

Breast Density and Aesthetic Outcomes of Volume Displacement Oncoplastic Techniques for Breast Cancer

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Abstract— Oncoplastic breast surgery (OBS) is an evolving comprehensive surgical approach for the management of early breast cancer; it has been recently expanded to include a wide range of volume displacement and volume replacement procedures performed by surgeons to optimize both shape and volume of the breast following breast cancer surgery. Many studies have analyzed the role of many influencing factors including breast density on the final aesthetic outcome of the volume displacement techniques. From June 2016 to September 2018, 200 patients presented with unilateral primary breast cancer including multifocal and post neoadjuvant cases with predicted excision volume (PEV) less than 20% managed with volume displacement oncoplastic technique and fulfilling the other eligibility criteria of the breast conservative therapy; were enrolled in this prospective study. Breast density (BD) was determined by the mammography according to American College of Radiology (ACR) density score; aesthetic outcomes were objectively evaluated one year after surgery by the semi-automated Breast Cancer Conservative Treatment (BCCT) core software. Patients' age has ranged from 27 to 74 years old (mean 43.4 ± 4.6 years), breast volume from 375 to 1140 cc (mean 735.5 ± 124.2 cc), and specimen volume from 64 to 220 cc (mean 120.3 ± 37.5 cc); total aesthetic results according to the objective BCCT core assessment were excellent in 41.5% (83 cases), good in 29.5% (59 cases), fair in 19.5% (39 cases), and poor in 9.5% (19 cases). Patients with high breast density ACR C and ACR D have achieved acceptable aesthetic results (excellent and good BCCT core outcomes) at a rate of 90% and 80% respectively in contrast to the low density breasts ACR B and ACR A (52% and 40% respectively). Breast density is one of the influencing factors of the aesthetic results of the volume displacement OBS; its preoperative value can refer to the most suitable oncoplastic surgical technique for each patient, expect the forthcoming postoperative complications, discrepancy and the necessity for contralateral symmetrization. Volume displacement OBS gives high aesthetic results with the high breast density and less acceptable results with the low one.

Index Terms— Aesthetic outcomes, Breast cancer, Breast density, Volume displacement oncoplastic surgery.

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I. INTRODUCTION

Breast-conservation surgery (BCS) has been established as a safe option when combined with radiotherapy for the management of the early breast cancer with no statistically significant difference in the 5 year survival and the local recurrence rates when compared with the mastectomy⁽¹⁾. Although this fact has a wide consensus in literature making the BCS with adjuvant radiotherapy the standard surgical management for the early breast cancer⁽²⁾, still up to 25 to 30% of the BCS may result in poor aesthetic results⁽³⁾. Oncoplastic Breast Surgery (OBS) has provided a third option filling the gap between the BCS and mastectomy for the management of the breast cancer⁽⁴⁾; it has emerged as an attempt to allow wider excision for large tumours without compromising the shape of the breast and to achieve more advanced and natural aesthetic results⁽⁵⁾. OBS depends on a group of advanced surgical approaches which combine the principles of both oncological and plastic surgeries⁽⁶⁾; it has been rapidly expanded to include many different volume displacement and replacement surgical techniques⁽⁷⁾. Many factors have been suggested to influence the aesthetic results of the OBS; those factors have been addressed in many previous studies including the patient's age, breast volume, tumour size, size, and breast tissue density⁽⁸⁾. Volume displacement reconstructive techniques depend on transposition of local glandular or dermoglandular vascularized flaps⁽⁹⁾; this makes breast density which reflects the amount of the fibrous and glandular breast tissue, an important indicator of the aesthetic success of those surgical approaches⁽¹⁰⁾. We have decided in this study to correlate the American College of Radiology (ACR) density score with the objectively evaluated aesthetic outcomes by the Breast Cancer Conservative Treatment (BCCT) core software.

II. STUDY METHOD

From June 2016 to September 2018, 200 patients presented with unilateral primary breast cancer fulfilling the eligibility criteria of the breast conservative therapy including multifocal and post neoadjuvant cases with predicted excision volume (PEV) less than 20% and managed with volume displacement oncoplastic technique according to tumour size and location (Level I and II); were evaluated, consented, operated and enrolled in this prospective study. Preoperative determination of the PEV was done for all the patients from this mathematical equation introduced by Cochrane et al⁽¹¹⁾:

$$PEV = \frac{4 (\text{Radius of Lesion} + 1 \text{ cm})^3}{(\text{Radius of Breast})^2 \times \text{Height of Breast}}$$

Beast density (BD) has been determined preoperatively according to the ACR mammographic breast density score⁽¹⁰⁾ for all patients. Breast volume (BV) was calculated as an elliptical cone based on the preoperative medio-lateral oblique (MLO) mammogram view using this formula⁽¹²⁾:

$$BV = 1/3 \pi \text{ breast radius}^2 \times \text{Breast height.}$$

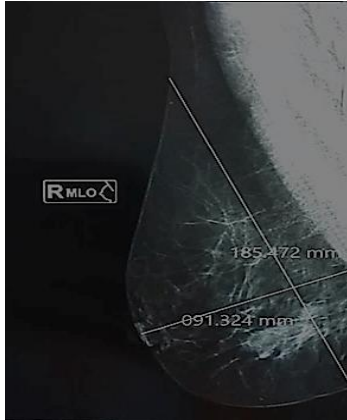


Figure (1): MLO mammogram view showing the estimated breast radius and height.

Specimen volumes were measured after surgical excision by Archimedes (Water Displacement) method⁽¹³⁾.

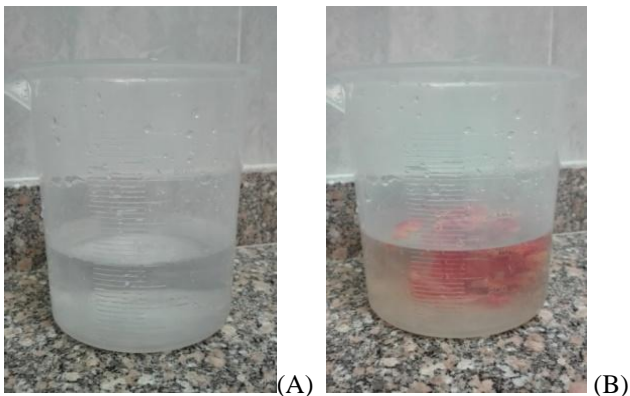


Figure (2): Archimedes method for specimen volume measurement.

Aesthetic outcomes were objectively evaluated one year after surgery (after adjuvant radiotherapy). This evaluation was done by the semi-automated Breast Cancer Conservative Treatment (BCCT) core software presented by Cordoso et al⁽¹⁴⁾ using frontal two-dimensions digital photos that were taken by a single photographer using 12 megapixel digital camera; both flash use and asymmetric illumination were avoided using single light source standing at equal distances from both breasts with the use of a light colored non-reflective background behind. Patients were stood at attention with their hands on their hips (standardized view). Our photographic framing was made to include the suprasternal notch above and the scale mark below (midline drawn point 25cm inferior to the suprasternal notch); this determined frame has controlled and standardized the distance between camera and patients, and maintained constant picture magnification. Each photo was loaded on the BCCT. Core 3.0 software[®] and the digital red dots were adjusted manually on the suprasternal notch, scale mark, nipples and axillae on both sides and the "Auto Adjust" button was pressed. Software automatically identifies the breast contour on both sides and adjusts the white digital dots

over them and carries out automated measurements to calculate the overall aesthetic outcomes in the 4-point scale. For statistical analysis, data were collected and coded to facilitate manipulation and double entered into Microsoft Access; data analysis was performed using SPSS software version 18 in windows 7. Simple descriptive analysis for qualitative data in the form of numbers and percentages and arithmetic means as central tendency measurement were done. Kruskal Wallis test has been used in comparing more than two independent quantitative groups and Chi square test to compare two of more than two qualitative groups.

III. RESULTS

Patients' age has ranged from 27 to 74 years old (mean 43.4 ± 4.6 years), breast volume from 375 to 1140 cc (mean 735.5 ± 124.2 cc), and specimen volume from 64 to 220 cc (mean 120.3 ± 37.5 cc); total aesthetic results according to the objective BCCT core assessment were excellent in 41.5% (83 cases), good in 29.5% (59 cases), fair in 19.5% (39 cases), and poor in 9.5% (19 cases). Patients were divided into four groups according to the described ACR breast density classification and the objective BCCT core aesthetic results were analyzed for each group (Table 1).

Most of our patients have ACR C breast density (72 patients representing 36%), followed by ACR D (51 patients representing 25.5%), ACR B (42 patients representing 21%), and ACR A (35 patients representing 17.5%). Patients with high breast density ACR C and ACR D have achieved acceptable aesthetic results (excellent and good BCCT core outcomes) at a rate of 90% and 80% respectively in contrast to the low density breasts ACR B and ACR A (52% and 40% respectively).

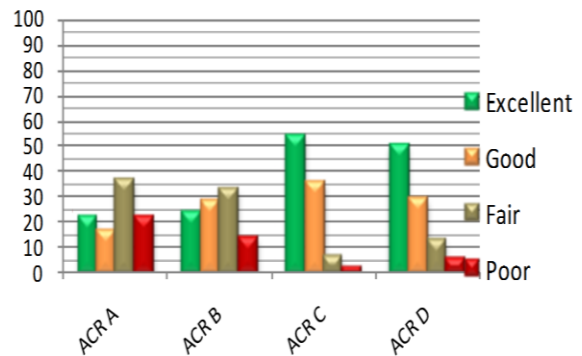


Chart (1): EEV groups and the BCCT core aesthetic results.

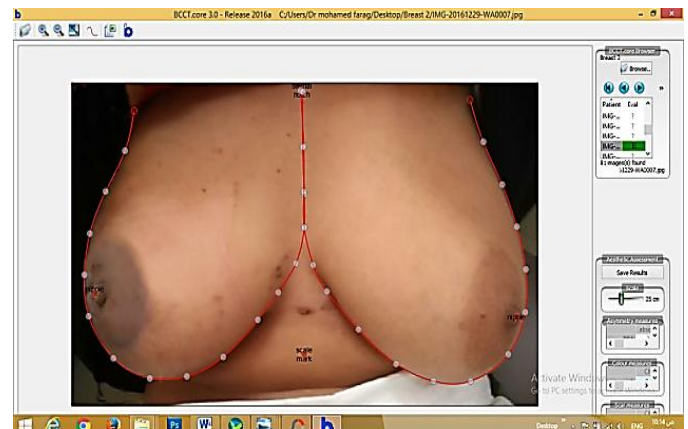


Figure (3): Right side round block, ACR C breast density and excellent BCCT core result.

Table (1): EEV groups and the BCCT core aesthetic results.

Breast Density	BCCT Results				Total
	Excellent	Good	Fair	Poor	
ACR A	8 (22.8%)	6 (17.2%)	13 (37.2%)	8 (22.8%)	35 patients (17.5%)
ACR B	10 (23.8%)	12 (28.6%)	14 (33.4%)	6 (14.2%)	42 patients (21%)
ACR C	39 (54.3%)	26 (36%)	5 (7%)	2 (2.7%)	72 patients (36%)
ACR D	26 (51%)	15 (29.4%)	7 (13.7%)	3 (5.9%)	51 patients (25.5%)
Total	83 (41.5%)	59 (29.5%)	39 (19.5%)	19 (9.5%)	200

IV. DISCUSSION

Many studies and systematic reviews have addressed the topic of the influencing factors on the aesthetic outcome after OBS and reported different factors and conflicting results; all of the age, body mass index (BMI), breast volume, breast density, tumour size, tumor position, specimen volume, excision volume ratio, operative technique, scar visibility, comorbidity, postoperative complications and adjuvant therapy were thought to act as influencing factors and have received a share of the study under three main headings of patient, tumor and treatment related factors (3).

Tissue density with the shape and volume are the most variable characteristics of the breast that differ among women; fatty breasts have besides the increased risk for cancer development, another negative impact on the aesthetic outcome with the basic operative step of wide undermining for breast re-shaping in the volume displacement reconstruction; this step can compromise the blood supply and cause both skin and fat necrosis; so fatty breasts, smoking, diabetes and connective tissue diseases are considered as patients' risk factors for vascular compromise and unacceptable aesthetic results (15).

Our study has been designed to correlate the breast density with the aesthetic outcomes of the volume displacement oncoplastic surgeries for the breast cancer and before the contralateral symmetrization. After review of the literature, Cochrane et al (11) equation that have been proposed for calculating the PEV was adopted in this study, Archimedes' method (13) was adopted as a direct, easy and accurate method for evaluation of the specimens' volumes, and the proposed formulae that treats the breast as a cone depending on the dimensions measured from the oblique mammographic film rather than the craniocaudal one was accepted as an accurate and readily available method for measurement of the breast volume (16). Many different methods for the postoperative aesthetic assessment have been mentioned in literature; some depend on the patient's self-evaluation or the observer evaluation representing the subjective methods and others depend on the physical and the photographic measurements to represent the objective methods (17); we have intended to depend on the objective method (BCCT core software) (14) to review our results excluding the possibility of subjective bias. Excision volume was found in many studies as the most important influencing factor which can

compromise the aesthetic results if the excision volume exceeds 10% of the breast volume with the standard BCS and 20% with the volume displacement OBS (18); so, in the

current study, PEV less than 20% was set as the highest cut-off point for volume displacement patients.

Total aesthetic results according to the objective BCCT core assessment were excellent in 41.5% (83 cases), good in 29.5% (59 cases), fair in 19.5% (39 cases), and poor in 9.5% (19 cases); those results were in close correspondence with the results of the systematic review (7) that has included 25 studies evaluating the aesthetic outcomes of the OBS for breast cancer patients (n=1,962) and revealed excellent, good, fair and poor outcomes in 55.2%, 31.0%, 9.4% and 4.4% of the patients respectively. Patients with high density breast tissues ACR C and ACR D have achieved the high aesthetic results (excellent and good BCCT core outcomes) with the volume displacement breast reconstruction in contrast to the low density breasts ACR B and ACR A. Few studies have addressed the aesthetic effect of the glandular density of the breast; their results refer to the higher risk of fat necrosis, subsequent fibrosis, asymmetry, and compromised aesthetic results with the low density breast tissue after undermining which represents a major technical requirement to perform volume displacement OBS (19, 20). Our results have showed statistically significant positive correlation between the breast density and the aesthetic results and considered it as one of the influencing factors of the aesthetic results of the volume displacement OBS; its preoperative value can refer to the most suitable oncoplastic surgical technique for each patient (volume displacement vs. replacement), expect the forthcoming postoperative complications, discrepancy and the necessity for contralateral symmetrization.

V. CONCLUSION

Over the last two decades, Volume displacement and replacement OBS has enabled breast surgeons to excise larger volumes and achieve advanced aesthetic outcomes. Many factors were found to have a great influence on these aesthetic outcomes and may stand against the achievement of good aesthetic results. Volume displacement OBS depends mainly on the ability to perform breast undermining and reshaping safely without complications; this ability depends on the

breast density which predicts the fatty composition of the breast tissue, the risk of fat necrosis, fibrosis, asymmetry, and compromised aesthetic results. Current study has revealed that breast density is one of the influencing factors of the aesthetic results of the volume displacement OBS with high aesthetic results with the high breast density and less acceptable results with the low one. Preoperative value of the breast density can refer to the most suitable oncoplastic surgical technique for each patient (volume displacement vs. replacement), expect the forthcoming postoperative complications, discrepancy and the necessity for the contralateral symmetrization.

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