Egypt, J. Plast. Reconstr. Surg., Vol. 44, No. 4, October: 479-485, 2020

The Correlation between Weight of Resected Breast Tissue During Reduction Mammaplasty and Pulmonary Functions Parameters: An Objective Analysis

LAILA A. ABOUL NASR, M.D.*; HEIDI A. RAMADAN, M.Sc.*; IBRAHIM N. RIZK, M.D.*; ALAA E. SHALABY, M.D.** and SARAH S. RAAFAT, M.Sc.*

The Departments of Plastic Surgery and Chest Disease**, Faculty of Medicine, Cairo University, Egypt*

ABSTRACT

Background: Breast hypertrophy is seen in clinical practice to have various physical symptoms and signs on patients. These symptoms vary in severity according to breast weight. Symptoms may include back and neck pain, postural changes, skin affection (intertrigo) and psychological affection in form of depression, anxiety and low self-esteem.

Insufficient and contradictory data from previous studies described the effects on chest wall dynamics, which guided this study to furtherly investigate these changes and prove the hypothesis of the relation between the resected breast weight and the improved effect on lung functions. The aim of this study is to evaluate and document this relation and hypothesis by performing pulmonary function tests pre and post operatively.

Methodology and Results: Twenty-five adult female patients presenting with symptomatic macromastia were included in the study. Paired *t*-test showed significant change in some spirometric parameters (FVC, FVC%, B/P, FEV1, FEV1, %B/P) after reduction mammoplasty. Spearman correlation coefficient discovered a significant positive correlation between the total weight of breast tissue resected and pulmonary functions, and a non-significant correlation between the age, BMI and the pulmonary functions.

Conclusion: In conclusion, this study has documented the restrictive effects on chest wall compliance caused by macromastia. Statistically significant improvement in pre- and post-operative pulmonary functions was documented. The correlation between the resected breast weight and pulmonary function tests improvement, proved to be linear.

Key Words: *Breast Reduction – Mammoplasty – Lung functions – Respiratory functions.*

INTRODUCTION

Increased breast weight may influence the daily activities and quality of life [1].

Excessive breast weight is seen in clinical practice to have various physical symptoms and signs on patients. These symptoms vary in severity according to breast weight. Symptoms may include back and neck pain, postural changes, skin affection (intertrigo) and psychological affection in form of depression, anxiety and low self-esteem [2,3].

In cases of excessive breast weight and size, patients may even present with breathing difficulties. In these cases, especially, bilateral breast reduction surgeries are considered life-changing and of great value [4].

Macromastia can be described as an excess of breast tissue greater than 1 (>1) and less than (<2) 2kg per breast. Gigantomastia on the other hand can be used as a term for resection weight above 2.0kg. [11]. However, there is discordance in the literature with the weight of reduction ranging from 0.8 to 2kg, or even a D cup bra size. Practically this is a postoperative definition which is of little use to the clinician in terms of patient management or prognosis [12].

Some insurance companies still limit and refuse payment for reduction mammaplasty, as it is still categorized as an aesthetic procedure. It is important economically to provide evidence of breast reduction surgery benefits to help decrease these limitations and support women in need of this procedure [5].

Multiple studies discussed the beneficial effects of breast reduction surgeries on patients suffering of macromastia. The mammaplasty consequences were mainly subjective and did not include objective documentations for finding proper measures needed to be used for the evaluation [7].

Insufficient and contradictory data from previous studies described the effects on chest wall dynamics, which guided this study to furtherly investigate these changes and prove the hypothesis of the relation between the resected breast weight and the improved effect on lung functions.

The aim of this study is to evaluate and document this relation and hypothesis by performing pulmonary function tests pre and post operatively.

PATIENTS AND METHODS

Study design:

This prospective study was conducted at Kasr Al-Aini University Hospital, Department of Plastic and Reconstructive Surgery, during the period from December 2017 till June 2018.

The protocol was accepted by the scientific and Ethical Committee of Plastic Surgery Department of Cairo University Hospitals. Patients agreed verbally and signed an informative written consent for the operation and participation in the study.

This study included 25 female patients, between the age of 20 and 60 years. All patients came to Kasr Al-Aini outpatient clinic requesting reduction mammoplasty suffering from classic symptoms of macromastia and with a brassiere cup size of D or more. All patients suffered at least one of the following symptoms; neck, shoulder, back, and breast pain, sore brassiere strap grooving, intertrigo, poor posture, chest tightness, sleeping on multiple pillows, restricted activity or low self-esteem. Patients who were smokers, with a pre-existing lung disease (e.g. COPD), history of previous thoracic surgery, skeletal chest abnormalities, recent history of upper respiratory tract infection or medical comorbidities e.g. diabetes or hypertension were excluded from this study; as these factors may affect pulmonary function testing results.

Preoperative preparation:

A detailed history was obtained from patients, including personal data, previous surgeries, BMI, brassiere size and drug allergies.

Patients' height and weight were documented with their BMI preoperatively, and were taken into consideration and used in the statistics postoperatively.

Breast examination was done in upright, sitting and supine position for detection of masses, breast abnormalities, chest anomalies and scars of previous surgeries.

Conventional spirometry with MasterScreen PFT (Fig. 1) was used for assessment of lung function according to the standards of the American Thoracic Society one day before surgery date.

Fig. (1): MASTERSCREEN™ PFT SYSTEM; pulmonary function test station.

This was done at the chest diseases Department at Cairo University. All patients arrived at 10 am, tests were started after a period of rest (30 minutes). Procedure was explained to patients in detail. Pulmonary functions tested with this device are done at rest. All pulmonary function tests are done at rest. Deep inhalation and forced expiration are already considered as lung exercise, which needs to be measured alone without any external stress factors. Pulmonary functions can be testes under stress, which is the cardiopulmonary stress test, which combines cardiac functions as well. In this study all patients with cardiac comorbidities were excluded. Therefore, according to Chest Department guidelines, pulmonary functions were done at rest to be able to properly evaluate pulmonary function parameters.

The measured parameters were taken once as atrial before the actual readings were documented.

To achieve good results, careful instructions and demonstration were done. Patients were asked to sit in upright position with their feet firmly on the ground and avoid leaning forward during the maneuver. A nose clip and a disposable mouth piece were handed to each patient and asked to seal mouth tightly around it while forcibly exhaling for at least 6 seconds. They were asked not to insert tongue in the mouth piece opening or do any vocalizations or cough.

Spirometric and PFT results were printed and kept for later comparison with the postoperative test results at 6 weeks.

The evaluated pulmonary function parameters were forced vital capacity (FVC), the volume of air expired forcibly as fast as possible after the patient has taken in the deepest possible breath;

forced expiratory volume in 1 second (FEV1), the volume of air that can be forcibly exhaled from the lungs in the first second of a forced expiratory maneuver; FEV1/FVC ratio, the percentage of the total FVC expelled from the lungs during the first second; and peak expiratory flow (PEF), the maximal expiratory flow rates achieved by the patient during the FVC maneuver.

Pre-operative mammogram was done for all patients as well as routine investigations including full blood picture, liver and kidney function tests and fasting blood sugar.

Photography was performed for all patients pre-operatively and post-operatively. Views included anteroposterior, right and left oblique and right and left lateral views.

Consent:

Before the surgery, potential complications were explained to all patients and a signed standard informed consent was obtained.

Operative technique:

Preoperative markings were designed for a superomedial pedicle artistic breast reduction in standing position, to standardize the technique and eliminate bias. However, technique of breast reduction is of irrelevance, only weight of resected breast was the target of the study. Markings included midline, breast meridian, inframammary fold (IMF) position, new nipple position (by the Pitanguy point), vertical tangential limbs (9-11cm) and superomedial pedicle. (Fig. 2).

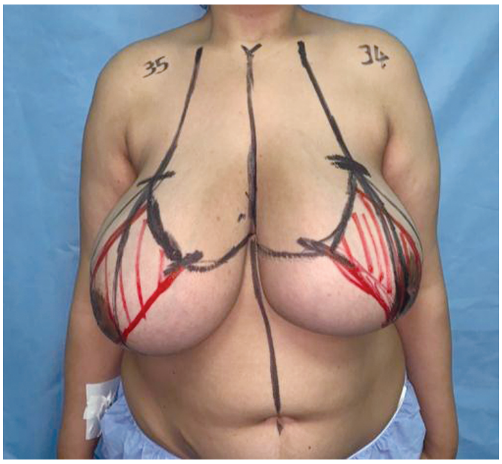

Fig. (2): Pre-operative markings.

Surgery was performed with patients in the supine position, with arms abducted and under general anesthesia. Anesthesiologists were asked to check lung function measurements on monitor before surgery commenced.

The pedicle was de-epithelialized then cut to the depth with dissection straight down to the chest wall just above the pectoralis fascia. The pedicle was usually about 2 to 2.5cm in thickness. The majority of the reduction and excised breast tissue was from the lower outer quadrant of the breast. Careful dissection and excision were performed especially underneath the pedicle flap. The medial and lateral pillars were then dissected.

They may be thicker than the nipple pedicle or a similar plane depending upon volume of breast required. Therefore the “new” breast can be dissected off the main bulk of the breast to be excised. It can even be roughly approximated to help assess the new volume and shape. This allows adjustments to be planned by retaining some inferior tissue if required. For greater projection, more tissue is left on the pedicle or centrally on the inferior tissue to be excised. The inferior excision is then made, with the scalpel angled toward the skin to empty this area fully. This is taken down to the relatively avascular plane above the pectoral fascia leaving a layer of loose tissue covering the fascia. This large inferior wedge can then be undermined. Before connecting this inferior to the superior dissection, the volume of the “new breast” is checked once again by approximating the pillars. If more volume is required, some of the inferior tissue can be preserved. If not, as is usual, this can be connected with the upper dissection creating a single excision. Any trimming of the pedicle and pillar is then performed. Use of additional tissue around the pedicle or tissue preserved centrally can be used for additional projection.

The breast tissue to be excised was removed en bloc and its weight was measured.

The incised breast envelope was closed using skin staples and patient was put in semi sitting position before skin closure to evaluate symmetry. NAC was closed using Monocryl 4-0. The vertical incision and breast parenchyma were closed in layers, starting with deep dermal sutures. The IMF horizontal incision was closed with 3-0 Vicryl dermal stitches. Sutures were from medial and then lateral side directing the breast envelope flaps in the direction of the natural “resting place” of the T-junction. Simple dressings were applied.

Post-operative care:

Prophylactic antibiotics were administered for 5-7 days post-operatively. Light dressing was used to cover the wounds with soft dressing at NAC.

Pulmonary functions tests were repeated after 6-8 weeks post-operatively, with same technique, conditions and doctors as the pre-operative tests.

Patient satisfaction questionnaire was filled by direct interview with the patients.

Follow-up visits were after 24 hours, three days, one week, then weekly till pulmonary function tests were performed, then monthly for six months.

RESULTS

In this prospective study 25 patients were included. Their ages ranged from 22 years to 47 years with a mean age of 33.7. Mean BMI was 33.56±3.81kg/m^2. Mean weight of resected tissues was 3113.6±676.7g. (Table 1).

Table (1): Showing mean, standard deviation, median, minimum & maximum of age, BMI, weight of resected tissues.

	Mean	Standard deviation	Median	Minimum	Maximum
Age	33.72	6.80	33.00	22.00	47.00
BMI	33.56	3.81	33.00	25.00	40.00
Wt-Rt	1553.20	381.19	1550.00	870.00	2100.00
Wt-Lt	1560.40	304.23	1640.00	950.00	2200.00
Total weight of resected tissues	3113.60	676.79	3230.00	1820.00	4300.00

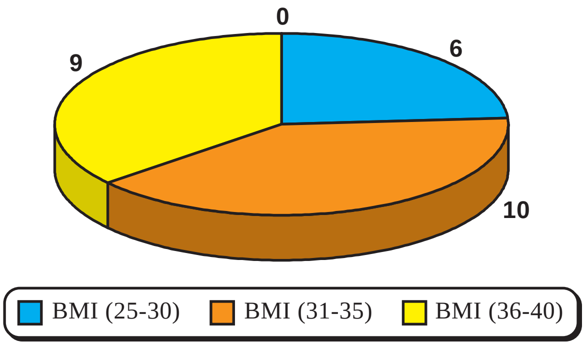

Fig. (3): Pie chart illustrating BMI in patients.

Measured BMI in patients was documented pre-operatively. Patients were distributed among three different groups (between 25 and 30, 31 and 35, 36 and 40). 24% were overweight and the majority (40%) was between 31 and 35 BMI.

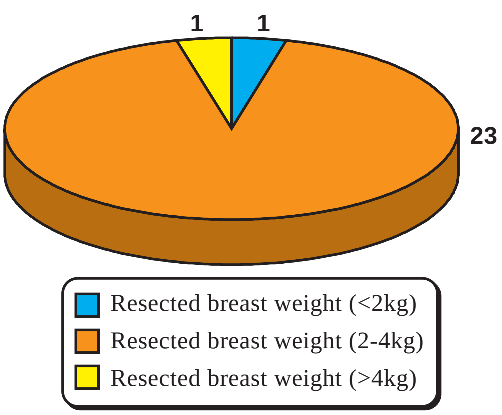

Fig. (4): Total breast weight resected.

Almost all patients had breast weight resected between 2 and 4kg with an average of 3.1kg.

Pre-operative and postoperative FVC values were in average 2.82±0.48 and 2.94±0.39L, respectively.

The difference in FVC showed statistically noteworthy improvement (paired *t*-test, p=0.016). Same for FEV1 values with average values 2.39±0.33 and 2.48±0.27L, respectively also showed statistically important improvement (paired *t*-test, p=0.047).

The other parameters in which reduction mammaplasty had statistically remarkable improvement were FVC Best/predicted ratio (B/P) (paired *t*-test, p=0.009) & FEV1 B/P (paired *t*-test, p=0.036). There were no statistical variances between preoperative and post-operative values for MEF25. Additionally, a remarkable positive association was found amid weight of resected tissues and advances in the FVC, FVC B/P, FEV1, FEV1 B/P (Best/predicted ratio). There was no significant correlation between body mass index, age and the changes in PFT. (Tables 2,3,4) (Figs. 5-8).

Table (2): Showing mean, standard deviation, median, minimum & maximum of pulmonary function parameters.

	Mean	Standard deviation	Median	Minimum	Maximum
FVC best pre	2.82	0.48	2.80	2.09	3.78
FVC best post	2.94	0.39	2.88	2.22	3.69
FVC %B/P pre	88.20	10.96	87.20	67.70	108.90
FVC %B/P post	92.00	8.83	92.00	71.30	109.30
FEV1 best pre	2.39	0.33	2.30	1.75	3.23
FEV1 best post	2.48	0.27	2.47	2.00	3.04
FEV1 %B/P pre	86.68	9.94	86.10	66.80	102.20
FEV1 %B/P post	90.28	9.34	90.70	71.40	110.20
MEF25 best pre	1.34	0.51	1.26	0.60	2.52
MEF25 best post	1.41	0.58	1.20	0.60	2.93
MEF25 %B/P pre	70.34	27.79	68.90	32.10	139.80
MEF25 %B/P post	73.86	30.40	64.10	29.70	158.70

Table (3): Showing mean, standard deviation, median, minimum & maximum of percentage change of spirometric parameters.

	Mean	Standard deviation	Median	Minimum	Maximum
FVC best % change	4.90	8.44	5.36	-12.25-	23.83
FVC %B/P % change	4.94	8.27	5.39	-12.30-	23.63
FEV1 best % change	4.87	10.28	6.54	-12.28-	30.29
FEV1 %B/P % change	4.77	10.16	6.46	-12.29-	30.24
MEF25 best % change	7.30	24.96	5.13	-51.75-	61.54
MEF25 %B/P % change	7.12	24.86	5.04	-51.16-	60.61

Table (4): Showing (a) Significant *p*-values for changes of pre-operative & post-operative values of FVC, FVC %B/P (Best/predicted ratio), FEV1, FEV1 %B/P (Highlighted Values) (b) Insignificant *p*-Value for changes of MEF 25, MEF %B/P.

	Mean	Standard deviation	Median	Minimum	Maximum	*p*-value
FVC best pre	2.82	0.48	2.80	2.09	3.78	0.016
FVC best post	2.94	0.39	2.88	2.22	3.69	
FVC %B/P pre	88.20	10.96	87.20	67.70	108.90	0.009
FVC %B/P post	92.00	8.83	92.00	71.30	109.30	
FEV1 best pre	2.39	0.33	2.30	1.75	3.23	0.047
FEV1 best post	2.48	0.27	2.47	2.00	3.04	
FEV1 %B/P pre	86.68	9.94	86.10	66.80	102.20	0.036
FEV1 %B/P post	90.28	9.34	90.70	71.40	110.20	
MEF25 best pre	1.34	0.51	1.26	0.60	2.52	0.178
MEF25 best post	1.41	0.58	1.20	0.60	2.93	
MEF25 %B/P pre	70.34	27.79	68.90	32.10	139.80	0.201
MEF25 %B/P post	73.86	30.40	64.10	29.70	158.70	

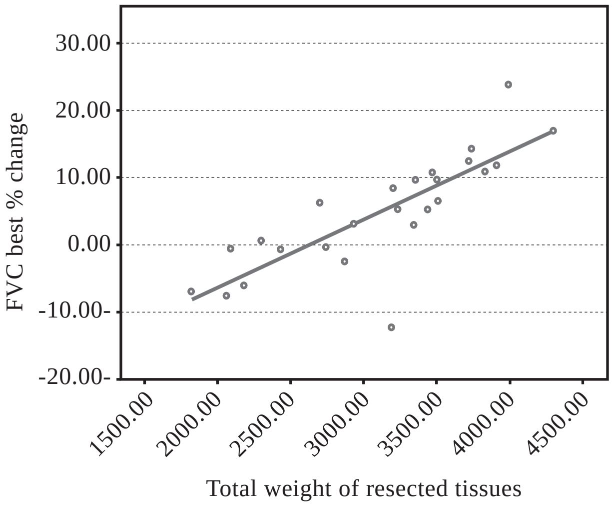

Fig. (5): Graph showing direct proportional relation between FVC Best change and total weight of resected tissues.

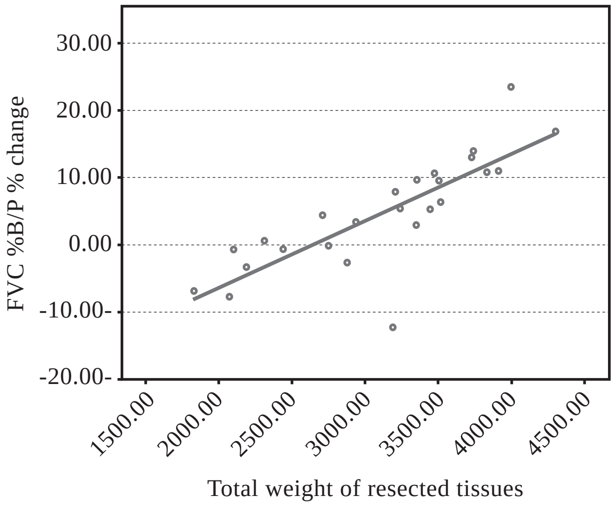

Fig. (6): Graph showing direct proportional relation between FVC %B/P change and total weight of resected tissues.

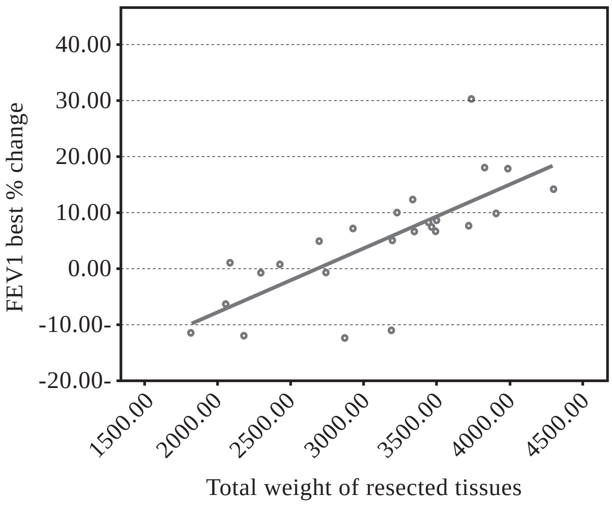

Fig. (7): Graph showing direct proportional relation between FEV1 Best change and total weight of resected tissues.

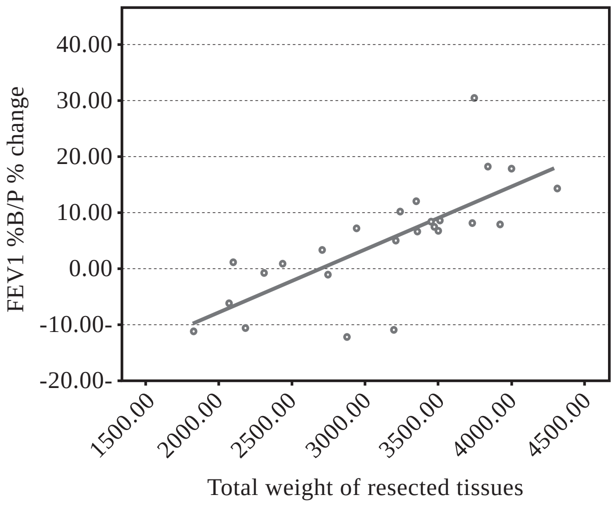

Fig. (8): Graph showing direct proportional relation between FEV1 %B/P change and total weight of resected tissues.

Complications:

No notable complications, including infection, hematomas, necrosis or deformity were noted during our study. There were no healing problems or bad scarring in all patients during the follow-up period.

DISCUSSION

Women undertaking reduction mammaplasty have reported improvements and changes in their preoperative symptoms and their quality of life. Previous studies have subjectively reported these changes without objective documentation and evidence. There have been limited studies stating objective parameters changes in relativity to breast reduction **[8]**.

Anesthesiologists have observed a decrease in peak inspiratory pressure during breast reduction surgeries. This triggered plastic surgeons to further investigate this phenomenon and analyze pulmonary functions post breast reduction **[6]**.

Reduction mammoplasty has been suggested to relieve breathing difficulties. Chest wall movement and therefore compliance may be restricted with increased weight on chest wall as in case of heavy weight breast. Thus, decreasing breast weight, would hypothetically improve ventilation and compliance of chest wall **[5]**. In the study of Cunha et al., restrictive effects of heavy breasts on the compliance of chest wall was discussed. Therefore, morbid obesity was considered to also play a role in chest wall mobility **[9]**.

This is the reason why we included BMI correlation in our study. Statistics in this study proved no correlation or significance between the BMI and PFTs pre and postoperatively.

Spirometry and pulmonary function test values support the theory of compliance improvement with breast weight reduction. FEVI/FVC ratio did not alter significantly, which shows that big airway obstruction did not contribute in these test variations **[10]**.

Reduction mammaplasty effects on pulmonary function are one of the controversial topics in literature. Goldwyn et al., showed in his study, that PFTs were not changed postoperatively. Other studies, such as Starley et al., Sood et al., and Iwuagwu et al., on the contrary showed changes in postoperative PFTs post reduction mammaplasty **[9]**.

The relationship between breast weight and size and lung functions has been of interest and the paucity and contradiction in the studies inspired this study.

This study proved that reduction mammaplasty had significant effect on FVC, FEV1, %B/P of FEV1 and the ratio of FVC best/predicted parameters. A correlation was found between the excised breast tissue weight and the pulmonary function test values. The more weight of the resected breast, the more changes and improvements in the post-operative PFTs.

Pulmonary function test results showed no correlation to patient's BMI and age. There were no noteworthy effects on FEV1/FVC, MEF25 parameters post reduction mammaplasty. A decrease in FVC ratio indicates restrictive lung condition. Three out of 25 women in this study showed mild restrictive pattern during spirometry. These patients were in normal range values of PFTs postoperatively. The rest of patients showed improvement from low normal to high normal values. Significant improvement in FVC, FEV1, FCV %B/P, FEV1 %B/P was documented.

These values demonstrate the restrictive effect of macromastia. In order to eliminate bias and increase reliability, tests were performed under same condition by same operator. PFTs diurnal variation was eliminated by performing tests at approximate times between 9 and 11 am.

Postoperative tests were performed 6 to 8 weeks after surgery, to avoid the restrictive effect of postoperative pain. Physiological systems with big reserve may bear changes widely. PFTs may show normal results with variations with cases of mild respiratory system affection. Therefore, it is of mere importance to note that absence of respiratory symptoms and normal PFTs do not exclude mild respiratory impairment.

The results of this study have shown the impact of resected breast tissue weight on pulmonary functions. The technique of breast reduction is of irrelevance, as long as the weight of breast resected is more than 1.5kg; which according to definition of macromastia and gigantomastia is the excess weight. All patients in this study showed pulmonary function improvement irrelevant to preoperative BMI or total weight resection. In this study surgeon's preference of reduction technique and pedicle was used and standardized in all cases to keep study design and parameters as equal as possible.

Patients under trials may show behavioral changes and add bias to a study, just by knowing that they are being watched. Nevertheless, this is an anticipated bias with any examined parameter in trials in general. Circumstances, under which patients were tested for pulmonary function, were made as identical as possible, in means of timing, physician, location, as well as repetition of trials, to assure decrease in bias and accuracy of the measured values.

Conclusion:

In conclusion, this study has documented the restrictive effects on chest wall compliance caused by macromastia. Statistically significant improvement in pre- and postoperative pulmonary functions was documented. The correlation between the resected breast weight and PFTs improvement, proved to be linear.

Therefore, it is of great importance to consider patients suffering of macromastia to be medical rather than aesthetic patients.

Declaration of conflict of interests: Authors have nothing to disclose.

Funding: This research did not receive any funding from any agency in the public, commercial, or not-for-profit sector.

All authors have made substantial contributions to this study.

Consent: Patients provided verbal and written consent for the procedure and participation in the study.

REFERENCES

1- Latham, Kerry, Walter Brehm and Danny J. Sharon: "Comparing fitness performance before and after breast reduction surgery". Military Medicine, 176.11: 1351-1354, 2011.

2- Kerrigan, Carolyn L., et al.: "The health burden of breast hypertrophy". Plastic and Reconstructive Surgery, 108.6: 1591-1599, 2001.

3- Güemes, Antonio, et al.: "Quality of life and alleviation of symptoms after breast reduction for macromastia in obese patients: Is surgery worth it?". Aesthetic Plastic Surgery, 40.1: 62-70, 2016.

4- Miller, Brian J., et al.: "Prospective study of outcomes after reduction mammaplasty". Plastic and Reconstructive Surgery, 115.4: 1025-1031, 2005.

5- Ceber, Mehmet, et al.: "Reduction mammaplasty effect on pulmonary function and arterial blood gas in the overweight female". Aesthetic Plastic Surgery, 39.4: 540-546, 2015.

6- Kececi, Yavuz and Seyhan Dagistan: "Effects of breast reduction on pulmonary function". International Surgery, 99.4: 300-304, 2014.

7- Neto, Miguel Sabino, et al.: "Self-esteem and functional capacity outcomes following reduction mammaplasty". Aesthetic Surgery Journal, 28.4: 417-420, 2008.

8- Gonzalez, Marco A., et al.: "Quality of Life After Breast Reduction Surgery: A 10-Year Retrospective Analysis Using the Breast Q Questionnaire Does Breast Size Matter?". Annals of Plastic Surgery, 69.4: 361-363, 2012.

9- Rasslan, Zied, et al.: "Evaluation of pulmonary function in class I and II obesity". J. Bras Pneumol., 30.6: 508-14, 2004.

10- Starley I.F., et al.: "An investigation into changes in lung function and the subjective medical benefits from breast reduction surgery". British Journal of Plastic Surgery, 51.7: 531-534, 1998.

11- Chetty, Vaneshri and Elias Ndobe: "Macromastia and gigantomastia: efficacy of the superomedial pedicle pattern for breast reduction surgery". South African Journal of Surgery, 54.4: 46-50, 2016.

12- Dancey, Anne, et al.: "Gigantomastia–a classification and review of the literature". Journal of Plastic, Reconstructive & Aesthetic Surgery, 61.5: 493-502, 2008.