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The efficacy of balance training on balance performance in obese patients undergoing sleeve gastrectomy

Ola Mansour Shawkey

A physical therapist police hospital in Cairo Egypt

Ashraf Al Sibai Mohamed

Professor Doctor of Plastic Surgery, Faculty of Medicine, Cairo University

Mohamed Maher Elkeblawy

Researcher in National Center Research

Ereny Sobhy Wahba Khalil

Department of Physical Therapy for Surgery, Faculty of Physical Therapy, Cairo University, Egypt

Abstract--Background: The goal of this study was to investigate the effect of balance training on balance performance in obese patients undergoing sleeve gastrectomy. Study Design: in the current study the participants will be selected from the police hospital Subjects & Methods: Sixty patients who had sleeve gastrectomy were randomly divided into two equal groups interventions. Group (A) received a program of balance training programs Periodic exercises were frequently performed for 45 min without rest among workouts with routine physical therapy program post abdominal surgical (breathing exercise, cough, and regular exercise). For three days per week for four weeks. Group (B): who takes sleeve gastrectomy with routine physical therapy program post abdominal surgery (breathing exercise, cough, and regular exercise). Main outcome measure: visual analog scale (VAS) and the Biodex Balance System (BBS). Results: Comparing both groups post- program revealed a statistically significant reduction in pain and increase in the Medio lateral stability index, anteroposterior stability index, and overall stability index in standing in both legs, on standing in RT leg only and standing in the left leg only. . All statistical measures were carried out using the statistical program for social sciences (SPSS) with version 27.

Keywords---sleeve gastrectomy, Obesity, Balance, pain and The Biodex Balance System (BBS).

Introduction

It is estimated that over 1.9 billion people suffer from overweight worldwide, 600 million of whom are classified as obese depending on WHO report (**Omonu et al.,2015**). Obesity has been increasingly cited as a major health issue in the USA and other countries all over the world (**Ogden et al.,2007**).

Body mass index (BMI) is a good indicator of obesity. According to reference study results, BMI > 25 is considered as overweight, BMI > 30 as obese, and BMI > 35 as morbid obese (**Weisell et al.,2002**). Individuals with a body mass index (BMI) of over 35 may face an increase in mortality of 40% in females and 62% in males, as compared to individuals with BMI in the normal range (**Mehta et al.,2009**).

One of the daily activities altered among obese individuals is balance control. Balance control is a key factor in prevention of the related injuries (**Weisell et al.,2006**) obesity could theoretically disrupt postural equilibrium, increasing the risk of falls,(**Hoang et al.,2014**).

Bariatric surgery has increased over the last four decades and the efficiency of this weight-loss technique has been approved. This surgery is an appropriate option for the individuals who excessively need to lose weight and their life is in risk (**Ben-David et al.,2011**) Bariatric surgery for severe obesity is associated with long-term weight loss and decreased mortality. Laparoscopic sleeve gastrectomy (LSG) has been recently introduced as a surgical option. It involves removing approximate 80 percent of the stomach, mainly the body and fundus, leaving behind only a gastric tube along the lesser curve This gastric tube has been shown to have less dispensability than the whole stomach, with high intraluminal pressure, thus restricting the amount of food that can be consumed at one time (**Tzioni et al.,2008**).

However, to the best of our knowledge, the effect of balance training exercises on postural stability has not been examined among the obese individuals undergoing bariatric surgery. Thus, the present study aimed to assess the effect of weight loss and balance training on clinical balance performance. LSG were considered more effective in achieving weight loss (**Juan et al.,2011**).

Materials and Methods

Ethical considerations

The ethical committee of Cairo University's Faculty of Physical Therapy has authorized the current research (No: PT/REC/012-003443). A formal consent has been signed by the participants' parents was also acquired to initiate the study process.

Study design

Study design the study was designed as a prospective, randomized- pre –post – test controlled trial. The study was conducted between march 2021 and April 2022.

Participants

This clinical trial was conducted on 60 obese individuals referred to police Hospital, Egypt. The participants were divided into intervention and control groups by random allocation. The inclusion criteria of the study were 20–30 years of age, BMI over 35 kg/m² and less than 40kg/m² , and after laparoscopic sleeve gastrectomy . On the other hand, the exclusion criteria of the study were any reports of lower limb injuries such as fractures, dislocations, muscle, and articular lesions; soft tissue injury; any condition resulting in non-weight bearing on the leg that lasted for longer than one day during the past 6 months; musculoskeletal and neuromuscular disorders such as rheumatoid arthritis, diabetes, myopathy, and neuropathy; any surgery on the muscles, joints and bones in the lower limb; middle ear disorders; and flexion contracture of the knee joint. Balance training programs (standing on one leg, standing in tandem mode, standing on one leg with closed eye, walking in tandem mode (one foot in front of the other), walking on toes and heel, standing while one upper extremity and the opposite lower extremity were up, rotating the head from one side to side, walking backward for four steps, and shifting weight from one foot to another) with routine physical therapy program post abdominal surgical (breathing exercise, cough,) (at least 3 times a week, 30–45 min each time);

Their performance was examined using Biodex Balance system (BBS) and visual analogue scale. a questionnaire, including age, weight, height, BMI, was filled out for each participant. Afterwards, balance exercise sessions started for the patients 5 days after the surgery and the patients were evaluated after 4 weeks.

Statistical analysis

For normality test of data, shapiro –Wilk test was performed, for comparison of age, pain and anterior- posterior stability index (RT leg) between the two groups, Mann-Whitney test was performed.

For comparison of anterior-posterior stability index (LT)leg, medial- lateral stability index, overall stability index between the two groups, independent t test was performed.

For comparing between pre-and post-treatment mean values of pain and anterior-posterior stability index In each group, Wilcoxon test was performed.

For comparing between pre and post treatment mean values of medial-lateral stability index and overall stability index in each group, paired t test was performed.

The arithmetic mean as an average description of central tendency of the results.

Alpha level was 0.05.

All statistical measures were performed through the statistical package for social studies (SPSS)version 27 for windows

Results

There was a non-significant difference in age in group A as compared with that of group B ($P=0.629$)

The finding of the present study showed that There was a significant difference in medial-lateral stability index (both legs) in group A post-treatment as compared with that pretreatment ($P < 0.001$).

There was a significant difference in the medial-lateral index (both legs) in group B post-treatment compared with that pre-treatment ($P= 0.045$).

Pairwise comparison showed that there was a non-significant difference in the mean values of pre-treatment between groups A and B ($P= 0.336$). Also, there was a significant difference between group A and B post-treatment ($P < 0.001$).

There was a significant difference in the medial-lateral stability index (RT leg) in group A post-treatment compared with that pretreatment ($P < 0.001$).

There was a significant difference in medial-lateral stability index (RT leg) in a group B post-treatment compared with that pretreatment ($P < 0.001$).

Pairwise comparison showed that there was a non-significant difference in the mean values of pretreatment between groups A and B ($P= 0.377$). Also, there was a significant difference in medial-lateral stability index (RT leg) between groups A and B post-treatment ($P < 0.001$).

There was a significant difference in medial-lateral stability index (LT leg) in group A post-treatment as compared with that pretreatment ($P < 0.001$).

There was a significant difference in medial-lateral stability index (LT leg) in group A post-treatment as compared with that pretreatment ($P < 0.001$).

Pairwise comparison showed that there was a non-significant difference in the mean values of pre-treatment between groups A and B ($P= 0.131$). Also, there was a significant difference in medial-lateral stability index (LT leg) between groups A and B post-treatment ($P < 0.001$).

There was a significant difference in anterior-posterior stability index (both legs) in group A post-treatment compared with that pretreatment ($P < 0.001$).

There was a significant difference in anterior-posterior stability index (both legs) in group B post-treatment compared with that pretreatment ($P < 0.001$).

Pairwise comparison showed that there was a non-significant difference in the mean values of pre-treatment between groups A and B ($P= 0.3$). Also, there was a significant difference between group A and B post-treatment ($P < 0.001$).

There was a significant difference in anterior-posterior stability index (RT leg) in group A post-treatment compared with that pretreatment ($P < 0.001$).

There was a significant difference in anterior-posterior stability index (RT leg) in group B post-treatment compared with that pretreatment ($P < 0.001$).

Pairwise comparison showed that there was a non-significant difference in anterior-posterior stability index (RT leg) in the mean values of pre-treatment between groups A and B ($P= 0.3$). Also, there was a significant difference between group A and B post-treatment ($P < 0.001$).

There was a significant difference in anterior-posterior stability index (LT leg) in group A post-treatment compared with that pretreatment ($P < 0.001$).

There was a significant difference in anterior-posterior stability index (LT leg) in group B post-treatment compared with that pretreatment ($P < 0.001$).

Pairwise comparison showed that there was a non-significant difference in anterior-posterior stability index (LT leg) in the mean values of pre-treatment

between groups A and B ($P= 0.81$). Also, there was a significant difference between groups A and B post-treatment ($P <0.001$).

There was a significant difference in overall stability index (both legs) in group A post-treatment compared with that pretreatment ($P<0.001$).

There was a significant difference in overall stability index (both legs) in group B post-treatment compared with that pretreatment ($P<0.001$).

There was a significant difference in overall stability index (RT leg) in group A post-treatment compared with that pretreatment ($P<0.001$).

There was a significant difference in overall stability index (RT leg) in group A post-treatment compared with that pretreatment ($P<0.001$). Pairwise comparison showed that there was a non-significant difference in the mean values of pre-treatment between groups A and B ($P= 0.405$).

There was a significant difference in overall stability index (LT leg) in group A post-treatment as compared with that pretreatment ($P<0.001$).

There was a significant difference in overall stability index (LT leg) in group B post-treatment compared with that pretreatment ($P<0.001$). Pairwise comparison showed that there was a non-significant difference in the mean values of pre-treatment between groups A and B ($P= 0.083$). Also, there was a significant difference between groups A and B post-treatment ($P <0.001$).

There was a significant difference in pain in group A post-treatment compared with that pre-treatment ($P<0.001$).

There was a significant difference in pain in group B post-treatment compared with that pretreatment ($P<0.001$).

Pairwise comparison showed that there was a non-significant difference in pain in the mean values of pre-treatment between groups A and B ($P= 0.257$). Also, there was a significant difference between groups A and B post-treatment

	Study group (A) mean \pm SD	Control group(B) mean \pm SD	p- value
Age	28.8 \pm 0.997	28.53 \pm 1.358	0.629 NS
Pretreatment medial-lateral stability (both leg)	6.34 \pm 1 1.671	5.9 \pm 1.838	<0.001 S
Post treatment medial-lateral stability (both leg)	4.07 \pm 1.174	5.45 \pm 0.962	0.045 S
Pretreatment medial-lateral stability(right leg)	8.32 \pm 1.355	7.99 \pm 1.56	0.377
Post treatment medial- lateral stability(right leg)	4.99 \pm 1.443	6.66 \pm 2.081	< 0.001 S
Pretreatment medial- lateral stability(left leg)	9.73 \pm 1.862	9.19 \pm 0.524	0.131 S
Post treatment medial -lateral	4.26 \pm 1.288	7.32 \pm 1.699	< 0.001 S

stability(left leg)			
Pretreatment anterior –posterior stability index (both leg)	9.55 ± 2.983	10.4 ±3.304	0.3
Post treatment anterior posterior index (both leg)	5.55 ±2.16	9.06 ± 2.835	< 0.001 S
Pretreatment anterior posterior index (RT leg)	10. 71± 2.792	10.9 ± 3.068	0.824
Post treatment anterior posterior index (RT leg)	5.93 ± 2.286	8.5 ± 2.083	< 0.001
Pretreatment anterior posterior stability index (left leg)	11.28 ± 2.694	1.13± 2.153	0.81
Post treatment anterior posterior stability index (left leg)	6.17 ± 2.095	9.54± 2.862	0.001
Pretreatment Overall stability index (both leg)	14.45 ± 2.202	14.82± 1.0013	0.405
Post treatment Overall stability index (both leg)	7.58 ± 2.108	13.75±1.136	0.001
Pretreatment overall stability index (RT leg)	16.3±2.086	15.84±0.942	0.284
Post treatment overall stability index (RT leg)	8.31±1.974	12.95±1.92	<001
Pretreatment overall stability index (lift leg)	16.3±2.086	15.84±0.942	0.284
Post treatment over all stability index(lift leg)	8.31±1.974	12.95±1.92	<0.001
Pain pretreatment	8.07±0.691	8.72±0.691	0.257
Pain posttreatment	4.27±1.048	6.1±0.759	<0.001

Discussion

The present study was designed to compare the effect of balance training on balance performance in obese patients undergoing sleeve gastrectomy. The obese patients undergoing sleeve gastrectomy are assessed by the biodex balance system and by visual analog scale system five days' after laparoscopic sleeve

gastrectomy and after four weeks. Laparoscopic sleeve gastrectomy is defined as an approximately 80% of the stomach is permanently removed by creating a tubular pouch (**Franco et al.,2011**)

The degree of improvement was determined after four weeks or 12 sessions.

(Zamanian et al.,2011) conducted a same study on 40 elderly women who were able to walk 6 m or more without an assistive device. These women were randomly allocated to intervention and control groups. The intervention group took part in 1 h balance training exercises performed three times a week for 8 weeks. On the other hand, no balance training was performed in the other group. Based on the results, balance control increased in the intervention group. Besides, **(Clemson et al.,2012)** conducted Lifestyle integrated Functional Exercise (Life) program, which included balance and strength activities, among persons with the mean age of 70 years for 12 months. The findings of that study showed an increasing in static balance among these persons. Moreover, **(Hauer et al.m2001)** investigated 57 women with the mean age of 82 years. Balance exercise was performed three times a week for 3 months. The results showed an improvement in balance control after 3 months. Similar to the present study, the abovementioned investigations revealed that balance exercise had a positive effect on improvement of balance control. Also, **(Binder et al.,2002),(King et al.,2002),** and **(Gao et al.,2014)** in their studies mentioned that activities and exercises including balance training improve balance control.

There are three important systems used for the control of posture. Balance is assessed by somatosensory, visual, and vestibular systems [**Shirazi et al.,2013**]. Vestibular and visual systems were kept stable in the present study. Thus, it can be concluded that the most important factor affecting balance is the somatosensory system that is stimulated by specific balance exercises. So, this system may be responsible for better performance in postural control during clinical tests. Balance training that was used in this study included unusual activities such as walking on toes and heels, side walk, walking while one upper extremity and the opposite lower extremity are up. *Participants* performed these activities for 4 weeks, so these kinds of training could improve somatosensory system significantly.

In contrast, **(Hortobágyi et al.,2011)** investigated obese individuals above 60 years of age with BMI > 25 kg/m² before and 6 months after the surgery in terms of walking patterns, Ground Reaction Force (GRF), and kinetic and kinematic knee joint parameters. They found that after the surgery, the speed and length of one step were increased; also, the vertical GRF and knee adduction torques in the frontal plane were decreased.

Teasdale et al. also examined obese individuals with BMI > 40 kg/m² who had undergone bariatric surgery. They found that measures of postural stability, including center of pressure speed and the peak magnitude of both anterior/posterior (AP) and medial/lateral (ML) directions with open and closed eyes, were increased with weight loss after 12 months **(Teasdale et al.,2007)**.

These two studies indicated that weight loss improved the balance control without doing balance training; this was incompatible with the findings of the current

study. This may be due to the different variables to assess postural control (force plate in the previous studies and using clinical balance performance tests in current study) and longer duration of follow-up (6–12 months) in previous studies compared with the current study (4 weeks). In addition, BMI in participants in the previous studies and current study was different.

Also, **(Handrigan et al.,2010)** and **(Matrangola et al.,2009)** showed that the weight loss was more efficient at improving the balance control than enhancing the muscle strength. **(Matrangola et al.,2009)** only investigated nine participants and their methodology was dependent on mathematical issues with different evaluations. In the study of Handrigan, the mean of weight loss was about 66 kg (45 % of weight) during 3–12 months compared with the current study, less weight loss during 4 weeks. In addition, we used clinical test but they used force plate. The findings of the present study showed a significant difference between the intervention and control groups regarding clinical balance performance. Accordingly, balance performance improved significantly in the patients attending balance training sessions for 4 weeks after sleeve gastrectomy. In fact, the present study showed that, regardless of weight loss, balance training exercises after bariatric surgery could enhance balance performance that may be due to stimulation of somatosensory system. However, one of the limitations of this study was lack of somatosensory system measurements before and after the balance exercises.

Conclusion

A routine physical therapy program was effective and beneficial in improving balance after laparoscopic sleeve gastrectomy as manifested by the highly increased anterior-posterior stability, medial-lateral stability, and overall stability and the significant decrease in pain. But the balance training and routine Physical therapy program were more fruitful and effective than the routine Physical therapy program alone.

Conflict of interest

There is no conflict of interest to highlight.

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