



Bilobed lateral artery perforator-based flap for partial breast reconstruction – Technique description and results from a ten-year cohort

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ABSTRACT

Introduction: We present a new technique, the bilobed lateral artery perforator-based flap, for breast-conserving surgery of large central tumors or nearby, combining Zymany's bilobed flap and a Lateral Intercostal Perforator (LICAP) flap, and its 10-year outcomes.

Materials and methods: We studied 37 patients with malignant breast tumors near or involving the central skin, without ptosis or desire to correct it, who avoided mastectomy with this modified bilobed flap from 2013 to 2022. The same surgeon operated on them in different institutions. This research project was approved by our ethical committee (n. 2.322.212).

Results: The mean age was 57.17 (± 12.60) years. The mean specimen weight was 74.32 (± 25.84)g, and the mean tumor size was 40.35 (± 15.81) mm. Fourteen (37.84 %) tumors were larger than 5 cm and one was multicentric. Thirty-two (86.49 %) patients had invasive ductal carcinomas. Nipple areola complex was removed in 19 (51.35 %) cases due to clinical involvement, and immediately reconstructed in two cases with contralateral free grafting. Twenty-one (56.76 %) patients received neoadjuvant chemotherapy. Three (8.11 %) patients had immediate contralateral mastopexy. Radiotherapy was indicated in all cases. There were 3 (8.11 %) minor complications, one positive margin, and no surgical revisions. In a mean follow-up of 39.97 (± 29.43) months, there were no local recurrences, 2 metastasis, and one death. Satisfaction and aesthetic results were good or excellent in most cases.

Conclusions: The new technique enabled breast conservation, with high rates of free margins, high levels of satisfaction, few complications in women with large central tumors on small breasts with limited ptosis.

1. Introduction

A central defect after a quadrantectomy may result in significant volume loss and shape asymmetry, which may affect the patient's quality of life. Several techniques have been proposed to reconstruct the central quadrants, such as mammoplasty or regional flaps for volume replacement, but mastectomy and breast reconstruction remain the most common approach [1–3].

Attempts to incorporate new oncoplastic surgery techniques are important to avoid mastectomies and improve the outcomes of conventional conservative surgeries. Compared to oncoplastic surgery, mastectomy and total breast reconstruction are associated with worse aesthetic results, higher risk of complications, lower satisfaction, lower quality of life and more surgeries required, as well as not showing better oncological results than conservative treatment [4–6].

Some locoregional flaps, like thoracolateral and thoracoepigastric

flaps, more recently called according to their sources of vascularization, as lateral, anterior or medial intercostal perforator vessels (LICAP, AICAP, MICAP) are a good option for volume replacement. The LICAP flaps, in Hamdi's technique, can be transferred as propeller flaps or as a transposition flap, but they may face challenges in repairing large defects in the central region of the breast due to the distance from their vascular source and a restricted rotation arc [7–13].

The facial bilobed flap was first described by Esser in 1918, who referred difficulties in the mobilization of different areas to close a defect with adjacent areas, so he divided the flap into two and rotated them, reducing the possibility of tension, repairing the donor areas in first intention. Later came the modifications from Zimany, and Zitelli applied in the nasal area, suggesting the best ways of rotating the flaps. Multiple authors applied this tissue transposition in different parts of the body with different designs to cover defects [14–16].

In 2008, a Brazilian plastic surgeon, Rodrigo Tostes, suggested the

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use of a random bilobed flap in breast defects of the upper medial quadrants. It was a modified design, part of advancement and part of rotation. According to Tostes, the upper lateral quadrant should be advanced to the tumoral zone and the lateral thoracic region rotated to the upper lateral quadrant [17,18]. Instead, for defects in the medial quadrants, we more frequently use other oncoplastic solutions, such as Burrow's triangles and a thoraco-lateral flap, with VY closure [19,20].

Over the past decade, we have been developing a type of bilobed flap, based on a modification of Zimany's marking, called the Bilobed Lateral Intercostal Artery Perforator (LICAP) flap. This technique is designed to correct large defects in the central breast region, particularly in cases where there is insufficient ptosis to perform a mammoplasty.

The Bilobed LICAP flap is a double transposition flap that utilizes modern concepts of vascularization through intercostal perforators and/or lateral thoracic vessels. This approach allows for the transfer of large tissue volumes while preserving the breast contour, thereby avoiding the need for mastectomy.

We have been developing, in the last two decades, a type of bilobed flap, based on a modification of Zimany's marking [16], called Bilobed Lateral Intercostal Artery Perforator flap (Bilobed LICAP flap), aimed for correcting large defects of the central region, in breasts without enough ptosis to perform a mammoplasty. It is a double transposition flap, which is based on the modern concepts of vascularization through the intercostal perforators and/or the lateral thoracic vessels, which could bring large tissue volumes and preserving the breast contour, thus avoiding mastectomy.

The aim of this article is to describe the Bilobed LICAP technique and report on 37 cases performed over 10 years using this technique by a single surgeon.

2. Patients and methods

From January 2013 to December 2022, we identified in our archives 37 patients submitted to the bilobed LICAP. All patients were operated on by a single surgeon trained in breast oncoplastic surgery.

The surgeries were performed at three different locations: the Federal University of Goiás, the Araujo Jorge Cancer Hospital, and the main author's private clinic. Out of the 37 women who underwent the procedure, 16 (43.2 %) were from the university, 15 (40.5 %) from the cancer hospital, and 6 (16.2 %) from our private clinic. Typically, this new modified bilobed flap technique was suitable for patients who met the following criteria: usually they had large tumors involving the skin or near the skin, in the central or adjacent quadrants, they did not have ptosis or did not want to correct it. The main goal of the technique was to preserve the breast and avoid a noticeable deformity.

The diagnosis and treatment of breast cancer followed the general guidelines. All cases had a pathological diagnosis, and an immunohistochemical panel, and a Fish test for HER2 tumors that were not clearly positive or negative. Before surgery, the patients underwent routine examinations, mammograms, and breast ultrasound. Magnetic resonance imaging (MRI) was not routinely used, but it was performed in some cases, such as young women, patients with a family history of breast cancer, patients with dense breasts, or patients who needed to evaluate the response to neoadjuvant chemotherapy. Neoadjuvant chemotherapy was usually indicated for locally advanced breast carcinomas, HER2 tumors larger than 2 cm, or triple-negative larger than 1 cm, or for trying to reduce the tumour to allow for conservative treatment.

2.1. Preoperative markings and technique description

The preoperative markings are based on the bilobed flap markings described by Zimany and its adaptation for the breast by Tostes [16,18, 21]. To understand how we developed our markings, it will be helpful to review these two different designs (Figs. 1 and 2).

The bilobed LICAP uses two rotational lobes to cover the defect,

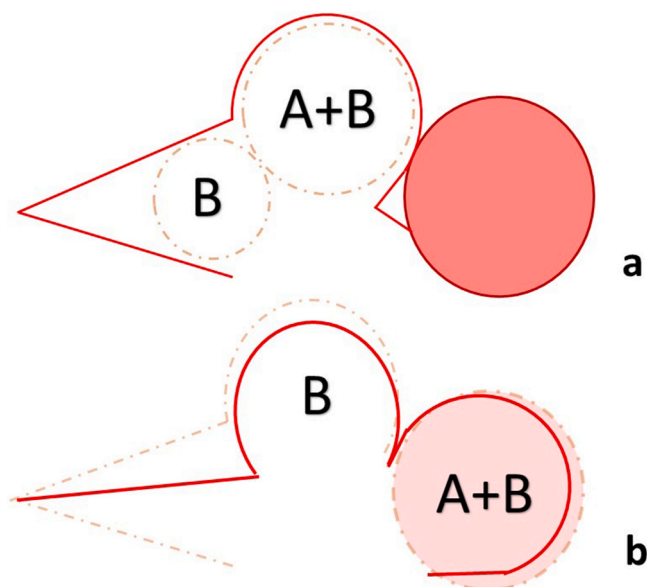


Fig. 1. Fig. 1a shows the original schematic planning of a bilobed flap according to Zimany. The skin resection defect can be compensated by two other lobes, each lobe 25 % smaller to better fit the defect. The rotation arc should not exceed 90° among lobes. Fig. 1b shows the final appearance of the scar in red.

following Zimany's suggestions. To prevent suture tension and ensure proper repair, the surgeon should assess the amount of skin laxity and volume in the lateral thoracic wall. This is the crucial step of marking, as the tumoral defect should not exceed the skin and volume that may be used from this area and from the upper outer quadrant. Instead of reducing the size of the lobes as in the original technique, this method keeps them proportional to the defect ratio, aiming to replace the lost volume (Fig. 3).

The first lobe that is the upper outer quadrant is undermined from the pectoralis muscle. The second lobe, that is a thoracolateral flap, is detached from the latissimus dorsi muscle and the serratus muscle. The lobes are then transposed toward the defect with a rotation arc of no more than 90°.

The intercostal perforator vessels near the inframammary fold should be preserved because of the vascularization. This may be done using an intraoperative portable Doppler or, as is our preference, simply by avoiding detach the lower outer quadrants, where some of these vessels are. A video showing how to perform a bilobed LICAP flap with nipple areola complex preservation is available through the QR code and link in Fig. 4.

The bilobed LICAP flap can be applied when the nipple-areola complex needs to be removed. The nipple-areola complex was removed in 19 (51.35 %) women due to tumoral infiltration or proximity. In 2 (10.53 %) cases, immediate reconstruction of the areola and the nipple was possible with a free graft from the contralateral nipple-areola complex.

To achieve a rounder shape for the breast, some standing cones may require adjustments, particularly on the lower outer quadrant and the tip of the second lobe. The final scar appearance curiously resembles a thumbs-up emoji. The scars on the lateral thoracic wall, the upper outer quadrant and the central quadrant are noticeable, but none of the patients expressed dissatisfaction with how they looked. Radiotherapy also helps to enhance the appearance of the scars. Ultimately, we think that having a scar like this is preferable to have a mastectomy.

Round incisions over the tumor were performed in 36 (97.30 %) cases, and the skin was preserved, and part of the flap de-epithelialized in one (2.70 %) case.

Another source of vascularization, as the Lateral Thoracic Artery Perforator vessels (LTAP) may be preserved, although it is not

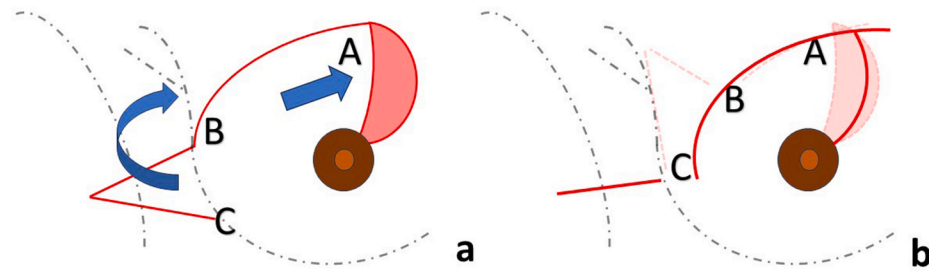


Fig. 2. The bilobed flap technique proposed by Tostes for covering defects especially in the upper medial quadrants of the breast. As shown in Fig. 2a, the upper poles of the breast are advanced to fill the defect, while a thoracolateral flap is rotated to the upper lateral quadrant to restore volume. The thoracolateral flap is partially de-epithelialized to improve contour. Fig. 2b shows the final scar aspect in red.

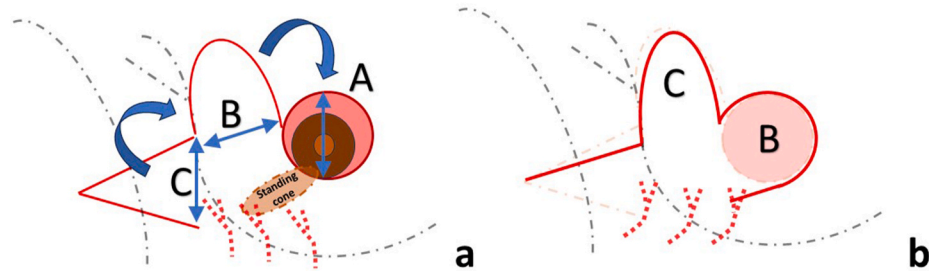


Fig. 3. The bilobed LICAP technique. This technique uses two rotational lobes to cover the defect, similar to Zimany’s method. The lobes are transposed toward the defect with a rotation arc of no more than 90° for optimal adjustment. Some standing cones may need to be corrected at the end to give the breast a rounder shape. The intercostal perforator vessels near the inframammary fold are preserved, either by using Doppler or simply by avoiding detach the lower outer quadrants. Unlike the original technique, the lobes are not reduced in size, but are proportional to the defect ratio, since the aim is to replace volume. Fig. 3b. The final scar appearance in red resembles a thumbs-up emoji.

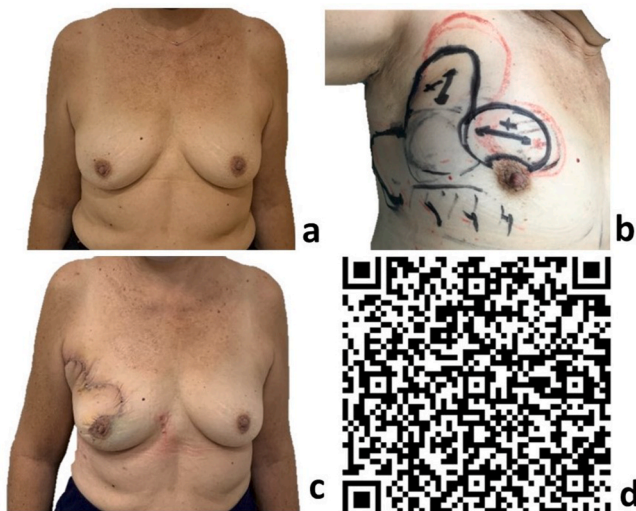


Fig. 4. Preoperative and postoperative views of a partial breast reconstruction using a bilobed LICAP flap in a 60-year-old woman with right breast cancer. (a) Preoperative views showing a small, non-ptotic right breast with a periareolar luminal B/HER invasive ductal carcinoma at 12 o'clock and skin thickening over the tumor. The tumor stage was T4bN0M0 and there was no response to neoadjuvant chemotherapy. (b) Pre-operative markings of the bilobed LICAP, consisting of a round circular defect and two proportional lobes designed to fill the defects. The intercostal perforator vessels zone, which should be preserved during the flap elevation, is highlighted. (c) Postoperative view after one month of a quadrantectomy, sentinel node biopsy and bilobed LICAP reconstruction. The nipple-areola complex was preserved. (d) QR code linking to a demonstrative video with the step by step of performing the bilobed LICAP flap. The video can also be accessed by the following link: <https://pt.oncoplasty.com/?wix-vod-video-id=678ae51046cf497b9f7ed4163728a09b&wix-vod-comp-id=comp-ka78wmxq>.

mandatory. In our series, one (2.70 %) patient had the LTAP also preserved, besides the LICAP.

2.2. Postoperative care

The post-operative care for all patients included the following steps. Wearing compression stockings and receiving anticoagulation and intermittent pneumatic compression to prevent blood clots. Receiving prophylactic cephalothin, an antibiotic, within 24 h to prevent infection. Being discharged the next day after surgery. Having suction drains removed after 24 h if they had a sentinel node biopsy or after 7–10 days if they had an axillary clearance. Using compression bras for at least 40 days to support the healing process.

2.3. Cosmetic evaluation and patient's satisfaction

The cosmetic evaluation of the surgical outcomes was done using two methods: the Harris scale and the BCCT.core software.

The Harris scale, which was applied after 6 months from the surgery or radiotherapy. This scale rated the results as excellent, good, fair, or poor, depending on how similar or different the treated breast was from the untreated breast. The Harris scale score was determined according to the opinion of the main surgeon.

The BCCT.core software program, which provided an objective assessment of the aesthetic results.

Two patients (5.41%) did not come back for a photo session for this evaluation and were excluded from the Harris scale and the BCCT.core analysis.

The degree of breast ptosis (sagging) was measured using the classification of Regnault and Bostwick. This classification assigned a grade from 0 to 3, depending on how high or low the nipple and most of the mammary gland were in relation to the inframammary crease. Grade 1 is when the nipple is at the level of the crease; grade 2 is when the nipple is

below the crease but above the lower outline of the breast; and grade 3 is when the nipple is below the inframammary crease and below the lower outline of the breast [22].

To evaluate the patient-reported outcomes and satisfaction with the surgical results, a Portuguese version of the suitable BREAST-Q questionnaire was administered after 6 months from surgery and radiotherapy. This was done after obtaining permission from the BREAST-Q authors and signing the User Agreement. However, nineteen patients (51.35 %) did not complete the questionnaire due to refusal or follow-up challenges, especially during the COVID-19 pandemic. In these cases, we based our evaluation, on the available photos and the analysis of the notes collected in the patients' records.

2.4. Ethical approval and data analysis

This study has received ethical approval from the Ethics Committees of our institutions (approval number: 2.322.212). It is part of a larger project that compares oncoplastic breast surgery with total breast reconstruction. We have collected data prospectively for patients that returned for follow-up after at least 6 months from surgery and radiotherapy using a specific questionnaire and analyzed it using the SPSS software. For the patients who did not return, evaluation was based on medical record and available photos.

3. Results

The mean age of the patients was 57.17 ± 12.60 years (mean \pm standard deviation). Twenty-seven women (72.97 %) were Caucasian. Three patients (8.11 %) had a first-degree family history of breast cancer. Ten (27.03 %) were hypertensive, six (16.22 %) had diabetes mellitus, two (5.41 %) were current smokers and 6 (16.22 %) ex-smokers. Twelve patients (48.00 %) were overweight and 6 (24.00 %) were obese. The mean body mass index (BMI) of patients was 27.25 ± 4.13 kg/m².

The mean clinical tumour size was 46.22 ± 17.13 mm (range: 20–80 mm) before chemotherapy and 40.67 ± 15.81 mm (range: 13–80 mm) after. There were 14 (37.84 %) tumors larger than 5 cm, and 1 (2.70 %) multicentric tumour. Mean pathological invasive tumour size was 22.63 ± 15.92 mm (range: 0–80 mm). The mean weight of the lumpectomy specimen was $74.32g \pm 25.84g$ (range: 30–150g). Axillary evaluation was performed with sentinel lymph node biopsy in 25 patients (67.57 %) and axillary dissection in 12 (32.43 %).

There were 33 (89.19 %) invasive ductal carcinomas, three (8.11 %) invasive lobular carcinomas, one (2.70 %) mucinous carcinoma and 1 (2.70 %) *in situ* ductal carcinoma. Twenty-two (59.46 %) tumors were grade 2; eight (21.62 %) grade 1 and 7 (18.92 %) grade 3. According to immunohistochemistry, based on the St. Gallen classification, there were 15 (40.54 %) luminal A-like tumors, twelve (32.43 %) luminal B-like tumors, four (10.81 %) luminal B/HER tumors, one HER tumour (2.70 %), and 5 (13.51 %) triple negative tumors [23]. Extensive *in situ* carcinomas were found in 5 (13.51 %) specimens, and angiolymphatic invasion in 5 (13.51 %).

The use of adjuvant chemotherapy, endocrine therapy and trastuzumab were recommended by clinical oncologists, according to their choices and protocols. Twenty-one (56.76 %) patients were submitted to neoadjuvant chemotherapy, of which there were 4 (19.05 %) complete pathological responses. Eleven women underwent adjuvant chemotherapy (29.73 %). All patients received adjuvant radiotherapy. The electron boost dose was given in all cases, targeted to the metallic clips in the tumour bed. Neoadjuvant hormone therapy was performed in 3 (11.11 %) cases, adjuvant hormone therapy in 29 (78.38 %) cases, and one (2.70 %) patient received prophylactic tamoxifen. Anti-HER therapy was performed in 7 (18.92 %) cases.

Thirty-four tumors were in the central quadrant or close to it (91.89 %). There were 2 (5.41 %) large tumors infiltrating multiple quadrants and one (2.70 %) multicentric tumour. The nipple-areola complex was

resected in 19 (51.35 %) cases due to the apparent involvement or due to a possible compromised vascular viability. It was immediately reconstructed in 2 (5.41 %) cases, by means of a free grafting from the contralateral areola, with total graft integration in all cases. Contralateral symmetrization was required, and performed immediately, in 3 (8.11 %) cases with reduction mammoplasty, due to previous asymmetry. The bilobed LICAP allowed a one-stage partial breast reconstruction in 36 (97.30 %) cases. Intraoperative frozen section of the margins was done in 20 (54.05 %) cases, according to the surgeon's judgment, because of margin involvement suspicion, resulting in 5 (13.51 %) immediate re-excisions. There were one (2.70 %) focally positive margin, treated with delayed re-excision. No patient wanted to undergo a second procedure to improve the aesthetic results.

Minor complications occurred in 3 (8.11 %) patients. There was one (2.70 %) case of hyperaemia treated with antibiotics, one (2.70 %) small hematoma with clinical resolution, and one (2.70 %) small area of fat necrosis, leading to retraction and asymmetry in the late follow-up. The only case of fat necrosis occurred in a patient with previous mammoplasty, in which the LICAP vessels must have been damaged in the previous surgery. There were no cases of seroma, dehiscence, skin necrosis, delay in the adjuvant treatment, reoperation for correcting complications, or scar revision. Prior to surgery, based on the Regnault classification [22], twenty (50.05 %) patients did not have ptosis and 13 (35.14 %) had grade 1 ptosis. The rate of ptosis was not affected by surgery.

According to the main surgeon, using the Harris scale [24], aesthetic results were rated as excellent in 17 (48.57 %) cases, good in 16 (45.71 %), and fair in 2 (5.71 %) case. According to the BCCT.core software [25], using photos 6 months after surgery or radiotherapy, results were rated as excellent in 5 (14.29 %), as good in 23 (65.71 %), and as regular in 7 (20.00 %). Two patients have not returned to take photos for the aesthetic evaluation after surgery. The bilobed LICAP flap has a robust blood supply and does not involve undermining the breast tissue from the skin or the muscle, which usually leads to a relative satisfactory long-term tolerance of radiotherapy. (Fig. 5 and Table 1).

Eighteen (48.65 %) patients answered the BREAST-Q questionnaire. The BREAST-Q scores were: 75.33 ± 17.82 for the satisfaction with breasts; 91.59 ± 11.71 for the satisfaction with outcomes; 79.18 ± 17.09 for the psychosocial well-being; 73.69 ± 24.91 for the sexual well-being; 70.12 ± 15.62 for the physical well-being; 83.60 ± 15.78 for the satisfaction with information; 91.81 ± 6.74 for the satisfaction with the surgeon; 97.69 ± 6.39 for the satisfaction with the medical team; 96.25 ± 15.00 for the satisfaction with office staff. So far, there were no local

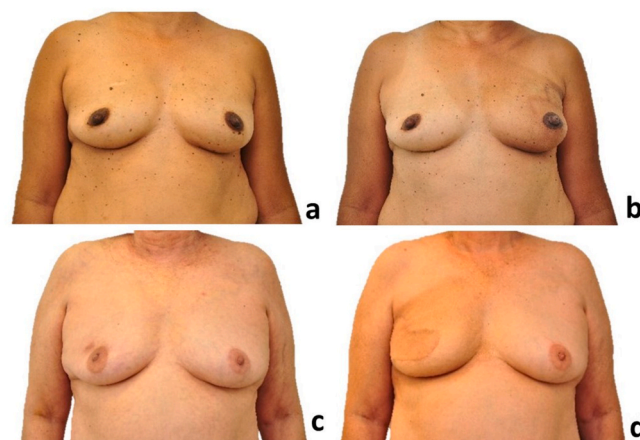


Fig. 5. Typical appearance before (left) and after (right) surgery at two years. The bilobed LICAP flap usually has a low risk of shrinkage over time after radiotherapy, because of its robust blood supply and because it does not involve undermining the breast tissue from the muscle and from the skin. The scars may fade over time with the aid of radiotherapy.

Table 1
Clinical characteristics and long-term results of patients from Fig. 5.

Fig. 5	(a) (b)	(c) (d)
Age (years-old)	45	60
Clinical tumour size	3.5 cm	7.0 cm
Clinical stage	T2N0M0	T4bN2M0
Subtype	Luminal A, invasive ductal carcinoma	Luminal B, invasive ductal carcinoma
Neoadjuvant chemotherapy	Without response	Partial clinical response (4.0 cm after)
Specimen weight (g)	94	92
Satisfaction with the breasts	81	100
Satisfaction with the results	100	100
Harris scale	Excellent	Good
BCCT.core software	Good	Good

recurrences in the breast and axilla. Two (5.41 %) patients developed metastasis to the bones and lungs, respectively. There was one (2,70 %) death caused by breast cancer, after a mean follow-up time of 35.49 ± 28.91 months.

4. Discussion

The bilobed flap is a double transposition flap technique designed to covers cutaneous defects. Esser introduced it for facial defects in 1918, and Zimany and Zitelli later modified it for other body areas [14,21,26]. Tostes adapted it for breast reconstruction in the upper medial quadrants in 2008 [17].

We described in this article a new modification, called LICAP bilobed flap, for central or nearby breast defects, with or without areola-nipple complex preservation. We also report the outcomes of 37 patients who received this flap in 10 years. This was not a frequent technique in our practice. According to a previous publication, the bilobed LICAP technique accounted for approximately 4 % of breast reconstructions in our Breast Units [4]. This flap was used for very precise indications of large central defects, especially in small breasts without ptosis, in which a mastectomy or a partial reconstruction with a latissimus dorsi muscle flap would be the most common option for most surgeons.

All patients had an unfavorable tumor-to-breast ratio and could be considered as extreme oncoplasty cases. Typically, the patients presented with small breasts, no ptosis or minimal ptosis, and large T2, T3 or T4 tumors in a region unfavorable for conservation, near the central area of the breast. We consider the original definition of extreme oncoplasty by Dr Silverstein – breast conservation in cases that would typically require a mastectomy – as subjective. What may be suitable for conservative treatment for a surgeon could be an indication for mastectomy for another. We would prefer to define extreme oncoplasty as breast-conserving surgery for tumors over 5 cm or multicentric tumors, which accounts for nearly half of our cases.

This flap had several advantages. It used intercostal perforators and/or lateral thoracic vessels for vascularization [27,28]. We believe that knowing and preserving well-defined vascularization sources for locoregional flaps, as the LICAP, may increase safety, feasibility, and may lead to complication rates reduction, as show in our results [9]. The flap mobilized enough tissue to correct large central defects. It had low complication and reoperation rates [29]. This flap was able to prevent cosmetic sequelae of conservative treatment, prevented mastectomies and total breast reconstructions, as well as reduced the need to use the latissimus dorsi muscle in these large defects in the central region of the breast [4,30].

Unfortunately, not all patients returned or agreed to complete the Breast Q questionnaire. We only included postoperative evaluations conducted at least six months after radiotherapy. This represents a limitation of our study, regarding patient's satisfaction.

This flap left a long scar in the upper breast and lateral thorax. Still,

we believe that this scar is better than mastectomy with other reconstructive methods [4,5]. This flap also preserved the breast's shape, contour, and ptosis, similar to before surgery. This maintained breast symmetry without contralateral adjustments in most cases. This kind of volume replacement flap is important when symmetry is hard to achieve, or when altering a healthy breast is not acceptable to the patient.

The LICAP bilobed flap is a good alternative for breast-conserving surgery in large central tumors, especially in small breasts without ptosis, where reduction mammoplasty is usually not possible. The high rates of clear margins, good or excellent symmetry, and few complications showed the value of this flap for oncoplastic surgery in breast cancer treatment, especially in challenging cases that would otherwise need mastectomy.

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The authors declare no conflict of interest in relation to the writing of this article.

CRediT authorship contribution statement

Regis R. Paulinelli: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Ana F.F. Goulart:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Horacio Mendoza Santos:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Barbara A. Barbosa:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Formal analysis, Data curation, Conceptualization. **Ana-Luisa F. Silva:** Writing – review & editing, Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Luiz-Fernando J. Ribeiro:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Formal analysis, Data curation, Conceptualization. **Ruffo Freitas-Junior:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.suronc.2024.102161>.

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