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Impact of Scapular Mobilization and Strengthening Exercises on Shoulder Function Post Mastectomy

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ABSTRACT

Background: Mastectomy after breast cancer is usually accompanied by shoulder dysfunction which interferes with the daily life activities of the patients and causes physical and psychological impairments.

Objectives: This study aimed to assess the impact of scapular mobilization and strengthening exercises on shoulder function post mastectomy. **Patients and methods:** A single blinded randomized controlled trial included forty female patients, their ages ranged from 40 to 55 years suffering from post-mastectomy shoulder dysfunction. They were allocated randomly into two equal groups: the study group (group A), managed by scapular mobilization and strengthening exercises besides their conventional physical therapy program and the control group (group B), managed by the conventional physical therapy program only. Trial was applied for (three sessions/week) and lasted for four weeks. Shoulder pain and impairment, upward rotation of the scapula and shoulder range of motion were measured pre- and post- four-weeks of intervention. **Results:** after 4 weeks of treatment, percentage of change in shoulder pain and disability index (SPADI), upward rotation of scapula, shoulder flexion, abduction and external rotation was 34, 103.55, 45.71, 63.19 and 31.41% respectively in the study group and14.77, 58.42, 22.25, 30.30 and 23.40% in the control group, respectively. In all measures, there was a statistically significant difference in favour of the study group ($p< 0.001$).

Conclusion: It could be concluded that adding scapular mobilization and strengthening exercises are more effective in improving shoulder function regarding pain and ROM post-mastectomy than using the conventional physical therapy program only.

Keywords: Scapular mobilization, Scapular strengthening exercise, Shoulder function, Mastectomy.

INTRODUCTION

Shoulder dysfunction is a communal problem associated with mastectomy. It disrupts patient's daily living activities. The possibility of soft tissue changes because of surgery might enhance the likelihood of scapula kinematic changes. Breast cancer survivors have been shown to have increased scapula internal rotation throughout arm raising and lowering after operation, describing how the shoulder's biomechanical alterations are related to changes in soft tissue. At one month after surgery, shoulder flexion and abduction are reduced in 60% of breast cancer patients, and there was a persistent decrease in ROM after 1 year in 10% of survivors [1, 2].

Due to the lack of osseous support at the glenohumeral (GH) joint, the shoulder complex encompasses a set of static and dynamic components to keep up joint stability. The glenohumeral joint motion and the scapular motion on the thorax is required for the upper limb to move normally and painlessly. Synchronization between the muscles functioning through the joints allows for coordinated motion of these joints, which is necessary for arm raising. In breast cancer survivors, subacromial impingement syndrome has been associated with greater anterior tilting, increased internal rotation, and decreased upward rotation of the scapula [3, 4]. Scapular mobilization is a treatment of passive movements at the joint interface that can relax muscles, break up adhesions, realign collagen, and promote scapular motion. Also, it has a sedative effect related to the neurophysiological influence [5]. Scapular strengthening exercise, also known as scapular stabilization exercise, are exercises that aim to enhance shoulder kinematics by stabilizing the scapula through restoring its position, orientation, motor control of the muscles and movement pattern [6].

Based on the evidence, shoulder dysfunction is a common problem associated with mastectomy. It disrupts patient's daily living activities, also there is a lack in the quantitative knowledge and information in the published studies about the impact of scapular mobilization and strengthening exercises on shoulder function post-mastectomy. Thus, this study was designed to evaluate the impact of multifactorial physical therapy rehabilitation by adding scapular mobilization and strengthening exercises to the traditional physical therapy protocol in improving shoulder ache, ROM, and function of patients with shoulder dysfunction post-mastectomy.

MATERIALS AND METHODS

This study was a single-blinded randomized control trial. Participants were collected from National Cancer Institute and Baheya Hospital. The research was held between January 2022 and June 2022 at the Outpatient Clinic at Faculty of Physical Therapy, Cairo University.

Subjects: All patients who were diagnosed by the orthopaedist with post-mastectomy shoulder dysfunction, were examined to determine if they were qualified to take part in the study. Enrolment of the participants was only done if they matched the inclusion criteria.

Inclusion criteria: Post-mastectomy female subjects with age between 40-55 years, all patients had shoulder dysfunction (three months to six months' post mastectomy).

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Exclusion criteria: Participants were eliminated if they have rheumatoid arthritis, history of trauma or injuries, neurological deficits (stroke, Parkinsonism), history of surgery on involved shoulder, and diabetic patient. Patients who rejected to participate in the trial, or to summit the formal consent form.

Sample size and Randomization: The calculation of sample size was done by G*Power statistical software (version 3.1.9.2; Franz Faul, Universitat Kiel, Germany). It led to the conclusion that the appropriate sample size for this trial was 20 subjects in each group. Calculations were done using α=0.05, power 80% and effect size = 0.91 and allocation ratio N2/N1=1.

Forty female patients participated in this study, they received thorough details of the study's nature, objectives, and benefits, and before participating, individuals were required to sign the written consent form. They were splitted into two equal groups at random, the scapular mobilization and strengthening group (study group) and the conventional physical therapy program group (control group) using a sealed envelope, the groups names were written on cards that were wrapped in the envelopes. Participants were assigned into the appropriate group based on the selected card. Starting dates for treatment was determined, which began after the first week of randomized process.

Study design

Interventions: All patients in the two groups were managed by conventional physical therapy program three times per week for four weeks, which is composed of shoulder joint mobilization, posterior capsular stretching, and ROM exercises in form of Codman/pendulum exercise. To mobilize the shoulder joint, distraction of the glenohumeral joint, posterior glide and caudal glide were performed to the patients in a supine lying position at a frequency of two to three oscillations/second for one to two minutes. Every direction was repeated three to four times. At the resting position rhythmic oscillations grade I and II were applied. In posterior capsule stretching each stretch was repeated ten times for 20 seconds, between each stretching a 30-second break was given. Pendulum exercise was demonstrated to the patient at first, then they performed it in the forward-backward direction, side-to-side direction, and circular pattern, for two to three minutes in each direction [7, 8].

Patients in the study group received scapular mobilization and strengthening exercises. Scapular mobilization was done in five manners, superior glide, inferior glide, up-ward rotation, down-ward rotation, and distraction. Each mobilization was done ten times. A thirty second break was given between each set. While the scapular strengthening exercises composed of diagonal two (D2) flexion pattern, the subject raises her arm with elastic resistance or a weight from her contralateral side of the waist to her ipsilateral side of the head, the combined glenohumeral flexion, abduction, and external rotation movement aim to augment the upper, middle, lower, and serratus anterior muscles' activity level. To activate upper trapezius muscle, shoulder shrug exercise was used. To activate serratus anterior muscle, Wall slide exercise was used. Scapular retraction exercise for rhomboids and middle trapezius activation was done. Strengthening exercises performed using weights were initiated with two sets of ten repetitions, beginning with a weight of 0.5 kg and progressed to 0.75, and1kg [9-11].The outcome measures included measuring the SPADI, upward rotation of the scapula and shoulder flexion, abduction, and external rotation range of motion. All measures were collected before and after treatment.

- The Arabic version (SPADI) was used to evaluate the shoulder dysfunction. It is a self-administered questionnaire that was found to be both sensitive and reliable. It contains thirteen items, which assess two domains (pain and disability). The patient circled the best number that reflected their ache or impairment on a scale from 0 to 10, which has an 8-items subscale to evaluate disability and a five-items subscale to measure pain. To calculate a final percentage score for assessing shoulder dysfunction, the scores from the two aspects were averaged [12].
- Baseline bubble inclinometer was utilized to assess flexion of the shoulder, abduction, external rotation, and upward rotation of the scapula. An inclinometer was used on the patient while she was in a standard starting position. The patient was instructed to move the joint through its ROM just after the inclinometer was adjusted to zero. The ROM measurement was the inclinometer's final.
- Reading throughout the measurement, there was good contact between the patient and the inclinometer [13, 14].

Ethical consent: This study was ethically approved by the Institutional Review Board of the Faculty of Physical Therapy, Cairo University (P.T.REC/012/003464). The study was registered retrospectively at Clinical Trial Registry (NCT05529680). Written informed consents were taken from all participants. The study was conducted according to the Declaration of Helsinki.

Statistical analysis

An unpaired t-test was utilized to compare the age of the groups. The Shapiro-Wilk test was conducted to identify whether the data were normally distributed. Levene's test for homogeneity of variances was performed for the homogeneity between groups. Average estimations of SPADI, scapular upward rotation, and shoulder ROM were compared between groups using an un-paired t-test. Paired t-test was utilized to compare within each group's pre- and post-intervention data. All statistical analyses had a significant level of $p \leq 0.05$. The statistical package for social studies (SPSS) version 22 for Windows was used for all statistical analyses (IBM SPSS, Chicago, IL, USA).

RESULTS

The flow chart of those patients is illustrated in figure (1). Table (1) listed the baseline demographics of all patients in the trial and control groups. There were no statistically significant age-related changes between both (p = 0.31).

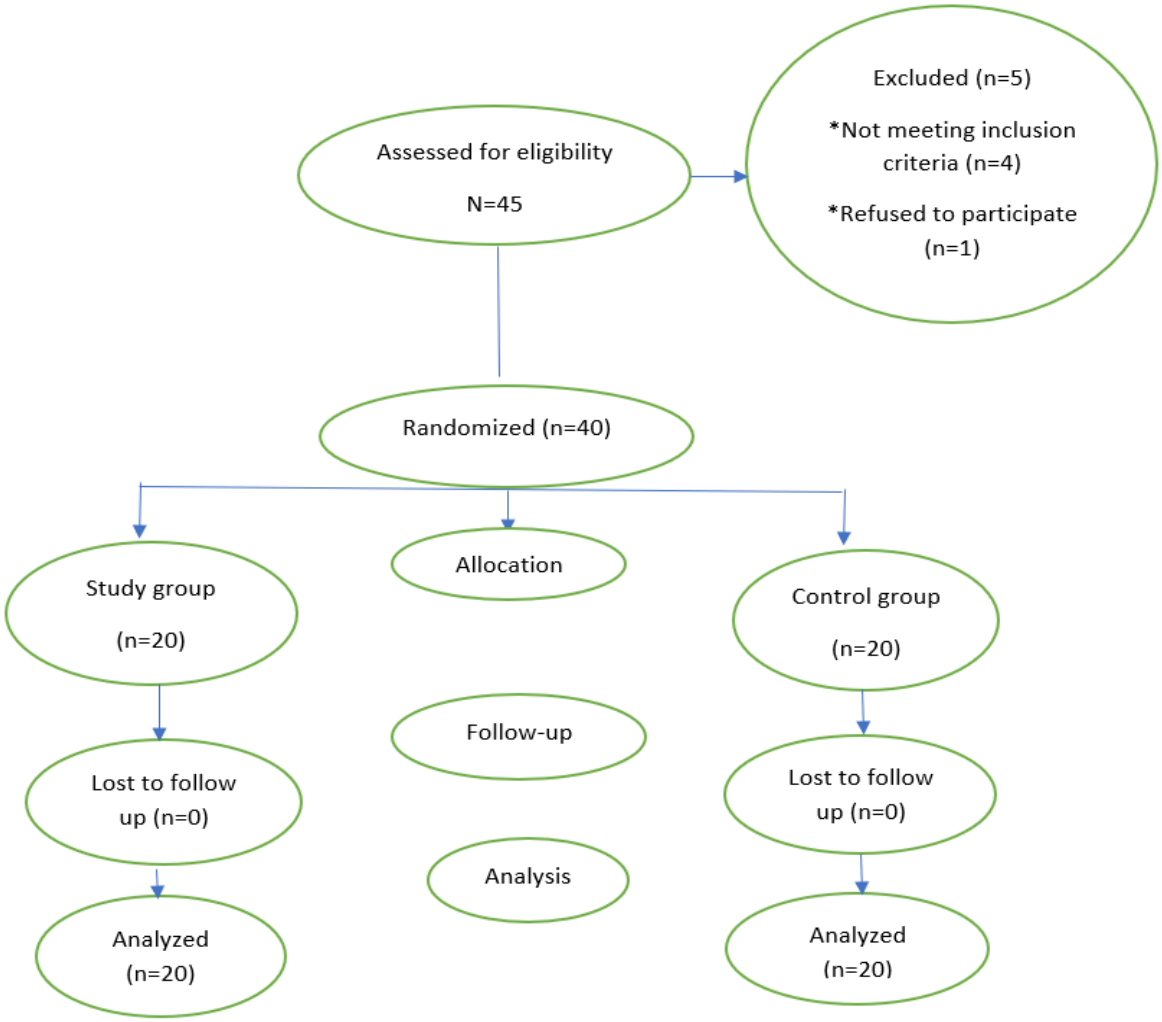

Figure (1): Flow diagram showing the progress of subjects at each stage of the clinical trial.

Table (1): Participant characteristics

		Study group	Control group	t-value	p-value
Age, Mean ± SD (years)		47.05 ± 5.1	48.7 ± 4.93	-1.04	0.31
Affected side, n (%)	Right	11 (55%)	12 (60%)	(χ^2= 0.1)	0.75
	Left	9 (45%)	8 (40%)		
Hormonal therapy. n (%)	Yes	16 (80%)	15 (75%)	(χ^2= 0.14)	0.70
	No	4 (20%)	5 (25%)		
Chemotherapy. n (%)	Yes	2 (10%)	1 (5%)	(χ^2= 0.36)	0.54
	No	18 (90%)	19 (95%)		
Radiotherapy, n (%)	Yes	3 (15%)	4 (20%)	(χ^2= 0.12)	0.72
	No	17 (85%)	16 (80%)		

$\bar{x}$: Mean SD: Standard deviation t value: Unpaired t value

t value: Unpaired t value χ^2: Chi squared value p value: Probability value

After therapy, a statistical reduction in SPADI within both groups in comparison with pre-intervention (p < 0.001) (2).

Table (2): Mean SPADI prior and following intervention of both groups

SPADI (%)	Study group	Control group			
	Mean ± SD	Mean ± SD	MD	t- value	p value
Pretreatment	59.62 ± 14.71	61.67 ± 13.13	-2.05	-0.46	**0.*64***
Post treatment	39.35 ± 11.88	52.56 ± 11.36	-13.21	***-3.59***	**0.001**
MD	20.27	9.11			
% Of change	34.00	14.77			
t- value	8.34	15.04			
	p = 0.001	***p = 0.001***			

SD, standard deviation; MD, mean difference; p-value, probability value.

Additionally, the 2 groups experienced a significant improvement in scapular upward rotation and shoulder ROM following intervention compared to pre-intervention ($p < 0.001$), as illustrated in table.

Between- group comparison, no statistically changes were found between both groups considering shoulder function, ROM (flexion, abduction, and lateral rotation), and upward rotation of the scapula at pre-intervention ($p > 0.05$). Post intervention, a statistical decrease of SPADI and increase of scapular elevation and shoulder range of motion were reported in comparison with the other group ($p > 0.001$) as illustrated in table (3).

Table (3): Mean scapular upward rotation and shoulder ROM prior and following intervention of both groups:

ROM (degrees)	Study group	Control group			
	Mean ± SD	Mean ± SD	MD	t- value	p value
Scapula upward rotation					
Pretreatment	***21.1 ± 5.28***	20.2 ± 6.55	0.9	0.***47***	**0.*63***
Post treatment	42.95 ± 5.29	32 ± 4.79	10.95	6.***85***	**0.001**
MD	-21.85	-11.8			
% Of change	103.55	58.42			
t- value	-19.81	***-9.32***			
P-value	***p = 0.001***	***p = 0.001***			
Flexion					
Pretreatment	106.75 ± 8.64	105.6 ± 12.05	1.15	0.34	**0.73**
Post treatment	155.55 ± 12.28	129.1 ± 9.56	26.45	7.6	**0.001**
MD	-48.8	-23.5			
% Of change	45.71	22.25			
t- value	-27.08	-15.21			
P-value	***p = 0.001***	***p = 0.001***			
Abduction					
Pretreatment	85.3 ± 11.75	83.65 ± 13.61	1.65	0.41	**0.68**
Post treatment	139.2 ± 17.57	109 ± 13.53	30.2	6.08	**0.001**
MD	-53.9	-25.35			
% Of change	63.19	30.30			
t- value	-17.97	-13.52			
P-value	***p = 0.001***	***p = 0.001***			
External rotation					
Pre-treatment	62.4 ± 9.7	58.55 ± 7.88	3.85	1.37	**0.17**
Post treatment	82 ± 9.09	72.25 ± 6.17	9.75	3.96	**0.001**
MD	-19.6	-13.7			
% Of change	31.41	23.40			
t- value	-10.10	-9.59			
P-value	***p = 0.001***	***p = 0.001***			

SD, standard deviation; MD, mean difference; p-value, probability value

DISCUSSION

The current study demonstrated statistical improvements in SPADI, upward rotation of scapula and shoulder range of motion in the treatment group in comparison with the other group ($p < 0.001$). Results of this trial may confirm that adding scapular mobilization and strengthening exercises to the traditional physical program that focus only on shoulder mobilization and exercises has a prominent and significant impact on shoulder pain, function, and ROM than traditional physical therapy alone.

Movement deviation patterns in females post mastectomy are like those reported in other known shoulder disorders. According to kinematics of shoulder movement, shoulder tightness alters scapulohumeral rhythm and glenohumeral translation, which causes changes in scapular motion. Particularly, limitations on external, and upward rotation, backward tilting, and scapular elevation might result from shortened pectoralis major and minor, which encompass the anterior surface of shoulder and trunk [(15)].

Most of previous studies focused on shoulder exercises and mobilization as a rehabilitation program for shoulder dysfunction. To the authors' knowledge, however, no study has specifically addressed adding scapular mobilization and strengthening exercises to the rehabilitation program for shoulder dysfunction in post-mastectomy patients. The findings of our trial are consistent with those of other investigations which founded that scapular mobilization and strengthening exercises has beneficial therapeutic impact on shoulder pain, function, and ROM [(16-19)].

Despite the benefits of the conventional shoulder mobilization and exercises, it is recommended that multifactorial physical therapy might be effective in treating musculoskeletal nociceptive pain, including a combination of accessory joint mobilisation, exercising actively with gradual intensity increment, and neurodynamics [(20)].

According to the results of this study, scapular mobilization and strengthening exercises when added to physiotherapy programme might be an efficient method in reducing shoulder discomfort and improving shoulder ROM and functions as scapular mobilization enhances the tissue remodelling and increases the tensile loading as it produces a stretching effect that leads to re-arrangement of connective tissues, extracellular matrix, and collagen tissues. So, it breaks down the adhesions, releases the scapular muscles and increases the scapular motion. All these effects ideally lead to amelioration in shoulder ROM, decreasing in shoulder discomfort and enhancement in overall shoulder functions. Also, the scapular strengthening exercises provide more efficient recruitment of trapezius, serratus anterior, rhomboids muscles and more maximizing the activity of these muscles to repair the biomechanics of scapular imbalance thus, lead to improvement in shoulder joint function [(21, 22)].

In this trial, the exercises programme in the controlled group also improved the shoulder pain, function, and ROM. In keeping up with earlier investigations, the exercises in this trial enhanced function while being safe and well-tolerated.

The study had some limitations: First, the absence of muscles strength assessment, which could have produced superior statistical data, was one of the study's limitations. Second, relatively small sample size. Third, absence of long-term follow-up, which could provide better statistical analysis. Consequently, additional research is necessary to evaluate the long-term effects of including scapular mobilization and strengthening exercises in the conservative physiotherapy programme.

CONCLUSION

According to the findings revealed by our trial, physical therapists and other medical practitioners must take into account the effects of including co scapular mobilization and strengthening exercises to the traditional physical therapy in rehabilitation of shoulder dysfunction post mastectomy.

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