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Effect of strengthening and elongation exercises of upper extremity muscle to forward head posture correction

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Abstract

This study was designed to provide basic data for developing exercise program that helps correcting posture by knowing the effect of strengthening and elongation exercises of upper extremity muscle to forward head posture correction. In this study determined subjects whether they had forward head posture or not. On the basis of the New York state posture rating, if a subject's posture is match up with the normal standard posture, gives 5 points and if the posture is slightly get out of the normal standard posture, gives 3 points and if the posture is apparently get out of the standard, gives 1 points. When determining the forward head posture, if talus, humerus and outer ear center are on the same line, it is determined as normal and if outer ear center is off the line less than 1.0cm, it is a slight deformation and if outer ear center is off the line more than 1.0cm, it is a high deformation. In the study selected people who have more than 1 cm gap between two vertical lines start from outer ear center and acromion separately as subjects. Length between the ideal alignment line measured by using goniometer and temporal region showed statistically significant decrease as 2.36±1.07cm before the intervention and 1.06±0.88cm after the intervention. After 4 weeks of neck and chest extensor muscle exercise, the group who exercised both showed increase in range of neck joint motion and neck flexion of the forward head posture. Meanwhile the group who only exercised neck extensor muscle only and the group who only exercised chest extensor muscle didn't showed statistically significant result. That only the group who exercised both muscles showed significant result is the different with studies before. Because this study didn't target patient who had a lesion, couldn't compare effect of the conservative manner and exercise. However, this study provides the fact that the group who exercised both neck and chest muscle had more effect than the control group.

Keywords: *Forward head posture, Strengthening, Elongation exercise, Upper extremity muscle, G*lobal postural system

I. Introduction

The amount of physical activity of people in modern society has significantly decreased due to the

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development of industries and machine civilization driven by computer technology. People barely walk, and replace even light work with monotonous movements using machines. Excessively repetitive work and habitually unstable postures stiffen muscles, and it was also reported that 8 out of 10 people experience a musculoskeletal disease once or more in their life time due to a chronic lack of exercises. [1].

Office workers and students who sit at a computer or desk most of the day keep the head forward and place the hands on a keyboard, staring at a monitor. In this case, it is difficult to maintain a normal spinal posture, and the head is leaning forward from the spinal centerline, called forward head posture. [2]

An ideal neck posture is keeping the head not tilted either forward or backward, or sideways, and keeping the neck muscles not stretched or rotated. [3] In the forward head posture, the centerline of the head moves forward, and this deformed posture is often observed in patients with cervical spine diseases such as cervical disc disorders, muscle sprains and strains, acquired cervical spine deformities, etc. [4]

In general, when a forward head dislocation is over 15mm in a lateral x-ray of the cervical spine, it is categorized as a forward head posture. [5] In this posture, the head is leaning forward, and the flexion moment of the neck is increased, which causes the compensatory backward flexion of the upper cervical spine joint and the atlanto-occipital joint to fix the eyes forward, the contraction of the muscles of the back of the head and neck, and the forward protrusion of the upper cervical spine. [6]

Maintaining a bad posture for a long time reduces the flexion of the normal cervical spine [7] [8] and weakens deep flexors such as the rhomboid, the serratus anterior and the lower trapezius. It also contracts the pectoralis major and minor muscles, the upper trapezius and the levator scapulae [9] [10] [11], and causes pain in the head, jaw joint, cervical spine, backbone, shoulders and arms. [12] [13]

Many studies suggested the following therapeutic approach to improve forward head posture: strengthening weakened muscles, and stretching shortened muscles to align posture. [12] [14] [15]

Earlier studies on forward head posture mainly focused on the flexion and extension of the neck. [16] [17] However, in order to improve the quality of life of patients with forward head posture and work efficiency, it will be necessary to make efforts to correct posture and reduce pain by performing proper stretching and strengthening exercises.

Against this backdrop, this study aimed to examine the effects of stretching and strengthening exercises for each body part on forward head posture observed in people in modern society, and to provide basic data for the development of exercise programs to correct posture.

2. Methods

2.1 Objects and Duration

This study was conducted on 30 adults in their 20s from January 4 to 29, 2017 for 4 weeks, and objects performed exercises 3 times a week. Based on the following criteria, 30 objects were randomly selected (15 for the stretching exercise group, and 15 strengthening exercise group).

1) Those who are fully informed of the purpose and methods of this study, and consent to participate in this study

2) Those who do not have any congenital or acquired musculoskeletal disease

3) Those who are suspected to have a forward head posture after measuring using a global postural system (GPS)

2.2 Measuring Methods and Tools

2.2.1 Global postural system (GPS)

Prior to conducting this study, objects were tested to examine whether they have forward head posture using a global postural system (GPS).

Posture was evaluated according to the New York Posture Rating Chart (normal: 5 points, slightly tilted: 3 points, distinctively tilted: 1 point). When the talus, humerus and outer ear's center are on the same line, it is categorized as a normal posture. When the outer ear's center is off the normal line forward by 0.5 ~ 1.0cm, and over 1.0cm, it is categorized as a slight deformity and a severe deformity respectively (Part et al., 2013). In this study, a straight line was drawn from the acromion to the external auditory meatus, and the distance between the line and that of the ideally aligned line was measured. Those whose distance between the two lines was over 1cm were selected as an object.

Figure 1. Before experiment Figure 2. After experiment

2.2.2 Goniometer

A goniometer was used to measure the distance from the ideally aligned line to the temporal region.

2.2.3 Statistical analysis

In this study, statistical analysis was conducted using Windows SPSS version 15.0. A paired samples t-test was conducted to examine differences between before and after exercises, and the significance level was set at α=0.05 to test statistical significance.

3. Exercise Program

In this study, an exercise program suggested by Park et al. [18] was used, and exercises were conducted 3 times per week for 4 weeks. The levator scapulae and the upper trapezius were self-stretched, and the levator scapulae was laterally flexed in the opposite direction and the upper trapezius was flexed forward. All the postures were maintained for 10 seconds, and repeated 3 times.

Strengthening exercises were applied to the middle and lower trapezius. For the middle trapezius, objects were instructed to lie face down, to spread their arms and to bend and lift the elbow joints. For the lower trapezius, objects were instructed to lie face down, to bend the arms by 135˚ and to lift the arms. The exercises for the two muscles were repeated 3 sets (15 times per set).

Figure 3. Strengthening exercise 1

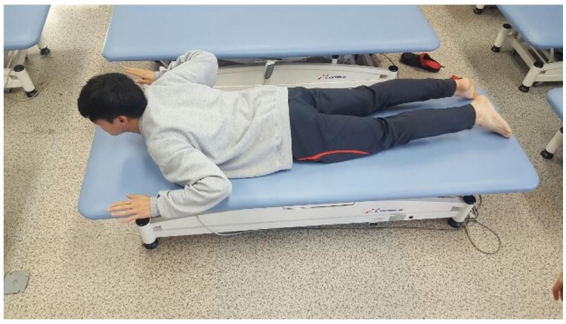

Figure 4. Strengthening exercise 2

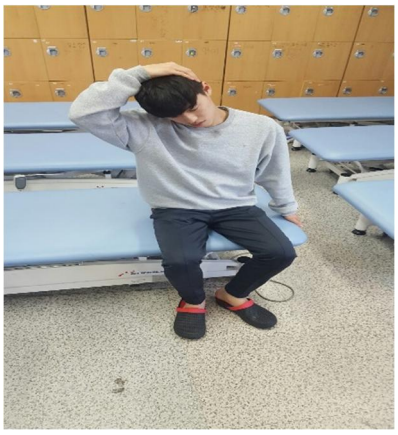

Figure 5. Stretching exercise 1

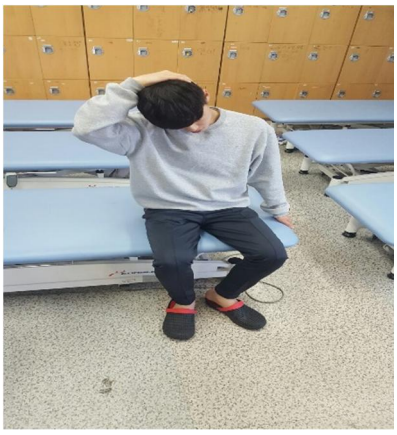

Figure 6. Stretching exercise 2

Figure 7. Stretching exercise 3

3. Results

3.1 General characteristics of objects

In this study, 40 healthy college students who do not have any disease or disorder that can affect this study were selected as an object. The general characteristics of the objects are as shown in Table

Table 1. General characteristics

	Male (n=20)	Female (n=20)
Age	23.95±1.1909	21.45±1.3945
Height	174.95±5.2362	160.95±5.236
Weight	73.41±6.016	58.76±7.221

3.2 The effects of strengthening and stretching exercises for the upper extremity muscles on the correction of forward head posture

Table 2. shows the effects of strengthening and stretching exercises for the upper extremity muscles on the correction of forward head posture.

Strengthening and stretching exercises for the upper extremity muscles had a statistically significant impact on the correction of forward head posture (P<.05). The distance from the ideally aligned line to the temporal region that was measured using a goniometer was 2.36±1.07cm before mediation, and 1.06±0.88cm after mediation, showing a statistically significant decrease (p<.05).

Table 2. Distance from the ideally aligned line to the temporal region before and after mediation

(CM)

	N= 40				
	Before mediation	After mediation	Before-after mediation		
				t	sig.
Distance from the ideally aligned line to the temporal region	M±SD	M±SD	M±SD		
	2.36±1.07	1.06±0.88	1.28±0.66	12.374	0.00*

*p<0.05

4. Discussions

People in modern society experience various symptoms in the neck due to continuous stress caused by the fatigue and overload in the cervical spine and lack of exercises, unhealthy behaviors, undesirable postures at work, accidents, etc. [19] [20] As many people have experience pain in the neck, people start to pay more attention to it and more studies have been conducted. However, most studies focus on treatment only, overlooking the relationship between pain in the neck and muscular strength and posture. In this regard, it was recommended to conduct research on the relationship between treatment and prevention of pain in the neck, and in particular, studies on the potential occurrence of pain in the neck also need to be conducted for those who do not have pain in the neck yet but have a relatively poor posture. [20] [21]

In a forward head posture, the levator scapulae, the sternocleidomastoid, the scalenes, the upper trapezius, and the pectoralis major and minor muscles are contracted, and the muscles in the lower cervical spine, the erector spinae, the middle and lower trapezius, and the rhomboid become weaker. [22]

Since these issues can be addressed by correcting forward head posture, exercises to correct the abnormal alignment of the head are often used in clinical settings. [23] In addition, it was also reported that forward head posture needs to be treated through exercises based on the understanding of proper postures and ergonomic work environment. [15]

In this study, stretching and strengthening exercises were conducted as an efficient mediation method on

objects who showed forward head posture in order to improve their weakened muscles. After conducting stretching exercises for the levator scapulae and the upper trapezius, and strengthening exercises for the middle and lower trapezius for 4 weeks, any improvement in forward head posture was measured and analyzed using a global postural system (GPS).

Undesirable postures cause pain and muscular imbalance [24], and those who work at a desk for a long time tend to lean the head forward from the spinal centerline, which results in forward head posture. The head and the upper cervical spine are extended, and the lower cervical spine is flexed, which makes the cervical spine excessively extended. [25] In particular, forward head posture has been observed more recently in college students and office workers who have to sit at a desk for a long time.

Kim & Lee(2004) [26] conducted a study to analyze the effects of stretching exercises on pain in the neck and shoulders among occupational musculoskeletal diseases. A questionnaire survey was conducted on female production workers (43 in the experimental group, and 34 in the control group) and their pain was measured using a visual analog scale (VAS). After 4 weeks of stretching exercises, there was a statistically significant decrease in pain related to musculoskeletal diseases, and it was also reported that stretching exercises are important to prevent a recurrence of pain.

In another study (Roddey et al., 2002) [27], the effects of stretching exercises for the pectoralis major on the shoulder blades in a calm state were analyzed, and the study was conducted on people who have different postures such as forward head posture and rounded shoulder posture. Those who had severe forward head posture and rounded shoulder posture were divided into Group A, and those who had light forward head posture and rounded shoulder posture were divided into Group B. Stretching exercises were conducted for the groups, but were not conducted on Group C, composed of those who had light forward head posture and rounded shoulder posture. The study concluded that stretching exercises are effective to correct posture.

Choi & Hwang(2011) [28] conducted another study on 16 healthy adults in their 20s to 40s who did not have any treatment due to pain in the neck, shoulders or back in the past year. The horizontal distance from the tragus to the posterior aspect of the acromion in a standing position was measured, and those who showed over 5cm (forward head posture) were selected as an object. For the experimental group (8 objects), instructions on posture and 10 weeks of stretching and strengthening exercise programs were provided, and for the control group (8 objects), instructions on posture were provided only. Before and after the experiment, their head rotation angle was measured. The head rotation angle in the experimental group decreased, while that in the control group did not show any change. Before conducting the experiment, there was no statistically significant difference between the two groups, but after the experiment, there was a statistically significant difference between the two groups ($p < .05$).

Lee(2011) [29] compared changes in posture using a GPS before and after balancing and stretching exercises in order to examine the effects of the exercises on forward head posture. Using surface electromyogram, changes in muscular activity before and after the exercises were compared. There was no statistically significant change in posture, but muscular activity increased after the exercises. Park et al. (2013) [18] also measured changes in posture before and after exercises using a GPS, and there was also a statistically significant difference. In the study, there was a statistically significant difference in posture and muscular activity before and after exercises in the experimental group, and also between the experimental and control groups after the experiment.

In this study, there was a statistically significant increase in the retraction of forward head posture and in the range of motion in the group in which 4 weeks of strengthening exercises were conducted both for the neck and chest extension. However, there was no statistically significant difference in the groups in which strengthening exercises were conducted either for the neck or for the chest extension. In other words, there

was a statistically significant difference only in the group in which strengthening exercises were conducted both for the neck and chest, which is different from the results of the study above.

Since this study was not conducted on patients who showed symptoms, it was difficult to directly compare the effects of conservative treatment and exercises. However, the group to which strengthening exercises were applied for the neck and chest showed a statistically significant difference compared to the control group. The result that performing strengthening exercises for the neck and chest extension at the same time affects forward head posture coincides with the results of the study above. [28] After strengthening and self-stretching exercises for the middle and lower trapezius, the abnormal alignment of the cervical spine was improved, which shows that the exercises were effective in improving forward head posture.

There were some limitations in this study. First, the number of objects was too small, and the duration was too short to generalize the results of this study. Second, objects were selected from those in their 20s only, and thus it was difficult to apply the results to all age groups. Third, it was also difficult to check whether objects performed the exercises properly and to control their activities after the exercises.

However, there were only few studies on the prevention and reduction of pain despite the high prevalence of musculoskeletal diseases in Korea. In this regard, the results of this study are meaningful, and it is necessary to conduct a follow-up study on a larger number of objects for a longer period of time (over 6 months).

5. Conclusions

This study aimed to find an efficient mediation method by comparing changes in forward head posture before and after stretching the levator scapulae and the upper trapezius, and strengthening the muscles in the lower cervical spine and the middle and lower trapezius, and to provide basic data for the development of exercise programs to prevent pain in the neck and shoulders and to correct forward head posture. Strengthening and stretching exercises for the upper extremity muscles are expected to correct forward head posture and thus to reduce stress and pain in the cervical spine.

In this study, the effects of strengthening and stretching exercises for the upper extremity muscles on the correction of forward head posture were measured using a goniometer. The distance from the ideally aligned line to the temporal region was 2.36±1.07cm before mediation, and 1.06±0.88cm after mediation, showing a statistically significant decrease ($p<.05$).

After stretching exercises for the levator scapulae and the upper trapezius. and strengthening exercises for the middle and lower trapezius, the abnormal alignment of the cervical spine was improved. Based on the results, it can be concluded that the exercises are effective in improving forward head posture.

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