Original Article

Oncoplastic breast-conserving surgery (OBCS) *vs.* mastectomy with reconstruction: a comparison of outcomes in an underserved population

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Background: Oncoplastic breast-conserving surgery (OBCS) has demonstrated superior cosmetic outcomes to traditional breast-conserving surgery (BCS) while maintaining oncologic safety. While prior studies have compared OBCS to mastectomy, there is a scarcity of literature on the impact of social determinants of health on outcomes. Furthermore, although traditionally tumors larger than 5 cm and multifocal disease were treated with mastectomy, the literature has now shown OBCS to be safe in treating such disease. As a result, patients with large or multifocal tumors could be eligible for both mastectomy and OBCS, which prompts the need for comparison between the two. Thus, the aim of our study was to compare OBCS and mastectomy with reconstruction using BREAST-Q and oncologic outcome measures, as well as stratify these outcomes based on race, ethnicity, and body mass index (BMI).

Methods: A retrospective chart review was performed for 57 patients treated with OBCS and 204 patients treated with mastectomy with reconstruction from 2015 to 2021. Variables including age, race, ethnicity, BMI, insurance status, surgery type, pathology, recurrence, and complications were recorded. Patient-reported outcomes (PROs) were recorded using BREAST-Q pre- and post-operatively.

Results: Despite having a higher BMI (P<0.001), OBCS yielded higher "satisfaction with breast" and "satisfaction with outcome" than mastectomy (P=0.02 and P=0.02, respectively). When stratified by race, there were no statistical differences in the PROs between the two surgeries for Hispanic nor African American patients. OBCS had a significantly lower rate of infection and fewer additional surgeries than mastectomy (P=0.004 and P<0.001, respectively). There were no differences in positive margin rate or recurrence rate between the groups.

Conclusions: In our study, OBCS yielded better PROs than mastectomy while maintaining oncologic safety and resulting in fewer surgeries and complications. These excellent outcomes in a majority non-Caucasian cohort support the utilization of OBCS for underserved, minority populations. Larger studies evaluating PROs in diverse and uninsured groups are needed to reinforce these conclusions.

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Keywords: Oncoplastic breast-conserving surgery (OBCS); mastectomy; BREAST-Q; patient-reported outcomes (PROs); social determinants of health

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Introduction

Background

Breast cancer is the most common newly diagnosed malignancy among women across the United States (1). Breast cancer incidence increases by about 0.5% per year; approximately 290,560 patients will be diagnosed with breast cancer in 2022 (1,2). For many years, mastectomy was perceived as the only treatment option; however, as the number of cases has grown, so has the advancement of treatment options, leading to a transition from radical mastectomy to simple mastectomy, and then to breast-conserving surgery (BCS). In terms of oncological outcomes, BCS followed by adjuvant radiotherapy has been shown to be as effective as mastectomy (3-5). With the evolution of new surgical techniques and improved survival rates, the demand for better cosmetic outcomes has become paramount. Oncoplastic BCS (OBCS) has demonstrated promising cosmetic outcomes and thus has become a popular choice of treatment amongst patients and providers (6-8). OBCS combines BCS with a plastic surgery procedure, such as breast reduction, mastopexy, or mammoplasty, and has shown to have equal, if not superior, oncologic safety as compared to standard BCS (6,8-10).

A caveat for performing BCS has been proven to be patient dissatisfaction. Prior literature demonstrates that 30–40% of breast cancer patients who undergo BCS suffer from poor cosmetic outcomes (6,9,11-13). Patient dissatisfaction after BCS is multifactorial, with higher body mass index (BMI), adjuvant treatment, tumor location, and adverse effects of BCS surgery all contributing significantly to patients' dissatisfaction and poor cosmesis (6,8,14,15). Furthermore, the degree of dissatisfaction is proportional to the amount of breast tissue excised (6,8,14,16). OBCS, on the other hand, results in a better patient experience because it allows for large tissue excision without compromising cosmesis (6-8). Additionally, compared to BCS, OBCS has been shown to have lower positive margin, re-excision, and local recurrence rates (6,8,9).

Highlight box

Key findings
- In our majority non-Caucasian cohort, oncoplastic breast-conserving surgery (OBCS) yielded better patient-reported outcomes (PROs) than mastectomy while maintaining oncologic safety and resulting in fewer surgeries and complications.

What is known and what is new?
- In small studies comparing OBCS to mastectomy, OBCS had better PROs, but these analyses did not include race, ethnicity, body mass index (BMI), or socioeconomic status.
- We compared OBCS to mastectomy in an underserved, majority non-Caucasian Bronx population with relatively large breast tumors and a high prevalence of multifocal disease.
- Despite a higher BMI in the OBCS group, patient satisfaction after OBCS was significantly higher than after mastectomy.

What is the implication, and what should change now?
- Although traditionally large and multifocal tumors were treated with mastectomy, OBCS has been shown to be equally as safe and effective.
- This study confirms the safety and improved satisfaction of OBCS even in an underserved population with such tumors.

Rationale, knowledge gap, and objective

Traditionally, tumors larger than 5 cm and multifocal disease were treated with mastectomy (17,18). However, one study analyzing outcomes of OBCS in patients with multifocal, multicentric, and locally advanced tumors >5 cm found positive margin rates similar to that of BCS as well as relatively low conversion-to-mastectomy and local recurrence rates (19). Similarly, another study compared long-term oncologic outcomes of OBCS to those of mastectomy for patients with primary multicentric and multifocal tumors and did not find any difference in overall survival, disease-free survival, or local and distant recurrence rates (20). Therefore, patients with large or multifocal tumors could be eligible for both mastectomy and OBCS, which prompts the need for comparison between the two.

Moreover, the current OBCS literature focuses on

technique, safety, cosmesis, and patient satisfaction associated with this procedure, often in comparison to BCS; however, there is a paucity of literature comparing OBCS and mastectomy on these same variables. Several small retrospective studies have shown that OBCS supersedes both mastectomy and BCS in terms of patient-reported outcomes (PROs), cosmesis, and overall quality of life (QOL) improvement (21-24). However, none of these studies stratified outcomes based on race, ethnicity, or BMI nor analyzed these data in relation to surgical outcomes such as complications or need for additional procedures. Including data on race, ethnicity, and socioeconomic status is crucial in research overall considering the significant effects that social determinants of health have on health outcomes. In cancer screening in particular, health literacy and access to care can significantly affect patients' screenings and thus cancer detection as well as their ability to undergo treatment. Furthermore, PROs, specifically those relating to one's sexuality and satisfaction with appearance, are heavily influenced by cultural norms and societal standards. Patients from different backgrounds have different perceptions of what beauty is and what an "ideal" female form looks like. Thus, it is crucial to study the effect of different operations on PROs in a wide range of patient demographics, as the impact of fully removing breasts via mastectomy may vary significantly based on the patient's background and expectations. Therefore, the aim of our study was to compare OBCS and mastectomy with reconstruction on a range of different variables, including PROs and measures of oncologic safety, as well as stratify these outcomes based on race, ethnicity, and BMI in order to help give all patients, including those minorities underrepresented in medical research, evidence-based recommendations in pre-operative planning. We present this article in accordance with the STROBE reporting checklist (available at https://gs.amegroups.com/article/view/10.21037/gs-23-403/rc).

Methods

Data collection

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the institutional review board of Albert Einstein College of Medicine (No. FWA #00023382) and individual consent for this retrospective analysis was waived. A retrospective chart review was performed for breast cancer patients treated with either OBCS or mastectomy with reconstruction from 2015 to 2021 at Montefiore Einstein Comprehensive Cancer Center, Albert Einstein College of Medicine in the Bronx. Demographic information such as age, race, ethnicity, BMI, language, and insurance status in addition to clinical information such as date of diagnosis, type of surgery, pathology, treatment (including chemotherapy and radiation), recurrence, complications (including wound healing issues), and the need for additional surgery were all recorded. PROs were measured using BREAST-Q, specifically its reduction/mastopexy and mastectomy with reconstruction modules.

Statistical analysis

A chi-square test was performed for categorical variables. For numerical variables, normality was first assessed for each variable using a combination of visual assessment using Q-Q plots and mathematical interpretation using a Shapiro-Wilk test. If the data was normally distributed, an unpaired two-tail *t*-test was performed. If a numerical data was not normally distributed (as was often the case), a non-parametric equivalent of the *t*-test called the Mann-Whitney test was used. For the correlations, a Pearson correlation (parametric) was performed on normally distributed data and a Spearman correlation (nonparametric equivalent) was performed on non-normal distributions. Patients with missing data in any given variable were excluded from that analysis, and the n values for each were reported accordingly.

PROs

BREAST-Q is a clinically validated tool used for collection of PROs following various types of breast surgery. Patient-reported data from BREAST-Q surveys are converted to a score between 0 and 100 with the higher scores indicating more favorable outcomes (25-27). In our study, PROs were recorded using BREAST-Q pre-operatively as well as post-operatively. The post-operative time point used was the one furthest away from the surgery, ranging between 6 months and 5 years after.

Results

Demographics

A total of 261 patients' data were evaluated, of which 204

patients underwent mastectomy and 57 patients underwent OBCS. In total, 89% of the OBCS group and 79% of the mastectomy group identified as Hispanic and/or non-Caucasian. When compared to the mastectomy group, patients in the OBCS group were older (P=0.02) and had higher BMIs (P<0.001) (*Table 1*). However, there was no correlation between BMI and PROs (*Table 2*).

Disease and management

Between the two groups, there was no significant difference in the prevalence of multifocal disease (P=0.27); however, OBCS patients had a lower clinical stage of disease than mastectomy patients (P=0.04). In the OBCS group, 15/57 (26.3%) patients had stage 0 disease, 22/57 (38.6%) had stage 1, 14/57 (24.6%) had stage 2, 3/57 (5.3%) had stage 3, no patients were stage 4, and in 3/57 (5.3%) the stage was unknown. Contrastingly, among mastectomy patients, 31/204 (15.2%) had stage 0 disease, 63/204 (30.9%) had stage 1, 70/204 (34.3%) had stage 2, 32/204 (15.7%) had stage 3, 4/204 (2.0%) had stage 4, and in 4/204 (2.0%) the stage was unknown. There was no difference in tumor size between the two groups, with a median size of 22.5 mm among OBCS patients (range, 0.5–120 mm) compared to 20 mm among mastectomy patients (range, 0–140 mm) (P=0.59). More mastectomy patients had nodal-positive

Table 1 Comparison of OBCS *vs.* mastectomy demographics

Variables	OBCS	Mastectomy + reconstruction	P value
Total number of patients	57	204	
Age (years)[†]	55 [39–77]	52 [26–82]	0.018*
Race			
White	5 (8.8)	24 (11.8)	0.525
Black/African-American	26 (45.6)	62 (30.4)	0.032*
Asian	1 (1.8)	4 (2.0)	0.920
Other	20 (35.1)	88 (43.1)	0.275
Unavailable	5 (8.8)	26 (12.7)	0.412
Ethnicity			
Non-Hispanic	28 (49.1)	95 (46.6)	0.732
Hispanic	21 (36.8)	80 (39.2)	0.745
Unavailable	8 (14.0)	29 (14.2)	0.972
Medicaid/no insurance	24 (42.0)	83 (40.7)	0.847
BMI (kg/m^2)	32.4 [27.7–38.1]	29.0 [17.3–49.7]	<0.001*
Multifocal disease	27 (47.4)	80 (39.2)	0.269
Clinical stage			0.038*
0	15 (26.3)	31 (15.2)	
1	22 (38.6)	63 (30.9)	
2	14 (24.6)	70 (34.3)	
3	3 (5.3)	32 (15.7)	
4	0 (0.0)	4 (2.0)	
Unknown	3 (5.3)	4 (2.0)	

Table 1 (*continued*)

Table 1 (*continued*)

Variables	OBCS	Mastectomy + reconstruction	P value
Procedure type	Oncoplastic reduction + symmetrizing reduction: 53 (93.0)	Nipple sparing: 55 (27.0)	
	Oncoplastic mastopexy + symmetrizing mastopexy: 2 (3.5)	Skin sparing: 149 (73.0)	
	Oncoplastic mastopexy: 1 (1.8)	Bilateral: 60 (29.4)	
	Bilateral oncoplastic reduction: 1 (1.8)	Immediate TE: 138 (67.6)	
	Wise incision pattern: 50 (87.7)	Implant after TE: 81/138 (58.3)	
	Vertical incision pattern: 7 (12.3)	Autologous recon after TE: 33/138 (23.9)	
	Periareolar incision pattern: 1 (1.8)	TE removal 2/2 infection: 8/138 (5.8)	
		TE & awaiting further recon: 9/138 (6.5)	
		TE then lost-to-follow-up/ deceased: 7/138 (5.1)	
		Immediate autologous recon: 54 (26.5)	
		Immediate implant recon: 12 (5.9)	
Weights (g)	Lumpectomy: 157 [37–722]	Mastectomy: 660 [59–2,378]	<0.001*
	Ipsilateral reduction: 180.5 [10–1,754]	Mastectomy: 660 [59–2,378]	<0.001*
	Contralateral reduction: 438 [87–1,726]	Mastectomy: 660 [59–2,378]	<0.001*
Positive margins	4 (7.0)	10 (4.9)	0.525
Pathology			
IDC	33 (57.9)	120 (58.8)	0.900
ILC	5 (8.8)	22 (10.8)	0.659
DCIS	15 (26.3)	29 (14.2)	0.031*
Pathology (mixed)	4 (7.0)	33 (16.2)	
Hormone receptor status			
Estrogen receptor (+)	46 (80.7)	150 (73.5)	0.268
Triple negative	9 (15.8)	36 (17.6)	0.743
HER2 (+)	4 (7.0)	32 (15.7)	0.093
Tumor size (mm)	22.5 [0.5–120]	20 [0–140]	0.585
Patients with positive lymph nodes			
0	31(54.4)	125 (61.3)	0.348
≥1	17 (29.8)	65 (31.9)	
1–4	14 (24.6)	42 (20.6)	0.518
5–9	2 (3.5)	14 (6.9)	0.351
≥10	1 (1.8)	9 (4.4)	0.355
No sentinel lymph node biopsy	9 (15.8)	14 (6.9)	0.036*
Neoadjuvant chemotherapy	11 (19.3)	64 (31.4)	0.075

Table 1 (*continued*)

Table 1 (*continued*)

Variables	OBCS	Mastectomy + reconstruction	P value
Neoadjuvant endocrine therapy	9 (15.8)	14 (6.9)	0.036*
Adjuvant chemotherapy	17 (29.8)	87 (42.6)	0.080
Adjuvant endocrine therapy	39 (68.4) (compliance rate =68.9%)	134 (65.7) (compliance rate =64%)	0.699
Adjuvant radiation therapy	45 (78.9)	75 (36.8)	<0.001*
Radiation toxicity (≥ grade 2)	2 (3.5)	6 (2.9)	0.826
Any additional surgery	8 (14.0)	172 (84.3)	<0.001*
Unplanned additional surgery	8 (14.0)	113 (55.4)	<0.001*
Number of total surgeries	1	3	<0.001*
Complications			
Infection	3 (5.3)	45 (22.1)	0.004*
Wound healing problems	19 (33.3)	90 (44.1)	0.144
Mastectomy skin flap necrosis	–	52 (25.5)	–
Overall	19 (33.3)	97 (47.5)	0.056
Length of follow-up (months)	24.6	29.9	0.037*
Total recurrences	3 (5.3)	16 (7.8)	0.507
Local recurrences	1 (1.8)	2 (1.0)	0.628
Distant recurrences	2 (3.5)	14 (6.9)	0.351

Data are presented as number, median [range], n (%), n/total (%), or median. †, indicates a numerical variable that was normally distributed. *, P<0.05. OBCS, oncoplastic breast-conserving surgery; BMI, body mass index; TE, tissue expander; IDC, invasive ductal carcinoma; ILC, invasive lobular carcinoma; DCIS, ductal carcinoma in situ; HER2, human epidermal growth factor receptor 2.

Table 2 PROs correlations

Correlation	OBCS	Mastectomy + reconstruction
Number of surgeries *vs.* post-op breast satisfaction	r=−0.070	r=0.088
Number of surgeries *vs.* outcome satisfaction	r=−0.086	r=0.087
Any complications *vs.* post-op breast satisfaction	r=−0.07	r=−0.21
Any complications *vs.* outcome satisfaction	r=0.10	r=0.17
Infection *vs.* post-op breast satisfaction	r=0.329	r=−0.236
Infection *vs.* satisfaction with outcome	r=0.273	r=0.0854
BMI *vs.* post-op satisfaction with breasts	r=−0.0332	r=−0.138
BMI *vs.* satisfaction with outcome	r=0.163	r=−0.116

PROs, patient-reported outcomes; OBCS, oncoplastic breast-conserving surgery; post-op, post-operative; r, correlation coefficient; BMI, body mass index.

disease than OBCS patients (31.9% *vs.* 29.8%) and when positive they tended to have more nodes involved; however, these differences were not statistically significant. Patients in the OBCS group had a median follow-up of 24.6 months compared to 29.9 months in the mastectomy group (P=0.04) (see *Table 1*).

In terms of additional treatment, significantly more OBCS patients received neoadjuvant endocrine therapy and adjuvant radiation therapy than mastectomy patients, but there were no statistical differences between rates of neoadjuvant chemotherapy, adjuvant chemotherapy, or adjuvant endocrine therapy. Nine of 57 (15.8%) OBCS patients received neoadjuvant endocrine therapy, compared to 14/204 (6.9%) mastectomy patients (P=0.04). Forty-five of 57 (78.9%) OBCS patients had adjuvant radiation therapy compared to 75/204 (36.8%) mastectomy patients (P<0.001). Of note, it could not be confirmed if the remaining 12 OBCS patients received adjuvant radiation therapy despite it being the standard of care, as they were lost to follow-up or transitioned their care to an outside hospital with inaccessible records. Contrastingly, although more mastectomy patients had neoadjuvant chemotherapy than OBCS patients (31.4% *vs.* 19.3%), this difference was not statistically significant (P=0.08). Similarly, more mastectomy patients underwent adjuvant chemotherapy than OBCS patients (42.6% *vs.* 29.8%), but this difference also was not statistically significant (P=0.08). Comparable proportions of patients from both groups had adjuvant endocrine therapy (68.4% of OBCS *vs.* 65.7% of mastectomy, P=0.70) with similar compliance rates (68.9% for OBCS *vs.* 64% for mastectomy) (see *Table 1*).

Type of surgery

The majority of the OBCS patients underwent an oncoplastic reduction with a contralateral symmetrizing reduction (53/57, 93.0%) using a wise incision pattern (50/57, 87.7%). Two patients (3.5%) had an oncoplastic mastopexy with a contralateral symmetrizing mastopexy, 1 patient (1.8%) had a bilateral oncoplastic reduction, and 1 patient (1.8%) had an oncoplastic mastopexy without an operation on the contralateral breast (see *Table 1*).

Most mastectomy patients had a skin-sparing mastectomy (149/204, 73.0%), with the remainder having nipple-sparing (55/204, 27.0%), and 29.4% of them were bilateral (60/204). All mastectomy patients underwent immediate reconstruction: 67.6% via tissue expander (TE) placement (138/204), 26.5% via autologous reconstruction with flaps (54/204), and 5.9% via implant-based reconstruction (12/204). Of those patients with an immediate TE, 81/138 (58.3%) had a delayed implant placement, 33/138 (23.9%) patients had delayed autologous reconstruction, 8/138 (5.8%) had the TE removed due to infection, 9/138 (6.5%) were awaiting the second stage of reconstruction at the time of this study, and 7/138 (5.1%) were lost-to-follow-up (see *Table 1*).

PROs

BREAST-Q questionnaires were completed post-operatively by 18 of the 57 patients in the OBCS group (31.6%) and 77 of the 204 patients (37.7%) in the mastectomy group (P=0.39). Twelve of the 57 patients (21.1%) in the OBCS group and 77 of the 204 patients (37.7%) in the mastectomy group completed both pre- and post-operative BREAST-Q (P=0.02) (see *Table 3*). Of the OBCS patients who filled out BREAST-Q, 7/18 identified as African-American, 3/18 as White, 5/18 as other, 2/18 declined, and 1/18 as Asian. In terms of ethnicity, 7/18 identified as Hispanic, 8 identified as non-Hispanic, and the rest declined. Of the mastectomy patients who filled out BREAST-Q, 26/77 identify as African-American, 37/77 as other, 4/77 as white, 2/77 as Asian, 1/77 as Indian, and 7/77 declined. In terms of ethnicity, 33/77 identified as Hispanic, 36/77 as non-Hispanic, and the rest declined.

In two of the four categories analyzed, "satisfaction with breasts" and "satisfaction with outcome", OBCS yielded better post-operative PROs than mastectomy. The median post-operative "satisfaction with breast" was 71.5/100 for OBCS and 58/100 for mastectomy (P=0.02). Similarly, the median "satisfaction with outcome" was 100/100 for OBCS and 75/100 for mastectomy (P=0.02). Of note, mastectomy patients had significantly lower "satisfaction with outcome" and "satisfaction with breast" than OBCS patients, regardless of whether they had adjuvant radiation or not. In the other two categories, "psychosocial well-being" and "sexual well-being", the difference in post-operative scores was not statistically significant (P=0.42 and P=0.78, respectively) (see *Table 3*).

In stratifying PROs by type of mastectomy, there was no difference in post-operative "satisfaction with breast", "satisfaction with outcome", "psychosocial well-being", or "sexual well-being" between nipple-sparing and skin-sparing mastectomies (P=0.99, P=0.88, P=0.85, P=0.40, respectively) (*Table 4*). Furthermore, when comparing OBCS to nipple-sparing mastectomies only, OBCS patients still reported

Table 3 Comparison of OBCS *vs.* mastectomy PROs

Variables	OBCS	Mastectomy + reconstruction	P value
Patients who filled out BREAST-Q	18 (31.6)	77 (37.7)	0.392
Patients who filled out BREAST-Q & received radiation	–	27 (13.2)	–
Patients who filled out BREAST-Q & did not receive radiation	–	45 (22.1)	–
Patients who filled out BREAST-Q pre-op and post-op	12 (21.1)	77 (37.7)	0.0188*
Last post-op survey time point			
1 month	4/18 (22.2)	0/77 (0.0)	
3 months	1/18 (5.6)	8/77 (10.4)	
6 months	2/18 (11.1)	14/77 (18.2)	
Last post-op survey time point			
1 year	4/18 (22.2)	30/77 (39.0)	
2 years	0/18 (0.0)	14/77 (18.2)	
3 years	2/18 (11.1)	6/77 (7.8)	
4 years	3/18 (16.7)	5/77 (6.5)	
5 years	2/18 (11.1)	0/77 (0.0)	
PRO: pre-op sexual well-being	49/100	54/100	0.836
PRO: pre-op psychosocial well-being	62/100	63/100	0.911
PRO: pre-op satisfaction with breasts	49/100	58/100	0.276
PRO: post-op sexual well-being			
All	52/100 [18]	53/100 [77]	0.783
With radiation	52/100 [18]	52/100 [27]	0.924
Without radiation	52/100 [18]	54/100 [45]	0.660
PRO: post-op psychosocial well-being			
All	72.5/100 [18]	68.5/100 [77]	0.415
With radiation	72.5/100 [18]	68/100 [27]	0.332
Without radiation	72.5/100 [18]	65/100 [45]	0.464
PRO: post-op satisfaction with breasts			
All	71.5/100 [18]	58/100 [77]	0.0165*
With radiation	71.5/100 [18]	55/100 [27]	0.0443*
Without radiation	71.5/100 [18]	59/100 [45]	0.0192*
PRO: satisfaction with outcome			
All	100/100 [11]	75/100 [77]	0.0197*
With radiation	100/100 [11]	75/100 [27]	0.0182*
Without radiation	100/100 [11]	71/100 [45]	0.0461*
Black post-op satisfaction with breasts†	84/100	56.5/100	0.199
Black satisfaction with outcome†	88.5/100	67/100	0.108
Hispanic post-op satisfaction with breasts†	59/100	58/100	0.533
Hispanic satisfaction with outcome	100/100	75/100	0.421

Data are presented as n (%), n/total (%), or median score out of 100 possible points [n]. †, indicates a numerical variable that was normally distributed. *, P<0.05. OBCS, oncoplastic breast-conserving surgery; PROs, patient-reported outcomes; pre-op, pre-operative; post-op, post-operative.

Table 4 PROs based on type of mastectomy

Variables	Skin-sparing mastectomies	Nipple-sparing mastectomies	P value
Number of patients who filled out BREAST-Q	63	14	
Post-op satisfaction with breasts	58/100	58/100	0.994
Satisfaction with outcome	75/100	67/100	0.882
Post-op psychosocial well-being	66/100	77.5/100	0.848
Post-op sexual well-being	53/100	65/100	0.398

Data are presented as number or median score out of 100 possible points. PROs, patient-reported outcomes; post-op, post-operative.

Table 5 OBCS *vs.* nipple-sparing mastectomy PROs

Variables	OBCS	Only nipple-sparing mastectomies	P value
Number of patients who filled out BREAST-Q	18	14	
Post-op satisfaction with breasts	71.5/100	58/100	0.077
Satisfaction with outcome	100/100	67/100	0.055
Post-op psychosocial well-being	72.5/100	77.5/100	0.755
Post-op sexual well-being	52/100	65/100	0.427

Data are presented as number or median score out of 100 possible points. OBCS, oncoplastic breast-conserving surgery; PROs, patient-reported outcomes; post-op, post-operative.

Table 6 PROs and outcomes based on type of reconstruction

Variables	Mastectomy + flap	Mastectomy + implant	P value
Number of patients	94	93	
Number of patients who underwent unplanned surgeries	62 (66.0)	41 (44.1)	0.002*
Number of patients who experienced a complication	52 (55.3)	40 (43.0)	0.0192*
Number of patients who filled out BREAST-Q	42	32	0.059
Post-op satisfaction with breasts	59/100	58.5/100	0.598
Satisfaction with outcome	75/100	71/100	0.996
Post-op psychosocial well-being	76/100	63/100	0.140
Post-op sexual well-being	60/100	53/100	0.638

Data are presented as number, n (%), or median score out of 100 possible points. *, P<0.05. PROs, patient-reported outcomes; post-op, post-operative.

higher post-operative "satisfaction with breasts" (71.5/100 *vs.* 58/100) and "satisfaction with outcome" (100/100 *vs.* 67/100), although these differences were not statistically significant (P=0.08 and P=0.06, respectively) (*Table 5*). Lastly, mastectomy patients who received autologous reconstruction with flaps *vs.* those who received implant-based reconstruction (whether immediately or delayed) did not report any statistically significant difference in satisfaction in any of the four categories analyzed (P=0.60, P>0.99, P=0.14, P=0.64, respectively) (*Table 6*).

Additionally, African American patients who underwent OBCS reported better "satisfaction with breast" compared to those who received a mastectomy (84/100 *vs.* 56.5/100), but this difference was not statistically significant (P=0.20). Hispanic patients, on the other hand, did not demonstrate any significant difference in "satisfaction with breast"

Table 7 Comparison of OBCS PROs before and after surgery

PRO category	Pre-operative	Post-operative	P value
Number	12	12	
Sexual well-being	49/100	84/100	0.721
Psychosocial well-being	62/100	85/100	0.518
Satisfaction with breasts	49/100	86/100	0.0588

Data are presented as number or median score out of 100 possible points. OBCS, oncoplastic breast-conserving surgery; PROs, patient-reported outcomes.

Table 8 Comparison of mastectomy PROs before and after surgery

PRO category	Pre-operative	Post-operative	P value
Sexual well-being	54/100	53/100	0.605
Psychosocial well-being	63/100	68.5/100	0.987
Satisfaction with breasts	58/100	58/100	0.974

Data are presented as median score out of 100 possible points. PROs, patient-reported outcomes.

between the two surgeries (59/100 for OBCS *vs.* 58/100 for mastectomy, P=0.53). Additionally, both African American and Hispanic patients reported better "satisfaction with outcome" post-OBCS than post-mastectomy, but these differences were not statistically significant (African Americans: 88.5/100 *vs.* 67/100, P=0.11; Hispanics: 100/100 *vs.* 75/100, P=0.42) (*Table 3*).

Furthermore, in comparing the pre- and post-operative PROs, "sexual well-being", "psychosocial wellbeing", and "satisfaction with breast" were higher post-OBCS than pre-OBCS, although none of these differences were statistically significant (P=0.72, P=0.52, and P=0.06, respectively) (*Table 7*); whereas these same three PROs were unchanged pre- and post-mastectomy (P=0.61, P=0.99, and P=0.97, respectively) (*Table 8*).

Oncologic safety

Positive margins after surgery were identified in four of 57 patients (7.1%) in the OBCS group compared to ten of 204 (4.9%) patients in the mastectomy group (P=0.53) (*Table 1*). These patients underwent different treatment modalities based on their preference and pathology report. All four patients in the OBCS group with positive margins underwent mastectomy (two nipple-sparing and two radical modified mastectomies) (7.0%) with reconstruction and of those, two received post-mastectomy radiation. Furthermore, of the ten out of 204 (4.9%) patients in the mastectomy group who had positive margins, seven received post-mastectomy radiation for local control, five received adjuvant chemotherapy, two underwent re-excision, and one underwent axillary lymph node biopsy.

Among the 15 patients with DCIS who underwent OBCS, only one had positive margins (6.7%) treated with a mastectomy and none of them experienced a local or distant recurrence. Of the 11 OBCS patients (19.3%) had neoadjuvant chemotherapy, one had positive margins (9.1%) treated with a mastectomy and another one had a local recurrence in the lumpectomy site treated with a mastectomy and is now in remission.

Furthermore, the recurrence rate in the OBCS group was 5.3% while it was 7.8% in the mastectomy group (P=0.51). Of note, there was one local recurrence in the OBCS group and two local recurrences in the mastectomy group, making the local recurrence rates 1.8% and 1.0% respectively (P=0.63). There were two distant recurrences in the OBCS group and fourteen distant recurrences in the mastectomy group, making the distant recurrence rates 3.5% and 6.9% respectively (P=0.35) (*Table 1*).

Finally, patients with positive margins after surgery underwent different treatment modalities based on their preference and pathology report. All four patients in the OBCS group with positive margins underwent mastectomy (7.1%) and of those, two received post-mastectomy radiation. Furthermore, of the 10 out of 204 (4.9%) patients in the mastectomy group who had positive margins, seven

received post-mastectomy radiation for local control, five received adjuvant chemotherapy, two underwent re-excision, and one underwent axillary lymph node biopsy.

Complications

Complications were defined as the presence of infection, difficulty in wound healing, and/or mastectomy skin flap necrosis. OBCS patients had a significantly lower rate of infection as compared to mastectomy patients (5.3% *vs.* 22.1%, P=0.004) as well as a lower rate of overall complications, although the difference was not statistically significant (33.3% *vs.* 47.5%, P=0.06) (*Table 1*). There were no correlations between overall complications and post-operative "satisfaction with breast" (OBCS: r=–0.07; mastectomy: r=–0.21) or "satisfaction with outcome" (OBCS: r=0.10; mastectomy: r=0.17) in either group. Similarly, there were no correlations between infection and post-operative "satisfaction with breast" (OBCS: r=0.33; mastectomy: r=–0.24) or "satisfaction with outcome" (OBCS: r=0.27; mastectomy: r=0.09) in either group (*Table 2*).

Moreover, OBCS patients underwent fewer additional surgeries as compared to mastectomy patients (14.0% *vs.* 84.3%, P<0.001). The median number of total surgeries was one for the OBCS group and three for the mastectomy group (P<0.001). Furthermore, mastectomy patients had significantly more unplanned surgeries compared to OBCS (P<0.001). There were 280 total unplanned surgeries in the mastectomy group, with a median of 2 (range, 1–8) unplanned operations per patient, and thirteen total unplanned surgeries in the OBCS group, with a median of 1 (range, 1–4) unplanned operation per patient (*Table 1*). There were no correlations between number of surgeries and "satisfaction with breast" or "satisfaction with outcome" in either group (*Table 2*). In addition, patients undergoing autologous reconstruction had more unplanned surgeries compared to implant-based reconstruction (66.0% *vs.* 44.1% respectively, P=0.002) and a higher rate of complications (55.3% *vs.* 43.0% respectively, P=0.02) (*Table 6*).

Discussion

Women's psychosocial well-being is significantly impacted by the diagnosis and treatment of breast cancer. In addition to fears about their health and survival, cancer patients' perceptions of their bodies, sexuality, and self-esteem have been shown to be negatively impacted by oncologic resection of their disease, which in turn affects their marriage, family and social life (28). However, these fears can be alleviated not only by encouraging the patient to participate in the decision-making process, but also by assisting them in achieving balance on all fronts—physical, emotional, spiritual, and social (29). To achieve this balance, it is imperative to focus on patients' QOL while also aiming for better cosmetic outcomes, since psychological recovery has been linked to cosmetic perception (30). OBCS, a non-inferior surgical management, helps to bridge a few of these concerns by providing better cosmesis and overall improved patient satisfaction and QOL (6-8,21-24).

In our study, we used BREAST-Q, a validated PRO questionnaire that includes multiple patient satisfaction and health-related QOL domains, to assess patient perception of results following breast surgery (26). This questionnaire encompasses four independent modules for breast surgery: breast reduction, augmentation, reconstruction, and mastectomy (26,31,32). Thus, when used in clinical practice, it can provide evidence-based data on QOL and patient satisfaction (33).

Multiple studies have been conducted comparing OBCS and mastectomy using this validated BREAST-Q instrument; however, there is a lack of literature highlighting the potential impact of race, ethnicity, BMI, and socioeconomic status on both surgical and PROs of OBCS. To the best of our knowledge, most OBCS studies thus far have not reported the race or ethnicity of their patients, nor taken those factors into account in analyzing the results [one exception is found in a recent study which compared PROs of OBCS to those of BCS and included race and BMI (34)]. Thus, in our study we analyzed these variables in conjunction with pre- and post-operative PROs and surgical outcomes to compare OBCS and mastectomy with reconstruction.

Prior literature has demonstrated that patients with higher BMIs have poor patient satisfaction after BCS and an increased rate of complications after OBCS requiring additional surgeries (14,15,35). Contrastingly, in our study the median BMIs in the OBCS and mastectomy group were 32.4 and 29 kg/m^2 respectively, and despite significantly higher BMI in the OBCS group than in the mastectomy group (P<0.001), OBCS patients were still more satisfied and experienced fewer unplanned surgeries. Moreover, 42% of the patients in OBCS group and 40.7% patients in mastectomy group were uninsured or on Medicaid, demonstrating the low socioeconomic status of our patient population. Of note, when stratified by race, either by

Hispanic patients or African American patients, there was no longer statistically significant differences between the OBCS and mastectomy groups in terms of PROs. This result is most likely a result of our relatively small sample size of patients with BREAST-Q forms overall, making the numbers of patients in these subgroups too small. Our findings and prior study (22) found that patients undergoing OBCS had better patient satisfaction and lower complication rates, but also had earlier clinical stages of disease than mastectomy patients. However, Bazzarelli *et al.* (21) found that OBCS patients still had better PROs than mastectomy patients despite having more advanced stages of disease.

Although our study had a shorter duration of follow-up in the OBCS group as compared to the mastectomy group (24.6 *vs.* 29.9 months, P=0.04), prior literature shows that even with long-term follow-up, no significant difference between OBCS and mastectomy recurrence rates emerges (20). In addition, the oncologic outcomes of the OBCS group in our study were comparable to those reported in previous literature (although this end point was significantly limited by our small cohort size and relatively short follow-up period). A large meta-analysis of over 8,000 patients comparing OBCS to traditional BCT found a positive margin rate of 12% after OBCS, a conversion-to-mastectomy rate of 6.5%, and a local recurrence rate of 4% over 37 months of follow-up with an average tumor size of 2.7 cm (36). Our data showed a positive margin rate of 7.1%, a conversion-to-mastectomy rate of 7.0%, and a local recurrence rate of 1.8% over 24.6 months with a median tumor size of 2.3 cm.

In focusing on OBCS patients with DCIS and those who received neoadjuvant chemotherapy, two less common subgroups in the OBCS literature, their recurrence and positive margin rates were similar to those of the cohort overall. The DCIS subgroup had a 6.7% positive margin rate and a 0% recurrence rate. The neoadjuvant chemotherapy group had a positive margin rate of 9.1% and a recurrence rate of 9.1%.

The clinical utility of BREAST-Q in our patient population yielded better results for OBCS than mastectomy, with patients scoring higher in terms of "satisfaction with breasts" and "satisfaction with outcome", but similar scores were observed for post-operative "psychosocial well-being" and "sexual well-being". Multiple studies have found similarly high levels of patient satisfaction after OBCS, but in different domains (21-23). However, none of these studies determined pre-operative satisfaction and well-being; whereas in our study, we first determined that there were no differences in any of the PRO measures between the two groups pre-operatively. As a result, we were able to demonstrate that the difference in post-operative outcomes between OBCS and mastectomy was not due to mastectomy decreasing breast satisfaction, but rather to OBCS improving patients' satisfaction with their breasts.

Additionally, a presumed contributor to patient dissatisfaction following mastectomy is the loss of the nipple (37-39). Our data potentially supports this hypothesis. On one hand, when comparing only nipple-sparing mastectomies to OBCS, there is no longer any statistically significant difference between post-operative satisfaction with breasts nor satisfaction with outcome between the groups (see *Table 5*). However, this could be due to the relatively small sample size of patients who underwent nipple-sparing mastectomies and filled out BREAST-Q (n=14) considering that the type of mastectomy procedure had no impact on PROs in our cohort; those who had non-nipple-sparing procedures reported the same levels of satisfaction as those who had nipple-sparing surgeries in all four PRO domains (see *Table 4*). This outcome is contrary to most studies which found nipple-sparing mastectomies to result in higher patient satisfaction than non-nipple-sparing procedures (40-46). Similarly, Char *et al.* (46) and Yueh *et al.* (47) found that autologous/flap-based reconstruction resulted in significantly higher satisfaction than implant-based reconstruction, and yet we found there no be no differences in PROs based on the type of reconstruction.

Our study demonstrates that mastectomy patients experienced significantly higher rates of infection as well as significantly more surgeries. Even when controlling for the fact that many mastectomy patients had a planned 2-stage reconstruction with a TE and subsequent implant exchange or autologous reconstruction, these patients underwent more unplanned surgical procedures than OBCS patients did, primarily to address the plethora of complications they experienced such as infection, wound healing problems, and mastectomy skin flap necrosis. Brown *et al.* (35) also evaluated the need for secondary surgeries following OBCS and found that 21% of patients in their cohort required unplanned returns to the operating room. Chand *et al.* (23) found that 29.3% of OBCS patients (mammaplasty specifically) underwent additional surgeries. These rates are slightly higher than in our study where 14% of OBCS patients had unplanned surgeries following the initial procedure. Chand *et al.* (23) also found that 34.8% of mastectomy with reconstruction patients (latissimus

dorsi miniflap) underwent additional surgical procedures, significantly lower than our group in which 55.4% underwent unplanned additional surgeries.

Although prior literature has shown that patient satisfaction is negatively impacted by surgical complications (48), we did not find any correlations between complications and PROs in our study. However, higher rates of infection and more surgery in the mastectomy group could explain their worse PROs. In comparison to the existing literature, our study had much higher overall complication rates for both OBCS and mastectomy with reconstruction patients. Prior literature showed complication rates of 8.9% for OBCS (49) and 10–35% for mastectomy (with and without reconstruction) (50,51), as opposed to 33.3% and 47.5% in our study, respectively. This disparity between our study and established complication rates could be attributed to our high BMI, high rate of comorbidities (particularly diabetes and smoking), and possibly compliance due to lower socioeconomic status.

Our study has several limitations. Firstly, the relatively small number of patients studied overall, in addition to the even smaller amount who filled out all the BREAST-Q questionnaires (31.6% and 37.7% for OBCS and mastectomy with reconstruction, respectively), reduced the power of our conclusions. If we had been able to collect more surveys, we also could have also stratified the results by stage of disease. The coronavirus disease 2019 (COVID-19) pandemic was a significant contributor to difficulty acquiring these surveys, as it increased loss to follow-up and resulted in more virtual visits, during which BREAST-Q forms were not collected. Furthermore, comparing surveys filled out at different time points post-operatively may have influenced PROs, as patients may have a better perception further away from the operation itself. If we had been able to collect more surveys, we could have stratified comparisons by different time points. Secondly, there were many significant differences between the groups at baseline, namely different ages, BMIs, and clinical stages of disease, that were not controlled for in our analyses. In particular, the higher average BMI in the OBCS group compromised the strength of our conclusions as higher BMIs can directly impact patient satisfaction with a breast reduction. The difference in age is also significant, as the patients in the mastectomy group were younger and younger patients can have higher aesthetic standards, potentially resulting in worse PROs post-operatively. Lastly, the relatively short follow-up of both groups made it difficult to draw dramatic conclusions about recurrence rates. Thus, we plan on following this group longitudinally to collect more data and report on it in the future in order to bolster our findings. By following more patients for longer, such research would confirm the oncologic safety of OBCS in patients belonging to ethnic and racial minority groups and further strengthen our knowledge of how certain drawbacks to both OBCS and mastectomy affect these patients' QOL.

Conclusions

In our study, OBCS yielded better PROs than mastectomy while maintaining oncologic safety and resulting in fewer surgeries and complications. These excellent outcomes in a majority non-Caucasian cohort support the utilization of OBCS for patients of color. However, larger studies evaluating PROs in diverse and underserved populations are needed to reinforce these conclusions.

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Footnote

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://gs.amegroups.com/article/view/10.21037/gs-23-403/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the

institutional review board of Albert Einstein College of Medicine (No. FWA #00023382) and individual consent for this retrospective analysis was waived.

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