

The Effects of Intensive Serratus Anterior and Lower Trapezius Muscle Training with Thera-band on Muscle Activation, Height of Shoulder in People with Rounded Shoulder

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Purpose This study was to investigate the effect of intensive serratus anterior muscle and lower trapezius muscle training with Thera-band on muscle activation and height of shoulder in people with round shoulder. **Method** Sixteen students with rounded shoulder were recruited in D college and randomly allocated both groups. Both serratus anterior training group(n=8) and lower trapezius group(n=8) were performed intensive muscle training with Thera-band for 6 weeks(10 sessions/time, 3times/week, total 18 times). We measured height of shoulder and muscle activation with EMG MR 3.8 software(NORAXON Desktop DTS, USA) for comparing the results of pre-post training. **Result** There were significant difference on scapular height and muscle activation in both serratus anterior group and lower trapezius group(p<0.05). However, in correlation between height of shoulder and muscle activation, we could not find significant difference in both group(p>0.05). **Conclusion** This study indicated that both of serratus anterior muscle and lower trapezius muscle intensive training using Thera-band effect the improvement rounded shoulder in college students.

Key Words Round shoulder, Muscle activation, Serratus anterior, Lower trapezius, Thera-band

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1. Introduction

The development of automation and mechanization in modern society cause stress by repetitive tasks for a long time accumulates in the body and it cause micro damage to the entire body, resulting in chronic pain and paresthesia in not only the lower back but also the extremities.¹⁾ The pain of upper extremity is common major injury with low back pain in clinical field, it affects everyday activity and their occupation in adult population.²⁾ The most painful site was reported as the shoulder and neck due to incorrect posture alignment and the incidence rate showed increasing from 11.5 to 29.³⁾ The problems related to posture alignment are rapidly increasing due to the prolonged use of smart devices with flexed forward head to look at the screen, and these specific alignment increases the rounded shoulder posture.⁴⁾ Shoulder joint plays an important role in providing an appropriate range of motion for the upper extremity during daily life

and movement.⁵⁾ To maintain the function of the shoulder joint, the alignment and movement of the scapular must be kept in a normal condition. However, rounded shoulder posture(RSP)shows a protracted and downward rotated scapula due to lordotic cervical vertebra and kyphotic upper thoracic vertebra.⁶⁾ The reason that is a leading pain in the neck, upper back, and shoulder joints varies and habitually take inappropriate posture of neck for a long time can lead to rounded shoulder posture.⁷⁾ This rounded shoulder posture is highly likely to cause degeneration of acromioclavicular joint, impingement syndrome of rotator cuff muscles, and compression of nerve, blood vessel bundles at the thoracic outlet.⁸⁾ An incorrect posture such as the rounded shoulder posture keep constantly, it causes weakness in lower trapezius and anterior serrated muscle therefore the unbalance activation pattern occurs due to overuse of the upper trapezius muscle and underuse of the anterior serratus muscle.⁹⁾ The imbalance between the upward rotators of the scapula and the functional instability of the shoulder joint reduces the muscle ac-

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tivity of the anterior serratus muscle and lower trapezius muscle, which play an important role in the upward rotation of the scapula. In order to effectively train the upper scapularis, it is said that the unbalanced posture of the shoulder and pectoral muscles can be corrected to the correct posture by controlling the muscle strength by strengthening the anterior serratus and lower triceps muscles. Previous study suggested that the unbalanced posture of the scapulothoracic joint muscles can be corrected by controlling the muscle strength as strengthening of the anterior serratus and lower trapezius muscle to effectively train the upward rotators of the scapula.^{9,10)}

The muscle strengthening training builds muscle strength and at the same time increases muscle strength for each part, thereby increasing the ability to support the body as a whole and it acts as a power to endurance of recurrent muscle diseases by increasing resistance to the weight of an object.^{11,12)} Basically, used props for strength training include yoga mats, Thera-bands, gym balls, foam rollers, and dumbbells and we used the most popular items as Thera-band of them. Thera-band is elastic rubber band that can move in any direction with resistance. In addition, since the speed and strength of resistance can be adjusted therefore resistance can be applied differently compared with other exercise equipment that weighs weights such as dumbbells, and the Thera-band during props exercise has advantages in space, exercise time, and economic aspects.¹³⁾ Thera band can apply various resistance by grip length, grip methods and color of band.¹⁴⁾ The purpose of this study was to compare the effect of intensive serratus anterior and lower trapezius muscle training with Thera-band on muscle activation and scapula height in people with round shoulder.

II. Materials and Methods

1. Subjects

This study was conducted with sixteen adults who are enrolled in D University. Prior to the experimental, all the experimental procedure was fully explained and

Table 1. The general characteristics of the subjects

Group	Age	Height	Weight
Serratus anterior	22±1.7	161.6±7.5	55.7±6.45
Lower trapezius	21.8±2.5	165.5±5.0	58.5±8.69

written informed consent from all participants were obtained. Subjects with a height of at least 2.5cm from the table to the acromion of scapular while prone position randomly assigned to a serratus anterior training group who were 8 and a lower trapezius group who were 8. Table 1 shows the general characteristics of the subjects. (Table 1)

2. Experimental tools

1) Thera-band

The Thera-band is elastic rubber band that can apply in any direction with resistance and it can control the speed and strength. Therefore, the Thera-band can apply a variety of resistance depending on the length, methods of grip, and color compared to weight-bearing exercise equipment such as dumbbells.¹³⁾ Basically, the selection of the Thera-band is suitable for one's physical strength when it detects the tenth strength by pulling it 10 times with the same motion.¹⁵⁾

2) Electromyography(EMG)

The muscle activations of the serratus anterior and lower trapezius were measured with EMG MR 3.8 software (NORAXON Desktop DTS, AZ, USA, 2015)

3) Tape measure

The shoulder height was measured using a 10M pocket tape measure (TRUSCO co, Japan).

3. Measurement

1) Measurement of the height of the shoulder

Shoulder height measurement is performed by placing both arms on the side of the trunk while the subject lies comfortably on a table. The height was measured from the table to the acromion of the shoulder.



Figure 1. The measurement of serratus anterior

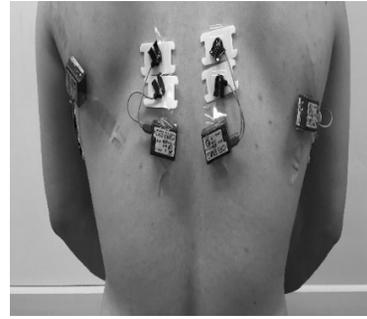


Figure 2. The measurement of lower trapezius activation



Figure 3. The anterior serratus exercise



Figure 4. The lower trapezius exercise

2) Measurement of muscle activation

After confirming the electrode attachment site for each muscle (Figure 1) (Figure 2), an active electrode and a reference electrode were horizontally attached to the electrode attachment site for each muscle along the muscle fiber direction and the distance between the centers of each electrode was within 2cm.¹⁵⁾ To prevent errors in the surface EMG signals, the skin was cleaned with rubbing alcohol, after that a pad was attached to the skin. Before measurement, we checked if there was no signal or noise and reposition the electrode if there was a problem.¹⁷⁾

4. Intervention

The experiment was performed at 10 times a set, 3set a session, 3 times a week for 6weeks. In the initial position, the subject stands by holding a medium-strength blue Thera-band with the thumb up. To the anterior serratus exercise, the shoulder is flexed 90° with the elbow joint is fully extended, and then the arm is extended one by one (Figure 3), on the

other hand, the lower trapezius exercise is the elbow joint flexed 90° with the shoulder is abducted at the shoulder level, and retraction of the scapular with lateral rotation of the shoulder (Figure 4), hold for 10 seconds and then return to the original position. The rest time between sets was 30 seconds. Data of muscle activation and shoulder height were measured before and after the experiment.

5. Data Analysis

The SPSS WIN12.0(IBM, Chicago, IL, USA, 2018) was used to analyze the average value of shoulder height and muscle activation pre-post intervention for each group, and a non-parametric test was performed. The Wilcoxon signed-ranks test was used to analyze the mean difference between the two groups before and after the experiment, and the Mann-Whitney test was performed to compare the maximum values of shoulder height and muscle activation. All values were presented as the mean and standard deviation and statistical significance was set at $p < 0.05$.

III. Results

1. The comparison of muscle activation

There were significant differences in muscle activation of pre-post intensive muscle training in both groups(p<0.05) The average value increased from 122.87±10.94 to 132.75±15.05 in the serratus anterior muscle training group, and from 120.37±4.86 to 144.25±7.75 in the lower trapezius muscle training group. It was found that the mean for lower trapezius muscle training group increased more than the mean for serratus anterior group. (Table2)

2. The comparison of height of shoulder

There were significant differences in shoulder height of pre-post intensive muscle training in both groups(p<0.05). In comparison of shoulder height before and after exercise. The average value decreased from 7.68±0.75 to 5.81±0.88 in the serratus anterior muscle training group and from 6.87±0.95 to 4.93±1.23 in the lower trapezius muscle training group. The results showed that the mean for lower trapezius muscle training group decreased more than the mean for serratus anterior group. (Table 2)

3. The correlation of muscle activation and height of shoulder

There was no statistically significant difference in the

correlation analysis between muscle activation and height of shoulder in each muscle exercise group(p<0.05). The rank of average was 7.45 for serratus anterior group and 7.55 for lower trapezius group, respectively. (Table 3)

IV. Discussion

Previous studies reported that the rounded shoulder was improved with the round shoulder correction exercise program, but the study which muscles are more effective in improving rounded shoulder are lack of evidence. The purpose of present study was to investigate the effect of 6weeks intensive serratus anterior and lower trapezius muscle training with Thera-band on muscle activation and shoulder height in young adult with rounded shoulder. In this study, subjects with round shoulders were divided into serratus anterior group and lower trapezius group and then muscle intensive training was performed. As a result, both groups showed significant improvement in muscle activation and shoulder height.

Park JM¹⁸⁾ suggested that the effect of the push-up plus exercise on muscle activity and height of shoulder in 46 subjects with rounded shoulder. Before and after the intervention, the shoulder height decreased significantly from 7.44±1.86cm to 5.10±1.14cm.

Table 2. The comparison of the muscle activation and height of shoulder between the groups

Muscle		Pre	post	Z	P
Serratus anterior	Muscle activation(%)	122.87±10.94	132.75±15.05	-2.106	0.035*
	Height of shoulder(cm)	7.68±0.75	5.81±0.88	-2.546	0.011*
Lower trapezius	Muscle activation(%)	120.37±4.86	144.25±7.75	-2.524	0.012*
	Height of shoulder(cm)	6.87±0.95	4.93±1.23	-2.536	0.011*

Values are presented as mean± standard deviation, *p<0.05

Table 3. The correlation of muscle activation and height of shoulder between the groups

Muscle	Rank average			Z	P
Serratus anterior	7.45	Muscle activation(%)	138.5±13	-1.944	0.052
Lower trapezius	7.55	Height of shoulder(cm)	5.37±1.13	-1.541	0.123

Values are presented as mean± standard deviation, *p<0.05

Kim DH¹⁸⁾ conducted the serratus anterior muscle strengthening program in subjects with the rounded shoulder, then reported the improvement of shoulder. The results of these previous studies are similar with this study that the serratus anterior muscle strengthening exercise was effective in improving round shoulders. Lee HS et al²⁰⁾ recruited 24 middle school students with rounded shoulder and performed the lower trapezius muscle strengthening training then measured muscle activity. They find out the effect of the round shoulder exercise program on shoulder height and muscle activity. The result showed that height of shoulder significantly decreased from 4.09 ± 0.85 cm to 3.05 ± 1.11 cm after intervention ($p < 0.05$) as this study. Besides, Park SK et al¹⁷⁾ reported that the effect of 4 weeks lower trapezius strengthening training for students. As a result, the height of shoulder decreased from 7 cm to 5 cm and this previous study demonstrated similarity of our study that strengthening the lower trapezius muscle was effective in improving the rounded shoulder.

These results suggest that the rounded shoulder was actively improved by strengthening the anterior serratus muscle and the lower trapezius muscle, which were weakened by the rounded shoulder posture.

In this study, we found that the comparison of muscle activation and shoulder height before and after the experiment, there were significant differences in both groups. In addition, when comparing muscle training effects for each muscle, there was no statistically significant difference, therefore both groups improved rounded shoulders. The serratus anterior and lower trapezius provide stability of low border of scapula and upper trapezius controls the retraction and stability of scapula. When we consider the previous study that MVIC 20-40% of the serratus anterior is activated and the lower trapezius is activated in the elevation of the scapula, this suggest that training both the serratus anterior and the lower trapezius, which play a major role in the stability of the scapula, can maximize the effect.²¹⁾

The limitation of this study was that it was difficult to generalize due to the small sample of subjects in college and short term of study period. Also, we

couldn't control the activity of daily life excluded training time and there was a concern of compensation for incorrect movements due to the lack of guidance personnel.

In future studies, it is considered necessary to conduct studies with an adequate study period, a large number of samples, and a sufficient number of researchers.

The purpose of this study was to compare the effect of intensive serratus anterior and lower trapezius muscle training with Thera-band on muscle activation and scapula height and improvement in people with round shoulder. As a result, both groups showed round shoulder improvement, but there was no significant difference when comparing the two muscle groups. Therefore, we propose that intensive training of both the serratus anterior and lower trapezius is effective for improving the rounded shoulder and appropriate apply according to the environment of the treatment, the ability of therapist, and the condition of patient.

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