Are Breast Cancer Outcomes Compromised by General Surgical Resident Participation in the Operation?

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OBJECTIVE: The effect of surgery resident participation on breast cancer recurrence has not been previously reported. The objectives of this study were to determine if resident participation was associated with either immediate postoperative or long-term breast cancer outcomes.

DESIGN: We retrospectively reviewed a prospectively collected breast center database to identify all patients with breast cancer undergoing surgery in a single center during a 9-year period ending 1 January 2010. Patients were divided into 2 groups based on whether surgery residents completed more than 50% of the critical portions of the case (Resident group) or not. The outcomes of operation length, reoperative rates, morbidity, and the long-term outcomes of cancer recurrence were compared by group. Comparisons of immediate postoperative outcomes were made with chi-square and Fisher exact tests. Comparisons of operation length were analyzed by Wilcoxon rank-sum testing. Survival analyses were calculated using the Kaplan-Meier method with log-rank comparison. Multivariate analysis with Cox regression was also performed.

SETTING: The study occurred at a community-based hospital that has an accredited general surgery training program.

PARTICIPANTS: In all, 1107 consecutive patients with stage 0–3 breast cancer undergoing breast cancer operations were included.

RESULTS: Median age of patients was 64 years (range: 24-97). Median and longest follow-up were 5.5 and 12.5 years, respectively. Initial operation was breast conserving in 796 (72%) and mastectomy in 311 (28%). Of the 1107 patients, 887 (80.1%) had resident participation. The Resident group was associated with longer operative times. We identified no differences in operative morbidity, reoperations, overall survival, disease-free survival, or local-regional recurrence in the Resident and No Resident groups.

CONCLUSIONS: Resident involvement in breast cancer operations was associated with longer operative times but did not affect any other perioperative or cancer outcome in our institution. This information can be used to reassure program directors, attending surgeons, and patients if they have questions or concerns about the safety or effectiveness of cancer surgery when there is surgical resident participation. (J Surg 72:1109-1117. © 2015 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: breast cancer, breast surgery, surgical residents, resident education

COMPETENCIES: Patient Care, Interpersonal and Communication Skills, Practice-Based Learning and Improvement

INTRODUCTION

Surgical resident training has changed dramatically in the last decade. These changes include but are not limited to work-hour restrictions, simulation laboratories, and the "Milestones" project, a methodology for yearly measurement of resident competency.[1-3] During this evolution, the

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importance of resident involvement in actual operations remains constant. Resident competence in the operating room has historically been determined by operative volume, diversity of case type, and staff surgeon observations. All are surrogate measures of performance. There has been an assumption that so long as residents have completed a minimally acceptable number and type of cases, they are technically prepared for graduation and independent surgical practice. Attestation of adequate technical skills, based primarily on qualitative narratives supplied by staff surgeons, followed by residency program director review is also necessary. To date, no resident-specific benchmarks for performance metrics regarding surgical or oncologic outcomes have been required. Recent changes, such as the surgical Milestones, were developed to provide a more objective and graduated assessment of resident performance.[1] Milestones describes specific levels of performance that must be achieved annually for advancement. It also requires the resident to track his or her patient outcomes, emphasizing the importance of life-long self-assessment and improvement. As resident competency must be established before graduation, long-term patient outcomes, such as cancer recurrence after resections, are not a suitable Milestones measurement for competency. Hence, the usual resident-specific postoperative outcome measurements under development are largely related to 30-day morbidity and mortality.[2,3]

It is intuitive that a patient with breast cancer may wonder whether resident involvement in the operating room affects either their immediate complication rate or their cancer outcome. They may question surgical resident competency or even the appropriateness of active resident participation. Key measures of importance to patients are not restricted to the immediate complications of their operation. Patients are concerned about cancer recurrence and other long-term outcomes.[4] The primary aim of our study was to determine whether surgical resident participation in breast cancer operations was associated with any difference in these longer term patient outcomes. The secondary aims were to assess whether the presence of residents affected the safety or technical proficiency of operations as measured by postoperative morbidity, unplanned reoperations, re-excisions after lumpectomy, number of sentinel and axillary nodes retrieved, length of operation, and cosmetic outcome.

METHODS

After Gundersen Health System Institutional Review Board approval of the study protocol, we retrospectively reviewed a prospectively collected database to identify all patients with stage 0-III breast cancer undergoing surgery in our medical center during the 9 years before 1 January, 2010. Patient subject inclusion was stopped at this time to allow sufficient follow-up time for cancer recurrence. All patient information in our prospective database was verified with retrospective review of paper or electronic medical records. Patients were excluded from study if they were male, underwent neoadjuvant therapy, received their initial cancer treatment elsewhere, or had bilateral synchronous breast cancer, prior breast cancer, or major flap reconstruction.

Study patients were treated in a 325-bed tertiary-care nonprofit teaching hospital. The hospital has an associated general surgical residency program. The structure and outcomes of breast care and the residency program at this institution have been previously described.[5,6] All breast cancer operations were performed by 1 of 2 breast surgeons (J.L./J.M.J.) and were open to resident participation, with no restrictions based on type or complexity of operation or resident program year. Owing to competing demands on resident time, however, not all operations had resident participation. In the absence of resident participation, operations were performed by staff surgeons with surgical assistants.

The degree of resident participation in specific operations was based on staff surgeon assessment, aided by department guidelines describing postgraduate year (PGY) of training and appropriate case types. The resident was designated the responsible surgeon for a case if the staff surgeon deemed that the resident had completed more than 50% of the critical portions of the case. If so, the resident was required to dictate the operative note. This was an established department policy during the years of this study. The policy aided the auditing of resident case number and case type to ensure adequacy of resident volume and exposure at each level of training. Attending surgeons and residents were compliant with this policy. Attending surgical staff were present for all operations.

Eligible patients were divided into two groups: those whose operative notes were dictated by surgical residents (*Resident as primary surgeon* group), and those whose operative notes were dictated by staff surgeons (*No Resident as primary surgeon* group). The No Resident group included patients with no resident present and patients with a general surgery and/or transitional resident present and assisting but not performing critical elements of the case as determined by the staff surgeon. Data regarding patient and tumor characteristics and treatment factors known to influence cancer outcomes were collected (Table 1). The primary study outcomes included overall survival (OS), disease-free survival (DFS), local-regional recurrence (LRR), and ipsilateral breast tumor recurrence (IBTR) in patients who underwent breast-conserving therapy. Survival analyses were performed by Kaplan-Meier curves with log-rank tests stratifying OS, DFS, LRR, and IBTR. Significant results were further assessed using a multivariate analysis method (Cox regression), adjusting for other factors, including but not limited to age, tumor size, stage, lymph node status, histology, type of anesthesia, and type of operation

TABLE 1. Characteristics of Patients With Breast Cancer and Tumor Stratified by Surgical Resident Participation in Operation

Patient Characteristics	No Resident ($n = 260$)	Resident ($n = 847$)	Total ($N = 1107$)	p Value
Age, years				0.3382
Mean (SD)	63.1 (12.3)	63.5 (13.3)	63.4 (13.2)	
Range	29-90	24-97	24-97	
Age group, years				0.6698
<40	7 (0.6)	24 (2.2)	31 (2.8)	
40-49	34 (3.1)	120 (10.8)	154 (13.9)	
50-59	60 (5.4)	189 (17.1)	249 (22.5)	
60-69	75 (6.8)	209 (18.9)	284 (25.7)	
70+	84 (7.6)	305 (27.5)	389 (35.1)	
Tumor size, mm, mean (SD)	18.2 (13.9)	18.1 (14.8)	18.1 (14.6)	0.2017
Tumor stage				0.2491
Tis	38 (3.4)	112 (10.1)	150 (13.5)	
T1	154 (13.9)	549 (49.6)	703 (63.5)	
T2	58 (5.2)	157 (14.2)	215 (19.4)	
T3/T4	9 (0.8)	27 (2.4)	36 (3.2)	
X	0 (0)	2 (0.2)	2 (0.2)	
Missing	1 (0.1)	0 (0)	1 (0.1)	
Lymph node				0.1312
Positive	51 (4.6)	189 (17.1)	240 (21.7)	
Negative	208 (18.8)	658 (59.4)	866 (78.2)	
Not sampled	1 (0.1)	0 (0)	1 (0.1)	
Stage				0.3462
0	37 (3.3)	113 (10.2)	150 (13.5)	
I	135 (12.2)	459 (41.5)	594 (53.7)	
II	74 (6.7)	222 (20.1)	296 (26.7)	
III	13 (1.2)	53 (4.8)	66 (6)	
Missing	1 (0.1)	0 (0)	1 (0.1)	
Histology				0.3666
Ductal carcinoma in situ	40 (3.6)	123 (11.1)	163 (14.7)	
Invasive ductal carcinoma	51 (4.6)	218 (19.7)	269 (24.3)	
Invasive lobular carcinoma	18 (1.6)	60 (5.4)	78 (7.0)	
Ductal carcinoma in situ + other tumor type	149 (13.5)	441 (39.8)	590 (53.3)	
Other	2 (0.2)	5 (0.5)	7 (0.7)	
Histological grade for invasive				0.1884
I	65 (6.9)	236 (25.2)	301 (32.1)	
II	96 (10.3)	343 (36.6)	439 (46.9)	
III	55 (5.9)	142 (15.1)	197 (21)	
Estrogen receptor				0.2444
Positive	207 (18.7)	707 (63.9)	914 (82.6)	
Negative	35 (3.2)	101 (9.1)	136 (12.3)	
Not Performed	18 (1.6)	39 (3.5)	57 (5.1)	
Progesterone receptor				0.3182
Positive	197 (17.8)	665 (60.0)	862 (77.8)	
Negative	45 (4)	143 (12.9)	188 (16.9)	
Not performed	18 (1.6)	39 (3.5)	57 (5.1)	

All values are number of patients (percent) unless otherwise indicated.

(mastectomy/lumpectomy). Backward elimination method was used to eliminate insignificant variables at alpha level of 0.05.

Patient and tumor characteristics and cosmetic outcomes in the Resident as primary surgeon vs No Resident as primary surgeon groups and the Senior Resident vs Junior Resident groups were compared using univariate analysis. For univariate analysis, we compared categorical variables using chi-square (or Fisher exact test when expected cell frequencies are <20%). For continuous variables, we compared medians using Wilcoxon Rank-Sum and Kruskal-Wallis test. Alpha level used in our study was 0.05. For comparisons by PGY of resident as primary surgeon, the residents were grouped as "junior residents" (PGY 1-3) and "senior residents" (PGY 4 and 5). Resident association with the secondary study outcomes of operative morbidity and technical proficiency was also studied to include length of operation, surgical site infection, reoperation rates, re-excision rates after initial lumpectomy for cancer, number of sentinel nodes harvested, number of axillary nodes excised during full dissections, and cosmetic outcome. Early cosmetic outcome, within 30 days of operation, in patients undergoing breast-conserving

surgery by an author was assessed prospectively by breast specialty registered nurses during a 2-year time period ending 2009 using a 4-point Likert-type scale of "excellent, good, fair, and poor." No cosmetic result in the "poor" category was identified and only 1 patient was in the "fair" category; hence this patient was placed in a "good-fair" category; subsequently, comparison of cosmetic outcome by resident presence was also determined in our analysis. The cosmetic outcome score assigned by the nurse was based on scar appearance, volume defects, and symmetry. It was not based on wound "complications." The length of operation was measured in minutes and we reported differences in medians of the duration of operation length by resident presence and resident year of training.

RESULTS

In all, 1107 patients met study criteria. Of these, 847 (77%) were in the Resident group, and 260 (23%) were in the No Resident group. Excluding "transitional" (nongeneral surgical) residents rotating through the Department of Surgery, there were 435 "senior" and 304 "junior" general surgery residents. Median age was 64 years (range: 24-97 years). Median and longest follow-up were 5.5 and 12.5 years, respectively. Patient and tumor characteristics were not significantly different between groups by univariate analysis (Table 1). Initial operation was breast conserving in 796 (72%) and mastectomy in 311 (28%). Although 30-day postoperative mortality was nil, 42 patients died of breast cancer (crude mortality 3.8%) during long-term follow-up and 34 (3%) patients had LRR. Median survival time was not reached.

OS was better in the No Resident group compared with the Resident group (Fig. 1), although DFS, LRR, and IBTR were not significantly different between groups (Figs. 2-4). The results of a multivariate analysis with Cox regression adjusted for cofactors (see section Methods), however, showed that resident involvement was not a significant predictor for any of the survival outcomes (OS, DFS, LRR, and IBTR).

Secondary study outcomes of postoperative complications and reoperations for the entire patient cohort are detailed in Table 2. Two hundred and two (18.3%) of 1107 patients undergoing lumpectomy or mastectomy in the study underwent reoperation for any reason, either a complication or an inadequate margin. One hundred and eighty seven (23.5%) of 796 lumpectomy patients underwent re-excision for close or positive margins. There was no difference in re-excision rate after lumpectomy stratified by resident as the primary surgeon or by PGY level of resident training. Additional results and comparisons of early postoperative outcomes to include measures of technical proficiency by resident as primary surgeon and by resident level of training are shown, respectively, in Tables 3 and 4. The initial analysis of all 1107 patients demonstrated 143 (16.9%) of 847 patients with resident participation and 59 (22.7%) of 260 without residents ($p = 0.034$) underwent reoperation for any reason (operative complication and/or re-excision for margins). However, in subsequent subanalysis, excluding transitional residents, no differences in reoperations were identified in 999 patients for the comparison of "No Resident" to "Junior" to "Senior Resident" groups (Table 4).

There were no significant differences by resident presence or resident level of training for re-excisions after lumpectomy, surgical site infection, number of sentinel lymph

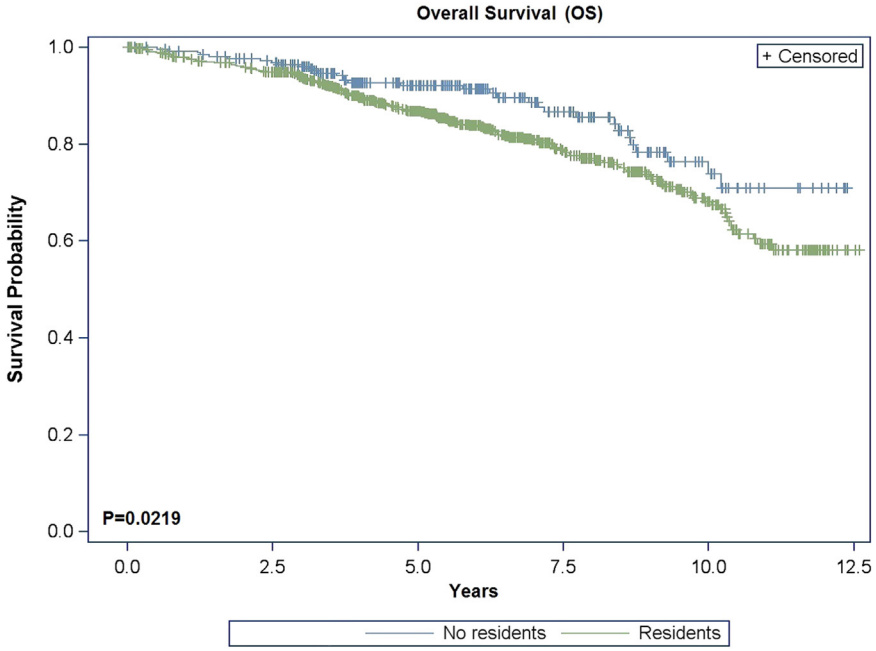

FIGURE 1. Overall survival and resident involvement.

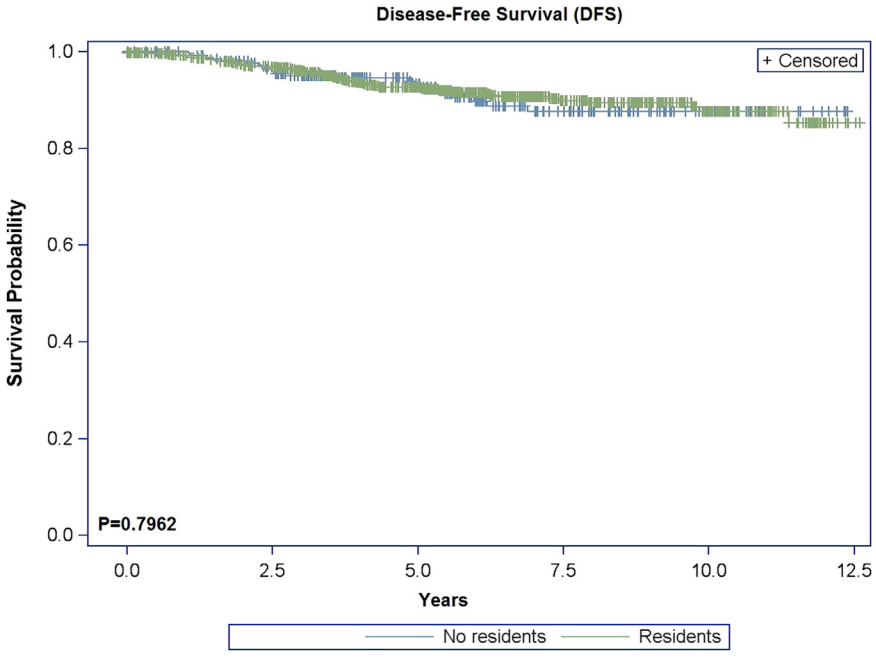

FIGURE 2. Disease-free survival and resident involvment.

nodes harvested, or number of nodes excised during full axillary dissections. Duration of operation length was longer when residents participated, but there was no difference in mean operative time between Junior (151.2 minutes, standard deviation [SD] 64) and Senior Residents (151.4 minutes, SD 63, p = 0.133).

Nurse assessment of early cosmetic outcome was "excellent" in 125 (80.1%) of 156 patients. Cosmetic outcomes were "excellent" and "good-fair" in 93 (77.5%) and 27 (22.5%) of 120 patients with "resident" participation and 32 (88.9%) and 4 (11.1%) of 36 patients without resident participation, respectively, p = 0.133.

DISCUSSION

The literature reporting resident effect on surgical outcomes is mixed.[7-14] The introduction of the National Surgical

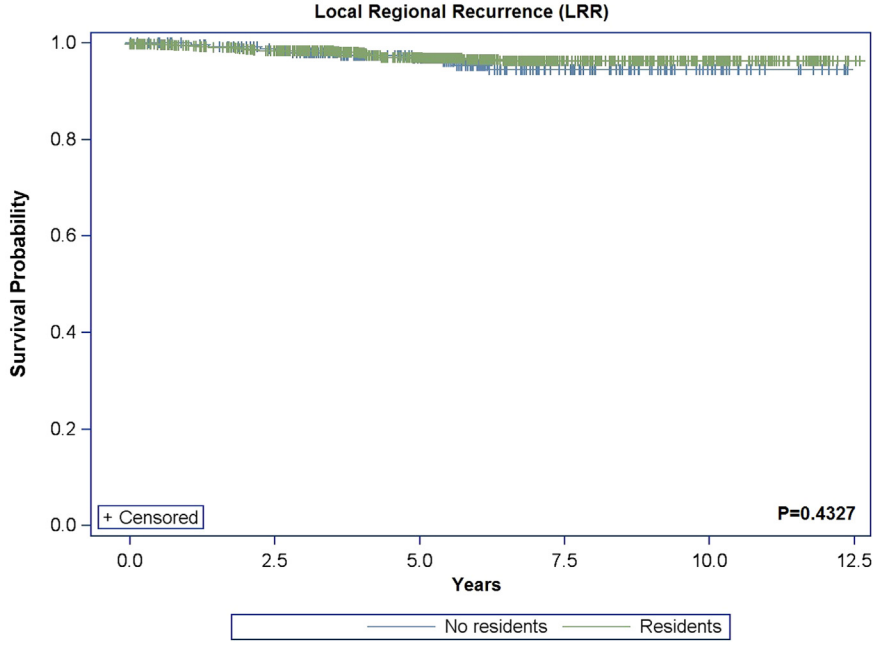

FIGURE 3. Local-regional recurrence and resident involvement.

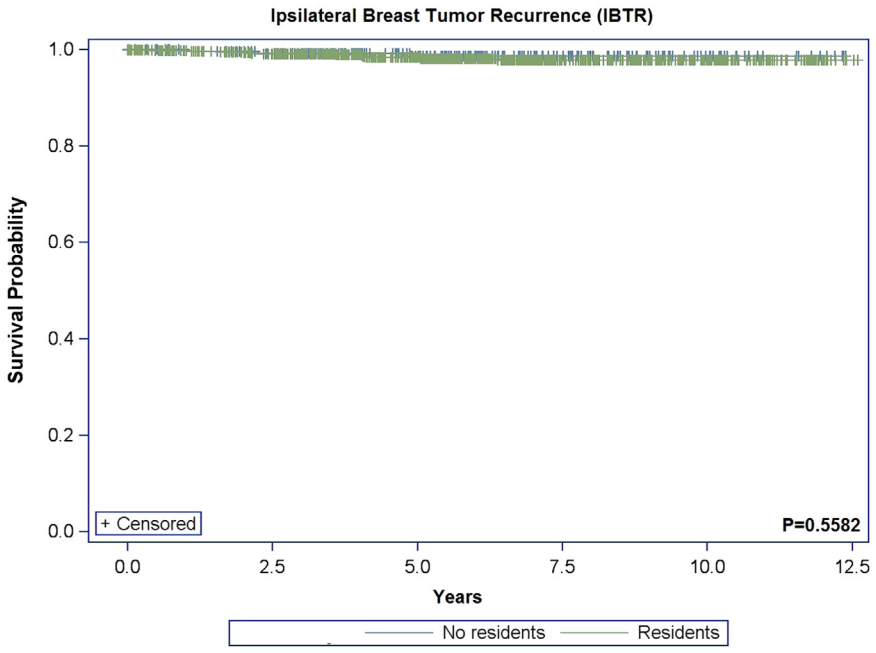

FIGURE 4. Ipsilateral breast tumor recurrence and resident involvement.

Quality Improvement Project (NSQIP) accelerated the investigation of resident effect on outcomes because NSQIP included a data field for resident participation.[7,9,11-14] Using NSQIP, Tseng et al.[12] reported the morbidity and mortality stratified by resident involvement for 7 general surgical operations. In this study, resident participation was associated with increased morbidity and duration of operative times, but with decreased mortality. No patients in this study had oncologic follow-up. Castleberry et al.[9] queried NSQIP to determine whether resident participation affected complication rates in patients undergoing complex oncology operations. They found higher 30-day morbidity, lower 30-day mortality, and better "rescue rates" after complications in patients with resident involvement. Another NSQIP review of general surgical operations by Raval et al.[14] had a similar conclusion. None of these studies reported on patients undergoing breast operations.

Information regarding the influence of residents assisting in breast surgery is needed because the volume and type of complications that occur with breast and axillary operations are different from those of other general surgical operations. Breast operations have less immediate postoperative morbidity, and 30-day mortality is almost nil.[15,16] In one of the few reports of resident outcomes and breast surgery, Fischer et al.[17] reviewed the records of patients with macromastia who underwent reduction mammoplasty. They concluded that resident participation was associated with increased morbidity and longer operative times. The PGY of training was also found to be inversely related to the risk of a surgical complication.

Resident participation in breast cancer operations, defined as performing more than 50% of the critical components of the case, was associated with increased operative times in our study. However, in contrast to the Fischer et al. mammoplasty study, we identified no association between residents and postoperative morbidity as measured by surgical site infection and unplanned reoperations for any reason. Our report is similar to others that document low rates of any early postoperative complications after breast cancer surgery.[15,16] The 30-day any "type" morbidity rate and combined infection and skin dehiscence rates after lumpectomy were both less than 2% in a report using the NSQIP database.[16] We also found that potential surrogate measures of technical proficiency and safety such as number of lymph nodes excised with a sentinel lymph node or full axillary dissection, re-excision for margins after

TABLE 2. Early Postoperative Outcomes in 1107 Patients With Breast Cancer

Outcome	*N* = 1107 (100%)
All patients, any cause reoperation*	
No	905 (86.8)
Yes	202 (18.2)
Any surgical complication causing unplanned return to OR	
No	1101 (99.5)
Yes	6 (0.5)
Unplanned return to OR for bleeding	
No	1104 (99.7)
Yes	3 (0.3)
Surgical site infection	
No	1073 (96.9)
Yes	34 (3.1)

*Includes re-excisions for margins.

TABLE 3. Early Postoperative Outcomes With and Without Resident as Primary Surgeon

Category	Resident, $n = 847$ (76.5%)	No Resident, $n = 260$ (23.5%)	Total, $n = 1107$ (100%)	p Value
Reoperation (any type)	143 (16.9)	59 (22.7)	202 (18.3)	0.034
Reoperation (any type) after initial lumpectomy*	134 (22)	53 (28.5)	187 (23.5)	0.066
OR time (mean ± SD)	149.6 (±63.1)	136.3 (±73.7)	146.48 (±65.98)	<0.001
Sentinel nodes (median)	3	3	3	0.601
Full axillary dissection nodes (median)	16	14.5	16	0.262

*Excludes transitional residents.

lumpectomy, and cosmetic outcomes were not affected by resident participation. Prior studies of the effect of residents on re-excision rates have been mixed.[18-20] Early postoperative outcomes including re-excisions after breast cancer operations were not compromised by resident training in our analyses.

To our knowledge, the relationship between resident participation in breast cancer operations and long-term cancer outcomes has not been previously reported. Cancer outcomes are of such importance to patients that many patients eligible for unilateral breast-conserving surgery choose bilateral mastectomy.[4] A recent thematic study based on interviews with newly diagnosed patients with breast cancer indicates that the fear of cancer recurrence drives the patient's decision to undergo more surgery, even after the patient is informed that less surgery is sufficient.[21] Hence, it is certainly conceivable that patients may also be concerned about the effect of resident participation on their cancer outcome. A study by Knifed et al.[22] found that surgical patients were generally "unaware" of the role of surgical residents. In the absence of data, it can sometimes be difficult to reassure patients of the safety of resident participation. In addition, attending surgeons may also question whether surgical oncologic effectiveness is compromised by resident participation. If so, then the willingness of a surgeon preceptor to allow the resident to perform key components of the operation may be affected.

We identified no difference in multivariate analysis for the primary cancer outcomes of OS, DFS, LRR, or in-breast-tumor-recurrence after lumpectomy stratified by surgical resident participation in breast cancer operations. This information can reassure patients, attending surgeons and program directors who have questions about the safety and effectiveness of surgical resident participation in breast cancer operations. We have provided proof of concept that general surgical residents can be trained without compromising outcomes of patients with breast cancer.

Limitations of our study include its retrospective nature, lack of randomization, and our inability to precisely quantify the extent of resident involvement in individual cases. Validated tools to precisely quantify extent of resident involvement have not yet been developed. Our method of assigning patients to the Resident Group was based on a qualitative assessment by the staff surgeon at case completion whether the resident performed more than half the critical components of the operation. Another study limitation is our lack of any objective measurement of patient anxiety regarding resident participation in their surgical care. Although we could survey patients now, such data would be subject to recall bias. Lastly, whether our findings

TABLE 4. Early Postoperative Outcome and Resident Level of Training*

Category	Jr. Resident ($n = 435$) (43.5%)	Sr. Resident ($n = 304$) (30.4%)	No Resident ($n = 260$) (26%)	Total ($n = 999$) (100%)	p Value
Reoperation (any type)	71 (16.3)	49 (16.1)	59 (22.7)	179 (17.9)	0.066
Reoperation (any type) after initial lumpectomy†	67 (20.3)	48 (23.1)	53 (28.5)	168 (23.2)	0.106
OR time	151 (±63.5)	151.4 (±62.75)	136.3 (±73.77)	146.48 (±65.9)	<0.001
SLN (median)	3	2	3	3	0.549
Full dissection (median)	18	14	14.5	16	0.172
Reoperation for non-bleeding complications	3 (0.7)	0 (0)	2 (0.7)	5 (0.5)	0.391
Reoperation for bleeding complications	2 (0.46)	1 (0.33)	0 (0)	3 (0.3)	0.793
SSI‡	11 (2.5)	12 (4)	6 (2.3)	29 (2.9)	0.423

SLN, sentinel lymph node.
*Excludes transitional residents.
†Includes only lumpectomy patients ($n = 796$).
‡Surgical site infection.

are reproducible in other settings with breast fellowship programs or residents with different levels or types of attending staff supervision requires further study.

We routinely provide a "report card" of our breast center performance to patients with breast cancer before their operation.[23] This report card includes morbidity risks and other measurements of quality based on internal audits, serving to aid informed consent and provide transparency. Our updated report card now includes information regarding surgical residents and their nondetrimental effect on cancer outcomes.

Future investigations may help determine whether resident participation in patients' breast cancer operation increases patient anxiety—and if so, whether this anxiety can be alleviated by providing them with the information described herein. Until then, we hope that the results of our study would be reassuring to patients.

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