



Original Article

Effects of scapular stability exercise on shoulder stability and rehabilitative ultrasound images in office workers

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Abstract. [Purpose] To examine the clinical effectiveness of scapular stability exercise on shoulder stability and rehabilitative ultrasound images in office workers. [Subjects and Methods] Thirty-eight subjects were randomly divided into a scapular stability exercise group (n=19) and a manual therapy group (n=19). Subjects in the scapular stability exercise group performed a scapular stability exercise designed to correct the abnormal location of the scapula, at 40 minutes per session, two times per week, for 6 weeks. Forward head horizontal distance, rounded shoulder posture, stability of the upper limb for the shoulder, and rehabilitative ultrasound images were evaluated before and after 6 weeks. [Results] After the intervention, both groups showed significantly decreased forward head horizontal distance and rounded shoulder posture, with significantly improved stability of the upper limb and rehabilitative ultrasound images. Forward head horizontal distance, rounded shoulder posture, stability of the upper limb, and rehabilitative ultrasound images showed greater improvements in the shoulder stability exercise group than in the manual therapy group. [Conclusion] Scapular stability exercise can improve shoulder stability and the thickness of the lower trapezius in rehabilitative ultrasound images of office workers, and could be useful in clinical rehabilitation.

Key words: Shoulder dysfunction, Shoulder stability, RUSI

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INTRODUCTION

Cervical and shoulder dysfunction in office workers is usually due to the work environment, including job and sociopsychological risk factors¹⁾. The resulting pain and functional impairment affect the muscles, skeleton, ligaments, cartilage, and nervous system, and result in musculoskeletal dysfunction²⁾. Shoulder pain and functional disorders are related to abnormal motion and the position of the scapula when it is stabilized³⁾. Cervical pain leads to impaired function, decreased occupational performance, and quality of life dissatisfaction including social and economic loss⁴⁾.

Weakness of the lower trapezius has a negative effect on scapular movement, with an increase in shoulder joint weakness, because the lower trapezius is the primary muscle maintaining the appropriate posture and alignment of the shoulder joint^{5,6)}. The serratus anterior also provides stability for the scapula. Together with the lower trapezius, it maintains the appropriate scapular location⁷⁾.

Therapeutic interventions for shoulder pain include hyperthermia, cryotherapy, transcutaneous electrical nerve stimulation, strengthening exercises⁸⁾, and stabilization exercises⁹⁾. Most of these interventions can relieve pain but are inefficient at preventing the recurrence of pain and maintaining normal function³⁾. Shoulder joint stabilization exercises have been prescribed for patients with shoulder pain. The stability of the shoulder joint is important; however, the stability and strength

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of the muscle are more important because the shoulder is very mobile³).

Postural stabilization is the state of maintaining a balanced body position, with the muscle and skeleton in a specific space, and the ability to maintain the center of mass¹⁰. Exercise stabilizes the scapula through active movements of the muscles surrounding the scapula, and maintains the effective length and tension of upper arm movement¹¹. Rehabilitative ultrasound images (RUSI) evaluate muscle mass, structure, and composition. This method uses ultrasound to examine blood vessels and organ shape. It is easy to control and accurately visualizes muscle structure and movement¹².

In this study, a stability exercise was prescribed for normal scapular location and muscle balance in order to determine the effect on scapular stability and RUSI, and to provide basic information for the rehabilitation of patients with shoulder pain.

SUBJECTS AND METHODS

A total of 38 office workers receiving physical therapy at Seoul H Hospital, who voluntarily agreed to active participation, were included in this study. The subjects were randomly divided into two groups. The stability exercise for the shoulder was performed two times per week, at 40 min per session, for a total of 6 weeks. The general characteristics of the subjects in the stability exercise group were as follows: 19 office workers (6 males and 13 females), mean age 36.2 ± 5.5 years, mean height 168.0 ± 8.1 cm, and mean weight 57.8 ± 11.3 kg. On the other hand, the subjects in the manual therapy group had the following characteristics: 19 office workers (6 males and 13 females), mean age 35.8 ± 4.1 years, mean height 167.2 ± 7.3 cm, and mean weight 60.2 ± 14.2 kg. There were no significant differences between the two groups. The present study was approved by the Sahmyook University Institutional Review Board (SYUIRB2015-014). The objective of the study and its requirements were explained to the subjects, and all participants provided written consent, in accordance with the ethical principles of the Declaration of Helsinki.

the scapular exercise for the shoulder joint was designed to correct the abnormal location of the scapula³). The exercise involved the upper trapezius, levator scapulae, suboccipital, sternocleidomastoid, and pectoralis major and minor muscles (all in a shortened state) in lengthening and stretching, with 10 sets of 10-s sessions. The following exercises were performed: isometric contraction in the supine position, retracting the subject's chin for deep cervical flexor enhancement; closed chain knee push-up for the serratus anterior; cow position and cat position for 10 sets of 10 s each to increase mobility of thoracic and cervical musculature; prone row and modified prone cobra, as suggested by Arlotta et al.¹³, to deactivate the upper trapezius and maximize lower trapezius activation; cow position, cat position, modified cat position, dead bug position, and plank, at 10 sets of 10 s each for cervical, thoracic, and shoulder movement.

The manual therapy program consisted of 2–3 min of soft tissue mobilization of the upper trapezius, levator scapulae, suboccipital, sternocleidomastoid, pectoralis major and minor, deep cervical flexor, serratus anterior, rhomboid, and middle and lower trapezius muscles, with prone thoracic mobilization, prone selected thoracic mobilization, cervical mobilization, and thoracic mobilization.

The forward head horizontal distance (FHHD) for cervical stability was measured with the Exbody somatometric system (PA-2010SM; Steps System Inc., Seoul, Korea), which is a medical angle meter. The subjects were measured from the side in a natural position while wearing shorts and shirts; a marker was placed on the tragus and acromion process, and the forward head position was evaluated by measuring the distance between the tragus and acromion process.

To assess changes in the rounded shoulder posture (RSP), the length was measured to 1/20 mm by using a Vernier caliper. With the supine method, the RSP determined the interval between the table surface and the acromion process. This was used to measure the length of the pectoralis major; however, it has good reliability (intraclass correlation coefficient, 0.88) with or without symptoms in the shoulder related to the effect of the scapular location on the shoulder joint¹⁴.

An upper limb closed chain exercise test was used for the stability of the upper limb (SUL)¹⁵. In the performance of the closed chain exercise test, the starting position, which had a width of 90 cm, was marked on the floor, and both hands of the subjects were placed on the marker dots in order to form a push-up position. To reduce changes in position, the width was reduced to 80 cm. The subjects alternately placed one hand over the other. Placement of one hand over the other was counted as one, performed for 15 s, and the number was counted. Between test performances, the subjects were allowed a 1-min break; measurements were performed two times, and the mean value was used¹⁶.

In this study, a portable RUSI device (UGE0 H60; Samsung Medison, Seoul, Korea) was used to examine the structural properties of muscles. Ultrasound examination was performed at 6–12 MHz in two-dimensional B-mode linearity, at T8 level, $r=0.77$ (muscle thickness) for the lower trapezius structural examination¹⁷; an average of two repetitions was used to measure values.

The SPSS 18.0 program (SPSS Inc., Chicago, IL, USA) was used for statistical analyses. The Shapiro-Wilk test was used to determine the distribution of the general properties and outcome measures of the subjects. The paired t-test was used to compare the pretest and posttest results of FHHD, RSP, SUL, and RUSI within each group, and the independent t-test was performed to compare the two groups before and after training. A p-value of <0.05 was considered significant.

Table 1. Comparison of shoulder stability and RUSI within and between groups (N=38)

Parameters	Values				Change values	
	SSEG (n=19)		MTG (n=19)		SSEG (n=19)	MTG (n= 9)
	Before	After	Before	After	Before-after	Before-after
FHHD (cm)	9.5 ± 2.4	7.8 ± 1.9*	8.4 ± 2.3	8.2 ± 2.3*	1.7 ± 0.8 [‡]	0.2 ± 0.2
Rt RSP (mm)	10.9 ± 1.9	10.3 ± 1.8**	9.7 ± 2.0	9.5 ± 2.0**	0.6 ± 0.3 [‡]	0.1 ± 0.1
Lt RSP (mm)	10.5 ± 2.0	9.9 ± 1.8**	9.2 ± 2.1	9.0 ± 2.1**	0.5 ± 0.3 [‡]	0.1 ± 0.1
SUL (numb)	9.5 ± 3.2	13.7 ± 2.8**	8.8 ± 3.5	9.3 ± 3.7**	-4.3 ± 1.2 [‡]	-0.5 ± 0.5
RUSI in Rt LT (mm)	3.6 ± 0.9	3.9 ± 0.9**	3.3 ± 1.2	3.4 ± 1.2*	-0.3 ± 0.2 [‡]	-0.1 ± 0.1
RUSI in Lt LT (mm)	3.4 ± 0.8	3.7 ± 0.8**	3.1 ± 1.1	3.2 ± 1.1*	-0.3 ± 0.2 [‡]	-0.1 ± 0.1

Values are means ± standard deviation. *p<0.05, **p<0.001: significant difference within the group, †p<0.05, ‡p<0.001: significant difference between groups; SSEG: scapular stability exercise group; MTG: manual therapy group; FHHD: forward head horizontal distance; RSP: rounded shoulder posture; SUL: stability of the upper limb; RUSI: rehabilitative ultrasound images; LT: lower trapezius; Lt: left; Rt: right

RESULTS

In the scapular stability exercise group, the FHHD was 9.5 cm before the training and 7.8 cm after the training, which was statistically significant (p<0.001). The right-side RSP showed a statistically significant decrease of 0.6 mm (p<0.001). The left-side RSP showed a statistically significant decrease of 0.5 mm (p<0.001). The SUL showed a statistically significant increase of 4.3 (p<0.001). In the manual therapy group, the FHHD showed a decrease of 0.2 cm (p<0.05). The right-side RSP showed a statistically significant decrease of 0.1 mm (p<0.001). The left-side RSP showed a statistically significant decrease of 0.1 mm (p<0.001). The SUL showed a statistically significant increase of 0.5 (p<0.001).

The scapular stability exercise group showed greater improvements than the manual therapy group in FHHD, left and right RSP, SUL, and left and right lower trapezius in RUSI (Table 1).

DISCUSSION

Postural cervical pain decreases muscle endurance, and increases muscle fatigue and functional impairment¹⁸; thus, working in an upright sitting position affects muscle length and tension to maintain low muscle activation¹⁹.

In this study, the FHHD was 9.5 cm before the training and 7.8 cm after the training, a decrease of 1.7 cm that was statistically significant (p<0.001), in the scapular stability exercise group. In the manual therapy group, the FHHD was 8.4 cm before the training and 8.2 cm after the training, a decrease of 0.2 cm (p<0.05). The scapular stability exercise group showed greater improvement than the manual therapy group in the FHHD. If the forward head position is severe, the distance between the tragus and acromion process increases; if the distance decreases, deep cervical flexor activation increases, and sternocleidomastoid and anterior scalene muscle activation decreases, thereby stabilizing the cervical position. In the forward head position and round shoulder position, the upper trapezius and pectoralis major and minor have increased activity, inducing scapular and thoracoscapular position change, which causes abnormal cervical alignment and decreased shoulder stability²⁰.

The upper, middle, and lower trapezius, and serratus anterior muscles are involved in shoulder joint stabilizing motion²¹. Therefore, in this study, isometric contraction was applied to enhance the upper, middle, and lower trapezius and serratus anterior strength in shoulder stabilizing exercises. As a result, the right-side RSP was significantly decreased by 0.6 mm (p<0.001), and the left-side RSP was significantly decreased by 0.5 mm (p<0.001). The SUL was 9.5 before the training and 13.7 after the training, a statistically significant increase of 4.36 (p<0.001), in the scapular stability exercise group. The scapular stability exercise group showed greater improvements than the manual therapy group in the SUL and left and right RSP. These results are considered to be due to the prone row and modified prone cobra, which were performed to minimize the upper trapezius activity and maximize the lower trapezius activity. According to RUSI, if lower trapezius muscle activation increases, then the muscle bulk changes²². Day and Uhl²² applied repetitive arm raises on 14 normal subjects in their 20s, and found considerable differences in the thickness of the lower trapezius (p<0.01).

In this study, the right-side lower trapezius in RUSI was significantly increased by 0.3 mm (p<0.001), and the left-side lower trapezius was significantly increased by 0.3 mm (p<0.001) in the scapular stability exercise group. The scapular stability exercise group showed greater improvement than the manual therapy group in the left and right lower trapezius in RUSI. The increases in muscle thickness in the scapular stability exercise group indicate increases in muscle mass and strength. This study provides basic material to aid in the development and promotion of individualized stability exercises, which can be applied in the work environment to improve shoulder stability in office workers.

A limitation of this study is the generalization of the results because the results are based on a selected group of participants office workers with shoulder pain. The short intervention period may also limit the pain and functional gains.

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