

## Determinants of Breast Conservation Rates: Reasons for Mastectomy at a Comprehensive Cancer Center

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■ **Abstract:** Bias in referral patterns and variations in multi-disciplinary management may impact breast conservation therapy (BCT) rates between hospitals. Retrospective studies of BCT rates are limited by their inability to differentiate indicated mastectomies versus those chosen by the patient. Our prospective breast cancer data base was queried for patients with invasive breast cancer who underwent surgical therapy at the University of Michigan over a 3-year period. Demographics, stage and histology were recorded along with the reason mastectomy was performed, categorized as “by need” (contraindication to BCT) or “by choice.” Multivariate analysis was used to identify factors significantly associated with mastectomy by choice. BCT was associated with tumor size, histology and nodal status, but not older age, either by choice or by need. Of the 34% of patients initially felt to be poor candidates for BCT, it was absolutely contraindicated in 44%, while 56% were thought to have a tumor-to-breast size ratio too large for successful BCT. Of this latter group, 80% underwent neo-adjuvant chemotherapy in an attempt to downstage the primary tumor and perform BCT, which was successful in over half the patients. For the patients initially thought to be good candidates for BCT, only 15% chose to undergo mastectomy, while 5% eventually required mastectomy due to failed attempts to achieve negative margins. Overall, the BCT rate was 63%, however without the use of neo-adjuvant chemotherapy, the BCT rate would have been only 53%. At a tertiary referral center, BCT rates are driven more by contraindications than patient choice, and may be heavily skewed towards mastectomy due to referral patterns. In addition to tumor factors such as stage and histology, BCT rate can be dramatically impacted by neo-adjuvant chemotherapy or genetic counseling. Examining BCT rates alone as a measure of quality, therefore, is not an appropriate standard across institutions serving diverse populations. ■

**Key Words:** breast conservation rates, breast surgery, quality measure

The evolution of breast cancer surgery from radical mastectomy to modified radical mastectomy and now breast conservation therapy (BCT) has been accompanied by randomized controlled trials demonstrating the oncologic safety and therapeutic efficacy of less radical procedures. In 1990, a National Institutes of Health consensus statement recommended BCT with radiation for the majority of women with stages I and II breast cancers (1). Increased screening and earlier diagnosis have increased the number of women presenting with early stage breast cancer, and with the introduction and increased use of neo-adjuvant chemotherapy to downstage primary breast

cancers, even more women may ultimately avoid mastectomy.

Despite these facts, many patients with breast cancer are still being treated by mastectomy. Many studies have examined patient and physician factors that might influence use of BCT versus mastectomy (2–6). There has also been discussion of using BCT rates as a measure of quality for comparing breast cancer care between hospitals (7). However, many mastectomies are performed because of absolute contraindications to BCT.

At the University of Michigan, our multi-disciplinary approach is heavily weighed towards promoting breast conservation, the success of which has been well documented (8–10). Despite this philosophical approach, the nature of our practice, in large part comprised of second opinions, may impact our breast conservation rate. Breast cancer patients initially offered lumpectomy might be more likely to stay with

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their primary surgeon, while women told they require mastectomy might be more likely to seek a second opinion at a referral center (and remain at that center for surgery). This could influence the breast conservation rate, which is particularly concerning if insurance companies seek to use this statistic as a yardstick of quality. With this information in mind, we sought to determine the proportion of patients undergoing BCT and the salient reasons for the surgical treatment decisions made by patients and their surgeons. In doing so, we demonstrate the importance of differentiating patients who require mastectomy from patients who are eligible for BCT but choose mastectomy, particularly when evaluating factors that are associated with BCT rates.

## MATERIALS AND METHODS

All biopsy-proven breast cancer patients seen at the University of Michigan Comprehensive Cancer Center are presented at a multi-disciplinary tumor board composed of surgical, medical, and radiation oncologists, radiologists, pathologists, and associated support staff. Patients who choose to obtain their surgery at the University of Michigan are then entered into an institutional data base. Our prospective breast cancer data base was queried for all patients with breast cancer who underwent surgical therapy at the University of Michigan over a 3-year period, between January 1, 2003 and December 31, 2005. Male breast cancer patients and patients with lobular carcinoma in situ were excluded. In addition, all women with synchronous, bilateral breast cancers were excluded, as this might affect a woman's choice of surgical therapy. This study was approved by the Institutional Review Board at the University of Michigan.

Data were collected on patient demographics, stage (as delineated by the sixth AJCC Staging Manual) and histologic diagnosis. Reasons for mastectomy were recorded and categorized as (i) BCT attempted but negative margins could not be achieved, (ii) radiation therapy contraindicated (pregnancy, collagen-vascular disease, previous radiation), (iii) presence of diffuse microcalcifications on mammography, (iv) evidence of multicentric tumors (defined as tumors in two quadrants of the breast or multiple tumors that could not be encompassed in one lumpectomy), (v) poor tumor-to-breast size ratio, (vi) other/unknown, and (vii) BCT eligible but patient preference for mastectomy. Some of these reasons were further grouped to produce the

category, "Mastectomy by need." This category included women for whom breast conserving therapy was contraindicated because of multicentricity, widespread calcifications, inability to undergo radiation therapy, or failed attempts at BCT. Neither strong family history nor documented genetic predisposition were considered absolute contraindications to BCT. Tumor size was not considered an absolute contraindication for patients with invasive carcinoma, as neo-adjuvant chemotherapy was an option, but was considered a "mastectomy by need" for ductal carcinoma in situ (DCIS).

## RESULTS

Between January 2003 and December 2005, 993 patients had surgery at the University of Michigan Medical Center for unilateral invasive breast cancer or DCIS. There were 161 evaluable cases of in situ disease and 784 evaluable cases of invasive disease. Forty-eight cases were excluded for incomplete data. Over half of the invasive cases were T1 tumors. The average age was  $54.2 \pm 12.7$  years of age, ranging from 17 (a case of secretory carcinoma) to 95. The majority of women were white (86%). Patient characteristics are summarized in Table 1.

For the entire study population, the breast conservation rate was 63%. The breast conservation rate was similar between patients with DCIS (68%) and patients with invasive cancer (62%). These percentages include both patients who required mastectomy (contraindications to BCT) and those who chose mastectomy. Among breast conservation eligible patients (those who had no contraindications to BCT), the

**Table 1. Study Population**

Average age: $54.2 \pm 12.7$ (range, 17–95)	
Race	
White	816 (86%)
Black	61 (6%)
Asian	33 (3%)
Hispanic	9 (1%)
Unknown	26 (3%)
Tumor stage	
Tis	161 (17%)
T1	480 (51%)
T2	220 (23%)
T3	54 (6%)
T4	30 (3%)
Nodal status	
Negative	580 (61%)
Positive	287 (30%)
Unknown	78 (8%)

BCT rate was 83% for DCIS and 78% for invasive cancer.

To get a better idea of what drove the breast conservation rate, we compared the reasons for mastectomy across patients with invasive cancer and those with DCIS (Table 2). In both groups of patients, the primary reason for mastectomy was patient choice. For patients with DCIS, the next most common reason for mastectomy was diffuse calcifications on mammography, representing more than one-quarter of mastectomies (27%). For patients with invasive cancer, over 70% were deemed poor candidates for breast conservation. The most common reason for this was tumor size (22%). This category excludes patients who were downstaged by neo-adjuvant chemotherapy and underwent breast conservation, but does include patients who either chose not to undergo neo-adjuvant chemotherapy, or underwent mastectomy after neo-adjuvant chemotherapy. The ultimate fate of the patients with invasive disease is outlined in Figure 1.

Two-thirds of patients with invasive disease were felt to be good candidates for breast conservation on initial evaluation. Of these patients, over 80% went on to successful breast conservation while 15% chose

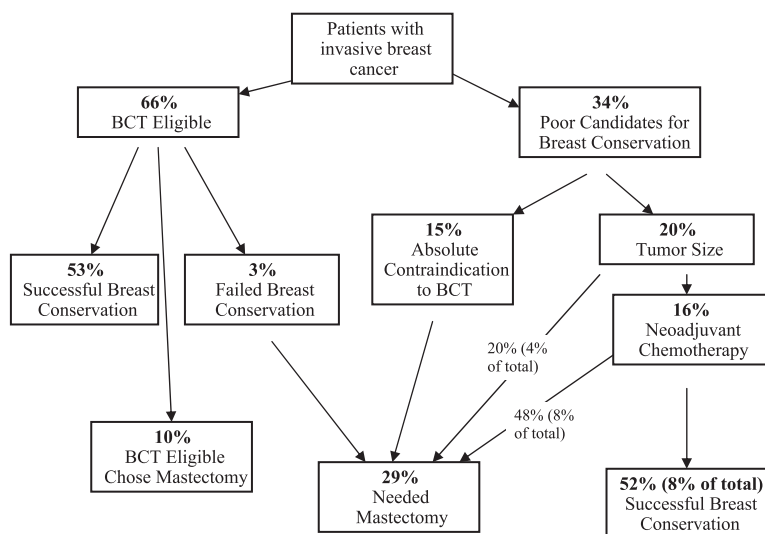
to undergo mastectomy. The remaining 5% of patients opted for BCT but failed attempts to achieve negative margins ultimately led to mastectomy. Of the initial one third of patients with invasive cancer who were felt to be poor candidates for BCT, nearly one-half had an absolute contraindication (44%) while just over one-half (56%) were thought to have a tumor-to-breast size ratio too large for successful breast conservation. For these patients with large tumors, 20% opted to proceed directly with mastectomy while 80% underwent neo-adjuvant chemotherapy. Most undertook chemotherapy in an attempt to downstage the primary tumor for breast conservation, although 14 patients underwent neo-adjuvant chemotherapy knowing mastectomy would be indicated after chemotherapy. Of the patients who had neo-adjuvant chemotherapy, BCT was successfully performed in 52%. Looking at the entire population of patients with invasive cancer, without the use of neo-adjuvant chemotherapy the breast conservation rate would have been only 53%.

To better clarify those factors that impacted whether a woman with invasive breast cancer underwent breast conservation or mastectomy, we analyzed

**Table 2. Reasons for Mastectomy for Patients with Invasive Carcinoma and DCIS**

Population	Patient choice	Tumor size	Multicentric	Diffuse calcifications	Attempt at BCT failed	Could not have XRT	Other or unknown
Overall (379)	31%	19%	15%	17%	9%	5%	4%
Invasive (319)	28%	22%	16%	15%	9%	6%	5%
DCIS (60)	45%	6%	12%	27%	4%	4%	2%

BCT, breast conservation therapy; XRT, radiation therapy; DCIS, ductal carcinoma in situ.



**Figure 1.** Pathways from diagnosis to final surgery for patients with invasive breast cancer.

both BCT versus mastectomy (regardless of reason) and BCT versus mastectomy by need. Significant predictors of BCT included older patient age, ductal histology, decreasing T-stage and the absence of lymph node involvement. Table 3 shows the odds ratios for these features in the BCT, mastectomy by choice and mastectomy by need groups. Across the population as a whole, regardless of the reason women underwent mastectomy, these features were significant on both univariate and multivariate logistic regression models. However, when we compared BCT to mastectomy only among women who had a choice, eliminating those patients who were not candidates for BCT, age was no longer a significant covariate on multivariate analysis (Table 4). This was true whether age was modeled as a continuous covariate or in categorical decades. For women over the age of 40, the breast conservation rate in each decade group is nearly

**Table 3. Analytic Sample Characteristics for Invasive Cases (n = 784)**

Covariate	BCT (n = 483)	Mastectomy by choice (n = 141)	Mastectomy by need (n = 160)
Prophylactic contralateral mastectomy: n (%)			
Yes	0	45 (31.9)	22 (13.8)
No	483 (100)	96 (68.1)	138 (86.3)
Race: n (%)			
White	421 (62.0)	117 (17.2)	141 (20.8)
Black	32 (65.3)	7 (14.3)	10 (20.4)
Asian/Pacific Islander	10 (40.0)	10 (40.0)	5 (20.0)
Other	20 (64.5)	7 (22.6)	4 (12.9)
Age			
Mean	55.4	53.5	51.1
Median	55	53.5	50
Minimum–Maximum	24–89	25–95	17–89
Age decade: n (%)			
≤40	46 (41.4)	25 (22.5)	40 (36.0)
41–50	130 (61.6)	36 (17.1)	45 (21.3)
51–60	154 (66.4)	39 (16.8)	39 (16.8)
61–70	96 (69.1)	23 (16.6)	20 (14.4)
71+	57 (62.6)	18 (19.8)	16 (17.6)
Histology: n (%)			
Ductal	398 (63.9)	101 (16.2)	124 (19.9)
Ductal with lobular features	27 (61.4)	8 (18.2)	9 (20.5)
Lobular	32 (42.1)	26 (34.2)	18 (23.7)
Other	26 (63.4)	6 (14.6)	9 (22.0)
Tumor size (T-stage)			
1	344 (71.7)	63 (13.1)	73 (15.2)
2	125 (56.8)	44 (20.0)	51 (23.2)
3	12 (22.2)	24 (44.4)	18 (33.3)
4	2 (6.7)	10 (33.3)	18 (60.0)
Positive lymph nodes			
Yes	129 (45.0)	78 (27.2)	80 (27.9)
No	342 (71.3)	61 (12.7)	77 (16.0)
Unknown	12 (70.6)	2 (11.8)	3 (17.7)

BCT, breast conservation therapy.

**Table 4. Univariate and Multivariate Association of Covariates with Surgical Procedures for Invasive Breast Cancer**

Covariate	All cases		Elective cases	
	Univariate p-value	Multivariate p-value	Univariate p-value	Multivariate p-value
Age (categorical: decades)	<0.0001	0.0014	0.1012	0.1117
T-stage	<0.0001	<0.0001	<0.0001	<0.0001
Histology	0.0046	0.0290	0.0008	0.0028
Nodal involvement	<0.0001	0.0002	<0.0001	0.0002

identical. Older age was not associated with either an increased need for mastectomy, or an increased desire for mastectomy (Fig. 2).

Table 5 shows the use of contralateral prophylactic mastectomy among women undergoing mastectomy by choice and by need. Over half (56%) of patients under the age of 40 who chose a mastectomy actually chose to undergo bilateral mastectomies. This number decreased with increasing decades of life and was substantially lower among women who were not candidates for breast conservation.

## DISCUSSION

Although many surgeons were initially skeptical of breast conservation, once multiple randomized trials established its safety, the use of breast conservation slowly began to climb. This rise was further fueled by widespread mammographic screening and the associated decreases in the median tumor size at diagnosis. Today, the majority of women diagnosed with breast cancer are eligible for breast conservation, and for stage I or II breast cancer, breast conservation is considered by many to be the standard of care. With this in mind, a surgeon's, practice's or hospital's breast conservation rate – the percentage of newly diagnosed breast cancer patients treated by lumpectomy and whole-breast irradiation, has become a marker of appropriate care. The breast conservation rate has been used to compare cancer care among various regions in the country, patients of various races or socioeconomic status, community hospitals versus academic centers, fellowship-trained versus general surgeons, etc (11–18). Today, insurance companies are interested in using breast conservation rates as a method of assessing quality of breast cancer care (7,19). Much of this is based on the idea that mastectomy is a less desirable operation, and its use is

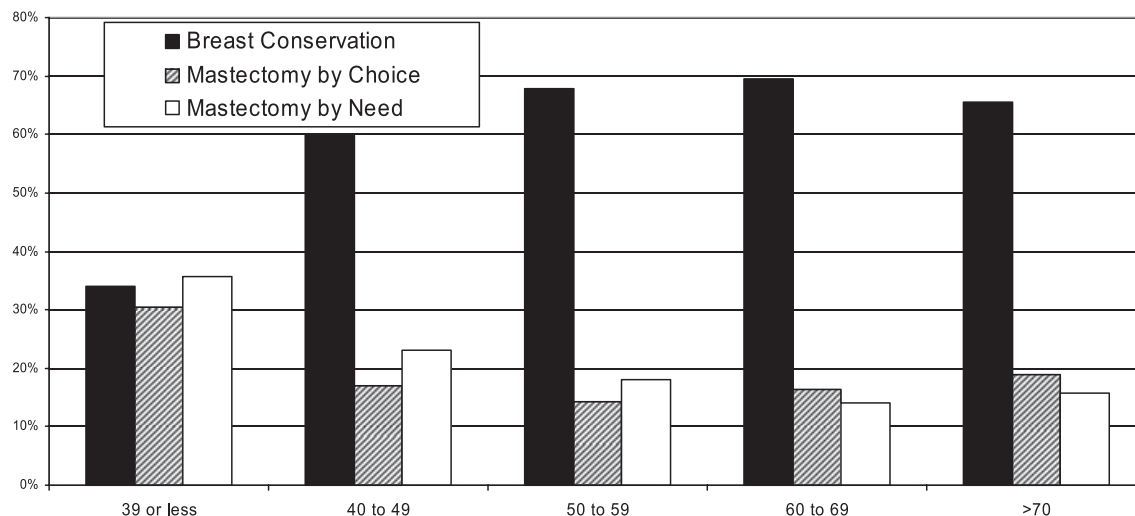


Figure 2. Breast conservation versus mastectomy by age.

Table 5. Use of Prophylactic Mastectomy among Women Undergoing Mastectomy

	Mastectomy by choice (%)	Mastectomy by need (%)
Age <39	56	20
40–49	37	15
50–59	36	17
60–69	23	4
>70	12	5

somehow a failure on the part of the surgeon, either by not offering it appropriately or by not informing patients well enough that they can choose the “right” operation. This has prompted a wealth of literature on what drives patient decision making when choosing between BCT and mastectomy and methods to decrease the “over-use” of mastectomy (2–4,20).

A significant problem arises when comparing breast conservation rates, and evaluating factors associated with BCT, using data from large data bases. Because the end point is usually whether a patient had BCT, without consideration of the reasons a woman underwent one treatment or the other, this might not accurately represent the institution’s approach to breast cancer surgery. Some women who are eligible for breast conservation choose to undergo mastectomy, and while some of the reasons for these choices may be based on incorrect assumptions (such as the likelihood of recurrence or an overestimation of the risks of radiation therapy), sometimes the choice to undergo mastectomy is a well-thought out and legitimate decision (such as a desire to avoid the inconvenience and side effects of radiation). More

importantly, many women with breast cancer are not eligible for breast conservation based on a number of absolute contraindications. These include an inability to undergo radiation, multicentric disease, or widespread microcalcifications on mammography. A third group of women might desire breast conservation, but ultimately fail multiple attempts to obtain negative margins around both the invasive and in situ components of their disease.

Overall, the breast conservation rate over the 3-year period studied was 63%; 68% for DCIS and 62% for invasive cancer. This is consistent with that described in the literature, although this number alone does not seem to imply a particularly aggressive use of breast conservation. To analyze this further, we divided mastectomy patients into two categories—those who had a “mastectomy by need,” including patients with an absolute contraindication to mastectomy or who failed BCT, and those who had a “mastectomy by choice,” those BCT eligible patients who ultimately chose mastectomy. More than half of the mastectomies performed were by need, driven by contraindications to BCT, and representing approximately 1/5 of our patient population. How this compares to other cancer centers or community hospitals is not clear, but it is evident that referral patterns will impact breast conservation rates.

Other aspects of our practice also impacted breast conservation rates. Driving a higher breast conservation rate was our use of neo-adjuvant chemotherapy. Approximately 20% of our patients were thought to have a tumor size to breast size ratio that, while not

an absolute contraindication to BCT (and not categorized as a “mastectomy by need”), would give a poor cosmetic outcome. Most of these patients were given neo-adjuvant chemotherapy, and nearly half of those patients ultimately underwent breast conservation. Without neo-adjuvant chemotherapy, the breast conservation rate would have been only 53%, well below the national average. Thus institutions with a less aggressive use of neo-adjuvant chemotherapy, or patient populations less willing to undergo neo-adjuvant chemotherapy, might have lower breast conservation rates.

In contrast, the breast conservation rate among younger patients was strongly driven by a desire for prophylaxis and BCT eligible patients undergoing bilateral mastectomies. This may, in part, be due to an aggressive use of genetic counseling during the initial evaluation of the breast cancer patient. Again, institutions with older populations or those not offering genetic counseling to patients may ultimately have higher breast conservation rates.

The importance of separating “mastectomy by need” and “mastectomy by choice” when analyzing breast conservation rates becomes apparent when multivariate analysis of those factors predictive of BCT is performed. When one looks at the entire population, including all mastectomy patients, four factors are significantly associated with BCT on multivariate logistic regression analysis; tumor size, patient age, histology (ductal versus lobular) and lymph node involvement. However, when one performs the same analysis, restricted to patients who had a choice in treatment, age is no longer a significant covariate. It becomes apparent that analyses such as these, performed on large national or insurance company datasets not separating mastectomy by need from mastectomy by choice, might give misleading or incorrect results.

Several other misconceptions regarding breast conservation rates also became apparent in this review, specifically the impact of age and histology. Several studies have addressed the impact of age on breast cancer treatment, including not only the use of breast conserving surgery but also the use of adjuvant

chemotherapy and radiation therapy (21–23). Many physicians are under the impression that older patients are less concerned with appearance or the psychosocial impact of mastectomy than their younger counterparts, a misconception reinforced by earlier studies suggesting a lower use of BCT in older populations than in younger patients (21–23). However, our findings were quite the opposite. Figure 2 illustrates that older women neither require mastectomy, nor choose mastectomy, at a higher rate than their younger counterparts. In fact, it was younger women that more often chose mastectomy over BCT, driven in large part by the desire for bilateral mastectomies for prophylaxis. This would suggest that, if all information is presented appropriately, patient populations with an older median age should have higher breast conservation rates, not lower rates as many might assume, a phenomenon that has been recently observed in other settings as well (17).

Nodal involvement was associated with an increased use of mastectomy, although the presence of nodal disease is not a contraindication to BCT. This group of patients included those with clinical evidence of nodal involvement and those with positive sentinel lymph nodes (approximately 8% of patients opted not to have axillary staging). One possible explanation is the strong association between tumor size (which clearly does impact BCT rates) and nodal metastases. However, one would expect nodal involvement to lose significance on multivariate analysis. Another possible explanation is that women who have ‘more aggressive disease’ may be pushed towards what they conceive to be more aggressive surgery (mastectomy versus lumpectomy). As there is no evidence that a mastectomy provides a survival advantage over BCT in node positive patients, this may represent a failure in communication between the surgeon and the patient.

Lobular histology was associated with an increased use of mastectomy. While this may not be surprising, the reasons for this, as shown in Table 6, might not be what many surgeons expect. Because the size of lobular carcinomas are often larger than what is seen on conventional imaging, many surgeons assume that

**Table 6. Reasons for Mastectomy for Ductal Carcinoma versus Lobular Carcinoma**

Population	Patient choice	Tumor size	Multicentric	Diffuse calcifications	Attempt at BCT failed	Could not have XRT	Other or unknown
Ductal (225)	30%	20%	14%	18%	8%	6%	5%
Lobular (44)	34%	25%	25%	2%	7%	5%	2%

BCT, breast conservation therapy; XRT, radiation therapy.

patients with lobular carcinoma undergo more mastectomies because of failed attempts at breast conservation. However, the BCT failure rate was identical for ductal and lobular histologies (8% and 7% respectively). Initial tumor size was a more common reason for mastectomy in patients with invasive lobular carcinoma, slightly due to the fact that lobular carcinomas were downstaged by neo-adjuvant chemotherapy less frequently than ductal carcinomas. In addition, more women with invasive lobular carcinoma had multicentric disease, precluding breast conservation.

In conclusion, although BCT is advocated as a superior therapeutic course for eligible patients, examining BCT rates as a measure of quality of care across institutions can be misleading unless other factors are considered. As we move towards a performance-oriented compensation model, the consequences of selecting fair and accurate assessment tools is incalculable. Breast conservation surgery is clearly dependent on appropriate patient selection; the patient populations at comprehensive cancer centers may be heavily skewed towards mastectomy due to the complexities of their disease. The use of BCT as a quality assessment tool may also increase the use of BCT for patients who are not good candidates, ultimately detracting from their quality of life and overall survival. Prospectively categorizing the clinical reasons women undergo mastectomy, and stratifying women who need mastectomy from women who choose mastectomy, should give a more accurate reflection of practice patterns. Breast conservation rates are suitable for the assessment of an institution's multi-disciplinary approach to breast cancer, especially when factoring in the use of neo-adjuvant therapy or genetic counseling, however BCT rates are a poor measure of a center's overall quality of cancer care.

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