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## Effect of elastic band exercises for rounded shoulders on chest expansion in young adults at the end of 6 weeks: An experimental study

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### Abstract

**Background:** Ideal posture is when the body parts, muscles and bones are aligned and work together in harmony, protecting the body from injury or progressive deformity, regardless of the attitude. Rounded shoulders 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 body. Rounded shoulders results from the shoulder being pulled forward by shortened or tight anterior shoulder girdle muscles, like pectoralis minor, pectoralis major and upper trapezius muscles, lengthening and weakness of rhomboids and lower trapezius. Respiratory muscles play an important role in overcoming lung, chest wall and airway resistances normally occurring during inspiration. Efforts by the respiratory muscles are required to enlarge the thoracic cavity and lower intrathoracic pressure. The tightness of pectoralis and scalene leads to decrease in chest expansion. Decreased chest expansion leads to decrease in the vital capacity and total lung volumes. An elastic band is a rubber band with elasticity and resistance, and the velocity and intensity of an elastic band can be controlled.

**Procedure:** 60 subjects having rounded shoulders as per pectoralis minor length test and reduced chest expansion measured by non elastic tape within the age group of 18-24 years were selected. They were given elastic band exercises and stretching of the pectorals 3 times a week for 6 weeks and post treatment results were recorded.

**Result:** The findings of the study revealed a significant improvement in pre and post intervention chest expansion at axillary (t value= -19.646, p value= <0.001) and nipple level (t value= -21.032, p value= <0.001) values.

**Conclusion:** The study concludes that elastic band exercises are effective in correcting the rounded shoulders which in turn increased the chest expansion of young adults at the end of 6 weeks.

**Keywords:** Rounded shoulders, chest expansion, elastic band exercises

### 1. Introduction

Posture maybe defined as “attitude of the body”. Ideal posture is when the body parts, muscles and bones are aligned and work together in harmony, protecting the body from injury or progressive deformity, regardless of the attitude<sup>[1]</sup>.

In particular, an inappropriate posture for a long time causes the centerline of the head to move 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. Rounded shoulders 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 body. There is increased protraction, upward rotation and anterior tilt of scapulae<sup>[2]</sup>. Rounded shoulders results from the shoulder being pulled forward by shortened or tight anterior shoulder girdle muscles, like pectoralis minor, pectoralis major and upper trapezius muscles. Subsequent increase in thoracic kyphosis will abduct the scapula, allowing for lengthening and weakness of rhomboids and lower trapezius<sup>[3]</sup>. The presence of excessive and habitual flexion of the back leading to shortening of pectorals fixes the shoulder in forward position. The etiology of rounded shoulders has been attributed to several factors, posture and relative alignment of body segments are affected by muscle shortening and weakness. Muscles that become tight tend to pull the body segments to which they are attached, creating postural deviation. The prevalence of rounded shoulders is 84% in young adults (18 – 24 years of age)<sup>[5]</sup>.

The respiration pump is comprised of muscles of respiration and the thorax which is made up of the ribs, scapulae, clavicle, sternum and the thoracic spine. Respiratory muscles play an important role in overcoming lung, chest wall and airway resistances normally occurring during inspiration. Efforts by the respiratory muscles are required to enlarge the thoracic cavity and lower intrathoracic pressure. The pectoralis and scalene commonly facilitate elevation of rib cage, thereby tightness leads to decrease in chest expansion [1]. The sternocleidomastoid draws the sternum superiorly, serratus anterior and pectoralis assist in raising the ribs and the scalene helps in raising first two ribs. Rhomboids have a role in stabilising the scapula to assist the serratus in forced inspiration [4]. Weakness of upper back erector spinae, middle and lower trapezius muscle interferes with the ability to straighten the upper back, thus limiting the ability to raise and expand the chest [4]. As per a study conducted, there is a negative correlation between the rounded shoulders and chest expansion [4].

An elastic band is a rubber band with elasticity and resistance, and the velocity and intensity of an elastic band can be controlled [2]. 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. They are easy to carry, economical and safe to use. Elastic bands can be used to improve muscular strength, flexibility and balance control in the elderly and young, regardless of gender. The effects of elastic band exercise programs have been reported to improve physical and postural control [2].

## 2. Need of Study

The prevalence of rounded shoulders is 84% among young adults (18 – 24 years of age). Young adults have typical bent posture due to lifestyle changes, use of mobile phones and laptops, carrying heavy backpacks with abnormal posture leading to muscular imbalance.

There has been studies which states that rounded shoulders is inversely proportional to chest expansion.

The tightness of pectoralis major and minor muscles leads to increased resistance that needs to be overcome to expand the thoracic cavity. This is one of the reasons that rounded shoulders leads to reduced chest expansion [4].

Weakness of middle and lower trapezius and upper back erector spinae muscles interferes with the ability to straighten the upper back, thus limiting the ability to raise and expand the chest and maximize the lung capacity [4].

Decreased chest expansion leads to decrease in the vital capacity and total lung volumes.

Kim, Tae-Woon, *et al.* "Effects of elastic band exercise on subjects with rounded shoulder posture and forward head posture." *Journal of physical therapy science* 28.6 (2016): 1733-1737: have shown to improve and correct the rounded shoulders posture [2].

Application of elastic band exercise programs in patients with chronic obstructive pulmonary disease was found to increase the patient's functional capacity and muscular function [2].

But there are few studies done to see the effect of elastic band exercises on increasing the chest expansion with correction of rounded shoulders.

Hence it becomes crucial to conduct a study which investigates the effect of elastic band exercises for rounded shoulders on chest expansion.

## 3. Aim

To study the effect of elastic band exercises for rounded shoulders on chest expansion in young adults at the end of 6 weeks.

## 4. Objectives

- To study the effect of elastic band exercises for rounded shoulders on chest expansion at axillary level in young adults at the end of 6 weeks.
- To study the effect of elastic band exercises for rounded shoulders on chest expansion at nipple level in young adults at the end of 6 weeks.

## 5. Hypothesis

### ▪ Null hypothesis

There will be no effect of elastic band exercises for rounded shoulders on chest expansion in young adults at the end of 6 weeks.

### ▪ Alternate hypothesis

There will be an effect of elastic band exercises for rounded shoulders on chest expansion in young adults at the end of 6 weeks.

## 6. Review of Literature

- **Pulkit Walia, Sumit Kalra, Ashu Gupta, Jatindar Munjal. "The effect of forward head posture on respiration" *Indian Journal of Physiotherapy and Occupational Therapy* 2017.**

Subject with forward head posture were taken to see the effect of forward head posture on respiratory parameters, showing the forward head posture has an influence on the respiration. After statistically analysing the data collected, they found that there was a significant impact of forward head posture on respiration. Conclusion: The study shows a relevance in the clinical practice since the study depicts the correlation of forward head posture on chest expansion which will lead to an effect on respiration. While the forward head posture treatment include posture correction and re-education of the postural muscles. The study explains why there is a need for breathing exercise in the rehabilitation protocol.

- **Kim, Tae-Woon, *et al.* "Effects of elastic band exercise on subjects with rounded shoulder posture and forward head posture." *Journal of physical therapy science* 28.6 (2016): 1733-1737.**

This study performed to investigate the effect of elastic band exercise program on the posture of subjects with rounded shoulder and forward head posture. The length of the pectoralis major, forward shoulder angle, and craniovertebral angle showed significant changes between before and after the exercise program. 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.

- **Ravi Savadatti, Gajanan Gaude. "Effect of forward shoulder posture on forced vital capacity- A Correlational study" *Indian Journal of Physiotherapy and Occupational Therapy* April – June 2011.**

The aim of the study was to know whether there is any effect of forward shoulder postures on forced vital

capacities. The mean values of forced vital capacities, plumb line and interscapular distance were taken. Conclusion: The present study concludes that, in patients with forward shoulder posture there is increase in the interscapular distance and plumb line measurements and both these variables have an effect on forced vital capacity. As the interscapular distance and plumb line measurements increases, there is decrease in the forced vital capacity.

- **Kluemper, Mark, Tim Uhl, and Heath Hazelrigg. "Effect of stretching and strengthening shoulder muscles on forward shoulder posture in competitive swimmers." *Journal of sport rehabilitation* 15.1 (2006): 58-70.**

Context: Imbalanced shoulder muscles might cause poor posture in swimmers, which has been implicated as potential cause of injury. Objective: To determine whether a training program can reduce forward shoulder posture. Design: Prospective pseudorandomized. Setting: College swimming pool. Participants: 39 competitive swimmers (age  $16 \pm 2$  years) divided into an exercise group ( $n = 24$ ) and a control group ( $n = 15$ ). Intervention: The experimental group performed a partner-stretching program on the anterior shoulder muscles and a strengthening regimen focusing on the posterior shoulder muscles for 6 weeks. The control group participated in normal swim-training activities. Main Outcome Measures: Shoulder posture was measured as the distance from the anterior acromion to a wall using a double-square method. Results: The experimental group significantly reduced the distance of the acromion from the wall in a resting posture ( $-9.6 \pm 7.3$  mm) as compared with the control group ( $-2.0 \pm 6.9$  mm). Conclusions: A training routine might reduce the forward shoulder posture present in most competitive swimmers.

- **Kotteswaran, K., K. Rekha, and Vaiyapuri Anandh. "Effect of stretching and strengthening shoulder muscles in protracted shoulder in healthy individuals." *International journal of computer application* 2.2 (2012): 111-18.**

Aim: To study the effect of stretching and strengthening shoulder muscles in protracted shoulder in healthy individuals. Objective: To determine the effectiveness of stretching and strengthening exercises in reduction of protracted shoulder in healthy individuals. Background: Many researchers have reported that protracted shoulder might lead to shoulder malposition, which may increase the subacromial impingement. In this study stretching of shoulder protractors and strengthening of shoulder retractors and external rotators has been done to reduce shoulder protraction and their by prevent shoulder pathologies. Outcome Measures: Lateral scapula slide test using vernier caliper (in centimeters) is used for measuring pre-test and post-test. Results: The study was significant in reducing the level of shoulder protraction with the pre-test mean and SD was 9.760cms and 0.338 respectively

and the post-test mean and SD was 8.860cms and 0.338 respectively and p-value  $< 0.0001$ . Conclusion: The study showed that the stretching and strengthening exercises are effective in reducing the protracted shoulder

## 7. Methodology

Study Type – Experimental study

Study Design – Pre and post experimental study

Sample size – 60

Sampling Design – Convenience sampling

Study Setting – OPDs and colleges in and around the city

Duration of Treatment – 6 weeks; 3 days/week

Duration of Study – 6 months

## 8. Criteria

### Inclusion Criteria

- Age group between 18-24 years <sup>[1,2]</sup>
- Both males and females
- Rounded shoulders: Distance between the couch and tip of shoulder  $>2.5$  cm <sup>[2]</sup>
- Reduced chest expansion measurement : axillary level  $<5.1$  cm <sup>[10]</sup>
- Muscle strength of upper limb and scapular muscles 3

### Exclusion Criteria

- Any associated cardiopulmonary pathology ( eg., Asthma, COPD )
- Rib fracture
- Scapula and upper limb fractures
- Patients with other upper limb musculoskeletal disorders
- Patients with cognitive impairments
- Patient with visual and auditory deficits

## 9. Materials

Tools and Materials-

- Pen
- Paper
- Couch
- Non elastic measuring tape
- Elastic bands (Thera band latex free red and green)

## 10. Outcome Measures

Chest expansion measurement

- Non elastic tape measurement technique is a common practice employed to measure chest expansion.
- Chest expansion is measured at various anatomical landmarks to represent upper, middle and lower chest wall mobility.
- The common landmarks proposed to measure chest wall mobility are axillary, 4<sup>th</sup> intercostal space and xiphoid process to measure upper, middle and lower thoracic wall mobility respectively.
- Values for axillary level chest expansion are: 1.4 (poor), 3.1 (moderate) and 5.1 (good) expansion.
- The intra-rater reliability is ICC (Intraclass correlation coefficient) 0.78 to 0.97. <sup>[8]</sup>



**Pectoralis minor length test**

- Patient is in supine position, arms by the side, elbows extended, palm upwards, knees bent, low back flat on the table [6].
- Examiner stands at the head of table and observes position of shoulder girdle.
- Amount of tightness measured by extent to which shoulder is raised from the table.
- The examiner measures the linear in centimeters using a non-elastic tape.
- The reliability in intra-rater measurement is ICC (Intraclass correlation coefficient) 0.95 to 0.97 [7].



**11. Procedure**

- The project was started with the presentation of synopsis and Ethical clearance from the ethical committee of PES Modern College of Physiotherapy will be taken.
- Participants were selected according to inclusion and exclusion criteria and will be explained about the study.
- Consent form were taken from the participants.
- Pre intervention values of rounded shoulders and chest expansion were recorded.
- Elastic band exercises were given 3 days per week for 6 weeks, 10 repetitions of 3 sets with pectoral stretches were given and then progressed.
- Post intervention values of rounded shoulders and chest expansion were recorded.

**Elastic Band Exercises**

- Scapular retraction exercise-



- Shoulder horizontal abduction exercise-



- Shoulder external rotation exercise-



- Shoulder abduction exercise



- Shoulder flexion exercise



Shoulder extension exercises-



Stretching of Pectorals

Pectoralis minor stretching

Patient position: In supine lying.

Physiotherapist: Retracts the patient shoulder and depresses the shoulder. Hand should be cupped around shoulder to allow firm, uniform pressure that helps to rotate the shoulder girdle back.

Done 3 times with 30 seconds hold.



Pectoralis major stretching

Patient position: In lying Physiotherapist: abduct the patients arm to 90 degree and flex the elbow to 90 degree and the therapist will extend the shoulder and externally rotate the shoulder.

Done 3 times with 30 seconds holds.

Progression

Week 1 – 10 repetitions of 3 sets

Week 2 – 15 repetitions of 3 sets

Week 3 – 20 repetitions of 3 sets

At the end of the third week the subjects progressed to the next higher level of resistance

Week 4 – 10 repetitions of 3 sets

Week 5 – 15 repetitions of 3 sets

Week 6 – 20 repetitions of 3 sets

12. Data Analysis

The pre and post treatment values of chest expansion were recorded and the data was prepared in the excel spreadsheet.

The data was analysed using PRIMER version 7.

Paired t test of pre and post treatment values was done.

Chest expansion: Axillary level

p value: 0.001

t value: -19.646

Chest expansion: nipple level

p value: 0.001

t value: -21.032

13. Statistical Analysis

Table 1: and graph 1 shows pre and post treatment values of rounded shoulders

Rounded shoulders	Pre treatment mean±SD	Post treatment mean±SD
Right sided	9.095±2.019	5.0585±1.683
Left sided	8.82±1.994	5.36±1.681

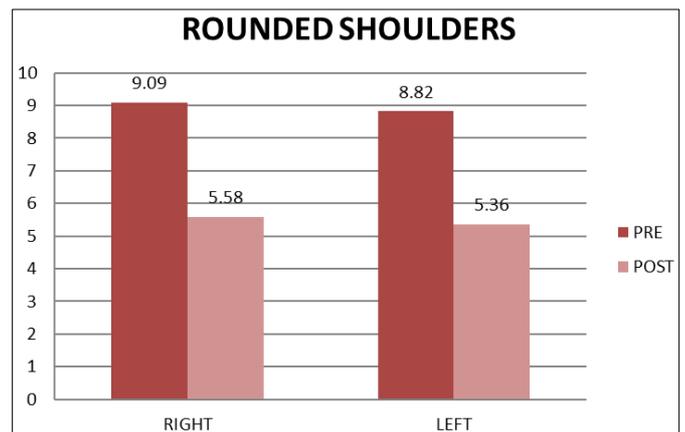
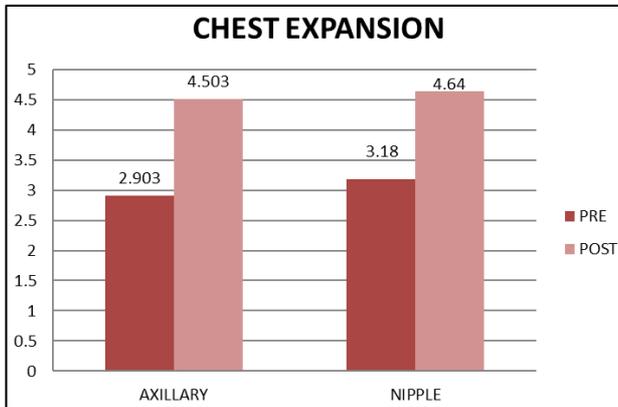


Table 2: and graph 2 shows pre and post treatment values of chest expansion at axillary and nipple levels

Chest expansion	Pre-treatment mean±SD	Post treatment mean±SD	t value	p value	Significance
Axillary level	2.904±0.7224	4.504±0.5913	-19.646	<0.001	Significant
Nipple level	3.18±0.104	4.64±0.0757	-21.032	<0.001	Significant



#### 14. Results

- The findings of the study revealed a significant improvement in pre and post intervention chest expansion at axillary (t value= -19.646, p value= <0.001) and nipple level (t value= -21.032, p value= <0.001) values.

#### 15. Discussion

The present study was done to see the effect of elastic band exercises for rounded shoulders on chest expansion in young adults at the end of 6 weeks.

For the study 60 subjects with rounded shoulders were selected according to the inclusion and exclusion criteria out of which there were 5 drop outs. The study was conducted in different clinics and hospitals in and around the city for 6 weeks.

Pre-treatment data was collected using pectoralis minor length test and chest expansion measurement. The treatment protocol was given for 6 weeks and post treatment same measures were recorded and the result was drawn out.

According to the results, there was an effect of elastic band exercises for rounded shoulders on increasing chest expansion at the end of 6 weeks.

In rounded shoulders there is abduction of scapula, allowing for lengthening of rhomboids and lower trapezius. Shortening of pectoralis major and pectoralis minor causes the shoulder to go into internal rotation causing weakness of external rotators. Therefore, the exercises were aimed at strengthening the weakened muscles and lengthening the shortened muscles. The exercise progression was based on the works of Wang *et al.* in which a similar protocol produced significant strength gains.

Elastic bands can be used to improve muscular strength, flexibility and balance control in the elderly and young, regardless of gender. The application of elastic band exercise program in the patients with chronic obstructive pulmonary disease was found to increase the patient's functional capacity and muscular function [2].

Scapular retraction exercises were given to strengthen the rhomboids. The rhomboids responsible for stabilising the scapula during chest expansion, were observed to be weak in most of the subjects.

The external rotation exercises were given to improve the strength of infraspinatus and teres minor. Shoulder extension exercises for latissimus dorsi, teres major and teres minor. Shoulder flexion exercises for anterior deltoid and chest mobility. Shoulder abduction exercises for supraspinatus, deltoid and chest mobility. Horizontal abduction exercises for posterior deltoid, infraspinatus and teres minor.

The pectoralis minor muscle helps elevate 3<sup>rd</sup> to 5<sup>th</sup> ribs during forceful inspiration. The sternocostal part of pectoralis major muscle works as an inspiratory muscle when the arm is raised, pulling manubrium and upper ribs up and out.

The pump handle motion of the thorax occurs in ribs 2 through 7. The movement of the ribs pushes the sternum ventrally and superiorly. There is increase in the anteroposterior diameter of the chest wall [12]. The tightness of pectoralis major and minor muscles leads to increased resistance that needs to be overcome to expand the thoracic cavity.

Therefore, stretching and eccentric contraction of the pectoralis major and minor muscles helps lengthen the muscles, decreasing the resistance caused due to their tightness and expanding the thoracic cavity more efficiently.

During the exercise regimen a few subjects developed delayed onset of muscle soreness after the first session, so they were advised icing and self stretching. Some patients reported complaints of interscapular pain pre treatment, which was reduced post treatment. This may be due to correction of faulty posture and strengthening of the muscle. Therefore, correction of rounded shoulders by strengthening of lengthened muscles through elastic band exercises and lengthening of shortened muscles through stretching and eccentric contraction leads to increase in the chest expansion of the subjects by efficient working of the pump handle motion the ribs.

#### 16. Conclusion

The study concludes that elastic band exercises are effective in correcting the rounded shoulders which in turn increased the chest expansion of young adults at the end of 6 weeks.

#### 17. Future Scope

- The study can be performed among subjects having respiratory conditions.
- The study can be performed among geriatric population.
- Similar study could be done considering the forward head posture.

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