Variability in Reexcision Following Breast Conservation Surgery

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HE CURRENT ENVIRONMENT OF health care reform in the United States calls for increasing physician and hospital accountability and transparency of health care outcomes.1 Surgical outcomes are usually assessed by mortality because it is an unambiguous outcome. For operations associated with low mortality, identifying outcomes that reflect the quality of care is challenging.2,4

Breast-conserving therapy, or partial mastectomy, is one of the most commonly performed cancer operations in the United States. Current estimates suggest 60% to 75% of breast cancer cases undergo partial mastectomy as initial treatment.3 Operative mortality estimates for partial mastectomy are less than 1%; however, low mortality does not necessarily equate to high quality.4 Currently, there are no readily identifiable quality measures that allow for meaningful comparisons of breast cancer surgical outcomes among treating surgeons and hospitals.

Partial mastectomy is optimally performed by achieving adequate surgical margins during the initial surgical resection while maintaining maximum cosmetic appearance of the breast. Failure to achieve appropriate margins at the initial operation will require additional surgery with reexcision rate estimates ranging from 50% to 75% of breast cancer surgical outcomes among treating surgeons and hospitals.

Context Health care reform calls for increasing physician accountability and transparency of outcomes. Partial mastectomy is the most commonly performed procedure for invasive breast cancer and often requires reexcision. Variability in reexcision might be reflective of the quality of care.

Objective To assess hospital and surgeon-specific variation in reexcision rates following partial mastectomy.

Design, Setting, and Patients An observational study of breast surgery performed between 2003 and 2008 intended to evaluate variability in breast cancer surgical care outcomes and evaluate potential quality measures of breast cancer surgery. Women with invasive breast cancer undergoing partial mastectomy from 4 institutions were studied (1 university hospital [University of Vermont] and 3 large health plans [Kaiser Permanente Colorado, Group Health, and Marshfield Clinic]). Data were obtained from electronic medical records and chart abstraction of surgical, pathology, radiology, and outpatient records, including detailed surgical margin status. Logistic regression including surgeon-level random effects was used to identify predictors of reexcision.

Main Outcome Measure Incidence of reexcision.

Results A total of 2206 women with 2220 invasive breast cancers underwent partial mastectomy and 509 patients (22.9%; 95% CI, 21.2%-24.7%) underwent reexcision (454 patients [89.2%; 95% CI, 86.5%-91.9%] had 1 reexcision, 48 [9.4%; 95% CI, 6.9%-12.0%] had 2 reexcisions, and 7 [1.4%; 95% CI, 0.4%-2.4%] had 3 reexcisions). Among all patients undergoing initial partial mastectomy, total mastectomy was performed in 190 patients (8.5%; 95% CI, 7.2%-9.5%). Reexcision rates for margin status following initial surgery were 85.9% (95% CI, 82.0%-89.8%) for initial positive margins, 47.9% (95% CI, 42.0%-53.9%) for less than 1.0 mm margins, 20.2% (95% CI, 15.3%-25.0%) for 1.0 to 1.9 mm margins, and 6.3% (95% CI, 3.2%-9.3%) for 2.0 to 2.9 mm margins. For patients with negative margins, reexcision rates varied widely among surgeons (range, 0%-70%; P = .003) and institutions (range, 1.7%-20.9%; P < .001). Reexcision rates were not associated with surgeon procedure volume after adjusting for case mix (P = .92).

Conclusion Substantial surgeon and institutional variation were observed in reexcision following partial mastectomy in women with invasive breast cancer.

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30% to 60%.6-9 These additional operations can produce considerable psychological, physical, and economic stress for patients and delay use of recommended adjuvant therapies. A high percentage (10%-36%) of women requiring reexcision undergo total mastectomy. Thus, the effect of reexcision on altering a patient’s initial treatment choice is significant.7-9

Our previous work demonstrated reexcision rates following initial partial mastectomy ranging between 11% and 25% among surgeons at a single high-volume university-based breast center.3 We have expanded this analysis to include 3 additional geographically diverse health systems and their surgeons. We sought to measure variation in reexcision rates across hospitals and surgeons treating patients with similar clinical conditions. Furthermore, we explored whether patient demographic, clinical, and pathologic criteria were associated with an increased likelihood of reexcision following initial breast-conserving surgery for invasive breast cancer. The ability to define both predictors of reexcision and extent of variability should allow for full evaluation of the utility of reexcision as a meaningful measure of breast cancer surgery quality.

METHODS

We developed a Breast Cancer Surgical Outcomes (BRCASO) research consortium between the Cancer Research Network (CRN) and the University of Vermont. The CRN participating sites included Kaiser Permanente, Colorado; Group Health, western Washington state; and Marshfield Clinic, Wisconsin. The BRCASO cohort12 includes women with breast cancer diagnosed between 2003 and 2008, and aged more than 18 years at diagnosis, whose initial breast cancer surgery was performed by a surgeon employed by a BRCASO study site, including any of the 3 participating CRN sites or Fletcher Allen Health Care Center, the sole hospital affiliated with the University of Vermont. We excluded men, patients with initial surgery performed by a surgeon outside the health care system where the reexcision was performed, and patients with breast cancer never treated surgically. Institutional review board approval was attained from all participating sites, and information from study participants was obtained via waiver of written informed consent. We collected detailed data regarding clinical features of initial breast cancer diagnosis, as well as highly detailed data regarding initial and all subsequent breast cancer surgeries performed on all patients. For this analysis, we only included patients with a final diagnosis of invasive ductal carcinoma or invasive lobular carcinoma who underwent initial breast conservation, either partial mastectomy or open breast biopsy as their first operative procedure for the incident breast cancer.

Data Collection

Trained medical abstractors with experience in breast cancer abstraction completed data collection via an exhaustive review of surgical, pathology, radiology, and surgeon and medical/ oncology clinical evaluations. The data collection instrument included clinical factors (age, previous history of breast cancer), demographic factors (insurance status, race/ethnicity as reported by study participants in the medical record), disease characteristics (preoperative nodal status, preoperative estimated tumor size), and treatment characteristics (initial surgical procedure type) at the time of initial surgical treatment decision making and at subsequent surgeries. Data collection at the participating CRN sites, including race/ethnicity data, partially relied on the CRN’s primary source of data infrastructure, the Virtual Data Warehouse and the availability of electronic medical records.13 Data from the University of Vermont were entirely abstracted from medical records. The study focused on initial breast cancer surgery outcomes and did not evaluate utilization of radiation therapy, chemotherapy or hormonal therapy, or long-term outcomes such as local recurrence.

Surgical margin status was recorded for the initial breast-conserving procedure and for any subsequent excisions. Margins were categorized as positive if there was tumor at the inked margin in the pathology report. Histologic tumor type at closest or any positive margin was categorized as either invasive cancer or ductal carcinoma in situ (DCIS), when DCIS co-existed with invasive cancer. For negative margins, the distance of the closest margin to the specimen edge was recorded in 1-mm increments. For purposes of analyses, when distinct margin distances were recorded for the invasive component as well as DCIS, the smaller of the 2 distances was used. The anatomic orientation of the closest or positive margin was recorded when indicated in the pathology report. Margins categorized as radial included those recorded as superior, inferior, lateral, or medial. Anterior and posterior margins were categorized as such.

We established volume criteria for surgeons based on average yearly case volume for all initial breast cancer operations identified in the BRCASO database. The upper and lower thresholds for the 4 volume categories were defined at the first and third quartiles of volume for all operations, with the middle threshold set closer to the mean in order to have more meaningful differences in case volume between categories 1 and 2. We defined low surgeon volume as less than 10 incident breast cancer operations annually, intermediate surgeon volume as 10 to less than 25 operations annually, high surgeon volume as 25 to less than 50 operations annually, and very high surgeon volume as 50 or more operations annually.

Statistical Analysis

Bivariate analyses relating reexcision and clinical covariates were performed by using Pearson χ² tests of independence for categorical variables and t tests for quantitative variables. The Cochran-Armitage trend test was used for ordinal variables. Variables that were significant in the univariate analyses, those identified from a stepwise logis-
tic regression model, and the variables of age and race/ethnicity were included in the multivariable random effects logistic regression model. Surgeons were entered as a random effect in the model and are nested within site, with no surgeon practicing in more than 1 site. This model was fit using maximum likelihood with adaptive quadrature.\(^1^4\) \(P\) values are reported for 2-sided tests and are not adjusted for multiple comparisons. Significance was defined by \(P \leq .05\). Confidence intervals are reported at the 95% level. Analyses were performed by using the FREQ, LOGISTIC, and GLIMMIX procedures in SAS version 9.2 (SAS Institute).

**Surgeon-Level Analyses**

Results for the median odds ratio (OR) and the range of ORs (ROR) are reported to quantify variability among surgeons on a scale that is directly comparable with that used for other variables in the study (ie, ORs). The median OR can be interpreted as the median value of the ratio of predicted odds of reexcision for 2 patients, randomly selected from different sites, with equivalent sets of covariates included in the reexcision model. In the model, the absolute difference between the log odds for 2 surgeons, with respect to reexcision, is a random variable following a half-normal distribution with variance \(\tau^2\) from the logistic regression model. The median OR is given by exp\(\left[\sqrt{2 \times \tau \times \Phi^{-1}(0.75)}\right]\), where \(\Phi\) is the cumulative distribution function for the standard normal distribution and \(\Phi^{-1}(0.75)\) is the 75th percentile of the distribution.\(^1^5\) The ROR is the ratio of the values at the 97.5th and 2.5th percentile of the distribution of ORs for individual surgeons. It represents a range of ORs because it is computed by exponentiation of the length of a 95% CI for the random effect variance component on the log-odds scale \(\text{ROR} = \exp(3.92 \times \tau)\), where 3.92 is 2 \(\times\) the 97.5th percentile of the standard normal distribution.\(^1^6\) The median OR and ROR provide measures of the outcome for a random effect that is directly comparable with the ORs used for fixed effects in the study.

### RESULTS

Overall, there were 4580 patients with 4684 new breast cancers who underwent initial breast cancer surgery. We excluded 11 patients with known stage...
IV cancer and 899 patients for whom final pathology demonstrated DCIS alone. We further excluded 79 patients with clinically suspected inflammatory breast cancer, 129 patients receiving neoadjuvant chemotherapy, 448 patients with preoperatively identified multifocal breast cancer, 278 patients with a history of previous breast cancer, and 12 patients with previous breast or chest radiation, resulting in 2724 patients with new breast cancers considered clinically eligible for breast conservation. We then excluded 430 patients who underwent mastectomy as a first procedure, 25 patients operated on by surgeons with less than 10 total cases in the BRCASO data set, and 63 patients in which the margin status (positive or negative) was not able to be assessed.

After applying these exclusions, 2206 women with 2220 newly identified invasive breast cancers who underwent a breast-conserving first surgical procedure were included in the study. Overall, 509 patients (22.9%; 95% CI, 21.2%-24.7%) underwent additional surgery on the affected breast. Among these patients, 454 (89.2%; 95% CI, 86.5%-91.9%) underwent a single reexcision, 48 (9.4%; 95% CI, 6.9%-12.0%) underwent 2 reexcisions, and 7 (1.4%; 95% CI, 0.4%-2.4%) underwent 3 reexcisions. Among all patients undergoing initial breast conservation, a total mastectomy was subsequently performed in 190 patients (8.5%; 95% CI, 7.2%-9.5%).

The mean age for patients in this study was 62.16 years (95% CI, 61.63-62.69; range, 30-98 years) and 92.8% (95% CI, 91.6%-93.9%) of patients with reported race/ethnicity were non-Hispanic white. The mean invasive tumor size was 14.7 mm (95% CI, 14.3-15.1 mm) and 22.0% (95% CI, 18.9%-22.3%) of patients were node positive. There were 232 patients (10.5%; 95% CI, 9.2%-11.7%) with a final diagnosis of invasive lobular cancer, with the remainder diagnosed with invasive ductal carcinoma. Table 1 and Table 2 show demographic and clinical factors associated with reexcision rates in patients with initially negative pathological margins.

The majority of patients had a preoperatively established breast cancer diagnosis before the initial surgery, but for 109 patients (5.7%; 95% CI, 4.7%-6.8%) the initial procedure was an open surgical breast biopsy, which was associated with a marked increase in reexcision (45.0%; 95% CI, 35.6%-
54.3% vs 10.7%; 95% CI, 9.3%-12.2%; P < .001). Women younger than 35 years (reexcision rate of 37.5%; 95% CI, 4.0%-71.0%), with less than 18.5 body mass index (calculated as weight in kilograms divided by height in meters squared) (reexcision rate of 40.0%; 95% CI, 4.0%-71.0%), and initial margins of less than 1 mm (reexcision rate of 47.9%; 95% CI, 4.0%-71.0%) were more likely to have reexcision based on univariable analysis. Reexcision rates for patients with initial negative margins varied by institution, from a low of 1.7% (95% CI, 0%-3.6%) at institution D compared with 20.9% (95% CI, 17.7%-24.1%) at institution B (P < .001). The anatomic direction of the closest involved margin also was associated with reexcision, with a demonstrated higher excision rate when the closest margin was a radial margin compared with anterior- or posterior-oriented closest margins. Reexcision rates for initial negative margins were associated with annual surgical volume on univariate analysis only.

Demographic and clinical factors associated with reexcision for patients with initially positive margins are shown in Table 3 and Table 4. Reexcision was performed in 85.9% (95% CI, 82.0%-89.8%) of 311 patients with initial positive margins, with a slightly higher reexcision rate for DCIS at the margin (92.6%; 95% CI, 86.9%-98.3%) than for invasive cancer at the inked margin (83.3%; 95% CI, 78.7%-88.3%; P = .04). Other factors associated with a higher reexcision rate of positive margins included lobular breast cancer as a final diagnosis and the presence of lymphovascular invasion demonstrated on histology. Surgeon volume did not appear to be associated with the likelihood of reexcision, but institution was associated with reexcision of positive margins, with rates ranging from 73.7% to 93.5% (P = .003). Patients undergoing an initial breast-conserving procedure with an unknown malignant diagnosis were more likely to undergo a reexcision compared with patients who had a preoperatively established malignant diagnosis (96.8%; 95% CI, 92.5%-100.0% vs 83.1%; 95% CI, 78.4%-87.7%; P = .005).

In multivariable analysis of patients with initially negative margins (Table 5), tumor size, study site, and a known preoperative malignant diagnosis all remained significantly associated with reexcision. The Hosmer and Lemeshow goodness-of-fit test did not show significant lack of fit (P = .88) for the logistic regression model. The OR of reexcision for patients with negative margins at institution B was 6.16
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(95% CI, 2.26-16.78) compared with study site A (P < .001). The broad CI partially reflects the wide variability in reexcision rates among surgeons at institution B.

We analyzed the association between individual surgeon and the likelihood of reexcision in our multivariable analysis. The figure demonstrates reexcision rates for individual surgeons, which ranged between 0% and 70%. This figure demonstrates both observed reexcision rates and those rates predicted by the statistical model for the 54 surgeons who had at least 10 procedures meeting the inclusion criteria for our study. The predicted reexcision rates account for both clinical variables as well as patterns of reexcision at the individual surgeon’s study site. The overall surgeon level variance component was significant (P = .003).

The observed median OR of 1.59 (95% CI, 1.36-2.64) corresponds with the median value of the relative odds of reexcision between 2 randomly chosen surgeons from different sites. This indicates a relatively large individual surgeon effect, because half the ORs between 2 randomly chosen surgeons will be larger than 1.59. The range of ORs from the lower to the upper 2.5th percentile of the distribution is 6.8, indicating substantial heterogeneity among surgeons in reexcision.

COMMENT

Despite the significant physical, psychological, and financial effect of partial mastectomy reexcisions on patients, there remains a lack of standardization regarding its application among surgeons performing breast cancer surgery. Our results demonstrate an overall reexcision rate of 22.9% that is lower than previous studies demonstrating reexcision rates of 36% to 50%.9,11 Morrow et al9 reported a reexcision rate following initial breast-conserving therapy of 37.9% in a similarly large series of 1459 patients, with 26.0% undergoing partial breast reexcision alone and 11.9% ultimately undergoing mastectomy. Our lower reexcision rate may be partially explained by our more extensive exclusion criteria, which were specifically chosen to select for patients considered most eligible for breast conservation. We excluded a significant number of women with preoperatively established multifocal breast cancer, a relative but not absolute contraindication for breast-conserving therapy.

In our study, the incidence of initial positive margins following breast conservation was 14.0%, which compares favorably with a similar cohort of 489 patients with invasive breast cancer undergoing initial breast conservation at a Canadian cancer center in which 26% of patients had initial positive margins.10 Patients in that study had a preoperatively confirmed diagnosis of cancer in 69% of patients (vs 92.3% in our study, which likely contributed significantly to our lower initial positive mar-

### Table 4. Clinical Variables Associated With Reexcision Following Initial Partial Mastectomy for Invasive Cancers in Patients With Initial Positive Margins

<table>
<thead>
<tr>
<th>Clinical Characteristics</th>
<th>No. of Patients</th>
<th>Initial Breast Conservation</th>
<th>Reexcision</th>
<th>Reexcision, % (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tumor size, mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>0.0-9.9</td>
<td>72</td>
<td>61</td>
<td>84.72 (76.41-93.03)</td>
<td>.78</td>
<td></td>
</tr>
<tr>
<td>10.0-19.9</td>
<td>120</td>
<td>100</td>
<td>83.33 (76.67-90.03)</td>
<td>.78</td>
<td></td>
</tr>
<tr>
<td>20.0-29.9</td>
<td>65</td>
<td>56</td>
<td>86.15 (77.76-94.55)</td>
<td>.78</td>
<td></td>
</tr>
<tr>
<td>30.0-39.9</td>
<td>25</td>
<td>23</td>
<td>92.00 (81.37-100.00)</td>
<td>.78</td>
<td></td>
</tr>
<tr>
<td>40.0-49.9</td>
<td>13</td>
<td>12</td>
<td>92.31 (77.82-100.00)</td>
<td>.78</td>
<td></td>
</tr>
<tr>
<td>≥50</td>
<td>14</td>
<td>13</td>
<td>92.86 (79.37-100.00)</td>
<td>.78</td>
<td></td>
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<tr>
<td>Malignant diagnosis</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>established preoperatively No</td>
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<td>61</td>
<td>96.83 (92.50-100.00)</td>
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<tr>
<td>Yes</td>
<td>248</td>
<td>206</td>
<td>83.06 (78.40-87.73)</td>
<td>.005</td>
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<tr>
<td>Final pathological tumor type Cancer</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Invasive ductal carcinoma</td>
<td>254</td>
<td>211</td>
<td>83.07 (78.46-87.68)</td>
<td>.003</td>
<td></td>
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<tr>
<td>Invasive lobular carcinoma</td>
<td>57</td>
<td>56</td>
<td>98.25 (94.84-100.00)</td>
<td>.003</td>
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<td>Margin status</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Positive for DCIS only</td>
<td>81</td>
<td>75</td>
<td>92.59 (86.89-98.30)</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>Positive for invasive</td>
<td>83</td>
<td>192</td>
<td>83.48 (78.68-88.28)</td>
<td>.04</td>
<td></td>
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<tr>
<td>Positive margin direction</td>
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<tr>
<td>Anterior or posterior</td>
<td>48</td>
<td>42</td>
<td>87.50 (78.14-96.86)</td>
<td>.64</td>
<td></td>
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<tr>
<td>Multiple</td>
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<td>6</td>
<td>75.00 (44.99-100.00)</td>
<td>.64</td>
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<tr>
<td>Radial</td>
<td>80</td>
<td>69</td>
<td>86.25 (78.70-93.80)</td>
<td>.64</td>
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<td>Lymph node status</td>
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<tr>
<td>Negative</td>
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<td>185</td>
<td>86.05 (81.41-90.68)</td>
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<tr>
<td>Positive</td>
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<td>75</td>
<td>89.29 (82.67-95.90)</td>
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<td>ER/PR status</td>
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<tr>
<td>ER and PR negative</td>
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<td>27</td>
<td>84.38 (71.79-96.96)</td>
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<tr>
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<td>237</td>
<td>85.87 (81.76-89.98)</td>
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<td>.04</td>
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<tr>
<td>Yes</td>
<td>70</td>
<td>65</td>
<td>92.86 (86.82-98.89)</td>
<td>.04</td>
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<tr>
<td>No</td>
<td>218</td>
<td>180</td>
<td>82.57 (77.53-87.60)</td>
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<tr>
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<td>23</td>
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<td>.04</td>
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<tr>
<td>Tumor grade</td>
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<td>.07</td>
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<tr>
<td>High</td>
<td>67</td>
<td>56</td>
<td>83.58 (74.71-92.45)</td>
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<tr>
<td>Low or medium</td>
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<td>208</td>
<td>86.31 (81.97-90.65)</td>
<td>.07</td>
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<tr>
<td>Unknown</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>.07</td>
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Abbreviations: DCIS, ductal carcinoma in situ; ER, estrogen receptor; PR, progesterone receptor.
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We identified 14.1% of patients with positive margins in our study who did not undergo any reexcision. This finding is notable given that positive margins (tumor at inked margin) have been correlated with a long-term increased risk of local recurrence and are therefore almost uniformly reexcised. A recent meta-analysis has suggested that the odds of local recurrence were 2.42 for women undergoing breast conservation with positive margins compared with negative margins.

Surveys among surgeons have also indicated consensus on the intent to reexcise positive margins following breast conservation. Our study may indicate that surgeon intent and actual clinical practice patterns do not necessarily have full correlation. We examined some clinical factors associated with reexcision and identified that surgeons were less likely to reexcise positive margins for invasive ductal carcinoma compared with invasive lobular carcinoma (83.07 vs 98.25%, \(P = .003\)). This may be due to the concern that invasive lobular cancer is often considered to have less distinct borders and may contribute to the greater tendency of reexcision of positive margins involving invasive lobular carcinoma.

We also observed variation in the reexcision of positive margins among institutions, with rates ranging between 73.7% and 93.5% (\(P = .003\)). This may reflect institutional variation in surgeons' training, regional variation in interpretation of the required criteria for reexcision, or both. Specific pathological features (eg, extent of intraductal component), clinical characteristics (eg, volume of breast tissue, intent for adjuvant radiation therapy), and patient decision making roles that may have influenced the decision not to reexcise a positive margin were not determined in our study. We assume that some of the variation may be explained by differences in the perceived risk of residual tumor based on the extent of margin positivity (eg, focally positive margins vs extensive involvement). The overall low number of patients with positive margins not undergoing reexcision precluded multivariable analysis.

Controversy regarding the necessity of reexcision for patients with pathologically clear margins exists because there is no current consensus on the appropriate distance required for a clear margin to be deemed adequate. Although the goal of reexcision is to further reduce the risk of breast cancer recurrence and mortality, the true benefit of reexcision remains undetermined. Nearly half of reexcision specimens do not harbor residual cancer. In our study, we found that 47.9% of patients with clear but less than 1.0-mm margins underwent reexcision, and 20.2% of patients with margins between 1.0 and 1.9 mm underwent reexcision.

These reexcision rates are considerably lower than would be predicted based on 3 recent surveys of practice patterns for close margins. These surveys highlighted the inconsistency of reported practice patterns and physician interpretation of an acceptable margin distance. In the study by Blair et al, the majority of surgeons indicated more than 1-mm margins were required and a significant minority (30%) indicated a greater distance of 2-mm margins as acceptable. In the study by Azu et al, when surgeons were given a scenario of a patient with a small (0.8 cm) invasive cancer, 11.2% accepted tumor not touching ink, 42% accepted 1- to 2-mm margins, 27.9% accepted at least 5-mm margins, and 18.9% desired more than 10-mm margins. Our study indicates that surgeons' actual clinical practices differ dramatically from these survey results. Although the Azu et al study suggests a 5-mm margin is desired by 46% of surgeons, we identified 535 patients with 2.0- to 4.9-mm margins, only 26 (4.86%) of whom had reexcisions.

The effect of close but negative margins on local recurrence rates has not been conclusively determined and reexcision under these circumstances may or may not influence rates of recurrence. Some studies have shown an increase in local recurrence risk in the presence of close margins (>0.2 mm), while other studies have demonstrated no difference compared with widely negative margins. Achieving greater margin distance (1 mm vs 2 mm vs 5 mm) was recently demonstrated in a meta-analysis to not be associated with differences in local recurrence rates, especially after adjusting for adjuvant therapy use.

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Additionally, based on survey reports, there appears to be variation in practice patterns among surgeons regarding the use of reexcision based on both margin distance and tumor histology present at the closest margin (DCIS vs invasive cancer).\(^ {19,26}\) In light of the large number of new cases of breast cancer diagnosed each year in the United States (182,460 in 2008), this variation in surgical practice patterns could have an enormous outcome on health care costs nationwide (American Cancer Society, http://www.cancer.org/index). Given the current degree of practice variation we have demonstrated in the management of close margins, as well as the potential effect on both local recurrence and the number of additional surgical procedures, it is critical that we continue to understand actual clinical practice patterns beyond physician survey reports.

We identified that individual institutions vary significantly in reexcision rates, which to a large degree reflects the sum of margin distance and tumor characteristics. Possible explanations might include differences in surgical training, surgeon confidence in their operative technique in localizing tumors, utilization of intraoperative assessment of margins, and surgeon’s and pathologist’s coordination of specimen orientation and margin interpretation. Surgical experience may play a role, but we did not observe differences in reexcision rates between high- and low-volume surgeons. Variability of what surgeons accept to be an adequate margin, as demonstrated by the aforementioned survey data, may therefore be a larger factor in the actual clinical variation in reexcision rates we observed.

The implications of variation in clinical practice of reexcision for positive and close margins warrants additional study, specifically as it relates to local recurrence health care costs and patients’ perceived quality of health. We are aware of 1 recent comparative effectiveness study\(^ {27}\) that reported individual surgeon variation may contribute to long-term differences in breast cancer ipsilateral recurrence rates in patients with DCIS. Whether these findings would be similar for patients with invasive breast cancer warrants additional study.

A major limitation of our study is the absence of data regarding decision making factors influencing treatment options. For example, we do not know how patient preferences affect observed reexcision rates. Additionally, we were not able to control for factors such as specific pathology methods or reporting structure of breast cancer specimens. Our study, however, is likely more generalizable to community-
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all survival could be affected by variability in initial surgical care. Even in the absence of effects on local control, the wide level of unexplained clinical variation itself represents a potential barrier to high-quality and cost-effective care of patients with breast cancer. Continued comparative effectiveness research of breast cancer surgery requires further attention to better determine the association of initial surgical care with long-term patient outcomes.

Author Contributions: Dr McCall had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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