EFFECT OF CORE STABILIZATION EXERCISES ON POSTURAL STABILITY AFTER BREAST RECONSTRUCTION IN MENOPAUSAL WOMEN

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Abstract

Back ground: One of the solutions after mastectomy is breast reconstruction using an abdominal flap. Women underwent this type of surgery demonstrated asymmetry in the vertical alignment of the trunk with greater asymmetry between the acronyms and greater trochanters, which can change trunk balance. In addition to rectus abdominis weakness that resulted in trunk flexion deficit. This reliable information gave the necessity for the prescription of physical therapy program to strengthen the abdominal muscles and correct the posture for better postural balance.

The purpose of this study was to highlight physical therapy considerations with these surgeries.

Materials and methods: this study was conducted on forty women who participated in the study were selected randomly from the research institute in Alexandria. They had undergone breast reconstruction surgery using transversus abdominis flap. Their ages ranged from 30-45 years old and their BMI didn`t exceed 29.9 kg/m². They were divided into two equal groups: A and B. Both were assigned to the same program for 30 minutes three times per week for eight weeks, and were treated by postural correction and diaphragmatic breathing exercises. Core stabilization exercises were added for group A. The study was conducted from July 2021 to January 2022. Balance was assessed using Berg scale and Modified Star Excursion test and functional capacity was assessed using six-minute walking test.

Results: showed that there was a significant increase in balance in both groups (A and B) post-treatment using berg scale and Modified Star Excursion test. The improvement was in favor to group A. There was a significant increase in functional capacity in both groups (A and B) post-treatment using a six-minute walking test. The improvement was in favor to group A.

Conclusion: It could be concluded that core stabilization exercises are valuable and effective method for improving stability and functional capacity.

Keywords: breast reconstruction, core, stabilization.

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INTRODUCTION:

Breast cancer is the most prevalent malignant tumor in female patients in developed countries (**G1owacka 2018**). One-sided mastectomy or minor breast surgery to treat breast cancer has been shown to have negative effects on posture and the musculoskeletal system, including changes in spine alignment, increased thoracic kyphosis with upper limb dysfunctions, and decreased shoulder joint angles on the operated side, according to recent studies **(Serel, 2017).**

After a mastectomy, lymphedema appeared to exacerbate asymmetries and changes in posture **(Vidt et al., 2020).**Furthermore, there were few researches on posture balance after breast cancer surgery in the literature; instead, a decline in bone strength and balance function following breast cancer therapy could lead to dangerous falls. Some researchers believe that increased breast weight lead to postural changes in the spine, such as dorsal kyphosis and anterior shoulder dislodgement **(Algeo et al., 2021).**

As a result of these assumptions, it was reasonable to postulate that following a mastectomy for breast cancer, postural spine changes, particularly in the sagittal plane, may develop, as well as a postural imbalance.

Transversus rectus abdominis myocutaneous, which uses soft tissues from the abdomen in the form of a rectus abdominis muscle pedicle skin-muscle flap, is still a typical treatment in autologous reconstruction. However, using one or both rectus abdominis muscles for tissue transfer weakens the abdominal muscle wall which can lead to an inappropriate static position **(Townley and Hofer, 2015)** and, as a result, poor body posture therefore, the use of postural global reeducation **(Guastala et al., 2016),** Pilates **(Teixeira and Sandrin, 2014),** core exercises **(Stuber et al., 2014),** and upper limb exercise **(Murtezani et al.,**

2014) as part of the rehabilitation protocol could be beneficial.

A core stability exercise program begins with recognition of the neutral spine position (mid-range between lumbar flexion and extension), the first stage of core stability training begins with learning to activate the abdominal wall musculature. Cueing individuals on abdominal hollowing, which may activate the transversus abdominis, as well as abdominal bracing, which activates many muscles including the transversus abdominis, external obliques, and internal obliques, is an important beginning step. One study showed that performing abdominal hollowing and bracing prior to performing abdominal curls facilitated activation of the transversus abdominis and internal obliques throughout the abdominal curling activity (**Suehiro et al., 2014).**

As progression is made through the initial stages of a core strengthening program, emphasis should be placed on developing balance and coordination while performing a variety of movement patterns in the three cardinal planes of movement: sagittal, frontal, and transverse. Exercises should be performed in a standing position and should mirror functional movements **(Tyler et al., 2014).**

The purpose of this study was to determine the effect of core stabilization exercises on postural stability in patients after TRAM flap breast reconstruction surgery.

SUBJECTS, MATERIAL AND METHODS

This experimental pretest-posttest study was approved by the research ethical committee, Faculty of Physical Therapy, Cairo University on 9th February 2020 with approval no: **P.T.REC/012/002658**.

2.1 Subjects

Forty women, who have undergone TRAM flap breast reconstruction surgery, participated in this study. They were selected from the Research Institute in Alexandria. The study was conducted from July 2021 till October 2022.

2.2 Randomization:

They were randomly divided into two equal groups (A, B). Both groups underwent the same program which was postural correction and diaphragmatic breathing with group A performing core stabilization exercises as an addition for 3 sessions per week for 8 weeks.

2.3 Inclusion and exclusion criteria

The criteria considered for inclusion were: the ages ranged from 30-45 years old and their BMI didn`t exceed 29.9 kg/m². The flap was taken from same side, exercises started after 3 months post-operative. They have finished their chemo therapy and radiotherapy and are taking hormonal therapy. Patients were excluded if they had surgical complication as delayed wound healing after surgical intervention, balance problems prior to surgery, cardiovascular diseases, severe lymphedema, axillary web syndrome, uncontrolled hyper tension or diabetes and visual problems that were not corrected by lenses

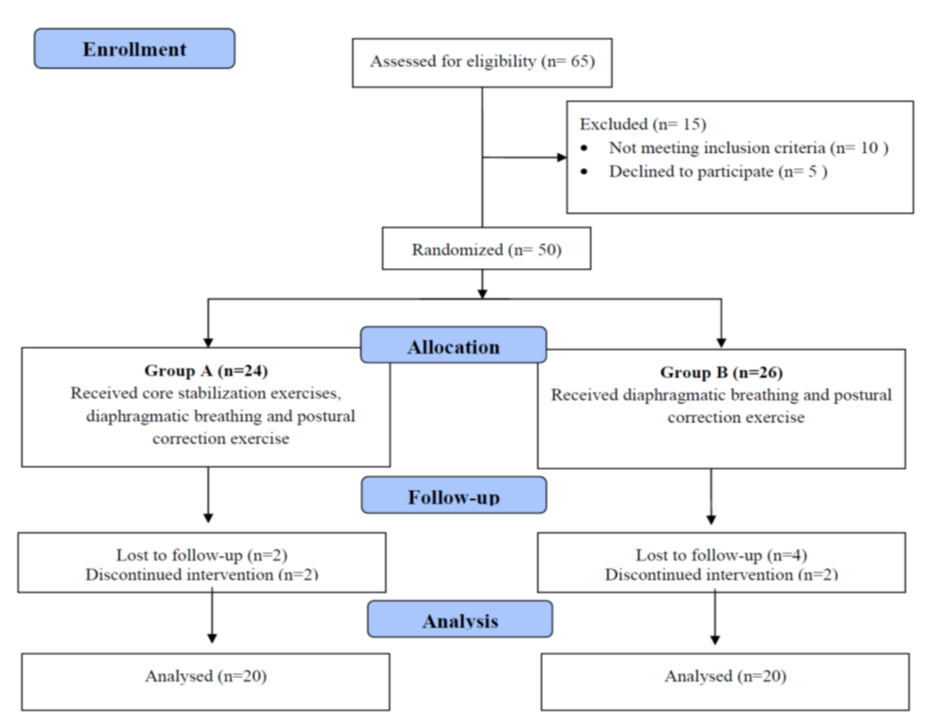

Figure (1): Flow chart of study participants

Methods of assessment:

Berg scale:

It was developed as a clinical measure of functional balance. The test took 15–20 minutes and comprised a set of 14 simple balance related tasks, ranging from standing up from a sitting position, to standing on one foot. The degree of success in achieving each task is given a score of zero (unable) to four (independent), and the final measure is the sum of all of the scores.

Modified Star Excursion Balance Test (MSEBT)

MSEBT is a concise version of the Star Excursion Balance Test (SEBT) and is used to assess postural control, strength, and proprioception (**van Lieshout et al., 2016)**. MSEBT was administered by instructing the person to stand on one leg while the other leg reaches in three different directions (Ant), (PL), and (PM). A composite score was then determined by adding the distances achieved in the three reach directions. MSEBT is a reliable and valid tool for quantitative balance assessment (**Picot et al., 2021**).

The test could be used to evaluate her capacity, but it could also be used to check for deficiencies in complex postural control caused by musculoskeletal injury (**van Lieshout et al., 2016).**

From erect standing position, the participant was instructed to extend one leg maximally in three directions (ANT, PM, and PL) without changing the position of her stance leg. The participant was instructed to place her hands on her hips while performing the test. The therapist measures the distance from the stance leg till the point reached by the other leg. All reach distances were normalized as a percentage of the stance limb length (LL) using the formula [% = (excursion distance/LL) × 100]. A composite score, which is an average of all three reach distances, [Comp= ((ANT+PM+PL)/ (3 × LL)) × 100] was also calculated for each limb. The absolute difference in the anterior reach direction distance (centimeters) between limbs was calculated to assess side-to-side asymmetry (**van Lieshout et al., 2016).**

Six minute walking test:

Functional capacity was assessed with 6-minute walk test which assesses submaximal level of functional capacity. The walking distance was 12 meters in length. In this test the patient was asked to walk as far as possible in a period of 6 minutes. It seems to be as valid and reliable as in healthy elderly, cardiac and pulmonary patients **(Cazzoletti et al., 2022).**

Treatment procedure:

Postural correction included scapular retraction for one set of 10 repetition with hold for 5 sec each, then progressed to two sets in 4th and 5th week then three sets from 5th till the 8th week then to pull the abdomen in with the same sequence as scapular retraction, keeping the head in neutral position and equally distributing the weight over both feet. The exercises were performed in supine first in first two weeks then progressed to standing in 3rd and 4th week and sitting on Swiss ball in 5th till 8th week for 20 minutes and was assigned as a home program once per day.

Diaphragmatic breathing through instructing the patient to take a deep breath through the nose and fill her abdomen with air, hold for 3 seconds then expire slowly through the mouth, it was repeated for 3-5 times then relax and is repeated for 10 minutes.

Core stabilization exercises: It consisted of curl up, posterior pelvic tilt, abdominal bracing, Contra-lateral arm lift, pelvic floor activation and bridging. The exercises were performed for 30 minutes.

The patient began with one set of 15 repetitions in the first two weeks, progressed to two sets of 15 repetitions in the third and fourth week then three sets of 15 repetitions from fifth week till the eighth week. It consisted of curl up exercises for rectus abdominis strengthening where the patient was asked to contract her abdomen and raise her head off the plinth and hold for 5 minutes then relax. Posterior pelvic tilt was performed from crock lying, the patient was asked to contract her abdominal muscles and press lumbar region down, hold for 5 seconds then relax. Abdominal bracing to activate transverses abdominis where the patient was asked to brace the abdominal wall, holding the lumbar spine in a neutral position, and slowly raised one foot 15-30 cm off the ground with alternate legs. Contra-lateral arm lift to activate multifidus, pelvic floor activation and bridging to activate gluteus maximus where the patient began the exercise in a hook-lying position, with arms resting to the sides, she activated the abdominals and squeezed the gluteal cheeks prior to initiating the movement then she lifted the pelvis and hips off the ground while maintaining neutral lumbar alignment.

STATISTICAL ANALYSIS

Results were expressed as mean ± standard deviation (X±SD). Comparison between different variables in the two groups was performed using either unpaired t test or Mann-Whitney U test whenever it was appropriate. Pair-wise comparison (pre- versus post-treatment) within the same group for different variables was performed using either paired t test or Wilcox on Signed Ranks test whenever it was appropriate. Statistical Package for Social Sciences (SPSS) computer program (version 19 windows) was used for data analysis. P value ≤ 0.05 was considered significant and < 0.01 was considered highly significant.

RESULTS:

Outcome measures:

Table (1): Statistical analysis of all outcome measures pre- and post-treatment between and among groups:

outcome measure	Group A X±SD	Group B X±SD	MD	t-value	P- value	Sig.
Berg scale (score)						
Pre-treatment	45.50 ± 2.78	46.00 ± 3.09	-0.5	-0.537	0.594	NS
Post-treatment	50.05 ± 2.78	47.45 ± 2.92	2.6	2.879	0.007	HS
t-value	-33.64	-9.44				
P- value	<0.001	<0.001				
% of change	↑ 10 %	↑ 3.15 %				
MSEBT (right side – anterior direction) (scale)						
Pre-treatment	67.88 ± 1.60	66.72 ± 2.31	1.15	1.834	0.074	NS
Post-treatment	75.44 ± 1.36	68.81 ± 2.06	6.63	11.98	<0.001	HS
t-value	-23.84	-15.51				
P- value	<0.001	<0.001				
% of change	↑ 11.13 %	↑ 3.13 %				
MSEBT (right side – Posteromedial direction) (scale)						
Pre-treatment	74.39 ± 5.05	73.00 ± 4.46	1.39	0.921	0.363	NS
Post-treatment	85.15 ± 5.23	74.44 ± 4.39	10.7	7	<0.001	HS
t-value	-27.35	-10.58				
P- value	<0.001	<0.001				
% of change	↑ 14.46 %	↑ 1.97 %				
MSEBT (right side – Posterolateral direction) (scale)						
Pre-treatment	67.86 ± 3.14	68.82 ± 3.54	-0.95	-0.905	0.371	NS
Post-treatment	80.44 ± 3.84	71.14 ± 3.34	9.29	8.16	<0.001	HS
t-value	-31.07	-11.38				
P- value	<0.001	<0.001				
% of change	↑ 18.5 %	↑ 3.37 %				
MSEBT (Left side – Anterior direction) (scale)						
Pre-treatment	66.47 ± 1.65	66.24 ± 1.82	0.23	0.423	0.675	NS
Post-treatment	73.54 ± 1.79	68.29 ± 1.72	5.25	9.437	<0.001	HS
t-value	-21.9	-23.3				
P- value	<0.001	<0.001				
% of change	↑ 10.63 %	↑ 3.09 %				
MSEBT (Left side – Posteromedial direction) (scale)						
Pre-treatment	73.34 ± 5.24	72.68 ± 4.45	0.65	0.427	0.672	NS
Post-treatment	84.56 ± 5.74	74.26 ± 4.62	10.29	6.236	<0.001	HS
t-value	-30.3	-12.29				
P- value	<0.001	<0.001				
% of change	↑ 15.29 %	↑ 2.17 %				
MSEBT (Left side – Posterolateral direction) (scale)						
Pre-treatment	67.86 ± 3.14	68.82 ± 3.54	-0.959	-0.905	0.371	NS
Post-treatment	79.53 ± 3.76	70.65 ± 3.50	8.87	7.72	<0.001	HS
t-value	-36.57	-1				
P- value	<0.001	0.33				
% of change	↑ 17.19 %	↑ 2.65 %				
Functional capacity (6min walk test)						
Pre-treatment	378.60 ± 38.6	363.0 ± 31.35	15.6	1.402	0.169	NS
Post-treatment	525.6 ± 37.86	416.40 ± 53.53	109.2	7.44	<0.001	HS
t-value	-26.09	-7.88				
P- value	<0.001	<0.001				

% of change	↑ 38.82 %	↑ 14.71 %

Statistical analysis of all outcome measures:
All subjects completed the assigned training routine. There was no significant difference in any of the measurements between the two groups at baseline.

The table represented the difference in balance measured by Berg scale before and after exercise training as it improved by (10 % in group A, mean scores were 45.50 ± 2.78 pre training versus 50.05 ± 2.78 post training) while in Group B it improved by (3.15% with mean scores 46.00 ± 3.09 pre training vs. 47.45 ± 2.92 post training) with a high significant difference post treatment between the two groups in favors to group A (P: 0.007).

After treatment there was a high significant increase in MSEBT of the right leg in group A in the three directions; anterior by 11.13% with mean score 67.88 ± 1.60 pretreatment vs. 75.44 ± 1.36 post treatment, posteromedial by 14.46% with mean scores 74.39 ± 5.05 pretreatment vs. 85.15 ± 5.23 post treatment and posterolateral by 18.5% with mean scores 67.86 ± 3.14 pretreatment vs. 80.44 ± 3.84 post treatment. When compared together post treatment there was a significant increase in group A than B ($P<0.001$). Testing the left leg, MSEBT showed a high significant difference between the two groups in favor to group A ($P<0.001$),where it raised by 10.63% in anterior direction from 66.47 ± 1.65 to 73.54 ± 1.79, in posteromedial direction was raised by 15.29 % from 73.34 ± 5.24 to 84.56 ± 5.74 and posterolateral by 17.19 % from 67.86 ± 3.14 to 79.53 ± 3.76.

Six minute walking test results showed high significant difference post treatment between both groups ($P<0.001$) with group A improving than B, where group A increased by 38.82 % vs. 14.71 % with mean scores 378.60 ± 38.6 pretreatment vs. 525.6 ± 37.86 post treatment for group A while group B scored 363.0 ± 31.35 pretreatment vs. 416.40 ± 53.53 post treatment.

DISCUSSION:

The objective of this study was to investigate the effect of the core stabilization exercises on balance and functional capacity in patients after breast reconstruction using abdominal flap.

The goal of core stability exercise program was enabling performance of high level activities in daily life and sports while keeping the spine stabilized through increasing muscle stiffness **(Barr et al., 2007).**

The results of this study revealed that there was a statistically high significant improvement in all measured variables in favor to group A. This group had specific core stabilization training. The program was conducted for 1 hour, 3 times per week for 8 successive weeks. There was a high significant improvement in balance and functional capacity.

One of outcome measures in this study was functional capacity. It was improved by increasing the distance covered in the 6-minute walk test. This might be according to the fact that contracting and relaxing large muscles acted to strengthen the cardiovascular system and increased its oxygen-carrying capacity. For the individual, this translated to a noticeable improvement in functional ability; routine activities associated with normal living become easier and less of a strain **(Hellsten and Nyberg, 2011)**. This came with agreement with the **Courneya et al., (2003)** paper measured the effects of aerobic exercise on cardiopulmonary function in addition to quality of life variables specifically in postmenopausal breast cancer survivors (n = 53). Exercise sessions took place three times a week for 15 weeks at a moderate intensity (70–75% of maximal oxygen consumption). Reliable outcome measurements indicated a long list of benefits: drastic increase in peak oxygen consumption (17.4% in the exercise groups compared with 3.4% in the control group), which indicated increased cardiopulmonary improvement, happiness, self-esteem, fatigue and overall quality of life.

Balance as one of the outcome measurement was improved through increasing muscle stiffness where segmental motion is controlled through appropriate muscle recruitment of local stability system **(Comerford and Mottram, 2001).** In addition to exercising the deep and global musculature that increase intra-abdominal pressure and therefore, increasing lumbar stability and precise neural control of lumbar muscles, so that they fire in a normal and efficient manner **(Barr et al., 2007).** This comes in agreement with **Bagheri et al. (2019)** who found that 20 sessions of core stabilization training had a substantial effect on static balance, similar to the findings of **Taheri et al., (2017)** and **Bastani et al.,** (**2017**) who revealed that balance can be improved through core stabilization exercises. Also, **Staron et al.** (**1994)** who described a number of neural adaptations following core strength training that included more efficient neural recruitment patterns, faster nervous system activation, improved synchronization of motor units and a lowering of neural inhibitory reflexes

The findings of this study corroborated those of **Kim (2019)**, who found that a four-week core stability training program greatly improves elderly balance, as well as **Ozmen and Aydogmus (2016),** who found that a five-week core stability training program involving Swiss ball and floor exercises enhanced balance.

The findings of this study were backed up by **Nam et al., (2015)**, who claimed that abdominal drawing-in maneuver (ADIM) training combined with electromyography feedback improved static core stability and postural stability. He showed that ADIM training combined with electromyography significantly enhanced morphologic changes in transversus abdominus muscle thickness as well as the neuromuscular pattern of an overly active superficial external oblique muscle, resulting in improved static core stability and postural stability.

The findings were consistent with those of **Gebel et al., (2018)**, who used the Tetrax Interactive Posturography and Balance System to explore the effects of back strength and balance training. They discovered that balance training reduced body sway and enhanced strength.

Juvet et al. (2017) stated that exercise intervention trials in breast cancer patients show that exercise is associated with significant improvements in muscular strength, aerobic capacity, health-related quality of life (HRQoL), fatigue, anxiety and self-esteem.

On the other hand, **Ernandes et al. (2020)** claimed that improvements in postural control caused by core stability training were limited to the ML plane, with no influence on balance in the AP plane. This could be explained by the fact that the gluteus medius muscles were in charge of maintaining balance in the ML plane. Since sagittal balance is maintained at the ankle joints **(Ernandes et al., 2020),** and the triceps surae and tibialis anterior muscles were not notably involved in the exercises, no effect was detected in the AP plane.

The main limitation was the lack of a longer follow-up period. It would be worthwhile to know if the supervised group maintained or even increased the intensity or duration of their exercise activity.

CONCLUSION:

On the basis of the results obtained in the present study, it could be concluded that core stabilization exercise was valuable and effective method in improving balance and functional capacity for women after TRAM surgery

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