Oncoplastic Volume Displacement Approaches in Breast-Conserving Surgical Procedures for Breast Cancer Patients

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Abstract

Background: Breast cancer, the second most common malignancy in women. Cancer traits determine treatment, usually mastectomy and lumpectomy. Oncoplastic breast surgery increases patient satisfaction and decreases postoperative deformity while preserving breast-conserving aspects.

Objectives: To implement oncoplastic breast-conserving to achieve safe margins and good aesthetics, while evaluating patient satisfaction, complications, and recurrence rates.

Patients and methods: This prospective study was conducted with 30 breast cancer patients eligible for breast conservation, excluding those with prior radiation or large tumors. Diagnostic tools included ultrasound, mammography, and magnetic resonance imaging. Oncoplastic techniques ensured minimum margins and proper flap relocation, utilizing methods such as glandular flap displacement and reduction mammoplasty. Patients received post-surgery radiotherapy and were monitored for complications and metastasis over two years.

Results: The study comprised 30 patients with a mean age of (43.2±8.72) years and a mean body mass index of (30.3±4.61) kg/m². 16.67% had hypertension, 10% diabetes, and 6.67% ischemic heart disease. Breast cup sizes were 56.67%B, 30% C and 13.33% D. Lateral Mammoplasty (20%), inferior pedicle mammoplasty (13.33%), Round Block Technique (23.33%) and Various techniques were each (3.33%). Seroma (16.67%) and wound infection (10%) were complications. The average surgeon aesthetic score was (4.07±0.73), and the average tumor size was (3.87±1.76) cm. Both invasive ductal carcinoma (76.67%) and ductal carcinoma in situ (16.67%) were biologically classified as Luminal A (43.33%) and B (43.33%).

Conclusion: Oncoplastic procedures produced free pathological margins, surgeon aesthetic scores and patient satisfaction results were great, and 3.33% recurrence encouraging the wider use of these breast cancer treatments.

Keywords: Oncoplastic, Volume Displacement, Breast Conserving Surgery, Breast Cancer, Surgical Techniques.

Keywords: Insulin resistance; Sex-specific association; Waist-to-hip ratio; Body mass index

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Introduction

Only nonmelanoma skin cancer is more common in women than breast cancer, which kills the most people worldwide. The comprehensive approach to breast cancer treatment considers tumor grade, stage, and molecular subtype. Optimizing disease management safety and efficacy requires this personalized method **(Trayes and Cokenakes, 2021).**

Breast cancer surgery includes lumpectomy and complete mastectomy, often with reconstructive surgery **(Burguin et al., 2021).** Oncoplastic breast surgery (OBS) improves cosmetic outcomes while maintaining oncological safety in breast-conserving surgery. Oncoplastic techniques aim to reshape, replace volume, and symmetrize the contralateral breast while allowing broader excisions to provide appropriate margins without neoplastic involvement **(Mohamed et al., 2022).**

Oncoplastic treatments reduce postoperative breast deformity, improving patient quality of life compared to breast-conserving surgery. **Kavanian et al. (2020)** found that these operations displace, replace, and repair breast tissue, improving aesthetics and patient satisfaction. Such findings emphasize the necessity of incorporating oncoplastic surgery into breast cancer treatment to improve oncology and patient outcomes.

The study aims to implement oncoplastic breast-conserving techniques in breast cancer patients to achieve safe margins and good aesthetics, while assessing patient satisfaction, postoperative complications, and recurrence rates.

Patients and methods

The research protocol for this prospective cross-sectional study received ethical clearance from the Institutional Review Board of the Qena Faculty of Medicine at South Valley University, Egypt, with the ethical approval number designated as **SVU-MED-SUR011-2-21-7-215.** This study was executed at South Valley University Hospitals in conjunction with the Oncology Center at Mansoura University. Inclusion criteria focused on patients diagnosed with breast cancer who met the requirements for breast-conserving surgery.

Patients were excluded from the study if they had a history of prior breast radiation, contraindications to radiotherapy, inflammatory breast cancer, a significant tumor-to-breast volume ratio, or multicentric breast cancer. The target sample size for the study was established at 30 cases.

All participants underwent a comprehensive ultrasound (US) examination conducted with a 7.5 MHz transducer. The ultrasound scans were performed at intervals of 5 mm or 1 mm, both longitudinally and transversely across the breast tissue. For patients older than 35 years, mammographic imaging was carried out using a microfocus tube mammographic unit equipped with 0.45 mm and 0.09 mm focal spots, allowing for the acquisition of mediolateral and craniocaudal projections. Additionally, magnetic resonance imaging (MRI) scans were obtained for patients with dense breast tissue who had undergone neoadjuvant chemotherapy.

The histopathological diagnosis was validated preoperatively via core needle biopsy. On the day of the surgical intervention, a repeat ultrasound was performed to accurately mark the tumor's position on the skin, particularly for early-detected non-palpable tumors. Preoperative markings involved identifying key skin landmarks, including the inframammary fold, the peri-areolar region, and the specific location of the tumor.

Surgical procedures were executed under general anesthesia, and the axillary status concerning nodal involvement was assessed. For patients with palpable axillary nodes prior to surgery, level 1 and 2 axillary

dissections were performed. Oncoplastic surgical techniques were selected based on individual patient factors, including breast shape, size, tissue density, and the anatomical location of the tumor.

Glandular Flap Displacement (Gurleyik et al., 2017): Preoperative markings were meticulously established for all patients undergoing breast-conserving surgery, particularly in the upper breast quadrant. This approach was implemented to address potential intraoperative complications where cases initially deemed suitable for simple mobilization of adjacent breast tissue might require conversion to more extensive surgical techniques during the procedure.

During the surgical intervention, the breast tissue encompassing the primary tumor and pectoral fascia was carefully dissected from the underlying pectoral muscle. A wide local excision of the primary tumor was performed, ensuring a minimum margin of 1 cm to achieve adequate oncological clearance. To facilitate subsequent radiotherapy, two clips were strategically placed within the tumor bed. An extended glandular flap was then created by detaching the breast tissue from both the overlying skin and the pectoralis fascia, extending to the preoperatively marked subclavicular area.

Preservation of critical vascular structures was paramount during the procedure. Specifically, care was taken to retain the perforators of the internal mammary artery in cases involving external tumors, while branches of the lateral thoracic artery were preserved for internal tumors. The glandular flap was subsequently repositioned to fill the defect created by tumor excision, and meticulous suturing was performed using 3/0 absorbable mattress sutures.

Upon placement of the flap, a thorough assessment of breast shape was conducted while applying gentle pressure from above to ensure the nipple was aligned according to the preoperative marking. Finally, the flap was secured to the surrounding breast tissue using absorbable sutures, completing the reconstruction while maintaining optimal cosmetic outcomes **(Fig. 1, 2).**

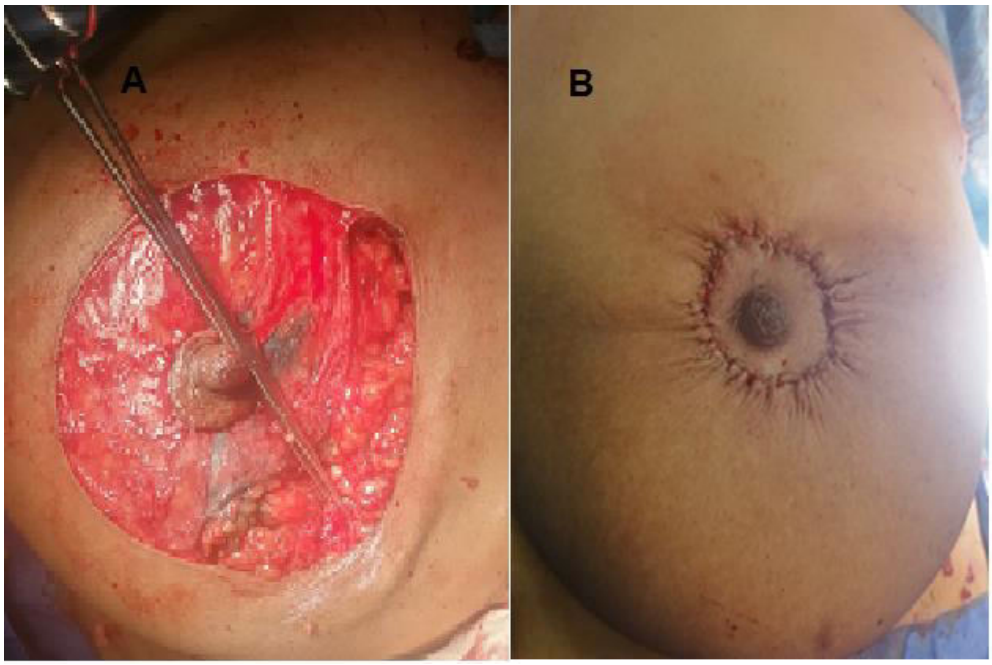

Fig.1. Round block Technique.

Recentralization of the nipple-areolar complex (NAC) was performed for patients at risk of NAC deviation toward the excised area to enhance aesthetic outcomes.

Fig.2. Remodeling the breast using Hemi-patwing Technique.

Reduction Mammoplasty (Yehia, 2021): For patients diagnosed with macromastia and presenting with tumors in the upper breast quadrant, inferior pedicle reduction mammoplasty was implemented as the surgical intervention of choice. Conversely, for tumors located in the lower quadrant, a superior pedicle reduction mammoplasty utilizing an inverted T-scar technique was planned.

The Wise pattern therapeutic reduction mammoplasty technique was employed to facilitate extensive tumor excision while simultaneously preserving the integrity of the breast skin flap and the designated vascular pedicle when the neoplastic tissue fell within the confines of the planned design. This approach not only ensures effective oncological management but also optimizes aesthetic outcomes by maintaining the breast's contour and vascular supply.

Tumors were excised with a minimum margin of 1cm. The breast surgeon adjusted the resection of the skin flap based on the excised volume. If the cancer was not within the reduction mammoplasty design, an incision was made at the center of the mass in a radial direction from the nipple. Following reshaping, closure was achieved using 3/0 absorbable mattress sutures, with modifications made based on the excised mass volume to adhere to the preoperative design. **(Fig.3).**

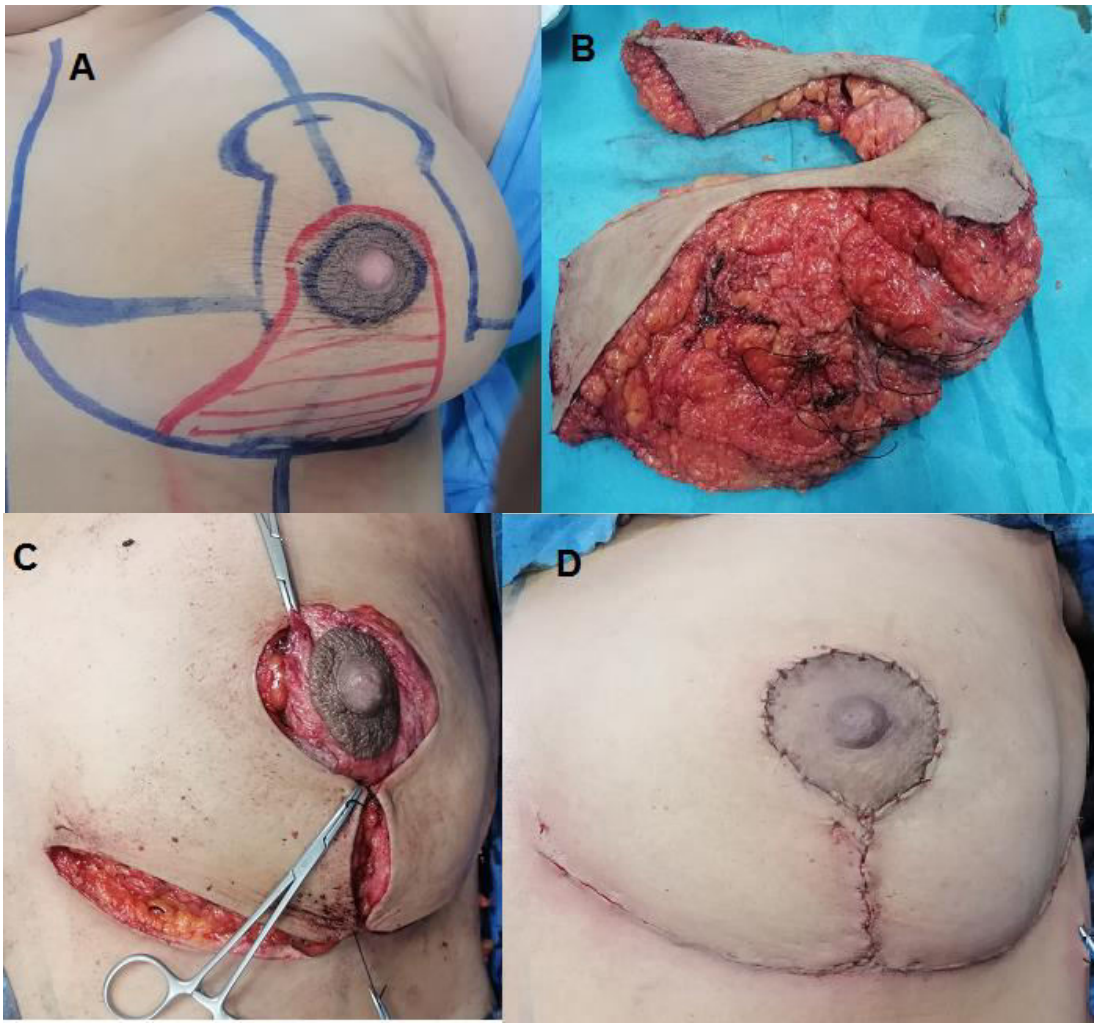

Fig.3. Inferior pedicle mammoplasty technique

Proper hemostasis was ensured without the use of drains, providing significant advantages for the subsequent nipple-areolar complex (NAC) reconstruction.

Follow-up: During the first 30 days post-surgery, patients were monitored for early complications. Subsequently, patients returned every 3 months for the first 2 years, during which physical examinations were conducted. Mammography and ultrasound were performed annually, and magnetic resonance imaging was utilized as needed. Follow-up assessments included monitoring for local, regional, and distant metastasis, as well as evaluating aesthetic outcomes at each visit. **Figs.(4, 5, 6).**

Fig.4. Round block technique; frontal view of a case with right breast cancer 2 Weeks after surgery

Fig.5.: Bilateral inferior pedicle reduction mammoplasty; frontal view of a case with right breast cancer 1year after surgery

Fig.6.Round block technique; frontal view of a case with right breast cancer 1year after surgery

Statistical analysis

Quantitative factors were presented as means with standard deviations (SD), whereas qualitative variables were expressed as percentages and numbers. The data was analyzed using SPSS version 16. In order to find significant relationships, both multivariate and univariate logistic regression analyses were run. The mathematical mean and standard deviation were given in the summaries. Students' t-tests for independent groups, Mann-Whitney U tests for non-normally distributed data, one-way ANOVA for multiple groups, Fisher's exact test for non-parametric data, and Chi-square tests for relationships were all used for comparisons. The level of statistical significance was set at 5%, and p-values that were less than 0.05 indicated significance, while p-values greater than 0.05 indicated non-significant.

Results

The included subjects (N = 30) had a mean age of 43.2 ± 8.72 years, with a median of 43 years and a range from 31 to 66 years. The mean BMI was 30.3 ± 4.61 kg/m², with a median of 31.8 kg/m² and a range between 18 and 38.4 kg/m².(**Table.1).**

Table 1. Age and BMI

Variables		Value (N = 30)
Age (Years)	**Mean ± SD**	43.2 ± 8.72
	Median (Range)	43 (31 - 66)
BMI (kg/m^2)	**Mean ± SD**	30.3 ± 4.61
	Median (Range)	31.8 (18 - 38.4)

Bronchial asthma was present in 2 subjects (6.67%). Both diabetes mellitus (DM) and hypertension were observed in 2 subjects (6.67%), while DM alone was seen in 1 subject (3.33%). Hypertension was present in 1 subject (3.33%), and hypertension alone was reported in 2 subjects (6.67%). Ischemic heart disease (IHD) occurred in 2 subjects (6.67%), and rheumatic heart disease was reported in 1 subject (3.33%). (**Table.2).**

Table 2. Medical comorbidities distribution

Variables	**Value (N = 30)**
Medical comorbidities	
Bronchial asthma	2 (6.67%)
DM and Hypertension	2 (6.67%)
DM only	1 (3.33%)
Hypertension	1 (3.33%)
Hypertension only	2 (6.67%)
IHD	2 (6.67%)
Rheumatic heart disease	1 (3.33%)

Cup size B was the most common, found in 17 subjects (56.67%). Cup size C was observed in 9 subjects (30%), while cup size D was present in 4 subjects (13.33%). (**Table .3).**

Table 3. Breast cup size

Variables	Value (N = 30)
Breast cup size	
B	17 (56.67%)

C	9 (30%)
D	4 (13.33%)

The Batwing technique (6.67%). Bilateral inferior pedicle reduction mammoplasty, hemi batwing technique, LIQ_V reduction mammoplasty, and vertical pedicle mammoreduction were each performed on 1 subject (3.33%). Inferior pedicle mammoplasty was used in 4 subjects (13.33%), and lateral mammoplasty in 6 subjects (20%). Medial mammoplasty and superior pedicle mammoreduction were each performed on 2 subjects (6.67%). The round block conservative technique was the most common, used in 10 subjects (33.33%). (**Table .4).**

Table 4. Surgical Techniques

Variables	**Value (N = 30)**
Technique	
Batwing Technique	2 (6.67%)
Bilateral inferior pedicle reduction mammoplasty	1 (3.33%)
Hemi batwing technique	1 (3.33%)
Inferior pedicle mammoplasty	4 (13.33%)
Lateral mammoplasty	6 (20%)
LIQ_V reduction mammoplasty	1 (3.33%)
Medial Mammoplasty	2 (6.67%)
Round block conservative technique	10 (33.33%)
Superior pedicle mammoreduction	2 (6.67%)
Vertical pedicle mammoreduction	1 (3.33%)

One subject (3.33%) had an infiltrated margin despite an initially free frozen section, requiring a second surgery. Recurrence after 1 year, despite a histopathologically free margin, was observed in 1 subject (3.33%). Seroma occurred in 5 subjects (16.67%), while wound dehiscence was reported in 1 subject (3.33%). Wound infection occurred in 3 subjects (10%). (**Table .5).**

Table 5. Complications

Variables	**Value (N = 30)**
Complications	
Seroma	5 (16.67%)
Wound dehiscence	1 (3.33%)
wound infection	3 (10%)

The tumor size among the included subjects (N = 30) had a mean of 3.87 ± 1.76 cm. The median tumor size was 4 cm, with a range between 1 and 8 cm. Ductal carcinoma in situ (DCIS) was present in 5 subjects (16.67%), invasive ductal carcinoma (IDC) in 23 subjects (76.67%), and invasive lobular carcinoma (ILC) in 2 subjects (6.67%).Luminal A and Luminal B, each occurred in 13 subjects (43.33%). Triple-negative breast cancer was found in 3 subjects (10%), while the Her2-enriched subtype was present in 1 subject (3.33%). (**Table .6).**

Table 6. Tumor characteristics

Variables		Value (N = 30)
Tumor size (Cm)	**Mean ± SD**	3.87 ± 1.76
	Median (Range)	4 (1 - 8)
Pathological type		
DCIS		5 (16.67%)
IDC		23 (76.67%)
ILC		2 (6.67%)
Biological type		
Her2enriched		1 (3.33%)
Luminal A		13 (43.33%)
Luminal B		13 (43.33%)
Triple –ve		3 (10%)

Excellent scores were given to 7 subjects (23.33%), while good scores were assigned to 13 subjects (43.33%). Fair scores were observed in 8 subjects (26.67%), and poor scores were given to 2 subjects (6.67%). (**Table.7, Fig.7).**

Table 7. Surgeon aesthetic score distribution

Variables	Value (N = 30)
Surgeon aesthetic score	
Excellent	7 (23.33%)
Good	13 (43.33%)
Fair	8 (26.67%)
Poor	2 (6.67%)

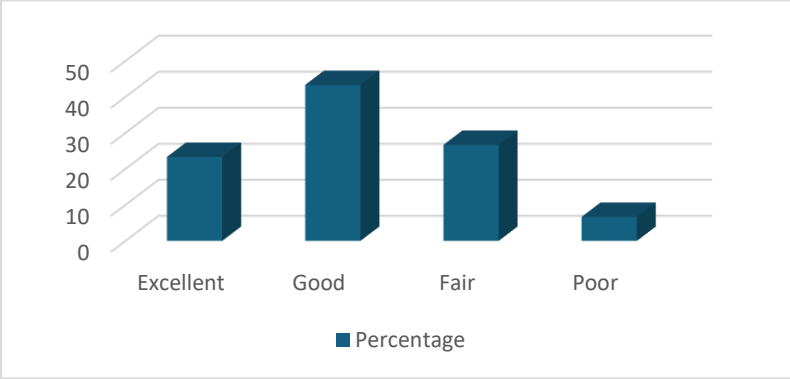

Fig.7. Surgeon aesthetic score distribution

Excellent satisfaction was reported by 11 subjects (36.67%), while good satisfaction was reported by 16 subjects (53.33%). Fair satisfaction was observed in 1 subject (3.33%), and poor satisfaction in 2 subjects (6.67%). (**Table .8, Fig.8).**

Table 8. Patient satisfaction distribution

Variables	Value (N = 30)
Patient satisfaction	
Excellent	11 (36.67%)

Good	16 (53.33%)
Fair	1 (3.33%)
Poor	2 (6.67%)

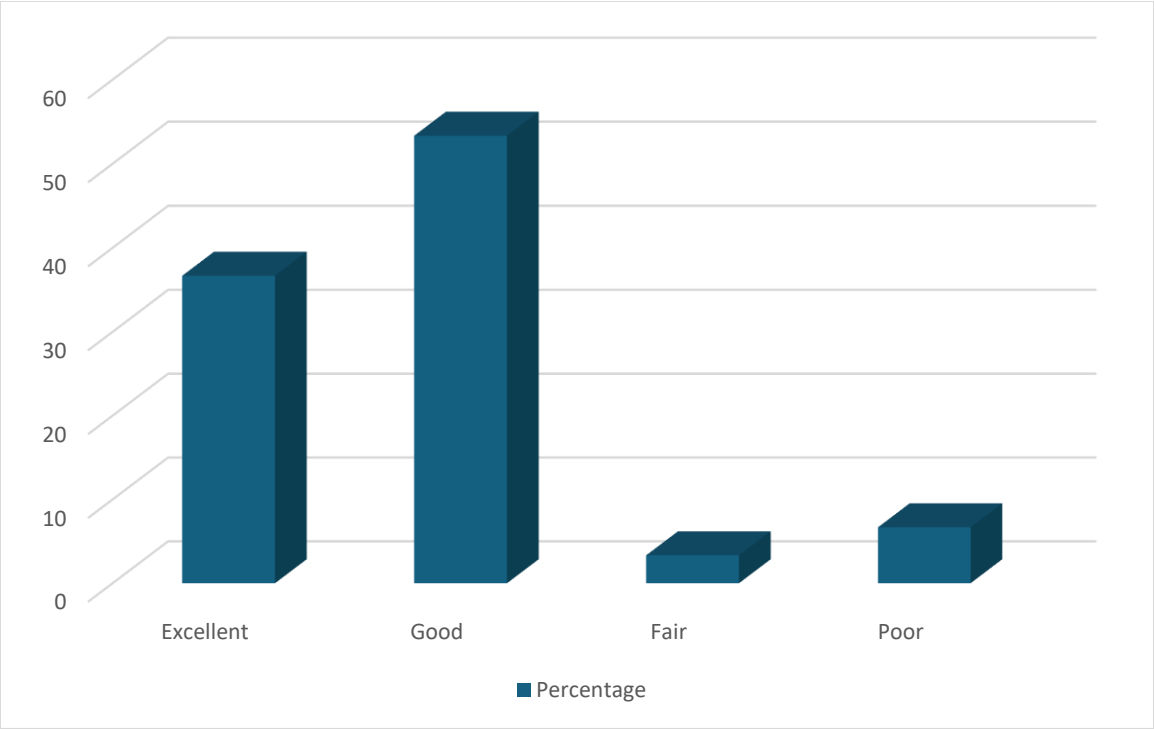

Fig.8. Patient satisfaction distribution

Discussion

Our study included a mean age of 43.2 years (±8.72) and a mean BMI of 30.3 kg/m² (±4.61). Patients had hypertension (16.67%), diabetes (10%), rheumatic heart disease (3.33%), bronchial asthma (6.67%), and ischemic heart disease (6.67%). Breast cup sizes were 13.33% A, 66.67% B, and 20% C. Our study matches Rutherford et al. (2022)'s oncological safety and esthetic outcomes of oncoplastic volume replacement breast surgery. Out of 155 publications reviewed, 40 satisfied the criteria, involving 2,497 patients with a mean age of 47.8 years and a BMI of 24.3 kg/m². The mean follow-up was 37.1 months, with a 29.7 mm pathological tumor and 123.6 g material. Re-excision was 7.2%, locoregional and distant recurrence were 2.5% and 3.1%, respectively.

Additionally, **Van-Paridon et al. (2017)** found a mean age of 53.0 years, a mean BMI of 27.5 kg/m², and a follow-up of 17 months in their study population. The study found that 13% of breasts were ≤A, 21.7% were B, 17.4% were C, and 43.5% were ≥D. Our research used numerous surgical methods: One participant (3.33%) underwent bilateral inferior pedicle reduction, hemi batwing, LIQ_V, and vertical pedicle reduction mammoplasty. Lateral mammoplasty was performed on 6 participants (20%) and inferior pedicle mammoplasty on 4 (13.33%). Two participants (6.67%) underwent medial, superior pedicle, and batwing mammoplasty. The round block conservative method was utilized most, 10 (33.33%).

Our findings match **Almeida et al. (2021),** who compared oncoplastic and non-

oncoplastic breast-conserving surgery surgical and oncological outcomes. Most of the 89.8% of patients who had mammaplasty used the Wise design with superior (41%) and inferior (31%) pedicles. Symmetrization of the contralateral breast occurred in 92% of mammaplasties. Van-Paridon et al. (2017) found that malignant patients had a mean partial mastectomy resection weight of 341 g. In 15.2% of breasts, complex multilayer closure, 41.3% local tissue rearrangement, and 28.3% oncoplastic reduction mammoplasty were performed. Bilateral reduction was usual for Cup D or bigger instances.

We found 3.33% recurrence, 10% wound infection, 3.33% wound dehiscence, 3.33% infiltrated margin needing reoperation, and 16.67% seroma development after surgery. Our findings agree with Kaviani et al. (2020), who examined procedures and oncologic outcomes in 937 oncoplastic breast surgery (OBS) patients. For reduction-type OBS, seroma was the most prevalent consequence at 13.1%. 5.4% of patients had local recurrence, with a median time of 26.4 months, and 1.3% died from cancer recurrence.

André et al. (2021) found oncoplastic breast-conserving surgery (OPS) to be safe and low-recurrence. They found 61 local recurrences: 57 in conventional BCS (1.5%), 1 in simple OPS (0.4%), and 3 in complex OPS (1.4%; P = 0.368).

In a study of 10,607 individuals, **Carter et al. (2016)** found that OPBCS had less seromas and hematomas (13.4% and 1.9%) than normal BCS (18.0% and 2.5%; P≤0.05 OBS had higher rates of wound-related complications and surgical site infections (SSIs) compared to normal BCS (4.8% and 4.5% vs. 1.4% and 4.1%; P≤0.05). OPBCS resulted in fewer wound-related problems and SSIs than mastectomy with reconstruction (4.8% and 4.2% vs. 11.6% and 13.0%; P≤0.05).

Oberhauser et al. (2021) observed that patients in the NSM/SSM group had significantly delayed wound healing (32.7% vs. 5.8%, p < 0.001) and skin necrosis (13.9% vs. 1.9%, p = 0.020) compared to conventional mastectomy (CM). Compared to conventional breast-conserving surgery (BCS), oncoplastic breast-conserving surgery (OBS) had higher long-term morbidity rates, especially for chronic pain (13.3% vs. 6.6%, p = 0.011) and lymphedema (4.1% vs. 0.4%, p = 0.003). More seromas developed in the CM group than in the NSM/SSM group (5.8 vs. 0.5 per 100 patient years, p = 0.004). OBS, BCS, and CM had similar rates of positive margins and recurrence.

Our survey found surgeon aesthetic scores of 23.33% excellent and 43.33% good. Patient satisfaction was rated as excellent (36.67%), good (53.33%), fair (3.33%), and bad (6.67%), with an average tumor size of 3.87 cm (±1.76). Similar to our study, **Huang et al. (2021)** found that oncoplastic breast surgery (OBS) improves breast form, quality of life, and postoperative psychological trauma for early-stage breast cancer. Awad et al. (2021) analyzed 80 oncoplastic operations and found a 2.5% recurrence rate and 90% acceptable aesthetic outcomes based on the breast impact treatment scale.

In a meta-analysis by **Losken et al. (2014),** oncoplastic breast-conserving surgery (OPBCS) resulted in improved patient satisfaction with cosmetic outcomes (89.5% vs. 82.9%; P≤0.001). Wijesinghe et al. (2023) found higher symmetry, volume, nipple location, scar visibility, and re-excision rates in OPBCS, but no significant changes in operative time or complications.

A 5-year overall survival rate of 97% (95% CI 92-100) and a disease-free survival rate of 94% (95% CI 90-99) were reported

by **Sparavigna et al. (2023)** in 109 women receiving bilateral oncoplastic breast-conserving volume displacement surgery. This cohort had a median breast satisfaction of 74/100. Oncoplastic surgery is a feasible oncological alternative with good aesthetic satisfaction. Tumor site in the central quadrant (p=0.007), triple-negative breast cancer (p=0.045), and re-intervention (p=0.044) were linked with decreased aesthetic satisfaction.

Xia et al. (2023) found that 78.4% of 88 patients judged aesthetic results as "good," "very good," or "excellent" following inferior pedicle oncoplastic reduction mammoplasty in 179 breasts. Inferior pedicle oncoplastic reduction mammoplasty was associated with greater breast score satisfaction (p=0.017). Blok et al. (2022) found an 18.7% complication rate, 4% of which required invasive treatments, and median BREAST-Q scores of 56–100, indicating satisfactory to excellent cosmetic outcomes in 60–86% of patients.

In our study, 6.67% of the tumors were invasive lobular carcinoma (ILC), 16.67% DCIS, and 76.67% IDC. The biological classifications were Her2 enriched (3.33%), Luminal A (43.33%), B (43.33%), and Triple-negative (10%). In 349 instances, **Clough et al. (2018)** found 62.6% invasive ductal carcinoma, 25.1% DCIS, and 12.3% ILC. Neoadjuvant chemotherapy was given to 27.9% of invasive malignancies. Resection weight averaged 177 grams, and pathological tumor size averaged 26 mm (range 0–180 mm). The average size of invasive tumors was 23 mm (4–180 mm) and DCIS 32 mm (0–100 mm). Invasive ductal carcinoma had 10.5% specimen margin involvement, DCIS 14.7%, and invasive lobular carcinoma 20.9%. Overall breast conservation was 92%, with DCIS at 87.4% and invasive malignancies at 93.5%. 8.9% of patients had postoperative problems, delaying treatment 4.6%. The median follow-up was 55 months, with 2.2%, 1.1%, and 12.4% local, regional, and distant recurrences over 5 years.

Kaviani et al. (2020) found that invasive ductal carcinoma was the most common pathology (83.3%). Most patients had early-stage illness. Rezai et al. (2015) found that 60.6% of over 1,000 oncoplastic patients had invasive ductal breast cancer, 11.6% lobular, and 9.4% tubulo-ductal or lobular-ductal. Non-invasive breast cancer was 11.7%, mostly DCIS (95.5%). Luminal A was the most prevalent subtype at 62.6%, followed by hormone receptor positivity at 82.5% and Her2 receptor positive at 14.2%.

Our study limitations include a small sample size, impacting the generalizability of findings. The variety of oncoplastic techniques used complicates direct outcome comparisons. A short follow-up period restricts assessment of long-term recurrence rates and aesthetic outcomes. The subjective surgeon aesthetic score may introduce bias, and standardized patient-reported outcomes would enhance satisfaction evaluation.

Conclusion

In conclusion, our study shows that various oncoplastic breast-conserving techniques effectively achieve free pathological margins with a high surgeon aesthetic score and a low recurrence rate of 3.33%. Despite some postoperative complications, including wound infections (6.67%) and seroma formation (16.67%), overall patient satisfaction and clinical success demonstrate the viability and safety of these advanced surgical approaches, supporting their broader adoption to improve oncologic and cosmetic outcomes for breast cancer patients.

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