


















RESEARCH

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Reoperation rates following breast-conserving surgery in a contemporary cohort

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Abstract

Background Breast-conserving surgery (BCS) followed by adjuvant radiotherapy is the standard of care for early-stage breast cancer. However, reoperations after BCS may compromise aesthetic outcomes, increase surgical complications, and cause psychological distress. This study aimed to determine the reoperation rate after BCS in a multi-institutional cohort from Brazil and to identify predictive factors associated with reoperation.

Methods This retrospective multicenter cohort study included female breast cancer patients (AJCC clinical stage 0–III) who underwent BCS followed by adjuvant radiotherapy at six treatment centers in Brazil between January 2016 and December 2022. Logistic regression was used to assess the association between potential risk factors and reoperation.

Results The overall reoperation rate was 5.2%, with a higher rate in the public hospital (9.9%) than in private hospitals (4.8%). Patients had a mean age of 58.2 years, with 70.5% aged over 50; 58.3% were White, and 89.8% were treated in private settings. The most common histological type was invasive ductal carcinoma (67.0%), with AJCC stage I (49.3%) and hormone receptor–positive tumors (54.6%) predominating. Logistic regression showed that ductal carcinoma in situ (DCIS) was significantly associated with an increased risk of reoperation (OR 2.59, 95% CI 1.08–5.76, $p=0.024$), whereas the absence of multifocal tumors was associated with a reduced risk (OR 0.37, 95% CI 0.16–0.98, $p=0.031$).

Conclusion Reoperation after BCS was infrequent in this cohort. DCIS was associated with an increased risk of reoperation, whereas the absence of multifocal disease was associated with a reduced risk. Higher reoperation rates observed in the public hospital should be interpreted with caution given the limited representation of this setting.

Keywords Breast-conserving surgery, Reoperation, Surgical margins, Re-excision, Breast cancer, Oncoplastic breast surgery

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Introduction

Breast-conserving surgery (BCS), combined with adjuvant radiotherapy, is well established as the standard of care for early-stage breast cancer [1, 2]. This approach provides superior cosmetic outcomes without compromising overall survival, as demonstrated by landmark trials conducted by the National Surgical Adjuvant Breast and Bowel Project (NSABP) and the Milan group, which showed equivalent long-term survival between BCS and mastectomy [1, 2].

Despite its benefits, the adoption of BCS has fluctuated over recent decades [3, 4]. After a steady increase until 2005, a subsequent decline was observed [5]. This trend has been attributed to increased detection of multifocal disease with magnetic resonance imaging (MRI), expanded use of genetic testing for hereditary risk, and the Early Breast Cancer Trialists' Collaborative Group (EBCTCG) meta-analysis highlighting the importance of local control for survival [6–8].

From 2016 onwards, updated guidelines on margin management were associated with renewed use of BCS [9–11]. However, positive surgical margins remain a significant challenge and are strongly associated with local recurrence, underscoring the importance of achieving clear margins at the initial surgery [10, 11].

Several factors predict positive margins after BCS, including younger age, larger tumor size, multifocality, lobular histology, lymphovascular invasion, ductal carcinoma in situ (DCIS), nodal involvement, and microcalcifications on mammography [12–14]. These factors increase the likelihood of re-excision, which may lead to poorer aesthetic outcomes, increased healthcare costs, and greater psychological distress [15]. A meta-analysis reported that approximately one-quarter of patients undergoing BCS required re-excision, even with negative initial margins [10]. Re-excision is also associated with worse patient-reported outcomes, including lower breast satisfaction and impaired sexual well-being, as measured by instruments such as the BREAST-Q [16].

Historically, reoperation rates ranged from 23%–38% [7, 8], but more recent studies report rates of approximately 10–15%, particularly after the adoption of standardized margin guidelines [17–19]. Despite this decline, reoperation remains clinically relevant, highlighting the need to further optimize surgical outcomes and reduce patient morbidity.

In Latin America, particularly in Brazil, data on reoperation after BCS remain limited, especially in health-care systems with disparities between public and private sectors. This study aims to analyze reoperation rates in a multicenter cohort from Brazil, identify predictive factors, and provide evidence-based insights that can inform clinical practice improvements.

Methods

Study design, participants, and setting

A retrospective multicenter cohort study was conducted among female breast cancer patients (ICD-10 C50) who underwent breast-conserving surgery followed by adjuvant radiotherapy at six treatment centers in Brazil (five private and one public). Participating centers were selected based on investigator collaboration and availability of complete clinical data. The private institutions included specialized oncology centers and hospitals with dedicated breast surgery teams, while the public institution was a tertiary referral hospital providing breast cancer care within a structured surgical oncology service.

A total of 704 patients were screened for eligibility, of whom six were excluded based on predefined criteria, resulting in a final cohort of 698 patients.

Eligible patients were women aged ≥ 18 years with American Joint Committee on Cancer (AJCC) clinical stage 0–III breast cancer who underwent breast-conserving surgery between January 2016 and December 2022. Patients younger than 65 years who did not receive adjuvant radiotherapy were excluded, whereas patients aged ≥ 65 years could be included regardless of radiotherapy use, in accordance with evidence supporting the omission of radiotherapy in selected older patients. Patients who received neoadjuvant systemic therapy prior to breast-conserving surgery were included. Data were collected from both physical and electronic medical records.

Variables

The variables included were age, ethnicity, marital status, education level, originating hospital, AJCC clinical stage, date of diagnosis, tumor histology, immunohistochemistry (St. Gallen 2022 guidelines), tumor grade, cell proliferation index, date of surgery, surgery procedure, margin shaving, frozen section, margin status, multifocal tumors, residual burden cancer, chemotherapy, radiotherapy, hormone therapy, metastatic sites and date of diagnosis, last follow-up date, vital status, cause of death, and date of death. Therapeutic mastoplasty was defined as an oncoplastic breast-conserving surgery technique using volume displacement approaches.

Outcome

The primary endpoint of this study was reoperation, defined as any additional surgical procedure performed following initial breast-conserving surgery (BCS) to achieve clear surgical margins. Intraoperative assessment of surgical margins was routinely performed using frozen section analysis, except in one public hospital that did not have access to this technology. The decision to perform shaving was made at the surgeon's discretion. A “no ink on tumor” criterion was used to define negative margins

Table 1 Sociodemographic and clinicopathological characteristics of the study population

Variables	Total N=698 (%)
Age (mean, SD)	58.2 (13.0)
Age group	
<= 35	17 (2.4)
> 35 to 40	41 (5.9)
> 40 to 50	148 (21.2)
> 50 to 65	270 (38.7)
> 65	222 (31.8)
Originating Hospital	
Public hospital	71 (10.2)
Private Sector	627 (89.8)
Tumor size (T stage)	
Tis	84 (12.0)
T1	386 (55.3)
T2	187 (26.8)
T3	25 (3.6)
Missing	16 (2.3)
Nodal status (N stage)	
N0	599 (85.8)
N1	87 (12.5)
N2	11 (1.6)
Missing	6 (0.9)
TNM staging	
0	84 (12.1)
I	358 (51.3)
II A	155 (22.2)
II B	61 (8.7)
III A	26 (3.7)
III B	6 (0.9)
Missing	8 (1.1)
Histology	
Invasive ductal carcinoma	468 (67.0)
Ductal carcinoma in situ	84 (12.1)
Invasive lobular carcinoma	66 (9.5)
Others*	70 (10.0)
Missing	10 (1.4)
Grade	
1	138 (19.8)
2	302 (43.3)
3	159 (22.8)
Missing	99 (14.2)
Immunohistochemistry	
Hormone receptor-positive / HER2- negative	381 (54.6)
Hormone receptor-positive / HER2 positive	80 (11.5)
Hormone receptor-negative / HER2 positive	35 (5.0)
Triple-negative	75 (10.7)
Missing	127 (18.2)
Multifocal	
Yes	53 (7.6)
No	500 (71.6)
Missing	145 (20.7)
Surgery	
Lumpectomy	558 (79.9)

Table 1 (continued)

Variables	Total N = 698 (%)
Therapeutic mammoplasty	140 (20.1)
Frozen section	
Yes	463 (66.3)
No	228 (32.7)
Variables	Total
Missing	7 (1.0)
Shaving	
Yes	206 (29.5)
No	484 (69.3)
Missing	8 (1.1)
Margin Status	
Positive	36 (5.2)
Negative	629 (94.8)
Reoperate	
Yes	37 (5.2)
No	661 (94.8)
Chemotherapy	
Neoadjuvant chemotherapy	144 (20.6)
Adjuvant chemotherapy	141 (20.2)
Did not receive	380 (54.4)
Missing	33 (4.7)
Radiotherapy	
Adjuvant radiotherapy	639 (91.5)
Did not receive	35 (5.0)
Missing	24 (3.4)
Endocrine therapy	
Adjuvant endocrine therapy	492 (70.5)
Did not receive	167 (23.9)
Missing	39 (5.6)

*Others: Mixed carcinoma (56), Invasive tubular carcinoma (7), Invasive cribriform (4), Invasive adenoid cystic carcinoma (1), Invasive squamous cell carcinoma (1), Invasive metaplastic carcinoma (1)

at BCS. Margins were categorized as positive if a tumor was at the inked margin in the pathology report. Positive margins necessitated re-excision with wider margins.

Adjuvant whole-breast radiotherapy, with or without regional nodal irradiation, was administered according to international guidelines. Postoperative follow-up was conducted as per standard practice.

Statistical analysis

Continuous variables were described using means and standard deviations (SD) or medians and interquartile ranges (IQR), depending on their distribution. Categorical variables were presented as absolute (n) and relative (%) frequencies. Missing data were not imputed and were excluded from the analyses.

A logistic regression model was used to evaluate the association between potential risk factors and reoperation. Variables considered clinically relevant and those associated with the outcome in univariable analysis were included in the multivariable model. Age and histological

subtype were not retained in the final model due to lack of statistical significance in univariable analysis. Crude and adjusted odds ratios (OR), with corresponding 95% confidence intervals (CI), and p-values derived from the Wald test were calculated. Statistical analyses were performed using R for Windows version 4.4.3. A p-value < 0.05 was considered statistically significant.

Ethical aspects

This study was approved by the Institutional Review Board of Instituto D'Or de Pesquisa e Ensino (reference number 6,907,736). The requirement for informed consent was waived by the Institutional Review Board due to the retrospective nature of the study and the use of anonymized patient data. All procedures were conducted in accordance with the ethical standards of the institutional and national research committee, as well as with the Declaration of Helsinki and Brazilian National Health Council Resolution No. 466/12.

Table 2 Characteristics associated with reoperation following breast-conserving surgery

Variable	Reoperation (n=37)	No Reoperation (n=661)
Age (mean, SD)	54.7 (10.3)	58.1 (13.0)
DCIS (%)	9 (10.3)	78 (89.7)
Multifocal tumors (%)	7 (13.2)	46 (86.8)
Lumpectomy (%)	30 (5.4)	528 (94.6)
Therapeutic mammoplasty (%)	7 (5.0)	133 (95.0)
Frozen section used (%)	22 (4.8)	441 (95.2)
Margin shaving (%)	11 (5.3)	195 (94.7)
Positive margins (%)	35 (97.2)	1 (2.8)
Residual tumor in reoperation (%)	25 (92.6)	NA

Table 3 Types of reoperative surgery performed

Variables	TOTAL N=37 (%)
Reoperative surgery	
Wide local excision	24 (64.9)
Simple mastectomy	0 (0.0)
Skin-sparing mastectomy	2 (5.4)
Nipple-sparing mastectomy	10 (27.0)
Modified radical mastectomy	1 (2.7)
Residual tumor cells in reoperation	
Yes	25 (67.6)
No	11 (29.7)
Missing	1 (2.7)

Results

A total of 698 women with breast cancer were included in this study, all of whom underwent breast-conserving surgery. Among these, 37/698 (5.2%) required reoperation. The reoperation rate was higher in patients treated at the public hospital (7/71; 9.9%) compared to those treated in private institutions (30/627; 4.8%). The mean age of the patients was 58.2 years (SD 13.0), with the majority being over 50 years old (492/698; 70.5%). Most patients were of White ethnicity (407/698; 58.3%) and predominantly received care in the private sector (627/698; 89.8%). The most common tumor subtype was invasive ductal carcinoma (468/698; 67.0%), with most patients diagnosed at AJCC stage I (344/698; 49.3%) and presenting with hormone receptor-positive/HER2-negative tumors (381/698; 54.6%) (Table 1).

Regarding surgical techniques, 558/698 patients (79.9%) underwent conventional lumpectomy, while 140/698 (20.1%) received therapeutic mammoplasty (oncoplastic breast-conserving surgery using volume displacement techniques). Intraoperative margin assessment using frozen section analysis was performed in 463/698 cases (66.3%), and cavity margin shaving was employed in 206/698 patients (29.5%) (Table 1). Among the 37 patients who required reoperation, 36/37 (97.3%) presented with positive surgical margins, while one patient

(1/37; 2.7%) with a negative margin underwent reoperation due to margin narrowness and disease extent. Notably, among patients with positive surgical margins, nearly all underwent reoperation, except for one case with focal minimal margin involvement in which reoperation was omitted based on shared decision-making. Residual tumor cells were identified in 25/37 patients (67.6%) who underwent reoperation (Table 2).

Among patients who underwent reoperation, the majority (24/37; 64.9%) were treated with wide local excision. Nipple-sparing mastectomy was performed in 10/37 patients (27.0%), while 2/37 (5.4%) underwent skin-sparing mastectomy. One patient (1/37; 2.7%) required a modified radical mastectomy (Table 3).

Logistic regression analysis identified significant predictive factors for reoperation. Ductal carcinoma in situ (DCIS) was associated with a higher risk of reoperation (OR 2.59, 95% CI 1.08–5.76, $p=0.024$). In contrast, the absence of multifocal tumors was associated with a reduced risk of reoperation (OR 0.37, 95% CI 0.16–0.98, $p=0.031$) (Table 4).

Discussion

This multicenter study demonstrated a low overall reoperation rate of 5.2%, with higher rates observed in the public hospital compared to private institutions. Reoperation was predominantly driven by positive surgical margins, with residual tumor identified in a substantial proportion of re-excisions. In multivariable analysis, DCIS was associated with an increased risk of reoperation, whereas the absence of multifocal disease was associated with a reduced risk.

These findings are consistent with international quality benchmarks. The European Society of Breast Cancer Specialists (EUSOMA) recommends single-surgery rates of at least 80% for invasive cancer and 70% for in situ disease, with an optimal target of 90% [20]. Similarly, the American Society of Breast Surgeons (ASBrS), through the Collaborative Attempt to Lower Lumpectomy Reoperation Rates (CALLER) initiative, proposed reoperation rates below 20% [21]. The low rates observed in our cohort, particularly in private institutions, suggest that these benchmarks are being met or exceeded.

The higher reoperation rate observed in the public hospital suggests potential differences in care delivery. This finding may reflect factors not captured in our dataset; however, it should be interpreted with caution given the limited representation of the public sector in this cohort.

In our analysis, DCIS was independently associated with an increased risk of reoperation, consistent with prior evidence highlighting the challenges of achieving clear margins due to its multifocal and microscopic spread [12, 22, 23]. In contrast, the absence of multifocal disease was associated with a lower likelihood of

Table 4 Logistic regression of risk factors for reoperation following breast-conserving surgery

Reoperation				
Variables	No	Yes	OR (analysis univariable)	OR (analysis multivariable)
Originating Hospital				
Public hospital	64 (90.1)	7 (9.9)	-	-
Private Sector	597 (95.2)	30 (4.8)	0.46 (0.20–1.18, $p=0.077$)	-
DCIS vs. Invasor				
Invasive carcinoma	580 (96.0)	24 (4.0)	-	-
DCIS	75 (89.3)	9 (10.7)	2.37 (1.02–5.04, $p=0.031$)	2.59 (1.08–5.76, $p=0.024$)
Lymph Node Status				
Negative	560 (94.3)	34 (5.7)	-	-
Positive	95 (96.9)	3 (3.1)	0.52 (0.12–1.48, $p=0.286$)	-
Immunohistochemistry				
Hormone receptor-positive / HER2- negative	362 (95.0)	19 (5.0)	-	-
Triple-negative	71 (94.7)	4 (5.3)	1.07 (0.30–2.96, $p=0.900$)	-
Hormone receptor-negative / HER2-positive	32 (91.4)	3 (8.6)	1.79 (0.40–5.60, $p=0.371$)	-
Grade				
1	130 (94.2)	8 (5.8)	-	-
2	288 (95.4)	14 (4.6)	0.79 (0.33–2.02, $p=0.605$)	-
3	149 (93.7)	10 (6.3)	1.09 (0.42–2.93, $p=0.859$)	-
Surgery				
Lumpectomy	528 (94.6)	30 (5.4)	-	-
Therapeutic mastectomy	133 (95.0)	7 (5.0)	0.93 (0.37–2.04, $p=0.859$)	-
Frozen Section				
Yes	441 (95.2)	22 (4.8)	-	-
No	213 (93.4)	15 (6.6)	1.41 (0.70–2.76, $p=0.318$)	-
Shaving				
Yes	195 (94.7)	11 (5.3)	-	-
No	459 (94.8)	25 (5.2)	0.97 (0.48–2.08, $p=0.925$)	-
Multifocal				
Yes	46 (86.8)	7 (13.2)	-	-
No	475 (95.0)	25 (5.0)	0.35 (0.15–0.91, $p=0.020$)	0.37 (0.16–0.98, $p=0.031$)
Margin status				
Positive	1 (2.8)	35 (97.2)	-	-
Negative	591 (99.7)	2 (0.3)	0.00 (0.00–0.00, $p<0.001$)	-
Neoadjuvant chemotherapy				
Yes	522 (94.2)	32 (5.8)	-	-
No	139 (96.5)	5 (3.5)	0.59 (0.20–1.41, $p=0.277$)	-

Odds Ratios (OR), respective 95% Confidence Interval (CI) and p -values

reoperation, reinforcing the importance of accurate pre-operative assessment and surgical planning.

Notably, other established predictors of reoperation, including younger age, invasive lobular carcinoma, and hormone receptor status, were not significantly associated with reoperation in our study. This divergence from prior reports may reflect the relatively homogeneous profile of our cohort, predominantly composed of early-stage, hormone receptor-positive, and invasive ductal carcinomas, as well as limitations in sample size and statistical power.

Although cavity shaving was performed in a subset of patients, it was not associated with lower reoperation rates. This finding contrasts with previous evidence,

including a randomized trial demonstrating a reduction in positive margins from 34% to 19%, as well as a meta-analysis reporting a significantly lower risk of reoperation (OR 0.42; 95% CI 0.30–0.59, $p<0.05$) [24, 25]. The absence of benefit in our cohort may reflect its non-standardized use and selective application in more complex cases, as well as limited statistical power given the already low baseline reoperation rate.

Identifying predictors of reoperation remains clinically relevant, as re-excision is associated with increased morbidity and worse patient-reported outcomes. Our findings contribute to this field by providing contemporary data from a middle-income setting with a dual healthcare system.

This study has several limitations. Its retrospective design introduces the potential for selection bias and unmeasured confounding. Missing data were present in some variables, including immunohistochemistry and sociodemographic factors, which were handled according to the study design. In addition, the lack of detailed information on surgical techniques, margin width, and intraoperative assessment limits further interpretation of factors associated with reoperation.

Despite these limitations, the multicenter design enhances the generalizability of the findings, although the cohort was predominantly composed of patients treated in private institutions. The low reoperation rates observed, particularly in private settings, suggest that high-quality surgical outcomes are achievable within this context. The disparity observed between healthcare sectors underscores the need for strategies to ensure equitable access to optimized breast cancer surgical care.

Conclusion

This multicenter study demonstrated low reoperation rates following breast-conserving surgery in this cohort. DCIS increased the likelihood of reoperation, whereas the absence of multifocal disease was protective. Differences between healthcare settings suggest potential disparities in surgical care delivery. Further prospective studies are warranted to validate these findings and support strategies to optimize outcomes across diverse practice settings.

Abbreviations

AJCC	American Joint Committee on Cancer
DCIS	Ductal carcinoma in situ
BCS	Breast-conserving Surgery
CI	Confidence interval
IQR	Interquartile range
NSABP	National Surgical Adjuvant Breast and Bowel Project
OR	Odds ratio
SD	Standard deviations

Acknowledgements

The authors would like to thank all the patients and family members, and the staff from all the units who made this study possible.

Clinical trial number

Not applicable.

Authors' contributions

Conceptualization – ADNL, ECM, JB, FPC, FPZ, AM, MA, FPB, ALF Data curation – ADNL, ECM, JB Formal analysis – ADNL, ECM, FPZ, AM, MA Funding acquisition - Absence acquisition of the financial support for the project. Investigation – ADNL, ECM, FPC, FPZ, AM, MA, FPB, ALF, AQG, MBPL, AFOA, DPT, EG, ML, CFFL, RZT Project administration – ADNL, ECM, JB Resources – ADNL, ECM, JB, ALF Supervision – ADNL, ECM, JB, ALF Validation – ADNL, ECM, AM, FPC, MA Visualization – ADNL, ECM Writing – original draft – ADNL, ECM, JB, FPC, FPZ, AM, MA, ALF Writing – review & editing – ADNL, ECM, JB, FPC, FPZ, AM, MA, ALF.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

Data availability

The data underlying the results presented in this manuscript were collected using REDCap and are available upon request to qualified researchers. Requests should be directed to the corresponding author at [annedominiquelima@gmail.com].

Declarations

Ethics approval and consent to participate

This study was approved by the Institutional Review Board of Instituto D'OR de Pesquisa e Ensino (reference number 6,907,736). Informed consent was waived by the Ethics Committee due to the retrospective nature of the study and the use of anonymized patient data.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Received: 12 August 2025 / Accepted: 30 April 2026



References

- Veronesi U, Cascinelli N, Mariani L, Greco M, Saccozzi R, Luini A, et al. Twenty-year follow-up of a randomized study comparing breast-conserving surgery with radical mastectomy for early breast cancer. *N Engl J Med*. 2002;347(16):1227–32. <https://doi.org/10.1056/NEJMoa020989>.
- Fisher B, Jeong JH, Anderson S, Bryant J, Fisher ER, Wolmark N. Twenty-five-year follow-up of a randomized trial comparing radical mastectomy, total mastectomy, and total mastectomy followed by irradiation. *N Engl J Med*. 2002;347(8):567–75. <https://doi.org/10.1056/NEJMoa020128>.
- Morrow M, Harris JR, Schnitt SJ. Surgical margins in lumpectomy for breast cancer—bigger is not better. *N Engl J Med*. 2012;367(1):79–82. <https://doi.org/10.1056/NEJMs1202521>.
- Morrow M, Katz SJ. Margins in ductal carcinoma in situ: Is bigger better? *J Natl Cancer Inst*. 2012;104(7):494–5. <https://doi.org/10.1093/jnci/djs165>.
- Mahmood U, Hanlon AL, Koshy M, Buras R, Chumsri S, Tkaczuk KH, et al. Increasing national mastectomy rates for the treatment of early-stage breast cancer. *Ann Surg Oncol*. 2013;20(5):1436–43. <https://doi.org/10.1245/s10434-012-2732-5>.
- Houssami N, Turner R, Morrow M. Preoperative magnetic resonance imaging in breast cancer: meta-analysis of surgical outcomes. *Ann Surg*. 2013;257(2):249–55. <https://doi.org/10.1097/SLA.0b013e31827a8d17>.
- Chiba A, Hoskin TL, Hallberg EJ, Cogswell JA, Heins CN, Couch FJ, et al. Impact that timing of genetic mutation diagnosis has on surgical decision making and outcome for BRCA1/BRCA2 mutation carriers with breast cancer. *Ann Surg Oncol*. 2016;23(10):3232–8. <https://doi.org/10.1245/s10434-016-5328-7>.

8. Clarke M, Collins R, Darby S, Davies C, Elphinstone P, Evans V, et al. Effects of radiotherapy and differences in the extent of surgery for early breast cancer on local recurrence and 15-year survival: an overview of the randomised trials. *Lancet*. 2005;366(9503):2087–106. [https://doi.org/10.1016/S0140-6736\(05\)67887-7](https://doi.org/10.1016/S0140-6736(05)67887-7).
9. Morrow M, Abrahamse P, Hofer TP, Ward KC, Hamilton AS, Kurian AW, et al. Trends in reoperation after initial lumpectomy for breast cancer. *JAMA Oncol*. 2017;3(10):1352–7. <https://doi.org/10.1001/jamaoncol.2017.0774>.
10. Moran MS, Schnitt SJ, Giuliano AE, Harris JR, Khan SA, Horton J, et al. Society of surgical oncology–American society for radiation oncology consensus guideline on margins for breast-conserving surgery. *J Clin Oncol*. 2014;32(14):1507–15. <https://doi.org/10.1200/JCO.2013.53.3935>.
11. Morrow M, Van Zee KJ, Solin LJ, Houssami N, Chavez-MacGregor M, Harris JR, et al. Consensus guideline on margins for breast-conserving surgery in DCIS. *Ann Surg Oncol*. 2016;23(12):3801–10. <https://doi.org/10.1245/s10434-016-5449-z>.
12. Waljee JF, Hu ES, Newman LA, Alderman AK. Predictors of re-excision among women undergoing breast-conserving surgery. *Ann Surg Oncol*. 2008;15(5):1297–303. <https://doi.org/10.1245/s10434-007-9777-x>.
13. Schiller DE, Le LW, Cho BC, Youngson BJ, McCready DR. Factors associated with negative margins of lumpectomy specimen. *Ann Surg Oncol*. 2008;15(3):833–42. <https://doi.org/10.1245/s10434-007-9711-2>.
14. Aziz D, Rawlinson E, Narod SA, Sun P, Lickley HL, McCready DR, et al. The role of reexcision for positive margins. *Breast J*. 2006;12(4):331–7. <https://doi.org/10.1111/j.1075-122X.2006.00271.x>.
15. King TA, Sakr R, Patil S, Gurevich I, Stempel M, Sampson M, et al. Clinical management factors contribute to surgical decisions. *J Clin Oncol*. 2011;29(16):2158–64. <https://doi.org/10.1200/JCO.2010.29.4041>.
16. Matar-Ujvary R, Haglich K, Flanagan MR, Fuzesi S, Sevilimedu V, Nelson JA, et al. Impact of re-excision on patient-reported outcomes using the BREAST-Q. *Ann Surg Oncol*. 2023;30(9):5341–9. <https://doi.org/10.1245/s10434-023-13592-3>.
17. Havel L, Naik H, Ramirez L, Morrow M, Landercasper J. Impact of margin guideline on re-excision rates. *Ann Surg Oncol*. 2019;26(5):1238–44. <https://doi.org/10.1245/s10434-019-07247-5>.
18. Kuritzky A, Reyna C, McGuire KP, Sun W, DeSnyder SM, Aubry S, et al. Evaluation of margin guidelines on re-excision. *Breast*. 2020;51:29–33. <https://doi.org/10.1016/j.breast.2020.02.013>.
19. Monaghan A, Chapinal N, Hughes L, Baliski C. Impact of margin guidelines on reoperation rates. *Am J Surg*. 2019;217(5):862–7. <https://doi.org/10.1016/j.amjsurg.2019.01.007>.
20. Rubio IT, Marotti L, Biganzoli L, Aristei C, Athanasiou A, Campbell C, et al. EUSOMA quality indicators for non-metastatic breast cancer: an update. *Eur J Cancer*. 2024;198:113500. <https://doi.org/10.1016/j.ejca.2023.113500>.
21. Landercasper J, Attai D, Atisha D, Beitsch P, Bosserman L, Boughey J, et al. Toolbox to reduce lumpectomy reoperations. *Ann Surg Oncol*. 2015;22(10):3174–83. <https://doi.org/10.1245/s10434-015-4759-x>.
22. Jung W, Kang E, Kim SM, Kim D, Hwang Y, Sun Y, et al. Factors associated with re-excision after BCS. *J Breast Cancer*. 2012;15(4):412–9. <https://doi.org/10.4048/jbc.2012.15.4.412>.
23. Wolf JH, Wen Y, Axelrod D, Roses D, Guth A, Shapiro R, et al. Higher volume reduces re-excision in DCIS. *Int J Surg Oncol*. 2011;2011:785803. <https://doi.org/10.1155/2011/785803>.
24. Chagpar AB, Killelea BK, Tsangaris TN, Butler M, Stavris K, Li F, et al. Randomized trial of cavity shave margins. *N Engl J Med*. 2015;373(6):503–10. <https://doi.org/10.1056/NEJMoa1504473>.
25. Wang K, Ren Y, He J. Cavity shaving versus lumpectomy alone: meta-analysis. *PLoS ONE*. 2017;12(1):e0168705. <https://doi.org/10.1371/journal.pone.0168705>.
26. Jeevan R, Cromwell DA, Trivella M, Lawrence G, Kearins O, Pereira J, et al. Reoperation rates after breast-conserving surgery. *BMJ*. 2012;345:e4505. <https://doi.org/10.1136/bmj.e4505>.
27. McCahill LE, Single RM, Aiello Bowles EJ, Feigelson HS, James TA, Barney T, et al. Variability in reexcision following breast conservation surgery. *JAMA*. 2012;307(5):467–75. <https://doi.org/10.1001/jama.2012.43>.
28. Boughey JC, Hieken TJ, Jakub JW, Degnim AC, Grant CS, Farley DR, et al. Impact of frozen section margin analysis. *Surgery*. 2014;156(1):190–7. <https://doi.org/10.1016/j.surg.2014.03.025>.
29. Morrow M, Jagsi R, Alderman AK, Griggs JJ, Hawley ST, Hamilton AS, et al. Surgeon recommendations and mastectomy rates. *JAMA*. 2009;302(14):1551–6. <https://doi.org/10.1001/jama.2009.1450>.

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