

OUTCOMES AND AESTHETIC EVALUATION OF MODIFIED LATERAL INTERCOSTAL ARTERY PERFORATOR FLAP IN IMMEDIATE PARTIAL BREAST RECONSTRUCTION FOR BREAST CANCER

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Abstract

Background: Breast cancer remains a major health concern globally, and breast reconstruction plays a crucial role in the postoperative care of patients. The Modified Lateral Intercostal Artery Perforator (LICAP) flap offers a promising approach for immediate partial breast reconstruction. This study evaluates the clinical outcomes, aesthetic results, and complications associated with the Modified LICAP flap in breast cancer patients. **Materials and Methods:** A total of 54 female breast cancer patients who underwent immediate partial breast reconstruction using the Modified LICAP flap were included in this study. Data were collected retrospectively, focusing on patient demographics, tumor characteristics, operative parameters, complications, and aesthetic outcomes. Patient satisfaction and quality of life were also assessed using relevant scales. Statistical analysis was performed to identify correlations between various factors and postoperative outcomes. **Result:** The mean age of the patients was 49.5 ± 8.3 years, with a mean BMI of 26.2 ± 3.5 kg/m². Invasive ductal carcinoma (77.8%) was the most common histological subtype. The mean operative time was 94.2 ± 15.7 minutes, with 92.6% of patients achieving clear surgical margins. Flap perfusion was satisfactory in 85.2% of cases. Postoperative complications included seroma formation (11.1%), fat necrosis (13.0%), and donor site morbidity (14.8%). The mean Harris Scale score was 8.3 ± 1.2 , and 46.3% of patients rated their symmetry as excellent. Patients who experienced complications had longer operative times ($p=0.031$) and greater tumor excision volumes ($p=0.044$). Neoadjuvant chemotherapy was significantly associated with complications ($p=0.010$). **Conclusion:** The Modified LICAP flap is a feasible and effective technique for immediate partial breast reconstruction in breast cancer patients, offering good aesthetic results and low rates of major complications. However, factors such as operative time, tumor excision volume, and neoadjuvant chemotherapy may impact postoperative outcomes. Larger, multicenter studies with longer follow-up are needed to validate these findings and further optimize the technique.

INTRODUCTION

Breast cancer is the most common malignancy among women worldwide, with India witnessing an increasing incidence, accounting for nearly 14% of all cancers in women.^[1] With advances in early detection and treatment, breast-conserving surgery (BCS) has emerged as a preferred surgical approach,

offering oncological outcomes comparable to mastectomy while preserving breast aesthetics. However, a significant proportion of patients undergoing BCS experience volume deficits, contour deformities, and breast asymmetry, particularly in cases where large tumor excisions or central/lateral quadrant resections are involved.^[2] Oncoplastic techniques, particularly immediate partial breast

reconstruction (IPBR), play a crucial role in addressing these deformities by reshaping the breast and ensuring optimal cosmetic outcomes without compromising oncological safety.^[3]

Among the various reconstructive options, perforator-based flaps, such as the lateral intercostal artery perforator (LICAP) flap, have gained prominence due to their ability to provide well-vascularized tissue without sacrificing underlying muscle. The LICAP flap, first introduced as a modification of the thoracodorsal artery perforator (TDAP) flap, utilizes the lateral intercostal artery perforators to mobilize soft tissue from the lateral thoracic region, making it particularly suitable for lateral and lower breast defects.^[4,5] It has been demonstrated that LICAP flaps significantly improve aesthetic outcomes with minimal donor-site morbidity, shorter hospital stays, and better patient satisfaction compared to traditional musculocutaneous flaps.^[5] However, certain limitations, such as restricted flap mobility, unpredictable perfusion in some cases, and challenges in contour restoration, have been noted in conventional LICAP techniques.

To address these challenges, the modified LICAP flap technique has been introduced, incorporating refinements in pedicle dissection, flap positioning, and vascular optimization to enhance its reliability and aesthetic outcomes. This modification allows for improved flap reach, better contour restoration, and reduced incidence of fat necrosis, which has been reported in up to 15% of traditional LICAP flaps.^[6] Additionally, studies have shown that the modified LICAP flap provides complication rates as low as 5–10%, significantly lower than musculocutaneous alternatives, which may have donor-site morbidities of up to 30%.^[7] Despite these advantages, data on the effectiveness of the modified LICAP flap in Indian patients remain limited. Given the differences in breast size, tumor characteristics, and patient preferences in Indian populations compared to Western cohorts, further evaluation is essential.^[8,9]

This study aimed to assess the surgical feasibility, aesthetic outcomes, and complication rates of the modified LICAP flap in immediate partial breast reconstruction following BCS for breast cancer. By analyzing functional and cosmetic outcomes, this study seeks to provide valuable insights into optimizing oncoplastic strategies for improved breast conservation outcomes in Indian patients.

MATERIALS AND METHODS

Study Design and Setting: This retrospective observational study was conducted at a tertiary care center in Tertiary care center of North India, and included female patients diagnosed with early-stage or locally advanced breast cancer from March 2016 to February 2021. The study was approved by the Institutional Ethics Committee, and all patients included had provided informed consent for surgical procedures and data collection.

Study Population: The study included female patients diagnosed with early-stage or locally advanced breast cancer who underwent breast-conserving surgery (BCS) with immediate partial breast reconstruction using the modified lateral intercostal artery perforator (LICAP) flap. Patients were eligible if they were aged 18 years or older, had histologically confirmed breast carcinoma, and required oncoplastic reconstruction due to significant volume loss following tumor excision. Only patients with tumors located in the lateral, lower, or central quadrants of the breast were considered, as these regions are most amenable to LICAP flap reconstruction. Patients with distant metastases at the time of surgery, a prior history of ipsilateral breast radiation or breast surgeries that could interfere with reconstruction, or uncontrolled comorbidities contraindicating surgical intervention were excluded. Additionally, cases requiring total mastectomy or alternative reconstructive techniques were not considered for this study. So, a total of 54 patients were found eligible and included in the study.

Surgical Technique: All patients underwent preoperative Doppler ultrasonography to map the lateral intercostal artery perforators and assess their suitability for flap harvesting. The surgical procedure began with standard breast-conserving surgery, ensuring complete oncological resection with negative margins. Following tumor excision, the modified LICAP flap was designed based on the identified perforators. The flap was harvested from the lateral thoracic region, incorporating modifications such as precise pedicle dissection, an optimized arc of rotation, and an improved flap inset technique to enhance vascular reliability and ensure optimal contour restoration. Care was taken to preserve the underlying latissimus dorsi muscle while maintaining sufficient soft tissue volume to prevent postoperative contour irregularities. The flap was then transposed into the defect and meticulously sutured to achieve symmetry with the contralateral breast. Intraoperative flap perfusion was assessed visually and, in cases where necessary, confirmed using indocyanine green fluorescence angiography. Drains were placed as required, and layered closure was performed to minimize donor-site morbidity.

Data Collection: Patient demographics, clinical parameters, and surgical details were collected retrospectively from hospital medical records and operative reports. The collected data included age, body mass index (BMI), comorbidities such as diabetes and hypertension, and tumor-specific characteristics, including tumor size, histological subtype, receptor status, and lymph node involvement. Surgical parameters such as the volume of resected breast tissue, flap dimensions, operative time, and intraoperative complications were documented. Postoperative data included flap viability, incidence of wound complications such as seroma, hematoma, and infection, as well as specific complications related to the flap, including fat necrosis and partial or total flap loss. Additionally,

the need for revision surgeries and adjuvant therapies such as radiation and chemotherapy was recorded.

Outcome Assessment: Aesthetic outcomes were evaluated using a combination of objective and subjective measures. Standardized preoperative and postoperative photographs were assessed by a panel of three independent plastic surgeons using the Harris scale, a validated tool for aesthetic assessment following oncoplastic breast surgery.^[10] Additionally, patient-reported satisfaction was measured using a structured questionnaire at six months postoperatively, with responses graded on a five-point Likert scale. Surgical complications were categorized according to the Clavien-Dindo classification, with major complications defined as those requiring surgical intervention or prolonged hospitalization.^[11]

Statistical Analysis: All data were analyzed using SPSS version 20.0. Descriptive statistics were used to summarize patient characteristics and surgical outcomes, with categorical variables presented as frequencies and percentages and continuous variables expressed as mean \pm standard deviation (SD). Comparisons between groups were performed using the chi-square test for categorical variables, while independent t-tests was applied for continuous

variables depending on data distribution. A p-value of <0.05 was considered statistically significant for all analyses.

RESULTS

The mean age of the study population was 49.5 ± 8.3 years, with a mean BMI of 26.2 ± 3.5 kg/m². The majority were postmenopausal (59.3%). Hypertension (33.3%) and diabetes mellitus (22.2%) were the most common comorbidities. The mean tumor size was 3.1 ± 1.2 cm, with the upper outer quadrant being the most frequent tumor location (51.9%). Invasive ductal carcinoma was the predominant histological subtype (77.8%), with Grade 2 tumors being most common (57.4%). Hormone receptor positivity (ER+/PR+) was observed in 64.8%, while 20.3% were HER2-positive and 14.8% were triple-negative. Lymph node involvement was seen in 35.2%, and the mean Ki-67 proliferation index was 23.4 ± 10.5 . Neoadjuvant chemotherapy and hormonal therapy were received by 31.5% and 16.7% of patients, respectively [Table 1].

Table 1: Baseline Characteristics of the Study Population.

Variable	Frequency (%) / Mean \pm SD
Age (years)	49.5 ± 8.3
BMI (kg/m ²)	26.2 ± 3.5
Menopausal Status	
Premenopausal	22 (40.7%)
Postmenopausal	32 (59.3%)
Comorbidities	
Hypertension	18 (33.3%)
Diabetes Mellitus	12 (22.2%)
Hypothyroidism	9 (16.7%)
Cardiovascular Disease	6 (11.1%)
Chronic Kidney Disease	2 (3.7%)
Tumor Size (cm)	3.1 ± 1.2
Tumor Location	
Upper Outer Quadrant	28 (51.9%)
Lower Outer Quadrant	15 (27.8%)
Central Quadrant	11 (20.3%)
Histological Subtype	
Invasive Ductal Carcinoma	42 (77.8%)
Invasive Lobular Carcinoma	8 (14.8%)
Other (Mucinous, Medullary)	4 (7.4%)
Tumor Grade	
Grade 1	11 (20.4%)
Grade 2	31 (57.4%)
Grade 3	12 (22.2%)
Hormone Receptor Status	
ER+ / PR+	35 (64.8%)
HER2+	11 (20.3%)
Triple Negative	8 (14.8%)
Lymph Node Involvement	19 (35.2%)
Ki-67 Proliferation Index (%)	23.4 ± 10.5
Neoadjuvant Therapy	
Chemotherapy	17 (31.5%)
Hormonal Therapy	9 (16.7%)

The mean operative time was 94.2 ± 15.7 minutes, with a mean tumor excision volume of 45.6 ± 12.3 cc. Clear surgical margins were achieved in 92.6% of cases, while 5.6% had close margins and 1.9% had

positive margins. The mean flap dimensions were 7.2 ± 1.5 cm², with a rotation angle of 45.6 ± 10.2 degrees. Clinically satisfactory flap perfusion was observed in 85.2%, while 14.8% required

confirmation with ICG angiography. Intraoperative complications were minimal, with vascular compromise in 3.7%, excessive bleeding in 5.6%,

and additional revision needed in 7.4%. Drain placement was required in 83.3% of cases, with a mean retention duration of 5.3 ± 1.4 days [Table 2].

Table 2: Surgical and Intraoperative Parameters.

Parameter	Frequency (%) / Mean \pm SD
Operative Time (minutes)	94.2 ± 15.7
Tumor Excision Volume (cc)	45.6 ± 12.3
Margin Status	
Clear Margins	50 (92.6%)
Close Margins	3 (5.6%)
Positive Margins	1 (1.9%)
Flap Dimensions (cm ²)	7.2 ± 1.5
Flap Rotation Angle (degrees)	45.6 ± 10.2
Flap Perfusion Assessment	
Satisfactory (Clinically)	46 (85.2%)
Confirmed with ICG Angiography	8 (14.8%)
Intraoperative Complications	
Vascular Compromise	2 (3.7%)
Excessive Bleeding (>500ml)	3 (5.6%)
Need for Additional Revision	4 (7.4%)
Drain Placement	45 (83.3%)
Duration of Drain Retention (days)	5.3 ± 1.4

Postoperative complications were observed in a subset of patients, with seroma formation in 11.1%, fat necrosis in 13.0%, and donor site morbidity, including pain and scarring, in 14.8%. Surgical site infection occurred in 9.3%, while wound dehiscence was noted in 5.6%. Partial flap loss was seen in 3.7%,

but no cases of total flap loss were reported. Hematoma and vascular compromise each occurred in 3.7% of patients, and 7.4% required revision surgery. The mean time to complete wound healing was 14.6 ± 4.1 days, and the average hospital stay was 3.2 ± 1.1 days [Table 3].

Table 3: Postoperative Complications and Flap-Related Outcomes.

Complication	Frequency (%)
Seroma Formation	6 (11.1%)
Hematoma	2 (3.7%)
Surgical Site Infection	5 (9.3%)
Fat Necrosis	7 (13.0%)
Partial Flap Loss	2 (3.7%)
Total Flap Loss	0 (0.0%)
Wound Dehiscence	3 (5.6%)
Donor Site Morbidity (Pain, Scar)	8 (14.8%)
Need for Revision Surgery	4 (7.4%)
Time to Complete Wound Healing (days)	14.6 ± 4.1
Hospital Stay (days)	3.2 ± 1.1

The mean Harris Scale Score for surgeon-assessed outcomes was 8.3 ± 1.2 . Symmetry was rated as excellent in 46.3% of cases, good in 37.0%, fair in 11.1%, and poor in 5.6%. Patient satisfaction, measured on a Likert scale, had a mean score of 4.2 ± 0.8 . Regarding scar satisfaction, 64.8% rated it as

good, 25.9% as fair, and 9.3% as poor. The mean psychological well-being score on the Body Image Scale was 7.9 ± 1.3 . Impact on daily activities was reported by 16.7% of patients, indicating functional and cosmetic considerations post-reconstruction [Table 4].

Table 4: Aesthetic and Patient Satisfaction Outcomes.

Outcome Assessment	Frequency (%) / Mean \pm SD
Harris Scale Score (Surgeon-assessed)	8.3 ± 1.2
Symmetry Rating	
Excellent	25 (46.3%)
Good	20 (37.0%)
Fair	6 (11.1%)
Poor	3 (5.6%)
Patient Satisfaction (Likert Scale)	4.2 ± 0.8
Patient-Reported Scar Satisfaction	
Good	35 (64.8%)
Fair	14 (25.9%)
Poor	5 (9.3%)
Psychological Well-being Score (Body Image Scale)	7.9 ± 1.3
Impact on Daily Activities	9 (16.7%)

Patients who experienced complications had a significantly longer operative time (102.6 ± 17.1 vs. 92.3 ± 14.8 minutes, $p=0.031$) and a greater resected tumor volume (50.3 ± 13.7 vs. 44.8 ± 11.2 cc, $p=0.044$) compared to those without complications. Higher BMI was also associated with complications (27.9 ± 4.1 vs. 25.8 ± 3.2 kg/m², $p=0.022$). While diabetes mellitus (33.3% vs. 19.0%, $p=0.189$) and

smoking history (25.0% vs. 9.5%, $p=0.108$) were more common in the complication group, the differences were not statistically significant. However, neoadjuvant chemotherapy was significantly associated with complications (58.3% vs. 23.8%, $p=0.010$), suggesting its potential impact on surgical outcomes [Table 5].

Table 5: Association Between Surgical Variables and Postoperative Complications.

Variable	No Complications (n=42)	Complications (n=12)	p-value
Operative Time (minutes)	92.3 ± 14.8	102.6 ± 17.1	0.031
Resected Tumor Volume (cc)	44.8 ± 11.2	50.3 ± 13.7	0.044
Flap Size (cm ²)	7.1 ± 1.4	7.6 ± 1.7	0.091
BMI (kg/m ²)	25.8 ± 3.2	27.9 ± 4.1	0.022
Diabetes Mellitus	8 (19.0%)	4 (33.3%)	0.189
Smoking History	4 (9.5%)	3 (25.0%)	0.108
Neoadjuvant Chemotherapy	10 (23.8%)	7 (58.3%)	0.010

DISCUSSION

The study aimed to evaluate the surgical and aesthetic outcomes of breast reconstruction using the Modified Lateral Intercoastal Artery Perforator (LICAP) flap in breast cancer patients, as well as to investigate factors influencing postoperative complications. The findings from the baseline characteristics of the study population reveal that the average age of participants was 49.5 ± 8.3 years, with a mean BMI of 26.2 ± 3.5 kg/m². The majority of the patients were postmenopausal (59.3%), aligning with previous studies by Surakasula et al., and Heer et al., that indicate a higher prevalence of breast cancer in postmenopausal women.^[12,13] Hypertension and diabetes mellitus were the most common comorbidities, affecting 33.3% and 22.2% of participants, respectively, consistent with the findings of Woelfel et al., who also reported a high burden of comorbidities in breast cancer patients.^[14] Tumor characteristics revealed that the mean tumor size was 3.1 ± 1.2 cm, with the upper outer quadrant being the most frequent tumor location (51.9%), a finding congruent with previous studies by Rummel et al., and Aljarrah et al., showing that this location is commonly affected by breast cancer.^[15,16] In terms of histology, invasive ductal carcinoma (IDC) was the predominant subtype (77.8%), aligning with global data that report IDC as the most frequent histological type.^[17] Hormone receptor positivity (ER+/PR+) was observed in 64.8%, while 20.3% were HER2-positive, and 14.8% were triple-negative, which is consistent with the distribution of molecular subtypes in breast cancer populations.^[18] Lymph node involvement was noted in 35.2%, which is in line with data from studies by Chakraborty et al., and Zhang et al., that report variable rates of lymph node involvement, ranging from 20% to 40%.^[19,20] The mean Ki-67 proliferation index was $23.4 \pm 10.5\%$, highlighting the aggressive nature of the tumors in this cohort, as elevated Ki-67 levels are associated with poor prognosis.^[21]

In our study, the mean operative time was 94.2 ± 15.7 minutes, which is comparable to other study Yee et al., evaluating similar flaps.^[22] Clear surgical margins were achieved in 92.6% of cases, with only 1.9% of patients having positive margins, which is consistent with optimal surgical outcomes typically expected with well-executed breast reconstruction surgeries.^[23] The flap dimensions and rotation angles were also in line with established standards for LICAP flap reconstructions, with minimal intraoperative complications reported. However, 14.8% of patients required confirmation of flap perfusion with ICG angiography, which is becoming increasingly important in ensuring optimal flap viability.^[24]

Postoperative complications included seroma formation (11.1%), fat necrosis (13.0%), donor site morbidity (14.8%), and surgical site infections (9.3%). These rates are consistent with the study by Kim et al., based on flap-based breast reconstruction.^[25] While these complications are common in breast reconstruction procedures, they were largely manageable. The mean time to complete wound healing was 14.6 ± 4.1 days, and the average hospital stay was 3.2 ± 1.1 days, which is relatively short compared to other surgical options for breast cancer reconstruction.^[26]

In terms of aesthetic outcomes, the Harris scale score for surgeon-assessed outcomes averaged 8.3 ± 1.2 , with 46.3% of patients rating their symmetry as excellent. These results are in agreement with study by Korayem et al., reporting high satisfaction rates for LICAP flap reconstructions.^[27] Patient satisfaction, measured on a Likert scale, had a mean score of 4.2 ± 0.8 , indicating overall positive feedback. Scar satisfaction was also generally favorable, with 64.8% of patients rating it as good. Psychological well-being, measured on the Body Image Scale, averaged 7.9 ± 1.3 , which is comparable to study by Rosenkranz et al., that have found positive psychological outcomes following breast reconstruction.^[28] However, 16.7% of patients reported an impact on daily activities, suggesting that there may still be some functional limitations post-

reconstruction, as previously reported by Pačarić et al.^[29]

The study also explored factors influencing complications. Patients with complications had significantly longer operative times and greater resected tumor volumes compared to those without complications. A higher BMI was associated with complications, which is consistent with study by Roy et al., showing that obesity increases the risk of surgical complications.^[30] Neoadjuvant chemotherapy was significantly associated with complications, likely due to the effects of chemotherapy on tissue healing and vascularity.^[30,31]

Limitations

This study has several limitations. First, it is a single-center, retrospective analysis with a relatively small sample size, limiting the generalizability of the findings. Second, the short follow-up period of postoperative outcomes may not capture long-term complications or aesthetic results. Third, patient-reported outcomes such as psychological well-being and satisfaction may be influenced by subjective bias. Lastly, the lack of comparison with other breast reconstruction techniques limits the ability to draw definitive conclusions regarding the superiority of the Modified LICAP flap.

CONCLUSION

In conclusion, the Modified LICAP flap in immediate breast reconstruction for breast cancer patients demonstrates favorable surgical, aesthetic, and psychological outcomes. While complications such as seroma formation and fat necrosis were noted, they were within the expected range for this type of surgery. Factors such as operative time, tumor volume, BMI, and neoadjuvant chemotherapy were found to influence the likelihood of complications. These findings support the use of LICAP flaps in appropriate patients, although careful consideration of patient characteristics, particularly BMI and prior chemotherapy, may be important in optimizing outcomes. Further studies with larger sample sizes and longer follow-up periods are needed to confirm these results and explore the long-term impact on quality of life.

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