Original Article

Breast-conserving therapy versus mastectomy for breast cancer: a ten-year follow-up single-center real-world study

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Background: The rapid development of early diagnostic methods and systematic treatment for breast cancer have shed lights on the insight of prognosis of breast-conserving therapy versus mastectomy. However, there are relatively few studies with long-term follow-up, large patient cohort and under the contemporary setting in China on the subject of survival of patients undergoing breast conserving therapy versus mastectomy.

Methods: Data on the cases of breast-conserving therapy and mastectomy for breast cancer from October 1, 2005 to September 31, 2010 were retrieved from the breast cancer database of Chinese PLA General Hospital. The clinicopathological characteristics of patients were compared by chi-square test or Fisher's exact test. Breast cancer-specific survival, disease-free survival, local recurrence-free survival, loco-regional recurrence-free survival, and distant metastasis-free survival were calculated and compared by Kaplan-Meier survival analysis and log-rank test firstly. And then Cox Proportional-Hazards model was used for multivariate analysis.

Results: There were 296 patients in the breast-conserving surgery group and 675 patients in the mastectomy group. For patients with invasive breast cancer in the entire cohort, the 10-year breast cancer-specific survival rate of patients in the breast-conserving surgery group at stage I-II was significantly higher than that of the mastectomy group. However, surgical method was not an independent prognostic factor for breast cancer-specific survival, disease-free survival and local recurrence-free survival. Moreover, N stage and luminal B-like subtype were independent prognostic factors for the breast cancer-specific survival of invasive breast cancer in the entire cohort.

Conclusions: This study suggests that there is no significant difference in breast cancer-specific survival between breast cancer patients undergoing breast-conserving surgery and mastectomy after adjusting for confounding factors. Lymph node staging is the major risk factor affecting patients' survival. In this case, choosing patients with smaller tumor size, avoiding patients with stage N3, and removing a smaller volume of breast tissue including tumors while ensuring negative margins may reduce the patient's risk of local recurrence and loco-regional recurrence.

Keywords: Breast cancer; breast-conserving therapy (BCT); mastectomy

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Introduction

From Halsted's mastectomy in 1880s to modified mastectomy in 1970s, breast cancer treatment first revolved around local treatment but gradually progressed towards systematic treatment as doctors experimenting with less drastic approaches saw similar prognosis (1). Breast-conserving therapy (BCT) was eventually established as the standard treatment for early-stage breast cancer. Randomized trials with long-term follow-up have provided sufficient and high-level evidence that BCT can achieve similar prognosis compared with mastectomy (MT) (2-5). However, a few recent observational studies have arrived at the conclusion that BCT displayed better survival outcomes than MT (6-9). This discrepancy may derive from the difference in patient composition, development of systematic treatment and involvement of other socioeconomic factors. Some studies have proposed that the improvement in overall survival with BCT is associated to early stage, negative lymph node stage, luminal and triple-negative subtype (10,11). The role of other impacting factors such as tumor biology, systematic treatment, surgery type on prognosis is also the center of debate since it concerns patient selection on BCT (12).

Consistent with the general trends in breast cancer treatment, breast-conserving surgery (BCS) adopted a less invasive approach with the goal of minimizing resection volume (RV) in order to achieve better aesthetic outcome (13). To guarantee a clean margin and total resection of the tumor, intraoperative margin assessment (IMA) rose in response (14,15). However, due to the short amount of time and varied quality of IMA, its efficacy remains controversial (16). Likewise, axillary lymph node dissection (ALND) is no longer routinely performed since ALND and sentinel lymph node biopsy (SLNB) was confirmed to yield similar survival with patients undergoing SLNB suffering from less adverse reactions such as lymphedema. New evidence has surfaced that patients within limited range of lymph node metastasis are also potential candidates for SLNB (17-20).

By comparing prognosis in BCT with MT in patient subgroups, we aim to clarify the influence of surgery type on different individuals. Patients with ductal carcinoma in situ (DCIS) components undergoing BCS is attached with special emphasis. In addition, we also place a special interest on whether having higher RV, conducting an IMA, and ALND is necessary for better local control. It is noteworthy that the aforementioned randomized trials were mostly targeted at early-stage breast cancer and options for systematic treatment were rather limited at time of study. This is the first long-term follow-up real-world study with large cohort of breast cancer patients conducted in China in recent years. We intend to match treatment options with a specific group of patients who will most likely become its beneficiary which can help clinicians reach wise and informative clinical decisions. We present the following article in accordance with the STROBE reporting checklist (available at https://gs.amegroups.com/article/view/10.21037/gs-22-142/rc).

Methods

The nature of this study is retrospective and data were retrospectively collected. This study collected cases of BCT and MT for breast cancer from October 1, 2005 to September 31, 2010 in the breast cancer database of Chinese PLA General Hospital. In the first 2 years after surgery, patient was seen for follow-up every three months. After that, patient was followed every six months. Follow-up was done in the form of phone call or outpatient clinic visit. A total of 971 patients were enrolled in this study who were divided into the BCS and the MT group. Level 2 BCS was standard treatment at our hospital. The exclusion criteria were as follows: (I) patients receiving neo-adjuvant chemotherapy; (II) patients with synchronic bilateral breast cancers; (III) male patients with breast cancer; (IV) patients who have undergone lumpectomy in other hospitals; (V) cases lost to follow-up; (VI) patients with incomplete pathological data. For patients with asynchronous bilateral breast cancer, they were grouped and analyzed according to the surgical treatment of the breast cancer that occurred earlier. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ethics Committee of Chinese PLA General Hospital (No. S2022-147-01) and individual consent for this retrospective analysis was waived. The following information of the patients was recorded: age at diagnosis; pathological classification [invasive breast carcinoma (IBC) or DCIS] of tumors; histological grade of IBC; extent of invasive carcinoma; lymph node status; the expression status of hormone receptors of IBC; Ki67 index of IBC; HER-2 status of IBC; axillary nodal surgery methods; location of the tumor; IMA methods including frozen section (FS) method and gross examination (GE) by surgeons in the BCS group; the duration for pathological FS analysis of surgical margins; three-dimensional size (length, width, and height) of breast tissue removed during

BCS; maximum tumor diameter (MTD) including the largest diameter of the infiltrating component and DCIS component in the BCS group; pathological classification (DCIS or IBC) of ipsilateral breast tumor recurrence (IBTR) and regional recurrence in the BCS group; the treatment of patients including chemotherapy, endocrine therapy, and radiotherapy; the patients' follow-up time and survival status.

Endpoints were defined referring to the STEEP System. BCSS was defined as the time period between surgery and death from breast cancer. DFS was defined as the minimum time period between surgery and local recurrence/regional recurrence/distant metastasis (21). Pathological stages of IBC were evaluated according to the eighth edition of Cancer Staging Manual of the American Joint Committee on Cancer (AJCC) (22). For cases in the two groups that did not undergo ALND or SLNB, and imaging examinations showed no lymph node metastasis, they were staged as pathological classification N0. Histological grading of IBC was performed according to Nottingham modification of the SBR grading system (23). The positivity of HER-2, ER, and PR was defined referring to recommendations of the American Society of Clinical Oncology/College of American Pathologists HER2, ER and PR testing guideline (24,25). According to 2013 St Gallen International Expert Consensus (26), the molecular subtypes of IBC were defined as follows: luminal A-like type: ER+, HER2–, Ki67 <20%, PR ≥20%; luminal B-like type: ER+, and/or HER2+, and/or Ki67 ≥20%, PR <20%; HER2 overexpression type: ER–, PR–, HER2+; Basal-like type: ER–, PR–, HER2–. RV of breast tissue including the tumor in the BCS group was calculated by one half of each of the three dimensions and the formula $4/3\pi$ (1/2 length × 1/2 width × 1/2 height) for an ellipsoid specimen volume (27).

Statistical analysis

The clinicopathological characteristics of patients from the BCS and the MT group were compared by chi-square test or Fisher's exact test. One-way analysis of variance (ANOVA) was used to compare the RV in the BCS group. Correlation analysis (Pearson) was used to compare the relationship between MTD and RV of breast tissue. Breast cancer specific survival (BCSS), disease-free survival (DFS), local recurrence-free survival (LRFS), loco-regional recurrence-free survival (LRRFS), and distant metastasis-free survival (DMFS) were calculated and compared by Kaplan-Meier survival analysis and log-rank test firstly. And then Cox Proportional-Hazards model was used for multivariate analysis of BCSS, DFS, LRFS, LRRFS, and DMFS. Statistical significance was defined as P<0.05. All statistical analyses were performed using IBM Statistical Package for SPSS version 22.0.

Results

Baseline characteristics

In this study, there were 296 patients in the BCS group, including 267 patients with IBC and 29 patients with DCIS, and 675 patients in the MT group, including 638 patients with IBC and 37 patients with DCIS. There 971 patients in the entire cohort and all of them were female. *Table 1* described the demographic characteristics, clinicopathological characteristics, and follow-up of patients with IBC in the BCS and MT group. Compared with the MT group, the proportion of patients <40 years old (P<0.001), the proportion of IBC with histological grade 1 (P=0.003), the proportion of patients of stage I-II (P<0.001), the proportion of patients undergoing SLNB (P<0.001) and radiotherapy (P<0.001) were higher in the BCS group. There was no significant difference in the distribution of molecular subtypes and the proportion of patients receiving chemotherapy and endocrine therapy between the two groups of patients.

Table 2 described the demographic characteristics, clinicopathological characteristics, and follow-up of patients with DCIS in the BCS and MT group. Compared with the MT group, patients in the BCS group had a lower percentage of patients receiving axillary nodal surgery (P=0.010), and a higher percentage of patients receiving radiotherapy (P<0.001). The overall local recurrence rate (25.0% *vs.* 0%, P=0.002) and the overall local-regional recurrence rate (25.0% *vs.* 2.7%, P=0.017) in the BCS group were higher than those in the MT group. And there were no deaths or distant metastases in the patients with DCIS of the two groups. In the BCS group, a total of 7 patients with DCIS had IBTR, 3 cases of recurring tumors were DCIS, and 4 cases were IBC. In the MT group, 1 case of DCIS had regional recurrence, and metastatic carcinoma appeared in the left supraclavicular lymph node.

According to whether the tumor contained DCIS component, the patients in the BCS group were divided into cases with and without DCIS component. *Table 3* described the demographic, clinicopathological characteristics and follow-up of breast cancer patients with and without DCIS

Table 1 Demographic and clinicopathological characteristics of patients with IBC in the BCS and the MT group

Characteristic	Surgery type, n (%)			P value
	BCS	MT	All	
No. of patients	267 (29.5)	638 (70.5)	905 (100.0)	
Age at diagnosis, years				<0.001
<40	68 (25.5)	82 (12.9)	150 (16.6)	
40–59	158 (59.2)	414 (64.9)	572 (63.2)	
≥60	41 (15.4)	142 (22.3)	183 (20.2)	
Histologic grade				0.003
1	36 (13.5)	42 (6.6)	78 (8.6)	
2	170 (63.7)	427 (66.9)	597 (66.0)	
3	61 (22.8)	169 (26.5)	230 (25.4)	
Molecular subtypes				0.198
Luminal A-like	90 (40.2)	191 (34.2)	281 (35.9)	
Luminal B-like	79 (35.3)	219 (39.2)	298 (38.1)	
HER2 overexpression	17 (7.6)	63 (11.3)	80 (10.2)	
Basal-like	38 (17.0)	85 (15.2)	123 (15.7)	
Stages				<0.001
I-II	253 (94.8)	519 (81.3)	772 (85.3)	
III-IV	14 (5.2)	119 (18.7)	133 (14.7)	
T stages				<0.001
Tmic	9 (3.4)	12 (1.9)	21 (2.3)	
T1	188 (70.4)	312 (48.9)	500 (55.2)	
T2	66 (24.7)	285 (44.7)	351 (38.8)	
T3/T4	4 (1.5)	29 (4.5)	33 (3.6)	
N stages				<0.001
N0	212 (79.4)	379 (59.4)	591 (65.3)	
N1	43 (16.1)	144 (22.6)	187 (20.7)	
N2	10 (3.7)	77 (12.1)	87 (9.6)	
N3	2 (0.7)	38 (6.0)	40 (4.4)	
Nodal surgery				<0.001
SLNB	64 (24.0)	66 (10.3)	130 (14.4)	
ALND	189 (70.8)	567 (88.9)	756 (83.5)	
None	14 (5.2)	5 (0.8)	19 (2.1)	
Chemotherapy				0.605
No	62 (25.6)	158 (27.7)	220 (27.1)	
Yes	180 (74.4)	413 (72.3)	593 (73.0)	

Table 1 (*continued*)

Table 1 (*continued*)

Characteristic	Surgery type, n (%)			P value
	BCS	MT	All	
Radiotherapy				<0.001
No	71 (29.6)	395 (75.8)	466 (61.2)	
Yes	169 (70.4)	126 (24.2)	295 (38.8)	
Endocrine therapy				0.337
No	61 (38.1)	154 (42.7)	215 (41.3)	
Yes	99 (61.9)	207 (57.3)	306 (58.7)	
Mean follow-up time, months (SD)	127.4 (37.8)	114.2 (33.2)	118.1 (35.1)	
10-year BCSS rate (%)	96.6	88.3	90.8	<0.001
I-II	96.8	92.3	93.8	0.025
III-IV	91.7	70.3	72.7	0.207
10-year DFS rate (%)	87.6	83.8	84.9	0.146
I-II	89.5	88.5	88.8	0.759
III-IV	52.2	62.6	61.1	0.832
10-year LRFS rate (%)	93.1	96.1	95.1	0.023
I-II	93.6	96.0	95.2	0.064
III-IV	83.9	96.4	94.9	0.041

IBC, invasive breast cancer; BCS, breast-conserving surgery; MT, mastectomy; SLNB, sentinel lymph node biopsy; ALND, axillary lymph node dissection; BCSS, breast cancer-specific survival; DFS, disease-free survival; LRFS, local recurrence-free survival.

component in the BCS group. There were no significant differences in the age distribution, N stages, IMA methods, axillary nodal surgery methods, and endocrine therapy options for the two types of lesions. A higher proportion of breast cancer patients with DCIS component received radiotherapy. *Table 4* described the tumor location in patients undergoing ALND, SLNB and none nodal surgery in the BCS group. The proportion of tumor located in the upper-lateral quadrant in the ALND group was higher that of the SLNB group, though the difference was statistically insignificant (55.0% *vs.* 44.6%, P=0.304). There was no correlation between MTD and RV of breast tissue in the BCS group (*Table 5*, P=0.132). A total of 29 cases in the BCS group performed IMA through pathological evaluation of FS, and the average duration required for FS analysis was 34–99 (average 61) minutes.

Surgery type and BCSS in the entire cohort

Patients with invasive breast cancer in the entire cohort were followed up for 2–192 (average 118.1) months. Kaplan-Meier survival analysis showed that the 10-year BCSS rate (96.6% *vs.* 88.3%, P<0.001) of patients with IBC in the BCS group was significantly higher than that in the MT group (*Table 1*). The stratification of IBC by staging showed that for IBC of stage I-II, the 10-year BCSS rate (96.8% *vs.* 92.3%, P=0.025) of the BCS group was significantly higher than that of the MT group (*Table 1*). For IBC of stage III-IV, the 10-year BCSS rate (91.7% *vs.* 70.3%, P=0.207) of the BCS group was higher than that of the MT group, but there was no statistical difference (*Table 1*). Univariate Cox regression shows that 4 factors were adversely correlated with BCSS of IBC in the entire cohort: molecular subtypes (HR for luminal B-like type =3.601, P<0.001 and HR for HER2 overexpression type =2.828, P=0.025); pathological stage III-IV (HR =5.434, P<0.001); increasing N stages (HR for N1=2.478, P=0.003, HR for N2=5.701, P<0.001; HR for N3=11.102, P<0.001); MT (HR =3.194, P=0.001) (*Table 6*). Multivariate Cox regression showed that Luminal B-like type (HR=15.101, P=0.009) and N stages (HR for

Table 2 Demographic and clinicopathological characteristics of patients with DCIS in the BCS and the MT group

Characteristic	Surgery type, n (%)			P value
	BCS	MT	All	
No. of patients	29 (43.9)	37 (56.1)	66 (100.0)	
Age at diagnosis, years				0.109
<40	8 (27.6)	4 (10.8)	12 (18.2)	
40–59	17 (58.6)	22 (59.5)	39 (59.1)	
≥60	4 (13.8)	11 (29.7)	15 (22.7)	
Nodal surgery				0.010
SLNB	10 (34.5)	17 (45.9)	27 (40.9)	
ALND	11 (37.9)	19 (51.4)	30 (45.5)	
None	8 (27.6)	1 (2.7)	9 (13.6)	
Radiotherapy				<0.001
No	7 (28.0)	28 (96.6)	35 (64.8)	
Yes	8 (72.0)	1 (3.4)	19 (35.2)	
Endocrine therapy				0.496
No	15 (68.2)	23 (76.7)	38 (73.1)	
Yes	7 (31.8)	7 (23.3)	14 (26.9)	
Mean follow-up time, months (SD)	123.9 (35.4)	119.1 (29.3)	121.2 (32.0)	
Death rate	0	0	0	
Local recurrence rate	7 (25.0)	0 (0)	7 (10.8)	0.002
Loco-regional recurrence rate	7 (25.0)	1 (2.7)	8 (12.3)	0.017
Distant metastasis rate	0	0	0	
Pathological classification of IBTR and regional recurrence				1.000
DCIS	3 (42.9)	0 (0)	3 (37.5)	
IBC	4 (57.1)	1 (100.0)	5 (62.5)	

DCIS, ductal carcinoma in situ; BCS, breast-conserving surgery; MT, mastectomy; SLNB, sentinel lymph node biopsy; ALND, axillary lymph node dissection; IBTR, ipsilateral breast tumor recurrence; IBC, invasive breast cancer.

N1=4.545, P=0.017, HR for N2=11.842, P=0.001; HR for N3=9.167, P=0.014) were independently associated with BCSS, and surgery type was not an independent factor associated with BCSS of IBC in the entire cohort (*Table 6*).

Surgery type and DFS/LRFS in the entire cohort

Kaplan-Meier survival analysis showed that there was no significant difference in the 10-year DFS rate of IBC (87.6% *vs.* 83.8%, P=0.146) between the BCS and MT group (*Table 1*). The 10-year LRFS rate of IBC (93.1% *vs.* 96.1%, P=0.023) in the BCS group was significantly lower than that in the MT group (*Table 1*). For IBC of stage I-II, the 10-year LRFS rate of patients with BCS was lower than that of those with MT (93.6% *vs.* 96.0%, P=0.064), but there was no statistical difference (*Table 1*). For IBC of stage III-IV, the 10-year LRFS rate of the BCS group was significantly lower than that of the MT group (83.9% *vs.* 96.4%, P=0.041) (*Table 1*). Multivariate Cox regression showed that surgery type was not an independent factor

Table 3 Demographic and clinicopathological characteristics of patients with or without DCIS component in the BCS group

Characteristic	Breast cancer type, n (%)			P value
	BC with DCIS	BC without DCIS	All	
No. of patients	128 (43.2)	168 (56.8)	296	
Age at diagnosis, years				0.446
<40	36 (28.1)	40 (23.8)	76 (25.7)	
40–59	76 (59.4)	99 (58.9)	175 (59.1)	
≥60	16 (12.5)	29 (17.3)	45 (15.2)	
N stages				0.403
N0	108 (84.4)	133 (79.2)	241 (81.4)	
N1	17 (13.3)	26 (15.5)	43 (14.5)	
N2	2 (1.6)	8 (4.8)	10 (3.4)	
N3	1 (0.8)	1 (0.6)	2 (0.7)	
Nodal surgery				0.056
ALND	40 (31.3)	34 (20.2)	74 (25.0)	
SLNB	77 (60.2)	123 (73.2)	200 (67.6)	
None	11 (8.6)	11 (6.5)	22 (7.4)	
Intraoperative margin assessment				0.565
FS	14 (10.9)	15 (8.9)	29 (9.8)	
GE	114 (89.1)	153 (91.1)	267 (90.2)	
Radiotherapy				0.022
No	26 (22.2)	52 (35.1)	78 (29.4)	
Yes	91 (77.8)	96 (64.9)	187 (70.6)	
Endocrine therapy				0.378
No	38 (45.2)	38 (38.8)	76 (41.8)	
Yes	46 (54.8)	60 (61.2)	106 (58.2)	
Mean follow-up time, months (SD)	124.6 (35.9)	129.0 (38.7)	127.1 (37.5)	
10-year BCSS rate (%)	95.8	97.8	96.9	0.605
10-year DFS rate (%)	80.3	90.7	86.2	0.011
10-year LRFS rate (%)	86.3	94.4	91.2	0.024
10-year LRRFS rate (%)	85.4	94.4	90.5	0.009
10-year DMFS rate (%)	93.0	95.5	94.4	0.278

DCIS, ductal carcinoma in situ; BCS, breast-conserving surgery; BC, breast cancer; ALND, axillary lymph node dissection; SLNB, sentinel lymph node biopsy; FS, frozen section; GE, gross examination; BCSS, breast cancer-specific survival; DFS, disease-free survival; LRFS, local recurrence-free survival; LRRFS, local-regional recurrence-free survival; DMFS, distant metastasis-free survival.

Table 4 Tumor location in patients undergoing ALND, SLNB and none nodal surgery in the BCS group

Nodal surgery type	Tumor location, n (%)			P value
	Upper-lateral quadrant	None upper-lateral quadrant	All	
ALND	110 (55.0)	90 (45.0)	200	0.304
SLNB	33 (44.6)	41 (55.4)	74	
None	11 (50.0)	11 (50.0)	22	

ALND, axillary lymph node dissection; SLNB, sentinel lymph node biopsy; BCS, breast-conserving surgery.

Table 5 Correlation analysis between maximum tumor diameter and resection volume of breast tissue

Parameters of tissue	No. of patients	Mean (range)	SD	P value
Maximum tumor diameter (cm)	296	2.121 (0.4–7.0)	1.1	0.132
Resection volume (cm^3)	296	92.3 (2.2–533.8)	77.8	

associated with DFS (P=0.202) and LRFS (P=0.223) of IBC in the entire cohort (*Tables 6*,7). The age of 40–59 (HR =0.412, P=0.003), Stage N2 (HR =2.435, P=0.047), and ALND (HR =0.470, P=0.038) were independent prognostic factors for DFS (*Table 6*). Only the age of 40–59 (HR =0.236, P=0.003) was an independent factor for LRFS of IBC in the entire cohort (*Table* 7).

DCIS component and BCSS/DFS in the BCS group

Kaplan-Meier survival analysis showed there was no significant difference between the 10-year BCSS rate (95.8% *vs.* 97.8%, P=0.605) of breast cancer patients with DCIS component and that of breast cancer patients without DCIS component in the BCS group (*Table 3*). The 10-year DFS rate (80.3% *vs.* 90.7%, P=0.011) of breast cancer patients with DCIS component was significantly lower than that without DCIS component in the BCS group (*Table 3*). Univariate (HR =6.416, P=0.021) and Multivariate (HR =35.611, P=0.008) Cox regression both showed only stage N2 was a prognostic factor for BCSS in the BCS group (*Table 8*). Univariate Cox regression showed breast cancer with DCIS component, MTD, RV, stage N2, N3, and endocrine therapy were adversely associated with DFS in the BCS group (*Table 8*). Multivariate Cox regression showed MTD (HR =1.349, P=0.049), RV (HR =1.005, P=0.039), stage N3 (HR =14.610, P=0.021), and ALND (HR =0.289, P=0.021) were independent prognostic factors for DFS in the BCS group, while BC with DCIS component, stage N2, IMA, radiotherapy, and endocrine therapy were not (*Table 8*).

DCIS component and LRFS/LRRFS/ DMFS in the BCS group

Kaplan-Meier survival analysis showed that the 10-year LRFS rate (86.3% *vs.* 94.4%, P=0.024) and the 10-year LRRFS rate (85.4% *vs.* 94.4%, P=0.009) of breast cancer patients with DCIS component were significantly lower than that of breast cancer patients without DCIS component in the BCS group (*Table 3*). And there was no significant difference between the 10-year DMFS rate (93.0% *vs.* 95.5%, P=0.278) of breast cancer patients with DCIS component and that without DCIS component in the BCS group (*Table 3*). Multivariate Cox regression showed MTD (HR =1.449, P=0.044) and RV (HR =1.009, P=0.004) were independent risk factor for local recurrence in the BCS group (*Table 9*). MTD (HR =1.465, P=0.035), RV (HR =1.010, P=0.002), and stage N3 (HR =29.001, P=0.007) were adversely associated with LRRFS in the BCS group (*Table 9*). And breast cancer with DCIS component, IMA, were not independent prognostic factors for LRFS and LRRFS in the BCS group (*Table 9*). ALND was a protective prognostic factor for local recurrence (HR =0.265, P=0.036) and local-regional recurrence (HR =0.262, P=0.034) in the BCS group (*Table 9*). Only N stages (HR for N1 =7.763, P=0.030, HR for N2 =27.044, P=0.007; HR for N3 =43.841, P=0.009) were independent factors for DMFS in the BCS group (*Table 9*).

Discussion

This study showed that the 10-year BCSS rate of patients

Table 6 Univariate and multivariate analyses of prognostic factors for BCSS and DFS of patients with IBC in the entire cohort

Variable	BCSS				DFS			
	Univariate		Multivariate		Univariate		Multivariate	
	HR (95% CI)	P	HR (95% CI)	P	HR (95% CI)	P	HR (95% CI)	P
Age at diagnosis, years								
<40	Ref		Ref		Ref		Ref	
40–59	1.081 (0.588–1.985)	0.802	0.651 (0.213–1.994)	0.452	0.646 (0.428–0.974)	0.037	0.412 (0.228–0.745)	0.003
≥60	0.933 (0.439–1.986)	0.858	0.246 (0.040–1.511)	0.130	0.589 (0.342–1.014)	0.056	0.488 (0.201–1.181)	0.111
Histologic grade								
1 *vs.* 2/3	23.164 (0.771–696.039)	0.070	459.991 (0–5.726E+16)	0.711	1.588 (0.777–3.247)	0.205	1.355 (0.462–3.975)	0.581
Molecular subtypes								
Luminal A-like	Ref		Ref		Ref		Ref	
Luminal B-like	3.601 (1.844–7.031)	<0.001	15.101 (1.989–114.668)	0.009	1.856 (1.212–2.843)	0.004	1.712 (0.949–3.092)	0.074
HER2 overexpression	2.828 (1.138–7.032)	0.025	3.276 (0–8.088E+85)	0.991	1.053 (0.504–2.200)	0.891	0 (0–1.055E+59)	0.893
Basal-like	1.952 (0.809–4.711)	0.137	4.436 (0–1.095E+86)	0.988	1.192 (0.656–2.166)	0.564	0 (0–2.017E+59)	0.900
Pathological stages								
I-II *vs.* III-IV	5.434 (3.484–8.475)	<0.001			4.160 (2.912–5.944)	<0.001		
T stages								
Tmic	Ref		Ref		Ref		Ref	
T1	2702.949 (0–9.457E+43)	0.868	1031.937 (0–1.520E+40)	0.874	0.856 (0.268–2.737)	0.793	6672.385 (0–1.571E+67)	0.906
T2	6615.571 (0–2.314E+44)	0.853	1815.339 (0–2.678E+40)	0.864	1.522 (0.478–4.849)	0.477	12646.815 (0–2.979E+67)	0.899
T3/T4	16128.032 (0–5.651E+44)	0.839	5876.859 (0–8.730E+40)	0.842	3.245 (0.905–11.635)	0.071	24890.946 (0–5.879E+67)	0.892
N stages								
N0	Ref		Ref		Ref		Ref	
N1	2.478 (1.371–4.477)	0.003	4.545 (1.314–15.713)	0.017	1.787 (1.150–2.777)	0.010	1.925 (0.964–3.843)	0.063
N2	5.701 (3.154–10.303)	<0.001	11.842 (2.831–49.538)	0.001	4.051 (2.579–6.362)	<0.001	2.435 (1.011–5.868)	0.047
N3	11.102 (5.873–20.985)	<0.001	9.167 (1.572–53.449)	0.014	6.338 (3.641–11.034)	<0.001	2.166 (0.685–6.844)	0.188
Surgery type								
BCS *vs.* MT	3.194 (1.642–6.210)	0.001	1.057 (0.332–3.363)	0.925	1.335 (0.903–1.974)	0.147	1.572 (0.785–3.145)	0.202

Table 6 (*continued*)

Table 6 (*continued*)

Variable	BCSS				DFS			
	Univariate		Multivariate		Univariate		Multivariate	
	HR (95% CI)	P	HR (95% CI)	P	HR (95% CI)	P	HR (95% CI)	P
Nodal surgery								
SLNB	Ref		Ref		Ref		Ref	
ALND	1.938 (0.842–4.462)	0.120	0.424 (0.099–1.817)	0.248	1.032 (0.627–1.698)	0.902	0.470 (0.230–0.960)	0.038
None	1.266 (0.152–10.519)	0.827	0.001 (0–6.466E+137)	0.965	0.408 (0.054–3.058)	0.383	0 (0–9.177E+212)	0.970
Chemotherapy								
No *vs.* yes	1.852 (0.905–3.789)	0.092	0.499 (0.116–2.158)	0.352	1.672 (1.040–2.688)	0.034	0.674 (0.289–1.572)	0.361
Radiotherapy								
No *vs.* yes	1.504 (0.815–2.774)	0.192	0.320 (0.095–1.072)	0.065	2.297 (1.546–3.413)	<0.001	1.517 (0.745–3.091)	0.251
Endocrine therapy								
No *vs.* yes	1.833 (0.812–4.138)	0.145	1.620 (0–3.950E+85)	0.996	2.282 (1.380–3.774)	0.001	0 (0–2.869E+59)	0.904

BCSS, breast cancer-specific survival; DFS, disease-free survival; IBC, invasive breast cancer; BCS, breast-conserving surgery; MT, mastectomy; SLNB, sentinel lymph node biopsy; ALND, axillary lymph node dissection; Ref, reference group.

with IBC in the BCS group was significantly higher than that of the MT group (96.6% *vs.* 88.3%, P<0.001). However, after stratification by staging, only the 10-year BCSS rate of patients in the BCS group at stage I-II was significantly higher than that of the MT group (96.8% *vs.* 92.3%, P=0.025), and there was no difference in the 10-year BCSS rate of patients at stage III-IV between the two groups (P=0.207). After controlling for other confounders including age, histological grade, molecular classification, T/N staging, axillary nodal surgery methods, and systemic treatment by multivariate survival analysis, BCSS (HR =1.057, P=0.925), DFS (HR =1.572, P=0.202), and LRFS (HR =2.132, P=0.223) had no significant difference between the two surgical methods. This is consistent with the results of several randomized clinical trials published from 1980 to 2008 that showed no significant difference in OS (2,28-37) and DFS (2,28,34,36) between stage I-II (T1-2, N0-1) IBC patients who underwent BCS plus radiation and radical or modified radical mastectomy at 5-20 years of follow-up. Similar to the results of this study, a meta-analysis including 25 Chinese Case-Control Studies from 2004 to 2010 showed that there was no significant difference between 3-year and 5-year OS of IBC patients with early stage in the BCS group and the MT group (38). We believe that large randomized clinical trials can better eliminate confounders and compare the impact of the two surgical methods on the survival more objectively. It may be because our multivariate survival analysis included more comprehensive prognostic factors, which led to BCSS and DFS being consistent with conclusions of the clinical trials. Different from the results of this study, several large retrospective studies in recent years had shown that the prognosis of IBC patients of early stage with BCS plus radiotherapy after long-term follow-up was better than that of patients with MT (6,7,39). We consider two possible reasons leading to this conclusion. First, although the survival analysis of these studies has included as many prognostic factors as possible, including socioeconomic/demographic, clinicopathological characteristics and systemic treatments, there will still be unmeasured confounders. For example, the retrospective study of the Netherlands Cancer Registry did not take the prognostic effects of Herceptin targeted therapy into account (39). In the population-based study for Danish breast cancer patients and Louisiana women with early stage breast cancer, lymph node management was not included as a prognostic risk factor (6,7,39). Second, early clinical randomized trials were carried out more than 30 years

Table 7 Univariate and multivariate analyses of prognostic factors for LRFS of patients with IBC in the entire cohort

Variable	Univariate multivariate		Multivariate	
	HR (95% CI)	P	HR (95% CI)	P
Age at diagnosis, years				
<40	Ref		Ref	
40–59	0.344 (0.175–0.676)	0.002	0.236 (0.093–0.604)	0.003
≥60	0.418 (0.170–1.026)	0.057	0.302 (0.072–1.261)	0.101
Histologic grade				
1 *vs.*2/3	0.586 (0.247–1.394)	0.227	0.647 (0.170–2.455)	0.522
Molecular subtypes				
Luminal A-like	Ref		Ref	
Luminal B-like	1.435 (0.637–3.230)	0.383	2.560 (0.843–7.772)	0.097
HER2 overexpression	1.171 (0.322–4.257)	0.810	0 (0–1.392E+79)	0.924
Basal-like	1.676 (0.638–4.403)	0.295	0 (0–1.265E+79)	0.924
Pathological stages				
I-II *vs.* III-IV	0.966 (0.379–2.462)	0.942		
T stages				
Tmic	Ref		Ref	
T1	0.565 (0.134–2.392)	0.438	9031.701 (0–1.332E+87)	0.926
T2	0.508 (0.115–2.238)	0.371	25188.862 (0–3.716E+87)	0.917
T3/T4	0.431 (0.039–4.751)	0.492	42147.674 (0–6.285E+87)	0.913
N stages				
N0	Ref		Ref	
N1	1.119 (0.528–2.372)	0.770	0.592 (0.158–2.213)	0.436
N2	1.130 (0.396–3.221)	0.820	0.515 (0.094–2.833)	0.445
N3	0 (0–6.603E+287)	0.972	0 (0–3.121E+77)	0.918
Surgery type				
BCS *vs.* MT	0.497 (0.269–0.919)	0.026	2.132 (0.631–7.201)	0.223
Nodal surgery				
SLNB	Ref		Ref	
ALND	0.629 (0.290–1.368)	0.242	0.363 (0.125–1.052)	0.062
None	0 (0–2.102E+242)	0.969	0	0.982
Chemotherapy				
No *vs.* Yes	0.884 (0.437–1.790)	0.732	0.442 (0.132–1.481)	0.186
Radiotherapy				
No *vs.* Yes	2.311 (1.199–4.455)	0.012	3.267 (0.926–11.526)	0.066
Endocrine therapy				
No *vs.* Yes	1.351 (0.651–2.802)	0.419	0 (0–8.450E+78)	0.920

LRFS, local recurrence-free survival; IBC, invasive breast cancer; BCS, breast-conserving surgery; MT, mastectomy; SLNB, sentinel lymph node biopsy; ALND, axillary lymph node dissection; Ref, reference group.

Table 8 Univariate and multivariate analyses of prognostic factors for BCSS and DFS of patients in the BCS group

Variable	BCSS				DFS			
	Univariate		Multivariate		Univariate		Multivariate	
	HR (95% CI)	P	HR (95% CI)	P	HR (95% CI)	P	HR (95% CI)	P
Age at diagnosis, years								
<40	Ref		Ref		Ref			
40–59	0.766 (0.183–3.212)	0.716	0.976 (0.078–12.246)	0.985	0.631 (0.325–1.224)	0.173	0.606 (0.248–1.483)	0.273
≥60	1.390 (0.231–8.352)	0.719	3.993 (0.131–121.987)	0.427	0.630 (0.229–1.734)	0.371	0.972 (0.224–4.226)	0.970
BC with DCIS *vs.* BC without DCIS	0.722 (0.209–2.498)	0.607	1.189 (0.119–11.931)	0.883	0.453 (0.242–0.848)	0.013	0.436 (0.172–1.104)	0.080
MTD	1.296 (0.838–2.003)	0.244	0.963 (0.359–2.582)	0.940	1.365 (1.105–1.687)	0.004	1.349 (1.002–1.818)	0.049
RV	0.999 (0.990–1.008)	0.791	0.996 (0.982–1.010)	0.592	1.004 (1.001–1.007)	0.015	1.005 (1.000–1.010)	0.039
N stages								
N0	Ref		Ref		Ref			
N1	0.869 (0.107–7.069)	0.896	0	0.990	1.659 (0.756–3.640)	0.207	3.242 (0.987–10.643)	0.052
N2	6.416 (1.327–31.020)	0.021	35.611 (2.558–495.749)	0.008	3.916 (1.372–11.171)	0.011	3.670 (0.446–30.206)	0.227
N3	0	0.989	0	0.999	7.493 (1.001–56.079)	0.050	14.619 (1.499–142.526)	0.021
Nodal surgery								
SLNB	Ref		Ref		Ref			
ALND	0.353 (0.092–1.358)	0.130	0.113 (0.006–1.969)	0.135	0.665 (0.333–1.331)	0.249	0.289 (0.101–0.826)	0.021
None	1.060 (0.118–9.525)	0.958	0	0.996	1.422 (0.458–4.419)	0.543	2.084 (0.220–19.771)	0.522
IMA								
GE *vs.* FS	2.115 (0.449–9.967)	0.343	2.163 (0.108–43.374)	0.614	1.187 (0.466–3.024)	0.720	1.698 (0.556–5.188)	0.353
Radiotherapy								
No *vs.* yes	2.728 (0.328–22.717)	0.353	0.665 (0.030–14.636)	0.796	1.597 (0.730–3.495)	0.242	1.067 (0.344–3.308)	0.910
Endocrine therapy								
No *vs.* yes	46.004 (0.028–76321.831)	0.311	266601.119 (0–5.205E+281)	0.969	2.546 (1.032–6.281)	0.042	2.573 (0.993–6.671)	0.052

BCSS, breast cancer-specific survival; DFS, disease-free survival; BCS, breast-conserving surgery; BC, breast cancer; DCIS, ductal carcinoma in situ; MTD, maximum tumor diameter; RV, resection volume; SLNB, sentinel lymph node biopsy; ALND, axillary lymph node dissection; IMA, intraoperative margin assessment; GE, gross examination; FS, frozen section; Ref, reference group.

Table 9 Univariate and multivariate analyses of prognostic factors for LRFS, LRRFS, and DMFS of patients in the BCS group

Variable	LRFS				LRRFS				DMFS			
	Univariate		Multivariate		Univariate		Multivariate		Univariate		Multivariate	
	HR (95% CI)	P	HR (95% CI)	P	HR (95% CI)	P	HR (95% CI)	P	HR (95% CI)	P	HR (95% CI)	P
Age at diagnosis, years												
<40	Ref				Ref				Ref			
40–59	0.638 (0.283–1.437)	0.278	0.533 (0.180–1.577)	0.256	0.729 (0.331–1.608)	0.434	0.544 (0.186–1.593)	0.267	0.442 (0.155–1.261)	0.127	0.662 (0.163–2.685)	0.564
≥60	0.581 (0.160–2.113)	0.410	0.713 (0.115–4.427)	0.716	0.589 (0.162–2.142)	0.422	0.820 (0.140–4.811)	0.826	0.539 (0.112–2.597)	0.441	1.326 (0.121–14.480)	0.817
BC with DCIS *vs.* BC without DCIS	0.418 (0.191–0.914)	0.029	0.441 (0.137–1.417)	0.169	0.375 (0.174–0.807)	0.012	0.423 (0.136–1.317)	0.137	0.583 (0.217–1.565)	0.284	0.277 (0.061–1.263)	0.097
MTD	1.392 (1.076–1.802)	0.012	1.449 (1.010–2.078)	0.044	1.395 (1.089–1.788)	0.008	1.465 (1.027–2.090)	0.035	1.398 (1.018–1.921)	0.039	1.270 (0.783–2.059)	0.333
RV	1.004 (1.001–1.008)	0.014	1.009 (1.003–1.016)	0.004	1.004 (1.001–1.008)	0.011	1.010 (1.004–1.017)	0.002	1.005 (1.001–1.009)	0.021	1.004 (0.998–1.010)	0.197
N stages												
N0	Ref				Ref				Ref			
N1	1.389 (0.524–3.685)	0.509	2.928 (0.676–12.688)	0.151	1.660 (0.670–4.114)	0.273	2.955 (0.689–12.671)	0.145	2.213 (0.587–8.345)	0.241	7.763 (1.213–49.687)	0.030
N2	1.101 (0.148–8.191)	0.925	0.347 (0.015–8.160)	0.511	1.098 (0.148–8.171)	0.927	0.255 (0.009–7.044)	0.420	14.161 (4.258–47.100)	<0.001	27.044 (2.469–296.165)	0.007
N3	0	0.981	0	0.987	11.551 (1.499–89.022)	0.019	29.001 (2.473–340.105)	0.007	22.755 (2.751–188.230)	0.004	43.841 (2.569–748.008)	0.009
Nodal surgery												
SLNB	Ref				Ref				Ref			
ALND	0.505 (0.219–1.163)	0.108	0.265 (0.077–0.920)	0.036	0.584 (0.258–1.320)	0.196	0.262 (0.076–0.903)	0.034	0.938 (0.297–2.960)	0.913	0.240 (0.040–1.435)	0.118
None	1.470 (0.397–5.446)	0.564	5.569 (0.569–54.511)	0.140	1.449 (0.391–5.366)	0.578	5.312 (0.535–52.741)	0.154	0.977 (0.109–8.756)	0.983	0	0.989
IMA												
GE *vs.* FS	1.461 (0.505–4.226)	0.484	1.940 (0.504–7.460)	0.335	1.342 (0.467–3.856)	0.585	1.909 (0.493–7.392)	0.349	1.236 (0.281–5.438)	0.779	1.991 (0.391–10.134)	0.407
Radiotherapy												
No *vs.* yes	1.706 (0.636–4.575)	0.288	2.009 (0.444–9.092)	0.365	1.860 (0.700–4.937)	0.213	1.933 (0.442–8.447)	0.381	0.568 (0.160–2.014)	0.381	0.656 (0.115–3.742)	0.635
Endocrine therapy												
No *vs.* yes	1.846 (0.665–5.126)	0.240	2.573 (0.785–8.434)	0.119	2.003 (0.728–5.512)	0.179	2.837 (0.852–9.449)	0.089	0.288 (0.063–1.316)	0.108	2.924 (0.598–14.308)	0.185

LRFS, local recurrence-free survival; LRRFS, local-regional recurrence-free survival; DMFS, distant metastasis-free survival; BCS, breast-conserving surgery; BC, breast-cancer; DCIS, ductal carcinoma in situ; MTD, maximum tumor diameter; RV, resection volume; SLNB, sentinel lymph node biopsy; ALND, axillary lymph node dissection; IMA, intraoperative margin assessment; GE, gross examination; FS, frozen section; Ref, reference group.

ago. At the time when recent observational studies were conducted, breast imaging methods, systemic treatment, radiotherapy methods, and evaluation methods of margin have advanced rapidly, which may improve the survival of patients with BCS. The cases enrolled in our study were patients from 2005 to 2010, when BCS was first initiated in our hospital. In our next step, we intend to investigate the impact of changes in breast imaging examination methods, treatment methods, and pathological assessment methods on the survival of patients by conducting observational studies on recent cases, and further compare the survival between patients treated with BCS and MT.

Moreover, multivariate analysis in this study showed that N stage (HR for N1 =4.545, P=0.017, HR for N2 =11.842, P=0.001; HR for N3 =9,167, P=0.014) and luminal B-like subtype (HR =15.101, P=0.009) were independent prognostic factors for the BCSS of IBC in the entire cohort (*Table 6*). And stage N2 (HR =35.611, P=0.008) in the BCS group was the only independent risk factor for BCSS. This is consistent with previous studies (40,41), suggesting that regardless of the surgical method, early or advanced stage, IBC or DCIS, lymph node staging is the main factor affecting OS.

In our study, patients undergoing breast conserving surgery had both IBC and DCIS, both early and advanced cancer, including 253 cases of IBC of stage I-II, 14 cases of IBC of stage III-IV, and 29 cases of DCIS. We propose to analyze the survival and recurrence of these patients in the real world, as well as the prognostic factors, especially the factors affecting the loco-regional recurrence. Several randomized controlled trials and meta-analyses revealed local recurrence risk factors after BCS for IBC may include tumor size, histologic grade, margin status, lymph node metastasis, systemic therapy, and radiotherapy (42,43). A few nomograms predicting the risk of local recurrence after BCS for DCIS suggested that age, margin status, number of excisions, endocrine therapy, adjuvant RT, and treatment time period had a greater impact on local recurrence (44-46). With reference to the above reports, our study included age, MTD, RV of breast tissue, N stage, axillary lymph node surgery, methods of IMA, endocrine therapy, and radiotherapy as possible prognostic variables of loco-regional recurrence in the BCS group. However, a nomogram predicting IBTR suggested the presence of DCIS being one of major risk factors for recurrence of early breast cancer (47). So in our study design, we further divided patients in the BCS group into two subgroups according to whether DCIS component was present in the tumor. The 10-year LRFS rate (86.3% *vs.* 94.4%, P=0.024) and the 10-year LRRFS rate (85.4% *vs.* 94.4%, P=0.009) of breast cancer with DCIS component were significantly lower than that of breast cancer without DCIS component in the BCS group (*Table 3*). But multivariate Cox regression showed the presence of DCIS component was not an independent factor for local recurrence (HR =0.441, P=0.169) and local-regional recurrence (HR =0.423, P=0.137) in the BCS group (*Table 9*). Consistent with the reports above, stage N3 is an independent risk factor for local-regional recurrence (HR =29.001, P=0.007) of patients with BCS (*Table 9*).

Another end of our study was to assess whether MTD and RV of breast tissue were related to local and loco-regional recurrence. As was reported in the literature (48), MTD was an independent risk factor for local-recurrence (HR =1.449, P=0.044) and local-regional recurrence (HR =1.465, P=0.035) in the BCS group of our study. A few studies suggested that the volume of breast tissue removed during BCS was inversely correlated with local recurrence. Data from Vicini *et al.* showed that a smaller resection volume of breast tissue (<60 cm^3) was an independent risk factor for local recurrence after BCS in patients with DCIS (49). Mazeh *et al.* found that the specimen-to-tumor-volume ratio was significantly negatively correlated with local recurrence for breast cancer patients with BCS (50). Contrary to existing research results, RV in the BCS group of our study was an independent risk factor for local recurrence (HR =1.009, P=0.004) and local-regional recurrence (HR =1.010, P=0.002). It has been reported that the inflammatory response caused by surgery may provoke angiogenesis, proliferation of dormant cancer cells, and local micro-metastasis, which may be a likely explanation for early postoperative recurrence (51,52). We speculate that the increase in the resection volume breast tissue may trigger a wider area of inflammatory response, which is more conducive to the proliferation and metastasis of dormant cancer cells, thereby increasing the risk of local recurrence.

In our study, only 29 cases (10%) of the margins in the BCS group were determined by the FS method during the operation, and the rest were determined by the surgeon using the GE method. Interestingly, the multivariate analysis of this group showed that whether or not FS was performed was not related to LRFS (P=0.335) and LRRFS (P=0.349), but the FS analysis took an average of 61 minutes. Similar to our study, Nowikiewicz *et al.* compared the methods of IMA during BCS at their center,

and the results indicated that the positive rate of margins and the percentage of reoperations of FS and GE method were not significantly different, but the use of FS method has dramatically increased the operation time (53). A few theories arise which can account for the similar judgment effects between macroscopic and microscopic inspection. They were listed as follows: (I) the FS method for margin evaluation is susceptible to subjectivity and uncertainty. The influencing factors include pathologists' skillfulness in FS and histologic diagnosis, the sampling method, the number of cut edges, and the controversial definition for positive margin (54); (II) the experience and techniques of the surgeon can improve the accuracy of IMA (55). In recent years, with the development of new techniques and methods for IMA, in addition to traditional pathology and imaging methods, research on non-traditional imaging methods and biological dye methods continued to emerge (56-60). The search for methods that can improve the accuracy of IMA while shorten the duration of operation time is always a problem that urgently needs to be addressed by surgeons and pathologists.

Our hospital started SLNB in early 2007, which gave us the opportunity to observe the impact of SLNB and ALND on the survival and loco-regional recurrence of patients undergoing BCS in the same period (2005–2010) in the real world. Multivariate survival analysis showed that ALND in the BCS group was not an independent prognostic factor for BCSS (HR =0.113, P=0.135), but ALND was an independent protective factor for local-regional recurrence (HR =0.262, P=0.034). In support of our conclusion, there have been many observational studies, clinical trials, and meta-analyses suggesting that patients undergoing BCS showed no difference in survival between SLNB and ALND, but ALND can reduce axillary regional recurrence by 1–3% (61). The multivariate survival analysis of our study showed that ALND is an independent protective factor for local recurrence (HR =0.265, P=0.036) in the BCS group. Only a few studies found that there was no significant difference in the IBTR rate of BCS patients after SLNB and ALND in univariate analysis (62). An intriguing correlation between the quadrant of the breast tumor and whether or not the ALND was performed has caught our attention. This phenomenon could partially account for the protective function of ALND against recurrence. Our study has shown that more patients in the BCS group presenting with breast cancer located in the upper-lateral quadrant has had ALND compared with SLNB. Considering that tumor located in that specific region is susceptible to lymph node metastasis in the axilla, surgeons are prone to take a more drastic approach so as to prevent recurrence. In addition, speaking from a technical point of view, the vicinity of upper-lateral breast tumor and axillary breast cancer sometimes makes it inoperable to perform SLNB.

It should be noted that our results may be biased due to limited cases enrolled, influencing factors which we did not take into consideration such as socioeconomic status, comorbidity, detailed plan of chemotherapy, radiotherapy and endocrine therapy.

Conclusions

This study suggests that there is no significant difference in BCSS between breast cancer patients undergoing BCS and MT after adjusting for confounding factors. Lymph node staging is the major risk factor affecting patients' survival. Therefore, patients might have a wider range of choices of surgical methods based on their subjective wishes. In this case, choosing patients with smaller tumor size, avoiding patients with stage N3, and removing a smaller volume of breast tissue including tumors while ensuring negative margins may reduce the patient's risk of local recurrence and loco-regional recurrence.

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Footnote

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Ethical Statement: The authors are accountable for all

aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ethics Committee of Chinese PLA General Hospital (No. S2022-147-01) and individual consent for this retrospective analysis was waived.

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