



Original Article

Effects of elastic band exercise on subjects with rounded shoulder posture and forward head posture

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Abstract. [Purpose] This study performed to investigate the effect of elastic band exercise program on the posture of subjects with rounded shoulder and forward head posture. [Subjects and Methods] The body length, forward shoulder angle, craniovertebral angle, and cranial rotation angle of participants (n=12) were measured before and after the exercise program. Furthermore, the thicknesses of the pectoralis major, rhomboid major, and upper trapezius were measured using an ultrasonographic imaging device. The exercises program was conducted with elastic bands, with 15 repetitions per set and 3 sets in total. [Results] The length of the pectoralis major, forward shoulder angle, and craniovertebral angle showed significant changes between before and after the exercise program, whereas the changes in the other measurements were not significant. The thickness of the upper trapezius showed a significant increase between before and after the elastic band exercise. [Conclusion] These findings suggest that the elastic band exercise program used in the study is effective for lengthening the pectoralis major and correcting rounded shoulder and forward head posture.

Key words: Rounded shoulder, Forward head posture, Elastic band exercise

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INTRODUCTION

Most people employed in economic activities complain neck, shoulders, and lower back disease. In particular, when one uses a computer in an inappropriate posture for a long time, the centerline of the head moves forward and upward, which causes an increase in the weight of the head supported by the neck, ultimately resulting in changes in the head, neck, and areas connecting the shoulders^{1, 2)}. If the head is located anteriorly for long periods, the bending moment of the head increases, and compensatory excessive straightening of the upper neck joints and atlanto-occipital joints is required to fix the gaze to the front. This can cause shortening of the posterior head and neck muscles, and the upper neck bones can protrude relatively forward when the face is oriented upward^{3, 4)}. Moreover, due to structural characteristics, this can cause rounded shoulder with rounding of the back⁵⁾. Rounded shoulder is a typical bent posture in which the scapulae are elevated and the acromion is protruded forward in comparison with the center of gravity of the body. The angle between the lower neck bone and upper back bone was increased, and the protraction, upward rotation, and anterior tilt of the scapulae were increased^{6, 7)}. Such changes cause imbalance in the surrounding muscles and eventually cause pain in the head, temporomandibular joints, neck, back, shoulders, and arms^{8–11)}.

Changes in the skeletal alignment can indicate imbalance in stretching and shortening of muscles, imbalance in use of

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Table 1. General characteristics of the participants

	Age (yr)	Height (cm)	Weight (kg)	Gender	
				Male	Female
Group	20.8 ± 0.8	167.3 ± 7.3	64.5 ± 7.3	n=6	n=6

antagonist and agonist muscles, or skeletal defects that promote such muscular changes, and inappropriate postures aggravate pain and damage. Therefore, various posture correction programs that can correct skeletal alignment, decrease pain, and facilitate recovery of tissue and changes in the body have been suggested¹²). Although surgeries that can result in fast improvements within a short period are drawing attention, surgery alone cannot be used as the optimal treatment because symptoms can recur even after treatment of malpositioned vertebrae due to imbalance in peripheral soft tissues.

An elastic band is a rubber band with elasticity and resistance, and the velocity and intensity of the resistance of an elastic band can be controlled. Elastic bands can be used to apply resistance in a way that is different from that of exercise equipment with weights such as dumbbells. Moreover, they can be used in various ways just as exercise can be performed in all directions. Considering that exercise using elastic bands, which are easy to carry, is economical and safe, elastic bands can be used to improve muscular strength, flexibility, and balance control in the elderly and young, regardless of gender¹³⁻¹⁵). Exercise using elastic bands can be applied not only to ordinary people but also to patients with diseases. The application of elastic resistance band exercise programs to orthostatic hypotensive elderly was reported to be a safe method of improving strength, functional ability, and physical activity¹³). The application of elastic band exercise programs in patients with chronic obstructive pulmonary disease was found to increase the patients' functional capacity and muscular function¹⁶). The effects of elastic band exercise programs have been reported to improve physical and postural control. However, programs for people with forward head posture and rounded shoulder are lacking. In the present study, we investigated the effect of an elastic band exercise programs on physical alignment and changes in related muscles in subjects with rounded shoulder and forward head posture.

SUBJECTS AND METHODS

Subjects (n=12; the distance between on the table and the acromion > 2.5 cm) with rounded shoulder and forward head posture were included in the study⁷). Subjects who had scapula damage, had previously received surgery on the neck bone or upper limbs, or had other diseases were excluded. The study subjects performed 3 sets of the exercise program with 15 repetitions per set. Measurements were made before and after the exercise. Before the program, the purpose of the study was explained to the subjects, and only the subjects who agreed to participate in the study were included. Kyungnam University approved this study, which complies with the ethical standards of the Declaration of Helsinki. Table 1 presents the general characteristics of the subjects.

The exercise program included the following exercises: 1) a lat pull down, 2) a shoulder external rotation exercise, 3) shoulder horizontal abduction exercise, 4) a seated bend row, 5) a shoulder abduction exercise, 6) a shoulder flexion exercise, and 7) a shoulder extension exercise. For the lat pull down, the subjects held both ends of the elastic band while lifting the arms to shoulder width. They stretched the band slowly in both directions and pulled it down to their chest. The abdomen remained contracted while performing the exercise. 2) For the shoulder external rotation exercise, the subjects bent their arms to 90° and oriented their palms toward the ceiling, while their elbows at the height of the flank. They held the elastic band and slowly stretched it while rotating their shoulders externally. They were instructed to not move the elbows forward. 3) For the shoulder horizontal abduction exercise, the subjects extended their arms in front of their body at 90° and placed them shoulder-width apart. Their palms were oriented to face the ground, and they held the elastic band. They then stretched the elastic band horizontally while paying attention to keep their elbows straight. 4) For the seated bend row, the subjects placed the elastic band such that their feet were located at the middle of the band. They then sat on a chair and held the ends of the elastic band. The subjects stretched the elastic band as if their elbows were being put together and drew their shoulders together. 5) For the shoulder abduction exercise, the subjects stepped on the elastic band with the foot on the side being exercised, held the elastic band with one hand, and kept the hand low in its neutral position. They then opened the shoulders with the elbows slightly bent. 6) For the shoulder flexion exercise, the subjects stepped on the elastic band with the foot on the side being exercised, held the elastic band with one hand, and kept the hand low in its neutral position. They then bent the arm forward with the elbow straightened. 7) For the shoulder extension exercise, the examiner held one end of the elastic band, and the subject held the other. The subject started by holding the elastic band low in its neutral position, and then they extended the arm backward with the elbow straightened as much as possible. The following body measurements were ascertained: 1) height of the acromion, 2) distance between the third vertebra and the acromion, 3) distance between the third thoracic vertebra and the inferior angle of scapula, 4) distance between the inner surface of the scapula and the vertebrae, and 5) length of the pectoralis major. For the height of the acromion, the examiner measured the distance between the table and the acromion⁷) while the subject was in the supine position. For the distance between the third vertebra and the acromion, the

Table 2. The body lengths before and after elastic band exercise (unit: cm)

	Pre-ex	Post-ex
The distance between the bed and the acromion in the supine position	6.1 ± 2.6	6.2 ± 1.6
The distance between the acromion and the third thoracic vertebra (T3)	21.5 ± 2.1	21.9 ± 1.2
The distance between the seventh thoracic vertebra (T7) and the inferior angle of the scapula	16.5 ± 1.8	16.4 ± 1.5
The distance between the thoracic vertebrae and the inner surface of the scapula	8.7 ± 1.3	8.6 ± 1.2
The length of the pectoralis major	12.9 ± 1.9	17.6 ± 1.4*

Ex: exercise; *p<0.05 compared to pre-ex group

distance between the acromion and the middle of the spinous process of the third thoracic vertebra was measured^{17, 18}. For the distance between the third thoracic vertebrae and the inferior angle of the scapula, the inferior angle of the scapula and the spinous process of the third thoracic vertebra were marked, and then the distance between the two points was measured with a tape ruler. For the distance between the inner surface of the scapula and the vertebrae, the horizontal distance from the scapula to the vertebrae was measured with a tape ruler. For the length of the pectoralis major, the subject sat in a comfortable sitting position in a chair, and the examiner marked the middle of the sternal notch and the inner side of the coracoid process by using a marking tape and measured the distance between the two points with a tape ruler^{18, 19}. All measurements were performed on the dominant side. In order to measure the thicknesses of the pectoralis major, rhomboid major muscle, and upper trapezius muscle, a diagnostic ultrasonographic imaging device (SonoAce X8, Samsung, Medison, Republic of Korea) was used in the B-mode setting. The thickness of the pectoralis major was measured by first drawing a line between the halfway point of the sternum and the lateral lip edge of the bicipital groove. A 7.5-MHz linear probe was used as the axis to measure the thickness at the halfway point of the line. The thickness of the rhomboid major muscle was measured by first drawing a line between the inner surface of the scapula and the midpoint between the spinous processes of the third (T3) and fourth (T4) thoracic vertebrae, and a 7.5-MHz linear probe was used as the axis to measure the thickness at the halfway point of the line. The thickness of the upper trapezius muscle was measured by first drawing a line between the acromion process and the spinous process of the second thoracic vertebra (T2). A 7.5-MHz linear probe was used as the axis to measure the thickness at the halfway point of the line.

Forward shoulder angle was measured by attaching markers to the tragus, seventh cervical vertebra (C7), and acromion of the subjects and based on sagittal images. ImageJ (version 1.48) was used to measure the angle. For the craniovertebral angle (CVA), the angle between the vertical line and the line connecting C7 and the tragus was measured. For the cranial rotation angle (CRA), the angle between the line connecting C7 and the tragus and the line connecting the external canthal angles of the eyes was measured.

SPSS version 14.0 for Windows was used for the statistical analyses. In order to verify the effects observed in the subjects before and after the exercise program, paired t-tests were conducted. The level of significance was set at p<0.05.

RESULTS

When the distance from the bed and the acromion of the subjects was measured in the supine position, the mean pre- and post-exercise distances were 6.1 ± 2.6 cm and 6.2 ± 1.6 cm, respectively. The mean pre- and post-exercise distances between T3 and the acromion were 21.5 ± 2.1 cm and 21.9 ± 1.2 cm, respectively. The mean distances between T7 and the inferior angle of the scapula were 16.5 ± 1.8 cm and 16.4 ± 1.5 cm before and after the exercise, respectively. The distance from the thoracic vertebrae to the inner surface of the scapula was 8.7 ± 1.3 cm before the exercise program and 8.6 ± 1.2 cm after the program. The lengths of the pectoralis major before and after the exercise program were 12.9 ± 1.9 cm and 17.6 ± 1.4 cm, respectively. The pre- and post-exercise measurements indicate that the length of the pectoralis major showed a statistically significant change (p<0.05), whereas the other measurements did not (p>0.05; Table 2).

The pre- and post-exercise forward shoulder angles were 32.2 ± 6.2° and 29.5 ± 5.7°, respectively. CVA was 46.5 ± 3.7° before the exercise program and 50.0 ± 4.9° after the exercise program. The pre- and post-exercise CRAs were 164.0 ± 7.0° and 162.1 ± 6.8°, respectively. Although statistically significant differences were observed in the pre- and post-exercise measurements of forward shoulder angle and CVA (p<0.05), no significant difference was observed in CRA (p>0.05; Table 3).

The thickness of the pectoralis major before and after exercise was 1.2 ± 0.5 cm and 1.2 ± 0.4 cm, respectively. The thickness of rhomboid major before and after exercise was 1.1 ± 0.3 cm and 1.1 ± 0.3 cm, respectively. Thickness of upper trapezius before and after exercise was 0.8 ± 0.2 cm and 1.0 ± 0.2 cm, respectively (Fig. 1). Although statically significant differences were observed in thickness of the upper trapezius (p<0.05), no significant difference was observed in thickness of the pectoralis major and rhomboid major (p>0.05; Table 4)

Table 3. Forward Shoulder Angle, CVA, and CRA before and after elastic band exercise (unit: °)

	Pre-ex	Post-ex
Forward Shoulder Angle	32.2 ± 6.2	29.5 ± 5.7*
CVA	46.5 ± 3.7	50.0 ± 4.9*
CRA	164.0 ± 7.0	162.1 ± 6.8

Ex: exercise; CVA: craniocervical angle; CRA: cranial rotation angle; *p<0.05 compared to pre-ex group

Table 4. Thickness of muscles before and after elastic band exercise (unit: cm)

	Pre-ex	Post-ex
Pectoralis major	1.2 ± 0.5	1.2 ± 0.4
Rhomboid major	1.1 ± 0.3	1.1 ± 0.3
Upper trapezius	0.8 ± 0.2	1.0 ± 0.2*

*p<0.05 compared to pre-ex group

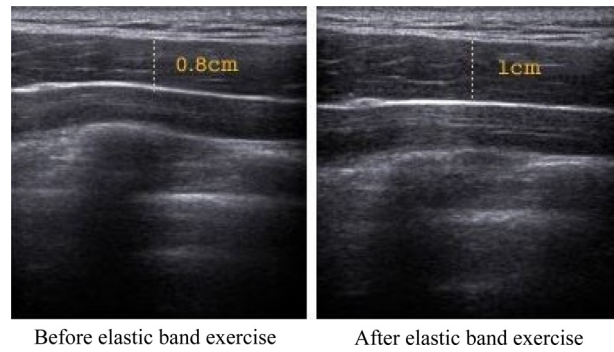


Fig. 1. Thickness of upper trapezius using ultrasonography

DISCUSSION

Ideal posture refers to a state in which body parts receive the minimum amount of stress against gravity and the position of the body is appropriately aligned in space. Inappropriate posture can cause inappropriate movements of the joints by affecting the level of tension and contraction of muscles, which can cause pain. Therefore, good posture is a measure of health²⁰. Typical postural changes were caused by inappropriate posture include forward head posture and rounded shoulder.

In forward head posture, the pectoralis major and pectoralis minor contract, and the rhomboid muscles weaken⁸. If subscapular muscles cannot create an appropriate muscular counterbalance, the head of the humerus can glide anteriorly, the shoulder girdle can descend, or lifting of the scapula can become difficult, leading to functional problems in the pectoralis major⁷. In comparison between the pre- and post-elastic band exercise measurements of the subjects with rounded shoulder, we found that the length of the pectoralis major increased by 5 cm. This means that the distance between the sternum and the lateral lip of the bicipital groove increased, and consequently, the pectoralis major, which was shortened previously, was thought to be stretched. Moreover, shortening of the pectoralis major, which contributes to rounded shoulder, seems to be relieved. However, no statistically significant difference was observed in the distance between the bed and the acromion, the distance between the acromion and the third vertebra, the distance between the third vertebra and the inferior angle of scapula, and the distance between the vertebrae and the inner surface of the scapula. This is believed to be due to the exercise program being applied only for 40 minutes per session and being unable to produce greater effects.

In forward head posture and forward shoulder angle, the head is located anteriorly from the centerline and seems rotated. This is because the upper cervical vertebra is straightened as the chin is held upward for correction of gaze. Moreover, this causes structural stress around the neck, which in turn causes shortening or excessive tension of the surrounding muscles²¹. Forward head posture can be evaluated by measuring the CVA and CRA. Forward head posture is diagnosed when the CVA is less than 50° and the CRA is greater than 145°²². When comparing the forward shoulder angles measured before and after the elastic band exercise program, we found that the forward shoulder angle decreased by 8.41% and that the CVA increased by 7.48%, showing a significant difference. However, no significant difference was observed in CRA. Decreased forward shoulder angle and increased CVA mean that the head has moved closer to the gravity line connecting the auricle and the acromion process. In other words, rounded shoulder and forward head posture are changing into good posture. Although the elastic band exercise program was conducted only once in the study, we could confirm changes in the length of the pectoralis major and observe movement of the head and neck bone alignment to close to the gravity line. Exercise programs with elastic bands, which are easily accessible, can be used effectively in the correction of posture, without temporal and spatial limitations.

The limitations of this study include the following: As the number of subjects in this study is small, generalization of the results is difficult. Moreover, the exercise program was conducted only once, and the same type of elastic band with the same strength was used for all the subjects, without consideration of their muscle strength. In future studies, exercise programs need to be applied for longer periods. In particular, studies on exercise programs that use elastic bands with strengths appropriate for individual subjects are deemed necessary.

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