ORIGINAL ARTICLE

European Journal of BREAST HEALTH

DOI: 10.4274/ejbh.galenos.2026.2026-2-11

Eur J Breast Health 2026;22(4):393-406

Role of Chest Wall Perforator Flaps in Breast Surgery: Military Cancer Centre Experience

Saleh Habahbeh[1], Muthanna Ababneh[1], Ahmad Kofahi[1], Abdullah Bani Fares[1], Mohannad Bawaneh[1], Mothana Yousef Al-Nawaflh[2], Mohammad Isam Bany Doumi[3]

[1]Department of Surgery, Military Cancer Center, Royal Medical Services, Amman, Jordan
[2]Department of Histopathology, Military Cancer Center, Royal Medical Services, Amman, Jordan
[3]Department of Radiology, Military Cancer Center, Royal Medical Services, Amman, Jordan

ABSTRACT

Objective: Chest wall perforator flaps (CWPFs) are a muscle-sparing alternative in oncoplastic breast surgery (OPBS). CWPFs offer favourable cosmetic and surgical outcomes while minimising donor-site morbidity. Despite their increasing global adoption, there is a paucity of data from the Middle East and North Africa (MENA) region. This retrospective, descriptive case series aimed to assess our institutional experience with CWPFs, emphasising their feasibility, versatility, and surgical and cosmetic results in breast surgery.

Materials and Methods: This retrospective case series included all patients who underwent CWPF-based OPBS at the Military Cancer Centre between December 2017 and January 2025. Data on patient demographics, tumour characteristics, surgical indications, flap types and techniques, complications, and patient satisfaction were collected.

Results: CWPF procedures were performed on 69 patients. The most popular flap type (78.3%) was the lateral intercostal artery flap. Indications included volume replacement (84.1%), implant coverage (4.3%), implant salvage (2.9%), wound closure (7.2%), and deformity correction (1.4%). Most flaps were intended to be turnover flaps (75.4%) rather than propeller flaps (24.6%). No flap loss was noted; the complication rates were low, and the re-excision rate was 0%. Over 85% of patients reported good-to-excellent satisfaction with cosmetic outcomes.

Conclusion: CWPFs are reliable and versatile techniques in breast-conserving surgery and OPBS, serving as a surgical solution for various reconstructive indications. The findings from this study emphasise the need for broader adoption of CWPFs in Jordan and the MENA region and demonstrate the effective use of CWPFs at a national centre in Jordan.

Keywords: Chest wall perforator flaps; oncoplastic surgery; breast reconstruction; breast cancer; retrospective observational study

KEY POINTS

- This manuscript presents a single-center experience with chest wall perforator flaps (CWPFs) in oncoplastic breast surgery over a seven-year period.
- It represents one of the largest reported series from the Middle East and North Africa region, addressing a significant gap in the current literature.
- The study demonstrates the versatility of CWPFs beyond traditional volume replacement, including implant coverage, implant salvage, wound closure, and deformity correction.
- Excellent oncological safety was observed, with zero flap loss and no re-excision for positive margins.

Corresponding Author: Saleh Habahbeh, MD;
E-mail: habahbeh1976@yahoo.com **ORCID:** orcid.org/0009-0002-6757-2137
Received: 24.02.2026 **Accepted:** 10.04.2026 **Available Online Date:** 23.09.2026
Cite this article as: Habahbeh S, Ababneh M, Kofahi A, Fares AB, Bawaneh M, Al-Nawaflh MY, et al. Role of chest wall perforator flaps in breast surgery: Military Cancer Centre experience. Eur J Breast Health. 2026;22(4):393-406

- Surgical morbidity was minimal, and patient-reported cosmetic satisfaction was high, with more than 85% rating outcomes as good or excellent.
- The findings support CWPFs as a reliable, muscle-sparing alternative to myocutaneous flaps with favorable functional and aesthetic outcomes.
- This work encourages wider adoption of CWPF techniques in similar healthcare settings and contributes valuable regional data to the global literature.

Introduction

Breast-conserving surgery (BCS), also known as lumpectomy, partial mastectomy, or wide local excision, involves removing the tumour with clear margins. BCS is regarded as a safer, less invasive and less morbid alternative to mastectomy for patients with breast cancer (BC), which is also linked to better survival outcomes (1). Nevertheless, BCS per se might not be the ideal option in terms of aesthetic outcomes, sexual wellbeing or overall quality of life in certain patient subgroups, particularly those with multicentric tumours or large tumour-to-breast size ratios (2).

As a result, oncoplastic breast surgery (OPBS) has become the standard of care in the management of patients with BC. OPBS combines tumour resection and plastic surgery techniques to enable immediate reconstruction of defects resulting from BCS. OPBS permits the removal of large tumours while maintaining breast shape and symmetry, thus being associated with better aesthetic outcomes, higher patient satisfaction and improved quality of life (3). This integrated approach has been shown to enhance surgical and cosmetic results without compromising the oncological outcome (4). Furthermore, it has been demonstrated to lower the re-excision rate of BCS (4).

OPBS techniques can be categorised into volume-displacement and volume-replacement procedures. Volume displacement involves advancing, rotating, or transposing a large portion of breast tissue to fill the defect caused by a partial mastectomy. This technique is more appropriate for small- to medium-sized defects. Common examples of volume-displacement procedures include reduction mammoplasty and mastopexy. Conversely, for larger defects, higher tumour-to-breast ratios or women with insufficient residual breast tissue for rearrangement, volume replacement techniques are preferred (5). A common example is the use of the latissimus dorsi (LD) myocutaneous flap. The LD flap has long been a fundamental method for both complete and partial (mini-LD flap) breast reconstruction. However, LD volume replacement can cause functional donor-site morbidity, such as functional impairment of corresponding shoulders, and an increased rate of wound complications such as seroma (6).

These limitations of myocutaneous flaps, combined with increased understanding of chest wall perforator anatomy, have led to the rising use of chest wall perforator flaps (CWPFs) in partial reconstruction procedures (7).

CWPFs are muscle-sparing flaps that use skin and subcutaneous fat from the chest wall and are supplied by perforating vessels arising from underlying arteries, such as the lateral thoracic, thoracodorsal, and intercostal arteries. CWPF is proven to be an excellent choice for improving aesthetic outcomes, reducing mastectomy rates and lowering donor-site morbidity associated with conventional myocutaneous flaps (8).

Despite the well-known benefits and widely recognised value of CWPFs for breast reconstruction, they remain relatively new and are not yet broadly adopted. Furthermore, data concerning their use and clinical outcomes, particularly in the Middle East and North Africa (MENA) region and Jordan, are limited. This gap emphasises the need to implement CWPFs and evaluate their effectiveness across diverse clinical settings. Consequently, this retrospective descriptive single-centre case series aimed to examine the functional, cosmetic, and surgical outcomes of CWPF reconstruction at the Military Cancer Centre (MCAC) in Jordan and to highlight the versatile roles of CWPFs beyond conventional volume replacement. To our knowledge, this is the first single-centre case series from Jordan and the MENA region to illustrate both conventional and emerging indications for CWPFs, including implant salvage, wound closure, and deformity correction.

Materials and Methods

Ethical Considerations

This study was approved by the Ethics Review Board of Military Cancer Center Royal Medical Services, Amman, Jordan (approval number: 8/2025, date: 17.06.2025). Informed consent was obtained from all participants, and written informed consent for the publication of clinical photographs was acquired from all patients.

Study Design and Setting

This retrospective, descriptive case series included all patients who underwent OPBS using CWPFs between December 2017 and January 2025 at the MCAC of the Jordanian Royal Medical Services. The study aimed to describe institutional experience with CWPF across reconstructive indications, rather than to compare outcomes with alternative reconstructive techniques.

Inclusion Criteria

All patients who underwent BCS with immediate or delayed CWPF reconstruction at the MCAC during the predefined period were included in the study. Moreover, patients with all reconstructive indications were considered: volume replacement, implant coverage or salvage, wound closure, and correction of deformities. No exclusion criteria were applied, as all patients undergoing CWPF at MCAC were included.

In routine practice, candidates for CWPF reconstruction are selected based on defect characteristics and reconstruction requirements. Therefore, a comprehensive pre-operative assessment is vital and should include clinical evaluation of breast size, ptosis grade, tumour location and size, as well as Doppler mapping of the perforators.

Preferred factors for using CWPF include small-to-moderate breast size, no or mild ptosis, tumour location suitable for perforator coverage, a small tumour-to-breast ratio, and defect volumes not exceeding one-quarter of the breast parenchyma.

Patient-related factors, such as comorbidities, especially smoking, diabetes, and obesity, are also carefully evaluated. However, selected patients with these risk factors may still be considered suitable candidates if a preoperative Doppler assessment confirms reliable, well-perfused perforators.

Data Collection

Data were collected from the hospital's electronic records, multidisciplinary team meeting reports, and physicians' notes. The data were then entered into Microsoft Excel spreadsheets.

The collected data were categorised into four sections. The first section included patients' demographics and medical history. The second section covered tumour characteristics: laterality, location, focality, histological type and grade, receptor status, Breast Imaging Reporting & Data System category, and the Nottingham prognostic index. The third section contained operative details, including the type of oncologic procedure (wide local excision, simple mastectomy, nipple-sparing mastectomy, and axillary surgery), flap type, size, technique, specimen weight, and the size of the invasive component. The fourth section collected data on post-operative complications, length of hospitalisation, adjuvant treatments, re-excision rate, and cosmetic satisfaction scores.

Operative Technique

Pre-operative Preparation

Breast and flap markings were performed for all patients during preoperative preparation. The inframammary fold, lateral mammary fold, and anterior axillary line were marked. Surgical markings were tailored to each case based on the anatomical and reconstructive requirements.

For example, Figure 1 illustrates the markings performed for a patient with an upper outer quadrant tumour. The figure depicts the midline and sternal notch markings, the planned tumour location, expected resection zone and the flap-specific markings, which included perforator mapping along the mid-axillary line between the 5th and 8th intercostal spaces as well as markings of the lateral breast border and projected flap skin paddle. Other possible markings needed in some cases included the breast meridian from the midpoint of the clavicle through the nipple, the boundaries of the nipple-areolar complex, the degree of nipple ptosis based on the Regnault classification, the skin excision markings if the oncologic resection was expected to include the skin, and the areas requiring skin replacement if a skin island was planned (some of which are shown in the figures presented in the results section).

A handheld Doppler was used to identify the perforators. The flap was shaped to include the identified perforator. The flap size was determined based on the expected defect size, while ensuring primary closure of the donor site.

Tumour factors (location, multifocality/multicentricity, histology, estimated defect size and nipple ptosis grade), treatment pathway (surgery upfront versus after neoadjuvant systemic therapy), and patient-related variables [body mass index (BMI), smoking status, breast size, diabetes mellitus and comorbidities] were considered in the decision to proceed with CWPF reconstruction and in the choice of flap.

Oncologic Resection and Flap Harvest and Inset

The oncologic breast resection/BCS procedures were performed by specialised breast surgeons, following institutional guidelines. Preoperative imaging and intraoperative observations guided both the extent of resection and the resulting defect size. The defect size was initially estimated preoperatively based on imaging and physical examination, and then precisely determined during surgery, after tumour removal.

Flaps were designed based on the perforator location and reconstructive needs. Various types of flaps were utilised in this study, each serving a specific purpose.

- Intercostal artery perforator flap: this category included the lateral intercostal artery flap (LICAP), the anterior intercostal artery flap (AICAP), and the medial intercostal artery flap (MICAP).

- The thoracodorsal artery perforator flap (TDAP) was harvested as a turnover or propeller flap and utilised for volume restoration, implant coverage, implant salvage, wound closure, or deformity correction.

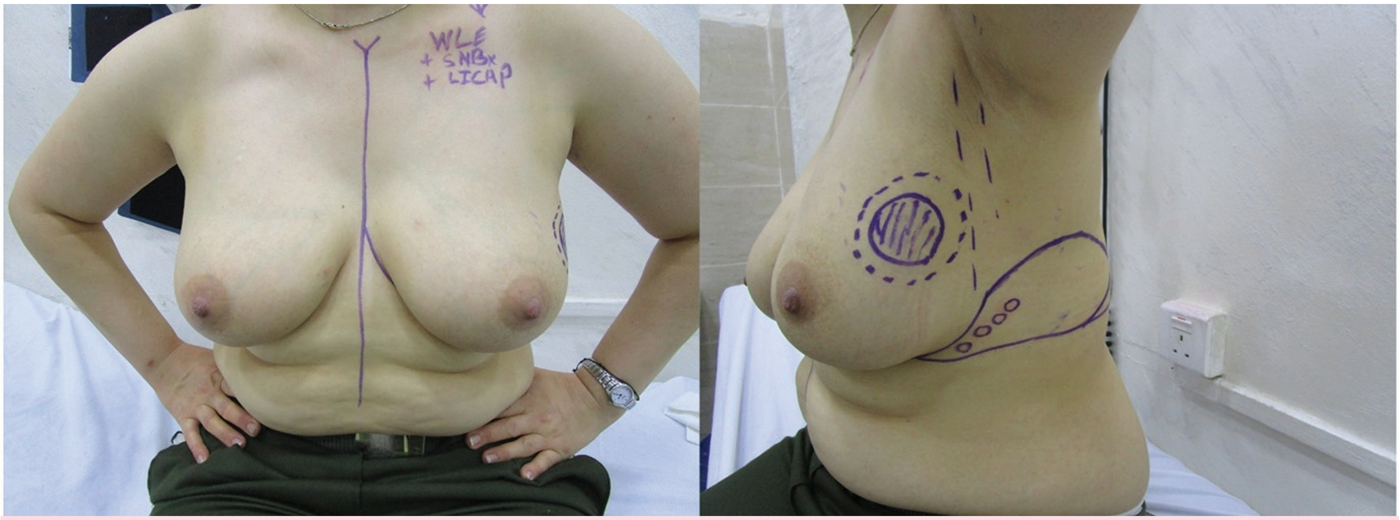

Figure 1. Pre-operative marking for LICAP flap partial breast reconstruction. Frontal and lateral views demonstrate key anatomical landmarks, including the midline, inframammary fold, anterior axillary line, and tumour location. The planned LICAP flap design is illustrated, with perforators identified preoperatively using handheld Doppler and marked accordingly

LICAP: Lateral intercostal artery flap

Flap Selection

LICAP flaps are commonly used for reconstructing defects in the outer quadrant of the breast. When additional volume is required, they can be combined with lateral thoracic artery perforator (LTAP) flaps to increase the bulk of the transferred tissue. Although used less frequently, LICAP flaps can be employed for inner-quadrant defects in selected cases involving small-to-moderate breasts, especially when adequate perforator length and reach are available. LICAP flaps are highly versatile and can be customised to meet individual reconstructive needs, whether the aim is volume replacement alone or with the inclusion of a skin island.

In comparison, MICAP and AICAP flaps have similar features but are less versatile and generally provide a smaller tissue volume. These flaps are mainly used for medial and lower quadrant defects. The flaps are especially useful for restoring volume and soft-tissue coverage in the medial and inferior parts of the breast, which are often challenging to address with LICAP or TDAP flaps.

The TDAP flap is particularly useful for addressing lateral breast defects. However, it is larger and its perforators reach farther, making it highly valuable in various settings. In addition to volume replacement, it can serve multiple functions, including covering implants, aiding wound closure, assisting in salvage procedures, and correcting contour deformities. Overall, TDAP flaps are beneficial when increased tissue volume, greater reach, or reliable wound closure are required, particularly when LICAP flaps are unsuitable.

Outcome Measures

All patients were followed up regularly at 1 week, 2 weeks, 1 month, 3 months, and 1 year.

Surgical Outcomes

Surgical outcomes included flap viability, short- and long-term complications (such as hematoma, necrosis, infection, and atrophy), re-operation, and oncological safety (margin status).

Oncological outcomes, re-excision rates, and mastectomy rates were also reported.

Cosmetic Outcomes

Patient satisfaction with the cosmetic result was evaluated using a five-category scale (very poor, poor, fair, good, and excellent). Patients were asked to rate their overall postoperative satisfaction with breast volume, shape, and symmetry.

Statistical Analysis

Data were analysed using SPSS (version 27; IBM, Armonk, NY, USA). Given the descriptive nature of the study and the absence of a comparison group, analyses were primarily descriptive and were reported as frequencies, percentages and means ± standard deviations. In addition, 95% confidence intervals (CIs) were calculated for key outcome proportions, including overall complication and flap loss rates.

Results

Patient Demographics and Clinical Features

A total of 69 patients underwent oncoplastic surgery with CWPF during the study period, with a median follow-up of 12 months. The mean age was 42.87±7.29 years. The average BMI was 25.56±3.92 kg/m². Most patients had no significant medical comorbidities, and the prevalence of smoking was 11.6%. Patient characteristics are summarised in Table 1.

Tumour Characteristics

Tumour laterality was balanced, with 56.5% occurring in the right breast and 43.5% in the left breast. Most tumours were located in the upper outer quadrant (63.8%), followed by the lower inner (10.1%), the upper inner (5.8%), the lower outer (4.4%) quadrants. Only one patient had a centrally located tumour. Approximately seven tumours were multicentric, involving multiple quadrants.

Most patients (69.6%) had unifocal disease, whereas multifocal and multicentric disease accounted for 17.4% and 10.1%, respectively. Two patients had previously undergone a mastectomy and therefore were excluded from location and nipple ptosis assessments.

Evaluation of nipple ptosis indicated that grade II was the most common category (59.4%), followed by grade I (27.6%) and grade III (10.1%).

Invasive ductal carcinoma was the most common histological diagnosis (85.5%). The other cases included ductal carcinoma *in situ*, invasive lobular carcinoma, lobular carcinoma *in situ,* phyllodes tumour, and one case of squamous cell carcinoma with lung metastasis. The other metastatic case also involved a fungating mass. Although metastasis is a contraindication to surgery, the procedure was performed as a palliative measure to control ulceration and bleeding. Other tumour characteristics are summarised in Table 2.

Table 1. Patient demographics and clinical characteristics

Variable	***n* = 69 (%)**
Age (years)	42.87±7.29
BMI (kg/m²)	25.56±3.92
Smoking status	
Smoker	8 (11.6)
Non-smoker	61 (88.4)
Comorbidity	
None	58 (85.6)
DM ± HTN	6 (8.7)
Hypothyroidism	2 (2.9)
Osteoporosis	1 (1.4)
Heart failure	1 (1.4)
Method of diagnosis	
Screening	2 (2.9)
Symptomatic	67 (97.1)

Data are presented as *n* (%) for categorical variables and mean ± standard for continuous variables. BMI: Body mass index; DM: Diabetes mellitus; HTN: Hypertension

Surgical and Perioperative Parameters

Wide local excision was performed in 85.5% of cases. Simple mastectomy and nipple-sparing mastectomy were performed in 3 (4.3%) and 2 (2.9%) cases, respectively. Five patients had previously undergone their primary oncological surgery and had received CWPF reconstruction for other indications, as described in the following section. Sentinel lymph node biopsy was performed in 42.0% of cases, and axillary lymph node clearance was performed in 49.3%. Only one patient (1.4%) underwent axillary lymph node sampling.

The average post-operative hospital stay was 3.26±7.35 days, and none of the patients required margin re-excision. Table 3 presents additional therapeutic details.

Utilisation and Roles of CWPF

Within our cohort, CWPFs demonstrated significant versatility across various reconstructive applications (Table 4). Flap sizes ranged from 7 cm to 14 cm; most (75.4%) were performed using a turnover technique, and the remaining 24.6% were performed as propeller flaps, mainly when a skin island was necessary.

LICAP flaps constituted the majority of reconstructions (78.3%) and were primarily used for volume replacement in outer-quadrant tumours; they were occasionally used in other cases, such as implant salvage and corrective surgery (see Table 4 for details). One combined LICAP-LTAP flap was utilised in a patient with a large defect in the upper outer quadrant. For implant coverage and wound closure, TDAP flaps were employed, representing 11.6% of cases. MICAP (7.3%) and AICAP (1.4%) were utilised for inner-quadrant reconstructions where the reach of LICAP is limited.

All procedures were performed as single-stage operations.

Volume Replacement (*n* = 58, 84.1%)

Volume replacement was the most common reason for CWPF in this cohort (84.1%). Tumours located in the outer quadrants were the predominant type, occurring in 47 patients, and these were reconstructed using LICAP flaps. Both unifocal and multifocal tumours were observed among these patients. An example of such a case is shown in Figure 2. One case involved using LTAP in addition to LICAP, owing to a larger defect.

Table 2. Tumour characteristics

Variable	*n* = 69 (%)
Site	
Left	30 (43.5)
Right	39 (56.5)
Tumour location	
Central	1 (1.4)
Lower inner	7 (10.1)
Lower outer	4 (5.8)
Upper inner	4 (5.8)
Upper outer	44 (63.8)
Multiple quadrants	7 (10.4)
NA (post mastectomy)	2 (2.9)
Disease extent	
Unifocal	48 (69.6)
Multifocal	12 (17.4)
Multicentric	7 (10.1)
Not applicable (post mastectomy)	2 (2.9)
Nipple ptosis grade	
I	19 (27.6)
II	41 (59.4)
III	7 (10.1)
Post mastectomy	2 (2.9)
BIRADS	
2	1 (1.4)
3	2 (2.9)
4	12 (17.4)
5	30 (43.5)
6	24 (34.8)
Distant metastasis	2 (2.9)
Histological type	
DCIS	5 (7.2)
IDC	59 (85.5)
ILC	2 (2.9)
LCIS	1 (1.4)
Phyllode tumour	1 (1.4)
Skin SCC	1 (1.4)
Grade	
1	5 (7.2)
2	25 (36.2)
3	31 (45.0)
NA (not invasive carcinoma)	8 (11.6)
NPI	4.2±1.8
Tumour receptor status	

Table 2. Continued

Variable	*n* = 69 (%)
HR +ve HER2 –ve	33 (47.9)
HR +ve HER 2 +ve	11 (15.9)
HR –ve HER2 +ve	5 (7.2)
HR –ve HER2 –ve	12 (17.4)
NA (Histologic type - not invasive carcinoma)	8 (11.6)

Data are presented as *n* (%) for categorical variables and mean ± standard for continuous variables. BIRADS: Breast Imaging Reporting & Data System; DCIS: Ductal carcinoma *in situ*; HER2: Human epidermal growth factor receptor 2; HR: Hormone receptor; IDC: Invasive ductal carcinoma; ILC: Invasive lobular carcinoma; LCIS: Lobular carcinoma *in situ*; NA: Not applicable; phyllodes tumour, fibroepithelial tumour of the breast; SCC: Squamous cell carcinoma

Table 3. Surgical and treatment characteristics of the study cohort

Variable	*n* = 69 (%)
Oncologic surgery	
WLE	59 (85.5)
Simple mastectomy	3 (4.3)
NSM	2 (2.9)
None	5 (7.2)
Surgery on the axilla	
ANC	34 (49.3)
ANS	1 (1.4)
SNLBx	29 (42.0)
No axillary surgery	5 (7.2)
Specimen weight (g) (WLE specimen)	160±95.151
Size of invasive component (cm)	2.62±3.61
Post-operative hospital stay	3.26±7.35
Neoadjuvant chemotherapy	36 (52.2)
Adjuvant chemotherapy	38 (55.1)
Adjuvant radiotherapy	67 (97.1)
Adjuvant hormonal therapy	49 (71.0)
Adjuvant biologic treatment	16 (23.2)

Data are presented as *n* (%) for categorical variables and mean ± standard deviation for continuous variables. ANC: Axillary lymph clearance; ANS: Axillary lymph node sampling; NSM: Nipple-sparing mastectomy; SLNBx: Sentinel lymph node biopsy; WLE: Wide local excision

Conversely, tumours in the inner quadrants were managed using MICAP (n = 5), LICAP (n = 4), and AICAP (n = 1) flaps; one case with tumour skin invasion required a skin island to replace the involved skin defect. Figure 3 illustrates the MICAP flap used for an inner-quadrant tumour.

In one instance, CWPF was utilised for a centrally located tumour. A LICAP flap was employed for this case, with a skin island used alongside the flap to cover the central defect and the involved nipple-areolar complex. Figure 4 shows preoperative, intraoperative, and postoperative photographs of this case. The outcomes were satisfactory at follow-up.

Implant Coverage (n = 3, 4.3%)

TDAPs were utilised in three patients as an alternative to mesh for providing soft-tissue coverage of the breast implant. Two of these cases involved immediate reconstruction following a nipple-sparing mastectomy, while the third case involved delayed reconstruction after a previous mastectomy for a phyllodes tumour. Figure 5 illustrates the use of the TDAP flap for breast implant coverage, whereas Figure 6 demonstrates its application for nipple-sparing mastectomy.

All of them reported a satisfactory aesthetic outcome, according to the patient. No complications were reported on follow-up.

Implant Salvage (n = 2, 2.9%)

LICAP flaps with skin islands were utilised were utilised for breast implant salvage in cases of implant extrusion post radiotherapy and wound dehiscence (shown in Figure 7) to prevent implant loss and restore soft tissue coverage.

Correction Surgery (n = 1, 1.4%)

A LICAP flap was used to correct a bird-beak deformity in a patient who had previously undergone a wide local excision of the left breast with involved margins and later presented with deformity

Table 4. Indications and characteristics of CWPF

Flap type	*n* (%)	Indication	*n*	Technique Turned over: 52 (75.4%) Propeller: 17 (24.6%)
LICAP	54 (78.3)	Volume replacement/outer quadrants	46	3 propeller, 45 turned over
		Volume replacement/inner quadrants	4	Turned over
		Volume replacement/central defect	1	Propeller
		Implant salvage	2	Propeller
		Deformity correction	1	Propeller
LICAP + LTAP	1 (1.4)	Volume replacement (large outer-quadrant defect)	1	Turned over
TDAP	8 (11.6)	Implant coverage	3	Propeller
		Wound closure	5	Propeller
MICAP	5 (7.3)	Volume replacement/inner quadrant	5	2 propeller, 3 turned over
AICAP	1 (1.4)	Volume replacement/inner quadrant	1	Turned over

Data are presented as *n* (%) for categorical variables and mean ± standard for continuous variables. AICAP: Anterior intercostal artery perforator; LICAP: Lateral intercostal artery perforator; LTAP: Lateral thoracic artery perforator; MICAP: Medial intercostal artery perforator; TDAP: Thoracodorsal artery perforator

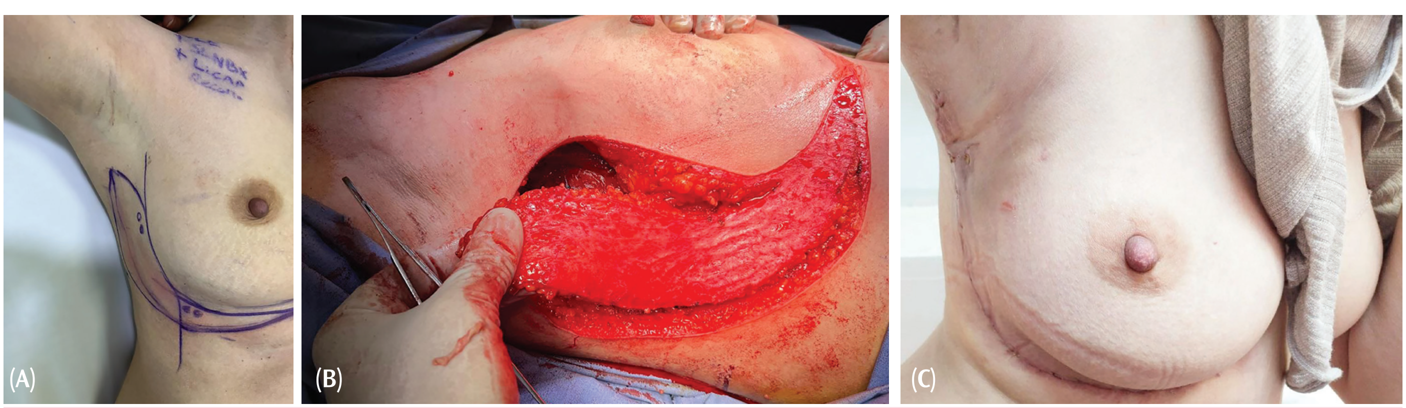

Figure 2. Use of the LICAP flap for volume replacement following resection of the outer quadrant tumour. (A) Pre-operative marking for LICAP flap (B) Intra-operative preparation of the de-epithelized LICAP flap, and (C) Post-operative outcome at 2-week follow-up

LICAP: Lateral intercostal artery flap

at the 6 o'clock position (as shown in Figure 8). Therefore, she underwent an oncological wide local excision combined with correction of the deformity.

Wound Closure (n = 5, 7.2%)

TDAP flaps were also utilised in five cases for wound closure, allowing immediate closure of extensive defects, including four cases following toilet mastectomy for large fungating tumours (example shown in Figure 9), and one case following excision of a recurrent right chest wall tumour, in which lesions were removed and a TDAP flap was employed for wound closure (shown in Figure 10).

Post-operative Complications

Post-operative complications were minimal in this cohort, occurring in 4 of 69 patients (5.8%, 95% CI: 2.3–14.1). One patient experienced a post-operative haematoma a few days after surgery and underwent haematoma evacuation. Another patient presented with significant atrophy and was managed conservatively. Partial necrosis was observed in two cases; both were treated conservatively and did not require further intervention. No flap loss was observed in any of the cases (0%; 95% CI: 0–5.2).

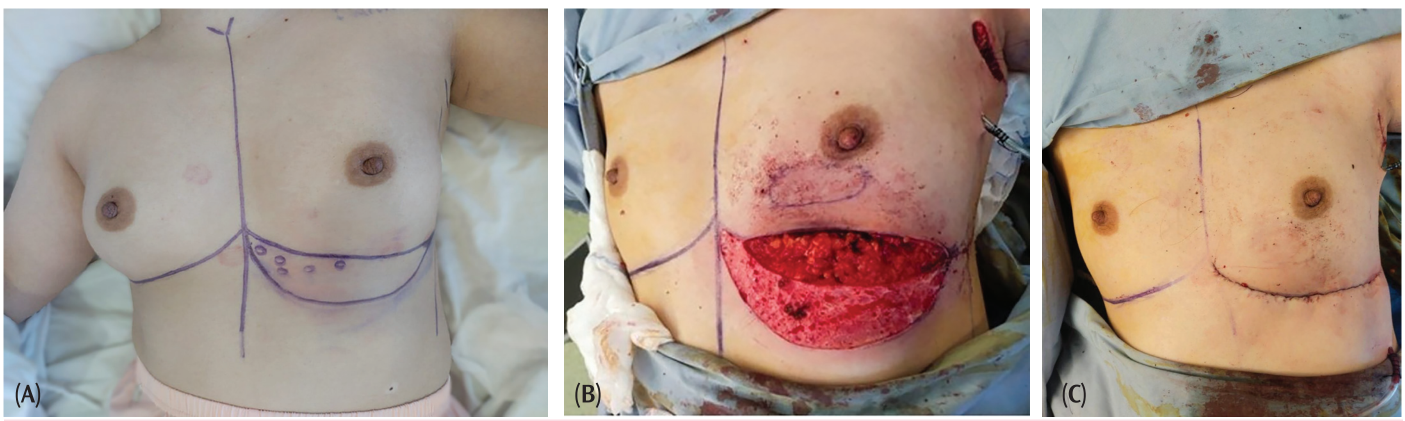

Figure 3. Use of the MICAP flap for volume replacement following resection of lower inner quadrant tumour. (A) Pre-operative marking outlining MICAP flap design with perforators identified and marked using hand-held Doppler, (B) Intra-operative view demonstrating the preparation of the MICAP flap, and (C) Immediate post-operative outcome showing satisfactory contour restoration

MICAP: Medial intercostal artery flap

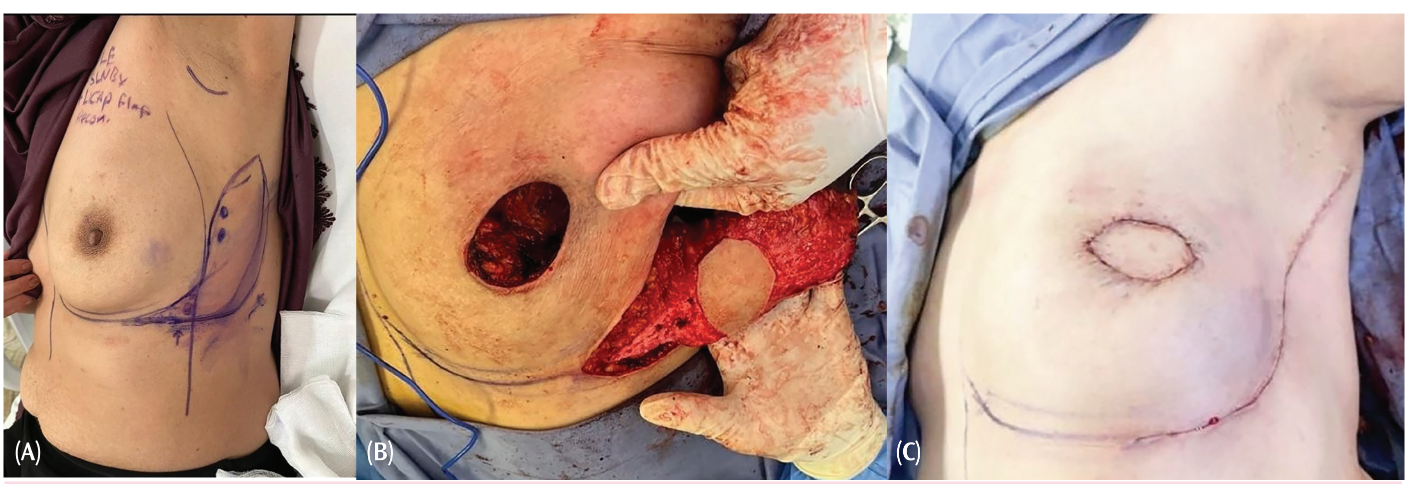

Figure 4. Use of the LICAP flap for volume replacement for a centrally located tumour. (A) Pre-operative marking for LICAP flap along with key anatomic landmarks. (B) Intraoperative preparation of LICAP flap with skin island designed to replace to replace the nipple-areola complex. (C) Immediate post-operative outcome

LICAP: Lateral intercostal artery flap

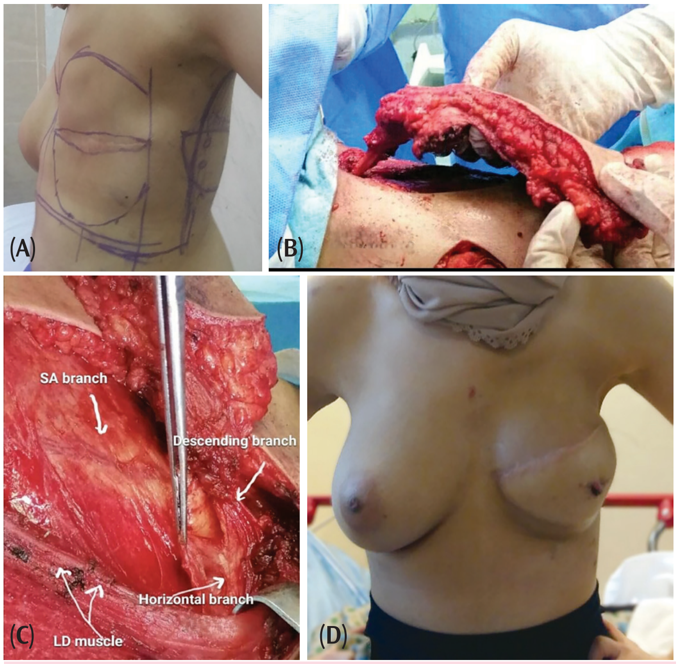

Figure 5. Using the TDAP flap with a skin island in a delayed reconstructive procedure to cover the implant. (A) Pre-op marking for TDAP flap and key anatomic landmarks and perforators, (B) Intraoperative illustration of TDAP flap with its skin island. (C) Intraoperative view demonstrating the thoracodorsal vascular pedicle and its branching pattern. The descending and horizontal branches of the thoracodorsal artery are clearly visualized, along with a serratus anterior branch. The latissimus dorsi muscle is exposed, serving as an anatomical landmark. These structures guide perforator selection and dissection during TDAP flap elevation. (D) Appearance at 1-year follow-up

TDAP: Thoracodorsal artery perforator flap

Cosmetic and Functional Results

The perceived satisfaction with the cosmetic outcome was assessed using a simple patient satisfaction score. Approximately 42% reported excellent satisfaction, while 44.9% reported good cosmetic results. Fair outcomes were reported by 13% of patients, and no patients reported poor outcomes.

Discussion and Conclusion

This retrospective, single-centre study is the first large series to report the use of CWPF in breast reconstruction surgery in the region. Among the 69 patients who underwent CWPF reconstruction, the LICAP flap was used most frequently (78.3%), primarily for outer-quadrant volume replacement. All procedures were performed in a single stage, and no cases required margin re-excision, indicating a high level of oncological safety. Notably, CWPFs were also employed for novel indications such as implant salvage and wound closure, which are less commonly reported in the literature. Furthermore, a low overall complication rate and high patient satisfaction were observed. As expected for a case series, this study did not include a comparison group and aimed to reflect institutional experience with CWPF reconstruction rather than to establish comparative effectiveness against other reconstructive methods.

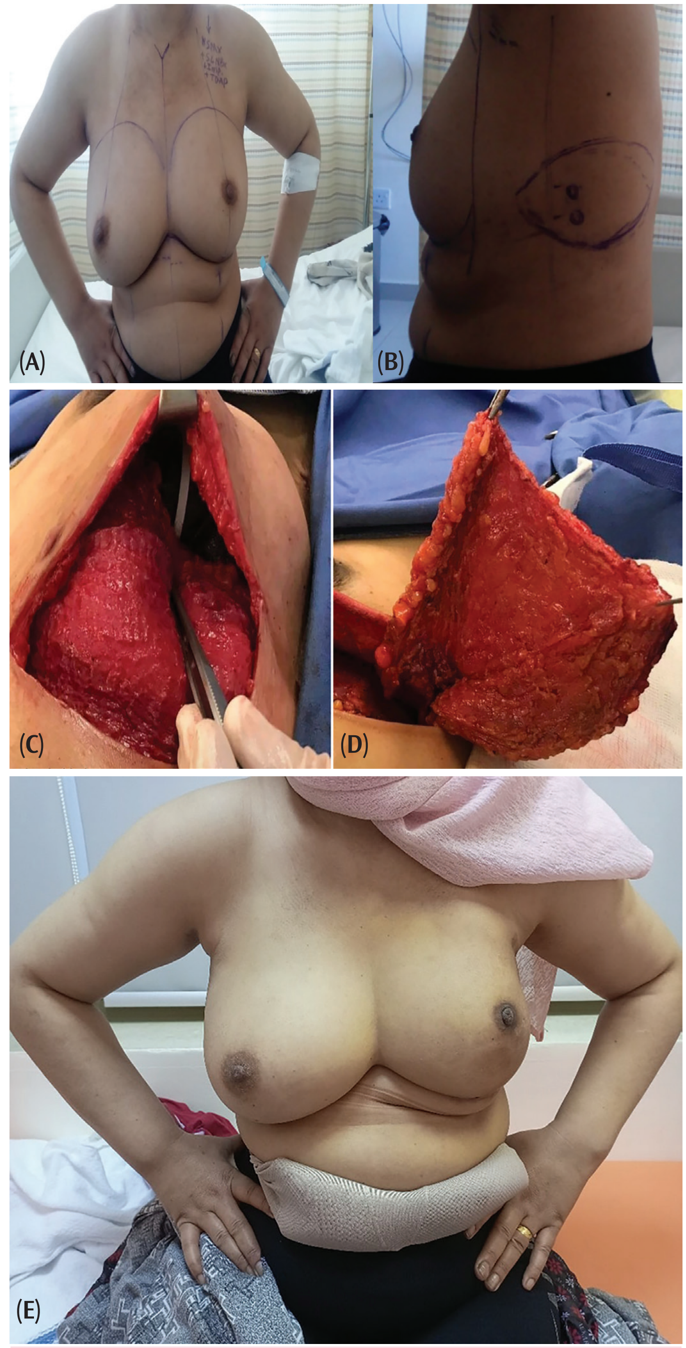

Figure 6. Use of the TDAP with nipple-sparing mastectomy in an immediate reconstructive procedure to cover the implant. (A-B) Pre-operative marking, (C-D) Intraoperative view of TDAP flap providing soft tissue coverage over the implant, (E) Clinical outcome at 1-year follow-up, demonstrating satisfactory contour and symmetry

TDAP: Thoracodorsal artery perforator flap

The reported use of CWPFs in our cohort aligns with global trends and supports their muscle-sparing and aesthetic benefits, as well as minimal donor-site morbidity. The anatomical reliability and reconstructive value of CWPFs in breast surgery have previously been emphasised by McCulley et al. (9) and Hamdi et al. (10). Nevertheless, our study broadens the application of CWPFs to reconstructive procedures following mastectomy and implant salvage scenarios, whereas most of the literature discusses their use for volume replacement in BCS.

The reliable vascular supply and muscle-sparing nature of CWPFs make them suitable for breast reconstruction. CWPFs are tissues supplied by perforator vessels. Harvesting these flaps focuses on preserving the muscle and nerves, making them a good alternative to muscular flaps, which can cause significant donor site morbidity (10). Various types of flaps have been documented for BCS in the literature (LICAP, TDAP, LTAP, AICAP and MICAP) (11, 12), and the choice depends on the tumour size, location and surgical goals. The LICAP flap, based on the lateral intercostal artery perforator, was first reported for use in breast reconstruction by Hamdi et al. (7). Thus far, it is the most widely used flap type overall (11). This widespread use can be attributed to most BCs being located in the upper outer quadrant, where the proportion of breast tissue is higher. Consistent with the literature, this study found that LICAP was the predominant type used in the cohort of outer-quadrant tumours. Furthermore, this study demonstrated the versatility of LICAP flaps in breast reconstruction: they were utilised for volume replacement in inner-quadrant and centrally located tumours. Furthermore, these flaps were employed for implant salvage and for delayed

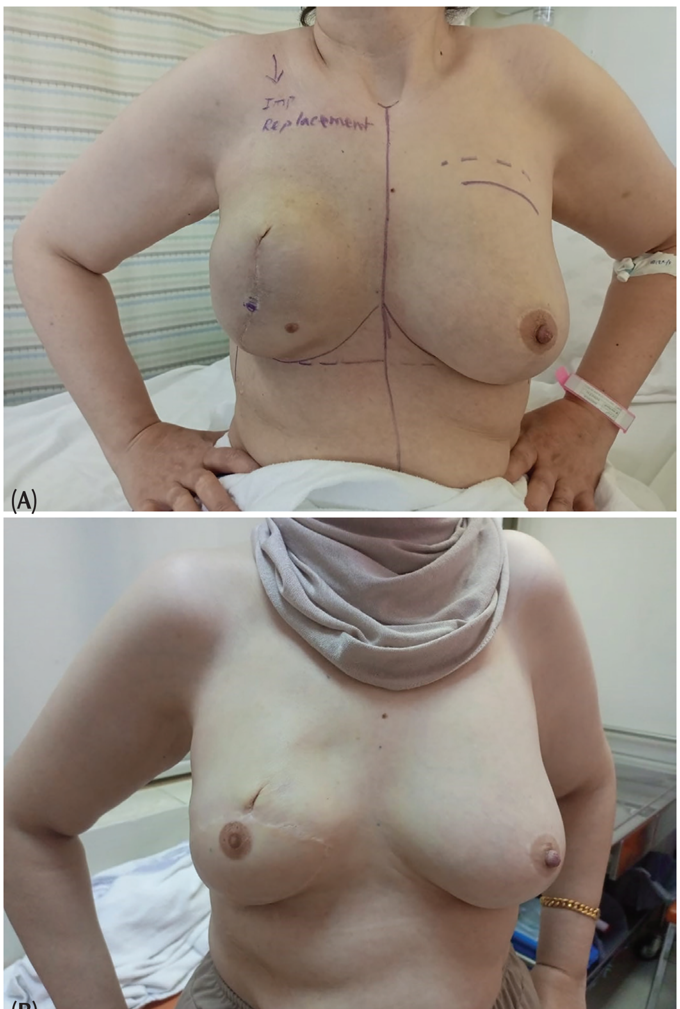

Figure 7. Use of the LICAP flap with a skin island for implant coverage following wound dehiscence and implant extrusion post radiotherapy treatment. (A) Pre-operative photo showing the right breast after skin-sparing mastectomy with implant-based reconstruction, complicated by implant extrusion and dehiscence; (B) Postoperative outcome at 1-year follow-up demonstrating durable coverage and nipple-areola complex tattooing

LICAP: Lateral intercostal artery flap

Figure 8. Use of the LICAP in deformity correction surgery. (A) Pre-operative frontal and lateral views demonstrating a lower pole bird beak deformity in the lower part of the left breast, (B) Clinical outcome at 1-year follow-up, showing restoration of breast contour and symmetry with excellent aesthetic result and deformity corrected along with negative margins

LICAP: Lateral intercostal artery flap

Figure 9. Use of the TDAP for wound closure after a toilet mastectomy for a large fungating mass. (A) Pre-operative view showing an extensive ulcerated fungating tumour involving the right breast, (B) Intraoperative image showing elevation and preparation of TDAP flap for reconstruction of chest wall defect (C) Immediate post-operative result showing the TDAP flap with skin island successfully inset to achieve tension-free closure of the defect

TDAP: Thoracodorsal artery perforator flap

surgery to correct breast deformity. This finding aligns with the literature, in which LICAP flaps have been used for various indications, including immediate reconstruction for volume replacement, implant salvage, wound dehiscence and deformity correction (13-15).

The LTAP flap is based on one or more perforators of the lateral thoracic vessels; it is mainly used in conjunction with the LICAP flap (9, 11) but can also be used alone (9, 11). In this study, LTAP was utilised in only one case involving a large tumour, together with the LICAP flap, to enhance perfusion and volume.

The AICAP flap, based on the anterior intercostal artery perforators, is typically used for tumours in the outer lower quadrant and for immediate reconstruction (16-18). Its use in implant coverage and wound dehiscence has also been recently documented (15, 19, 20). Lower-quadrant tumour resection is linked to the bird's beak deformity. This issue has been addressed in OBS using CWPFs. However, in cases of large tumours, insufficient tissue may still result in poorer cosmetic outcomes. Denning et al. (17) have therefore described a modification of the AICAP harvest technique that makes AICAP a viable option even for large lower-quadrant tumours. This study reports the use of AICAP for volume replacement of an inner lower quadrant tumour.

Ribuffo et al. (21) reported using a combination of LICAP and AICAP to restore breast volume and shape across multiple regions without requiring an implant. This technique could be utilised in OBS for cases involving multifocal or multicentric disease.

The use of MICAP flaps, based on the medial intercostal artery perforator, is less commonly reported in the literature (11, 12, 22). These flaps are employed for inner-quadrant tumours, as demonstrated in this study, in which MICAP was used to replace volume in a case of a lower inner-quadrant tumour. Despite limited data on MICAP use, some reports indicate that it has been utilised for purposes beyond volume replacement, such as implant salvage (14). MICAP has also been reported to be used in complete breast reconstruction after nipple-sparing mastectomy, in combination with LICAP (14).

The TDAP flap is based on one or more subcutaneous perforators that arise from the thoracodorsal artery, usually from its descending branch, supplying the skin and subcutaneous tissue without involving the LD muscle (23). The TDAP harvest is generally more complex and demands more detailed pre-operative Doppler mapping than LICAP (24). The use of TDAP has been reported for volume replacement and implant-based reconstruction, with high reliability and low complication rates and morbidity (25). Additionally, TDAP flaps have been used for implant coverage, salvage and managing wound dehiscence (25-27). In this study, TDAP was used for wound closure and implant coverage when LICAP flaps were not feasible.

Figure 10. Reconstruction of right chest wall defect using TDAP flap following excision of recurrent chest wall lesions. (A) Pre-operative view showing recurrent lesions at the right lateral chest wall, (B) Intraoperative image demonstrating the elevated TDAP flap with adequate perfusion and thickness for defect coverage, (C) Immediate post-operative appearance showing tension free closure of the defect with a well-vascularized skin island

TDAP: Thoracodorsal artery perforator flap

This study reports a low incidence of post-operative complications (5.8%), which is at the lower end of the rates reported in the literature (4.3–15%) (11, 12, 22, 28). Notably, a recent (2025) meta-analysis documented a pooled complication rate of 13% (29). This study also observed 0% re-excision rate and 0% flap loss compared with 1% and 12.9%, respectively, reported in the meta-analysis (29).

The cosmetic outcome was assessed postoperatively by reviewing patients' perceptions of breast volume, shape, and symmetry. Most patients reported excellent (42%) or good (45%) satisfaction levels; none reported poor outcomes. This finding aligns with previous studies that show favourable aesthetic results with CWPF reconstruction compared with mastectomy and volume displacement techniques (5) and high patient satisfaction (30). Nevertheless, an objective assessment of cosmetic outcomes, such as the BREAST-Q score, could have provided a more reliable evaluation and would be as important as assessing patient satisfaction.

Despite the well-documented surgical and cosmetic advantages of CWPFs, their use remains limited across the Arab and MENA regions. Therefore, providing institutional data and outcomes from a national centre encourages broader adoption and integration of CWPF techniques into routine breast reconstructive practice in similar healthcare settings. Consequently, a key strength of this study is its ability to address a significant regional gap. Furthermore, despite a relatively small sample size, this study demonstrates the versatility of CWPF across different indications within the contexts of OBS and BCS.

Study Limitations

The findings of this report are subject to certain limitations. First, the retrospective analysis confines data collection to previously recorded clinical data. Second, as previously discussed, cosmetic outcomes were assessed solely based on patient-reported satisfaction, as standardised objective or surgeon-based evaluation tools (e.g., BREAST-Q or BCCT. core) were not routinely employed during the study period. Additionally, the absence of pre-operative baseline satisfaction assessments limits our capacity to conduct pre- and post-operative comparisons. Moreover, the lack of a comparison group hampers direct comparison with other reconstructive approaches. Finally, the relatively small sample size from a single centre may restrict the generalisability of the reported low complication rate. Therefore, prospective multicentre studies incorporating standardised cosmetic evaluation tools and comparison groups are recommended to further validate these findings.

CWPFs offer a reliable muscle-sparing reconstructive option for patients with BC, yielding favorable surgical, cosmetic, and functional outcomes. This study demonstrates the versatility of CWPFs in BCS and their adaptability to novel clinical applications beyond conventional volume replacement, including implant coverage, salvage, wound closure, and deformity correction. It is the first study to present national data from Jordan, thereby filling a significant gap in the literature and underscoring the importance of adopting CWPF techniques widely across the MENA region. Additionally, this study highlights the benefits of CWPFs in BCS for improving patient satisfaction and cosmetic outcomes without compromising oncological safety.

Ethics

Ethics Committee Approval: This study was approved by the Ethics Review Board of Military Cancer Center Royal Medical Services, Amman, Jordan (approval number: 8/2025, date: 17.06.2025).

Informed Consent: Informed consent was obtained from all participants, and written informed consent for the publication of clinical photographs was acquired from all patients.

Footnotes

Authorship Contributions

Surgical and Medical Practices: S.H., M.A., A.K., A.B.F., M.B., Concept: S.H., A.K.; Design: M.A., M.I.B.D.; Data Collection or Processing: M.A., A.K., A.B.F., M.B., M.I.B.D.; Analysis or Interpretation: M.A., M.Y.A-N., Literature Search: M.A., A.K.; Writing: S.H., M.A., A.K., M.Y.A-N.

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

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

References

1. de Boniface J, Szulkin R, Johansson ALV. Survival after breast conservation vs mastectomy adjusted for comorbidity and socioeconomic status: a Swedish national 6-year follow-up of 48 986 women. JAMA Surg. 2021; 156: 628-637. (PMID: 33950173) [Crossref]
2. Duymus ME, Gumus S. Aesthetic outcomes of breast-conserving surgery and oncoplastic surgery with the new scale named quality of life questionnaire breast reconstruction module-23. Ann Surg Treat Res. 2023; 104: 249-257. (PMID: 37179696) [Crossref]
3. Gabriel A, Nahabedian MY, Maxwell GP, Storm T, editors. Spear's surgery of the breast: principles and art. 4th ed. Philadelphia: Wolters Kluwer, 2021. p.1500. [Crossref]
4. Chen JY, Huang YJ, Zhang LL, Yang CQ, Wang K. Comparison of oncoplastic breast-conserving surgery and breast-conserving surgery alone: a meta-analysis. J Breast Cancer. 2018; 21: 321-329. (PMID: 30275861) [Crossref]
5. Schaverien MV, Kuerer HM, Caudle AS, Smith BD, Hwang RF, Robb GL. Outcomes of volume replacement oncoplastic breast-conserving surgery using chest wall perforator flaps: comparison with volume displacement oncoplastic surgery and total breast reconstruction. Plast Reconstr Surg. 2020; 146: 14-27. (PMID: 32590634) [Crossref]
6. Lee KT, Mun GH. A systematic review of functional donor-site morbidity after latissimus dorsi muscle transfer. Plast Reconstr Surg. 2014; 134: 303-314. (PMID: 24732650) [Crossref]
7. Hamdi M, Van Landuyt K, de Frene B, Roche N, Blondeel P, Monstrey S. The versatility of the inter-costal artery perforator (ICAP) flaps. J Plast Reconstr Aesthet Surg. 2006; 59: 644-652. [Crossref]
8. Kabeer KK, Gowda S M, Jafferbhoy S, Marla S, Narayanan S, Soumian S. Impact of chest wall perforator flaps on rates of total mastectomy in breast cancer. Indian J Surg Oncol. 2022; 13: 488-494. (PMID: 36187523) [Crossref]
9. McCulley SJ, Schaverien MV, Tan VK, Macmillan RD. Lateral thoracic artery perforator (LTAP) flap in partial breast reconstruction. J Plast Reconstr Aesthet Surg. 2015; 68: 686-691. (PMID: 25660559) [Crossref]
10. Hamdi M, Van Landuyt K, Monstrey S, Blondeel P. Pedicled perforator flaps in breast reconstruction: a new concept. Br J Plast Surg. 2004; 57: 531-539. (PMID: 15308400) [Crossref]
11. Agrawal A, Romics L, Thekkinkattil D, Soliman M, Kaushik M, Barmpounakis P, et al; PartBreCon Collaborators. 'PartBreCon' study. A UK multicentre retrospective cohort study to assess outcomes following PARTial BREast reCONstruction with chest wall perforator flaps. Breast. 2023; 71: 82-88. (PMID: 37544090) [Crossref]
12. Pujji OJS, Blackhall V, Romics L, Vidya R. Systematic review of partial breast reconstruction with pedicled perforator artery flaps: clinical, oncological and cosmetic outcomes. Eur J Surg Oncol. 2021; 47: 1883-1890. (PMID: 33895022) [Crossref]
13. Retrouvey H, Mahoney MH, Pinchuk B, Jalil W, Somogyi R. The versatility of lateral chest wall perforator flaps in immediate and delayed breast reconstruction: retrospective study of clinical experience with 26 patients. Plast Surg (Oakv). 2023; 31: 261-269. (PMID: 37654533) [Crossref]
14. Laroiya I, Tan M, Zafar S, Shetty G. Pushing the boundaries of pedicled chest wall perforator flaps in oncoplastic breast surgery. Cureus. 2023; 15: e36686. (PMID: 37113375) [Crossref]
15. Mesa F, Mesa S, López F. Intercostal artery perforator flap for salvage breast reconstruction with exposed breast implants. Plast Reconstr Surg Glob Open. 2022; 10: e4548. (PMID: 36212083) [Crossref]
16. Adler N, Carmon E, Chapchay K, Billig A. Anterior intercostal artery perforator flap for immediate reconstruction following breast conservation surgery. Microsurgery. 2023; 43: 20-26. (PMID: 35312091) [Crossref]
17. Denning M, Hayes P, Tsang F, Leff D, Thiruchelvam P, Hadjiminas D. The modified crescenteric anterior intercostal perforator flap. Plast Reconstr Surg Glob Open. 2020; 8: e2785. (PMID: 33133888) [Crossref]
18. Katsuragi R, Zaha H, Koki A, Okiyama M, Abe N. Combination of hatchet and anterior intercostal artery perforator flaps in oncoplastic breast-conserving surgery. Plast Reconstr Surg Glob Open. 2025; 13: e7221. (PMID: 41078892) [Crossref]
19. Marruzzo G, Patanè L, Lo Torto F, Ribuffo D. New applications of the anterior intercostal artery perforator flap for prosthetic breast reconstruction in the setting of postoperative radiotherapy. Plast Reconstr Surg Glob Open. 2024; 12: e5957. (PMID: 38983947) [Crossref]
20. Miguel-Escuredo I, Cabañas-Weisz LM. Anterior intercostal artery flap for implant salvation procedure in aesthetic breast surgery. Case report. JPRAS Open. 2024; 42: 186-190. (PMID: 39398272) [Crossref]
21. Ribuffo D, Mosiello L, Abbaticchio D, Marcasciano M, Lo Torto F. Autologous breast augmentation combining the harvesting of the anterior intercostal artery perforator (AICAP) and lateral intercostal artery perforator (LICAP) flaps in massive weight loss patient: a case report. JPRAS Open. 2024; 41:110-115. (PMID: 38984324) [Crossref]
22. Karakatsanis A, Meybodi F, Pantiora E, Elder E, Cabel F, Hsu J, et al. Chest wall perforator flaps are safe and can decrease mastectomy rates in breast cancer surgery: multicentre cohort study. Br J Surg. 2024; 111: znae266. (PMID: 39485904) [Crossref]
23. Chartier C, Safran T, Alhalabi B, Murphy A, Davison P. "Locoregional perforator flaps in breast reconstruction: an anatomic review & quadrant algorithm". J Plast Reconstr Aesthet Surg. 2022; 75: 1328-1341. (PMID: 35181248) [Crossref]
24. Hashem T, Taha SN, Orabi A. LICAP versus TDAP for the reconstruction of partial breast defects. Indian J Surg Oncol. 2023; 14: 181-185. (PMID: 36891444) [Crossref]
25. Roshdy S, Fathi A, Wahab KA, Shams N, Abouzid A, Fathi A. Total breast reconstruction using synthetic implants covered by thoraco-dorsal artery perforator flap (TDAP). The Egyptian Journal of Surgery. 2022; 41: 1657-1665. [Crossref]

26. Nizamoglu M, Hardwick S, Coulson S, Malata CM. The use of the thoracodorsal artery perforator flap in both autologous and implant based breast reconstruction salvage surgery. Clinics in Surgery. 2020; 5. [Crossref]

27. Hamdi M, Salgarello M, Barone-Adesi L, Van Landuyt K. Use of the thoracodorsal artery perforator (TDAP) flap with implant in breast reconstruction. Ann Plast Surg. 2008; 61: 143-146. (PMID: 18650605) [Crossref]

28. Soumian S, Parmeshwar R, Chandarana M, Marla S, Narayanan S, Shetty G. Chest wall perforator flaps for partial breast reconstruction: surgical outcomes from a multicenter study. Arch Plast Surg. 2020; 47: 153-159. (PMID: 32203992) [Crossref]

29. Nava CM, Zinner G, Martineau J, Oranges CM. Chest wall perforator flaps in partial breast reconstruction: a systematic review and meta-analysis. Plast Reconstr Surg Glob Open. 2025; 13: e6996. (PMID: 40761627) [Crossref]

30. Kim JB, Kim DK, Lee JW, Choi KY, Chung HY, Cho BC, et al. The usefulness of pedicled perforator flap in partial breast reconstruction after breast conserving surgery in Korean women. Arch Plast Surg. 2018; 45: 29-36. (PMID: 29076314) [Crossref]