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Postoperative Cancer Surveillance Following Oncoplastic Surgery with Latissimus Dorsi Flap: a Matched Case–Control Study

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ABSTRACT

Background. The latissimus dorsi (LD) myocutaneous flap is a widely used local option in oncoplastic surgery for avoiding breast deformities; however, concerns exist regarding its influence in monitoring recurrence. In this study, we evaluated the impact of this flap on postoperative cancer surveillance.

Methods. Each patient receiving oncoplastic surgery with LD flap after partial mastectomy were matched in age, cancer stage, and body mass index with patients receiving partial mastectomy alone. Twenty-nine patients with the oncoplastic LD flap received 99 mammograms and 139 ultrasonograms, while 29 patients with partial mastectomy alone underwent 92 mammograms and 129 ultrasonograms. Mammographic and ultrasonographic findings were classified by Breast Imaging Reporting and Data System (BI-RADS) category and reviewed. Any recommendations for additional evaluation and recurrence were documented.

Results. During an average follow-up period of 44 months, although the oncoplastic group demonstrated more newly developed benign calcifications (control 14% vs. oncoplastic 41%; $p = 0.019$) on mammography, the percentage of recall for additional imaging in category 0, and the short-interval follow-up in category 3, was not different between the control and oncoplastic group. Regarding ultrasonography, BI-RADS category was also not different between the two groups; however, the control group showed more fluid collections than the oncoplastic group (control 21% vs. oncoplastic 0%; $p = 0.023$). One case of local recurrence was observed in the control group.

Conclusion. Although there was an increase in benign calcifications in the oncoplastic group, there were no additional abnormal findings requiring further intervention. We concluded that the LD flap for oncoplastic surgery does not interfere with cancer surveillance, and even decreases the rate of fluid collection.

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Surgical treatment of breast cancer has continued to undergo paradigmatic evolution, beginning with the Halsted radical mastectomy, to the simple mastectomy, and now with breast-conservation therapy (BCT). BCT was ushered into the standard of care by six large prospective trials demonstrating equivalent survival rates with BCT compared with mastectomy in early disease.[1–6] Oncoplastic techniques are necessary when tumor size is > 80 g in weight or larger than 20% of the native breast.[7,8] While reduction and mastopexy are viable options in the large breasted women with smaller tumors, females of smaller breast size and larger tumors require volume replacement strategies, particularly when defects are > 30% of the breast.[9,10] While downstaging may be possible with neoadjuvant chemotherapy, not all tumors respond to neoadjuvant chemotherapy.[7] Patients may not desire pre-treatment. Thus, pedicled flaps are instrumental in avoiding residual deformity and achieving better outcomes in this patient group. Volume replacement strategies have expanded indications for modern-day BCT.[11–14]

Available options for pedicled flaps from the back include the latissimus dorsi (LD) or muscle-sparing LD, the thoracodorsal artery perforator (TDAP), the lateral intercostal artery perforator, and the serratus anterior artery perforator (SAAP) flaps.[15] In our practice, the LD flap has become a workhorse due to its consistent anatomy, robust vasculature, ample volume, and ability to reach most quadrants of the breast. Patients who received oncoplastic reconstruction with the LD flap had better breast shape, better symmetry, less self-consciousness, and are more likely to select the operation again compared with women undergoing standard wide excision or mastectomy and immediate reconstruction.[16] Additionally, larger volumes of tissue are able to be excised compared with partial mastectomy.[16–19]

Critical to this discussion is the impact of the LD flap on postoperative cancer surveillance and additional imaging/intervention.[20,21] The gambit of oncoplastic techniques may require long periods of time until radiographic stabilization, and require a greater number of postoperative mammograms and ultrasounds.[22,23] Additional recall for further imaging results in an adverse psychological impact.[24] Selecting reconstructive options to minimize interferences in postoperative recovery is paramount. Mele et al.[21] have previously found that oncoplastic reconstruction with an LD flap does not interfere with postoperative monitoring by clinical examination or mammography. However, there was no control group in that study, and it remains to be seen whether the LD flap contributes to an additional need for postoperative imaging and biopsy compared with partial mastectomy. Herein, we present the best available evidence on the impact of the LD flap in oncoplastic reconstruction on postoperative cancer surveillance compared with matched controls receiving only partial mastectomy.

METHODS

Patient Selection

All patients who received partial mastectomy with or without oncoplastic surgery between May 2013 and December 2016 were reviewed ($N = 1664$). For the study group, the need for an LD flap reconstruction was suggested after review by a breast cancer multidisciplinary team considering various factors such as patients' age, body shape, size and location of the tumor, and type of mastectomy. Patients made the final decision during the preoperative consultation. A total of 31 patients received an LD flap during oncoplastic reconstruction. To examine the impact of the LD flap on postoperative cancer surveillance, a control group was created by matching the 31 LD flap patients by age, body mass index (BMI), and pathologic stage with patients undergoing partial mastectomy only. Seventy-five patients received other types of oncoplastic surgery and were thus excluded from the analysis. Among the 1589 patients, 29 patients were matched; therefore, two patients in the oncoplastic group were excluded. A total of 58 patients were included in the analysis—29 patients in the oncoplastic group and 29 patients in the control group. Oncoplastic reconstructions were performed by two plastic surgeons (DWL and SYS), and partial mastectomy controls were performed by three breast surgeons.

Operative Technique: Latissimus Dorsi Flap for Oncoplastic Reconstruction

After partial mastectomy was completed by obtaining a clear resection margin using intraoperative frozen section, the thoracodorsal pedicle was identified and the thoracodorsal nerve was ligated with the patient in supine position. The patient was then positioned in the lateral decubitus position. A horizontal incision was made along the brassiere line, incorporating a skin paddle, and the skin island was incised down to the subcutaneous plane. The adipose tissue below the superficial fascia was captured, along with the appropriate amount of LD. When significant volume replacement is necessary for symmetry, the entire LD is harvested; otherwise, muscle-sparing techniques are employed.[25] After returning to the supine position, the harvested flap was used to fill in the defect left by partial mastectomy.

Postoperative Cancer Surveillance and Data Collection

The clinical follow-up with ultrasonography occurred every 6 months during the first 1½ years, and then every year after that. Routine imaging study for postoperative cancer surveillance was performed using ultrasonography and, unless images showed suspicious findings, an annual mammography. A total of 99 mammograms and 139 ultrasonograms were performed in the oncoplastic group, and 92 mammograms and 129 ultrasonograms were performed in the control group. The density of breast was classified into four categories. Mammographic and ultrasonographic images were retrospectively interpreted by a board-certificated radiologist (MJK) specializing in breast imaging and with 18 years of experience in breast imaging. Images were categorized using the 5th edition of the Breast Imaging Reporting and Data System (BI-RADS) classification.[26] According to management recommendations for BI-RADS, category 0 patients were recommended for additional imaging and/or comparison with prior examination, while category 3 patients were recommended for short-interval (6-month) follow-up or continued surveillance. Tissue biopsy was recommended in categories 4 and 5. In all patients, any short-interval follow-ups and recommendations for additional evaluation or biopsy were examined. Predominant findings such as architectural distortion, calcification and mass in mammography and distortion, diffuse skin thickening, nodule, cyst, fat necrosis, calcification, and fluid collection in ultrasonography were collected. Furthermore, we examined the medical records to determine whether locoregional recurrence and systemic metastasis had occurred. Findings were reviewed retrospectively, and approval was obtained from the Institutional Review Board (IRB) of Severance Hospital (IRB No. 4-2018-1219).

Statistical Analysis

When data were assumed to be normally distributed, continuous data were analyzed using an independent samples t test, and the results presented as mean ± standard deviation. The χ^2 or Fisher's exact tests were used to analyze categorical data. Significance was set at $p < 0.05$, and SPSS Statistics software (version 22.0; IBM Corporation, Armonk, NY, USA) was used for all computations.

RESULTS

Patients in the control and oncoplastic groups were age-matched, with an average age of 47 years, and BMI-matched, at an average of 23.39 kg/m^2. Breast cancer pathologic stage was also matched: the oncoplastic group had 6 patients (21%) with stage 0, 12 patients (41%) with stage I, and 11 patients (38%) with stage II breast cancer, while the control group had 5 patients (17%) with stage 0, 11 patients (38%) with stage 1, and 13 patients (45%) with stage II breast cancer. When adjuvant therapy and tumor histology were compared between both groups, no significant difference was observed (Table 1). The average follow-up period was 44.2 ± 10.0 months (range 28–66) in the control group and 44.6 ± 13.1 months (range 23–66) in the oncoplastic group (p = 0.920). Breast surgeons performed intraoperative biopsy with frozen section analysis, while performing partial mastectomy to obtain a clear resection margin. Further excision was required in 11 patients in the oncoplastic group and 4 patients in the control group to obtain an oncologically safe resection margin (p = 0.070). Six of 11 patients in the oncoplastic group had further excision more than once, but only one patient in the control group (p = 0.102).

In mammography, the majority of patients had benign postoperative distortions, with the exception of two patients in the control group. Benign calcifications that were newly developed after partial mastectomy were present in 4 lesions in the control group and 12 lesions in the oncoplastic group, which showed a significant difference between the two groups (control 13.8% vs. oncoplastic 41.4%; p = 0.019) [Table 2]. Among these benign calcifications, 3 of 4 lesions and 10 of 12 lesions in the control and oncoplastic groups, respectively, were observed at the surgery site and were found to likely be postoperative dystrophic calcifications. There was also a significant difference among the oncoplastic or control groups in the number of postoperative dystrophic calcifications at the surgical site (control 10.3% vs. oncoplastic 34.5%; p = 0.028). In ultrasonography, the predominant findings are shown in Table 2. There was no significant difference between the two groups in most findings, such as distortion, diffuse skin thickening, nodule, cyst, fat necrosis, and calcification; however, more fluid collections were observed in the control group than the oncoplastic group (control 20.7% vs. oncoplastic 0%; p = 0.023).

The breast composition categories in mammographic findings were not different between the two groups, as shown in Table 3. Overall, distribution of the mammographic BI-RADS category was not significantly different between the two groups (p = 0.089) [Table 3]. Among a total of 191 mammograms, BI-RADS category 2 was ranked as the highest, with 64 mammograms (69.6%) in the control group and 80 mammograms (80.8%) in the oncoplastic group, followed by category 3, with 15 mammograms (16.3%) and 15 mammograms (15.2%) in the control and oncoplastic groups, respectively. In category 3 mammograms, 9 of 15 in the control group and 7 of 15 in the oncoplastic group had relevance to calcifications, while the remaining mammograms were linked to architectural distortion as postoperative changes. All category 3 mammograms related to calcification in both groups required a short-interval (6-month) follow-up. Category 3 patients with architectural distortion continued routine surveillance;

TABLE 1 Comparison of demographics

Clinical parameter	Control group [n = 29]	Oncoplastic group [n = 29]	p-Value
Age, years	47.1 ± 9.8	47.1 ± 9.8	> 0.99
BMI, kg/m^2	23.2 ± 3.0	23.6 ± 3.3	0.71
Pathologic stage			0.960
0	5 (17.2)	6 (20.7)	
I	11 (37.9)	12 (41.4)	
IIa	10 (34.5)	8 (27.6)	
IIb	3 (10.3)	3 (10.3)	
III	0 (0)	0 (0)	
IV	0 (0)	0 (0)	
Tumor histology			0.838
DCIS	5 (17.2)	6 (20.7)	
IDC	18 (62.1)	16 (55.2)	
ILC	2 (6.9)	3 (10.3)	
Tubular carcinoma	1 (3.4)	0 (0)	
Mucinous carcinoma	2 (6.9)	4 (13.8)	
Adenoid cystic carcinoma	1 (3.4)	0 (0)	
Adjuvant therapy			
CTx	12 (41.4)	13 (44.8)	0.791
RTx	29 (100)	29 (100)	NA
Hormonal therapy	22 (75.9)	24 (82.8)	0.517
Neoadjuvant CTx	4 (13.8)	2 (6.9)	0.670
Follow-up period, months	44.2 ± 10.0	44.6 ± 13.1	0.920

All data are expressed as mean ± standard deviation, or n (%)

NA not applicable, *BMI* body mass index, *DCIS* ductal carcinoma in situ, *IDC* invasive ductal carcinoma, *ILC* invasive lobular carcinoma, *CTx* chemotherapy, *RTx* radiotherapy

therefore, there was no significant difference in the short-interval (6-month) follow-up of category 3 mammograms (control 9.8% vs. oncoplastic 7.1%; $p = 0.499$). All category 3 follow-ups in both groups were suggestive of benign findings, which were ultimately classified as category 2. From the perspective of the first postoperative year mammogram, there were 7 category 3 mammograms (distortion, 4; calcification, 3) in the control group and 10 category 3 mammograms (distortion, 7; calcification, 3) in the oncoplastic group. In the second year, there were 6 category 3 mammograms (distortion, 2; calcification, 4) in the control group and 4 category 3 mammograms (distortion, 1; calcification, 3) in the oncoplastic group. Evidence supporting postoperative benign findings in the oncoplastic group can also be found in the fact that the number of category 3 images abruptly decreased in the first 2 years (from 10 to 4 mammograms) compared with the control group (from 7 to 6 mammograms).

Finally, BI-RADS category 0 was reported in three mammograms (3%) in the control group and one mammogram (1%) in the oncoplastic group. One category 0 mammogram in the oncoplastic group was upstaged due to faint microcalcification in the upper outer quadrant at postoperative year 1, and magnification view for further evaluation revealed that the lesion was postoperative dystrophic calcification, corresponding to category 2 (Fig. 1). Three category 0 mammograms in the control group were recalled after additional imaging such as magnification view or cone compression view. Among these three mammograms, radiologists stated that one of three cases was related to postoperative change, while the remaining two cases resulted from benign conditions unrelated to previous surgery. Both groups had an equivalent number of category 0 cases requiring additional imaging (control 3.2% vs. oncoplastic 1.0%; $p = 0.353$). In both groups, there were no abnormal mammographic findings above category 3 that required tissue diagnosis.

Similarly, the distribution of ultrasonographic BI-RADS category was also not significantly different between both groups ($p = 0.275$) [Table 4]. BI-RADS category 2 was the most common, with 69 ultrasonograms (53.5%) in the control group and 89 ultrasonograms (64.5%) in the oncoplastic group, followed by category 3, with 43 (33.3%) and 38 (27.3%) ultrasonograms in the control and oncoplastic groups, respectively. The causes of category 3 ultrasonograms in the control group were nodule (19

TABLE 2 Predominant mammography and ultrasonography findings

Mammography	Control group [n = 29]						Oncoplastic group [n = 29]						p-Value[a]
	Detection time [postoperative year]						Detection time [postoperative year]						
	1 [n = 29]	2 [n = 27]	3 [n = 19]	4 [n = 6]	5 [n = 3]	Overall [n = 29]	1 [n = 29]	2 [n = 27]	3 [n = 20]	4 [n = 13]	5 [n = 1]	Overall [n = 29]	
Distortion[b]	27 (93)	22 (81)	17 (89)	6 (100)	3 (100)	27 (93)	29 (100)	27 (100)	19 (95)	13 (100)	1 (100)	29 (100)	0.491
Calcification[b]	1 (3)	3 (11)	1 (5)	1 (17)	0 (0)	4 (14)	7 (24)	6 (22)	7 (35)	4 (31)	1 (100)	12 (14)	0.019
Mass	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	NA
Ultrasound	Detection time [postoperative year]						Detection time [postoperative year]						
	1 [n = 29]	2 [n = 28]	3 [n = 17]	4 [n = 7]	5 [n = 2]	Overall [n = 29]	1 [n = 29]	2 [n = 27]	3 [n = 18]	4 [n = 11]	5 [n = 3]	Overall [n = 29]	
Distortion[b]	28 (97)	24 (86)	16 (94)	7 (100)	2 (100)	27 (93)	29 (100)	24 (89)	15 (83)	10 (91)	2 (67)	24 (83)	0.423
Diffuse skin thickening[b]	5 (17)	2 (7)	0 (0)	0 (0)	0 (0)	5 (17)	8 (28)	4 (15)	1 (6)	0 (0)	0 (0)	8 (28)	0.345
Nodule	9 (31)	5 (18)	3 (18)	1 (14)	0 (0)	9 (31)	8 (28)	5 (19)	3 (17)	1 (9)	0 (0)	9 (31)	> 0.999
Cyst	3 (10)	4 (14)	1 (6)	0 (0)	0 (0)	6 (21)	3 (10)	2 (7)	2 (11)	1 (9)	0 (0)	3 (10)	0.470
Fat necrosis[b]	2 (7)	3 (11)	1 (6)	0 (0)	0 (0)	3 (10)	2 (7)	2 (7)	0 (0)	0 (0)	0 (0)	2 (7)	> 0.999
Calcification	2 (7)	2 (7)	1 (6)	0 (0)	0 (0)	2 (7)	1 (3)	1 (4)	2 (11)	1 (9)	0 (0)	2 (7)	> 0.999
Fluid collection[b]	6 (21)	3 (11)	0 (0)	0 (0)	0 (0)	6 (21)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.023

All data are expressed as n (%). Postoperatively developed findings were described

NA not applicable

[a]Comparison of overall values between the control and oncoplastic groups

[b]Presumed operation-related findings

TABLE 3 Breast Imaging Reporting and Data System in mammography

	Control group [29 patients, 92 mammograms]						Oncoplastic group [29 patients, 99 mammograms]						*p*-Value
Composition													
Grade A	1 (1.1)						2 (2.0)						0.359
Grade B	3 (3.3)						9 (9.1)						
Grade C	75 (81.5)						77 (77.8)						
Grade D	13 (14.1)						11 (11.1)						
BI-RADS category	Detection time [postoperative year][a]					Total mammograms	Detection time [postoperative year][a]					Total mammograms	
	1 [n = 29]	2 [n = 27]	3 [n = 19]	4 [n = 6]	5 [n = 3]	[n = 92]	1 [n = 29]	2 [n = 27]	3 [n = 20]	4 [n = 13]	5 [n = 1]	[n = 99]	
0	0 (0)	0 (0)	2 (11)	1 (17)	0 (0)	3 (3)	1 (3)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	0.089[b]
1	3 (10)	5 (19)	2 (11)	0 (0)	0 (0)	10 (11)	0 (0)	0 (0)	1 (5)	0 (0)	0 (0)	3 (3)	
2	20 (69)	17 (63)	14 (74)	5 (83)	2 (67)	64 (70)	18 (62)	24 (89)	18 (90)	13 (100)	1 (100)	80 (81)	
3	6 (21)	5 (19)	1 (5)	0 (0)	1 (33)	15 (16)	10 (34)	3 (11)	1 (5)	0 (0)	0 (0)	15 (15)	
4	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
5	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
6	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	

All data are expressed as *n* (%)

BI-RADS Breast Imaging Reporting and Data System

[a] *n* indicates the number of patients in each year

[b] Comparison of the total number of mammograms between the control and oncoplastic groups

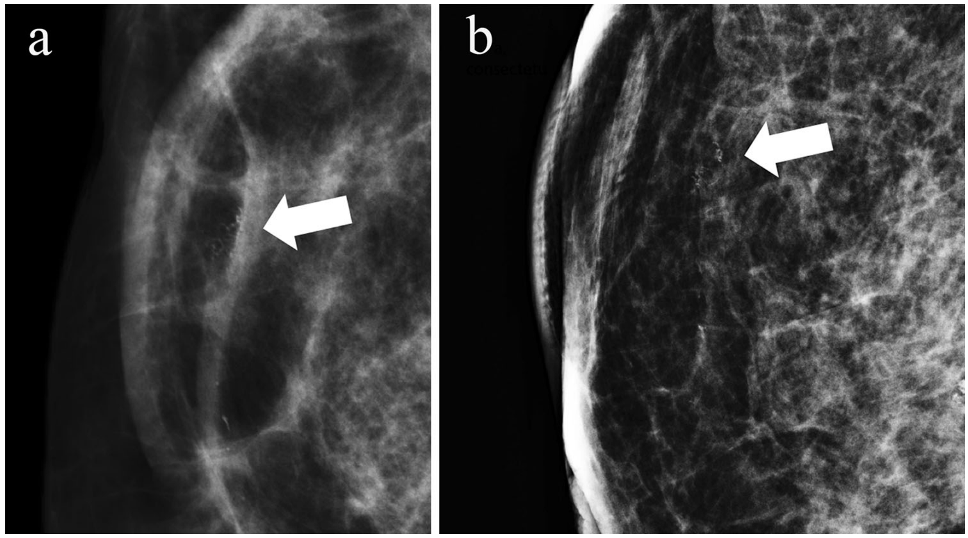

FIG. 1 Mammographic Breast Imaging Reporting and Data System category 0 in the oncoplastic group. **a** At 1 year postoperatively, faint microcalcification (arrow) in the upper outer quadrant was observed and classified as category 0. **b** Magnification view for further evaluation revealed that the lesion was a postoperative dystrophic calcification (arrow), corresponding to category 2

ultrasonograms), distortion (13 ultrasonograms), fat necrosis (7 ultrasonograms), diffuse skin thickening (3 ultrasonograms), and calcification (1 ultrasonogram), while the category 3 ultrasonograms in the oncoplastic group resulted from distortion (25 ultrasonograms), nodule (10 ultrasonograms), diffuse skin thickening (2 ultrasonograms), and fat necrosis (1 ultrasonogram). A category 3 short-interval follow-up was required in eight ultrasonograms in both the control and oncoplastic groups (control 6.2% vs. oncoplastic 5.8%; $p = 0.878$). All category 3 follow-ups in both groups were finally confirmed as benign. In the first postoperative year, there were 30 category 3 ultrasonograms (distortion, 12; nodule, 12; fat necrosis, 4; diffuse skin thickening, 2) in the control group, and 26 category 3 ultrasonograms (distortion, 17; nodule, 7; diffuse skin thickening, 2) in the oncoplastic group. In the second year, there were 12 category 3 ultrasonograms (nodule, 6; fat necrosis, 3; distortion, 1; diffuse skin thickening, 2; calcification, 1) in the control group and 10 category 3 ultrasonograms (distortion, 9; nodule, 1) in the oncoplastic group. An abrupt decrease in category 3 ultrasonograms during the first 2 years (from 30 to 12 in the control group, and from 26 to 10 in the oncoplastic group) suggests that these were benign postoperative findings. Category 4A was reported in two patients who underwent tissue biopsy: one patient in the control group was diagnosed with recurring breast cancer at 4 years postoperatively, while the other patient in the oncoplastic group was diagnosed with papilloma at 3 years postoperatively. Eventually, there was no recurrence in the oncoplastic group; however, one case of local recurrence in the ipsilateral breast was noted in the control group.

DISCUSSION

The success of BCT relies on the tenet of complete removal of the breast cancer, while preserving breast cosmetic appearance.[7] Achieving both goals together can be challenging; approximately 30% of patients who undergo BCT are known to be unsatisfactory with their aesthetic outcome.[27,28] Oncoplastic surgery complements deficiencies after BCT and preserves the natural breast shape. Oncoplastic techniques with flaps for large tumors and small-breasted women, and mastopexy/reduction for smaller tumors and large-breasted women, have less complications, less recurrence, and improved satisfaction on meta-analysis compared with partial mastectomy.[19] These findings have solidified the oncoplastic technique position as standard of care in tumors > 80 g in weight or larger than 20% of the native breast.[7,8] While some authors have found oncoplastic techniques result in a prolonged rate of mammographic stabilization.[22,23] other authors have not found this to be the experience of patients in their cohort.[21,29,30] Available modalities for postoperative cancer surveillance include clinical examination, radiographic imaging, and tissue sampling. Clinical examination is a critical component of monitoring. In a review of 261 LD flaps for oncoplastic reconstruction, Mele et al.[21] found that of the 11 recurrences, six were detectable by palpation. Of these six, three were not detectable on mammography. The recurrence rate in that series was 0.5% per year, similar to the 0.5–2% per year seen in early-stage breast cancer patients undergoing partial mastectomy alone and radiotherapy.[31] In our study, one case of local recurrence was noted in the control group, and 0.8% of a total of 58 patients developed local recurrence each year, which is in accordance with previous results. The recurred cancer was detected by ultrasonography.

TABLE 4 Breast Imaging Reporting and Data System in ultrasound

BI-RADS category	Control group [29 patients, 129 ultrasonograms]						Oncoplastic group [29 patients, 139 ultrasonograms]						p-Value
	Detection time (postoperative year)[a]					Total US [n = 92]	Detection time (postoperative year)[a]					Total US [n = 99]	
	1 [n = 29]	2 [n = 28]	3 [n = 17]	4 [n = 7]	5 [n = 2]		1 [n = 29]	2 [n = 27]	3 [n = 18]	4 [n = 11]	5 [n = 3]		
0	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.275[b]
1	1 (3)	4 (14)	1 (6)	0 (0)	0 (0)	16 (12)	0 (0)	3 (11)	3 (17)	1 (9)	1 (33)	11 (8)	
2	9 (31)	13 (46)	15 (88)	6 (86)	2 (100)	69 (54)	11 (0)	15 (56)	13 (72)	9 (82)	2 (67)	89 (64)	
3	19 (66)	11 (39)	1 (6)	0 (0)	0 (0)	43 (33)	18 (62)	9 (33)	1 (6)	1 (9)	0 (0)	38 (27)	
4	0 (0)	0 (0)	0 (0)	1 (100)	0 (0)	1 (1)	0 (0)	0 (0)	1 (100)	0 (0)	0 (0)	1 (1)	
5	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
6	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	

All data are expressed as *n* (%)

US ultrasonograms, *BI-RADS* Breast Imaging Reporting and Data System

[a] *n* indicates the number of patients in each year

[b] Comparison of the total number of ultrasonograms between the control and oncoplastic groups

To date, no consensus exists regarding the postoperative radiographic imaging protocol. The ultimate goals, as outlined by Losken et al., are (1) exclude residual disease; (2) rule out recurrences; (3) establish a new baseline; and (4) evaluate for metachronous disease.[22] Expected changes after most oncoplastic techniques include skin edema, fat necrosis, scarring, and dystrophic calcifications.[32,33] In serial examinations of mammographic findings, radiologists have found that changes present were predictable after LD and did not interfere with mammographic surveillance evaluation.[23,34,35] These additional characteristics include a thin opaque line that delineates the flap, a radiolucent paddle within the breast, and skin thickening where the surface of the de-epithelialized dermis is present.[30] Our study verifies this fact. Mammographic microcalcifications are rarely confounding in most oncoplastic reconstruction techniques, unless autologous fat grafting is performed.[23] In the current study, we focused on a population of primarily Korean women. Racial differences in mammographic breast density exist.[36] Accordingly, we included biannual ultrasonography during the first 1½ years of postoperative cancer surveillance because of our population of young breast cancer patients with dense breasts. Well-executed cohort studies estimated that using adjunct imaging such as ultrasonography and magnetic resonance imaging detected more second breast cancers than mammography.[37] Another recent study reported that biannual ultrasonography surveillance in patients with a history of breast cancer surgery is useful for detecting second cancers.[38] Although we adopted the protocol of biannual ultrasonography, it is not globally accepted. We intended to show the difference in postoperative cancer surveillance between the two groups rather than the postoperative surveillance protocol itself.

A greater number of dystrophic calcifications related to postoperative change were observed in the oncoplastic group compared with the control group (control 10% vs. oncoplastic 35%). Nevertheless, the oncoplastic and control groups had an equivalent number of category 0 cases requiring additional imaging, and category 3 cases requiring short-interval follow-up. These cases were in large part due to newly developed calcifications, proved to be benign through additional mammogram without any biopsy. These results suggest that while oncoplastic reconstruction using an LD flap leads to an increase in postoperative dystrophic calcification, there was no additional increase in recall compared with controls. Routine mammogram generally found these findings to be benign. An invasive diagnostic procedure such as fine needle biopsy was necessary in two ultrasonograms in this cohort. Recent studies[37,39,40] show a biopsy rate of 0.5–2.3% per year in the surveillance setting of combined mammography and ultrasonography; the biopsy rate for combined mammography and ultrasonography is reduced compared with that of mammography alone.[39] The annual biopsy rate in the current study, i.e. 0.8%, is observed to be within an acceptable range.

The findings in ultrasonography showed no difference between the control and oncoplastic groups, except for fluid collection, which is clinically regarded as a seroma. A seroma in breast cancer surgery is an abnormal collection of serous fluid in dead space beneath the mastectomy skin flap, in the axilla, or within the breast parenchyma following breast-conserving surgery.[41] Although the pathogenesis of seromas has not been fully elucidated, a few factors such as low BMI, the disuse of electrocautery for dissection, early drain removal, low vacuum drains, obliteration of dead space, and delayed shoulder physiotherapy have been demonstrated consistently.[42] Obliteration of dead space is a well-established factor, and a lot of techniques—mechanical or chemical—have been employed to obliterate the dead space to reduce a seroma.[43–46] In the current study, seromas occurred less frequently in the oncoplastic group. It is suggested that the LD flap obliterated dead space in the axilla or within the breast parenchyma after partial mastectomy, thereby minimizing lymph spillage. Oncoplastic surgery with an LD flap is even thought to enhance wound healing by filling dead space rather than interfere in cancer surveillance.

This is the first study to match postoperative mammographic and ultrasonographic changes after oncoplastic reconstruction using the LD flap with partial mastectomy controls. Nonetheless, future studies can be performed on a larger set of patients to determine if the LD flap results in more benign calcifications. Finally, the contribution of technical factors, such as skin paddle selection to limit fat necrosis, and clean surgical planes to limit dystrophic calcification, needs to be further examined.

CONCLUSIONS

Oncoplastic surgery using the LD flap prevents deformities that can occur after BCT, and enables BCT patients with a relatively large tumor to have a favorable cosmetic outcome. Our results indicate that the LD flap can lead to a decreased rate of postoperative seroma. We reviewed the impact of the LD flap in oncoplastic reconstruction on postoperative cancer surveillance compared with matched controls. No additional findings required further evaluation, such as recall for additional imaging and short-interval follow-up, although, in the oncoplastic group, there was an increase in postoperative dystrophic calcifications at the surgical site. We concluded that LD flap for oncoplastic surgery does not interfere with postoperative cancer surveillance.

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