

Clinical Surgery-American

Are mastectomy rates a reasonable quality measure of breast cancer surgery?

Laurence E. McCahill, M.D.*, Alicia R. Privette, M.D., Michael R. Hart, B.A.,
Ted A. James, M.D.

Department of Surgery, University of Vermont, Burlington, VT, USA

KEYWORDS:

Breast cancer;
Mastectomy rate;
Quality measures;
Surgical outcomes

Abstract

BACKGROUND: Quality measures of breast cancer clinical management adopted by the National Quality Forum do not address the quality of surgical performance. We evaluated mastectomy rate as one potential quality indicator.

METHODS: We reviewed the surgical management of small (stage T1; ≤ 2 cm) invasive breast tumors in patients treated from April 2003 through April 2007 at our institution. For patients undergoing mastectomy, factors leading to the selection of mastectomy were analyzed.

RESULTS: We identified 496 patients with invasive breast cancer: 433 did not undergo neoadjuvant chemotherapy, and 319 of these had pathologic tumors ≤ 2 cm in size. Of these, 55 (17.2%) underwent initial mastectomy. Medical contraindications to breast conservation were identified in 42 of 319 (13.2%) patients, whereas the selection of mastectomy was attributed to patient choice in 13 of 319 (4.1%) patients.

CONCLUSIONS: Medical contraindications to breast-conserving therapy were much more common than patient choice as the indication for mastectomy. Institution- or surgeon-specific mastectomy rates are unlikely to reflect the complexity of decision making in the surgical management of patients with breast cancer.

© 2009 Elsevier Inc. All rights reserved.

More than 15 years ago, the National Institutes of Health consensus statement for the treatment of patients with early stage breast cancer recommended breast-conserving therapy (BCT) as the clinical management of choice for such patients.¹ This recommendation was based on multicenter prospective randomized clinical trials that established equivalent long-term survival rates for patients with early stage invasive breast cancer treated by total mastectomy or partial mastectomy followed by radiation.^{2–4} Mastectomy rates have subsequently been used by both health care researchers

and policymakers as an indicator of clinical progress and the quality of breast cancer health care.

Numerous studies in the late 1980s and throughout the 1990s examined regional variation in the use of BCT in the treatment of patients with early stage breast cancer.^{5–8} An early study by Farrow et al identified a 20% variation (90.8% to 67.9%) in mastectomy rates among United States women.⁶ This regional variation subsequently fueled public interest and further inquiry into factors contributing to higher mastectomy rates. Physician treatment bias, patient age, patient fear of side effects of radiation therapy, distance to and duration of radiation therapy, and inadequate patient education concerning all available treatment options and outcomes were identified as contributing to higher mastectomy rates. Additional factors identified included patient

* Corresponding author. Tel.: +1-802-656-5830; fax: +1-802-656-5833.

E-mail address: laurence.mccahill@uvm.edu

Manuscript received August 17, 2007; revised manuscript December 17, 2007

consultation with subspecialists (ie, medical or surgical oncologists), hospital size, location, and teaching status of the institution.^{5,9–11}

Efforts to minimize these factors have resulted in a decrease in mastectomy rates to as low as 30% in several Western countries. However, persistent variation continues to be identified. Caldon et al recently reported mastectomy rates ranging from 25% to 45% across 11 institutions in the United Kingdom, with a 4-fold variation in mastectomy rates for invasive tumors ≤ 1.5 cm.¹² This continued variation has raised significant quality-of-care issues and fueled efforts to identify and monitor qualitative measures of breast cancer care delivery.

Recently, there has been a major initiative to report quality-of-care measures for both health care systems and professionals in the United States. Quality-performance measures have become well established and are now commonly reported to both insurance carriers and the general public, with reporting often mandated by state legislatures. Public report cards for coronary artery bypass grafting and valve surgery currently report surgical mortality rates associated with individual surgeons and hospitals.¹³ Similar reporting measures are also being adopted by national health care systems in other countries, such as the United Kingdom.¹³ Because of the high incidence and prevalence of breast cancer, the tremendous public interest in such, and the significant economic burden of breast cancer surveillance and treatment, the institution of a system of quality control is likely to be developed in the near future.

The National Quality Forum (NQF), in collaboration with the American College of Surgeons' Commission on Cancer, the National Comprehensive Cancer Network, and the American Society of Clinical Oncology, recently developed standardized guidelines designed to measure the quality of breast cancer care.¹⁴ The quality measures endorsed by the NQF are the first to define a single set of quality measures for breast cancer care. Although these measures encompass multidisciplinary aspects of breast cancer care, they do not currently address surgical quality measures.

Despite the current lack of standardization, several measures of surgical quality, eg, 30-day surgical mortality, have been proposed and are commonly reported. Although assessment of surgical mortality has been successfully applied to various procedures, the use of mortality as a distinguishing factor in the quality of breast cancer surgery is highly unlikely because of the low mortality associated with both total and partial mastectomy ($<1\%$).^{15,16} As a result, total mastectomy rate continues to be used as the primary measure of breast cancer quality in many studies. In a recent review of proposed quality measures, Schachter et al identified at least 10 studies evaluating the use of mastectomy rate as a quality measure in the treatment of patients with early stage breast cancer.¹⁷ However, despite its popularity, the use of mastectomy rate as a quality measure may have limitations.

A major underlying premise of monitoring mastectomy rates is the presumption that most patients, when given a

choice between mastectomy and BCT, would prefer BCT. However, several studies have indicated that patients may actually choose mastectomy.^{18,19} An additional limitation is that several clinical conditions limit the use of BCT: contraindications to radiation therapy secondary to collagen vascular diseases (ie, scleroderma, lupus), early stage pregnancy, and history of previous radiation to the proposed treatment field.²⁰ Other clinical conditions that may limit a patient's surgical treatment options include multicentric ipsilateral breast tumors, tumor size relative to patient breast size, and/or extensive suspicious microcalcifications identified in addition to invasive cancer. The relative contribution of these medical contraindications to the total mastectomy rate in modern series is unknown.

Because of the continued use of mastectomy rates in studies of patient care patterns and the interest in using mastectomy rate as a quality measure, we investigated the accuracy of this indicator as a barometer of the quality of breast cancer management provided by surgeons and hospitals. Specifically, we sought to determine the reasons that patients with small invasive breast tumors did not undergo BCT as their initial surgical treatment, despite the fact that their treatment was received at a multidisciplinary breast center with a low overall total mastectomy rate (26.2%).²¹ We additionally sought to establish whether mastectomy rate is an accurate indicator of patient treatment "choice."

Methods

Institutional Review Board approval was obtained from the University of Vermont. The Division of Surgical Oncology at the University of Vermont/Fletcher Allen Health Care (FAHC) has maintained a breast cancer surgery quality database since April 2003. This database maintains numerous clinical parameters and surgical outcomes for all patients undergoing breast cancer surgery for known breast malignancy at our institution. Data are collected by nurse breast health specialists and entered into an electronic database. Patients who underwent initial breast tumor excision at an outside institution and who received subsequent completion breast surgery at our institution for the same initial diagnosis of breast cancer were excluded. Patients with a distant previous history of breast cancer treatment were included.

We identified all patients at our institution undergoing initial surgical treatment for breast cancer from April 2003 through April 2007. Patients with ductal carcinoma in situ (DCIS) were excluded because controversy exists regarding the necessity of radiation for small-volume DCIS resected with negative pathologic margins. We then excluded patients who received neoadjuvant chemotherapy because our outcomes database records final pathologic tumor size and not pretreatment radiographic tumor size estimates. Thus, the pathologic tumor size recorded in our database does not

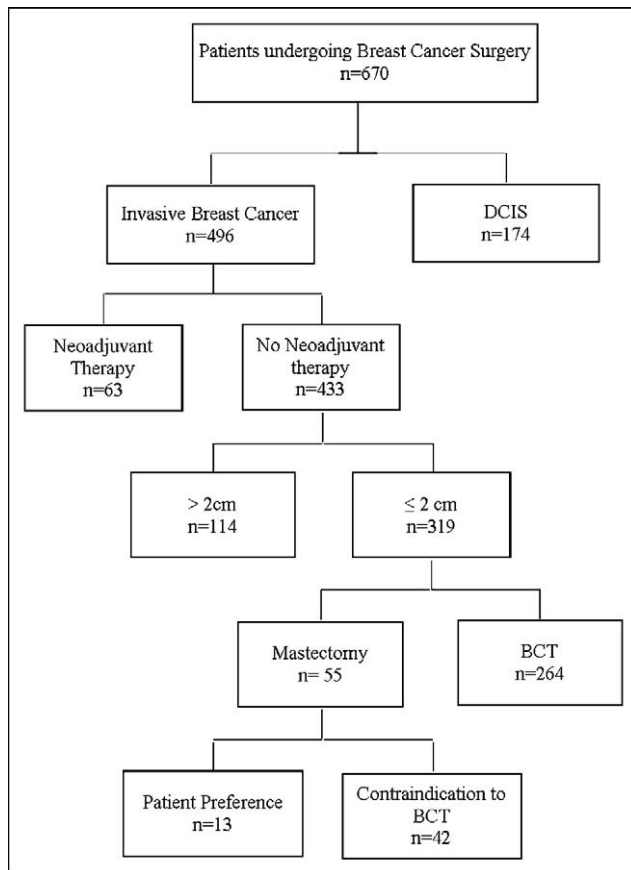


Figure 1 Breast cancer surgery performed at FAHC from 2003 through 2007.

necessarily reflect initial clinical tumor size and the clinical decision-making process at the time of initial surgical consultation. We subsequently identified patients with small invasive breast tumors. Tumor size ≤ 2 cm on final pathology was the inclusion criteria because tumors of this size generally allow for cosmetically acceptable partial mastectomy regardless of patient breast size. Male patients were also excluded because of the rarity of male breast cancer and the greater acceptance of total mastectomy as the treatment of choice in men.

For all patients undergoing mastectomy, a detailed review of the patients' medical records was performed to identify decision-making factors for the selection of total mastectomy. Specifically, we assessed the presence of clinical factors that are considered contraindications for BCT: previous radiation to the breast region, recurrent breast cancer, multicentric breast cancers, early stage pregnancy, and certain connective tissue disorders and collagen vascular diseases. The files were reviewed by an independent third party to assess the clinical factors involved in the surgical treatment decision, including whether mastectomy was an expressed preference of the patient. All of the files contained detailed information concerning the decision-making process. The cases were then reviewed by the involved surgeon for verification of the third-party assessment.

Results

We identified a total of 670 breast cancer patients who underwent initial surgery for newly diagnosed breast cancer at FAHC between April 2003 and April 2007. Of these, 496 (74.0%) had invasive cancer. Neoadjuvant chemotherapy was used in 12.7% (63 of 496) of patients with invasive cancer. These patients were excluded because tumor size data recorded after neoadjuvant therapy is unlikely to reflect original tumor size. Of the remaining 433 patients, 319 had a final pathologic tumor size ≤ 2 cm. Of these patients, 55 underwent total mastectomy as their initial surgical treatment, resulting in a 17.2% (55 of 319) initial mastectomy rate for women with small invasive breast tumors who did not undergo neoadjuvant chemotherapy (Fig. 1).

Age ranged from 32 to 85 years (mean 57). Mean tumor size was diameter 1.07 cm (range .2 to 2). Five of 55 patients had a preoperative diagnosis of invasive lobular cancer (9.1%), and the remainder had invasive ductal cancer. Medical conditions considered contraindications to BCT were identified in 42 of 55 (67%) patients (Table 1). Eighteen of 55 patients had multifocal or multicentric disease judged by the surgeon to contraindicate BCT. Seventeen patients had ipsilateral recurrent breast cancer occurring after previous BCT, including previous radiation. Three patients with biopsy-proven invasive cancer also had extensive indeterminate or suspicious microcalcifications in the remainder of the breast, making mammographic surveillance nontenable. Two patients had collagen vascular disease and were deemed unsuitable for breast radiation by a consulting radiation oncologist. Two patients were known BRCA gene-mutation carriers. Although BRCA gene mutation is not a definitive contraindication to BCT, both patients received bilateral mastectomies after medical discussion regarding the increased risk of recurrence in the contralateral breast.^{22,23} In addition, 1 of the BRCA patients had multicentric disease that precluded partial mastectomy. Of the 319 patients with invasive tumors ≤ 2 cm, the indication for mastectomy in 13 (4.1%) appeared to be patient choice.

The surgical group performing the operations consisted of 5 surgeons. Four of the 5 surgeons were fellowship trained in surgical oncology. Their experience ranged from

Table 1 Indications for mastectomy in patients with invasive cancer and tumor size ≤ 2 cm

Reason for mastectomy	No. of patients (%)
Multifocal cancer	18 (32.7)
Ipsilateral recurrence	17 (30.9)
Extensive microcalcifications	3 (5.5)
BRCA-2 gene mutation ^a	2 (3.6)
Collagen vascular disease	2 (3.6)
Patient choice	13 (23.6)

^aIn addition to BRCA-2, 1 patient had multifocal disease that precluded BCT.

newly fellowship trained to >20 years posttraining experience. Three of the 5 surgeons focused their practice solely on breast operations and were high-volume breast surgeons (>50 breast cancer operations/y).

Comments

In recent years, there has been growing interest among government agencies, insurance companies, and patient advocacy organizations in identifying and defining specific surgical quality measures. Although surgical quality measures, eg, 30-day surgical mortality, have been successfully applied to certain fields, such as cardiothoracic surgery, indicators such as these are difficult to apply to low-mortality operations, such as breast cancer surgery.^{13,16} Thus, the development of quality measures for breast cancer care is still in development and has so far focused primarily on the delivery of adjuvant therapies, such as chemotherapy, hormonal therapy, and radiation. Recent quality measures developed as a collaboration between the NQF, the American College of Surgeon's Commission on Cancer, the National Comprehensive Cancer Network, and the American Society of Clinical Oncology focus on compliance with the following: (1) use of radiation therapy in patients with invasive cancer who are undergoing partial mastectomy, (2) use of hormonal therapy in patients with hormone receptor-positive breast tumors, and (3) use of systemic chemotherapy in patients with node-positive, hormone receptor-negative breast tumors.¹⁴ Potential measures of the quality of initial breast cancer surgery, such as the incidence of initial mastectomy or re-operation rates after partial mastectomy, were not incorporated.

Although surgical quality measures have not been specifically identified, total mastectomy rates have been used throughout the literature as an indicator of quality cancer care. Articles regularly report institutional and national mastectomy rates and examine factors influencing these rates. Major factors associated with increased mastectomy rates include patients' fear of radiation therapy and fear of disease recurrence in the preserved breast.^{18,19,24-27} Longer travel distances to radiation treatment facilities or limitations in transportation have also been linked to higher mastectomy rates.²⁸⁻³⁰ In addition, researchers have indicated that there is a significant association between higher mastectomy rate and lack of patient understanding and lack of discussion by the surgeon of all available treatment options.^{8,31} As a result, decision-making aids, such as instructional videos highlighting the 2 major surgical treatment options and a thorough presentation of anticipated outcomes, have been proposed as a method to lower mastectomy rates.³²

Despite the complexity of factors influencing surgical decision making, a long-standing assumption persists that higher mastectomy rates are attributable to the personal bias of the treating surgeon.^{5,8,24,28} Although this may have been true in the past, recent data may indicate that this factor is

decreasing in significance. Mastectomy rates have been steadily decreasing since the introduction of BCT, most likely caused by increasing physician education and acceptance of clinical trial data showing equivalent survival between BCT and total mastectomy. Lazovich reported a total mastectomy rate of 40% for women with stage I breast cancer treated in 1995.³³ In 2002, the total mastectomy rate in the United States decreased to 30.2%.³⁴ The decrease in physician bias toward total mastectomy is further supported by the findings of Katz et al, who surveyed a large population of women diagnosed with DCIS. The survey showed that when patients received a physician recommendation for surgery, BCT was actually recommended more often than mastectomy.¹⁹

However, surgeon bias cannot be completely dismissed. Caldon et al recently demonstrated a 2-fold variance in total mastectomy rates (25% to 40%) between 11 different treatment centers in the United Kingdom.¹² The variation increased further to a 4-fold difference for the treatment of patients with small tumors (<1.5cm), suggesting that potential treatment biases or access-to-care issues may still be present. However, there has been some evidence that bias for total mastectomy may originate from the patient as well as the surgeon.^{19,27} A study by Tate et al attributed their high mastectomy rate (90%) to patient choice. The major reasons cited for this choice was patients' fear of radiotherapy (63%), radiotherapy being too time consuming (44%), and fear of cancer recurrence (29%).¹⁸ Although many of these concerns can now be decreased through early consultation with a radiation oncologist, educational videos, and appropriate time for discussion of patients' fears and concerns, there is still evidence that patients who are suitable for BCT are choosing total mastectomy.

Katz et al recently evaluated the patient's role in treatment decision making for early stage breast cancer, the majority of which was DCIS, and its correlation with the use of total mastectomy. This study demonstrated mastectomy rates of 27% in women who reported that they made the treatment decision compared with 16.8% who described a shared the decision-making process with their surgeon and just 5.3% in patients who stated that their surgeon made the decision.³⁴ This work was the first to identify a major limitation in using institutional mastectomy rate as a quality indicator. It clearly demonstrated that some patients prefer to undergo mastectomy. This refutes the long-standing contention that surgeons drive the choice of total mastectomy. Katz has subsequently suggested that the use of mastectomy rates as a quality indicator may actually result in surgeons biasing treatment selection contrary to the patient's personal preference.³⁵

Our study not only supports the idea that some patients choose mastectomy, it also identifies a second major limitation of using mastectomy rate as a surgical quality measure: the impact of patient medical conditions on treatment selection. In our study, medical contraindications, rather than patient choice, were the most commonly reported rea-

son for total mastectomy in patients with small (≤ 2 cm) invasive tumors. Specifically, of the 55 patients with small invasive tumors who underwent total mastectomy, 42 (76%) had generally accepted contraindications to BCT (Table 1). In fact, we found that among the 319 patients with small invasive tumors who underwent initial surgical therapy, only 4.1% specifically expressed a preference for mastectomy. We had previously underappreciated the contribution of patients with previous BCT and ipsilateral recurrence as the largest single patient group undergoing mastectomy at our breast center. Failure to appreciate the contribution of medical indications as well as personal preference in treatment selection makes total mastectomy rate an unreliable indicator of quality surgical breast cancer care.

This study highlighted a major limitation in using a parameter, such as mastectomy rate, as a measure of surgical quality. Treatment outcomes that are readily available in administrative databases, (eg, type of surgical procedure), are generally not amenable to detailed analysis of clinical factors influencing complex medical decision making. Given our current findings, as well as those of Katz, it appears that total mastectomy rate alone is not an accurate measure of breast cancer surgical care quality if used without analysis of concurrent medical and social factors.^{19,35,36} However, it may be possible to identify an appropriate range for mastectomy rates in patients with small invasive tumors that accounts for variation in clinical factors and patient treatment preferences. Total mastectomy rates for all patients with breast cancers typically range from 25% to 40%. Our institution reported a 17.2% mastectomy rate for patients with small invasive tumors, suggesting that 15% to 30% may be an acceptable standard for mastectomy rates in patients with small invasive tumors. In addition, further consideration should be given to defining mastectomy rates based on initial breast cancer diagnosis and tumor size. This would allow for a more standardized comparison of institutional and regional treatment patterns and may better identify variations in practice patterns resulting from health care disparities, which can be corrected.

Although we believe that our study provides valuable insight into the weaknesses of mastectomy rate as a quality indicator, it does have several limitations. Our breast cancer center is a multidisciplinary clinic with a highly specialized surgical staff. The presence of a multidisciplinary model, higher-volume surgeons, subspecialty training, and university practice location may have had a significant effect on the mastectomy rate, which is as low or lower than any reported in the literature. Thus, a rate this low may not be achievable in other less specialized settings. However, the low mastectomy rate makes our center ideal to evaluate the limits to further decreasing the mastectomy rate. Another limitation is that patients with newly diagnosed breast cancer at our institution do not routinely receive decision-making aids, other than literature, which may better address patient concerns about treatment options, side effects, and disease recurrence than physician consultation. Retrospec-

tively, we could not assess individual patient understanding of treatment options or physician counseling styles as potential contributors to mastectomy. Our center's approach has been to routinely have new breast cancer patients seen before surgery by medical, radiation, and surgical oncologists, with the assumption that this is likely to result in patients receiving a balanced discussion of treatment options and side effects. Furthermore, because our mastectomy rate for patients with small invasive tumors is so low, our institution may not be the ideal center to evaluate factors contributing to mastectomy. However, to better address this issue, our data could be used to initiate comparative studies across institutions to evaluate variations in mastectomy rates.

Despite these limitations, we believe that our data strongly support the belief that mastectomy rate alone should not be used as a quality indicator. A reasonable mastectomy rate range should be developed based on pre-operative diagnosis, and the influence of clinical and personal factors should be taken into consideration. Other potential measures of quality surgical breast cancer care, such as examination of a patient's desired versus actual role in the surgical treatment decision-making process or concordance between a patient's surgical treatment preference and the treatment received, should continue to be investigated.^{27,37} Evaluation of parameters related to the success of initial partial mastectomy, such as the rate of positive margins and the frequency of multiple surgeries to obtain negative margins, could potentially emerge as quality measures. Although none of these measures have been currently validated or widely accepted, we believe that the quality of initial breast cancer surgery performed is likely to emerge as an important contributor to overall breast cancer care and patient disease-related outcomes. Surgeons should maintain an important and active role in contributing to the selection of appropriate quality measures and participate in projects that might validate optimal quality measures of cancer surgery.

References

1. NIH consensus conference. Treatment of early-stage breast cancer. *JAMA* 1991;265:391-5.
2. Fisher B, Bauer M, Margolese R, et al. Five-year results of a randomized clinical trial comparing total mastectomy and segmental mastectomy with or without radiation in the treatment of breast cancer. *N Engl J Med* 1985;312:665-73.
3. Veronesi U, Saccozzi R, Del Vecchio M, et al. Comparing radical mastectomy with quadrantectomy, axillary dissection, and radiotherapy in patients with small cancers of the breast. *N Engl J Med* 1981;305:6-11.
4. Morris AD, Morris RD, Wilson JF, et al. Breast-conserving therapy vs mastectomy in early-stage breast cancer: a meta-analysis of 10-year survival. *Cancer J Sci Am* 1997;3:6-12.
5. Nattinger AB, Gottlieb MS, Veum J, et al. Geographic variation in the use of breast-conserving treatment for breast cancer. *N Engl J Med* 1992;326:1102-7.
6. Farrow DC, Hunt WC, Samet JM. Geographic variation in the treatment of localized breast cancer. *N Engl J Med* 1992;326:1097-101.

7. Goel V, Olivotto I, Hislop TG, et al. Patterns of initial management of node-negative breast cancer in two Canadian provinces. *British Columbia/Ontario Working Group. CMAJ* 1997;156:25–35.
8. Guadagnoli E, Weeks JC, Shapiro CL, et al. Use of breast-conserving surgery for treatment of stage I and stage II breast cancer. *J Clin Oncol* 1998;16:101–6.
9. Keating NL, Landrum MB, Ayanian JZ, et al. Consultation with a medical oncologist before surgery and type of surgery among elderly women with early-stage breast cancer. *J Clin Oncol* 2003;21:4532–9.
10. Ballard-Barbash R, Potosky AL, Harlan LC, et al. Factors associated with surgical and radiation therapy for early stage breast cancer in older women. *J Natl Cancer Inst* 1996;88:716–26.
11. Hebert-Croteau N, Brisson J, Pineault R. Review of organizational factors related to care offered to women with breast cancer. *Epidemiol Rev* 2000;22:228–38.
12. Caldon LJ, Walters SJ, Reed JA, et al. Case-mix fails to explain variation in mastectomy rates: management of screen-detected breast cancer in a UK region 1997–2003. *Br J Cancer* 2005;92:55–9.
13. Steinbrook R. Public report cards—cardiac surgery and beyond. *N Engl J Med* 2006;355:1847–9.
14. National Quality Forum Endorsed Commission on Cancer Measures for Quality of Cancer for Breast and Colorectal Cancers, American College of Surgeons Commission on Cancer. Available at: <http://www.facs.org/cancer/qualitymeasures.html>. Accessed: May 14, 2007.
15. Birkmeyer JD, Siewers AE, Finlayson EV, et al. Hospital volume and surgical mortality in the United States. *N Engl J Med* 2002;346:1128–37.
16. El-Tamer MB, Ward BM, Schiffner T, et al. Morbidity and mortality following breast cancer surgery in women: national benchmarks for standards of care. *Ann Surg* 2007;245:665–71.
17. Schachter HM, Mamaladze V, Lewin G, et al. Many quality measurements, but few quality measures, assessing the quality of breast cancer care in women: a systematic review. *BMC Cancer* 2006;6:291.
18. Tate PS, McGee EM, Hopkins SF, et al. Breast conservation versus mastectomy: patient preferences in a community practice in Kentucky. *J Surg Oncol* 1993;52:213–6.
19. Katz SJ, Lantz PM, Janz NK, et al. Patterns and correlates of local therapy for women with ductal carcinoma-in-situ. *J Clin Oncol* 2005;23:3001–7.
20. Mastectomy or lumpectomy? The choice of operation for clinical stages I and II breast cancer. The Steering Committee on Clinical Practice Guidelines for the Care and Treatment of Breast Cancer. Canadian Association of Radiation Oncologists. *CMAJ* 1998;158(suppl 3):S15–S21.
21. McCahill LE, James TA, Ratliff J, et al. Measuring individual surgeon performance in breast cancer surgery. *Ann Surg Oncol abstract book* 2007;14(suppl):44.
22. Robson M, Svahn T, McCormick B, et al. Appropriateness of breast-conserving treatment of breast carcinoma in women with germline mutations in BRCA1 or BRCA2: a clinic-based series. *Cancer* 2005;103:44–51.
23. Liebens FP, Carly B, Pastijn A, et al. Management of BRCA1/2 associated breast cancer: a systematic qualitative review of the state of knowledge in 2006. *Eur J Cancer* 2007;43:238–57.
24. Mandelblatt JS, Berg CD, Meropol NJ, et al. Measuring and predicting surgeons' practice styles for breast cancer treatment in older women. *Med Care* 2001;39:228–42.
25. Wei JP, Sherry RM, Baisden BL, et al. Prospective hospital-based survey of attitudes of Southern women toward surgical treatment of breast cancer. *Ann Surg Oncol* 1995;2:360–4.
26. Ward S, Heidrich S, Wolberg W. Factors women take into account when deciding upon type of surgery for breast cancer. *Cancer Nurs* 1989;12:344–51.
27. Keating NL, Guadagnoli E, Landrum MB, et al. Treatment decision making in early-stage breast cancer: should surgeons match patients' desired level of involvement? *J Clin Oncol* 2002;20:1473–9.
28. Ferguson CM, Feinstein AC, Pendergrast WJ. Determinants of primary therapy of early stage breast cancer. *J Med Assoc Ga* 1990;79:351–4.
29. Schroen AT, Brenin DR, Kelly MD, et al. Impact of patient distance to radiation therapy on mastectomy use in early-stage breast cancer patients. *J Clin Oncol* 2005;23:7074–80.
30. Goodwin JS, Hunt WC, Samet JM. Determinants of cancer therapy in elderly patients. *Cancer* 1993;72:594–601.
31. Katz SJ, Lantz PM, Zemencuk JK. Correlates of surgical treatment type for women with noninvasive and invasive breast cancer. *J Womens Health Gend Based Med* 2001;10:659–70.
32. Chapman GB, Elstein AS, Hughes KK. Effects of patient education on decisions about breast cancer treatments: a preliminary report. *Med Decis Making* 1995;15:231–9.
33. Lazovich D, Solomon CC, Thomas DB, et al. Breast conservation therapy in the United States following the 1990 National Institutes of Health Consensus Development Conference on the treatment of patients with early stage invasive breast carcinoma. *Cancer* 1999;86:628–37.
34. Katz SJ, Lantz PM, Janz NK, et al. Patient involvement in surgery treatment decisions for breast cancer. *J Clin Oncol* 2005;23:5526–33.
35. Katz SJ, Hawley ST. From policy to patients and back: surgical treatment decision making for patients with breast cancer. *Health Aff (Millwood)* 2007;26:761–9.
36. Yabroff KR, Kerner JF. Variations in surgery for early-stage breast cancer: what are we measuring? *Lancet* 2005;366:188–90.
37. Charles C, Gafni A, Whelan T. Decision-making in the physician-patient encounter: revisiting the shared treatment decision-making model. *Soc Sci Med* 1999;49:651–61.