BIOFEEDBACK TRAINING ON SHOULDER MUSCLES STRENGTH POST MASTECTOMY

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ABSTRACT

Background: *Shoulder weakness, disability and impaired movements are frequently reported complication in post- mastectomy patients.* ***Purpose:*** *The study was conducted to investigate the efficacy of biofeedback training on shoulder muscles strength post mastectomy. Subjects and methods: The present work was conducted on fifty four female patients with shoulder muscles weakness post mastectomy who participated in this study, their ages ranged from 40 to 60 years. The participants selected from Bahyea foundation of early detection and treatment breast cancer and were randomly divided into two groups; each group consisted of 27 patients. Group (A) (study group): received biofeedback training 3 days a week for 6 weeks in addition to their conventional physical therapy program (Mobilization exercises, shoulder capsule stretching and range of motion exercises).Group (B) (control group): received only their conventional physical therapy program, 3 days a week for 6 weeks. Hand held dynamometer was used to measure the shoulder strength. All assessments were conducted pretreatment and 6 weeks post treatment.* ***Results:*** *Comparison between groups revealed a significant increase of shoulder flexion, abduction and external rotation in group A compared respectively with that of group B post treatment ($p < 0.05$) for all measures.* ***Conclusion:*** *Adding biofeedback training to physical therapy treatment is important to improve the shoulder muscles strength post mastectomy.*

Keywords: *Biofeedback ; Mastectomy; sholder; muscles ; strength.*

INTRODUCTION

Mastectomy is a process that involves surgically removing the breasts in response to identified anatomical and functional abnormalities. A variety of surgical procedures, including lumpectomy and mastectomy, are available for therapy, with or without axillary lymph node removal[1] .

upper extremity still exhibited rates of pain (49%), weakness (47.1%), numbness (559.9%), and weariness (42.5%) as self-reported symptoms. While the majority of patients did not experience any restrictions while reaching with the affected upper limb, around one-third did report limits when it came to carrying out home tasks, heavy lifting, and other similar activities. Signs of trouble lifting and carrying items include a body mass index (BMI) of 25 or above and the use of the affected upper limb as the dominant limb[2] .

For women who have had a mastectomy, shoulder exercise may alleviate some of the pain and improve mobility in their upper limbs. Researchers have shown that strengthening the shoulders improves both the function of the shoulder and the ability to do ADLS[3]

The majority of scapular dyskinesia instances are brought on by changes in the way muscles and soft tissues work, which may be caused by a lack of flexibility, an imbalance in strength, or abnormal patterns of muscle activation. Symptoms of dyskinesia include a heightened protraction of the scapula, a diminution of upward rotation, an increase in internal rotation, and a worsening of anterior tilt. These positions cause the glenohumeral angle to rise above the "safe zone," which puts more strain on the anterior band of the inferior glenohumeral ligament and the posterior labarum. Additionally, they decrease the maximum activation of the rotator cuff, which in turn reduces the function of the "compressor cuff" muscles that establish dynamic stability [4].

the effects of electromyography (EMG) biofeedback training on functional capacity, pain, and quadriceps strength in young individuals with rheumatoid arthritis (JRA) revealed that the experimental group performed much better than the control group . Electromyography biofeedback training for rheumatoid arthritis in children and adolescents: impact on pain, quadriceps strength, and functional capacity[5]

Using m Trigger biofeedback may make recovering from shoulder impingement much easier. Gain insight into your performance both during and after a workout with this surface EMG biofeedback device. Since improper muscle activation patterns during basic actions are a common cause of shoulder impingement, this tool is great for motor learning and helps us apply what we've learned to the things we do every day.[6]

The majority of biofeedback research has focused on the effects of biofeedback therapy in the treatment of upper limb and lower limb motor deficits in neurological disorders. Traditionally biofeedback is presented to the patient and the clinician via visual displays, acoustic or vibrotactile feedback. [7].

The purpose of study was to determine if post mastectomy shoulder muscular strength might be improved with the use of biofeedback

Significant of study Because there was seen reduction in shoulder flexion and abduction seen in 60% of breast cancer patients at 1 month post mastectomy and in 10% of survivors at 12 months, found that the affection side’s shoulder strength was drastically diminished right after surgery . Shoulder strength was drastically diminished

at flexion by rate of 50.6% and abduction decreasing rate 49.1% compared to baseline. [4]

MATERIAL AND METHODS:

This trial was assented by the Ethical Committee of the Faculty of Physical Therapy, Cairo University. The study was anticipated registered in the Clinical Trial Registry (NCT06226688). The proposal for this work had been endorsed by the Ethical Committee of Cairo University's Faculty of Physical Therapy, Giza, Egypt (P.T.REC/012/004823). Bahyea IRB Protocol number (202309250044).

All aspects of the study were disclosed and informed consent was obtained. The patients were randomly assigned into two equal groups via the envelope mode. After patients' agreement to participate in the study, cards with either 'biofeedback training' or 'Traditional exercise' recorded on them were closed in envelopes; then a blinded physical therapist was asked to select one envelope according to the selected card, patients were assigned to their corresponding group. Group A comprised 27 patients who received biofeedback training in addition to traditional physical therapy and group B comprised 27 patients who received only their traditional physical therapy. Dates for starting the allocated therapy were regulated and the therapy was begun after the first week of randomization. The examiner physical therapist was not included in randomization procedures and was unaware of the therapy allocation. Patients were asked not to disclose their therapy allocation to the physical therapist during assessment. The participants were informed to report any harmful effects throughout the treatment period.

Sample size determination

Sample size calculation is performed using G*POWER statistical software (version 3.1.9.2; Franz Faul, Universitat Kiel, Germany) based on data of muscle strength derived from Anwer et al., 2011; and revealed that the required sample size for this study was 23 subjects per group. Calculations were made using α=0.05, power=90% and effect size = 0.99 and allocation ratio N2/N1 =1. To compensate for possible dropout the sample increase by 15% to be 27 subjects per group.

participants:

Fifty four female patients diagnosed with unilateral post mastectomy shoulder muscles weakness participated in this study. All patients were diagnosed by a specialized surgeon and recruited from the bahyea foundation. Patients were enrolled in the trial if they met the following criteria: (1) Female

patients' age ranged between 40-60 years old. (2) All patients had shoulder muscle weakness within 2 to 4 months post mastectomy. (3) All patients with chemo or radio therapy or hormonal. (4) All Patients with unilateral mastectomy and without lymphedema. (5)Patients with weakness in shoulder flexion, abduction and external rotation. (6) Patients clinically and medically stable. (7)All enrolled patients signed the informed consent. (8)All patients were free from any pathological conditions that might affect the results. Patients who had met one of the following criteria were excluded from the study: (1) Patients with lymphedema. (2) Diseases such as rheumatoid arthritis. (3) Infection. (4) Severe osteoporosis. (5) Tumors or metastasis. (6) Neurological or musculoskeletal disorders. (7) Severe psychiatrist illness.

Outcome measures:

Shoulder muscles strength was measured by a hand held dynamometer.

The Lafayette Model-01165 and the Hoggan microFET2 were the HHDs that gave the most reliable results when measuring isometric power and strength, respectively, by peak force. The reliability study of peak force and RFD showed good to exceptional results (coefficients > 0.70) for all muscle groups when comparing intra-rater, inter-rater, and inter-device reliability.**[8]**

Assessment Procedure: Patient in sitting position on chair with supported back , the HHD put proximal to bony prominence then the patient had a command to push , push , push and relax ,time of this assessment is **3 sec duration**.

Treatment procedure:

The standard six-week physiotherapy programme, consisting of one session per day, three sessions per week, and passive mobilization exercises for the glenohumeral (GH) joint, was administered to all patients in both groups.GH joint mobilizations (active range of motion exercises, pendulum exercises, posterior glide to increase flexion and internal rotation, and caudal glide to increase abduction); the patient was told to lean forward and place the unaffected hand on a table. Repeat the exercise by swinging the arm gently forward and backward while maintaining a straight back and a relaxed shoulder. After ten repetitions, move the arm in a circular motion**.** Exercises that involve wall climbing (hold for 15–30 seconds at the peak, 10 repetitions), shoulder wheel exercises (use a shoulder wheel to rotate the shoulder joint clockwise and anticlockwise), and stretching exercises for the posterior, anterior, and inferior capsular regions (hold

for 20 s for each 10 repetitions, with a 30-second break in between). For both groups, the entire treatment period lasted between thirty and forty minutes. **[9_12]**

The experimental group received biofeedback training which was applied for (shoulder flexors, abductors on and external rotators) respectively on anterior deltoid, chraco brachialis, middle deltoid and infraspinatus. Application of biofeedback: the patient was placed in standing position and asked to carry dumbbell in her hand. The electrode was put on active muscle to record its action and the ground electrode was put on elsewhere away from the active electrode, when the patient achieved the target number then the target number was elevated to the next level to encourage the patient for increasing the strength by increasing muscle contraction, then the weight of the dumbbell was increased and the same steps were repeated again for 10 to 30 repetation per once .

Statistical analysis reviewing as the following:-

Descriptive statistics were applied using means and standard deviations . Unpaired t test was conducted for comparison of patient's demographic data and main outcome measures between groups. Paired t test was conducted for comparison of outcome measures within each group. The level of significance for all statistical tests was set at $p<0.05$.All statistical tests were performed through the statistical package for social studies (SPSS) version 25 for windows. (IBM SPSS, chicago ,IL, USA).

RESULTS

- ***Subject characteristics*:**
- Forty-four patients with upper limb burn participated in this study. Table (1) shows the subject characteristics of group A and B. There was no significance difference between groups in age, BMI, time since surgery and type of surgery distribution ($p > 0.05$).
- **Table 1. Comparison of subject characteristics between group A and B:**

	Group A	**Group B**			
	Mean ±SD	**Mean ±SD**	**MD**	**t- value**	**p-value**
Age (years)	48.81 ± 5.43	49.52 ± 4.03	-0.71	-0.54	0.59
BMI (kg/m²)	31.16 ± 3.46	30.02 ± 4.71	1.14	1.01	0.32
Time since surgery (month)	2.74 ± 0.86	2.89 ± 0.69	-0.15	-0.69	0.49
Type of surgery, n (%)					

Total mastectomy	14 (52%)	15 (56%)	(χ^2 = 0.07)	0.78
Partial mastectomy	13 (48%)	12 (44%)		

- **SD, Standard deviation; MD, Mean difference; χ^2, Chi squared value; p value, Probability value**

Effect of treatment on shoulder muscle strength:

- **Within group comparison**

There was a significant increase in flexors, abductors and external rotators strength post treatment in both groups compared with that pre treatment ($p < 0.001$). The percent of change in flexors, abductors and external rotators strength of group A was 83.20, 95.08 and 81.80% respectively, and that in group B was 59.57, 71.10 and 63.90% respectively. (Table 2).

- **Between group comparison**

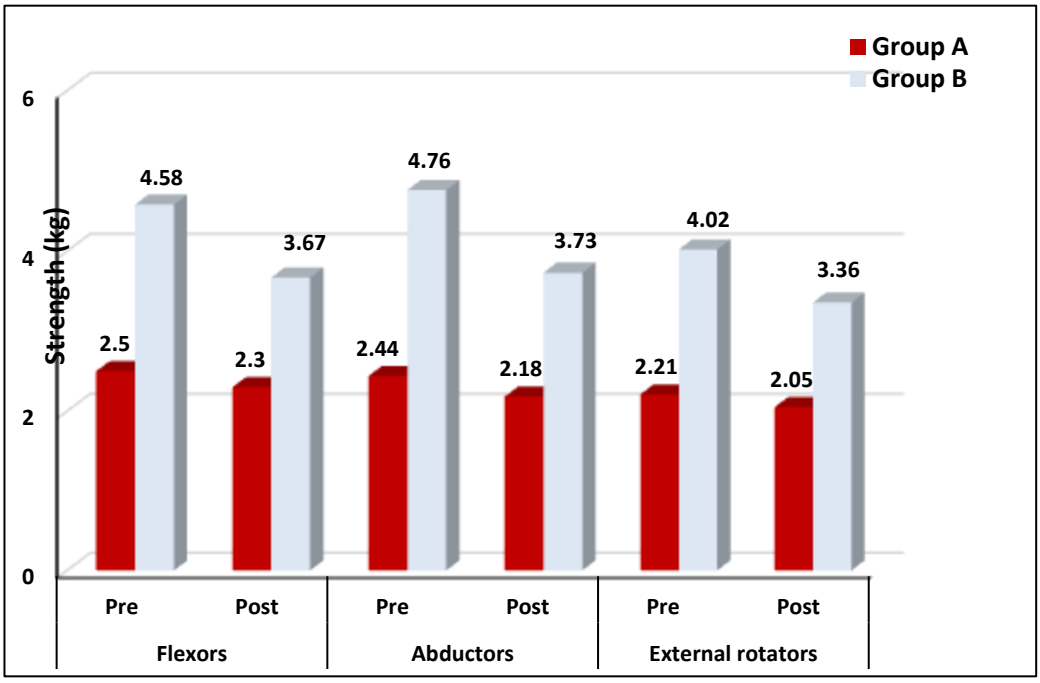
There was no significant difference between groups pre treatment ($p > 0.05$). Comparison between groups post treatment revealed a significant ncrease in flexors, abductors and external rotators strength of group A compared with that of group B ($p < 0.001$). (Table 2, figure 1).

Table 2. Mean flexors', abductors' and external rotators' strength pre and post treatment of group A and B:

Strength (kg)	Pre treatment	Post treatment	MD	% of change	t- value	p value
	Mean ±SD	Mean ±SD				
Flexors						
Group A	2.50 ± 0.74	4.58 ± 0.61	-2.08	83.20	-15.59	0.001
Group B	2.30 ± 0.53	3.67 ± 0.75	-1.37	59.57	-11.85	0.001
MD	0.2	0.91				
t- value	1.12	4.87				
	p = 0.27	***p = 0.001***				
Abductors						
Group A	2.44 ± 0.77	4.76 ± 1.12	-2.32	95.08	-16.62	0.001
Group B	2.18 ± 0.71	3.73 ± 1.06	-1.55	71.10	-11.37	0.001
MD	0.26	1.03				
t- value	1.31	3.44				

	p = 0.19	***p = 0.001***				
External rotators						
Group A	2.21 ± 0.65	4.02 ± 0.67	-1.81	81.90	-13.83	0.001
Group B	٢.٠٥ ± 0.69	3.36 ± 0.82	-1.31	63.90	-15.99	0.001
MD	0.16	0.66				
t- value	0.83	3.29				
	p = 0.41	***p = 0.002***				

- **SD, Standard deviation; MD, Mean difference; p value, Probability value**



- **Figure 1. Mean shoulder muscle strength pre and post treatment of group A and B.**

Informed consent

Informed consent had been obtained from all individuals included in this study.

DISCUSSION

As we saw in results there was a significant increase in flexors' strength of group A compared with that of group B post treatment (p = 0.001), There was a significant increase in abductors' strength of group A compared with that of group B post treatment (p = 0.001) and There was a significant increase in the external rotators' strength of group A compared with that of group B post treatment.

From our point of view, we justify the improvement of shoulder muscles strength in group A more than in group B as the combination of biofeedback training improved shoulder muscles strength and was

found to be comparatively better than the conventional physical exercises alone in improving strength.

This may be due to strengthening exercises using biofeedback training when added to physiotherapy programme might be an efficient method in reducing shoulder discomfort and improving shoulder strength as it increased muscles co-efficient force generated and more maximizing the activity of shoulder muscles to repair the biomechanics of scapular and shoulder imbalance thus, leads to improvement in shoulder joint function and repair the shoulder joint dysfunction.

The improvement in all patients on both groups due to add scapular mobilization and shoulder mobilization as they broke down the adhesions, released the scapular muscles and increased the scapular motion, all these effects ideally leaded to amelioration in shoulder ROM, decreasing in shoulder discomfort and enhancement in overall shoulder function. Performing exercises aimed at strengthening the upper limbs after a mastectomy may aid in the recovery of lost function in those areas that have been affected by the cancer therapy. When it comes to resistance training, a self exercise regimen is the best way to increase range of motion (ROM) in the shoulders, strength in the upper extremities, and quality of life (QOL) [13]. It was concluded that early, supported exercise after mastectomy enhanced shoulder function in patients and was accompanied with improved health-related quality of life and lower health-care costs than usual care.[14]. Women with BC have weaker shoulder girdle strength than healthy women who did not have BC. As a result, patients having axillary mastectomy with radiation therapy and training programmes for patients with BC should have their shoulder girdle strength aspects carefully considered [15]. Our study confirmed the importance of biofeedback training in post mastectomy management without reporting any adverse effects and presented the preliminary evidences for introducing biofeedback training as an essential part in post mastectomy rehabilitation, however, some limitations must be considered when explaining these results ,the most significant drawback of this experiment was absence of long-term effect of treatment examination due to the difficulty of following up after the trial, so future trials with patients' follow up are recommended, also to minimize human suffering and financial expenses, it is vital to raise awareness regarding the protection, early diagnosis, and timely therapy of shoulder difficulties in post-mastectomy sufferers, so trials should be conducted to evaluate early physical therapy intervention in prevention shoulder muscles weakness following mastectomy.

This was the first research to investigate the short-term effect of the biofeedback training strengthening exercises on shoulder function post mastectomy. The results of the study indicated that adding biofeedback training to the conventional Pt for strengthing shoulder muscles had a greater therapeutic effect than using the conventional physical therapy alone.

CONCLUSION:

In view of the findings revealed by this study, it could be concluded that:

Incorporation of biofeedback training to shoulder muscles strength was beneficial in improving post mastectomy shoulder function regarding strength post mastectomy when it was added to the conventional physical therapy program.

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Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest.

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