Patient-Reported Quality of Life and Satisfaction With Cosmetic Outcomes After Breast Conservation and Mastectomy With and Without Reconstruction

Results of a Survey of Breast Cancer Survivors

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Objective: Although breast conservation is therapeutically equivalent to mastectomy for most patients with early-stage breast cancer, an increasing number of patients are pursuing mastectomy, which may be followed by breast reconstruction. We sought to evaluate long-term quality of life and cosmetic outcomes after different locoregional management approaches, as perceived by patients themselves.

Methods: We surveyed women with a diagnosis of nonmetastatic breast cancer from 2005 to 2007, as reported to the Los Angeles and Detroit population-based Surveillance, Epidemiology, and End Results registries. We received responses from 2290 women approximately 9 months after diagnosis (73% response rate) and from 1536 of these 4 years later. We evaluated quality of life and patterns and correlates of satisfaction with cosmetic outcomes overall and, more specifically, within the subgroup undergoing mastectomy with reconstruction, using multivariable linear regression.

Results: Of the 1450 patients who responded to both surveys and experienced no recurrence, 963 underwent breast-conserving surgery, 263 mastectomy without reconstruction, and 222 mastectomy with reconstruction. Cosmetic satisfaction was similar between those receiving breast conservation therapy and those receiving mastectomy with reconstruction. Among patients receiving mastectomy with reconstruction, reconstruction type and radiation receipt were associated with satisfaction ($P < 0.001$), with an adjusted scaled satisfaction score of 4.7 for patients receiving autologous reconstruction without radiation, 4.4 for patients receiving autologous reconstruction and radiation therapy, 4.1 for patients receiving implant reconstruction without radiation therapy, and 2.8 for patients receiving implant reconstruction and radiation therapy.

Conclusions: Patient-reported cosmetic satisfaction was similar after breast conservation and after mastectomy with reconstruction. In patients undergoing postmastectomy radiation, the use of autologous reconstruction may mitigate the deleterious impact of radiation on cosmetic outcomes.

Keywords: breast cancer, breast reconstruction, lumpectomy, quality of life, radiation therapy

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Randomized trials have established breast conservation as an equivalent alternative to mastectomy for most patients with early-stage breast cancer.[1] Nevertheless, a substantial minority of patients continue to receive mastectomy, a decision driven in some cases by patient preference and in others by contraindications to breast conservation.[2] Some studies indicate that in the United States, rates of unilateral[3,4] and bilateral[5] mastectomy are rising. The reason for the increased use of mastectomy is uncertain, although it seems to be driven by patient choice,[2] and some have suggested that improved cosmetic outcomes with modern techniques of breast reconstruction may contribute to this trend.[6] The long-term quality of life (QOL) and cosmetic outcomes after different approaches can thus be an important consideration for patients when selecting a local therapy option for breast cancer treatment.

The patient's perception of cosmetic outcomes is a critical endpoint,[7] and measures of self-reported cosmetic outcomes are now increasingly incorporated into breast cancer clinical trial design.[8,9] Although interest in patient-reported outcomes has grown in recent years,[10,11] to date, the literature lacks information on patient-reported satisfaction with cosmetic outcomes of breast cancer treatment after the early postoperative period, particularly among breast cancer survivors who have received their care in a variety of settings and with a variety of therapeutic approaches.

Therefore, in a sample of breast cancer survivors identified through 2 metropolitan population-based cancer registries, we sought to describe QOL and long-term patient-reported satisfaction with cosmetic outcomes after breast cancer treatment. Specifically, we compared outcomes among those receiving breast reconstruction after mastectomy with those undergoing mastectomy alone and those receiving breast-conserving therapy. We further considered, in the

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subset of patients receiving reconstruction, whether reconstruction type, timing, or patient characteristics were associated with cosmetic satisfaction. Because of the potential implications for clinical practice, we were particularly interested in evaluating the hypothesis that the influence of reconstruction type or timing on patient outcomes might differ in those patients who receive postmastectomy radiotherapy as compared with those who do not.

METHODS

Sample

We conducted a longitudinal, multicenter cohort study of women with a diagnosis of breast cancer in metropolitan Los Angeles and Detroit. Patients aged 20 to 79 years and with a diagnosis of stage 0-III breast cancer between June 2005 and February 2007, as reported to the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) population-based program registries in those regions, were eligible for sample selection.

Patients were excluded if they had stage IV disease or could not complete a questionnaire in English or Spanish. Asian women in Los Angeles were excluded because of enrollment in other studies, as SEER protocol precludes patients from participating in more than 1 external study. Latina and black patients were oversampled to ensure sufficient minority representation.

Questionnaire Design and Content

We developed original questionnaires after considering existing literature, measures previously developed to assess relevant constructs, and theoretical models.[12–15] We used standard techniques of content validation, including systematic review by design experts and cognitive pretesting with patients.

Data Collection

After institutional review board approval, eligible patients were identified via rapid case ascertainment. After notifying physicians, we first surveyed 3133 patients a mean of 9 months after diagnosis (time from diagnosis to baseline survey return: mean = 288 days, SD = 100). We then contacted all respondents approximately 4 years later to complete a follow-up survey (time from diagnosis to survey response: mean = 1524 days, SD = 143). To encourage response, we provided a $10 cash incentive at each survey point and used a modified Dillman[16] method, including reminders to nonrespondents, achieving 73% and 68% response rates, respectively. All materials were sent in English and Spanish to those with Spanish surnames.[17] Responses to the baseline and follow-up surveys were combined into a single data set, into which clinical data from SEER were merged. The evolution of the sample is detailed in Figure 1.

Measures

We measured QOL using the validated FACT instrument, administered in the baseline and again in the follow-up survey. Our other key dependent variables were 2 measures of patient-reported satisfaction with cosmetic outcomes: one asked of all patients, and one specific to patients who received breast reconstruction (both derived from existing measures[12–15]); both were ascertained only in the follow-up survey to avoid assessing cosmetic outcomes soon after surgery. As more fully described in Supplementary Digital Content Appendix (available at http://links.lww.com/SLA/A618), the first measure (Satisfaction With Breast Cosmetic Outcomes) was a scale derived from a battery of questions posed to all patients, regardless of surgery type, that began by asking, "In the past 7 days, how satisfied have you been with . . . " and included items for "how you look in the mirror clothed, the shape of your breast(s) when you are wearing a bra, the shape of your breast(s) when you are not wearing a bra, how normal you feel in your clothes, how comfortably your bras fit, and how you look in the mirror unclothed." The mean of the scale was 3.33 (SD = 1.02), with a minimum of 1 and maximum of 5. The Cronbach α was 0.90, indicating high internal consistency in this scale.

The second measure of satisfaction (Satisfaction With Reconstruction Outcomes) was asked only of patients who reported that they had undergone breast reconstruction. Patients were asked to rate, from 1 (*very dissatisfied*) to 5 (*very satisfied*), their satisfaction with the overall results of reconstruction, reconstructed breast size, how natural the reconstructed breast(s) look, how the reconstructed breast(s) feel to touch, and how closely matched their breasts are to each other. The average of these 5 items was used to construct the scale. The scale ranged from 1 to 5, with a mean of 3.64 (SD = 1.27). The Cronbach α was 0.91, indicating high internal consistency.

We considered several independent variables based upon our conceptual models. For analysis of the entire cohort, the key independent variable of interest was surgery type (breast conservation, mastectomy without reconstruction, or mastectomy with reconstruction). For analysis of the reconstructed subset, the key independent variables were reconstruction type (autologous tissue vs implant-based) and timing (immediate—at the same time as mastectomy vs delayed). We also evaluated a number of other independent variables for inclusion in the models, based on our conceptual framework of the factors believed to be relevant. This included clinical factors: SEER-reported tumor size (grouped in 10-mm increments) and nodal stage and self-reported adjuvant treatments (radiation and chemotherapy), laterality of the mastectomy (unilateral vs bilateral), comorbidities (grouped as 0, 1, and 2 or more of the following proxies for vascular risk: stroke, myocardial infarction, diabetes, or chronic obstructive pulmonary disease), smoking, body mass index, and bra cup size at the time of diagnosis. This also included several sociodemographic factors determined in the baseline questionnaire: age (continuous), race/ethnicity (non-Hispanic white, non-Hispanic black, Latina, or other), educational status (high school or less, some college, or college graduate), family income at diagnosis (<$20,000, $20,000–$70,000, >70,000, and unknown), insurance (none, Medicare, Medicaid, and other/private), and marital status (married or partnered vs not). Finally, we considered geographic site (Los Angeles vs Detroit) as an independent variable in the analyses.

Statistical Analyses

After initial descriptive analyses, we conducted a longitudinal evaluation of QOL by surgery type and used 2 separate multivariable linear regressions to model cross-sectional long-term satisfaction with cosmetic outcomes: one for all patients and one for patients who underwent reconstruction alone. To achieve parsimony of the regression models, we used a backward variable selection method to eliminate the variables that did not reach the statistical significance level of 0.10. However, we retained certain variables of particular interest in the models regardless of the statistical significance; these variables included the key independent variables being investigated in the models (surgery type in the first model, reconstruction type, and timing in the second) and control variables for age and the level of education for both models. In addition, driven by our hypotheses, we explored potential interactions between reconstruction type and radiation receipt and those between reconstruction timing and radiation receipt. Where evidence of meaningful interactions was observed, we investigated the difference among the 4 fully interacted subgroups in the regression model.

As detailed in Supplementary Digital Content Appendix (available at http://links.lww.com/SLA/A618), all statistical analyses incorporate weights to account for differential probabilities of sample

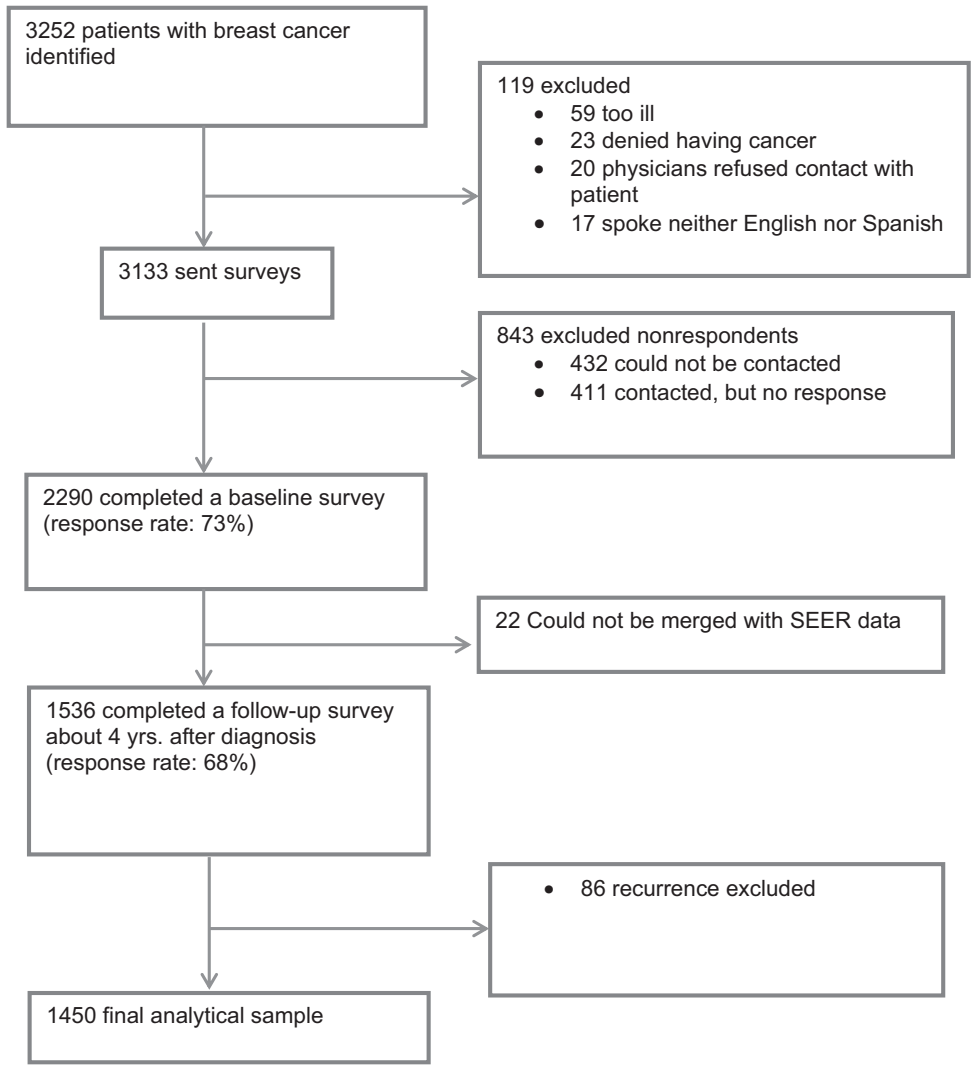

FIGURE 1. Patient flow into the study. It depicts the flow of patients into the study from those initially identified to the final analytic sample.

selection and nonresponse.[18] Weighting allows statistical inferences to be more representative of the target population. The jackknife resampling method was used to obtain estimates that are robust toward nonnormal distributions. All analyses used SAS software, version 9.3 (SAS Institute, Cary, NC), and R package, version 2.13 (Vienna, Austria).

RESULTS

A total of 1536 patients completed both questionnaires; 86 were excluded because of tumor recurrence, leaving 1450 patients for the analysis of satisfaction with cosmetic outcomes. Table 1 presents the sociodemographic and clinical characteristics of the analyzed sample, along with treatments received. Median age was 58 years. A substantial proportion of the sample was black (17.3%) or Latina (39.5%). Educational attainment was high school or less for 42.2% of the sample, and 54.1% had stage 0 or I disease. The majority of patients (n = 963; 63%) underwent breast-conserving therapy, with the remainder fairly evenly divided between mastectomy alone (n = 263) and mastectomy with reconstruction (n = 222).

Table 2 describes the QOL in our sample. We observed no significant differences in well-being by surgery type, except that there seemed to be a greater improvement in physical well-being by the time of the follow-up survey for patients who received mastectomy with breast reconstruction.

Table 3 presents a multivariable linear regression model of the scaled measure of Satisfaction With Breast Cosmetic Outcomes in the 1245 patients with complete variable information. Satisfaction was not significantly different between the group receiving breast conservation and the group receiving mastectomy with reconstruction with either implant technique or autologous technique. Satisfaction was slightly but significantly lower (0.38) (worse on a 5-point scale; 95% confidence interval, −0.56 to −0.20) in patients receiving mastectomy alone than those who received breast conservation. Other correlates of lower satisfaction were chemotherapy receipt, higher body mass index, smoking, and lower family income. As Figure 2

TABLE 1. Characteristics of Analyzed Sample (N = 1450)

Characteristic	Total		Mastectomy Without Reconstruction		Mastectomy With Reconstruction		Breast Conservation		*P**
	n†	Weight %‡	n	Weight %‡	n	Weight %‡	n	Weight %‡	
Patient characteristics									
Age at diagnosis									<0.001
<46	217	16.8	27	11.8	72	34.9	118	14.1	
46–55	411	27.3	50	19.7	90	38.5	271	27.2	
56+	816	55.7	186	68.5	60	26.6	568	58.4	
Missing	6	0.2	0	.	0	.	6	0.3	
Race									<0.001
White	714	43.3	111	36.7	122	46.9	481	44.8	
Black	362	17.3	66	18.1	38	11.5	256	18.1	
Latina, English-speaking	178	19.0	28	15.4	42	28.4	108	17.9	
Latina, Spanish-speaking	196	20.5	58	29.8	20	13.2	118	19.2	
Education									<0.001
High school or less	536	42.2	129	55.3	45	22.7	361	42.5	
Some college	487	31.0	67	20.7	89	42.6	331	31.8	
College graduate or more	403	24.7	63	22.2	87	34.5	253	23.3	
Missing	24	2.1	4	1.8	1	0.2	18	2.4	
Family income at the baseline survey									<0.001
<$20,000	246	18.6	67	24.9	17	7.4	162	19.2	
$20,000–$69,999	534	35.4	88	32.1	79	37.8	366	36.1	
$70,000+	407	25.5	47	16.1	99	41.8	261	24.9	
Missing	263	20.5	61	26.9	27	13.1	174	19.9	
Insurance									<0.001
None	85	7.9	26	12.0	13	6.2	46	6.9	
Medicaid	127	10.9	35	15.6	12	6.2	80	10.4	
Medicare	343	22.5	84	30.1	15	4.3	242	24.1	
Other	840	54.4	105	36.7	178	81.8	557	54.0	
Missing	55	4.3	13	5.7	4	1.5	38	4.6	
Marital status									0.057
Not married or partnered	611	41.7	123	44.9	72	33.3	415	42.5	
Married or partnered	828	57.4	138	54.4	150	66.7	539	56.3	
Missing	11	0.9	2	0.6	0	.	9	1.2	
Comorbidity									<0.001
0	1157	80.1	185	72.1	202	92.0	768	80.0	
1	227	15.5	58	19.5	15	5.6	154	16.6	
≥2	66	4.4	20	8.5	5	2.4	41	3.4	
Smoking history									0.582
No	1229	86.5	222	85.7	187	85.4	818	87.0	
Yes	207	12.3	38	12.7	35	14.6	134	11.6	
Missing	14	1.2	3	1.5	0	.	11	1.4	
BMI									<0.001
<25	408	29.7	71	27.5	89	44.8	248	26.8	
25–31	514	35.3	76	30.8	72	30.9	365	38.0	
>31	442	29.4	101	36.7	50	19.8	291	29.3	
Missing	86	5.6	15	5.1	11	4.5	59	5.8	
Prediagnosis bra cup size									0.312
A or B	436	30.2	89	31.7	79	37.2	268	28.1	
C	509	36.0	94	37.4	71	34.3	344	36.1	
D or greater	415	27.6	67	25.4	64	24.9	284	29.2	
Missing	90	6.1	13	5.5	8	3.6	67	6.7	
Geographic site									0.168
Los Angeles	794	79.0	160	82.4	115	78.2	518	78.1	
Detroit	656	21.0	103	17.6	107	21.8	445	21.9	
Tumor and treatment characteristics									
Stage									<0.001
0	366	18.6	37	9.5	62	20.5	267	21.3	
I	537	35.5	75	25.3	58	23.3	403	42.2	
II	411	33.9	92	38.8	72	39.9	247	30.8	
III	128	11.3	57	24.8	30	16.3	40	5.1	
Missing	8	0.7	2	1.6	0	.	6	0.6	

(*continued*)

TABLE 1. (*Continued*)

Characteristic	Total n†	Total Weight %‡	Mastectomy Without Reconstruction n	Mastectomy Without Reconstruction Weight %‡	Mastectomy With Reconstruction n	Mastectomy With Reconstruction Weight %‡	Breast Conservation n	Breast Conservation Weight %‡	*P**
Bilateral mastectomy									<0.001
No	1302	89.2	225	85.3	153	68.8	924	95.8	
Yes	110	8.1	25	10.4	67	30.7	18§	1.7	
Missing	38	2.8	13	4.3	2	0.5	21	2.5	
Radiation receipt									<0.001
Yes	1007	67.6	84	35.6	60	27.5	863	88.8	
No	387	29.7	162	60.7	160	71.8	64	8.4	
Missing	56	2.7	17	3.7	2	0.6	36	2.8	
Chemotherapy receipt									<0.001
Yes	659	52.1	158	63.9	120	65.0	380	44.8	
No	737	45.6	98	34.9	100	34.3	539	52.3	
Missing	54	2.2	7	1.2	2	0.7	44	2.9	

**P* value represents significance of differences in covariate by surgery subgroup.
†Number and weighted % values do not add up to 1450 (100%) because of missing values.
‡Weighted % values weighted by disproportionate survey sampling and nonresponse.
§A small number of patients who initially had breast-conserving therapy went on to have bilateral mastectomy by the time of the 4-year survey; 12 of those underwent this so to prevent future breast cancer and 6 did so for contralateral cancer diagnosis.
BMI indicates body mass index.

TABLE 2. Quality of Life as Measured by FACT*

	Mastectomy, No Reconstruction Mean	Mastectomy, No Reconstruction SE	Mastectomy With Reconstruction Mean	Mastectomy With Reconstruction SE	Breast Conservation Mean	Breast Conservation SE	*P*
Physical well-being							
T1	24.13	0.74	23.67	0.83	23.68	0.54	0.09
T2	25.82	0.61	26.94	0.60	26.06	0.44	0.34
Change	3.91	0.51	5.22	0.50	4.17	0.37	0.02
Social well-being							
T1	22.04	0.56	22.79	0.62	21.98	0.42	0.30
T2	19.56	0.50	20.50	0.54	20.00	0.38	0.24
Change	− 2.21	0.41	− 1.69	0.47	− 1.81	0.30	0.49
Emotional well-being							
T1	18.78	0.73	18.73	0.70	19.61	0.42	0.13
T2	20.62	0.46	20.81	0.51	20.86	0.37	0.83
Change	1.47	0.40	1.68	0.45	1.65	0.33	0.85
Functional well-being							
T1	21.76	0.79	21.05	0.78	22.60	0.79	0.10
T2	21.31	0.69	22.13	0.69	21.66	0.48	0.51
Change	2.02	0.60	2.65	0.65	1.86	0.46	0.31

*All means are adjusted means based on models that control for potentially significant confounders. Means are calculated at mean levels of body mass index, age, in non-Hispanic white patients who receive radiation but not chemotherapy, who lack major cardiovascular comorbidities, are nonsmokers, have high school or lower level of education, other/private insurance, tumor size >10 and ≤20 mm, and negative lymph nodes.
FACT indicates Functional Assessment of Cancer Therapy; SE, standard error.

details, on the 5-point Satisfaction With Breast Cosmetic Outcomes scale, the adjusted scaled satisfaction score was 3.4 for patients receiving breast conservation, 3.6 for those receiving mastectomy with autologous reconstruction, 3.3 for patients receiving mastectomy with implant reconstruction, and 3.0 for patients receiving mastectomy without reconstruction.

Of the 222 patients who received mastectomy and reconstruction, 200 had complete variable information and were further evaluated. There were 53 patients who received radiation therapy (among whom 54% had received reconstruction with autologous technique and 48% had delayed timing of reconstruction) and 147 who did not (among whom 23% had received reconstruction with autologous technique and 29% had delayed timing of reconstruction).

Table 4 presents a linear regression model of the scaled measure of Satisfaction With Reconstruction Outcomes in patients who received mastectomy and reconstruction. We observed a substantial and statistically significant difference among 4 groups formed by the type of reconstruction procedure and receipt of radiation. In particular, patients who received implants with radiation had a markedly lower satisfaction than the patients in all other subgroups. The pattern across subgroups also suggested that satisfaction was higher for patients who received autologous reconstruction and those who did not receive radiation. As Figure 3 details, on the 5-point Satisfaction

TABLE 3. Linear Regression Model of Satisfaction With Breast Cosmetic Outcomes* (N = 1245†)

Characteristic	Estimated Coefficient	SE	95% CI	*P*
Intercept	3.41	0.13	3.15 to 3.67	<0.001
Surgical treatment				0.0002
Mastectomy without reconstruction	−0.38	0.093	−0.56 to −0.20	
Mastectomy with autologous reconstruction	0.21	0.16	−0.093 to 0.52	
Mastectomy with implant reconstruction	−0.12	0.13	−0.38 to 0.14	
Breast conservation	0	0	0 to 0	
Chemotherapy	−0.16	0.071	−0.30 to −0.017	0.028
BMI‡	−0.027	0.006	−0.038 to −0.016	<0.0001
Smoking	−0.26	0.11	−0.46 to −0.048	0.016
Age§	0.003	0.003	−0.004 to 0.010	0.42
Education				0.23
High school or less	−0.14	0.093	−0.33 to 0.038	
Some college	−0.11	0.082	−0.28 to 0.049	
College or more	0	0	0 to 0	
Race				0.093
White (non-Latina)	0	0	0 to 0	
Black	0.20	0.084	0.039 to 0.37	
Latina (English-speaking)	0.015	0.097	−0.18 to 0.21	
Latina (Spanish-speaking)	0.010	0.12	−0.22 to 0.24	
Family income at diagnosis				0.011
<$20,000	0	0	0 to 0	
$20,000–$70,000	0.20	0.11	−0.023 to 0.43	
>$70,000	0.054	0.13	−0.19 to 0.30	
Unknown	0.34	0.13	0.092 to 0.60	

*Satisfaction with cosmetic outcomes was measured by an interval scale derived the mean of 6 items, as described more fully in the methods section. Mean (SD) of the scale was 3.33 (1.02), with a minimum of 1 and maximum of 5. The Cronbach α was 0.90.

†Measured in all patients, but 205 patients were not included because of missing values either in dependent or independent variables.

‡BMI centered about 30, such that every 1-unit increase in BMI results in an average of a 0.02-unit decrease in satisfaction, and each 1-unit decrease BMI below 20 results in a 0.02-unit increase in satisfaction.

§Age centered about 60, such that every 1-year increase in age results in an average of a 0.003-unit increase in satisfaction, and each 1-year decrease in age below 60 results in a 0.003-unit decrease in satisfaction.

BMI indicates body mass index; CI, confidence interval; SE, standard error.

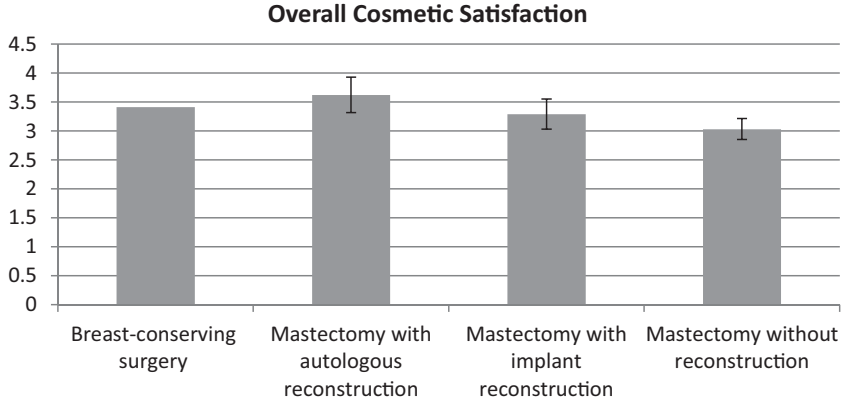

FIGURE 2. Satisfaction with breast cosmetic outcomes by surgery type. It depicts adjusted scores on the scaled measure of satisfaction with breast cosmetic outcomes by the type of surgery received, based on results from the model described in Table 3. Error bars represent 95% confidence intervals in comparison with the reference group (breast-conserving therapy). Satisfaction with breast cosmetic outcomes was measured by an interval scale derived the mean of 6 items, as described more fully in the "Methods" section. Mean (SD) of the scale was 3.33 (1.02), with a minimum of 1 and maximum of 5. The Cronbach α was 0.90.

With Reconstruction Outcomes scale, the adjusted scaled satisfaction score was 4.7 for patients receiving autologous reconstruction without radiation therapy, 4.4 for patients receiving autologous reconstruction and radiation therapy, 4.1 for patients receiving implant reconstruction without radiation therapy, and 2.8 for patients receiving implant reconstruction and radiation therapy. Thus, patients who received radiation and implant-based reconstruction had significantly lower satisfaction than those in the other 3 groups (those who received implant reconstruction without radiation, and those undergoing autologous reconstruction with or without radiation). We observed no significant association between timing of reconstruction and satisfaction with reconstruction outcomes, nor did we observe a significant interaction between timing and radiation receipt.

DISCUSSION

In this large sample of breast cancer survivors identified through metropolitan population-based registries, we found that QOL and long-term satisfaction with the cosmetic outcomes of breast cancer treatment overall were quite high. Breast reconstruction resulted in a level of patient-reported satisfaction with cosmetic outcomes in patients undergoing mastectomy that was statistically indistinguishable from that of patients who received breast-conserving therapy.

TABLE 4. Linear Regression Model of Satisfaction With Reconstruction Outcomes* (N = 200†)

Characteristic	Estimated Coefficient	SE	95% CI	*P*
Intercept	4.10	0.40	3.30 to 4.89	<0.001
Reconstruction type and radiation status				<0.001
Autologous no radiation	0.63	0.24	0.16 to 1.11	
Autologous with radiation	0.29	0.27	−0.24 to 0.82	
Implant no radiation	0	0	0 to 0	
Implant with radiation	− 1.32	0.34	−1.99 to −0.65	
Reconstruction timing				0.997
Immediate	0.00	0	0 to 0	
Delayed	0	0.22	−0.43 to 0.43	
Age‡	− 0.03	0.01	−0.05 to −0.01	0.015
Married/partnered	− 0.47	0.20	−0.86 to −0.07	0.021
Education				0.314
High school or less	− 0.26	0.24	−0.73 to 0.22	
Some college	− 0.33	0.22	−0.76 to 0.11	
College or more	0	0	0 to 0	
Insurance				0.033
Medicare	0.83	0.62	−0.38 to 2.05	
Medicaid	− 1.18	0.57	−2.30 to −0.06	
Other	− 0.25	0.28	−0.80 to 0.30	
None	0	0	0 to 0	

*Satisfaction with reconstruction outcomes was measured by an interval scale derived by the mean of 5 items, as described more fully in the "Methods" section. Mean (SD) of the scale was 3.64 (1.27), with a minimum of 1 and maximum of 5. The Cronbach α was 0.91.

†Measured in patients who received breast reconstruction; 22 patients were not included because of missing values in dependent or independent variables.

‡Age centered about 60, such that every 1-year increase in age results in an average of a 0.02-unit decrease in satisfaction, and each 1-year decrease in age below 60 years results in a 0.02-unit increase in satisfaction.

BMI indicates body mass index; CI, confidence interval; SE, standard error.

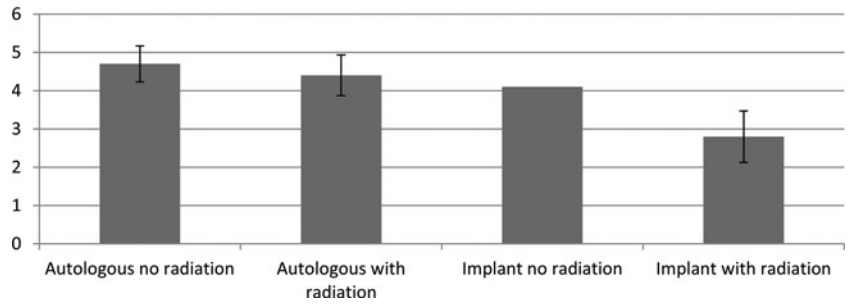

FIGURE 3. Satisfaction with outcomes of breast reconstruction by reconstruction type and receipt of radiation therapy. It depicts adjusted scores on the scaled measure of satisfaction with reconstruction outcomes, as measured in patients receiving breast reconstruction with various approaches, based on results from the model described in Table 4. Error bars represent 95% confidence intervals in comparison to the reference group (implant no radiation). Satisfaction with reconstruction outcomes was measured by an interval scale derived the mean of 5 items, as described more fully in the "Methods" section. Mean (SD) of the scale was 3.64 (1.27), with a minimum of 1 and maximum of 5. The Cronbach α was 0.91.

Among patients undergoing breast reconstruction, satisfaction with outcomes of reconstruction at 4 years was higher in patients receiving autologous reconstruction and lower in patients receiving postmastectomy radiation therapy. Moreover, the differences in satisfaction between the locoregional treatment subgroups postmastectomy were substantial: patients who received autologous reconstruction without radiation reported on average that they were very satisfied (score 4.7/5), whereas those who received implants with radiation reported on average that they were dissatisfied (score 2.8).

Previous studies, primarily conducted in centers of excellence or in the context of clinical trials, have suggested that the vast majority of patients treated with breast-conserving therapy in those settings have good or excellent cosmetic outcomes.[19] The aesthetic results of breast conservation reflect the size and location of the surgical defect and scar and also late radiation changes to the skin.[20–22] Breast edema, which results from both surgery and radiation therapy, resolves in time for most patients but may persist for years.[23,24] Fibrosis, again due to the interplay of surgical wound healing and reaction to radiotherapy, tends to manifest 6 to 18 months after treatment and may progress over time.[25] Among patients who do experience significant asymmetry as a result of such changes, QOL has been shown to be reduced.[26] Therefore, we found it particularly important in the current study to document the patient-reported QOL and cosmetic outcomes in a population of survivors treated in a broader variety of settings, at a time point after acute posttreatment changes have resolved. Our findings of high patient-reported satisfaction and few differences in QOL in this context are reassuring and do not support the notion that the recently observed increases in the rates of bilateral mastectomy for unilateral cancer are justified by poor cosmetic outcomes after breast-conserving therapy.

Our findings that the outcomes of breast reconstruction are similar to those of breast conservation, as experienced by patients treated in a variety of settings within 2 large and diverse metropolitan regions of the United States, are also reassuring. These findings

complement existing literature seeking to identify best practices and approaches toward reconstruction. For example, in one of the only multicenter studies of reconstruction outcomes reported from a US sample, aesthetic satisfaction at 2 years was higher in patients who had received autologous tissue-based reconstruction rather than implant techniques[15] and these differences seemed to increase over time.[27] Our findings support the idea that the use of autologous techniques for reconstruction is associated with improved satisfaction. In addition, in a population where a minority of women had contralateral prophylactic mastectomy, the high level of satisfaction with cosmetic outcomes and lack of significant association between receipt of bilateral mastectomy and satisfaction support the findings of a single-institution patient survey, in which no differences in satisfaction were observed between patients undergoing unilateral and bilateral mastectomy,[28] suggesting that contralateral prophylactic mastectomy is not necessary to achieve a good cosmetic outcome with breast reconstruction.

The impact of radiation therapy on breast reconstruction is a subject of considerable interest.[29,30] Radiation toxicity, including skin changes, vascular compromise, and fibrosis, can compromise the viability and cosmesis of the reconstruction and may require repeated interventions for correction. Previous retrospective studies have suggested that regardless of the type of reconstruction, radiation compromises cosmetic outcomes.[31–36] Our results not only support this idea but also suggest that autologous techniques may mitigate some of the deleterious impact of radiotherapy on cosmetic outcomes. Taken together, this evidence supports counseling women in whom it is evident at the time of initial surgical evaluation that postmastectomy radiotherapy is likely to be necessary (those with a larger primary tumor or clinically positive nodes) about the potential for a suboptimal cosmetic outcome with reconstruction under this clinical scenario. Those who are candidates for breast conservation may reasonably choose to pursue that option instead.

The optimal approach to breast reconstruction in patients who do receive mastectomy and require postmastectomy radiotherapy for disease control continues to generate debate.[37] Complications in implant patients who receive radiotherapy include scarring, capsular contracture, infection, pain, skin necrosis, fibrosis, and impaired wound healing.[31–34] Still, some institutions have reported excellent results using relatively uniform and carefully controlled approaches toward implant reconstruction in the setting of radiotherapy.[38,39] Women undergoing radiation after autologous reconstruction face increased risks of fat necrosis, fibrosis, atrophy, and flap contracture.[35,36] However, some clinicians believe that patients receiving radiation therapy may have better outcomes after autologous reconstruction than after implants[40] and have demonstrated good outcomes with such approaches.[41] However, estimates of the frequency of complications with different techniques and different sequences of radiation and reconstructive procedures have varied widely between different institutional series, and there is considerable need for patient-reported outcomes data from patients treated across practices in the community. The current study begins to address this need, and its findings suggest that autologous approaches may indeed be superior in patients who receive radiotherapy. Its findings also suggest, consistent with other studies on utilization of reconstruction,[42] that autologous techniques may be used more frequently in patients receiving radiation therapy than those who do not, but a substantial proportion of patients receiving radiation therapy do receive implants.[42]

Nevertheless, it is also important to consider limitations of this study. Of note, the number of patients who received reconstruction in this sample was substantial but not extremely large. Therefore, the lack of an observation of a statistically significant interaction between radiation receipt and timing of reconstruction is not evidence of the absence of such an effect. Given the sample size, the power to detect interaction effects was limited, and there may well be a differential impact of reconstruction timing in patients who received radiation therapy that this study was unable to detect. This does not, however, undercut the importance of findings such as the positive effect of autologous reconstruction on satisfaction, particularly in patients receiving radiotherapy. Still, given the number of patients receiving breast reconstruction in the overall sample, additional studies should be conducted to further validate these results. It is also important to note that as in all observational studies, associations may not indicate causation; however, given the impracticality of randomized trials to investigate these issues in the modern era, careful observational analysis may nevertheless yield insights. We have taken care to consider potential confounding factors and to obtain responses from a broad and more generalizable population than that achieved in single-institution studies. We cannot, however, control for the possibility that women electing breast reconstruction may have had greater baseline dissatisfaction with their breast size or shape.

CONCLUSIONS

The findings of this study provide reassuring evidence that QOL and satisfaction with cosmetic outcomes among breast cancer survivors overall are high. These results suggest that breast reconstruction allows patients undergoing mastectomy to have long-term satisfaction similar to that of patients undergoing breast conservation. Our findings regarding the deleterious impact of radiation on satisfaction after breast reconstruction may have implications for patient decision making, and the potential impact of autologous reconstruction in mitigating this effect merits further confirmation in independent, multicenter data sets. Patients' decisions about whether to pursue reconstruction and the specific type and timing of reconstruction should ideally be informed by rigorous, multicenter outcomes data such as those provided in this study.

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