



## DETERMINATION OF INCIDENCE OF PECTORALIS MINOR MUSCLE SHORTENING AND ITS EFFECTIVE STRETCHING ALONG WITH CONVENTIONAL THERAPY IN ADHESIVE CAPSULITIS.

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### ABSTRACT

The objective of this study is to determine the incidence of pectoralis minor muscle shortening and its effective stretching in conjunction with a conventional therapy in adhesive capsulitis. 50 subjects underwent the pectoralis minor muscle length test using Pectoralis Minor Muscle Index (PMI). PMI is suggested to show a shortened pectoralis minor when it is 7.65 or lower. As a result, out of 50 subjects, 30 were selected to participate in the study. 30 subjects fulfilling the inclusion criteria were assigned into 2 groups, control group (n=15) receiving conventional therapy and experimental group (n=15) receiving pectoralis minor Gross Stretch along with conventional therapy. There is large and medium effect size showing clinically significant differences in means of VAS, ROM, SPADI and PMI between the groups. The present study concludes that implementation of pectoralis minor Gross Stretch in conjunction with conventional treatment in the treatment of Adhesive Capsulitis is beneficial.

**KEYWORDS:** Shoulder Pain, Adhesive Capsulitis, Conventional Therapy, Pectoralis Minor Stretch.



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## INTRODUCTION

The shoulder joint is a complex anatomical and functional structure due to which the identification of source of lesion becomes complicated.<sup>1</sup>The incidence of shoulder pain is recorded as 11.2 per 1000 persons per year .It is one of the most frequent musculoskeletal complaints of patients visiting physicians. The prevalence of shoulder pain in the general population accounts between 6.9% and 34%.The etiology and pathology of shoulder pain is unclear because of its complexity of structure.<sup>2</sup>Inability to use the shoulder properly results in considerable difficulty in daily activities. Most of the acute and chronic disorders cause painful limitation of movement in the joint.<sup>3</sup>Adhesive capsulitis, also known to us as 'frozen shoulder', 'painful stiff shoulder' or 'periarthritits', is a common cause of shoulder pain and disability in middle-age. The condition was first described by Duplay in 1872and affected 2% to5% of the general population and 10% to 20% of people with diabetes.<sup>4</sup>Nevasier identified the pathology through histological and surgical examination of frozen shoulder patients.<sup>5</sup> He came to a conclusion that frozen shoulder was not actually periarthritits, but rather it was a "thickening and contraction of the capsule which becomes adherent to the humeral head" that he termed, "adhesive capsulitis." Adhesive capsulitis is characterized by pain, stiffness, and limited function of the glenohumeral joint, which affected the entire upper extremity. The most common limitations in range of motion are external rotation, abduction, and flexion. Three stages of frozen shoulder were described: painful stage, stiffness or "frozen" stage, and recovery or "thawing" stage, with the average symptoms lasting 30 months on an average.<sup>6</sup>Many postural deviations, such as forward head, forward shoulders i.e. scapular protraction, humeral internal rotation, and increased thoracic kyphosis, have been seen in the development of shoulder pain. The pectoralis minor muscle is the sole muscle connecting the scapula & anterior side of thoracic region. Therefore, shortening of this muscle is expected to prevent scapular motion in the superior & posterior direction.<sup>7</sup>Shoulder Periarthritis is one such condition in which there is minimum scapular posterior tilt due to short pectoralis minor. Sahrman stated that the shoulders tilt anteriorly because of a shortness of pectoralis minor.<sup>8</sup>There are very few studies that showed the effectiveness of pectoralis minor muscle stretch in other shoulder conditions that elicited positive results. There is no evidence regarding the treatment of pectoralis minor muscle in adhesive capsulitis literature. Therefore, there arises the need for this study.

## MATERIALS AND METHOD

This study was conducted at out patient department of susruta institute of physical medicine and rehabilitation center,Hyderabad and the use of human subjects were approved by our institutional ethical committee and informed consent was obtained from all the subjects before participation.. 50 subjects fulfilling the inclusion criteria(Unilateral stage two adhesive capsulitis, primary adhesive capsulitis, age group between 35-60 years, restriction of more than 50% in shoulder external rotation, abduction and flexion compared to other side)

were recruited . The subjects excluded from the study were Shoulder traumatic conditions, presence of osteoarthritis, fractures of upper limb, inflammatory diseases such as rheumatoid arthritis, previous manipulation under anesthesia, administration of injections with corticosteroids within a month, radiculopathy, neurological and vascular conditions of upper limb. Pectoralis minor muscle length was measured for all the 50 subjects using Pectoralis Minor Muscle Index (PMI).The PMI is calculated by dividing the resting muscle length measurement by the subject height and multiplying by 100.The resting muscle length is measured between the caudal edge of the 4th rib to the inferior medial aspect of the coracoid process with a measuring tape.PMI is suggested to show a shortened pectoralis minor when it is 7.65 or lower.<sup>8</sup> As a result, out of 50 subjects, 30 were eligible to participate in the study and were randomly divided into group A -control group (15 patients) and group B- experimental group (15 patients).Both the groups received treatment for 5 sessions per week for 4 weeks. Each session was carried out for 45minutes with rest interval in between. Both groups were given conservative treatment consists of Ultrasound therapy with continuous mode, frequency of 1MHZ, intensity of 1.5W/CM<sup>2</sup>. The treatment time is 10 minutes.<sup>9</sup> Codman's exercises, active and passive range of movements, mobilizations, capsular stretches, isometrics and patient education. In addition, group B received pectoralis minor stretch.

### *Pectoralis minor gross stretch technique*

- Subjects were positioned in the supine position with the test arm abducted and externally rotated to 90° and the elbow flexed to 90°.
- The therapist stabilized patient's body by placing a hand on the contra lateral coracoid.
- The therapist then passively, horizontally abducted the subject's shoulder.<sup>10</sup>

### *Pectoralis minor unilateral self-stretch technique*

- For stretching of the pectoralis minor, patient stood beside a doorframe and performed pectoralis minor self-stretching.<sup>11</sup>
- This stretch was performed in a standing position with the target shoulder abducted to 90° and the elbow flexed to 90°.
- With the hand's volar surface of the target arm placed against a vertical door frame or other flat rigid structure the patient then rotates the trunk away from the target shoulder.<sup>10,12</sup>

Both groups were monitored for 3 months follow up and have undergone pre, post and follow up evaluation by visual analogue scale for pain, goniometer for range of motion (flexion, abduction, external rotation) and SPADI(shoulder pain and disability index) for improving the functional ability.<sup>13</sup>

## RESULTS

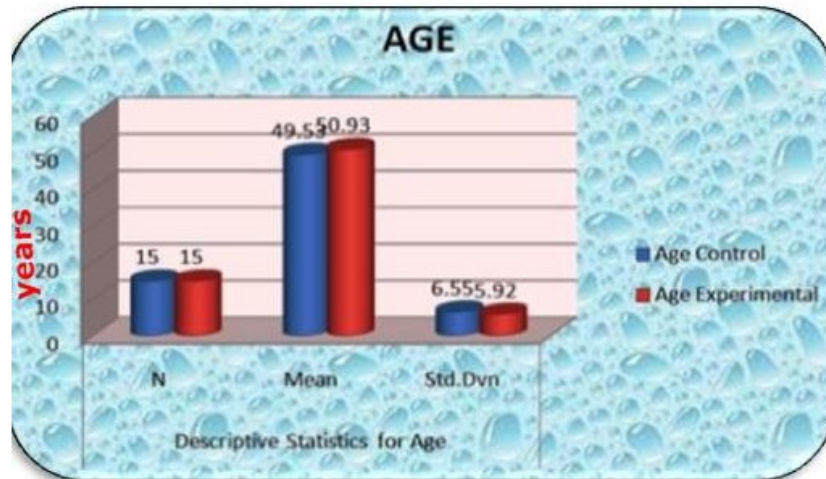
Statistical analysis has been carried out using SPSS version 24 software.. Mean, SD were calculated for Outcome measures (VAS, ROM, SPADI, PMI). Significance was assessed at 5% level of significance with p value was set at 0.05 less than this is considered as statistically significant difference.

## STATISTICAL TESTS

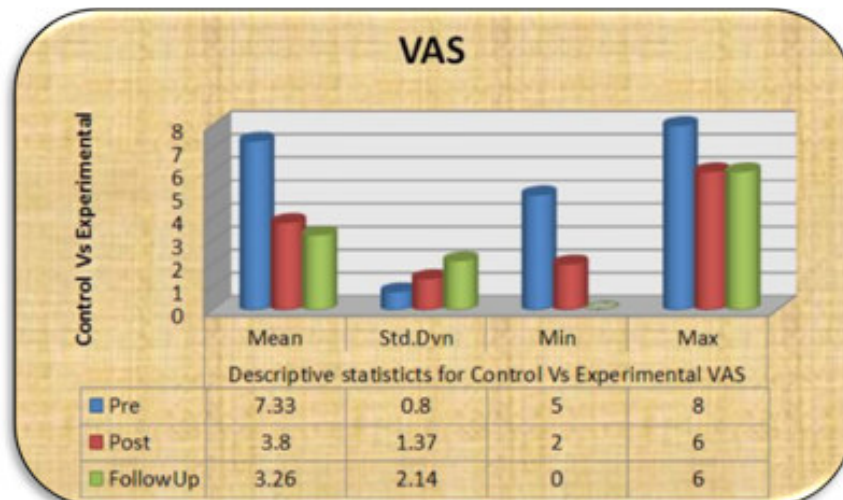
- Pearson Chi-square ( $\chi^2$ ) test has been used to analyze the significant of basic characteristic of gender and age distribution of the subjects studied.

- Repeated Measures Analysis of Variance (ONEWAY ANOVA) was used for analysis of VAS, ROM, SPADI and PMI within the group and Bonferroni's as post-hoc test was used to find the significance in pair-wise comparison pre to post treatment, post to follow-up treatment and pre-treatment to follow-up.

Mann Whitney U test, which is a non-parametric test has been used to compare the means of VAS, ROM, SPADI and PMI between the groups with calculation of percentage of difference between the means

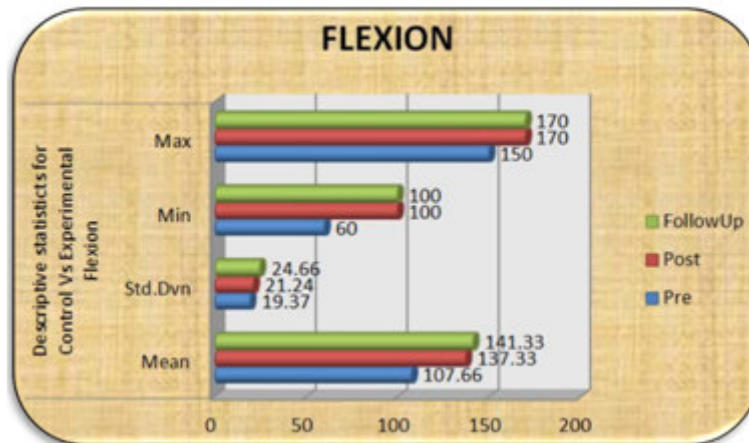


**Graph 1**  
*Age Distribution of the subjects studied*



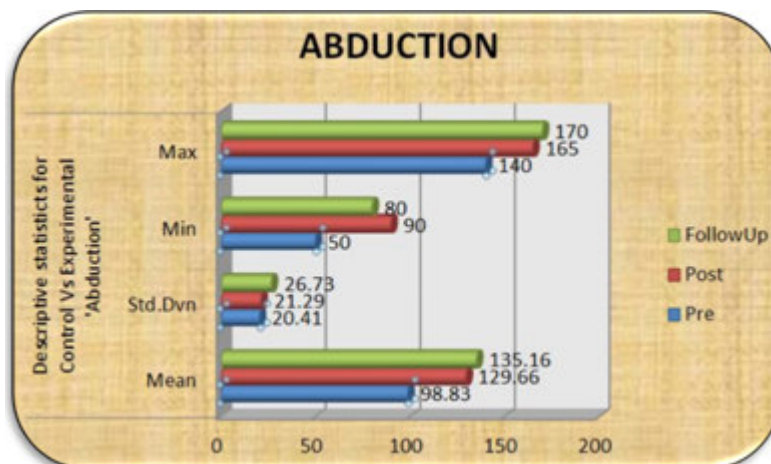
*The above graph shows there is statistically significant difference of VAS in pre-intervention, post intervention and follow-up means when control group and experimental groups are compared.*

**Graph 2**  
*Comparison of VAS between Experimental and Control Group*



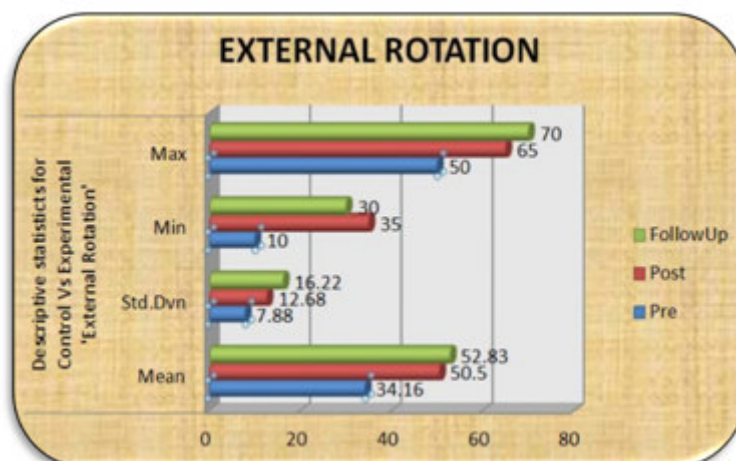
The above graph shows there is statistically significant difference of flexion ROM in pre-intervention, post intervention and follow-up means when control group and experimental groups are compared.

**Graph 3**  
**Comparison of Flexion ROM between Experimental and Control Group**



The above graph shows there is statistically significant difference of abduction ROM in pre-intervention, post intervention and follow-up means when control group and experimental groups are compared.

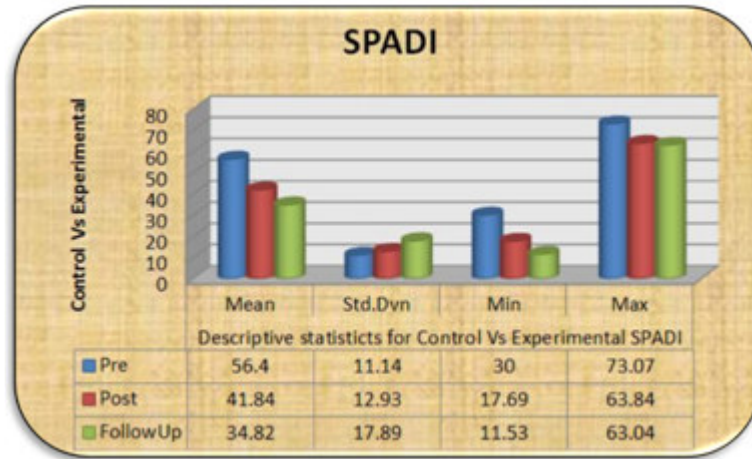
**Graph 4**  
**Comparison of Abduction ROM between Experimental and Control Group**



The above graph shows there is statistically significant difference of external rotation ROM in pre-intervention, post intervention and follow-up means when control group and experimental groups are compared.

**Graph 5**  
**Comparison of External Rotation ROM between Experimental and Control Group**





The above graph shows there is statistically significant difference of SPADI in pre-intervention, post intervention and follow-up means when control group and experimental groups are compared.

**Graph 6**  
Comparison of SPADI between Experimental and Control Group

**Table 1**  
Pectoralis minor index

**NPar Tests**

	N	Mean	Std. Deviation	Minimum	Maximum
Pre	30	5.4013	.79402	3.89	6.89
Post	30	6.9263	1.25504	5.06	9.30
FollowUp	30	7.2260	1.53619	5.06	9.88
PMI	30	1.5000	.50855	1.00	2.00

The above table shows the mean, standard deviation, minimum and maximum of PMI between Control Group and Experimental group.

**Table 2**  
Mann-Whitney Test

	PMI	N	Mean Rank	Sum of Ranks
Pre	Control	15	14.87	223.00
	Experimental	15	16.13	242.00
	Total	30		
Post	Control	15	8.40	126.00
	Experimental	15	22.60	339.00
	Total	30		
FollowUp	Control	15	8.13	122.00
	Experimental	15	22.87	343.00
	Total	30		

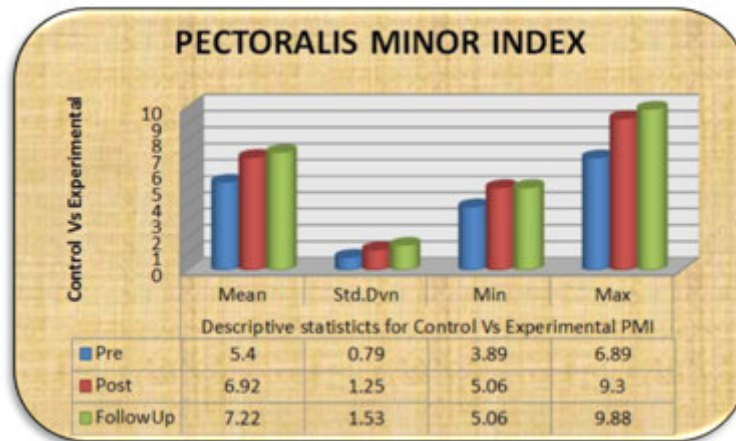
The above table shows the mean ranks for PMI when compared in control and experimental group.

**Test Statistics<sup>a</sup>**

	Pre	Post	FollowUp
Mann-Whitney U	103.000	6.000	2.000
Wilcoxon W	223.000	126.000	122.000
Z	-.394	-4.418	-4.585
Asymp. Sig. (2-tailed)	.693	.000	.000
Exact Sig. [2*(1-tailed Sig.)]	.713 <sup>b</sup>	.000 <sup>b</sup>	.000 <sup>b</sup>

- a. Grouping Variable: PMI
- b. Not corrected for Ties

The above table shows that there is a statistically significant value for PMI when control and experimental groups are compared.



The above graph shows there is statistically significant difference of PMI in pre-intervention, post intervention and follow-up means when control group and experimental groups are compared.

**Graph7**  
**Comparison of PMI between Experimental and Control Group**

## DISCUSSION

Forward shoulder posture, defined as a sagittal plane or transverse- plane scapular resting position change, is theorized to result in adaptive shortening of the pectoralis minor muscle by approximating the muscles' insertion sites on the coracoid process and ribs 3, 4, and 5. Decreased pectoralis minor muscle resting length results in an increase in the muscles passive tension during arm elevation, which restricts normal scapular upward rotation, posterior tipping, and external rotation.<sup>14 15 16 17 18</sup> The scapular motion alterations decrease the subacromial space as the acromion fails to move away from the humeral head during arm elevation, which results in increased compressive loads on the tendons of the rotator cuff or long head of the biceps muscle. A forward shoulder posture results in a tight pectoralis minor muscle<sup>19</sup>. Adhesive capsulitis is a syndrome characterized by shoulder pain with restriction of both active and passive movements.<sup>20</sup> In adhesive capsulitis the capsule is adhered which limits the physiological movements of the shoulder joint. This limited range of motion leads to altered shoulder girdle motion which results in altered scapula humeral rhythm.<sup>21 22</sup> In the previous studies regarding round shoulder posture it was found that one of the causes of scapular change is due to the shortening of the pectoralis minor which results in forward bending shoulder joint.<sup>11 23 24</sup> From the results, out of 50 subjects 30 subjects had the pectoralis minor muscle tightness with their PMI is less than 7.65. In this study, the incidence of pectoralis minor involvement in adhesive capsulitis is 60%. Out of the 30 subjects, both the groups showed significant improvement in pain, range of motion and functional improvement of the shoulder joint with p-value <0.05 after 4 weeks of treatment. In Group B along with conventional therapy, Gross Stretch to the pectoralis minor muscle was given<sup>10</sup>. This may be because, the stretch improved the posterior tilt and upper rotation of

the scapula<sup>25</sup> which was a baseline to correct the rounded shoulders. When this was corrected, the sub-acromial space, which was compromised due to the rounded shoulder, may be increased. As a result, scapulo humeral rhythm is normalized which is the basis for shoulder complex mobility. This improves the physiological movements of the shoulder joint. Pectoralis Minor Stretch has an additive effect that proves beneficial in Adhesive Capsulitis. This study is co-related with a study done by Gagdosik 2001 it is proved that stretching techniques improve the muscle length and extensibility. In another study done by Lee, Lynn Yoon, Choi et.al 2015 pectoralis minor muscle stretching increased pectoralis minor resting length & improved upward rotation and posterior tilting alignment of scapula. The study also compared the effects of treatment after 3 months follow up, which showed that group B maintained and rather improved in all the parameters.

## CONCLUSION

This study concludes that 4 weeks of pectoralis minor muscle gross stretch along with the conventional therapy for the subjects with adhesive capsulitis found statistically significant improvement in pain, range of motion, functional disability and pectoralis minor index (PMI). After a 3-month follow up it showed a greater percentage of significant improvement, compared to the subjects who received only conventional therapy. It is recommended that implementation of pectoralis minor gross stretch along with conventional therapy in adhesive capsule of shoulder joint, as it is an additive benefit to improve the scapula humeral rhythm.

## CONFLICT OF INTEREST

Conflict of interest declared none.

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