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Breast

The Influence of Surgical Specialty on Oncoplastic Breast Reconstruction

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Background: The integration of oncological surgery with reconstructive techniques has gained popularity in the treatment of breast cancer. oncoplastic reconstruction after partial mastectomy can be performed by the breast surgeon or in cooperation with a consulted plastic surgeon. This study aims to objectively assess the differences in outcomes for partial mastectomy and subsequent oncoplastic reconstruction performed by either general surgery alone or in combination with a plastic and reconstructive surgery team.

Methods: Unilateral oncoplastic breast reconstruction cases were extracted from the National Surgical Quality Improvement Program databases from 2005 to 2017. Outcomes of cases performed by the general surgery team alone were compared with those in which the partial mastectomy was performed by the general surgeon with subsequent reconstruction performed by plastic surgeons. To account for cohort baseline differences, propensity score-matched analysis was performed.

Results: In total, 4,350 patients were included in this study; 3,759 procedures were performed by general surgery alone versus 591 combined with plastic surgery. The analysis of propensity score-matched cohorts, comprising 490 patients each, showed no statistical difference in the risk for postoperative complications when surgery was performed by either of the 2 specialty services. A longer operative time and length of stay were found in the group reconstructed by plastic surgeons.

Conclusions: This study found no significant differences in adverse postoperative outcomes for oncoplastic reconstructions after partial mastectomy between the 2 groups. The data may indicate collaboration between both surgical specialties in oncoplastic breast care was not associated with increased morbidity in these patients.
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INTRODUCTION

Over the last century, the management of breast cancer has shifted from radical mastectomy as the unchallenged gold standard to today's broad range of therapeutic options, including more individualized and breast-preserving approaches.[1] The concept of a partial mastectomy followed by postoperative radiotherapy, also known as

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breast conservation therapy (BCT), emerged in the early 1960s.[2,3] Several clinical trials have demonstrated similar recurrence and survival rates for both radical mastectomy and BCT bringing about the NIH issued Consensus Conference which recommended BCT as the preferred surgical therapy for women diagnosed with early stage breast cancer.[4,5]

Recent studies have confirmed the oncologic viability of BCT with 20-year follow up data and have highlighted the inherent advantages to the less invasive nature of BCT, including shorter operative time, reduced intraoperative blood loss, and decreased length of stay.[6,7] Despite this, rates of BCT have declined since the start of the 21st century. In 2015, Kummerow et al. showed that mastectomy rates have risen, even in patients eligible for BCT.[8] The use of technical imaging such as MRI, genetic testing, and a greater degree of patient involvement in the decision for surgical treatment of breast cancer have contributed to preference for mastectomy over BCT.[9] This paradoxical discrepancy between objective outcomes described in the literature and patient preference is not fully understood, but is thought to be influenced by the wide array of options for postmastectomy reconstruction.[10] Obtaining the perfect balance between a sufficiently wide oncologic resection margin and an acceptable cosmetic outcome in BCT has been an arduous challenge. This challenge is especially apparent in wide resections of the lower pole and upper medial quartile, which tend to result in unacceptable aesthetic results.[11]

By combining cancer resection with reconstructive techniques, oncoplastic surgery pushes the operative limits of breast cancer therapy while maintaining the best possible oncological and aesthetic outcome. Consequently, oncoplastic reconstruction allows for more generous excision margins when compared to BCT, thus decreasing the theoretical risk of a re-excision operation.[12] The broad range of oncoplastic reconstructive techniques varies from complex layered closure of the defect to reduction mammoplasty that would allow for resection of up to half of breast tissue.[11] Other options include local tissue rearrangement and pedicled flaps, an option of particular utility in women with smaller breasts. In larger ptotic breasts, mastopexy and oncoplastic reduction mammoplasty may be preferred.[13]

Performing an oncoplastic procedure requires a multidisciplinary team of specialists including a pathologist, a medical oncologist, a radiologist, and an operative team consisting of either an oncologic breast surgeon and a plastic surgeon or a specially trained breast surgeon alone.[14,15] Although Silverstein et al. claimed involvement of both plastic and general surgery to be "absolutely necessary" to attain optimal oncologic and cosmetic results,[12] the number of positions for Breast Oncology Fellowships within the United States, a fellowship that may train general surgeons to independently perform oncoplastic procedures, has increased from 44 to 75 over the last decade.[16] Subsequently, there has been an ongoing debate as to which specialty is better equipped to perform oncoplastic reconstruction. Without taking into consideration political or financial interests that might influence this discussion, our large national database analysis aims to objectively assess the differences in outcomes for partial mastectomy and subsequent oncoplastic reconstruction performed by either general surgery alone or in combination with a plastic surgery team for reconstruction.

METHODS

Patient Selection

The National American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) participant user files from 2005 to 2017 were queried for all female patients who underwent a partial breast resection as their primary procedure [Current Procedural Terminology (CPT) codes: "19301Partial Mastectomy" performed by general surgery. To expand our study population, patients that underwent the diagnostic procedure "19125Excision of breast lesion identified by preoperative placement of radiological marker"] were also included. In total, 159,617 patients who underwent partial mastectomy were identified.

Patients who underwent oncoplastic reconstruction were identified by CPT codes used for this procedure ["19316Mastopexy," "19318Reduction mammaplasty," "19366Breast reconstruction other technique," "14000Adjacent tissue transfer or rearrangement, trunk; defect 10 cm^2 or less," "14001Adjacent tissue transfer or rearrangement, trunk; defect 10.1 cm^2 to 30 cm^2," "14301Adjacent tissue transfer or rearrangement, trunk; defect 30.1 cm^2 to 60 cm^2," "13100Repair, complex, trunk; 1.1 cm to 2.5 cm," "13101Repair, complex, trunk; 2.6 to 7.5 cm," (of note, complex closure has been mentioned as an important modality for oncoplastic reconstruction in the literature,[13] as such, it was included in our analyses) "15770Formation of direct or tubed pedicle, with or without transfer, trunk," "15740Flap; island pedicle requiring identification and dissection," and "15650Transfer, intermediate, of any pedicle flap, any location"]; performed under the same anesthetic. A total of 5,883 patients was identified.

Stratification of Surgical Teams

Registration of additional procedures performed under the same anesthetic are classified as either "Other Procedures": performed by the same surgical team who completed the primary procedure, or "Concurrent Procedures": performed by a different surgical team to that of the primary procedure. In this study, patients who had their reconstruction performed by the same surgical team that also completed the primary partial mastectomy were considered to have undergone general surgery reconstruction (GSR). When the reconstruction was performed by a different surgical team, the subsequent reconstruction was assumed to be performed by a plastic surgical team; plastic surgery reconstruction (PSR). A total of 4,375 patients undergoing GSR and 1,601 PSR patients were identified.

Exclusion Criteria

To omit bilateral reconstruction and lymph node dissection, in effort to standardize our study population, patients who had reconstructive procedures registered in both "Other Procedures" and "Concurrent Procedures" or multiple reconstructive codes in one case were excluded. All other procedures registered as performed under the same anesthetic were reviewed and patients receiving either bilateral mastectomy, lymph node dissection, or unrelated high-risk surgery were excluded. CPT codes can be reviewed in **Supplemental Digital Content 1**. (**See table, Supplemental Digital Content 1** which displays CPT codes used for primary search and filtering for reconstructive cases, bilateral mastectomy cases, and lymphadenectomy cases, ***http://links.lww.com/PRSGO/B59***) To prevent skewing of data, all patients undergoing concurrent lymphadenectomy were excluded. Furthermore, all patients with preoperatively diagnosed metastatic disease were excluded. In total, 1,533 patients were excluded. A summary of the patient selection process is shown in Figure 1.

Patient Demographics

Basic patient demographics included in our analysis were gender, age, body mass index (BMI), race, and the type of reconstruction performed. Data was stratified by various

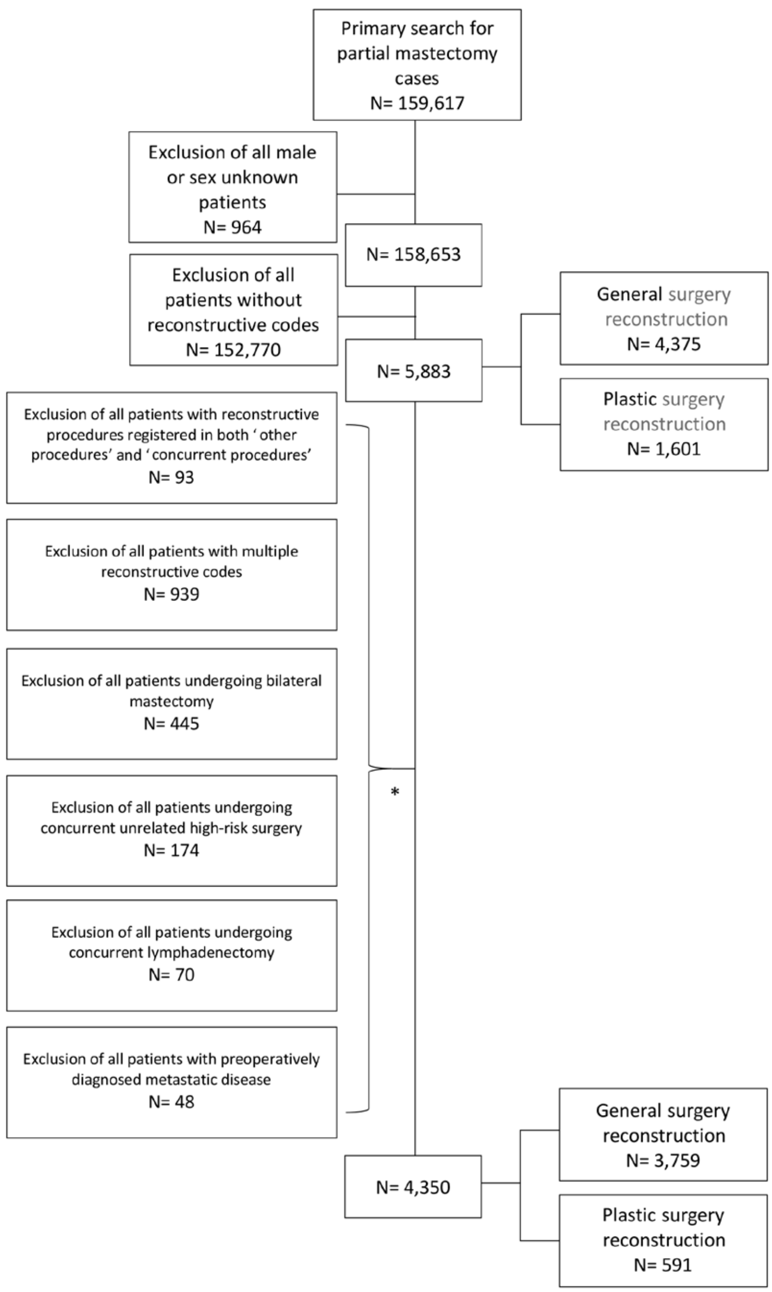

Fig. 1. Flowchart of patient selection process. *Because patients might qualify for multiple groups, the total number of exclusions is less than added up numbers of all specified categories.

preoperative measures to identify confounding factors. Patient comorbidities included diabetes, smoking status 1 year preoperatively, history of Chronic Obstructive Pulmonary Disease (COPD), dyspnea at moderate exertion, hypertension requiring medication, chronic steroid use, bleeding disorder, and dependent functional status preoperatively. BMI was categorized according to the WHO classification.[17] Age was categorized according to the age classification used by the American Society of Plastic Surgeons.[18] Additionally, the 5-factor frailty index, a valuable predictor of perioperative results based on patient vulnerability, was calculated.[19]

Outcomes

The primary outcome of this study was the 30-day overall complication rate. The overall complication rate was stratified into 3 different outcomes: wound complications, mild systemic complications, and serious systemic complications. Wound complication included as at least one of the following NSQIP-defined complications: "superficial incisional surgical site infection," "deep incisional surgical site infection," "organ or space surgical site infection," or "wound disruption". Systemic complications were stratified according to the Clavien-Dindo classification.[20] Clavien-Dindo class I–III complications were grouped as "mild systemic complication" and defined as occurrence of at least one of the following predefined NSQIP variables: "pneumonia," "transfusion intra- or postoperatively," "deep venous thrombosis (DVT) requiring therapy," "sepsis," "urinary tract infection," or "progressive renal insufficiency not requiring dialysis". Clavien-Dindo IV or V complications were grouped as "serious systemic complication" and defined as the occurrence of at least one of the following NSQIP variables: "unplanned intubation," "pulmonary embolism," "need for ventilator-assisted breathing >48 hours," "acute renal failure requiring dialysis," "stroke or cerebrovascular accident (CVA)," "cardiac arrest requiring CPR," "myocardial infarction," "septic shock," or death within 30 days postoperatively (Table 1). In addition, operating time and total length of hospital stay were analyzed.

Statistical Analysis

We performed propensity score matching to adjust for baseline differences between the 2 patient cohorts and make these cohorts more amenable to comparison.[21,22] Propensity score matching was performed in Stata (StataCorp. 2013. Stata Statistical Software: Release 13. College Station, Tex.: StataCorp LP). Logistic regression models were designed to determine the likelihood of undergoing PSR over GSR. Covariates for this model were selected a priori and included "age," "BMI," "diabetes," "current smoking status," "dyspnea," "functional status," "COPD," "hypertension," "steroid use," "bleeding disorder," "race," and "type of reconstructive procedure". Consequently, we matched patients undergoing PSR to the closest subject undergoing GSR using the propensity score in a 1:1 ratio. To avoid matching of noncomparable subjects, we used a match tolerance (caliper) of 0.03.[23] The homogeneity of each group's propensity scores were visually analyzed by overlapping plots of distribution and bias analysis. For bias analysis, a standardized difference <0.20 was considered as reasonable balance.[24] Patients with missing variables were excluded on a case-by-case basis in the regression analysis for propensity score matching. No additional patients were excluded based on missing data.

Both pre- and postoperative data on these matched cohorts were univariately analyzed using chi-square or Fisher's exact tests and independent sample *T* tests or Mann-Whitney *U* test, for comparison of categorical variables and continuous variables, respectively.

To verify the findings of our propensity score-matched analysis, we performed multivariable analysis with separate logistic regression models for each binary outcome variable and linear regression models for continuous variables. The a priori selected variables included in the regression model were "race," "age," "5-factor frailty index," "BMI," "smoking status," "steroid use," "type of reconstruction," and "operating time". The *P*-value for statistical significance was set at $P < 0.05$. Statistical analysis was performed using SPSS (IBM Corp. Released 2016. IBM SPSS Statistics for Mac, Version 24.0. Armonk, N.Y.: IBM Corp.).

The patient information in this study is de-identified and available to all institutions complying with ACS-NSQIP Data Use Agreement.

RESULTS

A total of 4,350 partial mastectomy patients were included in this study. For the majority of patients, reconstruction was performed by the same team (general

Table 1. Complication Stratification According to the Clavien-Dindo[19] Classification

Clavien-Dindo Classification	Definition	Complication Group	Included Complications
I	Any deviation from normal postoperative course without the need for pharmacological, surgical, endoscopic, or radiological treatment	Mild systemic complication	"Pneumonia," "transfusion intra- or postoperatively," "DVT requiring therapy," "sepsis," "urinary tract infection," and "progressive renal insufficiency not requiring dialysis"
II	Complication requiring pharmacological treatment		
III	Complication requiring surgical, endoscopic, or radiological intervention		
IV	Life-threatening complication	Severe systemic complication	"Unplanned intubation," "pulmonary embolism," "need for ventilator assisted breathing >48 hours," "acute renal failure requiring dialysis," "stroke or CVA," "cardiac arrest requiring CPR ," "myocardial infarction" or "septic shock," and "Death within 30 days postoperatively"
V	Death of a patient		

Table 2. Patient Demographics and Data Are Expressed as n (%), for Categorical Variables, or Mean ± SD, for Continuous Variables

	Unadjusted Cohorts			Matched Cohorts		
	General Surgery Reconstruction	Plastic Surgery Reconstruction		General Surgery Reconstruction	Plastic Surgery Reconstruction	
Demographic Parameters	N = 3,759	N = 591	P	N = 490	N = 490	P
Age (y)	60.3 ± 12.7	56.0 ± 11.4	<0.001	56.8 ± 11.6	57.0 ± 11.0	0.856
Age, categorical						
18–29	35 (0.9)	11 (1.9)	<0.001	4 (0.8)	7 (1.4)	0.397
30–39	131 (3.5)	34 (5.8)		26 (5.3)	21 (4.3)	
40–54	1,103 (29.5)	216 (36.5)		188 (38.4)	170 (34.7)	
55 and over	2,467 (66.0)	330 (55.8)		272 (55.5)	292 (59.6)	
Race						
White	2,797 (80.8)	467 (86.8)	<0.001	429 (87.6)	423 (86.3)	0.181
Black or African American	438 (12.7)	59 (11.0)		40 (8.2)	55 (11.2)	
Asian	214 (6.2)	11 (2.0)		19 (3.9)	11 (2.2)	
Other	13 (0.4)	1 (0.2)		2 (0.4)	1 (0.2)	
BMI	29.0 ± 7.2	31.1 ± 7.4	<0.001	30.2 ± 8.3	30.5 ± 6.9	0.570
BMI, categorical						
Underweight	53 (1.4)	6 (1.0)	<0.001	4 (0.8)	5 (1.0)	0.064
Healthy weight	1,176 (31.9)	128 (21.9)		151 (30.8)	113 (23.1)	
Overweight	1,101 (29.9)	151 (25.8)		123 (25.1)	132 (26.9)	
Obese	1,358 (36.8)	300 (51.3)		205 (41.8)	236 (48.2)	
Type of reconstruction						
Complex layered closure	214 (5.7)	30 (5.1)	<0.001	24 (4.9)	27 (5.5)	0.094
Tissue rearrangement	2,802 (74.5)	103 (17.4)		97 (19.8)	92 (18.8)	
Mammoplasty	718 (19.1)	458 (77.5)		363 (74.1)	371 (75.7)	
Pedicled flap	25 (0.7)	0 (0.0)		6 (1.2)	0 (0.0)	

surgery, GSR) (N = 3,759, 86.4%). For the remaining 591 patients (13.6%) the defect was reconstructed by plastic surgery (PSR) (Table 2).

Cohort Analysis before Propensity Score Matching

PSR patients were younger than GSR patients (56.0 ± 11.4 and 60.3 ± 12.7, respectively; $P < 0.001$) and had a higher BMI (31.1 ± 7.4 and 29.0 ± 7.2, respectively; $P < 0.001$). Of all PSR patients, almost 51.3% were classified as obese compared to 36.8% of GSR patients ($P < 0.001$). Furthermore, white race was slightly more prevalent in the PSR cohort than that of GSR (86.8% and 80.8%, respectively; $P < 0.001$). Although both groups did not differ significantly for most comorbidities, patients who underwent PSR were more likely to suffer from hypertension requiring medication ($P = 0.007$) and GSR patients were more likely to be smokers ($P = 0.019$). There was no difference in the 5-factor frailty index between the 2 groups ($P = 0.061$). The type of reconstruction performed differed significantly between the 2 groups ($P < 0.001$). General surgeons preferred reconstruction of the breast by means of tissue rearrangement (74.5%) whereas plastic surgeons performed more mammoplasty procedures, including mastopexy, reduction mammoplasty, and breast reconstruction procedures classified as "other technique" within the ACS-NSQIP data set (77.5%) ($P < 0.001$). Patient demographics and preoperative risk factors are detailed in Tables 3 and 4, respectively.

Propensity Score Matched Cohort Analysis

Propensity score matching resulted in 490 patients per cohort available for analysis. No noteworthy covariate imbalances were identified in the bias analysis. The density plots for propensity scores before and after matching can be found in Figure 2. The propensity score-matched groups were well balanced for all demographics and preoperative risk factors. A detailed description can be found in Tables 2 and 3, respectively.

Analysis of the 2 cohorts showed longer operating time (minutes) in the PSR group compared to GSR group (GSR 92.5 ± 59.9 versus PSR 151.5 ± 71.7; $P < 0.001$). A smaller percentage of PSR patients underwent same day discharge procedures (PSR 58.0% versus GSR 87.8%; $P < 0.001$). Overall complication rate, and the substratified rates of wound complication, mild systemic complication, and serious systemic complication rates did not differ significantly among the 2 groups. A more thorough description of operative and outcome variables can be found in Table 4.

DISCUSSION

This study aimed to compare NSQIP outcomes for oncoplastic reconstruction performed by 2 different surgical specialties. To control for confounding variables, propensity score matching was chosen over multivariate regression analysis. Propensity scoring allows for multivariable analysis without the risk of creating an overfitting regression model. In our study, propensity score matching generated 2 equally sized and balanced cohorts amenable to comparison. Propensity score matching has been shown to be "more robust and more precise" than logistic regression in studies where there were 6 or fewer events per confounder.[25]

As its principal focus, by analyzing a patient cohort extracted from the ACS-NSQIP data from 2005 to 2017, this study found no differences in 30-day complication rates between PSR and GSR. It is critical to highlight that the

Table 3. Preoperative Patient Characteristics and Data Are Expressed as n (%)

	Unadjusted Cohorts			Matched Cohorts		
	General Surgery Reconstruction	Plastic Surgery Reconstruction		General Surgery Reconstruction	Plastic Surgery Reconstruction	
Comorbidities	**N = 3,759**	**N = 591**	***P***	**N = 490**	**N = 490**	***P***
Diabetes						
Yes	466 (12.4)	67 (11.3)	0.465	48 (9.8)	53 (10.9)	0.599
Smoking status 1 year before surgery						
Yes	346 (9.2)	37 (6.3)	0.019	30 (6.1)	34 (6.9)	0.605
History of COPD						
Yes	94 (2.5)	10 (1.7)	0.232	10 (2.0)	9 (1.8)	0.817
Dyspnea at moderate exertion						
Yes	125 (3.3)	28 (4.7)	0.083	19 (3.9)	23 (4.7)	0.528
Hypertension requiring medication						
Yes	1,582 (57.9)	377 (63.8)	0.007	185 (37.8)	182 (37.1)	0.843
Chronic steroid use						
Yes	71 (1.9)	12 (2.0)	0.815	6 (1.2)	8 (1.6)	0.590
Bleeding disorder						
Yes	49 (1.3)	5 (0.8)	0.350	6 (1.2)	5 (1.0)	0.762
Dependent functional status preoperatively						
Yes	21 (0.6)	2 (0.3)	0.491	1 (0.2)	1 (0.2)	1.000
5-Factor frailty index						
0	2,043 (54.7)	349 (59.4)	0.061	296 (60.4)	286 (58.4)	0.437
1	1,267 (33.9)	190 (32.3)		152 (31.0)	165 (33.7)	
≥2	424 (11.3)	49 (8.3)		42 (8.6)	39 (8.0)	

goal of quantifying the performance of both surgical specialties was not to determine which service should perform oncoplastic surgery, but more to eliminate potentially unsubstantiated barriers for collaboration between general and plastic surgery in oncoplastic cases. Notably, these equivalent results should encourage general surgeons and plastic surgeons to further collaborate in the quest for the most optimal procedure in breast cancer care. Although we cannot confirm hospital volume through NSQIP data, these results could also serve as a foundation for broader guidelines in smaller hospitals that, for example, lack a plastic surgery service and rely solely upon general surgeons for oncoplastic procedures.

One finding of this study is the longer operating time in patients undergoing PSR. When striving for optimization of surgical outcomes, it is important to realize the influence of prolonged operative time whose detrimental effects have been described in literature for both general surgery and plastic surgery.[26–29] Hardy et al. found that the risk for developing a complication after plastic surgery increased by 21% for each additional hour of surgery.[28] In part, the increased operating time for PSR may be accounted for by the time spent on switching operative teams and in redraping the field. Another explanation might be the difference in techniques and indications for procedures and surgical approaches between general and plastic surgeons. Our analyses before propensity score matching support the notion that a majority of plastic surgeons will perform more complex procedures, including mastopexy and reduction mammoplasty, as compared to tissue rearrangement by their general surgeon counterparts. Being a fundamental principle of plastic surgery training, the emphasis placed on cosmesis and the subsequent use of advanced closure techniques may also contribute to additional operative time. However, this study could not corroborate such differences. Most importantly,

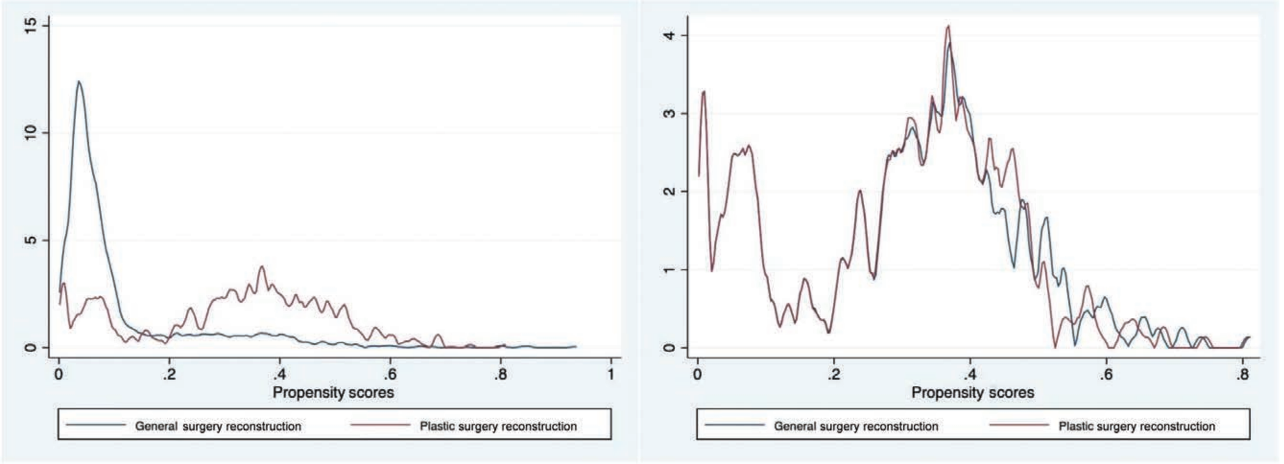

Fig. 2. Density plot of propensity scores, before (left) and after (right) matching.

Table 4. Outcomes and Data Are Expressed as n (%), for Categorical Variables, or Mean ± SD or Median (Min-Max), for Continuous Variables

	Unadjusted Cohorts			Matched Cohorts		
	General Surgery Reconstruction	Plastic Surgery Reconstruction		General Surgery Reconstruction	Plastic Surgery Reconstruction	
Surgical Outcome	N = 3,759	N = 591	P	N = 490	N = 490	P
Operation time (min)	78.9 ± 52.7	154.5 ± 75.7	<0.001	92.5 ± 59.9	151.5 ± 71.7	<0.001
Operating time (min), categorical						
<30	244 (6.5)	5 (0.8)	<0.001	36 (7.3)	2 (0.4)	<0.001
31–60	1,238 (33.0)	49 (8.3)		117 (23.9)	41 (8.4)	
61–90	1,150 (30.6)	64 (10.8)		136 (27.8)	58 (11.9)	
91–120	631 (16.8)	82 (13.9)		101 (20.6)	69 (14.1)	
121–150	271 (7.2)	111 (18.8)		44 (9.0)	95 (19.4)	
151–180	122 (3.2)	94 (15.9)		18 (3.7)	77 (15.7)	
>180	98 (2.6)	185 (31.4)		38 (7.8)	147 (30.1)	
Total length of stay (d)	0 (0–92)	0 (0–12)	<0.001	0 (0–11)	0 (0–5)	<0.001
Total length of stay (d), categorical						
Same day procedure	3,520 (93.7)	332 (56.2)	<0.001	430 (87.8)	284 (58.0)	<0.001
1	195 (5.2)	226 (38.2)		51 (10.4)	181 (36.9)	
2–10	34 (0.9)	32 (5.4)		7 (1.4)	25 (5.1)	
11–30	4 (0.1)	1 (0.2)		2 (0.4)	0 (0.0)	
>30	5 (0.1)	0 (0.0)		0 (0.0)	0 (0.0)	
Overall complication						
Yes	61 (1.6)	16 (2.7)	0.063	6 (1.2)	11 (2.2)	0.221
Wound complication						
Yes	43 (1.1)	12 (2.0)	0.073	5 (1.0)	8 (1.6)	0.402
Mild systemic complication						
Yes	11 (0.3)	3 (0.5)	0.391	1 (0.2)	2 (0.4)	1.000
Serious systemic complication						
Yes	7 (0.2)	1 (0.2)	0.928	0 (0.0)	1 (0.2)	1.000

this study found no association between prolonged operating time and increased complication rates. The length of stay was also longer in the PSR group. Nevertheless, in oncoplastic reconstruction, the length of stay might not be an objective outcome as it may be more influenced by hospital protocols or specialty guidelines than by actual necessity to remain hospitalized. Moreover, the logistics of schedule coordination between the 2 specialties need to be considered. This could be seen as a barrier for general surgeons to book cases together with plastic surgeons. For plastic surgeons, waiting for the resection portion of a procedure is also a disincentive. This also brings into question the availability of a plastic surgeon which has also helped to create the impetus for general surgeons to perform their own resections and reconstructions. Whether this is due to perceived and real opportunity costs incurred by the plastic surgeons, or the lack of plastic surgeons in the area, it is frequently cited by leaders of the American Society of Breast Surgeons as to some of the reasons, they need to train breast surgeons to perform oncoplastic reconstructions.[30]

This study should be interpreted in the context of its design and is not without limitations. Although powerful statistical tools, both the logistic regression and propensity score-matched analysis are unable to control for unmeasured confounders.[31] While propensity score matching mimics randomization, the decision of whether reconstruction is performed by a general surgeon or plastic surgeon is partly based on confounders that are not measured in NSQIP and could therefore not be accounted for within our model. For example, there may be reasons for general surgeons to be more willing to refer a patient to a plastic surgeon for the reconstructive portion of their procedure. This selection bias could be attributed to case complexity or surgeon experience. By including the type of reconstruction in our model for propensity score matching, we aimed to control for difficulty of the procedure. However, we have to acknowledge that unmeasured confounders, such as implicit surgeon preferences or established referral patterns based on patient complexities, could result in patient cohorts that might not be comparable, which would subsequently lead to unjustified equivalent outcomes. The lack of precision in procedure codes, in addition to NSQIP variable specifications, limit the scope of our findings. For example, we cannot confirm if procedures performed by a "general surgeon" were specifically performed by a fellowship-trained breast surgeon. Moreover, final pathology indicating a diagnosis of benign or malignant tumors may not always be available. Furthermore, by creating 2 equal patient cohorts through propensity score matching, a large number of general surgery patients were excluded. As the 2 final cohorts were each comprised of only 490 patients, our sample size could be considered too small to show a statistical difference in outcomes between the 2 groups. Still, some might argue the futility of inferring clinical relevance when the overall complication rate was less than 3%.

Additionally, due to the selection of patients based on CPT codes and criteria implemented to reduce confounders, such as the exclusion of bilateral surgery and multiple procedures, a relatively large number of patients were excluded. We cannot account for any bias that resulted from this patient selection.

More notably, NSQIP does not provide any follow-up beyond 30 days. As a result, aesthetic outcome and patient satisfaction could not be analyzed in this study. To justify choosing a treatment based on aesthetic outcome, knowing that there is no difference in complication rates is a crucial first step. However, we do acknowledge that patient satisfaction is a vital indicator for quality of care in breast reconstruction. A useful tool to identify patient satisfaction with outcomes are Patient-Reported Outcome Measures.[32] These validated questionnaires for patient experiences regarding surgical outcomes have been previously used to assess multiple different breast cancer treatment methods.[33,34] Despite these limitations, selecting a surgeon based on satisfaction and aesthetic outcome is only justified if postoperative complication rates are also comparable. For future studies, we suggest further research implementing Patient-Reported Outcome Measures to define potential patient-reported differences between GSR and PSR.

CONCLUSIONS

This analysis of a large NSQIP patient cohort demonstrates no differences in adverse postoperative outcomes between oncoplastic reconstructions performed by general surgeons or plastic surgeons despite the likelihood of more complex procedures being performed by the latter. These results support the collaboration between these 2 surgical specialties in oncoplastic breast care instead of exclusion of one. Further research is, however, needed regarding patient satisfaction and aesthetic outcomes.

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