Original Study

Usefulness of Lateral Thoracic Adipofascial Flaps After Breast-conserving Surgery in Small-to Moderate-sized Breasts

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Abstract

The usefulness of lateral thoracic adipofascial flaps to reconstruct breast defects following breast-conserving surgery (BCS) is unknown. In current study, bases on 58 female patients who underwent BCS, we first identified that the lateral thoracic adipofascial flaps were reliable and useful for reconstructing breast defects after BCS when the resected volume was confined to between 50 and 100 g, particularly in patients with small-to-moderate-sized breasts.

Background: Women with small- to moderate-sized breasts present a specific challenge to performing oncoplastic volume-displacement techniques for reconstructing breast defects after breast-conserving surgery (BCS). In such cases, the lateral thoracic wall region serves as a versatile reconstruction donor site. Therefore, in the present study, we aimed to investigate the effectiveness and feasibility of employing lateral thoracic adipofascial (LTA) flaps to reconstruct breast defects following BCS. **Patients and Methods:** A total of 58 female patients who underwent BCS between February 2016 and April 2017 were analyzed. Of these, 33 patients were reconstructed with LTA flaps, and the other 25 patients received BCS only and were assigned as the control group. All patients were followed up, and we assessed surgery-related complications, breast appearance, and disease recurrence. **Results:** The mean weight of the resected breast tissue was 65.9 g (range, 35-100 g). The mean volume of LTA flaps was 309.5 cm^3 (range, 112.6-588 cm^3). This oncoplastic technique was performed with minimal complications in all patients. Two patients exhibited partial adipose liquefaction (6.1%), and 2 patients manifested wound infections. **Conclusions:** The LTA flaps were reliable and useful for reconstructing breast defects after BCS when the resected volume was confined to between 50 and 100 g, particularly in patients with small- to moderate-sized breasts. This is optimal for patients with lesions located in the upper-outer quadrant.

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Introduction

Early stage breast cancers are increasingly being detected, with the advancement in diagnostic tools for breast cancer and the increasing number of women who undergo periodic medical examinations. Breast-conserving surgery (BCS) aims to minimize breast deformity after tumor lumpectomy without compromising tumor resection, but potentially insufficient resection margins may increase the risk of local recurrence if too much attention is paid to cosmesis. Therefore, oncoplastic surgical techniques have become more common. First mentioned in 1997 by Gabka et al[1] to expand the indication spectrum for BCS, such surgery can extend the possibility of BCS, avoid breast deformities, and reduce both mastectomy and re-excision rates.

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Breast size and excised volume are important considerations in BCS surgery. In patients with relatively large breasts, the residual tissue is sufficient to obtain satisfactory cosmetic outcomes using the volume-displacement technique. In female patients with relatively small- to moderate-sized breasts, the volume displacement technique can be performed after the removal of defects less than 50 g in mass. However, if the defects are greater than 50 g, satisfactory cosmetic outcomes can only be obtained using volume-replacement techniques.

In the present study, we report the lateral thoracic adipofascial (LTA) flap as an alternative option for reconstructing breast defects in patients undergoing BCS. Furthermore, the clinical effectiveness and feasibility of LTA flaps were also evaluated.

Patients and Methods

Design

Patients who underwent BCS in the Department of Breast Surgery between February 2016 and April 2017 were included in current study. The enrollment criteria of this study were as follows: (1) patients with breast cancer who were candidates for BCS; (2) tumor size no more than 3 cm in moderate- to small-sized breasts; and (3) tumor not centrally located. In all patients, brassiere size was an A to B cup. Breast cancer staging was performed according to the American Joint Committee on Cancer tumor-node-metastasis staging system of 2002.[2] Seven patients were diagnosed as stage I and 26 as stage II. Patients diagnosed with breast cancer who had neoadjuvant chemotherapy were excluded from the study. All patients were evaluated by ultrasonography, mammography, or magnetic resonance imaging, and all surgical procedures were performed by the same surgical team. Clinical records, including age, weight, body mass index, and excised tissue volumes, were collected and assessed. This study was approved by the ethics committee, and written informed consent was obtained from each patient.

We also retrospectively reviewed the clinical records of patients who received BCS without immediate volume replacement in our department from 2004 to 2006. During this period, we had not yet started to perform the oncoplastic technique that combines partial mastectomy with immediate volume replacement for those patients with lesions located on the outer quadrant area. Twenty-five patients were also enrolled in our study as a control group for comparison of cosmetic results.

Surgical Procedures

Under general anesthesia, the patients were placed in the standard supine position with the ipsilateral arm abducted. A wide excision approximately 2 cm from the initial tumor margin was performed by the surgeon, and tumor invasion at the resection margin was evaluated using frozen sections. The excised mass was between 50 and 100 g. Sentinel lymph node biopsy was performed in 22 patients, and axillary lymph node dissection was performed for 11 of them.

The LTA flap procedure was selected and marked based upon the location of the lesion preoperatively. We designed a round-shaped flap in the lateral thoracic area, and used the pinch test to measure the thickness of the lateral thoracic tissue. The course of the vascular architecture of the lateral chest wall was also marked and located, using a portable hand-held Doppler probe. An appropriate outline of the flaps was finally made according to the volume of the breast tissue defect.

A longitudinal incision along the anterior axillary line was made, and subcutaneous injections were administered into the adipose tissue layer just below the dermis. The superficial and deep fascia of the chest wall was raised until the posterior edge of the flap was reached. The flap was then elevated from peripheral to proximal aspects of the pedicle. The pedicle was traced to its origin—raising a cutaneous flap of fat attached to the fascia—and the flap was rotated into the medial defects, fixing the flap to the edge of the remaining breast. A surgical clip was subsequently inserted into the excised cavity to facilitate radiation therapy. Continuous closed-suction drainage was employed at the wound site, and sutures were made layer by layer.

Follow-up

The median follow-up period was 21 months (range, 13-27 months). Mammography, ultrasonography, and magnetic resonance imaging were performed to assess disease recurrence, breast appearance, and donor site function 6 months postoperatively.

A questionnaire survey was administered to the patients to evaluate their general and esthetic satisfaction. This standardized questionnaire was adopted from the Michigan Breast Reconstruction Outcomes Survey[3] and consisted of 7 questions (Table 1). Questions 1 to 5 assessed the general patient satisfaction with reconstruction, and questions 6 and 7 assessed their esthetic satisfaction. Each question was graded on a 5-point Likert scale, and the answers ranged from "very dissatisfied" to "very satisfied." Each answer with a "satisfied" score was recorded as 4 or 5, and a "dissatisfied" score was represented by 1, 2, or 3. The patients' levels of satisfaction were recorded as "generally satisfied" when they had a score of 5/5 for the questions on general satisfaction, and "esthetically satisfied" represented a score of 2/2 for the questions on esthetic satisfaction. Three surgeons blinded to the group performed an esthetic analysis using photographs of the patients with frontal and bilateral views for each patient.

Statistical Analyses

Statistical analyses was performed by using the software package SPSS version 11.5 (SPSS Inc, Chicago, IL). Values were presented as mean $\pm$ standard deviation for normally distributed variables. Statistical significance threshold was considered $\alpha = 0.05$.

Results

A total of 58 patients were included in the current study. The patients' clinicopathologic characteristics are listed in Table 2. Overall, the patients' mean age was 42.9 years old (range, 35-49 years). The patients' mean body mass index was 25.8 kg/m^2 (range, 24 to 28 kg/m^2). Tumor size ranged from 1 to 2.5 cm and 3 to 4 cm from the nipple. All surgical margins of 58 patients were cleared by at least 2 cm. The mean weight of the resected breast tissue was 65.9 g (range, 35-100 g). The length, width, and thickness of the LTA flap ranged from 16 to 21 cm, 4.4 to 8 cm, and 1.6 to 3.5 cm, respectively; the mean volume of LTA flaps was 309.5 cm^3 (range, 112.6-588 cm^3) (Figures 1, 2). A re-excised specimen was negative with respect to margin encroachment.

Table 1 Modified Michigan Breast Reconstruction Outcomes Survey

General satisfaction
1. Knowing what I know today, I would definitely choose to have breast reconstruction.
2. Knowing what I know today, I would definitely choose to have the type of reconstruction I had.
3. Overall, I am satisfied with my reconstruction.
4. I would recommend the type of reconstructive procedure I had to a friend.
5. I felt that I received sufficient information about my reconstruction options to make an informed choice among several procedures.
Aesthetic satisfaction
6. The size and shape of my breasts are the same.
7. My reconstructed breast(s) feel soft to the touch.

In the LTA group, 2 patients exhibited partial adipose liquefaction, and 2 cases exhibited wound infection postoperatively. However, these complications were resolved when managed with conservative treatment. Radiation therapy was performed in 30 cases and did not affect the aesthetic outcome, whereas 29 patients received chemotherapy.

We compared the surgical procedure and cosmetic scores between patients who received immediate volume replacement using the LTA flap and patients without any volume replacement (the control group). The number of patients cosmetically evaluated as good to excellent with volume replacement using the LTA flap was more than the control group, although statistical significance was not observed (Table 3).

The general satisfaction scores showed that 27 (81.8%) patients were satisfied, and the esthetic satisfaction scores showed that 25 (75.8%) patients were satisfied. The mean esthetic score of the plastic surgeons was 4.08. These results indicated that the cosmetic outcomes were generally satisfactory (Figures 1E, 1F, and 2F). No patient manifested local or distant recurrence during the observation period. The surgical complications as well as esthetic and oncologic outcomes among the study patients are shown in Table 3.

Discussion

Oncoplastic breast-conserving surgical techniques have emerged to a significant extent over the past 30 years, facilitating the improvement of the aesthetic outcome while ensuring oncologic principles. Two techniques are currently used in oncoplastic surgery according to the excised volume of the breast[4]: the volume-displacement technique, based on glandular reshaping or reduction mammoplasty, and the volume-replacement technique, which uses autologous tissue for different types of flaps. Volume-displacement techniques have proven to be useful for large-sized breasts, whereas the volume-replacement techniques that replace the volume of excised breast tissue with autologous tissue are particularly advantageous in small- to medium-sized breasts.[5,6] In 1985, Fisher et al reported no significant differences in local recurrence or survival rates between modified radical mastectomy and BCS followed by radiotherapy in patients with breast cancers < 4 cm in diameter.[7] Several randomized controlled trials have also not shown any differences in overall survival rates after BCS or mastectomy.[8-10] BCS has been accepted as the primary treatment modality in patients with breast cancers at stages I and II. The key to successful BCS is to provide both an adequate margin and a good shape to the breast. From the perspective of oncologic safety, the largest specimen should be removed to achieve the widest possible margin; from the perspective of aesthetics, the least amount of tissue excised yields a better cosmetic outcome. A breast deformity will, however, occur if a large piece of breast tissue is excised without being covered by an autologous tissue flap.

Breast size and excised volume are important considerations in oncoplastic surgery, and its advantages include wider free margins and better cosmetic results.[11] We expected that we had not selected a surgical margin of over 20 mm to obtain pathologically negative results, lumpectomy resection could have been performed, obviating or reducing the need for volume replacement. However, we preferred to decrease the risk of recurrence and therefore performed volume replacement. The comparison by Kaur et al of the volumes of the resected tissue and the degrees of infiltration into the surgical margin in the oncoplastic procedure—along with standard quadrantectomy in patients with breast cancer—showed that the oncoplastic procedure could resect a larger quantity of tissue and thus produce a wider negative surgical margin.[11] In patients with relatively large breasts (especially those in Europe), the residual tissue is usually sufficient to reconstruct the breast after tumor excision, and satisfactory cosmetic outcomes can be obtained using glandular reshaping for breast defects. In patients with relatively small breasts, especially in East Asian women who usually have small- to moderate-sized breasts, the volume-displacement technique can be performed after the removal of small-sized volume defects less than 50 g in mass. However, when moderate- or large-volume defects are between 50 and 100 g, satisfactory cosmetic outcomes are difficult to achieve using the volume-displacement technique. In these cases, acceptable cosmetic outcomes can be obtained with flaps from surrounding autologous tissue, such as the artery perforator flap or mini latissimus dorsi flap.[12]

In the mid-1970s, with the development of microsurgery and anatomical studies on muscle and vascularization, the lateral thoracic wall area was considered to be a promising donor site for tissue flaps. Many reconstructive structures, including skin, fatty tissues, fascia, and muscles, are located here and can provide perforator flaps, including the lateral intercostal artery perforator (LICAP) flap and the thoracodorsal perforator (TDP) flap.[13] Artery perforator flaps are associated with low donor-site morbidity, which make them appropriate for breast reconstruction.[14] The lateral chest wall is characterized by a triangular shape: the anterior border is the lateral boundary of the breast, the inferior border corresponds to an imaginary line extending along the inframammary fold, and the third segment is the posterior border to the posterior axillary line. The lateral chest wall has a dual blood supply from the branch of the thoracodorsal artery and the lateral thoracic artery[15]; as it has the advantage of raising large- or small-volume flaps while maintaining its intrinsic vascular supply, it has the potential to allow flaps to achieve transposition to a significant extent.

In the present study, we designed and successfully presented the LTA flap as an alternative flap from the lateral thoracic region. Our preliminary work was focused on utilizing the LTA flap for recovering traumatic defects; however, with technical advancements, we increasingly noted that the LTA flap could repair breast defects in some instances.

Table 2 Clinicopathologic Characteristics of the Patients

Variables	LTA Group (n = 33), n	Control Group (n = 25), n	*P* Value
Median patient age, y (range)	42 (35-49)	44 (37-49)	.23
Median patient BMI, kg/m^2 (range)	25.2 (24-27)	26.5 (25-28)	.16
Location			.31
Upper-outer quadrant	24	15	
Lower-outer quadrant	9	10	
Median excised volume, g (range)	73.8 (50-100)	55.5 (35-75)	.21
Pathology			.69
Invasive ductal carcinoma	28	23	
Mucinous carcinoma	2	1	
Ductal carcinoma in situ	3	1	
Stage			.36
I	7	3	
II	26	22	
Median flap dimensions, cm^3 (range)	309.5 (112.6-588)		NA

Abbreviations: BMI = body mass index; LTA = lateral thoracic adipofascial; NA = not available.

To select the appropriate oncoplastic procedure, multiple factors should be considered, including breast size, excised volume, and the location of the breast tumor. Evaluation of patients before surgery remains crucial to determining the volume of excised tissue, so as to allow optimal positioning of the tumor incisions; and we marked an appropriate outline of the flap according to the size and depth of the defects. The flaps were small-volume flaps less than 100 g and were matched with the weight of the excised masses. The tumor

Figure 1 A 41-year-old Patient With Breast Cancer of 3 cm in the Left Breast. A, Breast Defect After Quadrantectomy Resection. B, C, A Lateral Thoracic Adipofascial (LTA) Flap was Harvested That Contained Subcutaneous Tissue, Fat Tissue, and Fascia. D, The LTA Flap Was Rotated Into the Defects of the Breast. Some Points of the LTA Flap Were Peripherally Sutured to the Remnant Gland. E, F, Front View at 1 Week and 6 Months Postoperatively

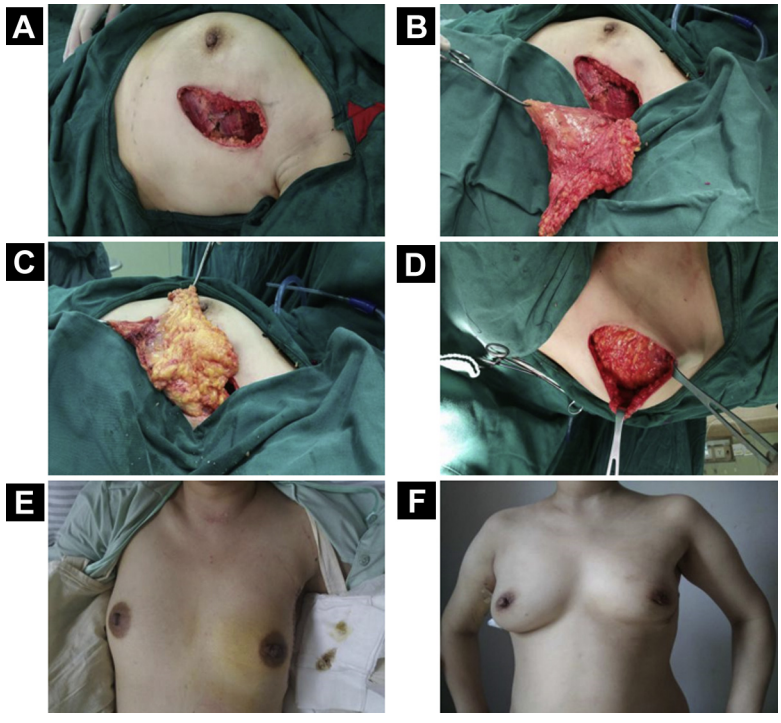
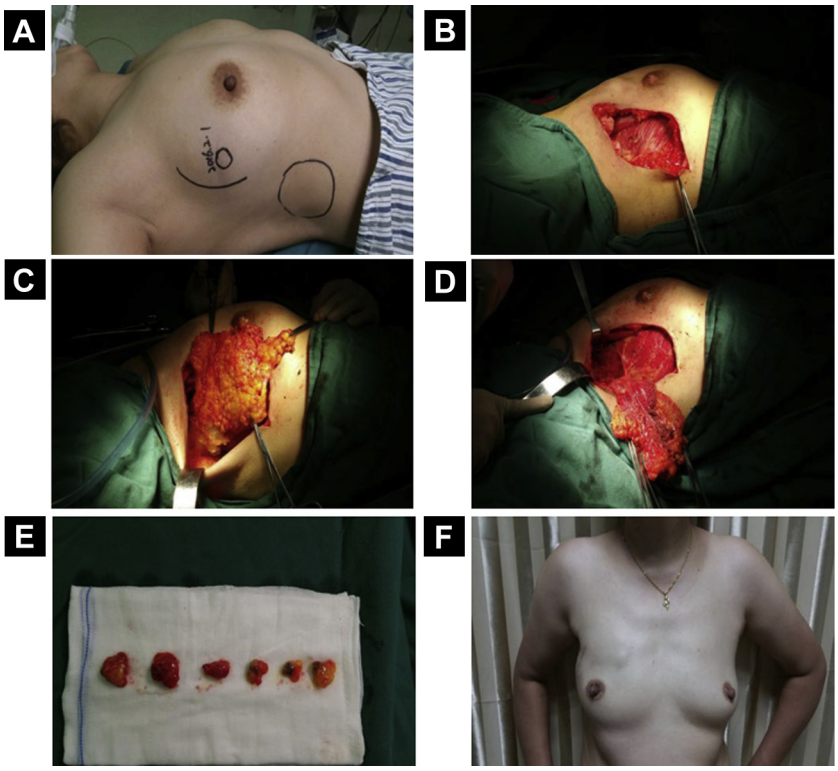


Figure 2 Reconstruction of Breast Defects With the Lateral Thoracic Adipofascial (LTA) Flap After Partial Mastectomy of the Right Breast. A, Macroscopic Findings of the Breast and Donor Site. B, Breast Tissue and Fascia of the Pectoralis Major Muscle Were Removed. The Results of Pathologic Examinations of 4 Points Along the Surgical Margin Were Negative. C, A Front View of the Raised LTA Flap. D, An Opposite View of the Raised LTA Flap. E, Intraoperative Sentinel Lymph Node Biopsy. F, A Continuous Suction Tube was Added to the Surface of the Breast



location should then be the primary consideration when selecting the type of flap. For example, although a perforator flap can be used in reconstructing lateral partial breast defects,[16,17] a LICAP flap is usually preferred.[18] The TDAP flap is a better reconstructive option for defects in the mediolateral area of the breast. Similarly, when a tumor is located in the upper-outer or lower-outer quadrant of the breast, the LTA flap procedure can be performed. Munhoz et al performed oncoplastic surgery with a lateral thoracodorsal flap in 34 patients with breast cancer, and all tumors were located in the lateral breast region.[19] In the present study, tumors were localized to the lateral quadrant in 32 of 33 patients in the LTA-flap BCS group.

Table 3 Surgical and Cosmetic Results in Patients With LTA Flap Construction

Findings	LTA Group (n = 33)	Control Group (n = 25)
SLNB/ALND	26/7	15/10
Total surgery time, min	72	64
Complications		
Adipose liquefaction	2	3
Infection	2	3
Cosmetic evaluation (excellent-good/fair-poor)	25/8	11/22
LR/DR	0/0	1/2

Abbreviations: ALND = axillary lymph node dissection; DR = distant recurrence; LR = local recurrence; LTA = lateral thoracic adipofascial; SLNB = sentinel lymph node biopsy.

The LTA flap provides several distinct advantages. First, with respect to ease of harvesting, the pedicle can be partially or completely mobilized to allow greater flap reach compared with the LICAP flap. When the lesion is in the lateral quadrant, the flaps are inclined to lie more superiorly than the LICAP perforators. Second, this technique is associated with minimal donor site morbidity compared with the TDAP flap because the LTA flap is harvested between the serratus anterior and latissimus dorsi muscles; harvesting this flap does not affect the function of the serratus anterior and latissimus dorsi muscles, circumventing the postoperative seroma of classic latissimus dorsi flap.[20] Consequently, the patients exhibited a short recovery period. Third, our technique preserves the option of the latissimus dorsi musculocutaneous flap if this is ultimately required. Lastly, the LTA flap provides texture and color that match the breast, and it can be raised without affecting the dermis or epidermis. No scars emerged at the donor site of the lateral thoracic area, there was no need for additional incisions, and reliable cosmetic outcomes were therefore

likely to be obtained. Considering these findings, we suggest that the LTA flap exhibits the advantage of a concealed location, better donor-site function, and cosmetic outcomes.

Our study demonstrates a practical use of the LTA flap technique, with satisfactory results. Of 33 patients in the LTA-flap BCS group, 28 patients were satisfied with breast symmetry and appearance. The aesthetic outcome and degree of patient satisfaction were correlated with the percentage of excised breast tissue; when the preoperative estimation of volume exceeded 20% of the total breast volume, our reconstructive technique produced the desired and satisfactory cosmetic outcome.[21]

There were no cases with severe complications and 4 cases with minor complications. Of the 33 patients, 2 (4.7%) showed partial adipose liquefaction, and 2 (4.7%) experienced adipose necrosis. Munhoz et al[19] reported that of 18 patients with breast reconstruction with lateral thoracodorsal flaps, 3 (8.8%) experienced partial flap necrosis, and 2 (5.8%) had fat necrosis. Similarly, Woerdeman et al[22] indicated that flap-related complications occurred in 18.3% of cases, of which 11.6% presented with partial flap necrosis, and 3.3% experienced fat necrosis; these authors also reported that partial flap necrosis increased proportionately with the flap length. The LTA flap is not an axial flap, and therefore, vascularization of the distal parts is difficult to predict; a long flap could increase the chance of liquefaction or necrosis of fat. The length of the flap should therefore be kept in some range; in our study, the range in flap length was 7 to 15 cm. For tumors located in the lower-inner quadrants, a wide inframammary incision during tumor resection might expose excessive vascularization. It is therefore wise to evaluate dermal bleeding at the tip of the flap and to shorten it to avoid partial flap loss.

Some limitations of our study should be acknowledged. First, when the lesions were located in the inner or lower area of the breast, and masses were over 100 g, the LTA flap could not be used, and other methods such as TDAP flaps or mini latissimus dorsi flaps must be used. Consequently, the LTA flap was only used in 38% of our cases. Second, anatomical variation and various vessel diameters were disadvantageous to using this flap. It was also difficult to distinguish between the signal of the perforator and the main pedicle owing to the relatively thin layer of subcutaneous tissue; moreover, ultrasonography did not allow us to locate the vascular architecture precisely. However, surgery to the lateral chest wall is contraindicated historically. Third, owing to the retrospective nature of our study, there was selection bias, and control over patient variables was limited. Furthermore, our analysis for postoperative complications was limited to 33 patients; therefore, a large sample size and a more extended follow-up period are essential to achieving significant conclusions. Although larger studies are highly desirable, the present study may serve as a method of analysis to motivate future investigations.

Conclusions

The LTA flaps constitute an ideal and reliable technique in BCS surgery with small- to moderate-sized breasts, particularly when lesions are located in the upper-outer quadrant. This technique might also improve the quality of life and self-esteem of the patients. We recommend proper case selection and preoperative planning to guarantee positive outcomes.

Clinical Practice Points

- Breast size and excised volume are important factors for considerations in oncoplastic surgery.
- In women with small-to-moderate-sized breasts after BCS, breast reconstruction remains controversial.
- In the current study, we demonstrated that the LTA flaps were reliable and useful for reconstructing breast defects after BCS in patients with small-to-moderate-sized breasts.

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Disclosure

The authors have stated that they have no conflicts of interest.

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