

## Long-term results of oncoplastic breast surgery with latissimus dorsi flap reconstruction: a pilot study of the objective cosmetic results and patient reported outcome

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**Purpose:** The goal of oncoplastic breast surgery is to restore the appearance of the breast and improve patient satisfaction. Thus, the assessment of cosmetic results and patient-reported outcomes (PROs) using appropriately constructed and validated instruments is essential. The aim of the present study was to assess the long-term objective cosmetic results and corresponding PROs after oncoplastic breast surgery.

**Methods:** Cosmetic results were assessed by the patients, a medical panel, and a computer program (BCCT.core). PROs were assessed using BREAST-Q, a questionnaire that measures the perception of patients having breast surgery. The cosmetic results and PROs were analyzed in patients who underwent quadrantectomy and partial breast reconstruction utilizing the latissimus dorsi flap.

**Results:** The mean duration of the follow-up period was 91.6 months (range, 33.3–171.0 months), and mean age of the patients was 51 years old (range, 33–72 years). The mean tumor size was 2.1 cm (range, 0.9–5.5 cm). There was fair agreement between the medical panel and BCCT.core score ( $K = 0.32$ ,  $P < 0.001$ ), and a statistically significant correlation between the BCCT.core score and medical panel cosmetic results was identified ( $r = 0.606$ ,  $P < 0.001$ ). A better BCCT.core result was related to a higher PRO of each BREAST-Q domain—satisfaction with breasts ( $R^2 = 0.070$ ,  $P = 0.039$ ), satisfaction with outcome ( $R^2 = 0.087$ ,  $P = 0.021$ ), psychosocial well-being ( $R^2 = 0.085$ ,  $P = 0.023$ ), sexual well-being ( $R^2 = 0.082$ ,  $P = 0.029$ ), and satisfaction with information ( $R^2 = 0.064$ ,  $P = 0.049$ ).

**Conclusion:** Our long-term results of oncoplastic surgery achieved a high level of patient satisfaction with good cosmetic results. The medical panel and BCCT.core results correlated well with the PROs of the patients using valid, reliable, and procedure-specific measures.

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**Key Words:** Breast, Carcinoma, Quality of life, Superficial back muscles, Surgical flap

### INTRODUCTION

The primary goal in the surgical management of breast cancer is to achieve local control. Over the past decades, the

surgical management of breast cancer has evolved from radical mastectomy to breast-conserving surgery. In Korea, while the proportion of patients who underwent total mastectomy decreased from 71.2% in 2000 to 33.8% in 2011, the proportion

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of patients who underwent breast-conserving surgery more than doubled, from 27.9% in 2000 to 65.7% in 2011 [1]. Additionally, in keeping with the concept of surgical management, treatments are customized to individual patients, based on oncological risk and optimal cosmetic results. Patient-reported outcomes (PROs) have emerged as another important issue after breast cancer surgery. Despite the recognized importance of cosmetic results, there is difficulty in evaluating the various techniques of breast cancer surgery and reconstruction. The Harris Scale is one of the most widely used measures in the assessment of cosmetic results after breast surgery [2]; however, this assessment is reportedly time-consuming due to its requirement of multiple health professionals for completion. Additionally, because the scale assesses cosmetic results purely on subjective indices, the Harris scale is subject to low interobserver agreement [3]. Although many different approaches have been tried in the assessment of the cosmetic results of breast surgery [4-7], there is currently no universally accepted, objective, quantifiable scale of breast aesthetics [8]. Therefore, it is important to identify a tool that quickly and easily provides a reproducible digital assessment of cosmetic results.

The breast cancer conservative treatment cosmetic results (BCCT.core) is a computer program that provides an overall aesthetic assessment based on breast symmetry, skin color changes, and surgical scar appearance on photographs of women who have undergone breast-conserving surgery with or without radiotherapy. BCCT.core was proven to assess the cosmetic outcome accurately in several studies by providing consistent and reproducible results [3,9-13].

One of the most important issues after oncoplastic breast surgeries, along with the cosmetic results, may be the PRO of the surgical procedure. Despite the growing demand for PRO instruments, a recent systematic review found that publications on the quality of life (QoL) following various breast reconstruction techniques used mainly standard instruments and drew ambiguous conclusions; none of the existing breast surgery-related measures have captured a range of important outcomes in a scientifically sound manner [14,15].

BREAST-Q is a newly developed PRO instrument to measure the perceptions of patients having reconstructive and cosmetic breast surgery. The conceptual framework of the BREAST-Q comprises the health-related (HR)-QoL and patient satisfaction domain. HR-QoL comprises physical, psychosocial, and sexual well-being. Additionally, patient satisfaction comprises satisfaction with breasts, satisfaction with the overall outcome, and satisfaction with care [16]. This PRO instrument was designed specifically for breast surgery, including reconstructive breast surgery, and the performance was validated in the literature [14,17].

Quadrantectomy and immediate partial reconstruction utilizing the latissimus dorsi (LD) flap has been widely

adopted as a part of oncoplastic breast surgery, and several studies have reported acceptable surgical outcomes in terms of cosmesis and oncological safety [18]. However, some factors, such as radiotherapy, changes in the body weight, and gradual breast ptosis with aging, could lead to breast asymmetry and deteriorate long-term cosmetic results [19].

The aim of the present study was to estimate the long-term objective cosmetic results and procedure-specific PRO of patients who underwent immediate partial breast reconstruction utilizing the LD flap.

## METHODS

### Patients

Sixty-four consecutive patients who underwent quadrantectomy with immediate LD flap reconstruction at our institution from June 2000 to April 2012 were included. All of the patients agreed to participate in the study, and informed consent for photographs and a questionnaire survey were obtained. The clinical data of the patients related to surgery were collected by medical chart review. The preoperative breast volume was calculated based on mammography results using a modified Katariya method [20] assuming the elliptical cone projection with the formula  $(1/3\pi R_{CC} R_{MLO} H_{MLO})$ , where  $R_{CC}$  (radius) was taken from the cranio-caudal mammographic view, and  $R_{MLO}$  (radius) and  $H_{MLO}$  (height) were taken from the medio-lateral-oblique mammographic view. The tumor size was defined as the largest dimension measured by mammography, and the estimated volume of resection was determined assuming that theoretical resection is a sphere  $(4/3\pi R^3)$  containing the tumor in its core surrounded by 1 cm of normal breast tissue (resection margin), where  $R$  is half the tumor size of +1 cm. The resected breast volume was measured, and the postoperative volume difference between the two breasts was calculated by breast MRI from 43 patients whose postoperative MRIs could be obtained.

In our series, breast cancer patients with a tumor size 0.9–5.5 cm and stage of 0–IIIC (Tis–T3, N0–N3) according to the American Joint Committee on Cancer TNM staging system were included. All of the patients received immediate LD flap reconstruction after quadrantectomy, followed by radiotherapy. The oncoplastic procedures were performed by the breast surgeon in cooperation with a plastic surgeon. This study was approved by the Soonchunhyang University Seoul Hospital Institutional Review Board (2012-085).

### Assessment of cosmetic outcomes

The patient survey was performed on follow-up visits at the outpatient clinic. Because the aim of the present study was to estimate long-term surgical outcome, patients whose follow-up periods were longer than 2 years were included. The patients

had completed adjuvant chemotherapy and radiation therapy, and they had visited the breast cancer clinic for endocrine therapy or cancer surveillance. Accordingly, the participants showed heterogeneous follow-up periods from 33.3 months to 171.0 months.

Postoperative photographs of the patients were taken, and the cosmetic results were analyzed by three different groups: the patients, a medical panel (breast surgeon, plastic surgeon, and breast clinic nurse), and the BCCT.core.

The patients and the medical panel assessed the photographs using the Harris scale [2] as follows: excellent to perfect symmetry with no visible distortion of skin changes; good to slight skin distortion with retraction or edema, mild telangiectasia, mild hyperpigmentation, or an absent nipple-areolar complex; fair to moderate distortion of the nipple or breast symmetry with moderate hyperpigmentation, prominent skin retraction, edema or telangiectasia; poor to marked distortion with edema, fibrosis, or severe hyperpigmentation.

The photographs were also analyzed using the BCCT.core, which assesses the cosmetic result based on symmetry, scar visibility, and skin color changes of the breast. The cosmetic results were categorized as excellent, good, fair, and poor (Fig. 1) [10].

### Assessment of the PROs

PRO was estimated utilizing the BREAST-Q questionnaire reconstruction module, designed and validated to assess breast-related outcomes following breast surgery. The BREAST-Q evaluates body image: satisfaction with the breast (appearance

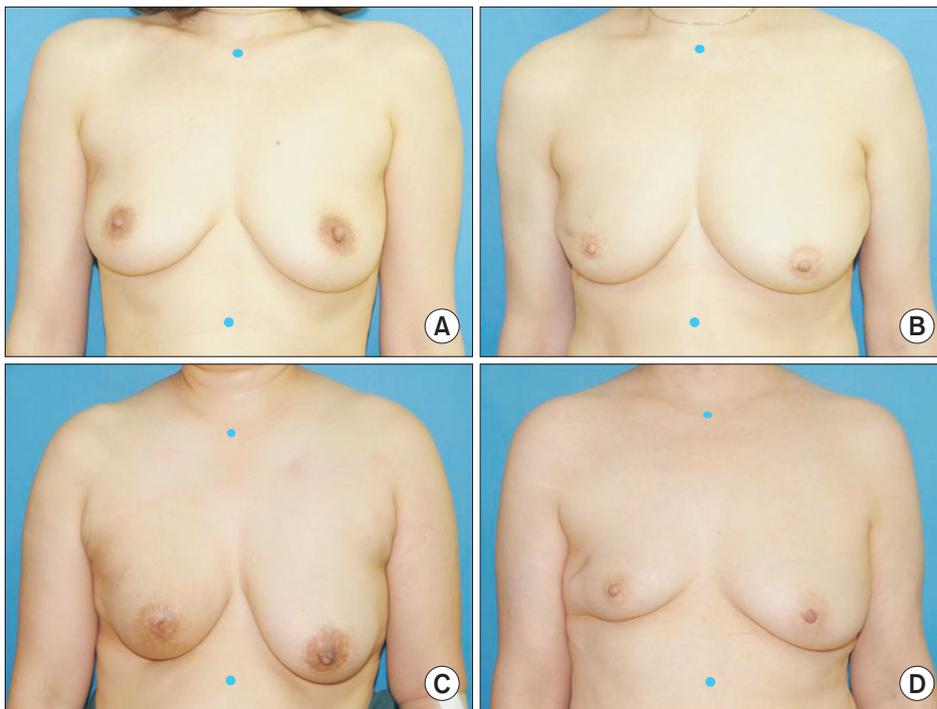
of the breast and fit of bras and clothing), psychosocial well-being (aspects of emotional and social health as they relate to body image, with specific reference to the breast area), and satisfaction with the outcome (patient's perception of the surgical outcome) [17]. All of the scales were scored from 0 to 100, with higher scores indicating better HR-QoL or greater satisfaction. Good psychometric properties had been reported for the BREAST-Q subscales (Cronbach alpha, 0.88–0.96), and good test-retest reliability had been reported (interclass correlation coefficient, 0.85–0.98) [14,21].

### Data analysis

Descriptive statistics were generated for the demographic, cancer-related, and outcome variables. Student t-test was used to compare the means for continuous variables, and chi-square test and Fisher exact test were used to calculate and compare the categorical variables. Pearson simple correlation test was used to evaluate the interrater associations. Statistical analyses were performed using SPSS ver. 15.0 (SPSS Inc., Chicago, IL, USA). All P-values were two-sided, and statistical significance was established at an alpha level of 0.05.

The cosmetic result of each case was compared among the patient score, median panel score (based on the Harris Scale classification), and score produced by the BCCT.core program.

The median score was calculated from three independent assessors of the medical panel. Correlation was compared between the assessors (patient and medical panel) and the BCCT.core program using Pearson correlation analysis. Agreement between the subjective score of the patient and that of the



**Fig. 1.** Cosmetic results were analyzed (*excellent, good, fair, and poor*) by the BCCT.core program using photographs of 64 patients who underwent quadrantectomy with immediate latissimus dorsi flap reconstruction. (A) Excellent outcome, 40-year-old female, 2.2-cm tumor in the right breast upper outer quadrant, 96.2-month follow-up. (B) Good outcome, 61 year-old female, 3-cm tumor in the right breast upper outer quadrant, 142.7-month follow-up. (C) Fair outcome, 46 year-old female, 2.4-cm tumor in the right breast upper outer quadrant, 146.9-month follow-up. (D) Poor outcome, 56-year-old female, 2.1-cm tumor in the right breast upper outer quadrant, 166.5-month follow-up.

medical panel and BCCT.core software was conducted using Cohen kappa coefficient. Linear regression was used to compare the objective cosmetic results (BCCT.core) and PRO of the patient (BREAST-Q).

## RESULTS

Sixty-four patients underwent quadrantectomy with immediate partial reconstruction using the LD flap followed by radiotherapy. The mean age of the patients was  $51.7 \pm 1.1$  years (range, 33–72 years), and the mean breast volume was  $829.6 \pm 269.3$  mL (range, 525–1,434 mL). The mean tumor size was  $2.1 \pm 1.0$  cm (range, 0.9–5.5 cm), and the mean estimated volume of resection was  $43.4 \pm 41.1$  mL (range, 12.7–221.0 mL). The mean resected volume was  $91.19 \pm 90.01$  mL (range, 28–422 mL). The mean duration of the follow-up period was  $91.6 \pm 46.3$  months (range, 33.3–171.0 months), and the mean follow-up period after radiotherapy was  $87.7 \pm 46.8$  months (range, 32.5–87.7 months) (Table 1). None of the patients developed local recurrence. Among the 43 patients whose postoperative breast MRIs were obtainable, the mean volume difference between both breasts was  $102.8 \pm 102.9$  mL (range, 23–250 mL), and the volume difference of both breasts showed a correlation with the BCCT.core score ( $R^2 = 0.22$ ,  $P = 0.039$ ).

### Cosmetic results and PRO

Among the 64 patients, 59 (92.2%) were satisfied with the cosmetic results, and 34 (53.1%) reported their cosmetic result

as *excellent* (good, 25; fair, 4; poor, 1). The medical panel scored 33 excellent results, 24 good results, 6 fair results, and 1 poor result. The BCCT.core program scored 23 excellent results, 30 good results, 10 fair results, and 1 poor result. Compared with the BCCT.core, the patients and medical panel showed a tendency to score more favorable cosmetic results. There was fair agreement between the medical panel score and BCCT.core score ( $K = 0.32$ ,  $P < 0.001$ ), and the correlation between the BCCT.core and medical panel cosmetic results was statistically significant ( $r = 0.606$ ,  $P < 0.001$ ) compared with that between the BCCT.core and patient cosmetic results ( $r = 0.165$ ,  $P = 0.191$ ).

The PRO measured by BREAST-Q showed overall high satisfaction scores for each related domain. Patients were especially satisfied with their surgical outcomes (mean, 82.4; range, 30–100), psychosocial well-being (mean, 76.0; range, 38–100), surgeon (mean, 84.4; range, 11–100), and medical team

**Table 2.** BREAST-Q results

Domains of BREAST-Q reconstruction module	Mean $\pm$ SD (range)
Satisfaction with breasts	64.6 $\pm$ 17.9 (30–100)
Satisfaction with outcome	82.4 $\pm$ 18.2 (47–100)
Psychosocial well-being	76.0 $\pm$ 16.7 (38–100)
Sexual well-being	58.5 $\pm$ 19.1 (26–100)
Physical well-being (chest)	68.7 $\pm$ 16.5 (50–100)
Physical well-being (back)	64.0 $\pm$ 23.5 (29–100)
Satisfaction with information	71.7 $\pm$ 18.8 (41–100)
Satisfaction with surgeon	84.4 $\pm$ 18.9 (11–100)
Satisfaction with medical team	84.6 $\pm$ 19.2 (42–100)
Satisfaction with office team	82.9 $\pm$ 21.4 (38–100)

BREAST-Q, a questionnaire that measures the perception of patients having breast surgery; SD, standard deviation.

**Table 1.** Clinical characteristics of the patients

Characteristic	Value
Age (yr)	51.7 $\pm$ 1.1 (33–72)
Mean breast volume (mL)	829.6 $\pm$ 269.3 (525–1,434)
Patients with breast volume (mL)	
500–1,000	58 (90.6)
>1,000	6 (9.4)
Tumor size (cm)	2.1 $\pm$ 1.0 (0.9–5.5)
Estimated volume of resection (mL)	43.4 $\pm$ 41.1 (12.7–221.0)
Resected volume (mL)	91.19 $\pm$ 90.01 (28–422)
Stage	
0	6 (9.4)
I	28 (43.6)
II	27 (42.2)
III	3 (4.8)
Pathologic classification	
Infiltrating ductal carcinoma	57 (89.1)
Ductal carcinoma <i>in situ</i>	6 (9.4)
Infiltrating lobular carcinoma	1 (1.5)
Postoperative follow-up (mo)	91.6 $\pm$ 46.3 (33.3–171.0)
Postradiotherapy follow-up (mo)	87.7 $\pm$ 46.8 (32.5–87.7)

Values are presented as mean $\pm$ standard deviation (range) or number (%).

**Table 3.** Correlation between the BCCT.core and the BREAST-Q results

Domains of BREAST-Q reconstruction module	$R^2$	P-value
Satisfaction with breasts	0.070	0.039
Satisfaction with outcome	0.087	0.021
Psychosocial well-being	0.085	0.023
Sexual well-being	0.082	0.029
Physical well-being (chest)	0.018	0.301
Physical well-being (back)	0.085	0.515
Satisfaction with information	0.064	0.049
Satisfaction with surgeon	0.056	0.065
Satisfaction with medical team	0.015	0.349
Satisfaction with office team	0.045	0.099

BCCT.core, breast cancer conservative treatment (objective measurement tool of cosmetic results; computer program); BREAST-Q, a questionnaire that measures the perception of patients having breast surgery.  $R^2$ , analyzed by linear regression.

(mean, 84.6; range, 42–100) (Table 2).

On linear regression analysis, better BCCT.core results were related to a higher PRO of each BREAST-Q domain regarding satisfaction with the breasts ( $R^2 = 0.070$ ,  $P = 0.039$ ), satisfaction with the outcome ( $R^2 = 0.087$ ,  $P = 0.021$ ), psychosocial well-being ( $R^2 = 0.085$ ,  $P = 0.023$ ), sexual well-being ( $R^2 = 0.082$ ,  $P = 0.029$ ), and satisfaction with information ( $R^2 = 0.064$ ,  $P = 0.049$ ) (Table 3).

## DISCUSSION

There is limited literature that investigates patients' satisfaction and outcomes of breast reconstruction in Korea. Our study is one of the few that examines the objective cosmetic results and HR-QoL and satisfaction outcome for patients who have undergone oncoplastic breast surgery, using a psychometrically robust PRO instrument specifically designed to evaluate the outcomes among women undergoing breast surgeries. Our long-term results of oncoplastic breast surgery achieved a high level of patient satisfaction along with good cosmetic results, although all of the patients received radiotherapy after surgery. In the present study, 59 patients (92.2%) were satisfied with the surgical outcomes, and 53.1% replied that the cosmetic results were *excellent* after a mean follow-up of 92 months, demonstrating that quadrantectomy with immediate LD flap partial reconstruction could sufficiently produce satisfactory results.

The autologous LD flap has produced a high level of patient satisfaction in a wide range of breast surgeries, from quadrantectomy to skin-sparing mastectomy [22-24]. Almost any patient could be a potential candidate for LD flap reconstruction due to its robust blood supply [25]; for most Korean women with a low to normal body mass index and small to moderately sized breasts, the LD flap could provide sufficient volume for partial breast reconstruction.

With the warranty of comparable oncological results to mastectomy [26], cosmetic results and PRO are now also a major point of oncoplastic breast surgery. Using procedure-specific, patient-reported measures and objective assessment tools, such as the BREAST-Q and BCCT.core, we measured and analyzed the HR-QoL and satisfaction data.

The BCCT.core, an objective measurement tool of cosmetic results, demonstrated a correlation with the medical panel scores. There was statistically significant agreement between the BCCT.core and medical panel assessment, with a kappa coefficient of 0.32 (fair agreement). This may be explained by some limitations in the photographs chosen and the subjective scale and techniques used by the BCCT.core for the assessment of the cosmetic results. A previous report by Cardoso et al. [13] demonstrated stronger agreement in the assessment between the BCCT.core and a panel of assessors when a subjective evalua-

tion was based on 4 views compared with a single anterior view. This may account for the weaker agreement observed, because the panel judged the cosmetic results based only on anterior views in our study. The Harris scale assesses symmetry, visible scars, nipple areola complex position, and overall aesthetics of the operated breast compared with the normal breast [2], including volume discrepancies of bilateral breasts. Among 43 patients whose postoperative breast MRI could be obtained, the volume difference of both breasts were measured; volume difference was positively correlated with the BCCT.core score ( $R^2 = 0.22$ ,  $P = 0.039$ ). Further studies are needed with a focus on reinforcing the vulnerable points in the assessment of cosmetic results.

According to the breast volumetry calculated by preoperative mammography, patients in the current study had relatively larger breasts than general Korean women, while the mean tumor size was  $2.1 \pm 1.0$  cm. Most patients included in the study had multifocal tumors in the same quadrant or had combined microcalcification, which necessitated wider excision of breast parenchyma than the actual tumor size. These patients required quadrantectomy according to intraoperative frozen section results of the resection margin. In some cases, breast-conserving surgery using a volume displacement technique could produce asymmetry, nipple retraction or displacement, and volume changes in the breast, and the cosmetic result may be unsatisfactory regarding the patients' expectation. The authors were in pursuit of a maximal cosmetic outcome using a volume replacement technique; consequently, this group of patients underwent quadrantectomy followed by LD flap reconstruction.

Regarding the surgical results, we observed a discrepancy between the estimated volume of resection and resected breast volume. The estimated volume of resection was calculated based on 2-dimensional mammography. If additional breast tissue needed to be excised according to the frozen section results during resection margin assessments or during the reconstruction procedure, then this may lead to a volume difference. We consider this to be an interesting issue for future study; preoperative volume estimation using breast MRI compared with the postoperative breast volume may provide an answer to the query.

While the BCCT.core does not consider a patient's perceived outcome in the assessment of cosmetic results, the BREAST-Q includes the body image perception of the patients, including psychosocial well-being, sexual well-being, and physical well-being in the HR-QoL domain, and overall satisfaction with the breasts, nipples, back (LD flap donor site), outcome, and satisfaction with medical care in the patient satisfaction domain. Moreover, the BREAST-Q reconstruction module contains patient expectation domains to assess the patients' expectations (support from the medical staff, pain, coping, and

breast appearance) for the process and outcome of surgery [16]. We believe that BREAST-Q, which incorporates such factors, could produce more clinically significant results combined with the BCCT.core. The PROs showed overall high satisfaction scores for each related domain; accordingly, better BCCT.core results were related to higher PROs of each BREAST-Q domain in our study (Table 3). The domains of BREAST-Q that showed relatively lower scores were identified.

Satisfaction with the breasts included questions such as how the patient looks in the mirror clothed or unclothed, the shape of reconstructed breasts when wearing a bra, how comfortably the bras fit, the softness of the reconstructed breast, and how the reconstructed breast feels to the touch. The psychosocial well-being domain included questions related to confidence in a social setting, emotional health, self-confidence, similarity to other women, and attractiveness. The sexual well-being domain, which showed the lowest scores, included questions regarding sexual activity or satisfaction with the patients' sex-life. The physical well-being of the chest and back domain included questions related to neck/upper back/shoulder/arm/rib/chest muscle/back pains, difficulties in lifting or moving arms, tightness/pulling/nagging feeling/tenderness/sharp pains in the breast area, location/length of the back scar, the shape of the back, and arm weakness. Apart from the cosmetic results, the above-mentioned factors should be considered in future studies to enhance the patients' perceived satisfaction after reconstructive breast surgery.

It is acknowledged that this study was limited by its small sample size with heterogeneous follow-up periods and a retrospective study design. We believe that a prospective, repeated measures study design will provide longitudinal data and the opportunity to compare the progress and evolution of outcomes in the future.

In conclusion, the long-term results of quadrantectomy with immediate LD flap reconstruction provided a high level of patient satisfaction with good cosmetic results even after radiotherapy. The strengths of this study include the use of valid, reliable, procedure-specific, PRO measures. BCCT.core, an objective measure of cosmetic results, and medical panel scores were well correlated with the PROs of the patients. HR-QoL, measured by BREAST-Q, was related to higher BCCT.core results. The combined use of both measures could provide more effective PRO measurement after breast reconstruction.

## CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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