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Original article

Survival outcomes after standard breast conserving surgery versus oncoplastic breast conserving surgery in breast cancer patients: A multicenter real-world evidence cohort study

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ABSTRACT

Background: Standard breast-conserving surgery (S-BCS) followed by radiotherapy is the preferred locoregional treatment for early-stage breast cancer but may result in unfavorable cosmetic outcomes, particularly in patients with small breasts. Oncoplastic breast-conserving surgery (O-BCS), allows wider resections while preserving breast shape. Although esthetic benefits are well established, data comparing long-term oncologic outcomes remain limited.
Objective: To compare oncologic outcomes between O-BCS and S-BCS in a multicenter real-world cohort.
Methods: This multicenter retrospective cohort study included women aged ≥ 18 years with stage 0–III breast cancer who underwent BCS followed by adjuvant radiotherapy between 2016 and 2022 at six institutions in Brazil. Survival outcomes were estimated using Kaplan–Meier methods and compared using multivariable Cox proportional hazards models adjusted for clinical stage.
Results: A total of 685 patients were included, of whom 550 (80.3%) underwent S-BCS and 135 (19.7%) O-BCS. Patients treated with O-BCS more frequently presented with advanced disease (≥IIB: 24.8% vs. 10.8%; $p < 0.001$). No statistically significant differences in survival outcomes were observed. At 60 months, LRRFS was 90.0% for S-BCS and 96.3% for O-BCS (HR 0.35; $p = 0.085$), RFS was 89.7% and 96.1%(HR 0.36; $p = 0.091$), BCSS was 97.3% and 98% (HR 0.26; $p = 0.198$), and OS 96% and 97.3% (HR 0.53; $p = 0.31$) respectively.
Conclusion: In this multicenter real-world cohort, O_BCS achieved oncologic outcomes comparable to S-BCS despite being used in patients with more advanced disease, supporting its use as a breast-conserving strategy in appropriately selected patients.

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Introduction

Standard breast-conserving surgery (S-BCS) followed by adjuvant radiotherapy is the preferred locoregional treatment for early-stage breast cancer, with long-term survival outcomes comparable to those of mastectomy.[1,2] The primary goal of this approach is complete tumor excision while preserving breast form and minimizing treatment-related morbidity. Nevertheless, unfavorable cosmetic outcomes remain a relevant concern. Up to 25–30% of patients may develop significant breast deformities after conventional BCS, particularly when tumors are large relative to breast volume or located in cosmetically challenging regions.[3]

Oncoplastic breast surgery (O-BCS) or therapeutic mammoplasty was developed to address these limitations and expand the indications for breast conservation.[4] By integrating oncologic principles with reconstructive techniques, O-BCS allows wider excisions while maintaining breast shape and symmetry.[5,6] Common approaches include volume displacement and volume replacement techniques, often combined with contralateral symmetrization when appropriate.[5,7–9]

Beyond improved esthetic outcomes, several studies have demonstrated potential oncologic and surgical advantages of oncoplastic techniques, including higher rates of negative margins and lower reoperation rates compared with standard BCS.[10,11] Patient-reported outcome measures have also shown superior cosmetic satisfaction and psychosocial well-being when compared with mastectomy followed by immediate reconstruction.[12] In addition, economic analyses suggest that O-BCS is a cost-effective surgical strategy.[5,13]

Despite these favorable findings, concerns regarding the oncologic safety of O-BCS persist, particularly in patients with more advanced tumors requiring larger resections. Importantly, most available evidence is derived from heterogeneous cohorts, and direct comparisons between o-BCS and S-BCS remain limited. Addressing this gap is essential to inform surgical decision-making and support the broader adoption of oncoplastic techniques.

Therefore, this study aimed to compare locoregional recurrence-free survival (LRRFS), recurrence-free survival (RFS), breast cancer–specific survival (BCSS), and overall survival (OS) between therapeutic mammoplasty and standard breast-conserving surgery in a multicenter real-world cohort, assessing whether oncologic outcomes remain comparable across heterogeneous clinical settings and patient risk profiles.

Methods

Study design, participants, and setting

This was a multicenter retrospective cohort study based on data from the cooperative project Reoperation Rates Following Breast-Conserving Surgery in a Brazilian Contemporary Cohort, which prospectively collected standardized clinical and surgical information from six breast cancer referral centers in Brazil. For the present analysis, we included women aged 18 years or older with a diagnosis of breast cancer (ICD-10 code C50) who underwent breast-conserving surgery followed by adjuvant radiotherapy between January 2016 and December 2022.

Eligible patients had American Joint Committee on Cancer (AJCC) clinical stage 0–III disease at diagnosis. Patients were excluded if they underwent primary mastectomy, presented with metastatic (stage IV) disease, or had a prior history of breast cancer surgery. The patient selection process, including inclusion and exclusion criteria, is detailed in Fig. 1. The study was designed and reported in accordance with the STROBE guidelines for observational studies.[14]. The principal investigators and centers participants are listed in supplementary table 1.

Definition of conventional and oncoplastic breast-conserving surgery techniques

S-BCS was defined as lumpectomy or wide local excision performed with the intent of tumor removal, with or without simple glandular remodeling. O-BCS was strictly defined as therapeutic mammoplasty, including Wise-pattern, vertical, and round block (Benelli) techniques. These procedures involve planned volume displacement and reshaping of breast tissue to allow wider resections while preserving breast contour, frequently accompanied by contralateral symmetrization for symmetry. Volume replacement techniques were not included in the O-BCS group.

Margin status and radiotherapy

Intraoperative margin assessment was performed using frozen section analysis at all participating centers except one public hospital where this resource was unavailable. The use of cavity shave margins was left to surgeon discretion.

Negative margins were defined as *no ink on tumor* for invasive carcinoma. A margin was considered positive when tumor cells were present at the inked surface on final pathology, prompting re-excision according to institutional practice.

Adjuvant radiotherapy to the whole breast, chest wall, and/or regional lymphatics was delivered according to international guidelines. The tumor bed was recommended to be marked intraoperatively with 2–3 titanium clips. However, administration of a tumor bed boost was not uniformly recorded across institutions and therefore was not included in the comparative analysis. Postoperative follow-up was conducted according to institutional protocols.

Follow-up

Patients were followed from the date of surgery until the occurrence of an outcome event or the last recorded clinical follow-up. Follow-up information was obtained through systematic review of medical records and institutional databases. The median follow-up duration was 42 months.

Variables

Collected variables included demographic characteristics (age, ethnicity, marital status, education level), treatment center (public or private), tumor-related variables (histology, grade, clinical stage, multifocality, immunohistochemical subtype according to St. Gallen 2021 criteria, and proliferation index), and treatment-related variables (type of surgery, use of frozen section analysis, cavity shaving, margin status, reoperations, neoadjuvant and adjuvant systemic therapies, radiotherapy, endocrine therapy, targeted therapy, and immunotherapy). Vital status, cause of death, dates of recurrence, metastatic diagnosis, last follow-up, and death were recorded when applicable.

Outcomes

The primary endpoint was LRRFS, defined as the time from the date of surgery to the occurrence of recurrence in the ipsilateral breast and/or ipsilateral axilla. Patients without locoregional recurrence were censored at the date of last follow-up for this outcome. Secondary endpoints included RFS, OS, and BCSS. RFS was defined as the time from the date of surgery to the first occurrence of either locoregional or distant recurrence. OS was defined as the time from the date of surgery to death from any cause, with patients alive at last follow-up censored. BCSS was defined as the time from the date of surgery to death specifically attributable to breast cancer, with deaths from other causes censored.

Statistical analysis

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

Group comparisons for mean age were performed using Student's *t*-test. Categorical variables were compared using Pearson's chi-square test.

Associations between exposure variables and type of surgery were assessed using logistic regression models. Initially, univariate (crude) odds

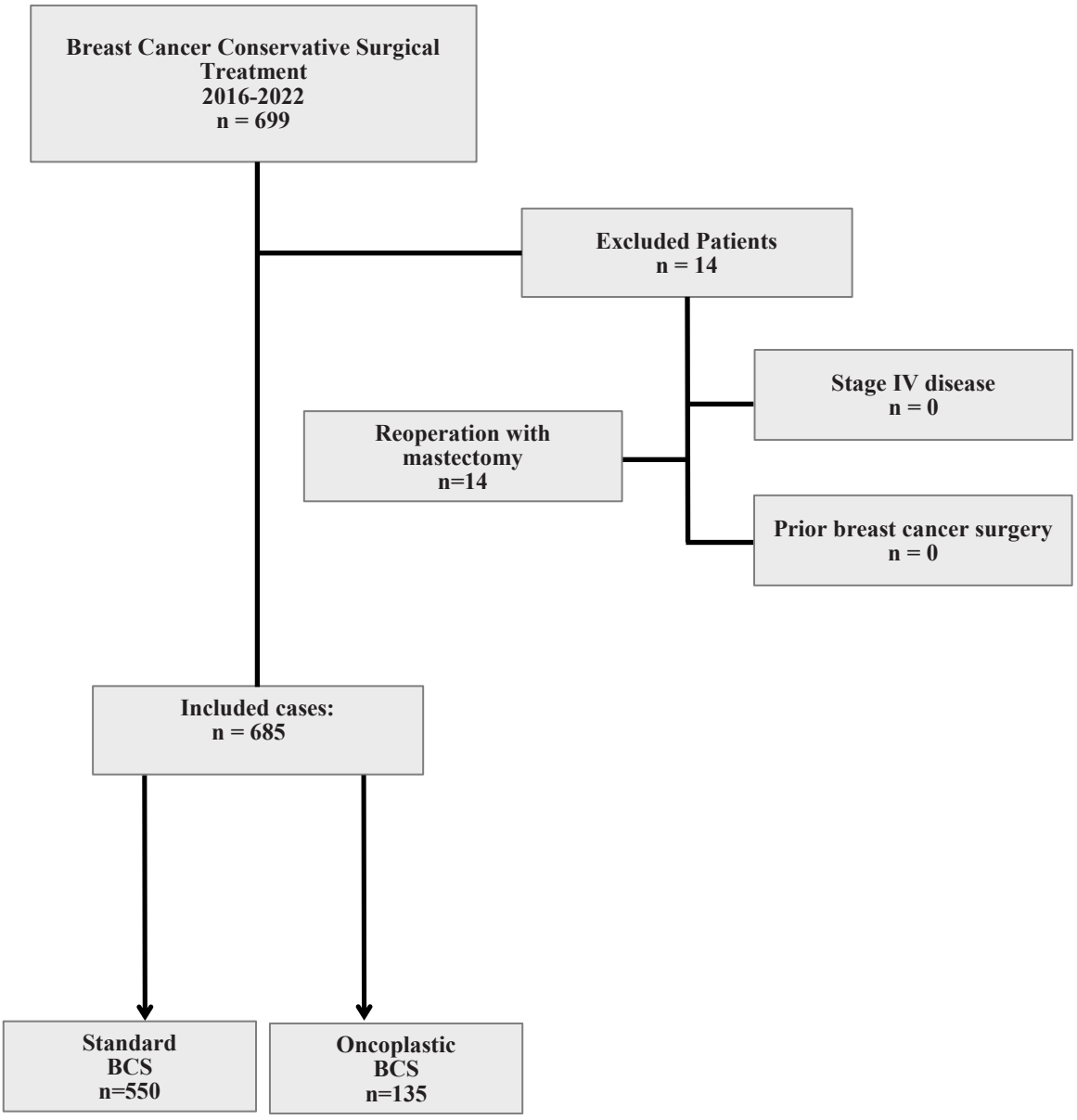

Fig. 1. Flowchart of patient selection and inclusion in the final cohort.

ratios (ORs) were calculated for each variable. Variables with a p-value < 0.02 in univariate analysis were manually entered into a multivariable logistic regression model using a forward stepwise selection method. Variables with p-values < 0.05 were retained in the final model. Adjusted ORs with 95% confidence intervals (95% CI) and corresponding p-values were reported.

Survival analyses were conducted for LRRFS, RFS, OS, and BCSS. Kaplan–Meier estimates were used to generate survival curves, with and without stratification by relevant categorical variables. Curves were compared using the log-rank test. Cox proportional hazards models were fitted to estimate hazard ratios (HRs) with 95% confidence intervals (95% CI). In survival analyses, patients without the event of interest at the last follow-up were censored at that time point.

All statistical analyses were performed using R for Windows (version 4.4.3). Two-sided p-values < 0.05 were considered statistically significant.

Ethical aspects

This study was approved by the IDOR Institutional Review Board (reference 6907,736; amendment 7922,438) and conducted in accordance with the ethical principles established by the Brazilian National Health Council. This study followed the guidelines outlined in Brazilian National Health Council Resolution No. 466/12 and its complementary regulations governing research involving human subjects.

Results

The study cohort included 685 patients who underwent breast-conserving surgery: 550 (80.3%) underwent S-BCS and 135 (19.7%) underwent O-BCS. The mean age was 59.5 years (SD ± 13.3) in the S-BCS group and 53.3 years (SD ± 10.6) in the O-BCS group, with patients undergoing O-BCS being younger on average. The proportion of patients under 50 years was higher in the O-BCS group. Most patients in both groups were white (61.5% in the S-BCS group vs. 44.4% in the O-BCS group), and the majority (89.9%) were treated in private hospitals. Invasive ductal carcinoma was the predominant histological type (68,4%), and hormone receptor-positive tumors were observed in 80% of cases (Table 1).

Tumor characteristics differed significantly between groups, with the O-BCS group having a higher proportion of larger tumors (T2: 36.8% vs. 25.0%; T3: 8.3% vs. 2.6%) and a higher incidence of positive axillary lymph nodes (20.3% vs. 12.8%; p = 0.038). Advanced stages

Table 1
Sociodemographic, clinical, and treatment characteristics of patients undergoing S-BCS versus O-BCS.

Variables	S-BCS (N = 550)	O-BCS (N = 135)	Total	p-value
Age, mean (SD)	59.5 (13.3)	53.3 (10.6)	58.3 (13.0)	< 0.001
Age groups, n%				< 0.001
< = 35	14 (2.5)	3 (2.2)	17 (2.5)	
> 35–40	28 (5.1)	11 (8.1)	39 (5.7)	
> 40–50	110 (20.0)	35 (25.9)	145 (21.2)	
> 50–65	196 (35.6)	67 (49.6)	263 (38.4)	
> 65	202 (36.7)	19 (14.1)	221 (32.3)	
Skin Color, n%				< 0.001
White	338 (61.5)	60 (44.4)	398 (58.1)	
Non-white	212 (38.5)	75 (55.6)	287 (41.9)	
Originating Hospital, n%				0.002
Public hospital	45 (8.2)	24 (17.8)	69 (10.1)	
Private Sector	505 (91.8)	111 (82.2)	616 (89.9)	
Tumor size, n%				< 0.001
T0	1 (0.2)	2 (1.5)	3 (0.4)	
Tis	70 (12.8)	9 (6.8)	79 (11.7)	
T1	320 (58.7)	58 (43.6)	378 (55.8)	
T2	136 (25.0)	49 (36.8)	185 (27.3)	
T3	14 (2.6)	11 (8.3)	25 (3.7)	
T4	2 (0.4)	4 (3.0)	6 (0.9)	
Tx	2 (0.4)	0 (0.0)	2 (0.3)	
Lymph Node Status, n%				0.038
Negative	476 (87.2)	106 (79.7)	582 (85.7)	
Positive	70 (12.8)	27 (20.3)	97 (14.3)	
TNM staging, n%				< 0.001
0	80 (14.7)	13 (9.8)	93 (13.7)	
I	283 (52.0)	52 (39.1)	335 (49.5)	
II A	122 (22.4)	35 (26.3)	157 (23.2)	
II B	42 (7.7)	19 (14.3)	61 (9.0)	
III A	15 (2.8)	10 (7.5)	25 (3.7)	
III B	2 (0.4)	4 (3.0)	6 (0.9)	
Tumor Staging, n%				< 0.001
< =IIA	485 (89.2)	100 (75.2)	585 (86.4)	
> IIA	59 (10.8)	33 (24.8)	92 (13.6)	
Histology, n%				0.032
Invasive ductal carcinoma	370 (67.3)	97 (71.9)	467 (68.4)	
Ductal carcinoma in situ	66 (12.0)	10 (7.4)	76 (11.1)	
Invasive lobular carcinoma	47 (8.5)	19 (14.1)	66 (9.4)	
Others*	67 (12.2)	9 (6.7)	76 (11.1)	
Grade, n%				0.546
1	110 (22.6)	25 (22.1)	135 (22.5)	
2	245 (50.3)	50 (44.2)	295 (49.2)	
3	123 (25.3)	35 (31.0)	158 (26.3)	
Not Applicable	9 (1.8)	3 (2.7)	12 (2.0)	
Immunohistochemistry, n%				0.467
HR+ /HER2-	298 (71.0)	76 (66.1)	374 (69.9)	
Triple-negative	58 (13.8)	15 (13.0)	73 (13.6)	
HR-/HER2 +	26 (6.2)	8 (7.0)	34 (6.4)	
HR+ /HER2 +	38 (9.0)	16 (13.9)	54 (10.1)	
Multifocal, n%				0.369
Yes	38 (8.4)	13 (12.4)	51 (9.1)	
No	403 (88.8)	88 (83.8)	491 (87.8)	
Not Applicable	13 (2.9)	4 (3.8)	17 (3.0)	
Variables	**S-BCS (N = 550)**	**O-BCS (N = 135)**	**Total**	**p-value**
Frozen section, n%				0.015
Yes	375 (68.9)	77 (57.5)	452 (66.7)	
No	169 (31.1)	57 (42.5)	226 (33.3)	
Shaving, n%				0.020
Yes	176 (32.2)	28 (21.4)	204 (30.1)	
No	370 (67.8)	103 (78.6)	473 (69.9)	
Margin Status, n%				0.271
Positive	23 (4.6)	2 (1.8)	25 (4.1)	
Negative	480 (95.4)	111 (98.2)	591 (95.9)	
Re-operative Surgery, n%				0.244
No	528 (96.0)	133 (98.5)	661 (96.5)	
Yes	22 (4.0)	2 (1.5)	24 (3.5)	
Chemotherapy, n%				< 0.001
Did not receive	322 (58.5)	54 (40.0)	376 (54.9)	
Neoadjuvant chemotherapy	100 (18.2)	42 (31.1)	142 (20.7)	
Adjuvant chemotherapy	100 (18.2)	34 (25.2)	134 (19.6)	
Missing	28 (5.1)	5 (3.7)	33 (4.8)	
Radiotherapy, n%				0.158

(*continued on next page*)

Table 1 (*continued*)

Variables	S-BCS (N = 550)	O-BCS (N = 135)	Total	p-value
Did not receive	26 (4.7)	2 (1.5)	28 (4.1)	
Adjuvant radiotherapy	504 (91.6)	130 (96.3)	634 (92.6)	
Missing	20 (3.6)	3 (2.2)	23 (3.4)	
Endocrine Therapy, n%				0.918
Did not receive endocrine therapy	129 (23.5)	32 (23.7)	161 (23.5)	
Neoadjuvant endocrine therapy	2 (0.4)	0 (0.0)	2 (0.3)	
Adjuvant endocrine therapy	383 (69.6)	92 (68.1)	475 (69.3)	
Neo and adjuvant endocrine therapy	7 (1.3)	2 (1.5)	9 (1.3)	
Missing	29 (5.3)	9 (6.7)	38 (5.5)	
Monoclonal antibody, n%				< 0.001
Did not receive	397 (72.2)	77 (57.0)	474 (69.2)	
Neoadjuvant chemotherapy	26 (4.7)	14 (10.4)	40 (5.8)	
Adjuvant chemotherapy	30 (5.5)	3 (2.2)	33 (4.8)	
Missing	97 (17.6)	41 (30.4)	138 (20.1)	
Immunotherapy, n%				0.001
Did not receive	497 (90.4)	108 (80.0)	605 (88.3)	
Neoadjuvant immunotherapy	1 (0.2)	3 (2.2)	4 (0.6)	
Adjuvant immunotherapy	1 (0.2)	0 (0.0)	1 (0.1)	
Missing	51 (9.3)	24 (17.8)	75 (10.9)	

* Others: Mixed carcinoma, Invasive tubular carcinoma, Invasive cribriforme, Invasive adenoid cystic carcinoma, Invasive squamous cell carcinoma, Invasive metaplastic carcinoma.

(≥ IIB) were also more frequent in the O-BCS group (24.8% vs. 10.8%; p < 0.001). Positive margins occurred in 4.6% of S-BCS and 1.8% of O-BCS procedures (p = 0.271) (Table 1).

Survival analyses were performed using multivariable Cox proportional hazards models adjusted for clinical stage. No statistically significant differences were observed between the groups across all endpoints.

Locoregional recurrence-free survival

Locoregional recurrence occurred in 29 of 548 patients (5.3%) in the S-BCS group and in 3 of 135 patients (2.2%) in the O-BCS group. Median LRRFS was not reached in either group during follow-up. At 60 months, the estimated LRRFS rate was 90.0% (95% CI: 86.3–93.8%) in the S-BCS group and 96.3% (95% CI: 91.8–100.0%) in the O-BCS group (Fig. 2). The hazard ratio for O-BCS compared with S-BCS was 0.35 (95% CI: 0.11–1.16; p = 0.085) (Table 2).

Recurrence-free survival

Recurrence events were observed in 29 of 533 patients (5.4%) in the S-BCS group and in 3 of 135 patients (2.3%) in the O-BCS group. Median RFS was not reached in either treatment arm. At 60 months, the estimated RFS rate was 89.7% (95% CI: 85.9–93.6%) for S-BCS and 96.1% (95% CI: 91.6–100.0%) for O-BCS (Fig. 2). Compared with S-BCS, O-BCS was associated with a hazard ratio of 0.36 (95% CI: 0.11–1.18; p = 0.091) (Supplementary Table 2).

Breast cancer-specific survival

Breast cancer–specific deaths occurred in 13 patients (2.4%) in the S-BCS group and in 1 patient (0.7%) in the O-BCS group. Median BCSS was not reached in either group. At 60 months, the estimated BCSS rate was 97.3% (95% CI: 95.4–99.3%) in the S-BCS group and 98.0% (95% CI: 94.3–100.0%) in the O-BCS group (Fig. 2). The hazard ratio for O-BCS versus S-BCS was 0.26 (95% CI: 0.03–2.01; p = 0.198) (Supplementary Table 3).

Overall survival

Deaths from any cause were documented in 19 patients (3.5%) in the S-BCS group and in 3 patients (2.2%) in the O-BCS group. Median overall survival was not reached in either cohort. At 60 months, the estimated OS rate was 96.0% (95% CI: 93.8–98.3%) for S-BCS and 97.3% (95% CI: 93.3–100.0%) for O-BCS (Fig. 2). The hazard ratio for O-BCS compared with S-BCS was 0.53 (95% CI: 0.16–1.81; p = 0.31) (Table 3).

Factors associated with use of oncoplastic surgery

In multivariable logistic regression analysis (Supplementary Table 4), treatment in a private hospital was independently associated with lower odds of undergoing O-BCS (adjusted OR 0.41; 95% CI, 0.24–0.71; p = 0.001). In contrast, patients with clinical stage ≥IIB were significantly more likely to be treated with O-BCS (adjusted OR 2.71; 95% CI, 1.67–4.35; p < 0.001).

Discussion

In this large multicenter real-world cohort, we found no statistically significant differences in locoregional recurrence-free survival, recurrence-free survival, breast cancer–specific survival, or overall survival between patients undergoing therapeutic mammoplasty and those treated with standard breast-conserving surgery. Importantly, these comparable oncologic outcomes were observed despite a higher proportion of patients with larger tumors, nodal involvement, and more advanced clinical stage in the oncoplastic group. Taken together, these findings support the oncologic safety of oncoplastic breast-conserving surgery when appropriately indicated.

These observations reflect routine clinical practice across diverse surgical settings and patient profiles. Despite inclusion of patients with more advanced disease in the oncoplastic cohort, local control remained comparable, supporting the oncologic safety of therapeutic mammoplasty beyond highly selected candidates.

Consistent with prior observational studies and meta-analyses, similar oncologic outcomes have been reported between oncoplastic and conventional breast-conserving approaches.[15–19] However, many previous studies included heterogeneous definitions of oncoplastic surgery, often combining volume displacement and volume replacement techniques. In contrast, our study focused exclusively on therapeutic mammoplasty, allowing a more homogeneous comparison and strengthening the internal validity of our findings. This distinction is particularly relevant, as therapeutic mammoplasty is increasingly used to extend breast conservation to patients who might otherwise be considered candidates for mastectomy.

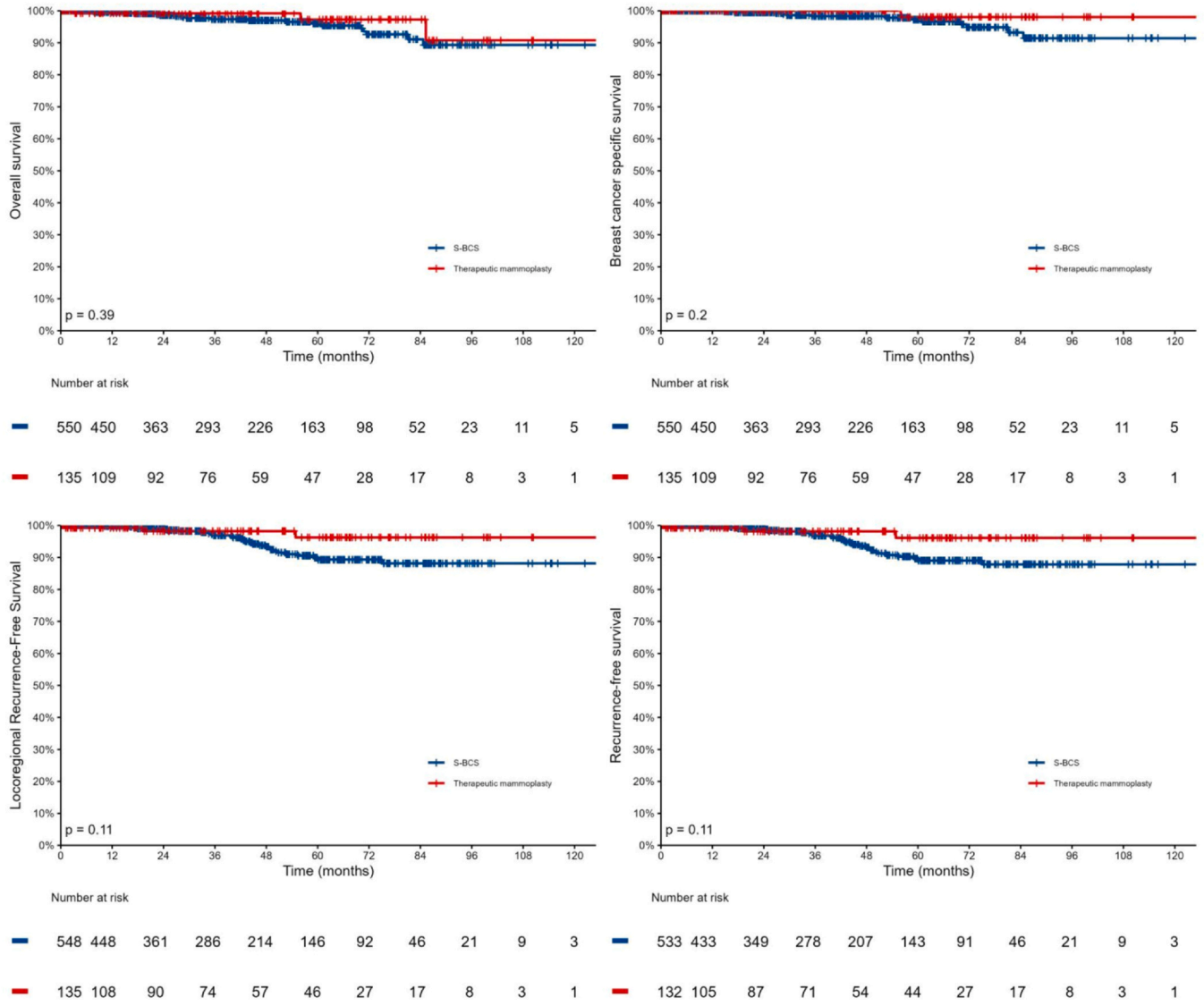

Fig. 2. Survival curves for locorregional recurrence-free survival, recurrence-free survival, breast cancer-specific survival and overall survival in S-BCS and O-BCS Groups.

The higher use of oncoplastic surgery among patients with more advanced disease observed in our cohort reflects contemporary surgical practice, in which larger resections are required to achieve adequate margins while preserving breast shape. Prior studies have similarly shown that younger patients and those with larger tumors are more likely to undergo therapeutic mammoplasty.[10,11,20] In our cohort, advanced clinical stage was independently associated with the use of O-BCS, underscoring its role as a surgical strategy to expand eligibility for breast conservation without compromising oncologic outcomes. The distribution of therapeutic mammoplasty across healthcare settings likely reflects differences in case-mix, with a greater burden of locally advanced disease in resource-limited environments.[21]

Margin status is a key determinant of local control in breast-conserving therapy.[22–25] In the present study, positive margin and reoperation rates were low in both groups and did not differ significantly between surgical approaches. These findings align with reports suggesting that therapeutic mammoplasty may facilitate wider excisions and lower re-excision rates by allowing greater flexibility in tissue rearrangement. While previous studies have reported positive margin rates ranging from 15% to 47% for S-BCS and 2–22% for O-BCS[10,26,27], our study observed substantially lower rates 4.6% in the S-BCS group and 1.8% in the O-BCS cohort. This difference may be attributed to larger resection volumes achievable with therapeutic mammoplasty, complemented by routine intraoperative frozen section analysis employed at most participating centers.[28] Although a Cochrane review presented low-certainty evidence due to bias and heterogeneity, it suggested that O-BCS might reduce re-excision rates, a trend supported by our findings.[17]

The implications of these findings are clinically meaningful. Oncoplastic techniques, particularly therapeutic mammoplasty, offer the potential to reduce mastectomy rates while maintaining oncologic safety, even in patients with more advanced tumors. When combined with modern systemic therapies and neoadjuvant treatment strategies, oncoplastic surgery may further expand breast conservation options, including in settings with limited resources.[29–31] The concept of extreme oncoplasty exemplifies this paradigm, providing an alternative to mastectomy in selected patients with extensive disease.[32–34]

Some aspects relevant to multidisciplinary care were not captured in this dataset. Timing of adjuvant therapy was not systematically recorded and therefore could not be evaluated. Previous studies have reported small delays in initiating radiotherapy after oncoplastic surgery, generally related to postoperative management, without evidence of impact on long-term oncologic outcomes.[19]

This study also has limitations inherent to its retrospective design, including potential selection bias and unmeasured confounding.

Table 2
Cox regression analysis for locoregional recurrence-free survival.

Variables	Total n%	HR (univariable)	HR (multivariable)
Age, mean (SD)	58.3 (13.0)	0.99 (0.96–1.02, p = 0.432)	-
Surgery			
S-BCS	550 (80.3)	-	-
O-BCS	135 (19.7)	0.39 (0.12–1.29, p = 0.123)	0.35 (0.11–1.16, p = 0.085)
Skin Color			
White	398 (58.1)	-	-
Non-white	46 (6.7)	1.48 (0.51–4.34, p = 0.473)	-
Tumor Staging			
< =IIA	585 (86.4)	-	-
> IIA	92 (13.6)	3.64 (1.72–7.70, p = 0.001)	3.91 (1.85–8.28, p < 0.001)
Histology			
Invasive ductal carcinoma	462 (68.4)	-	-
Ductal carcinoma in situ	79 (11.7)	1.16 (0.44–3.05, p = 0.764)	-
Invasive lobular carcinoma	66 (9.8)	1.08 (0.32–3.60, p = 0.900)	-
Others	68 (10.1)	0.36 (0.05–2.65, p = 0.315)	-
Immunohistochemistry			
HR+ /HER2-	374 (66.4)	-	-
Triple-negative	73 (13.0)	1.36 (0.50–3.66, p = 0.546)	-
HR-/HER2 +	34 (6.0)	2.78 (1.03–7.50, p = 0.043)	-
HR+ /HER2 +	54 (9.6)	0.00 (0.00-Inf, p = 0.996)	-
Grade			
1	135 (23.0)	-	-
2	295 (50.2)	0.45 (0.13–1.57, p = 0.211)	-
3	158 (26.9)	2.57 (0.95–6.97, p = 0.063)	-
Multifocal			
Yes	51 (9.4)	-	-
No	491 (90.6)	1.47 (0.35–6.19, p = 0.600)	-
Chemotherapy			
Did not receive	376 (54.9)	-	-
Neoadjuvant chemotherapy	142 (20.7)	2.13 (0.96–4.71, p = 0.062)	-
Adjuvant chemotherapy	134 (19.6)	1.03 (0.40–2.63, p = 0.953)	-

Hazard ratio (HR), respective 95% Confidence Interval (CI) and p-values.

Table 3
Cox regression analysis for overall survival.

Variables	Total n%	HR (univariable)	HR (multivariable)
Age, mean (SD)	58.3 (13.0)	1.03 (0.99–1.06, p = 0.153)	-
Surgery			
S-BCS	550 (80.3)	-	-
O-BCS	135 (19.7)	0.59 (0.18–2.00, p = 0.399)	0.53 (0.16–1.81, p = 0.314)
Skin Color			
White	398 (58.1)	-	-
Non-white	46 (6.7)	0.92 (0.21–4.01, p = 0.912)	-
Tumor Staging			
< =IIA	585 (86.4)	-	-
> IIA	92 (13.6)	5.43 (2.32–12.75, p < 0.001)	5.59 (2.38–13.11, p < 0.001)
Histology			
Invasive ductal carcinoma	462 (68.4)	-	-
Ductal carcinoma in situ	79 (11.7)	0.00 (0.00-Inf, p = 0.997)	-
Invasive lobular carcinoma	66 (9.8)	2.16 (0.72–6.50, p = 0.169)	-
Others	68 (10.1)	1.11 (0.26–4.86, p = 0.886)	-
Immunohistochemistry			
HR+ /HER2-	374 (66.4)	-	-
Triple-negative	73 (13.0)	1.81 (0.57–5.67, p = 0.312)	-
HR-/HER2 +	34 (6.0)	3.64 (1.25–10.58, p = 0.017)	-
HR+ /HER2 +	54 (9.6)	0.00 (0.00-Inf, p = 0.997)	-
Grade			
1	135 (23.0)	-	-
2	295 (50.2)	0.73 (0.12–4.35, p = 0.727)	-
3	158 (26.9)	5.29 (1.21–23.15, p = 0.027)	-
Multifocal			
Yes	51 (9.4)	-	-
No	491 (90.6)	1.69 (0.22–12.68, p = 0.612)	-
Chemotherapy			
Did not receive	376 (54.9)	-	-
Neoadjuvant chemotherapy	142 (20.7)	7.07 (2.63–18.96, p < 0.001)	-
Adjuvant chemotherapy	134 (19.6)	1.67 (0.47–5.92, p = 0.428)	-

Hazard ratio (HR), respective 95% Confidence Interval (CI) and p-values.

Patient-reported esthetic outcomes were not available, precluding formal assessment of the reconstructive benefit of therapeutic mammoplasty. Detailed information regarding tumor bed boost was not consistently captured across institutions and therefore its impact could not be specifically evaluated. Nevertheless, the multicenter design, including heterogeneous healthcare environments and surgeons with varying levels of expertise, enhances the external validity of the findings and reflects routine clinical practice.

Conclusion

In this multicenter real-world cohort, therapeutic mammoplasty achieved oncologic outcomes comparable to standard breast-conserving surgery despite being applied to patients with more advanced disease. These findings support oncoplastic breast-conserving surgery as a reliable approach to manage larger tumors while maintaining cosmesis and breast symmetry in appropriately selected patients.

Ethics

This study was approved by the Institutional Review Board of Instituto D'OR de Pesquisa e Ensino (reference number 6907,736).

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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].

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Credit

Conceptualization – ADNL, ECM, JB, FPC, FPZ, AM, MA, ALF
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Consent for publication

Not applicable.

Clinical trial number

not applicable.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.soi.2026.100239.

References

1. Johns N, Dixon JM. Should patients with early breast cancer still be offered the choice of breast conserving surgery or mastectomy? *Eur J Surg Oncol.* 2016;42(11):1636–1641.
2. Wrubel E, Natwick R, Wright GP. Breast-conserving therapy is associated with improved survival compared with mastectomy for early-stage breast cancer: a propensity score matched comparison using the national cancer database. *Ann Surg Oncol.* 2021;28(2):914–919.
3. Clough KB, et al. Cosmetic sequelae after conservative treatment for breast cancer: classification and results of surgical correction. *Ann Plast Surg.* 1998;41(5):471–481.
4. Margenthaler JA, Dietz JR, Chatterjee A. The landmark series: breast conservation trials (including oncoplastic breast surgery). *Ann Surg Oncol.* 2021;28(4):2120–2127.
5. Chatterjee A, et al. Results from the American society of breast surgeons oncoplastic surgery committee 2017 survey: current practice and future directions. *Ann Surg Oncol.* 2018;25(10):2790–2794.
6. Clough KB, et al. Improving breast cancer surgery: a classification and quadrant per quadrant atlas for oncoplastic surgery. *Ann Surg Oncol.* 2010;17(5):1375–1391.
7. Clough KB, et al. Conservative treatment of breast cancers by mammaplasty and irradiation: a new approach to lower quadrant tumors. *Plast Reconstr Surg.* 1995;96(2):363–370.
8. Grisotti A. Immediate reconstruction after partial mastectomy. *Oper Tech Plast Reconstr Surg.* 1994;1(1):1–12.
9. Rancati A, et al. Oncoplastic surgery in the treatment of breast cancer. *Ecancermedicalscience.* 2013;7:293.
10. De La Cruz L, et al. Outcomes after oncoplastic breast-conserving surgery in breast cancer patients: a systematic literature review. *Ann Surg Oncol.* 2016;23(10):3247–3258.
11. Losken A, et al. A meta-analysis comparing breast conservation therapy alone to the oncoplastic technique. *Ann Plast Surg.* 2014;72(2):145–149.
12. Kelsall JE, et al. Comparing oncoplastic breast conserving surgery with mastectomy and immediate breast reconstruction: Case-matched patient reported outcomes. *J Plast Reconstr Aesthet Surg.* 2017;70(10):1377–1385.
13. Asban A, et al. A cost-utility analysis comparing large volume displacement oncoplastic surgery to mastectomy with single stage implant reconstruction in the treatment of breast cancer. *Breast.* 2018;41:159–164.
14. Cuschieri S. The STROBE guidelines. *Saudi J Anaesth.* 2019;13(1):S31–s34.
15. Chen JY, et al. Comparison of oncoplastic breast-conserving surgery and breast-conserving surgery alone: a meta-analysis. *J Breast Cancer.* 2018;21(3):321–329.
16. De Lorenzi F, et al. Oncological results of oncoplastic breast-conserving surgery: Long term follow-up of a large series at a single institution: a matched-cohort analysis. *Anal Eur J Surg Oncol.* 2016;42(1):71–77.
17. Losken A, et al. The impact oncoplastic reduction has on long-term recurrence in breast conservation therapy. *Plast Reconstr Surg.* 2022;149(5):867e–875e.
18. Mohamedahmed AYY, et al. Comparison of surgical and oncological outcomes between oncoplastic breast-conserving surgery versus conventional breast-conserving surgery for treatment of breast cancer: a systematic review and meta-analysis of 31 studies. *Surg Oncol.* 2022;42:101779.
19. Nanda A, et al. Oncoplastic breast-conserving surgery for women with primary breast cancer. *Cochrane Database Syst Rev.* 2021;10(10):Cd013658.
20. Haloua MH, et al. A systematic review of oncoplastic breast-conserving surgery: current weaknesses and future prospects. *Ann Surg.* 2013;257(4):609–620.
21. Franzoi MA, et al. Advanced stage at diagnosis and worse clinicopathologic features in young women with breast cancer in Brazil: a subanalysis of the AMAZONA III study (GBECAM 0115). *J Glob Oncol.* 2019(5):1–10.
22. Hasan MT, et al. Oncoplastic versus conventional breast-conserving surgery in breast cancer: a pooled analysis of 6941 female patients. *Breast Cancer.* 2023;30(2):200–214.
23. Houssami N, et al. Meta-analysis of the impact of surgical margins on local recurrence in women with early-stage invasive breast cancer treated with breast-conserving therapy. *Eur J Cancer.* 2010;46(18):3219–3232.
24. Morrow M, et al. Society of surgical oncology-American society for radiation oncology-American SOciety of Clinical Oncology Consensus Guideline on Margins for Breast-conserving Surgery with Whole-breast Irradiation in Ductal Carcinoma in Situ. *Pract Radiat Oncol.* 2016;6(5):287–295.
25. Singletary SE. Surgical margins in patients with early-stage breast cancer treated with breast conservation therapy. *Am J Surg.* 2002;184(5):383–393.
26. Clough KB, et al. Long-term Results after oncoplastic surgery for breast cancer: a 10-year follow-up. *Ann Surg.* 2018;268(1):165–171.

27. Mansell J, et al. Oncoplastic breast conservation surgery is oncologically safe when compared to wide local excision and mastectomy. *Breast.* 2017;32:179–185.
28. Lima A, et al. Abstract P4-09-03: reoperation rates following breast-conserving surgery in a Brazilian cohort. *Clin Cancer Res.* 2025;31:P4-09.
29. Koppiker C, et al. Impact of oncoplasty in increasing breast conservation rates Post neo-adjuvant chemotherapy. *Front Oncol.* 2023;13.
30. Regaño S, et al. Oncoplastic techniques extend breast-conserving surgery to patients with neoadjuvant chemotherapy response unfit for conventional techniques. *World J Surg.* 2009;33(10):2082–2086.
31. Youssef MMG, et al. Oncologic and cosmetic outcomes of oncoplastic breast surgery in locally advanced breast cancer after neoadjuvant chemotherapy, experience from a developing country. *Indian J Surg Oncol.* 2018;9(3):300–306.
32. Hossino D, et al. Extreme oncoplasty: oncologically safe when compared with mastectomy. *Ann Surg Oncol.* 2024;31(11):7284–7288.
33. Koppiker CB, et al. Extreme oncoplastic surgery for multifocal/multicentric and locally advanced breast cancer. *Int J Breast Cancer.* 2019;2019:4262589.
34. Vieira, R., R.R. Paulinelli, and I. de Oliveira-Junior, Extreme oncoplasty: past, present and future. Front Oncol, 2023. 13: p. 1215284.