**The effect of biomechanical scapular mobilization with movement and motor learning in shoulder impingement patients**

**NCT: 04701814**

**Ethical committee approval:**

**The study was approved by research ethical committee in Pharos University in Alexandria (PUA 201901013).**

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## Introduction

The shoulder pain is one of most compliance among the musculoskeletal problem, which consider the third most common musculoskeletal compliance in general practice. **(VanDerWindt 1995)** [1] In which incidence is 14.7\1000 per year, that present 7-14% among population **(Medicina 2017)** [2]. It's common among female than male **(Linsell 2006)**. [3] On the other hand, shoulder impingement syndrome is the most common disorder of shoulder pain compline (**DeWitte 2011, Rizzo 2017**) [4,5]. That present 44 – 65% of all shoulder complain of shoulder pain (**Rizzo 2017**) [5]. The shoulder impingement is disorder in which the long head of biceps and rotor cuff muscles of shoulder especially tendon of supraspinatus with bursa all are compressed against the anterior edge of acromion processes of scapula and the coracoacromial ligament in subacromial space this occur especially when the patient elevate his arm (**Rizzo 2017, Gold 1993, Almekinders 2001** ) [5,7,9]. The etiology of shoulder impingement is summarized as narrowing of subacromial space or \ and enlargement of subacromial structure (bursa and tendon) (**Dabholkar 2017**) [8]. The abnormal mechanics can cause joint dysfunction (**Almekinders 2001** ) [9].

### Treatment options

The aim of treatment in shoulder impingement is to decrease the pain and restore the normal function of the shoulder (**Garving 2017**) [11]. There are two option to treat the shoulder impingement: first one is non-surgical treatment which is the first choice in treatment unless there is no major structure damage, while the second option is surgical procedure (**Garving 2017, Diercks 2014)**[11,12]. The conservative treatment including non-steroidal anti-inflammatory drugs, physical therapy intervention, tapping, active modification and corticosteroids injection (**Garving 2017, Akgu 2004**) [11,13]. However, there is no evidence tell us that the surgical intervention has the upper hand in treatment of shoulder impingement (**Diercks 2014**) [12].

## Statement of the problem

What is the effect of biomechanical scapular mobilization with movement and motor learning in shoulder impingement patients?

## Purpose of the study

This study was conducted to detect the effect of biomechanical scapular mobilization with movement and motor learning in decreasing the pain, and increasing the ROM in shoulder impingement.

## The significance of shoulder impingement:

Shoulder impingement can lead to disability (**Neumann 2010**) [15], which reduces the personal functionallevel and activity so the patientcouldn't do ADLs and work properly, especially in athletic persons who play sports that needed overhead activities.

## Limitation

The limitation that face me during the study is the physical status of patients and psychosocial factors and socioeconomic level in each person, while the delimitation is age, BMI, simple, gender and instrument.

## The hypothesis

The hypothesis is biomechanical scapular mobilization with movement and motor learning is effective in decrease the pain and increase the ROM and functional level in shoulder impingement syndrome.

# Methods

Thirty participants with shoulder impingement syndrome were diagnosed by physiotherapist selected from, Pharos University in Alexandria, outpatient clinic. Their ages were ranged from 25 to 50 years old. The including criteria: Patients with unilateral shoulder pain compatible with shoulder impingement syndrome who hadn't any pervious experiment of physical therapy session in affected shoulder. Also, patients were included if they had:

1. History of shoulder pain when they elevated their arm.
2. Limited range of motion due to the pain.
3. Pain localized at the painful point at proximal anterolateral shoulder region or medical diagnosis of shoulder impingement syndrome with at least 2 positive impingement tests including Neer, Hawkins or Jobe test.

The researches revealed that the pooled sensitivity and specificity for the Neer test were 79% and 53%, respectively, and for the Hawkins test were 79% and 59%, respectively. Because no single test had shown high specificity, a cluster of 2 or more tests is recommended to properly identify patients with Shoulder impingement syndrome (**Delgado-Gil 2015**)[14].

The excluding criteria included: patients were diagnosed by fibromyalgia, fracture or dislocation or subluxation of shoulder, history of trauma that causing shoulder pain, rupture of tendons, shoulder surgery, numbness or tingling in upper limb, corticosteroids injection within 1 year, ligamentous laxity and systemic illness. Patientsprovided written informed consent to participate in this study. The design of the study was two groups pre and post experimental study.

Patients will divide randomly in two equal groups (A and B): Group A (controlled group):

They will receive traditional physical therapy program including: passive range of motion (PROM)/ active assisted range of motion (AAROM)/ active range of motion (AROM), strengthen of rotator cuff, biceps, shoulder and scapular muscles, ultrasound (5 min. – 1.5 W/c.m$^2$ - 1 MHZ), electrical stimulation ( interferential bipolar technique for 20 min. on shoulder joint). Group B (study group): they were received the same physical therapy program as in group A, in addition to Biomechanical scapular mobilization with movement and motor learning.

## Assessment tools

All information including: Name, age, address, gender, height, weight, previous history of shoulder pain, location and duration of pain.

Visual analogue scale (VAS) Visual Analogue Scale: was used to evaluate the intensity of pain, which The pain VAS is a continuous scale comprised of a horizontal (HVAS) or vertical (VVAS) line, usually, 10 centimetres (100 mm) in length, anchored by 2 verbal descriptors, one for each symptom extreme. For pain intensity, the scale is most commonly anchored by “no pain” (score of 0) and “pain as bad as it could be” or “worst imaginable pain” (score of 10 centimetres [100-mm scale]).

Universal goniometer: was used to measure the available range of motion at a joint. Where used to measure an available range of motion of abduction and flexion of the shoulder joint.

In Abduction: the patient supine with his/ her shoulder in external rotation and her/ his elbow in extension. The fulcrum of goniometer was placed over the acromion process of scapula and the fixed arm parallel to midline of sternum, while movable arm aligned with longitudinal line of the humerus, using the epicondyle as a reference, then ask a patient to abduct his arm as possible as can (**Delgado-Gil 2015**)[14]

In Flexion: The assessment done with patient supine with 0 abduction and adduction and no rotation. While the elbow in extension and forearm in neutral position (midrange between supination and pronation). The fulcrum of goniometer was located laterally on center of humerus head near to acromion process and the fixed arm parallel to axillary line or midline of trunk, while the moveable arm aligned with longitudinal midline of humerus where lateral epicondyle is used as reference. Then ask a patient to flex the shoulder as possible as can (**Delgado-Gil 2015**) [14].

## Treatment method

All patients in the two groups (A&B) will receive passive range of motion (PROM)/ active assisted range of motion (AAROM)/ active range of motion (AROM) exercises, strengthen of rotator cuff, biceps, shoulder and scapular muscles, ultrasound (5 min. – 1.5 W/c.m2 - 1 MHZ), electrical stimulation ( interferential bipolar technique for 20 min. on shoulder joint). This treatment will repeate three times per weeks with 24 hours rest for 3 weeks.

All patients in group B will receive biomechanical scapular mobilization with movement and motor learning and traditional methods.

Biomechanical scapular mobilization with movement and motor learning will be applied on the patient seated at edge of the chair and his feet on the ground while his trunk was unsupported and his arm in external rotation. The therapist standing on lateral side of at affected shoulder with one hand on superior and anterolateral side of acromion. Where the thenar eminence of the hand applied mobilization to scapula in posterio-medial and inferior direction to position the scapula in posterior tilt and external rotation. While the index of the other hand on the inferior medial border of scapula while the thumb on the lateral border of scapula to mobilize the scapula upward rotated and external rotated of scapula ( the external rotation of scapula applied by thumb note that I applied technique by the pad of thumb to be not painful). Then the patient was asked to elevate his arm with maintain the external rotation of his arm and the therapist mobilized it with movement. Where the therapist maintained the force direction of mobilization during the movement. This technique was done 3 times then we added belt around the head of humerus or near to joint line and the other end of the belt supported by therapist's foot. The aim of using the belt was to apply inferior and posterior glide of shoulder during elevation of arm (you can also use the belt to apply inferior and anterior glide during the shoulder elevation).

1. Normal mechanics of shoulder elevation: During the elevation of arm there is ratio between the scapula and glenohumeral called scapulohumeral rhythm. This ratio is 2:1 where GH joint abducted 120° and 60° upward rotation occur in scapulothoracic this cause 180° abduction. The 60 degree of scapula during shoulder abduction cause elevation in sterno-clavicular (SC) joint with upward rotation in acromio-clavicular (AC) joint. Also, the SC joint is retracted and scapula posterior tilted and externally rotated (**Neumann 2010**, **Teece 2008**), [15,16]. On the other hand, there was relation of thoracic and shoulder elevation. When the shoulder elevated, the upper thoracic spine extend, side bend and rotate to same side of shoulder elevation. Also, the first and second ribs descend while the fourth to sixth ribs was ascended and third ribs act as an axis [17]. (table 2.1)

2. The mobilization of scapula is effective in increasing the range of motion and decreasing the pain in shoulder impingement syndrome (**Surenkok 2009**)[18].
3. The mulligan technique or mobilization with movement is effective in increasing the subacromial space (**Dabholkar 2017**) [8], and also effective in decreasing the pain and increasing of shoulder range of motion (**Dabholkar 2017, Delgado-Gil 2015**, **Guimaraes 2016)** [8,14,19].
4. The inferior glide to the Glenohumeral joint increase the abduction of shoulder while the posterior glide increase the flexion of shoulder (**Carolyn 2013, Maricar 2009, Chad 2012**)[20,21,22.]
5. Also the anterior glide and posterior glide have significant effect in increasing the abduction of arm (**Chad 2012, Hsu 2002**) [22,23].

From the previous evidence I want mix between the results of MWM with passive mobilization of glenohumeral joint and scapular mobilization in one technique. When I done this I see myself applied the mechanics of joint, therefore I create the biomechanics scapular mobilization with movement and motor learning technique, which adding biomechanics of shoulder complex to mobilization with movement technique.

Muscles and function failure is stimulus the motor control center in brain in order to learn new skills. For example when the baby learns to walk in the first time he takes some steps and then he falls, the every unsuccessful step there is aspect of success that is programmed in motor control center to create probable pattern for walking. From this point of view motor control center can achieve new successful routines (**Weinstock 2010**) [24].

So that I added motor learning technique in my technique to create new successful routines in the brain to increase the effect of mobilization and modulate the abnormal pattern. Motor learning technique wasn't the first time applied in shoulder impingement and it is effective in increasing ROM and decreasing pain **(Worsley2013)** [25]. Before I did my technique, I had teach all patients the normal mechanics of shoulder and what was done when he elevated his arm. Secondly, I did my technique with variable description of mobilization (told the patient that I pull your scapula back, down and medially) and used this in front of

mirror to add a visual feedback about mobilization. At the end of session I asked the patient to elevate the arm actively and I evaluated the movement either by observing the movements of the scapula or by putting my hand on the scapula to assess the movements of the scapula and gave the patient feedback if the kinematic of the shoulder is right or wrong At the end. The patient received verbal instructions about his/her performance and how to improve this next time. When the patient did it successfully and scapular movements were done properly during the motion I added functional training to shoulder elevation such as reaching high object. This technique will done 3 times per week with 24 hours rest between each session in which it repeated 30 times in every session for 3 weeks.

## Statistical method:

Data into the computer was done followed by tabulation and analysis. Analysis was done using SPSS-20 (Statistical package for Social Sciences version 21).

Quantitative data were described using mean and standard deviation for normally distributed data while abnormally distributed data was expressed using median, minimum and maximum.

***For normally distributed data, comparison between two independent population were done using independent t-test***

**Student (Unpaired-sample) "t" test:**

It is used during comparison between the means of different sample groups. The "t" is calculated as follows:

$$\mathbf{t} = \frac{X_1 - X_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

**Where**

$X_1$ = Mean of first group.

$X_2$ = Mean of second group.

$S_1$ = Standard deviation of the first group.

$S_2$ = Standard deviation of the second group.

$n_1$ = Sample size of the first group.

$n_2$ = Sample size of the second group.

**Chi-Square test:**

It tests the association between qualitative nominal variables, it is performed mainly on frequencies. It determines whether the observed frequencies differ significantly from expected frequencies.

$$\text{Computed}X^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

Where E = expected frequency

O = observed frequency

$$E = \frac{\text{Raw total x Column total}}{\text{Grand total}}$$

*Statistical analysis were done at level of significance of $P \leq 0.05$*

Table (1): Comparison between the Group A and Group B

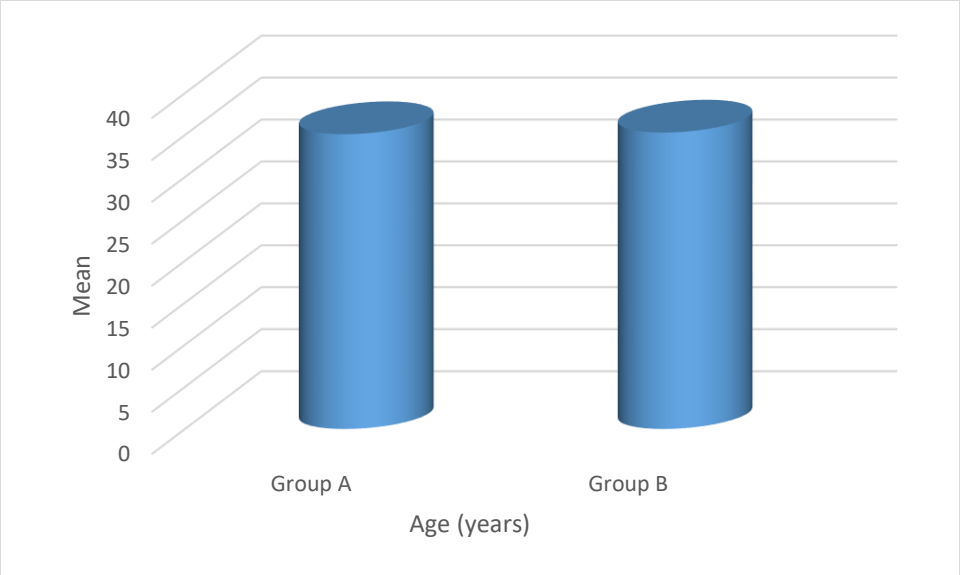
| | **Group A** | | **Group B** | | t<br>p |
|---|---|---|---|---|---|
| **Age (years)** | | | | | |
| Range | 25-50 | | 27-50 | | |
| Mean | 35.1 | | 35.3 | | 0.210 |
| S.D. | 8.123 | | 7.943 | | 0.852 |
| | **No** | **%** | **No** | **%** | $X^2$<br>P |
| **Sex** | | | | | |
| Male | 5 | 33.3 | 5 | 33.3 | 0.0 |
| Female | 10 | 66.7 | 10 | 66.7 | 1.0 N.S. |

t = student t-test

$X^2$ = Chi square test

P = p value and considered significant if $\leq 0.05$

N.S. Not significant difference between the two groups.



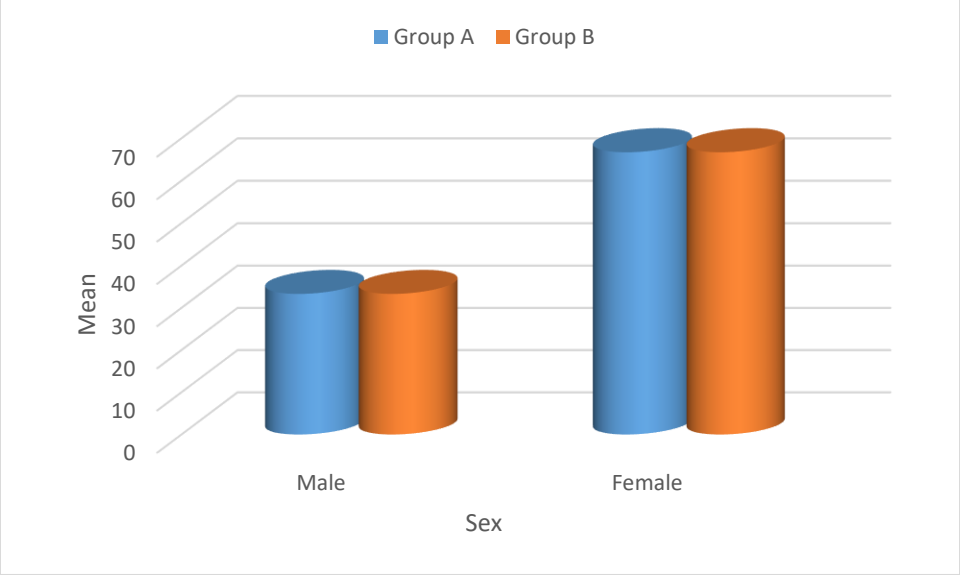




Fig.(1): Comparison between the Group A and Group B

Table (2): Comparison between VAS, abduction and flexion ROM Pre and Post-treatment in group A

| **Group A** | **Pre-treatment** | **Post-treatment** | **t-test** | **P value** |
|---|---|---|---|---|
| **VAS** | | | | |
| Range | 3-8 | 2-6 | | |
| Mean | 5.7 | 4.2 | 1.92 | 0.043* |
| S.D. | 1.543 | 1.474 | | |
| **Abduction** | | | | |
| Range | 63-88 | 73-97 | | |
| Mean | 75.7 | 85.7 | 2.01 | 0.025* |
| S.D. | 9.445 | 9.083 | | |
| **Flexion ROM** | | | | |
| Range | 101-134 | 112-147 | | |
| Mean | 119.3 | 131.7 | 2.11 | 0.013* |
| S.D. | 10.166 | 10.761 | | |

t = student t-test

P = p value and considered significant if $\leq 0.05$

* Significant difference from the before therapy.

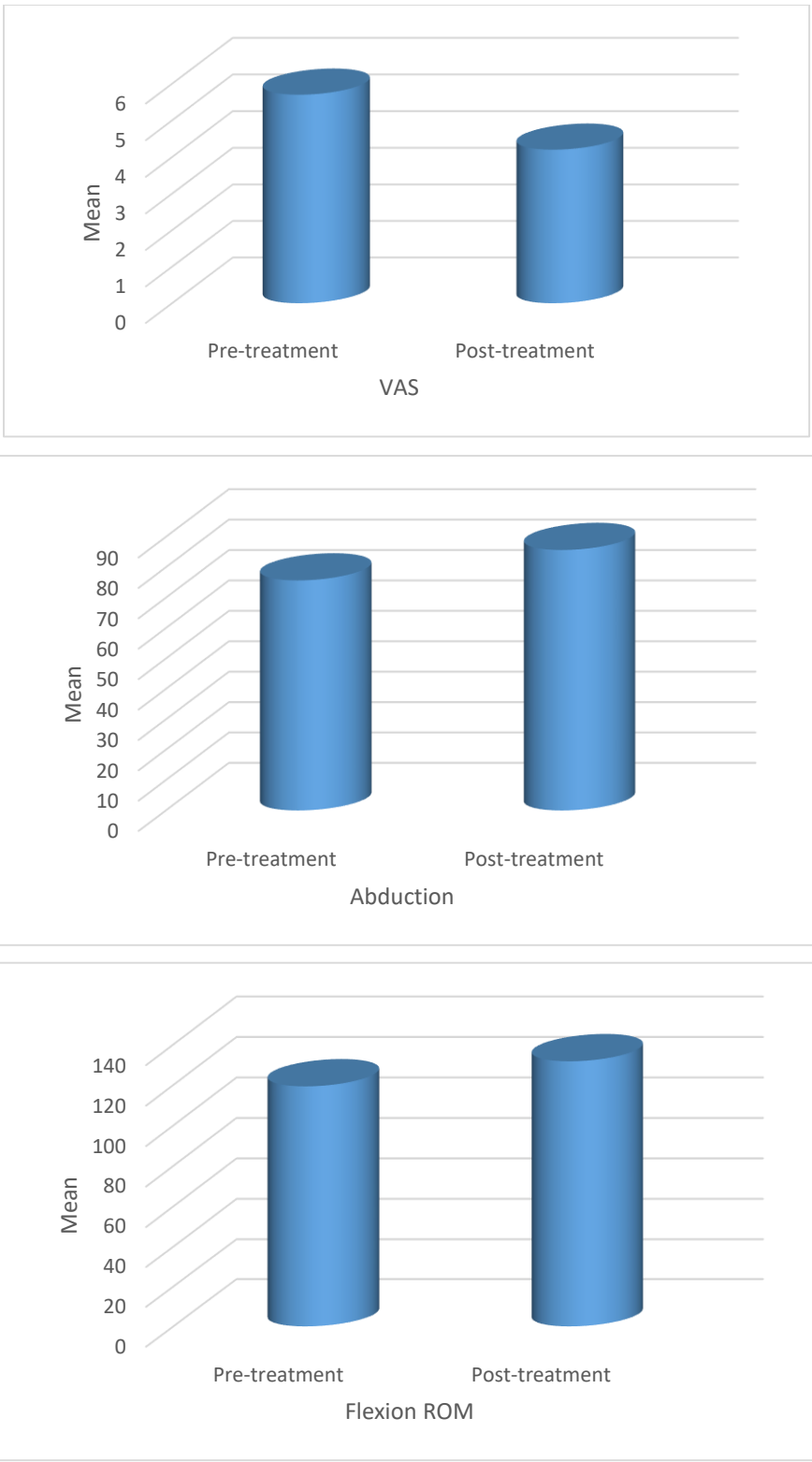



Fig.(2): Comparison between VAS, abduction and flexion ROM Pre and Post-treatment in group A

Table (3): Comparison between VAS, abduction and flexion ROM Pre and Post-treatment in group B

| Group B | **Pre-treatment** | **Post-treatment** | **t-test** | **P value** |
|---|---|---|---|---|
| **VAS** | | | | |
| Range | 4-8 | 0-4 | | |
| Mean | 6.0 | 0.9 | 12.25 | 0.0001* |
| S.D. | 1.254 | 1.280 | | |
| **Abduction** | | | | |
| Range | 60-85 | 118-142 | | |
| Mean | 72.8 | 130.9 | 8.25 | 0.001* |
| S.D. | 9.533 | 8.302 | | |
| **Flexion ROM** | | | | |
| Range | 100-131 | 162-180 | | |
| Mean | 116.6 | 173.4 | 5.89 | 0.001* |
| S.D. | 10.568 | 6.544 | | |

t = student t-test

P = p value and considered significant if $\leq 0.05$

* Significant difference from the before therapy.

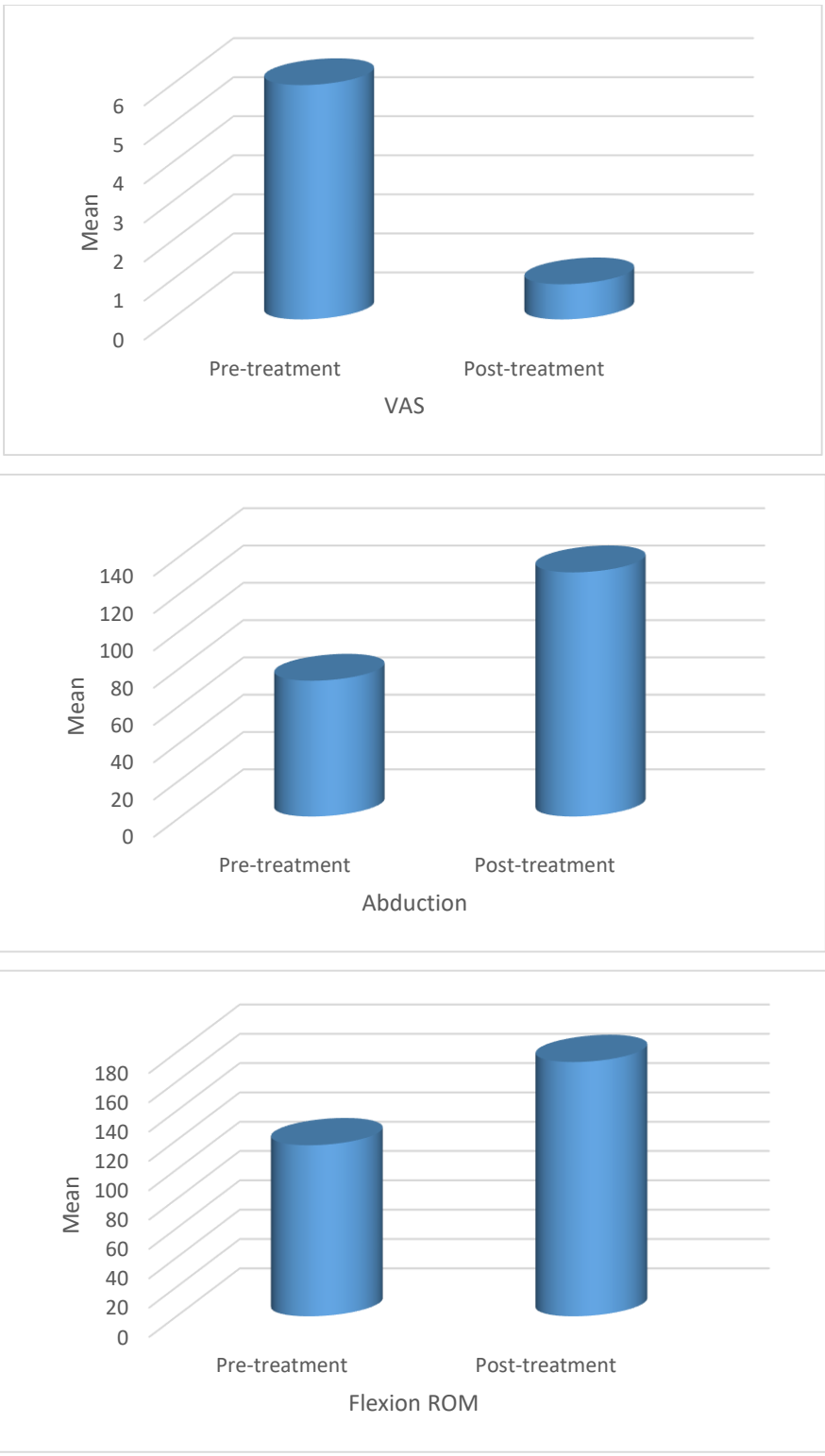



Fig.(3): Comparison between VAS, abduction and flexion ROM Pre and Post-treatment in group B

Table (4): Comparison between VAS, abduction and flexion ROM Pre treatment in the two studied groups

| Pre treatment | Group A | Group B | t-test | P value |
|---|---|---|---|---|
| **VAS** | | | | |
| Range | 3-8 | 4-8 | | |
| Mean | 5.7 | 6.0 | 0.82 | 0.425 N.S |
| S.D. | 1.543 | 1.254 | | |
| **Abduction** | | | | |
| Range | 63-88 | 60-85 | | |
| Mean | 75.7 | 72.8 | 0.93 | 0.341 N.S |
| S.D. | 9.445 | 9.533 | | |
| **Flexion ROM** | | | | |
| Range | 101-134 | 100-131 | | |
| Mean | 119.3 | 116.6 | 0.28 | 0.701 N.S |
| S.D. | 10.166 | 10.568 | | |

t = student t-test

P = p value and considered significant if $\leq 0.05$

N.S = No Significant difference.

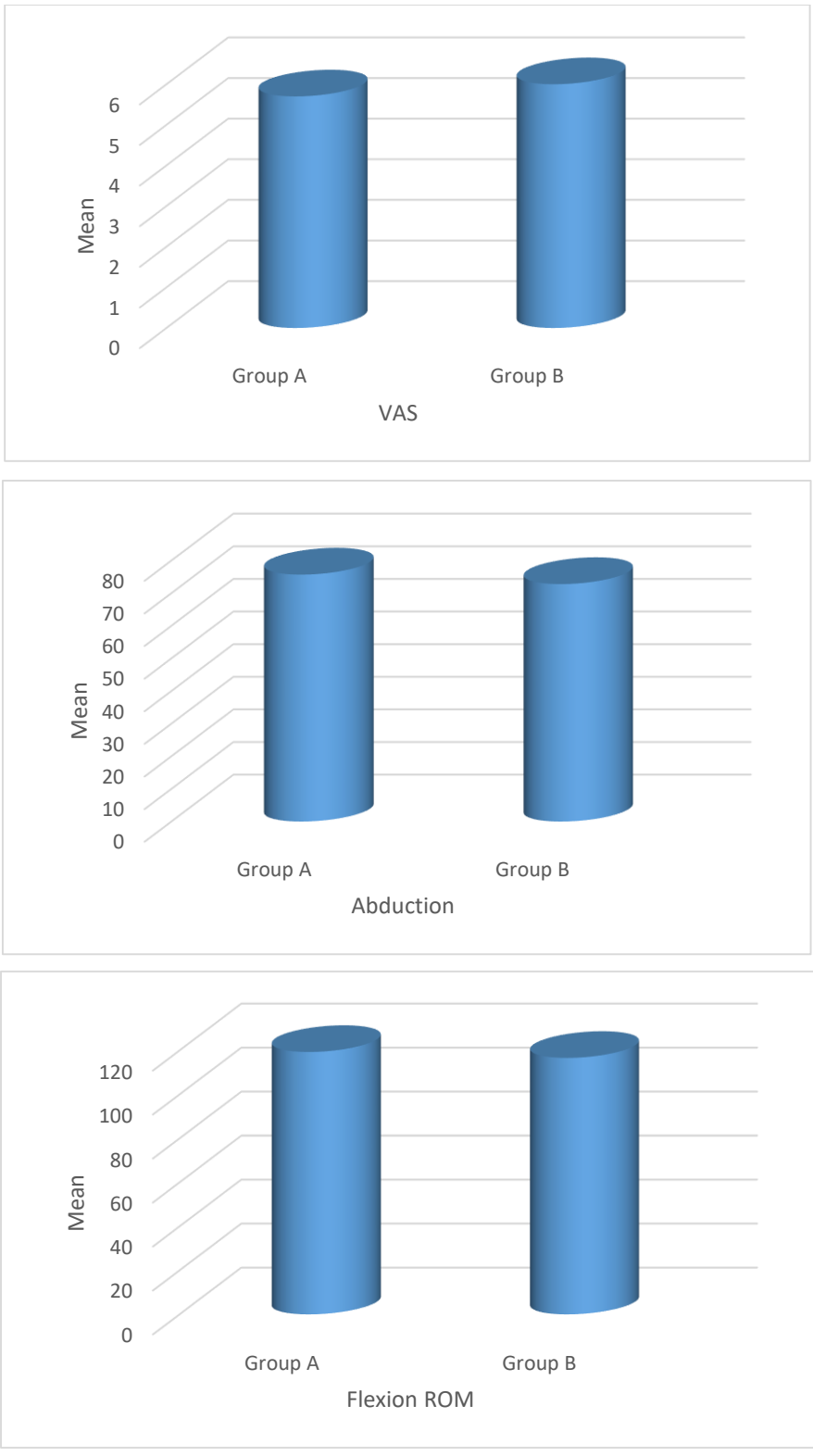



Fig.(4): Comparison between VAS, abduction and flexion ROM Pre treatment in the two studied groups

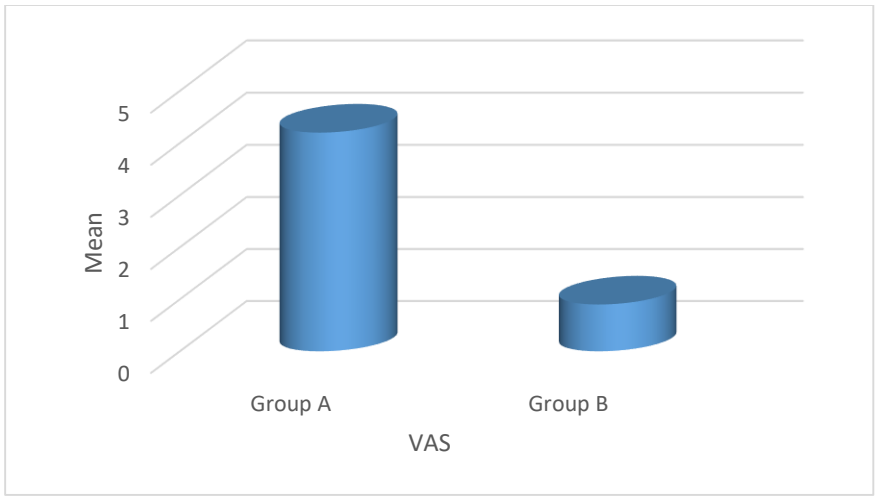
Table (5): Comparison between VAS, abduction and flexion ROM Post treatment in the two studied groups

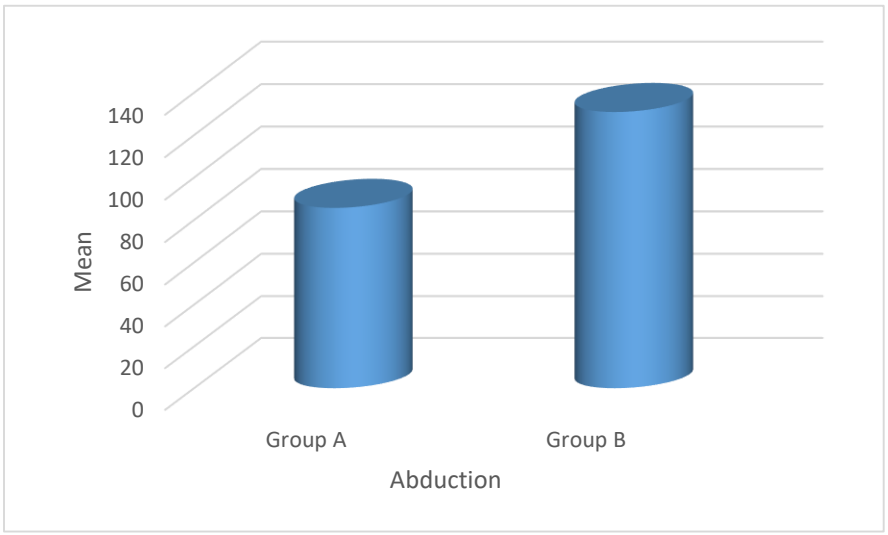
| Post treatment | Group A | Group B | t-test | P value |
|---|---|---|---|---|
| **VAS** | | | | |
| Range | 2-6 | 0-4 | | |
| Mean | 4.2 | 0.9 | 6.89 | 0.001* |
| S.D. | 1.474 | 1.280 | | |
| **Abduction** | | | | |
| Range | 73-97 | 118-142 | | |
| Mean | 85.7 | 130.9 | 7.25 | 0.001* |
| S.D. | 9.083 | 8.302 | | |
| **Flexion ROM** | | | | |
| Range | 112-147 | 162-180 | | |
| Mean | 131.7 | 173.4 | 5.01 | 0.001* |
| S.D. | 10.761 | 6.544 | | |

t = student t-test

P = p value and considered significant if $\leq 0.05$

* Significant difference between the two groups.



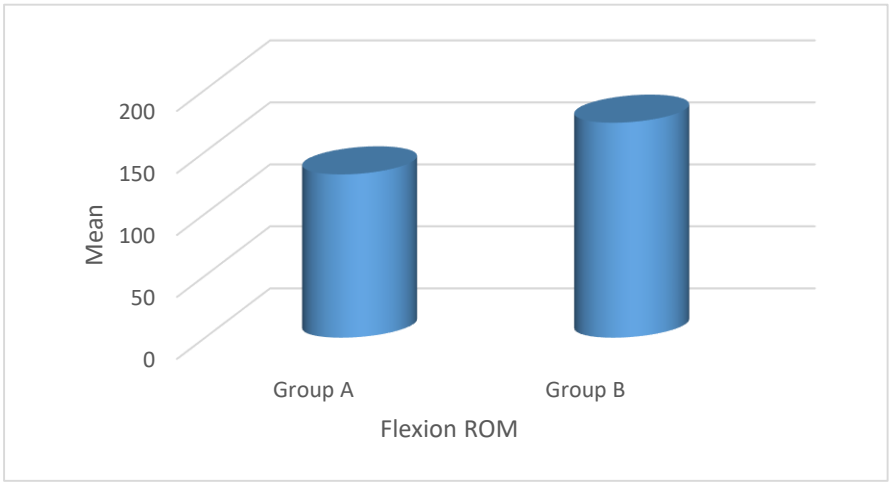




Fig. (5): Comparison between VAS, abduction and flexion ROM Post treatment in the two studied groups

**Informed consent form**

Recognition: I am miss or mr/ freely and voluntarily consent to participate in research study under the direction of researcher / M.A . A through description of procedure has been explained and I understand that I may withdraw my consent and discontinue participation in this research at any time without prejudice to me.

**Participant :** **date:**

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# Table of Contents