



Volumetric breast density is essential for predicting cosmetic outcome at the late stage after breast-conserving surgery

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Abstract

Background: The critical issue related to breast-conserving therapy (BCT) is that cosmetic outcomes deteriorate with long-term follow-up. There is little research for breast density as a predictor of cosmetic outcomes at the late stage after BCT. To improve the long-term quality of life after BCT of breast cancer patients, the correlation of volumetric breast density (VBD) and cosmetic outcome at the late stage after BCT was evaluated.

Study design: Breast volume, fibroglandular tissue volume, adipose tissue volume, and VBD were calculated on mammography using image analysis software (Volpara[®]) in 151 patients with BCT. Furthermore, the correlation of breast density and the change of breast volume over time was analyzed on mammography in 99 patients who were followed-up long-term after BCT.

Results: On multivariate analysis, VBD was a predictor of cosmetic outcome after BCT with percent breast volume excised (PBVE). Decreased adipose tissue volume and increased fibrosis were more common in patients with VBD < 15%. Furthermore, remnant breast volume continued to decrease over time in low breast density patients during long-term follow-up. 93% of patients with VBD ≥ 15% and PBVE < 10% had a better cosmetic outcome, while 60% of patients with VBD < 15% and PBVE ≥ 10% had a worse cosmetic outcome after BCT.

Conclusions: While PBVE was involved in cosmetic outcome at the early stage after BCT, VBD was associated with cosmetic outcome at the late stage after BCT. Thus, a combination of VBD and PBVE could predict cosmetic outcome after BCT and contribute to the selection for the appropriate BCT.

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Keywords: Breast cancer; Breast-conserving surgery; Cosmetic outcome; Breast density

Introduction

Progress in oncoplastic techniques has improved the cosmetic outcome in breast-conserving therapy (BCT).^{1,2} Furthermore, remarkable progress and spread of the technique of immediate breast reconstruction improves

Abbreviations: BCT, breast-conserving therapy; PBVE, percent breast volume excised; VBD, volumetric breast density; ROC, receiver operating characteristic; PRBV, percent of remnant breast volume.

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cosmetic outcomes over BCT, which is no longer the only way to avoid mastectomy.^{3,4} It is necessary to determine whether BCT alone or mastectomy with immediate breast reconstruction improves the quality of life of breast cancer patients.^{5,6}

The critical issue related to BCT is that cosmetic outcomes deteriorate with long-term follow-up.^{7,8} Fibrosis is known to be a factor contributing to a worse cosmetic outcome at the late stage.⁹ However, the cosmetic outcome is sometimes worse in patients without fibrosis. If the cosmetic outcome at the early stage immediately after surgery and irradiation is better, patient background characteristics are strongly suspected as being the cause of worse cosmetic outcomes at the late stage.

If the cosmetic outcome were retained, BCT would have greater advantages of low surgical damage and cost-effectiveness over immediate breast reconstruction.^{10–13} Factors to predict the long-term cosmetic outcome after BCT are required to choose the appropriate breast surgery for breast cancer patients. BCT should be selected for the patient group in whom better cosmetic outcomes are expected. Conversely, more aggressive oncoplastic surgeries such as immediate breast reconstruction should be selected for the patient group in whom worse cosmetic outcomes are predicted following BCT.

We focused on breast density as a factor related to worse cosmetic outcomes in the late stage after BCT. The relationship between breast density and cosmetic outcomes after BCT has remained unclear. The purpose of this study was to evaluate the relationship between breast density and cosmetic outcomes after BCT, particularly at the late stage. Furthermore, whether it is possible to predict the cosmetic outcome after BCT using a combination of percent of breast volume excised (PBVE) and volumetric breast density (VBD) was evaluated.

Patients and methods

Patients

A total of 357 patients underwent breast-conserving surgery and radiotherapy between January 2010 and December 2012 at Chiba University Hospital. Patients with bilateral breast cancer, a re-excision procedure, axillary dissection, or boost irradiation were excluded. In the remaining 151 patients, it was possible to analyze the raw data of mammography and evaluate cosmetic outcomes. The median time that had elapsed since radiotherapy to evaluation of the cosmetic outcome and analysis of mammography was 37 months (range, 22–58 months).

In another group of 217 patients who underwent BCT between January 2002 and December 2004, the change of breast volume on mammography was analyzed. A total of 99 patients were selected under the same conditions as the first group, and it was possible to analyze follow-up mammography examination over eight years.

The study protocol was approved by the ethics committee of our institute, and written informed consent was obtained from all patients.

Cosmetic evaluation

As oncoplastic techniques in BCT, periareolar incision and volume displacement technique was performed. Cosmetic outcomes and radiotherapy toxicity (fibrosis, pigmentation, telangiectasia, edema) were assessed using photographs taken from five directions (front; left side; right side; left oblique; and right oblique) in the first group of 151 patients by two breast surgeons and a plastic surgeon. Cosmetic outcomes were assessed using the four-category Harvard scale¹⁴ with the following definitions: “excellent”, treated breast looks essentially the same as the opposite breast; “good”, minimal but identifiable effects

Table 1

Relationships between clinical variables and cosmetic outcome evaluated using the four-category Harvard scale after breast-conserving therapy.

	Univariate			Multivariate		
	OR	95% CI (Lower/Upper)	P value	OR	95% CI (Lower/Upper)	P value
Age (years)	0.41	0.18/0.92	0.028*	0.64	0.24/1.59	0.340
<50/50≤						
Breast volume (cm ³)	0.89	0.43/1.82	0.754			
<364/364≤						
Volumetric breast density (%)	3.55	1.64/7.68	0.0009*	4.55	1.90/11.6	0.0005*
<13.8/13.8≤						
Tumor-nipple distance (cm)	3.05	1.43/6.51	0.003*	2.36	0.99/5.78	0.052
<3.1/3.1≤						
Tumor location	1.12	0.54/2.33	0.746			
Medial/Lateral location						
PBVE (%)	0.30	0.14/0.65	0.001*	0.28	0.10/0.68	0.004*
<10.1/10.1≤						

*P < 0.05, OR: Odds ratio, CI: confidence interval, PBVE: percent breast volume excised.

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