of the upper trapezius due to the improper alignment, leading to in the functional failure of the serratus anterior that prevented the upward rotation of the scapula while shoulder full flexion.

The visual information reduced excessive muscle activity of upper trapezius. Therefore, it is believed that during the shoulder flexion, incorrect scapular motion was corrected through visual information for head posture, reducing upper trapezius activity and increasing serratus anterior activity. The muscle activity of serratus anterior can improve scapular stability and assist with scapular motion for upward rotation to better allow subjects to perform shoulder flexion [16,17]. Therefore, visual information of head posture can be a useful way to facilitate serratus anterior activity.

The limitations of this study were that muscle activity of deep neck muscle did not find with control group. For individual with forward head posture, the visual information of head posture that demonstrates a high ratio of serratus anterior to upper trapezius would be an important component of rehabilitation to enable correcting for forward head posture.

***Conflicts of interest*:** The authors declare no conflicts of interest.

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