ORIGINAL ARTICLE

European Journal of BREAST HEALTH

DOI: 10.4274/ejbh.galenos.2026.2025-12-7
Eur J Breast Health 2026;22(3):294-306

Outcomes of Chest Wall Perforator Flaps for Partial Breast Reconstruction: A Single-Center, Single-Surgeon Experience

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ABSTRACT

Objective: Achieving clear margins in breast-conserving surgery (BCS) can result in significant tissue loss, particularly in women with small breast volumes or large tumours. Oncoplastic BCS aims to ensure an oncologically safe resection with superior cosmetic outcomes. Chest wall perforator flaps (CWPFs) offer a muscle-sparing, volume-replacement option in BCS. This study reports a single-centre, single-surgeon experience using CWPFs for partial breast reconstruction.

Materials and Methods: A retrospective cohort study was conducted, including all women who underwent wide local excision followed by reconstruction with a CWPF between 2023 and 2025. Demographic, tumour, treatment, and outcome variables were collected from electronic records.

Results: Fifty-five patients (median age 52) underwent CWPF reconstruction, most commonly with lateral intercostal artery perforator flaps (n = 48, 87.3%). Two (n = 2, 3.6%) patients had wound breakdown postoperatively, requiring return to theatre for re-suturing. Our margin re-excision rate was 9.1% (n = 5), and 3.6% of patients (n = 2) required completion mastectomy because final histology identified more extensive disease than preoperative imaging had indicated. No partial or complete flap losses were observed. Two patients (n = 2, 3.6%) required secondary lipofilling sessions for aesthetic purposes.

Conclusion: CWPFs are a reliable, safe, and aesthetically favourable option for partial breast reconstruction, particularly in women with small to moderate breast volumes and minimal ptosis. Rates of complications, flap loss, and re-excision were low and comparable to those reported in the existing literature. Further prospective multi-centre studies that include patient-reported outcomes are warranted to assess long-term satisfaction.

Keywords: Breast reconstruction; breast conserving surgery; oncoplastic breast surgery; chest wall perforator flaps

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Received: 24.12.2025 **Accepted:** 08.03.2026 **Available Online Date:** 17.06.2026
Cite this article as: Burhamah W, Shah U, Sharma K, Xiangmei C, Javeria I. Outcomes of chest wall perforator flaps for partial breast reconstruction: a single-center, single-surgeon experience. Eur J Breast Health. 2026;22(3):294-306

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KEY POINTS

- Chest wall perforator flaps (CWPFs) are an oncologically safe and an aesthetically favourable option for partial breast reconstruction.
- In women with small-to-moderate breast volumes and minimal ptosis, we report low complication rates.
- Most complications are managed non-operatively.
- The use of CWPF can avoid symmetrizing surgery.

Introduction

Achieving oncologically safe margins in breast cancer surgery often necessitates the removal of a considerable volume of breast tissue, which can lead to postoperative deformities, particularly in women with small breasts or large tumours. Breast-conserving surgery (BCS) has become the standard approach for early-stage breast cancer, aiming to maintain breast aesthetics while ensuring comparable oncological safety to mastectomy, especially when combined with adjuvant radiotherapy (1-3).

The advent of oncoplastic BCS (OPBCS) has expanded the potential for breast preservation following wide local excision. By integrating plastic surgical principles, OPBCS allows for improved cosmetic outcomes without compromising oncological safety (3-10). These procedures can be broadly categorized into volume displacement techniques, such as therapeutic mammoplasty, and volume replacement techniques utilizing local or regional autologous tissue flaps (6).

In patients with small breast volumes, excision of more than 20% of breast tissue often results in unsatisfactory cosmetic outcomes, making volume displacement techniques less suitable. In such cases, volume replacement approaches offer distinct advantages by restoring the breast's contour and volume while minimizing the need for contralateral symmetrizing procedures (10, 11). One effective strategy involves the use of chest wall perforator flaps (CWPFs). Their use is secondary to advances in understanding of the chest wall vascular anatomy; this has facilitated the development of several muscle-sparing reconstructive options based on perforator vessels. First described by Hamdi et al. (12), CWPFs are fascio-adipo-cutaneous pedicled flaps that preserve muscle integrity while providing reliable tissue coverage. Variants of CWPFs now include the thoracodorsal artery perforator (TDAP), lateral intercostal artery perforator (LICAP), lateral thoracic artery perforator (LTAP), anterior intercostal artery perforator (AICAP), and medial intercostal artery perforator (MICAP) flaps (9, 12, 13).

This is a single-centre, single-surgeon experience which aims to report outcomes of CWPFs in partial breast reconstruction, contributing to the current literature by extending our understanding of the utility, safety, and efficacy of CWPFs in breast-conserving surgery.

Materials and Methods

Study Design, Participants and Data Collection

This single-centre, retrospective cohort study included all women who underwent surgery for breast cancer, involving a wide local excision followed by breast reconstruction using a CWPF, performed by a single surgeon between 2023 and 2025. Patient details were retrieved from the hospital electronic patient record system, and relevant clinical data were extracted from clinic letters, operation notes, radiology and histology reports, and multidisciplinary team outcomes. This study is exempt from ethical approval due to the observational retrospective nature of the study design.

The study is registered with the hospital's Clinical Effectiveness Team (ID 3392).

The collected variables included patient demographics [age, smoking status, medical comorbidities, body mass index (BMI), bra size, cup size, presence or absence of ptosis], tumour factors [laterality, location, focality, histology, radiological dimensions, estrogen receptor (ER), progesterone receptor (PR), and human epidermal growth factor receptor 2 (HER2) status], treatment factors (type of flap, neoadjuvant and/or adjuvant treatment, lymph node procedures, gross tumour size, use of intra-operative drains), and, finally, outcome measures (complications, return to theatre, completion mastectomy rates, need for margin re-excision, and recurrence). Patients were followed up in a consultant-led clinic after the procedure; furthermore, our oncological surveillance is in line with the current follow-up policy set by the UK National Health Service. Patients receive annual bilateral mammograms for at least the first five years, followed by reversion to the 3-yearly National Health Screening programme for women aged 50–70.

Surgical Technique

All operations were performed by a single oncoplastic breast consultant surgeon. Chest wall perforator vessels were identified using a handheld Doppler device preoperatively. Cases were either performed as a single-stage procedure following wide local excision (Table 1) or performed following a previous wide local excision (WLE) necessitating further margin re-excision and reconstruction with CWPF (Table

Table 1. Summarizes baseline demographics and clinical characteristics by flap type. Continuous variables are summarised as median (IQR), and categorical variables are summarised as n (%)

Variable	Group	Total (*n* = 55)	LICAP (*n* = 48)	AICAP (*n* = 2)	MICAP (*n* = 3)	LTAP (*n* = 2)	*p*-value
Presentation	Symptomatic	29 (52.7%)	25 (52.1%)	1 (50.0%)	1 (33.3%)	2 (100.0%)	0.939
	Screening	26 (47.3%)	23 (10.4%)	1 (50.0%)	2 (66.7%)	0 (0.0%)	0.939
Age [median (IQR)]		52.0 (45.5, 58.0)	52.0 (45.0, 58.0)	59.5 (55.8, 63.2)	57.0 (52.0, 59.5)	43.5 (41.2, 45.8)	0.317
BMI kg/m^2 [median (IQR)]		27.2 (24.6, 32.2)	28.0 (24.5, 32.5)	29.7 (27.4, 32.0)	26.6 (24.9, 29.1)	25.0 (24.9, 25.1)	0.722
Comorbidities	Yes	21 (38.2%)	19 (39.6%)	2 (100.0%)	0 (0.0%)	0 (0.0%)	0.095
	No	34 (61.8%)	29 (60.4%)	0 (0.0%)	3 (100.0%)	2 (100.0%)	
Smoking	Yes	6 (10.9 %)	6 (12.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0
	No	49 (89.1 %)	42 (87.5%)	2 (100.0%)	3 (100.0%)	2 (100.0%)	
Bra size [median (IQR)]		36.0 (34.0, 38.0)	36.0 (34.0, 38.0)	37.0 (36.5, 37.5)	34.0 (34.0, 35.0)	34.0 (34.0, 34.0)	0.302
Cup size	A	2 (3.6%)	2 (4.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0.954
	B	12 (21.8%)	9 (18.8%)	1 (50.0%)	2 (66.7%)	0 (0.0%)	
	C	17 (30.9%)	17 (31.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
	D	17 (31%)	14 (33.2%)	1 (50.0%)	0 (0.0%)	2 (100.0%)	
	DD	4 (7.3%)	3 (6.2%)	0 (0.0%)	1 (33.3%)	0 (0.0%)	
	E	1 (1.8%)	1 (2.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
	F	1 (1.8%)	1 (2.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
	G	1 (1.8%)	1 (2.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Ptosis	No	23 (41.8%)	20 (41.7%)	1 (50.0%)	2 (66.7%)	0 (0.0%)	0.292
	1	24 (43.6%)	20 (41.7%)	1 (50.0%)	1 (33.3%)	2 (100.0%)	
	2	5 (9.1%)	5 (10.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
	3	3 (5.5%)	3 (6.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Tumour factors							
Side	Left	29 (52.7%)	25 (52.1%)	1 (50.0%)	2 (66.7%)	1 (50.0%)	0.968
	Right	26 (47.3%)	23 (47.9%)	1 (50.0%)	1 (33.3%)	1 (50.0%)	
Histology	NST	32 (58.2%)	28 (58.3%)	1 (50.0%)	2 (66.7%)	1 (50.0%)	0.002
	IDC	8 (14.5%)	7 (14.6%)	1 (50.0%)	0 (0.0%)	0 (0.0%)	
	LGDCIS	3 (5.5%)	3 (6.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
	ILC	8 (14.5%)	8 (16.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
	HGDCIS	3 (5.5%)	2 (4.2%)	0 (0.0%)	1 (33.3%)	0 (0.0%)	
	LCIS	1 (1.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (50.0%)	
Focality	Multifocal	22 (40.0%)	20 (41.7%)	1 (50.0%)	0 (0.0%)	1 (50.0%)	0.873
	Unifocal	33 (60.0%)	28 (58.3%)	1 (50.0%)	3 (100.0%)	1 (50.0%)	
Quadrant	UOQ	45 (81.8%)	42 (87.5%)	1 (50.0%)	0 (0.0%)	2 (100.0%)	0
	LOQ	5 (9.1%)	5 (10.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
	LIQ	5 (9.1%)	1 (2.1%)	1 (50.0%)	3 (100.0%)	0 (0.0%)	
	UIQ	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Radiological dimensions (mm) [median (IQR)]		25.0 (22.0, 33.5)	25.5 (22.0, 32.8)	25.0 (25.0, 25.0)	18.0 (14.5, 27.0)	38.0 (33.0, 43.0)	0.465
Tumour size (mm) [median (IQR)]		33.0 (24.0, 50.5)	31.5 (24.0, 50.2)	35.0 (27.5, 42.5)	38.0 (19.0, 42.0)	58.0 (57.0, 59.0)	0.3

Table 1. continued

Variable	Group	Total (n = 55)	LICAP (n = 48)	AICAP (n = 2)	MICAP (n = 3)	LTAP (n = 2)	p-value
Specimen weight (g) [median (IQR)]		63.0 (34.6, 105.0)	63.4 (35.2, 100.5)	105.5 (70.2, 140.8)	27.7 (25.4, 48.9)	97.5 (69.7, 125.2)	0.513
ER	Yes	50 (90.9%)	44 (91.7%)	2 (100.0%)	2 (66.7%)	2 (100.0%)	0.463
	No	5 (9.1%)	4 (8.3%)	0 (0.0%)	1 (33.3%)	0 (0.0%)	
PR	Yes	50 (90.9%)	44 (91.7%)	2 (100.0%)	2 (66.7%)	2 (100.0%)	0.463
	No	5 (9.1%)	4 (8.3%)	0 (0.0%)	1 (33.3%)	0 (0.0%)	
HER2	No	48 (87.3%)	41 (85.4%)	2 (100.0%)	3 (100.0%)	2 (100.0%)	0.76
	Yes	7 (12.7%)	7 (14.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Treatment factors							
Primary *vs.* secondary flap	Primary flap	50 (90.9%)	44 (91.7%)	2 (100.0%)	2 (66.7%)	2 (100.0%)	0.463
	Secondary flap	5 (9.1%)	4 (8.3%)	0 (0.0%)	1 (33.3%)	0 (0.0%)	
NACT	No	50 (90.9%)	43 (89.6%)	2 (100.0%)	3 (100.0%)	2 (100.0%)	0.849
	Yes	5 (9.1%)	5 (10.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Primary node surgery	SLNB	36 (65.4%)	31 (64.6%)	2 (100.0%)	2 (66.7%)	1 (50.0%)	0.626
	ANC	16 (29.1%)	15 (31.2%)	0 (0.0%)	0 (0.0%)	1 (50.0%)	
	None	3 (5.5%)	2 (4.2%)	0 (0.0%)	1 (33.3%)	0 (0.0%)	
Radiotherapy	Yes	49 (89.1%)	43 (89.6%)	1 (50.0%)	3 (100.0%)	2 (100.0%)	0.288
	No	6 (10.9%)	5 (10.4%)	1 (50.0%)	0 (0.0%)	0 (0.0%)	
Chemotherapy	No	46 (83.6%)	40 (83.3%)	2 (100.0%)	3 (100.0%)	1 (50.0%)	0.451
	Yes	9 (16.4%)	8 (16.7%)	0 (0.0%)	0 (0.0%)	1 (50.0%)	
ET	Yes	46 (83.6%)	40 (83.3%)	2 (100.0%)	2 (66.7%)	2 (100.0%)	0.702
	No	9 (16.4%)	8 (16.7%)	0 (0.0%)	1 (33.3%)	0 (0.0%)	
Drain	No	51 (92.7%)	44 (91.7%)	2 (100.0%)	3 (100.0%)	2 (100.0%)	0.89
	Yes	4 (7.3%)	4 (8.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Secondary nodal surgery	ANC	4 (7.3%)	4 (8.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1
Outcomes							
Margin re-excision	No	50 (90.9%)	44 (91.7%)	2 (100.0%)	2 (66.7%)	2 (100.0%)	0.63
	Yes	5 (9.1%)	4 (8.3%)	0 (0.0%)	1 (33.3%)	0 (0.0%)	
Completion mastectomy	No	53 (96.4 %)	47 (97.9 %)	2 (100.0%)	3 (100.0%)	1 (50.0%)	0.118
	Yes	2 (3.6%)	1 (2.1 %)	0 (0.0%)	0 (0.0%)	1 (50.0%)	
Complications	No	46 (83.6%)	41 (85.4%)	2 (100.0%)	1 (33.3%)	2 (100.0%)	0.092
	Yes	9 (16.4%)	7 (14.6%)	0 (0.0%)	2 (66.7%)	0 (0.0%)	
Follow-up duration (days) (median IQR)		569.0 (264.5–1018.0)	591.5 (354.2–1021.0)	1001.5 (788.8–1214.2)	373.0 (299.5–719.5)	96.0 (80.0–112.0)	0.075
Recurrence	No	55 (100%)					
	Yes	0 (0%)					

NST: No special type; IDC: Invasive ductal carcinoma; LGDCIS: Low-grade ductal carcinoma *in-situ*; ILC: Invasive lobular carcinoma; HGDCIS: High-grade ductal carcinoma *in-situ*; LCIS: Lobular carcinoma in-situ; UOQ: Upper outer quadrant; LOQ: Lower outer quadrant; LIQ: Lower inner quadrant; UIQ: Upper inner quadrant; ER: Estrogen receptor; PR: Progesterone receptor; HER2: Human epidermal growth factor 2 receptor; NACT: Neo-adjuvant chemotherapy; SLNB: Sentinel lymph node biopsy; ANC: Axillary node clearance; ET: Endocrine treatment; LICAP: Lateral intercostal artery perforator; AICAP: Anterior intercostal artery perforator; MICAP: Medial intercostal artery perforator; LTAP: Lateral thoracic artery perforator; IQR: Interquartile range

1). The CWPFs are raised as a turnover flap (folded 180°), a pendulum type flap based on longer pedicles (TDAP/LTAP) or as a propeller flap to reconstruct the tumour excision defect. A drain was used according to individual intraoperative circumstances. We followed the UK Association of Breast Surgery consensus for adopting and accepting a 1 mm tumour resection margin for invasive disease and 2 mm for ductal carcinoma *in situ* (DCIS) (14).

Statistical Analysis

Data analysis was conducted using Python (version 3.14) and the pandas, numpy, and scipystats modules. Continuous variables, including age, BMI, specimen weight, radiological dimensions, tumour size, and duration of follow-up, were evaluated for normality using visual inspection and summary statistics. Because the data were not normally distributed, findings were presented as median and interquartile range, and comparisons between groups were performed using the Kruskal-Wallis test or the Mann-Whitney U test, as appropriate. Categorical characteristics (e.g., smoking status, tumour quadrant, flap type, primary versus secondary surgery, complete mastectomy, and complications) were reported as frequencies and percentages. Relationships between categorical variables were assessed using the chi-square test or Fisher's exact test when expected cell counts were below 5.

All tests were two-tailed, and a p-value <0.05 was considered statistically significant. Data were summarized in tabular form, showing group comparisons (overall and stratified by completion mastectomy, margin re-excision, and complications).

Patient-Reported Outcome Measures (PROMS)-Patient Reported Outcome Measures

As part of our routine follow up, to assess patient satisfaction the Breast-Q PROM proforma is used in our practice. For the sake of simplicity and to maintain compliance, we collected information on the following parameters: pre- and post-operative satisfaction with the breasts, sexual well-being, and psychosocial well-being. Currently, there are no validated PROMs specifically for partial breast reconstruction with CWPF. During harvesting of CWPFs, the scar extends to the back. Therefore, we also included the domain assessing satisfaction with the back, which was originally designed for patients undergoing latissimus dorsi (LD) reconstruction. As we are evaluating the procedure performed by a single surgeon, we also included domains assessing satisfaction with information provided by the breast surgeon and with the surgeon's performance to enhance the study's relevance.

Results

Patient Demographics and Tumour Factors

A total of $n = 55$ patients underwent partial breast reconstruction with CWPF; the median age was 52.0 (45.5–58). Of these, $n = 6$ (10.9%) were smokers, and $n = 21$ (38.2%) had medical comorbidities, namely hypertension ($n = 8$), hypothyroidism ($n = 4$), rheumatological conditions ($n = 3$), asthma ($n = 3$), mental health conditions ($n = 3$), diabetes ($n = 2$), and inflammatory bowel disease ($n = 1$).

The median BMI was 27.2 kg/m^2 (24.6–32.2); the most common cup sizes were C ($n = 17$, 30.9%) and D ($n = 17$, 30.9%), while larger cup sizes (DD, E, F, G) collectively made up $n = 7$ (12.7%) of the patient cohort. Most patients had no ptosis or grade 1 ptosis ($n = 47$, 85.4%).

Most tumours were left-sided ($n = 29$, 52.7%), unifocal ($n = 33$, 60%), and located in the upper outer quadrant (UOQ) ($n = 45$, 81.8%). The most common histological type was no special type ($n = 32$, 58.2%), followed equally by invasive ductal carcinoma ($n = 8$, 14.5%) and invasive lobular carcinoma ($n = 8$, 14.5%), while only $n = 6$ (11%) patients had DCIS. Most cases ($n = 50$, 90.9%) were PR+ and ER+, while only $n = 7$ (12.7%) were HER2+ (Table 1).

Treatment Factors

The most common flap performed was the LICAP ($n = 48$, 87.3%), with only $n = 3$ (5.5%) MICAP, $n = 2$ (3.6%) LTAP and $n = 2$ (3.6%) AICAP with only $n = 4/55$ (7.3%) receiving a drain. Most flaps were performed as a primary single stage procedure $n = 50$ (90.1%), while only $n = 5$ (9.1%) were performed following a previous WLE and positive margin cavity shaves.

Most patients ($n = 36$, 65.4%) underwent simultaneous sentinel lymph node biopsy, and $n = 16$ (29.1%) received an axillary node clearance during the flap reconstruction procedure. Most patients ($n = 49$, 89.1%) received radiotherapy, and endocrine treatment was received by $n = 46$ (83.6%); only $n = 9$ (16.4%) received chemotherapy (Table 1).

Outcomes Measures

Of the patient cohort, $n = 9$ (16.4%) developed complications; $n = 4$ (7.3%) were wound breakdowns, of which $n = 2$ (3.6%) required return to theatre for wound re-suturing. Three patients ($n = 3$; 5.5%) developed a surgical site infection requiring antibiotics, and $n = 2$ (3.6%) developed a seroma that was managed non-operatively. The rate of partial and complete flap loss is 0% ($n = 0$). Two patients ($n = 2$, 3.6%) required subsequent lipo-filling procedures for aesthetic purposes. Our median follow-up duration was 569 days (264.5–1018). Five patients ($n = 5$, 9.1%) required a margin re-excision, and ($n = 2$, 3.6%) required a

Table 2. Summarizes patient demographics among those who developed complications

Variable	Group	Overall (*n* = 55)	Complications: yes (*n* = 9)	No (*n* = 46)	*p*-value
Presentation	Symptomatic	29 (52.7%)	5 (55.6%)	24 (52.2%)	1
	Screen	26 (47.3%)	4 (44.4%)	22 (47.8%)	
Age [median (IQR)]		52.0 (45.5, 58.0)	48.0 (41.0, 57.0)	52.0 (46.0, 58.0)	0.284
BMI kg/m^2 [median (IQR)]		27.2 (24.6, 32.2)	27.2 (26.6, 32.4)	27.4 (24.4, 31.9)	0.393
Comorbidities	Yes	21 (38.2%)	2 (22.2%)	19 (41.3%)	0.457
	No	34 (61.8%)	7 (77.8%)	27 (58.7%)	
Smoking	Yes	6 (10.9%)	1 (11.1%)	5 (10.9%)	<0.001
	No	49 (89.1%)	8 (88.9%)	41 (89.1)	
Bra size [median (IQR)]		36.0 (34.0, 38.0)	36.0 (36.0, 38.0)	36.0 (34.0, 38.0)	0.487
Cup size	A	2 (3.6%)	0 (0.0%)	2 (4.3%)	0.459
	B	12 (21.8%)	1 (11.1%)	11 (23.9%)	
	C	17 (30.9%)	3 (33.3%)	14 (30.4%)	
	D	17 (30.9%)	3 (33.3%)	14 (30.4%)	
	DD	4 (7.3%)	1 (11.1%)	3 (6.5%)	
	E	1 (1.8%)	0 (0.0%)	1 (2.2%)	
	F	1 (1.8%)	1 (11.1%)	0 (0.0%)	
	G	1 (1.8%)	0 (0.0%)	1 (2.2%)	
Ptosis	No	23 (41.8%)	1 (11.1%)	22 (47.8%)	<0.001
	1	24 (43.6%)	5 (55.6%)	19 (41.3%)	
	2	5 (9.1%)	0 (0.0%)	5 (10.9%)	
	3	3 (5.5%)	3 (33.3%)	0 (0.0%)	
Tumour factors					
Side	Left	29 (52.7%)	4 (44.4%)	25 (54.3%)	0.721
	Right	26 (47.3%)	5 (55.6%)	21 (45.7%)	
Histology	NST	32 (58.2%)	7 (77.8%)	25 (54.3%)	0.582
	IDC	8 (14.5%)	1 (11.1%)	7 (15.2%)	
	LGDCIS	3 (5.5%)	0 (0.0%)	3 (6.5%)	
	ILC	8 (14.5%)	0 (0.0%)	8 (17.4%)	
	HGDCIS	3 (5.5%)	1 (11.1%)	2 (4.3%)	
	LCIS	1 (1.8%)	0 (0.0%)	1 (2.2%)	
Focality	Multifocal	22 (40.0%)	3 (33.3%)	19 (41.3%)	0.727
	Unifocal	33 (60.0%)	6 (66.7%)	27 (58.7%)	
Quadrant	UOQ	45 (81.8%)	6 (66.7%)	39 (84.8%)	<0.001
	LOQ	5 (9.1%)	1 (11.1%)	4 (8.7%)	
	LIQ	5 (9.1%)	2 (22.2%)	3 (6.5%)	
	UIQ	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Radiological dimensions (mm) [median (IQR)]		25.0 (22.0, 33.5)	30.0 (24.0, 31.0)	25.0 (22.0, 34.2)	0.749
Tumour size (mm) [median (IQR)]		33.0 (24.0, 50.5)	41.0 (28.0, 52.0)	31.5 (24.0, 50.0)	0.569
Specimen weight (g) [median (IQR)]		63.0 (34.6, 105.0)	114.0 (47.0, 186.0)	56.5 (34.4, 84.9)	0.099
ER	Yes	50 (90.9%)	9 (100.0%)	41 (89.1%)	0.578
	No	5 (9.1%)	0 (0.0%)	5 (10.9%)	

Table 2. continued

Variable	Group	Overall (*n* = 55)	Complications: yes (*n* = 9)	No (*n* = 46)	*p*-value
PR	Yes	50 (90.9%)	9 (100.0%)	41 (89.1%)	0.578
	No	5 (9.1%)	0 (0.0%)	5 (10.9%)	
HER2	No	48 (87.3%)	8 (88.9%)	40 (87.0%)	1
	Yes	7 (12.7%)	1 (11.1%)	6 (13.0%)	
Treatment factors					
Primary *vs*. secondary flap	Primary flap	50 (90.9%)	8 (88.9%)	42 (91.3%)	<0.001
	Secondary flap	5 (9.1%)	1 (11.1%)	4 (8.7%)	
NACT	No	50 (90.9%)	8 (88.9%)	42 (91.3%)	1
	Yes	5 (9.1%)	1 (11.1%)	4 (8.7%)	
Flap	AICAP	2 (3.6%)	0 (0.0%)	2 (4.3%)	0.092
	LICAP	48 (87.3%)	7 (77.8%)	41 (89.1%)	
	MICAP	3 (5.5%)	2 (22.2%)	1 (2.2%)	
	LTAP	2 (3.6%)	0 (0.0%)	2 (4.3%)	
Primary node surgery	SLNB	36 (65.4%)	6 (66.7%)	30 (65.2%)	0.834
	ANC	16 (29.1%)	3 (33.3%)	13 (28.3%)	
	None	3 (5.5%)	0 (0.0%)	3 (6.5%)	
Drain	No	51 (92.7%)	7 (77.8%)	44 (95.7%)	0.121
	Yes	4 (7.3%)	2 (22.2%)	2 (4.3%)	
Radiotherapy	Yes	49 (89.1%)	7 (77.8%)	42 (91.3%)	0.251
	No	6 (10.9%)	2 (22.2%)	4 (8.7%)	
Chemotherapy	No	46 (83.6%)	7 (77.8%)	39 (84.8%)	0.631
	Yes	9 (16.4%)	2 (22.2%)	7 (15.2%)	
ET	Yes	46 (83.6%)	7 (77.8%)	39 (84.8%)	0.631
	No	9 (16.4%)	2 (22.2%)	7 (15.2%)	

NST: No special type; IDC: Invasive ductal carcinoma; LGDCIS: Low-grade ductal carcinoma *in-situ*; ILC: Invasive lobular carcinoma; HGDCIS: High-grade ductal carcinoma *in-situ*; LCIS: Lobular carcinoma *in-situ*; UOQ: Upper outer quadrant; LOQ: Lower outer quadrant; LIQ: Lower inner quadrant; UIQ: Upper inner quadrant; ER: Estrogen receptor; PR: Progesterone receptor; HER2: Human epidermal growth factor 2 receptor; NACT: Neo-adjuvant chemotherapy; SLNB: Sentinel lymph node biopsy; ANC: Axillary node clearance; ET: Endocrine treatment; LICAP: Lateral intercostal artery perforator; AICAP: Anterior intercostal artery perforator; MICAP: Medial intercostal artery perforator; LTAP: Lateral thoracic artery perforator; IQR: Interquartile range

Table 3. Summarizes patient-reported outcome measure scores

Breast Q domain	Range	Median
Satisfaction with breasts (preoperative)	64–100	82
Satisfaction with breasts (postoperative)	48–88	72
Satisfaction with back (postoperative)	49–90	74
Psychosocial well being	52–89	71
Sexual well-being	27–66	43 (only 21 patients answered this domain)
Satisfaction with information given by breast surgeon (postoperative)	62–91	80
Satisfaction with surgeon	70–100	86

Figure 1.1 Figure 1.2 Figure 1.3

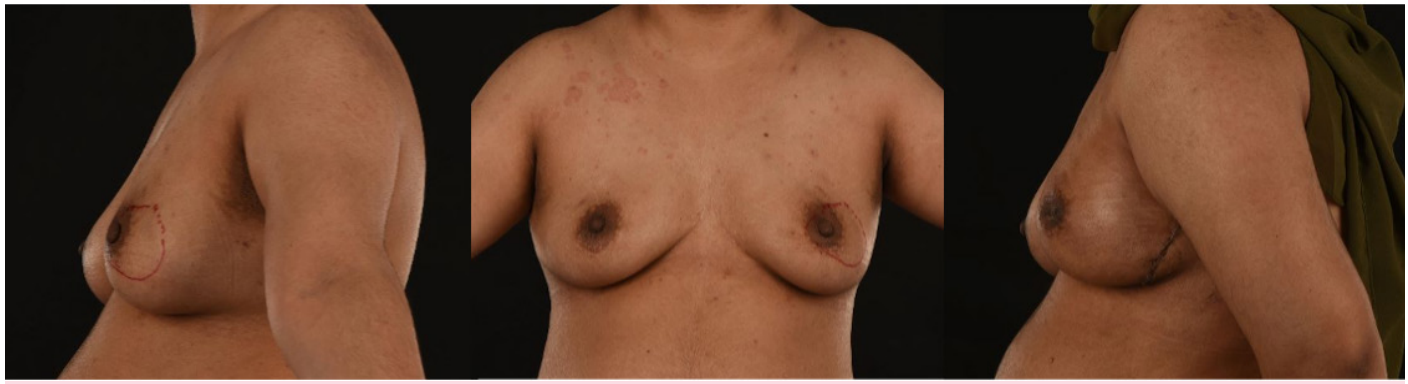

Figure 1. Figures 1.1 and 1.2 represent clinical photographs of a 29-year-old, non-smoking female with a BMI of 30 kg/m^2 and a bra size of 34C, who underwent a single stage WLE with partial breast reconstruction using an LICAP for a left sided breast tumour with no complications. Figure 1.3 shows images is 3 months post-surgery

LICAP: Lateral intercostal artery perforator; BMI: Body mass index; WLE: Wide local excision

Figure 2.1 Figure 2.2

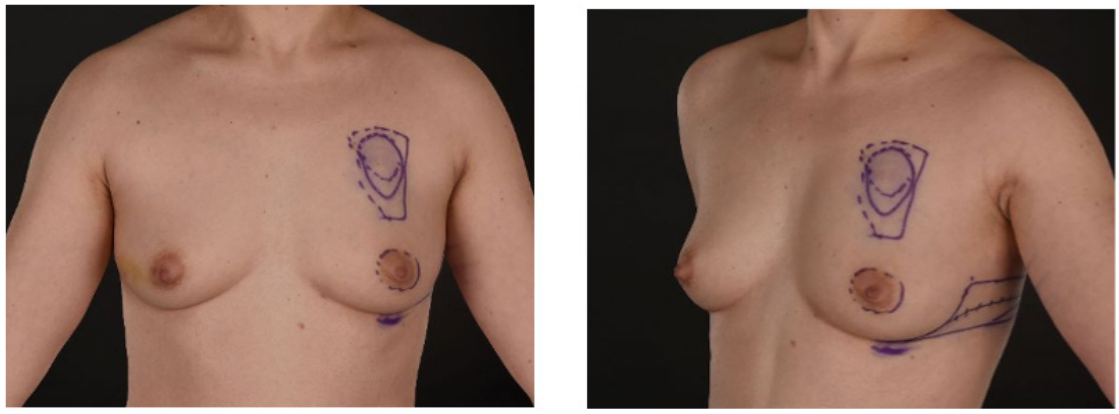

Figure 2.3 Figure 2.4

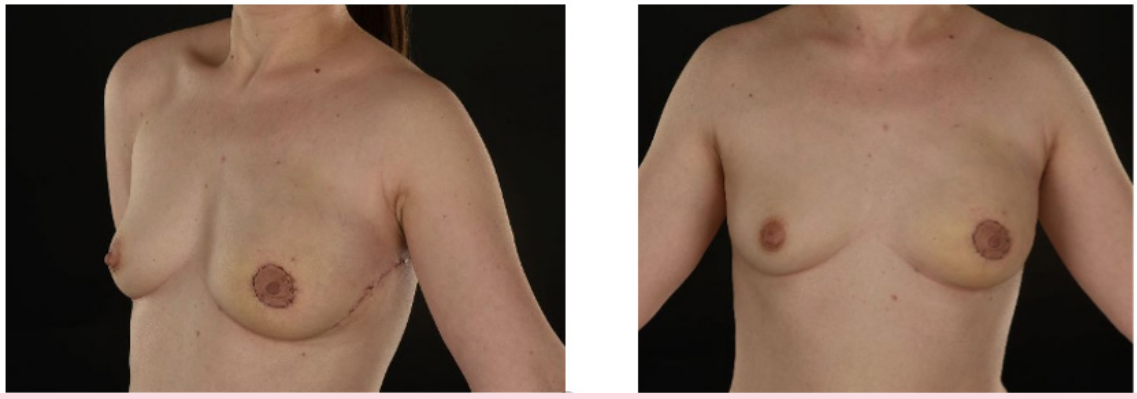

Figure 2. Figures 2.1 and 2.2 represent clinical photographs of a 34-year-old, non-smoking female with a BMI of 26 kg/m^2 and a bra size of 32B, who underwent a single stage WLE with partial breast reconstruction using an LICAP for a left sided breast tumour with no complications. Figure 2.3 and 2.4 shows images 3 months post-surgery

LICAP: Lateral intercostal artery perforator; BMI: Body mass index; WLE: Wide local excision

Figure 3.1

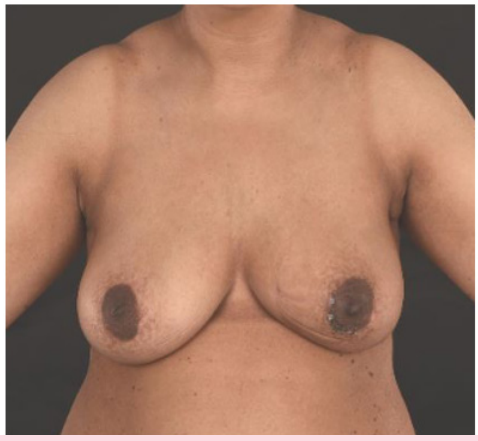

Figure 3.2

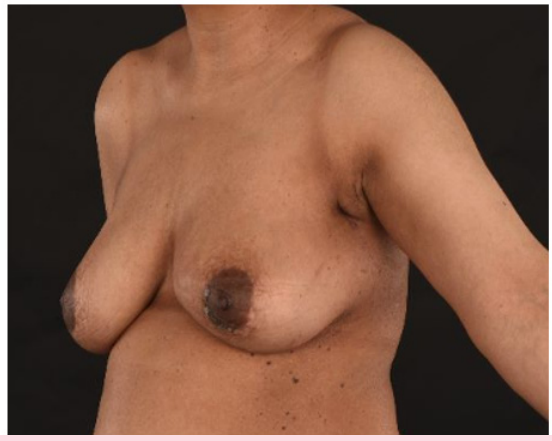

Figure 3. Figures 3.1 and 3.2 represent clinical photographs 1-month post-surgery of a 47-year-old non-smoking female with a BMI of 26.6 kg/m^2 and a bra size of 36D who underwent margin re-excision and subsequent MICAP partial breast reconstruction following a previous left sided WLE

MICAP: Medial intercostal artery perforator; BMI: Body mass index; WLE: Wide local excision

completion mastectomy (Tables 1, 2). The results of the PROMs are summarised in Table 3. Figures 1, 2, 3, 4, and 5 show clinical photographs of postoperative results.

Table 2 presents a bivariate analysis comparing patients who developed complications with those who did not. Smoking differed significantly between groups (p<0.001), suggesting a correlation between smoking exposure and the development of complications. Breast ptosis was also significantly associated with post-op complications (p<0.001). Patients with higher grades of ptosis, particularly grade 3 ptosis, were disproportionately represented among those who subsequently developed complications. Additionally, tumour location within the breast demonstrated a similarly significant association with post-op complications (p<0.001); lesions located outside the UOQ were more frequently associated with complications. Lesions in the UOQ were associated with a lower proportion of complications. Despite most patients undergoing a primary reconstruction at the time of tumour excision (n = 50, 90.9%), complications occurred more commonly following primary flap reconstruction compared with secondary procedures (p<0.001)

We have found no statistically significant differences between groups with respect to age, body mass index, comorbidities, cup size, tumour factors such as histology, focality, tumour size, specimen weight, and tumour receptor status (ER, PR, HER2), or neoadjuvant or adjuvant treatment modalities.

Discussion and Conclusion

The LD flap has long been regarded as a reliable option for breast reconstruction, particularly for patients unsuitable for microvascular procedures or those with smaller breasts (15-24). However, its use may be limited by potential complications such as shoulder dysfunction and donor site seroma, with reported incidences varying between 7% and 81% (25-28). In contrast, CWPFs preserve the underlying musculature, thereby reducing donor-site morbidity and maintaining shoulder mobility. These flaps derive their vascular supply from branches of the TDAP, LICAP, LTAP, or AICAP/MICAP (12). As muscle-sparing techniques, CWPFs have demonstrated lower morbidity than myocutaneous LD flaps, with studies reporting no impairment of shoulder function during long-term follow-up (29).

The choice of CWPF depends on the size and anatomical location of the defect following tumour excision. For instance, LTAP flaps—either alone or combined with LICAP flaps—are suitable for lateral, central, lower outer, and upper medial quadrant defects, whereas AICAP and MICAP flaps are more appropriate for lower central and inner quadrant defects (29-31). We have found that most of our reported cases presented with a tumour located in the UOQ, and that the most common flap used was the LICAP alone.

A key advantage of oncoplastic breast surgery using CWPFs is the ability to achieve oncologically safe reconstruction and favourable cosmetic results, often avoiding the need for contralateral symmetrisation procedures, particularly in women with smaller breasts (15, 16). In a large multicentre UK study by Agrawal et al. (17), symmetrisation surgery was required in only 1.2% of cases, with 2.6% undergoing minor revisions such as lipofilling or scar correction. Our findings align with the published literature: none of our patients required symmetrizing

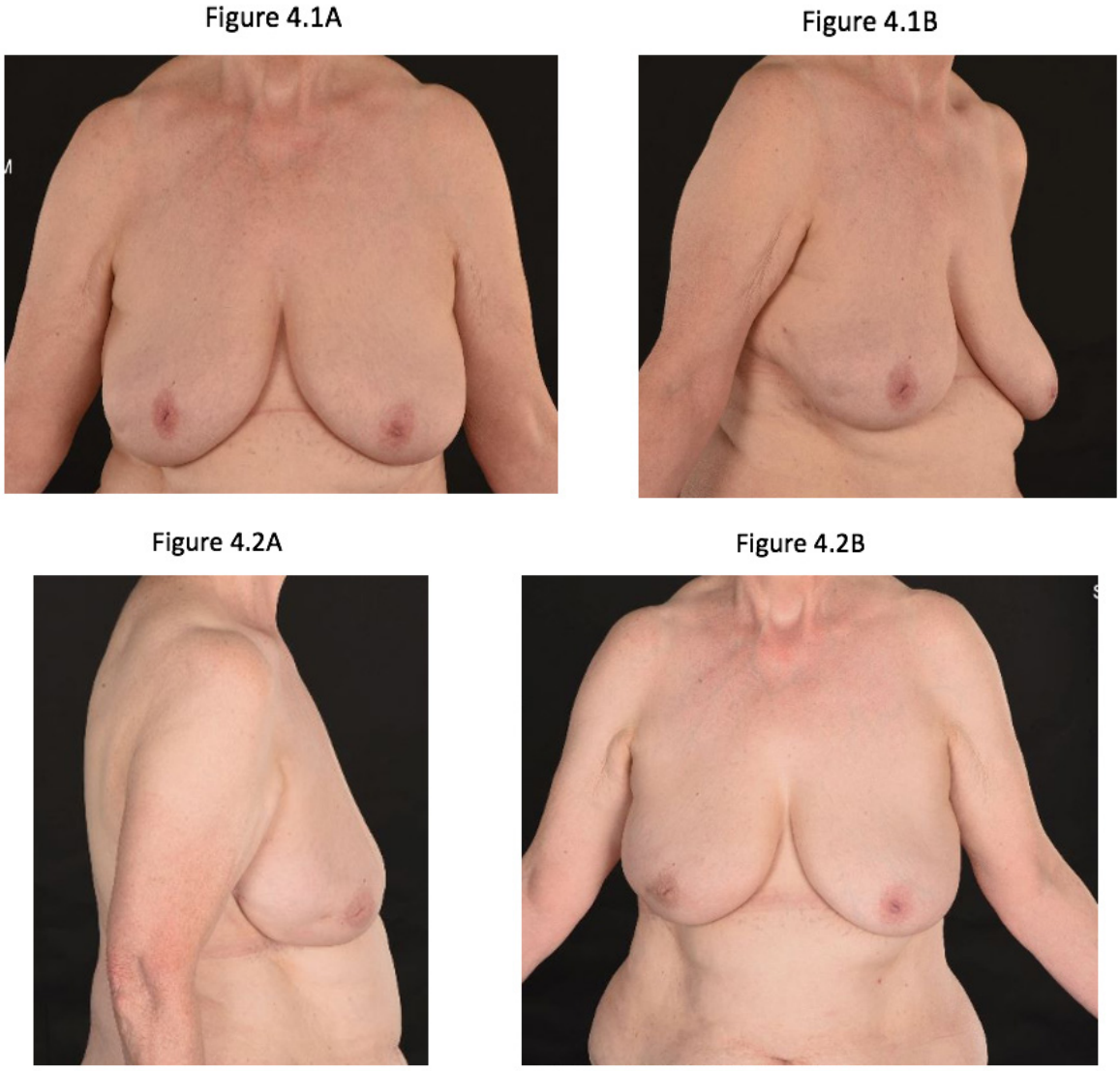

Figure 4. 4.1 A and B: represent pre-operative clinical photographs of a 69-year-old, non-smoking female with a BMI of 28 kg/m^2 and a bra size of 38C, who underwent a single stage WLE with partial breast reconstruction using an LICAP for a right sided breast tumour with no complications. She subsequently received adjuvant radiotherapy. Figures 4.2 A and B show her results 9 months post-surgery having gone through radiotherapy treatment

LICAP: Lateral intercostal artery perforator; BMI: Body mass index; WLE: Wide local excision

breast surgery, and only 2 required further procedures in the form of lipo-filling. Notably, 85.4% of our cohort had no or mild ptosis, which supports the suitability of CWPFs in this cohort.

Although outcome data are frequently reported collectively across different CWPF types, recent systematic reviews have confirmed low complication rates. Nava et al. (30) reported an overall recipient-site complication rate of 13%, a total flap loss rate of 1%, and noted that most complications—including seroma, hematoma, infection, and wound dehiscence—were managed conservatively, with only 20.5% necessitating surgical intervention. Similarly, Pujji et al. (15) documented low rates of total (0.2%) and partial (1.8%) flap necrosis. We report a comparably low rate of complications (16.4%) with only 22.2% of those experiencing complications required a surgical intervention. Additionally the rate of partial and complete flap loss is 0%. One of the common complications of breast surgery is fat necrosis, of which the rates in CWPFs seem to be around 2% in the published literature, which proves the reliability of the chest wall perforator blood supply (30).

Our findings, as represented in Table 2, indicate that smoking, breast ptosis, and tumour location show a significant correlation with the risk of developing complications. Despite the well-

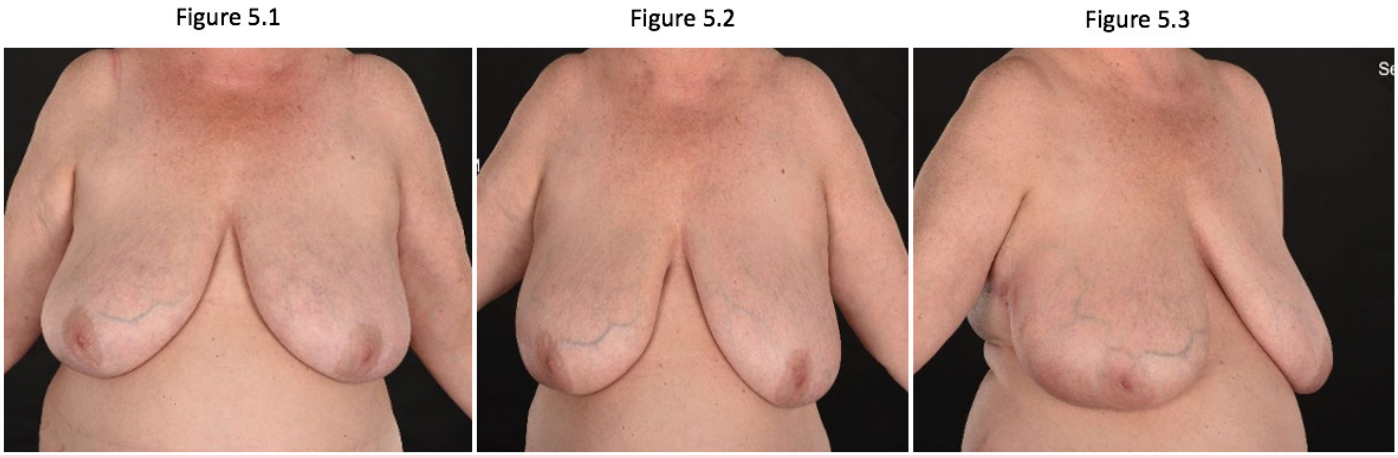

Figure 5. Figure 5.1: Represents a clinical photograph of a 58-year-old, smoking female with a BMI of 32 kg/m^2 and a bra size of 36C, who underwent a single stage WLE with partial breast reconstruction using an LICAP for a right sided breast tumour with no complications. Figures 5.2 and 5.3 shows images 1-month post-surgery

LICAP: Lateral intercostal artery perforator; BMI: Body mass index; WLE: Wide local excision

known effects of smoking on flap survival, we observed a 0% rate of flap necrosis, demonstrating the robust blood supply of CWPFs. However, we found that smoking correlates with complications. In our patient cohort, $n = 9$ (16.4%) developed complications, with $n = 4$ (7.3%) being wound breakdowns, for which smoking is a well-known risk factor. Additionally, patients with higher grades of ptosis, particularly grade 3, were disproportionately represented among those who subsequently developed complications. This further reinforces that the ideal candidates for a CWPF are those with minimal or no ptosis and emphasizes the importance of appropriate patient selection. Although most of our patients had a lesion in the UOQ ($n = 45$, 81.8%), this tumour location was associated with a lower proportion of complications.

From an oncological perspective, CWPFs have demonstrated safety, whereby pooled data from Nava et al. (30) indicated a completion mastectomy rate of 1.5% and a margin re-excision rate of 13%, supporting the oncological soundness of partial breast reconstruction using CWPFs. Although we report a higher rate of completion mastectomies (3.63%), we experience a lower rate of margin re-excision (9.0%).

This study evaluates patient-reported outcomes following BCS with CWPF reconstruction, an area in which PROMs data remain limited. Our results show that postoperative satisfaction with the breasts (median 72) was lower than preoperative scores (median 82), which is expected after oncologic surgery. These values, however, remain comparable to published Breast-Q scores for standard breast-conserving therapy, such as those reported by Dahlbäck et al. (32) (median 66) and O'Connell et al. (33) (median 68).

Given the paucity of studies evaluating patient satisfaction with CWPF donor-site scars, we however, report high postoperative postoperative patient satisfaction with donor-site scars. These findings are consistent with results by Muktar et al. (34), who reported favourable donor-site outcomes after CWPF reconstruction. Psychosocial well-being (median 71) was also in line with previously reported values for breast-conserving cohorts. Tomita et al. (35) found median psychosocial well-being scores of approximately 73 following BCS. While we report lower sexual well-being scores (median 43), these may well reflect factors beyond the reconstruction itself, including adjuvant therapies and the limited number of respondents in that domain ($n = 21$).

Study Limitations

Our results show that CWPF reconstructions result in high postoperative satisfaction, acceptable donor-site outcomes, and stable psychosocial well-being, supporting their use as a safe and well-tolerated volume-replacement option in breast-conserving surgery. However, this study has limitations, including its small sample size, its unequal distribution of flap types, its short follow-up period, and its retrospective design, all of which restrict the strength and generalisability of our findings. As the data reflect the experience of a single surgeon at a single centre, outcomes may differ elsewhere due to variations in expertise and patient demographics. Larger multi-centre and long-term prospective studies using validated PROMs are needed to better assess outcomes and quality of life in this patient group.

As oncoplastic breast surgery gains popularity, partial breast reconstruction using CWPFs is a valuable technique in the oncoplastic surgeon's armamentarium. This approach is particularly well suited to patients with small- to moderate-sized

breasts and minimal or no ptosis, when a relatively large volume of tissue needs to be excised. It may also be considered for patients with larger breasts, particularly those wishing to avoid symmetrising mammoplasty. Our results align with previously published studies and support both the technical feasibility and oncological safety of CWPFs in partial breast reconstruction following breast-conserving surgery. No cases of local or distant metastasis were observed, suggesting oncological safety, although extended follow-up is necessary. Patient-reported outcomes further demonstrated high satisfaction and favourable overall aesthetic results.

Ethics

Ethics Committee Approval: This study was reviewed by the Sandwell and West Birmingham Trust Research and Development Team (R&D), and deemed exempt from Research Ethics Committee approval, and registered with the hospital's Clinical Effectiveness Team (ID 3392).

Informed Consent: Written Informed consent is obtained from patients to publish clinical photographs anonymously for academic purposes.

Footnotes

Authorship Contributions

Surgical and Medical Practices: W.B., U.S., K.S., C.X., I.J.; Concept: W.B., U.S., K.S., C.X., I.J.; Design: W.B., U.S., K.S., C.X., I.J.; Data Collection or Processing: W.B., U.S., K.S., C.X., I.J.; Analysis or Interpretation: W.B., U.S., K.S., C.X., I.J.; Literature Search: W.B., U.S., K.S., C.X., I.J.; Writing: W.B., U.S., K.S., C.X., I.J.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

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