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Effect of mobilization with movement on shoulder range of motion in patients with impingement syndrome

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Abstract
Background: Shoulder impingement syndrome (SIS) is a painful condition of the upper extremity where is considered as a common indication for visits to primary care or orthopedic clinic worldwide.
Objectives: The purpose of this study was to measure the effect of thoracic mobilization with movement (MWM) on shoulder range of motion (ROM) in patients with shoulder impingement syndrome.
Methods: 40 patients aged from 25 to 40 years old with shoulder impingement syndrome participated in this study were randomly chosen from orthopedic clinic. Then, using an opaque sealed envelope, divide the subjects randomly into two groups: experimental group A (mulligan group) received Mobilization with movement (MWM) techniques on thoracic spine with traditional treatment and control group B (traditional group) received only traditional supervised exercises treatment. The subjects received the treatment three times per week for one month. Assessment of shoulder ROM was measured before the start the treatment and after treatment
Results: shoulder joint flexion, abduction, internal and external rotation all improved significantly in all two groups, according to the MANOVA test study but the level of improvement in the experimental group (A) was greater than that of the control group (B).
Conclusion: Mobilization with movement significantly improve shoulder joint flexion, abduction, internal and external rotation range of motion.

Keywords: impingement syndrome, thoracic spine MWM, range of motion

Introduction

Shoulder impingement syndrome (SIS) is one of the most common causes of shoulder pain and account for 44%-60% of all shoulder related symptom. The prevalence of diagnosed SIS is equal between males and females in the general population and in working populations and also there is no difference in prevalence between dominant and non- dominant arm in case of SIS (Dalbøge *et al*.,2014; Ertan *et al*., 2015; Milgrom *et al*., 1995) [2, 1, 3].

Shoulder impingement syndrome is classified into four types sub-acromial impingement syndrome (SAIS), sub-coracoid impingement, postero-superior inner impingement and antero-superior inner impingement. The Sub-acromial impingement syndrome is inflammation and irritation of the rotator cuff tendons as they impinge in the sub-acromial space, resulting in pain, weakness, and reduced range of motion within the shoulder joint due to repetitive arm elevation (overuse) and poor posture. (Garving *et al*.,2017) [4]. It can be occur suddenly or gradually and manifest as pain in the top and outer side of shoulder joint and worse when you lift your arm, especially when you lift it above your head, pain or aching at night, which can affect your sleep and weakness in your arm. (De and Tan, 2014; Creech and Silver, 2020) [6].

The Sub-acromial space bounded by the inferior aspect of the acromion process of the scapula superiorly and the superior aspect of the humeral head inferior and contain the supraspinatus tendon, sub-acromial bursa, long head of the biceps brachii tendon, and the capsule of the shoulder joint (Consigliere *et al*., 2018; Michener *et al*., 2003) [7, 8].

The two main mechanical factors that cause the (SIS) have been classified as intrinsic and extrinsic factors, the intrinsic factors are degenerative process that occurs over time with overuse, tension overload, or trauma of the tendons (Michener *et al*., 2003) [8].The extrinsic factors are where inflammation and degeneration of the tendon occur as a result of mechanical compression by some structure external to the tendon as faulty posture, altered scapular or glenohumeral kinematics, posterior capsular tightness, and acromial or coracoacromial arch pathology (De and Tan, 2014).

The biomechanical relationship between the arm and the thoracic spine is important to clinical practice because of the contribution of spinal to shoulder movements and vice versa (Theodoridis and Ruston, 2002) [9]. During arm elevation the thoracic spine moves in extension to make a distance in sub-acromial space that allow arm elevation to occur without impinge the subacromial space structures So limitation in thoracic spine mobility lead to decrease the acromio-humeral distance (AHD) during arm elevation which in turn lead to SAIS, Therefore the thoracic spine mobility is considered as a contributing factor in sub-acromial impingement syndrome (Stewart *et al*., 1995; Edmondston *et al*., 2012; Kalra *et al*., 2010; Theisen *et al*., 2010) [11, 10, 12, 13]. In cases of the sub-acromial impingent syndrome it was noted that there is changes in thoracic spine flexion and extension excursion and segmental mobility (Hunter *et al*., 2019; Kardouni *et al*., 2015) [15]. So, the purpose of the current study is to measure correlation between shoulder ROM and thoracic mobility in patients with subacromial impanigment syndrome

Material and methods
Design of study
Pre-posttest: randomized control clinical trials. The study protocol was approved by the research ethics committee of Faculty of Physical Therapy, Cairo University

Subjects
Forty patients of both gender aged from 25 to 40 years old with shoulder impingement syndrome participated in this study; Patients were diagnosed as stage II according to Neer's classification recruited from orthopedic clinic. Patients referred as unilateral SIS (stage 2) according to neer's classification, Had +ve Neer's sign, +ve Hawkins and Kennedy test and +ve Empty and full can tests. (Holmgren *et al*., 2012) [16]. patients were excluded if they have; History of shoulder adhesive capsulitis. (Shire *et al*., 2017) [17], Rotator cuff tendon tear/rupture (stage 3). (Shire *et al*., 2017) [17], Shoulder dislocation, sublaxation and fractures. (Shire *et al*., 2017) [17], History of cervical, shoulder, upper back surgery. (Lewis and Valentine, 2010) [20], Any spinal deformities such as scoliosis, kyphosis and rounded shoulder. (Strunce *et al*.,2009) [18], Diabetes mellitus. (Lewis and Valentine, 2010) [20], Radiculopathy. (Wright *et al*., 2017), History of breast cancer. (Strunce *et al*., 2009) [18], Previous stroke or Shoulder hand syndrome. (Lewis and Valentine, 2010) [20] Ligamentous laxity. (Camargo *et al*., 2009) [21]. Patients were assigned randomly into two group experimental group (A) & control group (B), The randomization performed by sealed envelope, each envelope contains 20 letters, 20 contains letter A for experimental group and the other 20 contains letter B for control group

The experimental group (A): 20 patients from both gender (13 females and 7 males) diagnosed as shoulder impanigment syndrome received SNAGS techniques on thoracic spine with traditional treatment consist of pendulum exercises and pain-limited active ROM exercises of shoulder elevation, depression, flexion, abduction, rotations, and strengthening exercises. Strengthening exercises were isometric in nature, working on the external shoulder rotators, internal rotators, biceps, deltoid, and scapular stabilizers (rhomboids, trapezius, serratus anterior, latissimusdorsi, and pectoralis major) supervised exercises (stretching and strengthening exercise) for 3 session per week for one month.

The control group (B): 20 patients from both gender (12 females and 8 males) diagnosed as sub-acromial impingement syndrome received only traditional treatment supervised the same as group B For 3 session per week for one month. (Djordjevic *et al*., 2012) [24].

Sample size calculation
Sample size calculation was performed using G*POWER statistical software (version 3.1.9.2; Franz Faul, Universitat Kiel, Germany) based on data of subacromial space from pilot study on 5 subjects in each group and revealed that the required sample size for this study was 20 subjects per group. Calculations were made using α=0.05, β=0.2 and effect size = 0.91 and allocation ratio N2/N1 =1.

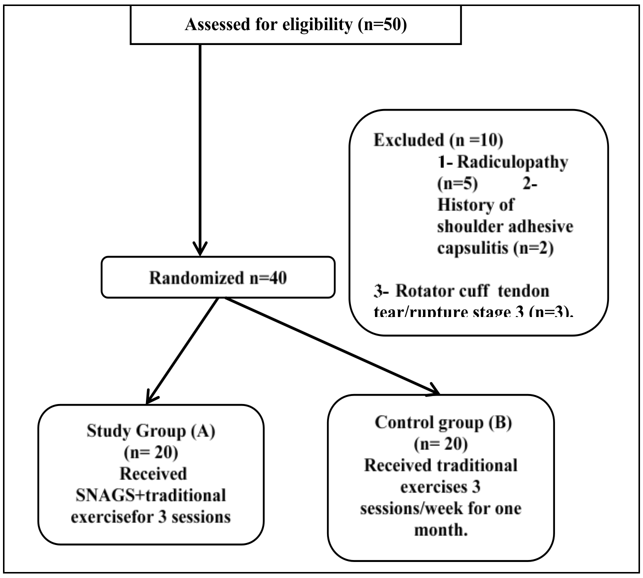

Fig 1: Flow chart of participants

Interventions
The experimental group (A): subjects received SNAGS technique on thoracic spine and traditional exercises 3 session per week for 4 weeks.

Thoracic SNAGs
The patient sat astride the end of the table with hands placed behind the neck to protract the scapulae allowing access to the mid thoracic spine for the therapist's hand. Therapist stood on their most efficient side for a centrally applied SNAG.

The therapist's mobilizing hand (ulnar border) applied a cephalad glide in line with the facet joint plane of the involved spinal level and the other arm holds the thoracic wall above the level to be mobilized. Traction is applied prior to glide, which was achieved by therapist knee extension, the technique done for 6 to 10 repetitions for 3 to 5 sets with rest between sets for 3 times per week for one month.

Traditional exercises
1. Pendulum exercise involve that the patients standing with a flexed trunk and the affected arm hanging downwards using the momentum of truncal movement to move the arm without contracting muscles of the shoulder girdle by using this technique, the arm can be moved forward, side to side or in a circular motion for 15 to 20 count (Cunningham *et al*.,2020) [22].

2. **Stretching exercise**
- Stretching for internal rotators (Anterior Shoulder Stretch): ask the patient to Place hands at shoulder level on each side of a door or in a corner of a room then lean forward into door or corner and hold for 30 seconds five times with 10 seconds rest between each stretch. (Kuhn, 2009) [23].
- Stretching for posterior capsule: ask the patient to bring affected arm across in front of body hold the elbow of the affected arm with other arm then apply a gentle pressure until you feel a stretch in the back of shoulder and hold for 30 seconds five times with 10 seconds rest between each stretch. (Kuhn, 2009) [23].

3. **Strengthening exercise: isometric in nature include**:

- Strengthening for external shoulder rotators: ask the patient to stand beside the wall, his shoulder close to the wall, Bend his elbow 90 degrees, make a fist, and press the back of your hand into the wall as if you were rotating your arm outwards. Use a small towel for a little padding, if needed. Hold into the wall for about five seconds then slowly release pressure on the wall for 3 sets of 10 repetitions. (Djordjevic *et al*., 2012) [24].
- Strengthening for internal rotators: ask the patient to stand in front of door frame or outside corner of a wall, the exercising shoulder should be near corner, then ask the patient to Bend his elbow 90 degrees, make a fist, and gently press into the corner wall or door jamb as if you were trying to rotate your hand inward towards your belly button. Use a small folded towel for padding. Hold for five seconds, and then slowly release for 3 sets of 10 repetitions (Djordjevic *et al*., 2012) [24].
- Strengthening for adductors: ask the patient to put a small towel between your inner arm and the side of your chest, then squeeze the towel against the side of your chest. Hold for 5 seconds, and then relax. For 3 sets of 10 repetitions. (Djordjevic *et al*., 2012) [24].

Control group B: patients recevied only traditional treatment the same as group A 3 session per week for 4 weeks

Outcome measures

Subjects were evaluated twice: once before therapy began and again four weeks after the trial began. Assessment of shoulder joint flexion, abduction, internal and external rotation by universal goniometer

Assessment of shoulder flexion

Starting position: patient set or stood, and therapist stood beside tested arm. Goniometer placement: stationary Arm of the goniometer was aligned with the lateral border of the scapula (mid axillary arm), and the moving arm was aligned with the humerus. Therapist grasp: one hand stabilized the stationary arm and other hand on movable arm allowing arm to move.Then patient was asked to forward flex the arm as possible.

Assessment of shoulder abduction

Starting position: patient set or stood and Therapist stood behind tested arm.

Goniometer placement: goniometer axis was placed at the midpoint of the posterior aspect of the glenohumeral joint, stationary arm was placed parallel to the trunk, and the moving arm was placed parallel to the longitudinal axis of the humerus. Therapist grasp: one hand stabilized the stationary arm and other hand on movable arm allowing arm to move. Then the patient was asked to actively elevate in abduction with the thumb pointed up toward the ceiling as possible.

Assessment of shoulder internal rotation

Starting position: patient was in supine with the hips and knees flexed approximately 45°.The tested arm was supported on the table in 90° of abduction, elbow flexed 90°, and the wrist in neutral position. Goniometer placement: The center of the goniometer was placed on the olecranon, stationary arm was Placed perpendicular to the floor, and the moving arm was parallel with the forearm. Therapist grasp: one hand stabilized fulucrum and stationary arm and other hand on movable arm to allow motion. Then the patient was asked to rotate arm forward into internal rotation as possible

Assessment of shoulder external rotation

Starting position: patient was in supine with the hips and knees flexed approximately 45°. The tested arm was supported on the table in 90° of abduction, elbow flexed 90°, and the wrist in neutral position. Goniometer placement: The center of the goniometer was placed on the olecranon, stationary arm was Placed perpendicular to the floor, and the moving arm was parallel with the forearm. Therapist grasp: one hand stabilized fulucrum and stationary arm and other hand on movable arm to allow motion. Then patient was asked to rotate arm backward into external rotation as possible.

Statistical analysis

Descriptive statistics and t-test was conducted for comparison of the subject characteristics between both groups. Chi squared test were conducted for comparison of sex distribution between groups. Normal distribution of data was checked using the Shapiro-Wilk test. Levene's test for homogeneity of variances was conducted to test the homogeneity between groups. Mixed MANOVA was conducted to compare the effect of time (pre versus post) and the effect of treatment (between groups), as well as the interaction between time and treatment on mean values of shoulder ROM. Post-hoc tests using the Bonferroni correction were carried out for subsequent multiple comparison. Statistical measures were performed through the statistical package for social studies (SPSS) version 22 for windows. The level of significance for all statistical tests was set at $p < 0.05$.

Results

The demographic data of patients is illustrated in Table (1), and no significant differences between groups were reported ($p > 0.05$).

Table 1: Comparison of study and control group subject characteristics

	Mean ± SD		p-value
	Study group	**Control group**	
Age (years)	33.15 ± 3.93	32.6 ± 4.2	0.61
weight	72.15 ± 5.13	73.4 ± 4.29	0.45
height	165.05 ± 3.83	167.1 ± 4.88	0.41
BMI	23.81 ± 1.45	24± 1.28	0.69
Females/males	13/7	12/8	0.74

BMI: body mass index; SD, Standard deviation; MD, Mean difference; $\chi 2$, Chi squared value; p value,

Probability value

The difference between the groups on the summed scores of all the outcomes measurements was presented using a mixed MANOVA. The results revealed a statistically significant difference between MWM and the control group for shoulder ROM after one month of intervention, with more favoring MWM, and also a significant difference between before and after therapy in all variables for both groups (Table 2).

Table 2

	Study group	Control group		
	Mean ±SD	Mean ±SD	p value	η^2
Flexion ROM (degrees)				
Pre treatmnt	80 ± 10.52	78 ± 9.46	0.81*	
Post treatment	90.5 ± 3.08	161.95± 6.12	0.001**	0.24
p value within	p = 0.001**	p = 0.004**		
Abduction ROM (degrees)				
Pre-treatment	100.4 ± 6.81	103.6 ± 5.47	0.86*	
Post tratment	123.35 ± 5.33	119.65 ± 4.16	0.01**	0.35
p value within	p = 0.005**	p = 0.03**		
Internal rotation ROM (degrees)				
Pre-treatment	55.34 ± 5.61	54.2 ± 5.01	0.83*	
Post treatment	67.54 ± 3.07	65.23 ± 4.2	0.001**	0.72
p value within	p = 0.002**	p = 0.04**		
External rotation ROM (degrees)				
Pretreatment	55.73± 6.25	54.3 ± 7.23	0.72*	
Post treatment	77.75 ± 3.38	69.65 ± 5.29	0.001**	0.54
p value within	p = 0.001**	p = 0.043**		

SD: Standard deviation; p-value, Level of significance; MD: mean difference; **: significant difference; *: no significant difference; CI: confidence interval; η^2: partial eta square

Discussion

The factors that affect physiological movements of the joints are normal shape of the articular surfaces, the thickness of the cartilage, the orientation of the fibers of ligaments and capsule, the direction of pull of muscles and tendons so any injuries or sprains in the joints lead to positional fault or joint mal tracking according to mulligan concept, the mulligan techniques correct these mal tacking problems or positional fault lead to return the joint to its normal movements. (Menek *et al*., 2018; Wilson, 2001) [25, 26].

The findings of the current study are in agreement with Strunce *et al*., (2009) [18] who concluded that there were significantly and clinically immediate improvement in shoulder range of motion measured by bubble inclinometer, where the patients received high-velocity thrust manipulative therapy to the upper thoracic spine and/or ribs and the type and number of manipulative techniques based on the presence or absence of specific thoracic and/or rib impairments.

And also Vinuesa *et al*., (2017) [27] who founded that there were significant differences between baseline and post treatment in all shoulder range of motions measured by digital goniometer where patients divided into two group and received cervicothoracic manipulation (repetitive lateral translation from both sides of cervical spine and 5 manipulation techniques on the thoracic spine plus exercise therapy or home exercise program (shoulder active range of motion (movements of flexion, extension, rotation, adduction, and abduction) for 10 sessions for 5 weeks (2 sessions/week).

Moreover, Park *et al*., (2020) [28] demonstrated that there is significant improvement in shoulder range of motions (flexion, abduction, medial rotation, and lateral rotation) in thoracic spine mobilization group measured by goniometer, wherease the patients divided into 3 group and received thoracic mobilization or exercise or both for 3 sessions per week for 4 weeks in patients with sub-acromial impingemnt syndrome.

The findings of the current study are contradicted with Andrews *et al*., (2018) [29] revealed that there were no significant improvement in all shoulder range of motions from initial visit to post treatment and from initial visit to 48 h follow up, where the patients received only mulligan thoracic SNAG treatment protocol so this study disagree with our results due to using the thoracic SNAGS alone without intervention or home program, for one session and there were no any modification of activity periods.

Limitations

This study investigate only the short term effect of mobilization with movement on shoulder range of motion and the long term effect was not reported in this study So, the author recommended future researches to study the long term effect of mobilization with movement in impangiment syndrome

Conclusion

Mobilization with movement significantly improve shoulder joint flexion, abduction, internal and external rotation range of motion

Acknowledgment

None

Conflict of interest

There was no conflict of interest.

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