

The Modified Lateral Intercostal Artery Perforator Flap

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Background: The main surgical options for treatment of breast cancer are breast-conserving surgery and mastectomy. BCS aims to achieve complete excision of the tumor while achieving a pleasing cosmetic result. Excision of tumors in the lateral aspect of the breast has been associated with issues such as contour deformities and asymmetry. Development of volume replacement techniques such as the lateral intercostal artery perforator flap (LICAP) aimed to address these issues. Our modification of the traditional LICAP offers a less visible scar, good access to the axilla, and no need to reposition the patient.

Methods: All patients undergoing a modified LICAP were identified from our database. The lateral intercostal artery perforators were marked with ultrasound and 2 “lazy S” lines were drawn to mark the flap. The wide local excision (with or without axillary surgery) was performed and the flap mobilized to fill the defect.

Results: Twenty-two patients underwent modified LICAP in 14 months. The mean specimen weight was 86 g. Four patients (18%) had a re-excision for positive margins. Nineteen patients had axillary surgery performed at the time of their modified LICAP flap. No patients had a scar that extended posterior to the posterior axillary line; no patients required a separate incision for axillary surgery; and no patients needed to be repositioned intraoperatively.

Conclusions: Our early experience with this innovative procedure has been favorable. The perioperative complication rate is low. Due to the relatively short follow-up, longer term outcomes such as postradiotherapy appearance are yet to be determined. (*Plast Reconstr Surg Glob Open* 2019;7:e2066; doi: 10.1097/GOX.0000000000002066; Published online 5 February 2019.)

INTRODUCTION

The main surgical treatment options for breast cancer are breast-conserving surgery (BCS) or mastectomy with or without reconstruction. The complexity of these operations is ever increasing due to greater understanding and implementation of oncoplastic techniques. BCS, when paired with adjuvant radiotherapy, has the same disease-specific survival as a mastectomy and the choice of procedure is therefore the result of a decision-making process taking into account tumor factors and patient body shape, comorbidity, and patient wishes.¹

The 2 key aims of BCS are complete resection of the cancer with negative margins, while achieving a pleasing aesthetic result. The volume of excised tissue in comparison to the volume of the breast; the location of the tumor; the density of the glandular breast tissue; and the overlying skin are factors that influence the outcome and risk of complications.^{2,3} With the traditional approach of resecting a relatively large upper outer quadrant tumor, there is a significant risk that the nipple-areola complex becomes deviated superolaterally, and following radiotherapy it is not uncommon to see a contour deformity or depression in the breast parenchyma. Oncoplastic techniques have been developed in an attempt to address these aesthetic problems, and may allow resection of larger volumes of tissue with a wider surgical margin compared with standard BCS.⁴ Examples of described techniques are the racquet incision and J mammoplasty as well as a modified wise

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Received for publication August 25, 2017; accepted October 10, 2018.

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 DOI: 10.1097/GOX.0000000000002066

Disclosure: The authors have no financial interest to declare in relation to the content of this article. The Article Processing Charge was paid for by the authors.

Supplemental digital content is available for this article. Clickable URL citations appear in the text.

METHODS

All patients undergoing a modified LICAP flap procedure were identified from a prospectively maintained database. Data collected included patient demographics; clinical and imaging findings; details of surgery (both breast and axilla); histopathology results; and any complications.

Surgical Technique

The LICAP vessels were marked using duplex ultrasound. A line was drawn along the inferior and lateral mammary fold in a “lazy S” toward the lower axilla. A second lazy S drawn inferolaterally completed the flap (Fig. 2). This alteration in direction of the incision and resulting flap is the main modification to the original technique. The area between the 2 “lazy S” lines was de-epithelialized. The wide local excision was performed from the anterior border of the flap and the axillary surgery from the superior border, thereby providing excellent access to both the breast and axilla.

Once the oncological resection was complete, the flap was mobilized in a fashion similar to the standard LICAP flap as described by Hamdi et al.⁶ The perforators were preserved in a mesentery of tissue around which the flap was either flipped or rotated to allow optimal filling of the defect (Fig. 2). Marking clips were then placed in the wide local excision cavity as usual. The flap was supported in its new location with a suture before closing the wound with deep dermal and subcuticular sutures (Fig. 2).

RESULTS

Patient Characteristics

Twenty-two patients underwent a modified LICAP flap since its introduction in October 2015 to the end of December 2016. A summary of patient characteristics is provided in Table 1. All patients were discussed in a multidisciplinary team meeting before and following their operation. The median follow-up period was 2 months (range, 1–12 months).

Tumor Characteristics

The indication for surgery was invasive breast cancer in 20 patients and in situ breast cancer in the remaining 2 patients. Fifteen patients had luminal tumor biology; 2

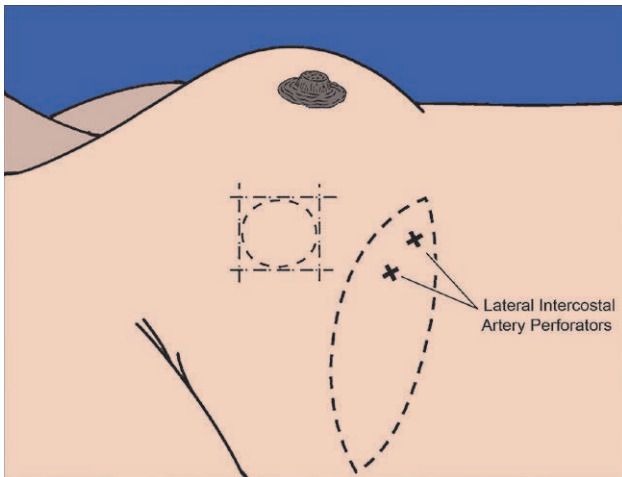


Fig. 1. The original LICAP flap.

pattern breast reduction technique.⁵ However, all of these techniques displace the breast volume, potentially resulting in noticeable difference in breast size and the need for contralateral reduction to maintain symmetry.

Replacing volume rather than displacing volume can address the issue of asymmetry in patients who have near symmetrical breasts preoperatively. The use of autologous tissue to fill the lateral defect has evolved from musculocutaneous flaps to fasciocutaneous flaps, and now “perforator” flaps of skin and subcutaneous tissue alone. Hamdi et al.⁶ pioneered a number of highly versatile flaps for use in breast reconstruction. His lateral intercostal anterior perforator (LICAP) flap was described as a flap based on the perforating arteries, which originate in the costal segment of the intercostal arteries (Fig. 1).⁶

While the LICAP as described by Hamdi et al.⁶ is an excellent option for volume replacement, it has 2 limitations. First, it is necessary to reposition the patient intraoperatively from lateral to supine to perform both the harvest of the flap and the breast cancer resection. Second, the scar that results is quite visible as it extends from the lateral mammary fold to approximately 5 cm posterior to the posterior axillary line.

To address these limitations, the LICAP technique was modified by our unit. The following study describes the surgical technique and examines the outcomes of the modified LICAP flap, which has been performed by surgeons at the Westmead Breast Cancer Institute.

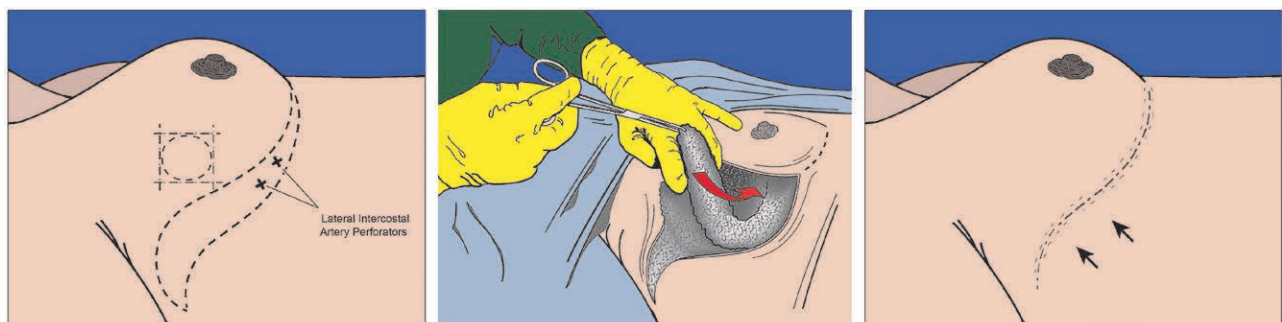


Fig. 2. The progression in a modified LICAP flap.

Table 1. Patient Characteristics (n = 22)

Characteristics	No. Patients (%)
Mean age in years (range)	58 (40–74)
Current smoker	2 (9%)
Type 2 diabetes mellitus	2 (9%)
Previous ipsilateral radiotherapy	0
Neoadjuvant chemotherapy	3 (14%)
Adjuvant chemotherapy	16 (73%)
Adjuvant radiotherapy	21 (95%)
Breast size	
A cup	0
B cup	5
C cup	4
D cup	8
DD cup	4
E cup	0
F cup	1

patients had HER2-positive disease, and 3 had triple negative disease. The mean maximum dimension of the tumor on preoperative imaging was 30 mm (range, 8–110). The tumor's position was upper outer quadrant in 11 patients; lower outer quadrant in 7 patients; lateral (3 or 9 o'clock) in 3 patients; and occupying the entire lateral half of the breast in 1 patient.

Operative Details

Operative details are outlined in Table 2 and demonstrated in **Supplemental Digital Content 1** (see video, Supplemental Digital Content 1, which displays the modified lateral intercostal artery perforator flap. This video is available in the "Related Videos" section of the Full-Text article at PRSGlobalOpen.com or at <http://links.lww.com/PRSGO/A950>). The mean specimen weight was 86 g. Twenty patients had BCS followed by a modified LICAP performed in the same operation. Two patients had the modified LICAP performed in a separate operation to initial BCS. One of these patients had BCS, sentinel lymph node biopsy (SLNB) and later a re-excision of margins at a different institution and had been referred to our center for consideration of a completion mastectomy. The patient preferred to avoid a

Table 2. Operative Details (n = 22)

Procedures	No. Patients (%)
Breast	
BCS and immediate LICAP	20
Staged/delayed LICAP	2
Axilla*	
None	1
SLNB before modified LICAP	1
SLNB at time of modified LICAP	9
SLNB following modified LICAP	1
SLNB and later ALND	4
ALND	6
Unplanned return to theater	
Re-excision	4 (18%)
Other	
SLNB	1 (5%)
Washout of infected axillary seroma	1 (5%)

*One patient had SLNB performed at the time of their original BCS in another institution. One patient was thought to have DCIS but final histopathology showed an area of microinvasion, so an interval SLNB was performed.



Video Graphic 1. See video, Supplemental Digital Content 1, which displays the modified lateral intercostal artery perforator flap. This video is available in the "Related Videos" section of the Full-Text article at PRSGlobalOpen.com or at <http://links.lww.com/PRSGO/B32>.

mastectomy if possible, and a margin re-excision and modified LICAP was performed for this patient. The other patient had a hemimastectomy (specimen weight, 465 g) and SLNB performed initially, and after confirmation of clear margins and discussion in our oncoplastic multidisciplinary team meeting, a modified LICAP was performed. None of the patients needed to be repositioned during their operation. No patients had a scar that extended posterior to the posterior axillary line.

Three patients did not have axillary surgery performed at the time of their modified LICAP flap, 6 had an axillary lymph node dissection, and 13 had an SLNB. Of the 3 patients who did not have axillary surgery at the time of their LICAP, 1 had SLNB at the time of the initial BCS, 1 had DCIS and therefore did not require SLNB, and a patient who had DCIS on core biopsy with microinvasion present on final histopathology had an interval SLNB. None of the patients who underwent axillary surgery at the same time as their modified LICAP flap required a separate incision in the axilla.

An example of the preoperative and postoperative appearances are shown in Figures 3, 4, respectively.

Histopathology Results

The size of the excised tumor ranged from 0 mm (in the patient who previously had breast conservation for a 45 mm tumor and very close margins after re-excision) to a multicentric tumor with 3 areas of invasive cancer measuring 80 mm, 48 mm, and 1 mm. In 4 patients (18%), there was involvement of a margin and re-excision was necessary. Two patients were found to have a positive SLNB and had an axillary lymph node dissection performed at a later date, and the existing incision was used in this situation.

Complications

There was no perioperative mortality. One patient (5%) had an unplanned return to theater for evacuation of an infected axillary seroma. Three patients had an infection, which was treated with oral antibiotics (14%). No patients developed wound necrosis.



Fig. 3. Preoperative photographs, 25 mm invasive ductal carcinoma at right breast 9 o'clock.



Fig. 4. Photographs 6 months post wide local excision and sentinel node biopsy (specimen weight 61 gr).

Adjuvant Therapy

Three of the 22 patients had neoadjuvant chemotherapy: 2 before BCS and modified LICAP, and 1 between BCS and interval modified LICAP. The indication for LICAP in the latter patient was margin involvement following re-excision. Sixteen patients had adjuvant chemotherapy. Twenty-one of the 22 patients had adjuvant radiotherapy. One patient did not have adjuvant radiotherapy because she experienced significant claustrophobia during the planning stage of radiotherapy. This was discussed in a multidisciplinary setting and, as she had a small low-grade cancer, the decision was made to perform close surveillance.

DISCUSSION

Our modified LICAP technique has the many advantages of the traditional LICAP flap but does not require repositioning of the patient and results in a more aesthetically pleasing scar. Our early experience with this innovative procedure has been very favorable. The perioperative complication rate is low. Due to the relatively short follow-up, longer term outcomes such as recurrence and postradiotherapy appearance are yet to be determined.

Using a volume replacement technique may enable BCS in patients who would otherwise have required a mastectomy due to a large tumor volume to breast volume ratio and may also make it possible to avoid mastectomy with reconstruction for patients not particularly suited for that technique. This technique is particularly suited to women who have some excess tissue lateral to the breast and a reasonable degree of skin laxity who

wish to maintain their current breast shape and size. In some cases, the cancer could have been resected using a therapeutic mammoplasty technique, thus reducing the size of the breast and correcting the associated ptosis; however, that would have required a bilateral procedure for symmetry. Two patients in this series wished to maintain their large breast volume and degree of ptosis; therefore, the modified LICAP was an ideal technique to achieve these aims.

The main objective of this article was to describe a modification of the LICAP, and therefore these are very early data. The limitations of this study are its short follow-up, the lack of patient-reported outcomes, and the lack of a formal assessment of cosmesis prospectively. It is hoped that these limitations will be addressed by examining patient satisfaction with the Breast Q questionnaire and longer term assessment of cosmetic outcome.

CONCLUSIONS

The modified LICAP flap is a volume replacement technique for immediate filling of defects following BCS in the lateral aspect of the breast. It affords excellent access to the axilla while avoiding an obvious scar and the need to reposition the patient intraoperatively, thus offering an option that facilitates both a pleasing aesthetic result and obviating the need for symmetrizing contralateral surgery to maintain breast symmetry.

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REFERENCES

1. Veronesi U, Cascinelli N, Mariani L, et al. Twenty-year follow-up of a randomized study comparing breast-conserving surgery with radical mastectomy for early breast cancer. *N Engl J Med*. 2002;347:1227–1232.
2. Clough KB, Kaufman GJ, Nos C, et al. Improving breast cancer surgery: a classification and quadrant per quadrant atlas for oncoplastic surgery. *Ann Surg Oncol*. 2010;17:1375–1391.
3. Blondeel PN, Hijjawi J, Depypere H, et al. Shaping the breast in aesthetic and reconstructive breast surgery: an easy three-step principle. Part III—reconstruction following breast conservative treatment. *Plast Reconstr Surg*. 2009;124:28–38.
4. Kaur N, Petit JY, Rietjens M, et al. Comparative study of surgical margins in oncoplastic surgery and quadrantectomy in breast cancer. *Ann Surg Oncol*. 2005;12:539–545.
5. Macmillan RD, James R, Gale KL, et al. Therapeutic mammoplasty. *J Surg Oncol*. 2014;110:90–95.
6. Hamdi M, Van Landuyt K, de Frene B, et al. The versatility of the inter-costal artery perforator (ICAP) flaps. *J Plast Reconstr Aesthet Surg*. 2006;59:644–652.