

The Effect of Resident Involvement on Postoperative Short-Term Surgical Outcomes in Immediate Breast Reconstruction: A National Surgical Quality Improvement Program Study of 24,005 Patients

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Background: The association between resident involvement and surgical morbidity in immediate breast reconstruction is not fully elucidated, and prior studies have had conflicting results. The authors studied whether resident involvement in immediate breast reconstruction is associated with the most important short-term outcomes: increased 30-day surgical morbidity, readmission and reoperation rates, operative time, and length of stay.

Methods: Patients undergoing immediate breast reconstruction were identified in the 2005 to 2012 American College of Surgeons National Surgical Quality Improvement Program Participant Use Data Files. The authors used simple and multivariable regression to assess surgical complications and secondary outcomes, stratifying by training level and reconstruction type.

Results: A total of 24,191 patients underwent immediate breast reconstruction; 17,840 had resident involvement. Thirty-day surgical morbidity was observed in 5.25 percent (95 percent CI, 4.92 to 5.58 percent) of cases with resident involvement and 5.12 percent (95 percent CI, 4.59 to 5.58 percent) of cases without, with no evidence of association between resident involvement and 30-day morbidity (adjusted OR, 0.97; 95 percent CI, 0.85 to 1.11; $p = 0.652$). Resident involvement was not associated with an increase in complications in implant-based or mixed types of reconstruction, and was associated with lower odds of complications in autologous reconstructions (OR, 0.70; 95 percent CI, 0.53 to 0.91; $p = 0.008$). It was associated with longer operative times (an average of 24 additional minutes for implant-based and 54 additional minutes for autologous reconstructions; $p < 0.001$); this was balanced by a shorter length-of-stay for patients undergoing implant-based reconstruction (adjusted OR, 0.88; 95 percent CI, 0.79 to 0.96; $p = 0.010$).

Conclusion: In immediate breast reconstruction patients, resident involvement was not associated with increased postoperative surgical morbidity or complications, although operative time was significantly increased with resident involvement across all levels of training. (*Plast. Reconstr. Surg.* 139: 1325, 2017.)

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Modern surgical residency training was started by Dr. William Halsted around 1890 with three main principles: the training should be accomplished in a set period of time, have a progressive increase in responsibility and operative experience, and have a final

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period of independent activity.¹ This transformed surgical training into a well-structured program in which freshly graduated medical doctors progressively gain more experience and independence, eventually becoming the leaders in their field.¹ However, by its very nature, this system introduces variably experienced residents into patient care, resulting in a mixed belief that residents may be prone to adversely affecting patient outcomes.²⁻⁴ Healthcare providers may be faced with the difficult task of reaching proper balance between the need to train new doctors and simultaneously maintaining optimal care for an individual patient.^{5,6} For this and other reasons, some patients are reluctant to have residents involved in their surgical care.⁷⁻⁹

The question of the true impact of resident involvement on patient outcomes remains unknown, or at least, incompletely understood. Previous studies in different surgical specialties, including studies in plastic surgery, support the safety of resident involvement in surgical care on postoperative outcomes.¹⁰⁻¹⁵ However, the association between resident involvement and postoperative outcomes in mastectomy and immediate breast reconstruction is not well-documented. The purpose of this study is to assess whether or not resident involvement in immediate breast reconstruction is associated with increased 30-day surgical morbidity, readmission and reoperation rates, operative time, or length of stay using the multi-institution Participant Use Data Files of the American College of Surgeons National Surgical Quality Improvement Program.

PATIENTS AND METHODS

Data Source

We used the 2005 to 2012 American College of Surgeons National Surgical Quality Improvement Program Participant Use Data Files for analysis of our population of interest. This retrospective review includes only deidentified patient information obtained from the American College of Surgeons National Surgical Quality Improvement Program database. This study conforms to the Declaration of Helsinki ethical principles for medical research. National Surgical Quality Improvement Program data collection methodology has been previously described.^{16,17} The National Surgical Quality Improvement Program is a project by the American College of Surgeons that prospectively collects data on surgical patients within the first 30 days of their primary operation. Data include

demographics, morbidity, laboratory test values, operative details, and outcomes. Variables from the multivariable logistic regression for which more than 20 percent of the data were missing were omitted.

Patient Identification

We identified patients in the National Surgical Quality Improvement Program using Current Procedural Terminology codes. We identified patients who underwent mastectomy (Current Procedural Terminology codes 19180, 19182, 19200, 19220, 19240, 19303, 19304, 19305, 19306, and 19307) and breast reconstruction (Current Procedural Terminology codes 19340, 19342, 19357, 19361, 19364, 19366, 19367, 19368, and 19369). Patients with simultaneous Current Procedural Terminology codes for mastectomy and breast reconstruction defined the immediate breast reconstruction population. Of these patients, we identified cases that were coded to have a resident involved in the operation (resident involvement) and those who did not have a resident involved (no resident involvement). We also classified the resident involvement group by level of training as follows: postgraduate years 1 and 2 (junior), postgraduate years 3 and 4 (senior), and postgraduate years 5 and 6 (chief).

Outcomes Definitions

The American College of Surgeons National Surgical Quality Improvement Program records postoperative morbidity data through postoperative day 30. We defined surgical morbidity, our primary outcome, as superficial and deep incisional surgical-site infection, organ space surgical-site infection, wound dehiscence, or reconstruction failure. Our secondary outcomes were 30-day readmission rates, 30-day reoperation rates, operative time, and length of stay, which we used as defined in the National Surgical Quality Improvement Program database. We used resident involvement as our explanatory variable, divided by resident training level for sensitivity analyses. We used covariates as defined in the National Surgical Quality Improvement Program database.

Statistical Analysis

We used Stata version 13.1 (StataCorp LP, College Station, Texas) for all analyses. We identified cases with and without resident involvement, comparing the two groups in terms of demographics, comorbidities, 30-day postoperative surgical morbidity, readmissions, reoperations, operative time, and length of stay.

We preliminarily analyzed the data set using cross-tabulation and descriptive analysis to inspect for missing data and data errors and to identify potential confounders and effect modifiers. We then estimated univariate associations using the chi-square test for categorical variables and *t* test or Wilcoxon rank sum test, as appropriate, for continuous variables.

We fitted a multivariable logistic regression model assessing the association between resident involvement and surgical 30-day postoperative morbidity, using clinical relevance and change-in-estimate methods to select variables in a stepwise, forward fashion.¹⁸ The covariates we included were age, body mass index class, type of reconstruction, American Society of Anesthesiologists class, inpatient status, hypertension, smoking status, diabetes, dyspnea, chronic obstructive pulmonary disease, bleeding disorders, and race. We tested for departures from linearity and effect modification using likelihood ratio tests to verify the assumptions in our fully adjusted model. We then examined these associations taking into account resident training level, using the chi-square test for trend for unadjusted analyses and multivariable logistic regression for adjusted analyses.

We assessed associations between resident involvement and secondary outcomes (i.e., 30-day readmission rates, 30-day reoperation rates, operative time, and length of stay) using the chi-square test for categorical variables and *t* test or Wilcoxon rank sum test, as appropriate, for continuous variables. We then fitted models to adjust for confounding using multivariable logistic regression for dichotomous variables (i.e., 30-day readmission rates and 30-day reoperation rates) and multiple linear regression for continuous variables (i.e., operative time and length of stay). For simplicity, we included the same covariates in these models as those we had selected for the primary outcome. Finally, we tested for departures from linearity and effect modification in these models using likelihood ratio tests.

RESULTS

We included 24,191 patients who underwent immediate breast reconstruction. Of these, 6351 patients (26.25 percent) did not have resident involvement, whereas 17,840 patients (73.75 percent) had resident involvement. Of cases with resident involvement, 4212 (23.61 percent) involved a junior resident, 3035 (17.01 percent) involved a senior resident, and 10,593 (59.38 percent) involved a chief resident.

Mean patient age was 51 ± 10.45 years (range, 18 to 90 years). Mean patient body mass index was 26.37 ± 11.71 kg/m²: 41.23 percent of patients were classified as having normal body mass index, 1.94 percent were underweight, 29.25 percent were overweight, and 27.59 percent were obese. Most patients were reported as white (77.45 percent), followed by black (6.66 percent), Pacific Islander or Hawaiian native (2.38 percent), and Hispanic (2.08 percent). There were 5724 patients (23.66 percent) classified as hypertensive and 1131 (4.68 percent) classified as diabetic. Table 1 lists population demographic characteristics by study groups.

Primary Outcome

Among all patients included in our data set, 30-day postoperative surgical complications were reported for 1261 patients (5.21 percent). Of these, the most complications consisted of superficial surgical-site infections (39.1 percent), followed by deep space surgical-site infection (21.81 percent), reconstruction failure (20.78 percent), organ space surgical-site infection (14.75 percent), and wound dehiscence (12.93 percent). Table 2 lists surgical complications by study groups.

Observed 30-day postoperative surgical complications were very similar between the group with

Table 1. Demographic Characteristics and Comorbidities of Patient Populations

Variable	Cases without a Resident (%)	Cases with a Resident (%)	<i>p</i>
No. of patients	6165	17,840	
Age, yr	51.48	50.93	<0.001
BMI, kg/m ²	26.18	26.44	0.121
White	4625 (72.82)	13,436 (75.31)	
Black	364 (5.73)	1336 (7.49)	
Asian	185 (2.91)	563 (3.16)	<0.001
Hispanic	353 (5.56)	680 (3.81)	
Native American	9 (0.14)	25 (0.14)	
Pacific Islander	224 (3.53)	959 (5.38)	
ASA class			
1	743 (11.7)	1637 (9.18)	
2	4598 (72.4)	12,394 (69.47)	<0.001
3	986 (15.53)	3744 (20.99)	
4	16 (0.25)	47 (0.26)	
Underweight	125 (1.98)	341 (1.92)	
Normal BMI	2615 (41.47)	7297 (41.14)	0.456
Overweight	1874 (29.72)	5158 (29.08)	
Obese	1692 (26.83)	4940 (27.85)	
Diabetes	283 (4.46)	848 (4.75)	0.335
Current smoker	847 (13.34)	2225 (12.47)	0.076
Inpatient	4801 (75.59)	14,401 (80.72)	<0.001
Hypertension	1547 (24.36)	4177 (23.41)	0.128
CHF	0 (0)	6 (0.03)	0.144
Dyspnea	221 (3.48)	546 (3.06)	0.102
COPD	47 (0.74)	115 (0.64)	0.423

BMI, body mass index; ASA, American Society of Anesthesiologists; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease.

Table 2. Unadjusted Model Comparing Study Groups for 30-Day Complications

	No Resident (%)	Resident (%)	<i>p</i>
No. of patients	6165	17,840	
Complications			
Superficial SSI	117 (1.84)	376 (2.11)	0.199
Deep SSI	79 (1.24)	196 (1.1)	0.348
Organ-site SSI	41 (0.65)	145 (0.81)	0.190
Reconstruction failure	80 (1.26)	182 (1.02)	0.113
Wound dehiscence	42 (0.66)	121 (0.68)	0.887
All surgical complications	325 (5.12)	936 (5.25)	0.690
Unplanned intubation	5 (0.08)	7 (0.04)	0.225
Pulmonary embolism	12 (0.19)	44 (0.25)	0.411
>48-hr ventilatory assistance	1 (0.02)	4 (0.02)	0.751
Progressive renal failure	0 (0)	5 (0.03)	0.182
Acute renal failure	2 (0.03)	1 (0.01)	0.112
Urinary tract infections	20 (0.31)	55 (0.31)	0.935
Stroke	1 (0.02)	3 (0.02)	0.955
Coma	0 (0)	0 (0)	—
Cardiac arrest	0 (0)	1 (0.01)	0.551
Myocardial infarction	2 (0.03)	2 (0.01)	0.280
Bleeding requiring transfusion	10 (0.16)	13 (0.07)	0.065
Deep vein thrombosis	26 (0.41)	48 (0.27)	0.082
Sepsis	25 (0.39)	88 (0.49)	0.317
All medical complications	124 (1.95)	337 (1.89)	0.751

SSI, surgical-site infection.

resident involvement [936 cases (5.25 percent)] and the group without resident involvement [325 cases (5.12 percent)] (Table 2). A chi-square test showed no evidence for this difference being statistically significant ($p = 0.690$) (Table 3). In addition, we fitted a multivariable logistic regression model to assess this association while adjusting for confounders (i.e., age, body mass index class, type of reconstruction, American Society of Anesthesiologists class, inpatient status, hypertension, smoking status, diabetes, dyspnea, chronic obstructive pulmonary disease, bleeding disorders, and race). Multivariable logistic regression revealed statistically weak evidence for effect modification from type of reconstruction on the effect of resident involvement on 30-day postoperative surgical complications ($p = 0.054$). Therefore, we decided to present estimates for this association stratified by type of reconstruction.

Autologous reconstructions were more frequent in cases with resident involvement ($p < 0.001$)

(Table 4). Using multivariable logistic regression, we found no evidence for an association between resident involvement and 30-day postoperative surgical complications in patients undergoing implant-based reconstruction (OR, 1.08; 95 percent CI, 0.92 to 1.26; $p = 0.372$) or mixed implant- and autologous-based reconstruction (OR, 0.96; 95 percent CI, 0.58 to 1.61; $p = 0.882$) (Tables 5 and 6). The odds of 30-day postoperative surgical complications in cases of autologous breast reconstruction were actually lower among patients with resident involvement, compared with those without resident involvement (OR, 0.70; 95 percent CI, 0.53 to 0.91; $p = 0.008$), suggesting a small but statistically significant protective effect of resident involvement.

We then stratified these outcomes by level of training of the resident involved (Fig. 1). In implant-based reconstructions, surgical complications were slightly higher among cases with junior resident involvement (5.15 percent), compared with cases with senior (4.64 percent), chief (4.45 percent), or no resident involvement (4.29 percent). A chi-square test for trend showed suggestive evidence for a trend in which involvement of residents with fewer years in training might be associated with higher surgical morbidity ($p = 0.069$). However, this association was no longer significant after adjusting for confounding ($p = 0.162$). Finally, we found no evidence for an association between surgical complications and resident involvement by training level in mixed ($p = 0.334$) or autologous ($p = 0.528$) breast reconstruction, even after adjusting for confounding ($p = 0.417$ and $p = 0.317$, respectively).

Secondary Outcomes

We found no evidence for a difference in 30-day readmission rates between resident involvement (6.20 percent) and no-resident involvement (6.81 percent) groups using the chi-square test (unadjusted OR, 0.90; 95 percent CI, 0.64 to 1.267; $p = 0.567$) and after adjusting for confounding (adjusted OR, 0.86; 95 percent CI, 0.61 to 1.22; $p = 0.400$) (Table 6). The same is true for 30-day reoperation rates, which were not

Table 3. Unadjusted and Adjusted Surgical Complications between Study Groups

	No Resident (95 percent CI)	Resident (95 percent CI)	<i>p</i>
No.	6165	17,840	
Surgical complications	5.12% (4.59–5.69%)	5.25% (4.92–5.58%)	
Unadjusted OR	1 (baseline)	1.03 (0.90–1.17)	0.691
Adjusted OR*	1 (baseline)	0.97 (0.85–1.11)	0.652

*Adjusted for age, body mass index, American Society of Anesthesiologists class, inpatient status, race, type of reconstruction, and comorbidities.

Table 4. Study Population by Type of Reconstruction

Type of Reconstruction	No Resident (%)	Resident (%)	<i>p</i>
Prosthesis	5080 (79.99)	13,504 (75.7)	<0.001
Mixed	414 (6.52)	1116 (6.26)	
Autologous	857 (13.49)	3220 (18.05)	

statistically significantly different between the resident involvement (8.27 percent) and no-resident involvement (9.35 percent) groups (unadjusted OR, 0.87; 95 percent CI, 0.65 to 1.17; *p* = 0.365; adjusted OR, 0.83; 95 percent CI, 0.62 to 1.11; *p* = 0.207).

Regarding operative time, median operative time in cases with resident involvement was higher than for cases with no resident involvement for both implant-based reconstruction [200 minutes (interquartile range, 152 to 258 minutes) versus 176 minutes (interquartile range, 131 to 231 minutes), respectively] and autologous reconstruction [374 minutes (interquartile range, 261 to 544 minutes) versus 320 minutes (interquartile range,

211 to 455 minutes), respectively] (Table 6). A Wilcoxon rank sum test showed that these differences were statistically significant (*p* < 0.001) and remained statistically significant after adjusting for confounding with multiple linear regression (mean difference, 27 minutes; 95 percent CI, 23.82 to 30.53 minutes; *p* < 0.001). We analyzed this association by training level and found that it showed a nonlinear behavior (*p* < 0.001). Compared with cases with no resident involvement, on average, cases with junior resident involvement were 24 minutes longer (95 percent CI, 19 to 28 minutes; *p* < 0.001), cases with senior resident involvement were 34 minutes longer (95 percent CI, 29 to 39 minutes; *p* < 0.001), and cases with chief resident involvement were 26 minutes longer (95 percent CI, 22 to 29 minutes; *p* < 0.001) (Fig. 2).

Hospital length of stay was longer among cases with resident involvement (median, 2 days; interquartile range, 1 to 3 days) compared to cases with no resident involvement (median, 2 days; interquartile range, 1 to 2 days), and a Wilcoxon

Table 5. Unadjusted and Adjusted Surgical Complications between Study Groups Stratified by Type of Reconstruction

Type of Reconstruction	No Resident (%)	Resident (%)	Unadjusted		Adjusted*	
			<i>p</i>	OR	95% CI	<i>p</i>
Prosthesis	218 (4.29)	627 (4.64)	0.305	1.08	0.92–1.26	0.372
Mixed	23 (5.56)	64 (5.73)	0.893	0.96	0.58–1.61	0.882
Autologous	84 (9.8)	245 (7.61)	0.036	0.7	0.53–0.91	0.008

*Adjusted for age, body mass index, American Society of Anesthesiologists class, inpatient status, race, type of reconstruction, and comorbidities.

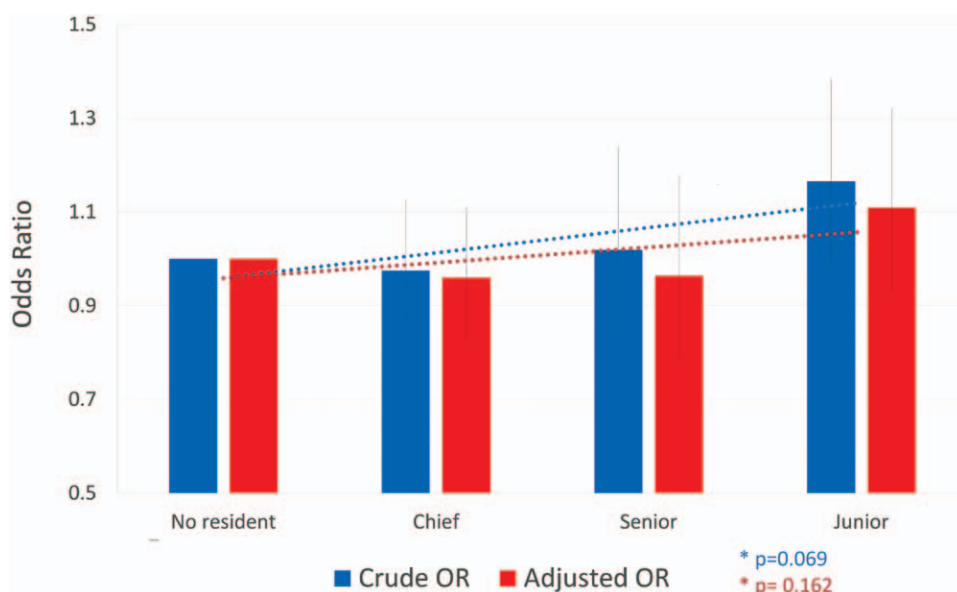


Fig. 1. Surgical morbidity by level of training adjusted for age, body mass index, American Society of Anesthesiologists class, inpatient status, race, type of reconstruction, and comorbidities.

Table 6. Secondary Outcomes between Cases with or without Resident Involvement

Secondary Outcomes	No Resident	Resident	Unadjusted			Adjusted*		
			OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
Readmission	42 (6.81%)	216 (6.20%)	0.9	0.64–1.27	0.56	0.86	0.61–1.22	0.4
Reoperation	59 (9.35%)	304 (8.27%)	0.87	0.65–1.17	<0.001	0.83	0.61–1.11	0.21
Median operative time in minutes (IQR)								
Prosthesis	176 (131–231)	200 (152–258)	1.6	1.5–1.72	<0.001	1.54	1.44–1.65	<0.001
Autologous	320 (211–455)	374 (261–544)	1.87	1.56–2.25	<0.001	1.72	1.42–2.09	<0.001

IQR, interquartile range.

*Adjusted for age, body mass index, American Society of Anesthesiologists class, inpatient status, race, type of reconstruction, and comorbidities.

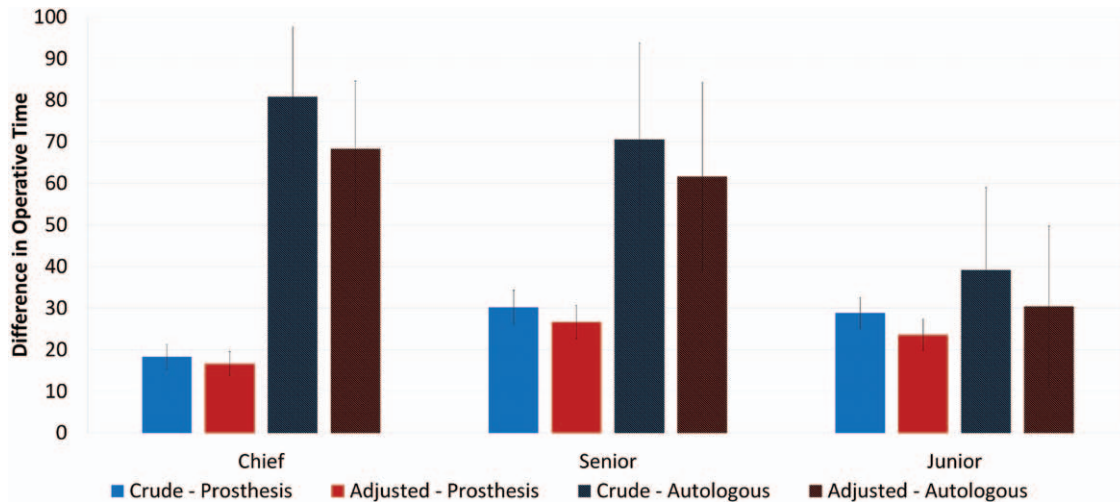


Fig. 2. Crude and adjusted difference in operative time by level of training compared to cases with no resident involvement.

rank sum test showed strong evidence for this difference being statistically significant ($p < 0.001$) (Table 7). After adjusting for confounding variables, this was no longer significant ($p = 0.963$). Stratifying by type of reconstruction, the resident involvement group had lower length of stay for cases of prosthetic-based breast reconstruction (OR, 0.88; 95 percent CI, 0.79 to 0.96), and in this group, resident involvement conferred a small but statistically significant improvement in the likelihood of being discharged before the overall median (although the two group medians were not significantly different).

DISCUSSION

Immediate breast reconstruction following mastectomy is an effective intervention to improve the quality of life in patients undergoing mastectomies^{19–21} and is often performed in academic institutions where residents are involved in performing the operations.^{3,22} Although some patients may have concerns regarding resident involvement in their surgical care,^{7–9} our study using National Surgical Quality Improvement Program data shows no association between resident involvement in immediate breast reconstruction and increased short-term postoperative surgical

Table 7. Median Length of Stay between Cases with or without Resident Involvement

Type of Reconstruction	Median Length of Stay (IQR)		Unadjusted			Adjusted†		
	No Resident	Resident	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
Prosthesis	1 (1–2)	1 (1–2)	0.97	0.89–1.07	0.49	0.88	0.79–0.96	0.010
Mixed	2 (1–3)	2 (2–3)	1.18	0.92–1.49	0.18	1.09	0.85–1.39	0.503
Autologous	4 (3–5)	4 (3–5)	1.13	0.95–1.35	0.17	1.01	0.83–1.22	0.922

IQR, interquartile range.

*Odds ratios refer to odds of length of stay being longer than median for each type of reconstruction.

†Adjusted for age, body mass index, American Society of Anesthesiologists class, inpatient status, race, type of reconstruction, and comorbidities.

morbidity, reoperation and readmission rates, and length of stay across all reconstruction types and levels of training.

Resident involvement in surgical care is the standard of care in academic hospitals across the United States.²² Several studies in the areas of general,^{12,23} orthopedic,¹⁰ cardiovascular,^{24,25} obstetrics and gynecology,²⁶ urology,²⁷ and plastic^{12,14,15} surgery have demonstrated the safety of resident involvement on surgical outcomes. These studies consist mainly of two study designs: those looking into the surgical specialty as a whole and those looking specifically into a certain surgical procedure within a specialty. Studies investigating the effects of resident involvement on a specialty as a whole can be helpful in providing a general gestalt regarding the impact of that involvement on surgical care. However, these studies do not necessarily take into account the varying levels of difficulty that often exist between cases and institutions.

In the field of plastic surgery, we identified three studies investigating the role of resident involvement across the entire field, with none specifically investigating immediate breast reconstruction.^{12,14,15} Although all three studies used National Surgical Quality Improvement Program data, their results yielded slightly different findings, likely because of differences in study design. Saliba et al. showed no significantly higher morbidity or mortality with resident involvement.¹² Jordan et al. found that resident involvement was a significant predictor of overall morbidity but was not associated with increased odds of wound infection; graft, prosthesis, or flap failure; or overall mortality.¹⁴ Massenburg et al. found that general complications, wound complications, and reoperation rates are consistently elevated in cases with resident involvement using the National Surgical Quality Improvement Program Participant Use Data Files from 2007 to 2012; however, after adjustment by year, these rates trended downward and failed to be statistically significant in 2012.¹⁵ These different conclusions demonstrate the value in specifically looking at commonly performed procedures such as immediate breast reconstruction to better understand the impact of resident involvement.

In this study, we investigated the association of resident involvement with postoperative immediate breast reconstruction outcomes. Looking into our primary outcome of surgical morbidity, there was no statistical evidence of increased postoperative surgical complications with residents involved with either the unadjusted or adjusted models. As trainees in different postgraduate years have

different amounts of surgical experience, it was important to stratify by resident training level. Although there was trending toward higher surgical morbidity with involvement from less experienced residents, the trend did not reach statistical significance between training groups. In addition, immediate breast reconstruction encompasses different types of reconstruction (autologous, prosthetic, and mixed), all of which have varying levels of complexity, making it important and informative to stratify by this variable. In stratifying, we found that autologous reconstructions documented in the National Surgical Quality Improvement Program database more frequently include resident involvement, an unsurprising finding, as these procedures are more commonly performed at academic institutions.^{3,22}

Interestingly, not only was there no association between resident involvement and increased surgical complications across all reconstruction types, resident involvement was associated with a 30 percent lower odds of surgical complications in autologous reconstructions. Although we are unable to determine causality for this association, it is likely not because of resident involvement alone but instead is a result of several factors: increased surveillance by resident physicians that may help prevent complications and the benefits of having the procedure performed at high-volume institutions that are more likely to have operative and postoperative care teams with extensive experience in caring for these patients.²⁸ This decreased morbidity conflicts with a study by Fischer et al. that investigated resident involvement in breast reduction, reporting it to have an added risk of surgical complications inversely related to resident postgraduate year.²⁹ This finding may have been attributable to these generally simpler cases being more sensitive to the significantly increased operative time associated with resident involvement.³⁰

Our findings regarding operative time are perhaps the most interesting but are not surprising. Looking into operative time in our cohort, it was significantly higher across all levels of training when compared to that of cases with no resident involvement, a finding consistent with those published by other surgical specialties.^{26,31,32} Although increased operative time has been associated with increased postoperative morbidity in other studies,³⁰ our data did not support increased postoperative complications. This may be because of the way in which residents are involved in complex cases. Although more time may be spent on intraoperative resident training, the two-team approach (e.g., having the resident work on the

donor site while the attending physician works on the recipient site) may help minimize the increase in operative time and its associated postoperative morbidity.¹⁴ Indeed, Saliba et al., Ross et al., and Ruhotina et al. reported similar results in their studies regarding operative time and postoperative morbidity.^{12,33,34}

Our investigation also included length of stay, readmission, and reoperation rates. Although other studies report variable lengths of stay when residents are involved in patients' operations,^{31,32,34–39} our adjusted analyses show no prolonged hospital course overall and a mild association between shorter length of stay in implant-based reconstruction with resident involvement. This variation between studies may be attributable to institutional differences in discharge protocols. For example, Bonde et al. reported that changing their discharge protocol to omit doctors from drain removal decreased patients' length of stay from 6 days to 3 days.⁴⁰ Similarly, resident involvement in postoperative care (e.g., making discharge-related orders) may affect length of stay and warrants additional investigation as a potential way to shorten hospital stays and reduce costs. Although there was an increase in return to the operating room and hospital with resident involvement, this difference decreased to nonsignificance following adjustment for confounding variables such as American Society of Anesthesiologists class and body mass index, a finding that agrees with previous studies^{33,34,41} and further supports the safety of resident involvement in immediate breast reconstruction.

Limitations

This study has several limitations. The National Surgical Quality Improvement Program database contains only 30-day postoperative follow-up data, making the assessment of longer term outcomes impossible. Nor does it report all breast reconstruction-specific outcomes of interest, such as seroma, capsular contracture, aesthetic outcome, or patient-reported data such as patient satisfaction or quality of life. Furthermore, National Surgical Quality Improvement Program-reported data do not describe the degree of involvement the residents had in the operation, preoperative care, or postoperative care.

Final Consideration

Conducting studies to determine causes of postoperative morbidity and mortality is critical to the ongoing improvement of patient care and the

education of surgeons in-training. Current residency training programs depend on the apprenticeship system to educate the next generation of physicians. Our responsibility to the public is two-fold: to provide high-quality patient care and to train resident surgeons. However, what do we do when these objectives contradict each other? Although our study supports the involvement of resident physicians in immediate breast reconstruction, the so-called elephant in the room may be how to address data that demonstrate poorer outcomes for surgical patients whose care was provided by a team that included trainees. This study also demonstrates that resident involvement increases operative time and subsequently the cost of patient care, highlighting the importance of continued funding of indirect medical education. As with other research findings, we hope that such studies would be replicated in other large, multicenter data sets and/or through prospective quality assessment/quality improvement initiatives. This challenge likely will only increase in relevance as third-party reimbursement becomes more closely tied to outcomes, and we look forward to how the field of plastic and reconstructive surgery will respond.

CONCLUSIONS

In immediate breast reconstruction patients, resident involvement was not associated with increased postoperative surgical morbidity, readmission and reoperation rates, or length of stay. Operative time was significantly increased with resident involvement. These data support the safety of involving residents in the surgical care of immediate breast reconstruction cases, which could be used in counseling patients who might have concerns about residents being involved in their surgical care.

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DISCLAIMER

The American College of Surgeons National Surgical Quality Improvement Program and its participating hospitals are the source of the data used herein; they have not verified and are not responsible for the statistical validity of the data analysis or the conclusions derived by the authors.

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