# Thoracodorsal-artery perforator flap as oncoplastic breast surgery

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**Background**
Breast-cancer surgery and management has evolved over years from radical mastectomies to breast-conserving surgeries, therefore, oncoplastic surgeries traditionally used volume-replacement muscle flaps as latissimus dorsi flaps that cause a lot of back morbidity and seromas the development of vascular surgery and Dopplers with perforator-vessel localization allowed for use of thoracodorsal vessel-perforator flaps in breast reconstruction.
**Aim**
To assess the use of thoracodorsal-artery perforator flap as oncoplastic procedure regarding intraoperative advantages, the postoperative complications, and benefits over traditional latissimus dorsi flap technique.
**Patients and methods**
A prospective cohort study was done at Ain Shams University Hospitals, including 20 patients with early-stage breast cancers who underwent breast-conservative mastectomies in the period between November 2019 and December 2021.
**Results**
In total, 20 patients underwent the procedure, the mean operative time was 200 min, five cases of complications occurred. A single case of mild wound infection, three cases of mild seroma occurred, and a single case of fat necrosis was managed conservatively. No flap loss occurred and all patients were satisfied with their outcome.
**Conclusion**
The thoracodorsal-artery perforator flap is a safe and reliable flap in reconstructive breast surgery with excellent outcomes as for satisfaction and minimal back morbidity.

**Keywords:**
breast-conservative surgery, oncoplastic surgery, reconstructive breast surgery, thoracodorsal perforator flap

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## Introduction

Breast cancer remains a major public health problem. The incidence is rising in most countries and is projected to rise further over the next 20 years, despite current efforts to prevent the disease [1].

The history of breast surgery has evolved over the past several decades, and now, breast-conserving surgery (BCS) followed by postoperative radiation therapy currently represents the standard of care for early-stage breast cancer [2].

Several studies have stated that BCS has the same overall and disease-free survival as compared with the mastectomies in early-stage breast cancers [1,3].

The significant developments in the surgical management of breast cancer have been paralleled by similar advancements in reconstructive surgery, and so, the advent of oncoplastic surgery has brought new dimensions to BCS and included the esthetic principles of breast surgery to cancer management [4,5].

The oncoplastic surgery includes either volume-replacement or volume-displacement techniques in order to reconstruct the breasts after tumor excision. These two methods are chosen according to the site of tumor, size, and breast characteristics [6]. Volume-displacement techniques involve use of breast tissue and glandular flaps to replace defects of excised tumors, while volume-replacement methods use local flaps to replace those defects.

BCS for early outer-quadrant breast cancers (most common site of breast cancer) can be reconstructed using volume-replacement methods that have evoluted

among the years from latissimus dorsi (LD) flap up to pedicled perforator flaps such as thoracodorsal-artery perforator (TDAP) flap, the intercostal-artery perforator flap, and long thoracic-artery perforator flap [7].

Although LD-flap superiority in being more simple, provides larger volume replacement, has reliable vascularity, it has other setbacks of causing marked morbidity of donor site, including limitation of shoulder movements and considerable amount of back seroma [8].

In 1995, Angrigiani and colleagues described the TDAP flap for the first time, including anatomy and sites of the perforators. However, Hamdi *et al*. [9] were the first to describe the use of TDAP in breast reconstruction in 2004.

The aim of this study was to assess the use of TDAP flap as oncoplastic procedure regarding intraoperative advantages, the postoperative complications, and benefits over traditional LD-flap technique.

## Patients and methods

This is a prospective cohort study done at Ain Shams University Hospitals, including 20 patients with early-stage breast cancers who underwent breast-conservative mastectomies in the period between November 2019 and December 2021, and will reconstruct the breast using TDAP flap.

Inclusion criteria were:

(1) All female patients of any age group with invasive mammary carcinoma who are candidates for breast-conservative surgery and need volume replacement to avoid contralateral breast reduction.
(2) Patients with UOQ/LOQ cancers.
(3) Patients with postneoadjuvent treatment.
(4) Patients with T1 and T2 breast cancer or less.

Exclusion criteria:

(1) Distant metastasis.
(2) Skin involvement of the tumor and chest-wall involvement.
(3) History of previously treated ipsilateral breast cancer.
(4) Inflammatory tumors and T4 breast cancer.

Approval of the Ethical Committee and written informed consent from all participants was obtained.

All patients who participated in the study were fully informed about the procedure they will have, its possible sequalae, and its complication with a written consent.

All patients included in the study were candidates for

(1) Clinical assessment:

   (a) Careful history taking.
   (b) General-condition assessment.
   (c) Local breast examination.

(2) Investigations (radiological and pathological):

   (a) Routine preoperative investigations.
   (b) Mammography.
   (c) Breast ultrasound.
   (d) Fine-needle aspiration cytology or true cut-needle biopsy.

(3) Metastatic workup before operations:

   (a) Computed tomography chest.
   (b) Pelviabdominal ultrasound.

(4) Operative procedure:

   (a) A preoperative Doppler is used to identify and map out the perforators starting about 6–8 cm below the posterior axillary fold and 2–4 cm inside the lateral border of the latissimus. The loudest one to two perforators are marked.
   (b) The patient is placed in the lateral decubitus position on a beanbag just as in the latissimus harvest. The flap dimensions needed are outlined, with the perforator on the longitudinal axis of the flap, the maximum reliable length of a TDAP flap that can be elevated on a single perforator has not been clearly established.
   (c) Tumor excision was done (wide local excision) and frozen section confirmed free margins of the specimen, with the resultant defect being a candidate for flap reconstruction.
   (d) Axillary dissection done for targeted lymph-node sampling (the sentinel lymph nodes+previously known affected lymph nodes clipped with the guide of ultrasonography before receiving neoadjuvent systemic therapy).
   (e) Flaps up to 25 cm in length have been reported.
   (f) The perforator(s) are identified using intraoperative handheld pen-Doppler.
   (g) All sites of perforators were compared with the preoperative Doppler to assess its accuracy.

(h) The dominant perforator is traced through the muscle to the descending branch of the thoracodorsal artery. A cutaneous nerve may be seen accompanying the largest perforator. A second perforator that appears to be in the same longitudinal plane as the first can also be dissected free and used to further nourish the flap. The perforator or perforators and the lateral branch of the thoracodorsal vessels are traced proximally, until the deep surface of the muscle is found and the plane between the latissimus and serratus is entered.
(i) The vessel distal to the perforator is clipped and the flap is then harvested on the pedicle through a subcutaneous tunnel to the recipient site.
(j) In case of small perforator size (>0.5 cm tiny but pulsating perforators), we dissected a small piece of muscle with the perforator's origin as to avoid injury of the perforator vessel and allow good vascularity of our flap, this is considered a MS TYPE-1 procedure (discussed by multiple authors).
(k) The mean operative time was recorded.
(l) Drains were placed in the donor and recipient areas, and were removed when their outcome was less than 50 ml per day.

### Follow-up

All patients were followed up clinically for

(1) Cosmetic outcome, patient's satisfaction on a grading scale from very poor to excellent (subjective) on a grading scale based on patients' opinion, and breast nurses and surgeons not included in our team.
(2) Any flap complications for a period of 6 months postoperatively, including seroma, wound infection, hematoma, flap congestion, fat necrosis, or any flap loss.
(3) Assessment of local recurrence in the same period of 6 months postoperative.

## Results

In total, 20 patients were candidates for this study undergoing BCS with TDAP flap, the mean age was 42.5 years (Table 1).

Most of the patients' perforator vessels were identified preoperatively and accurately confirmed intraoperatively using pen-Doppler (Fig. 1) about 3 cm below and lateral to the tip of the scapula and medial to the lateral border of LD (near the area identified by preoperative Doppler). Our average flap size was 9 × 14 cm.

**Table 1 Patients' data and tumor stages**

| | Total no.=20 |
|---|---|
| Age | |
| Mean±SD | 42.45 ± 7.46 |
| Range | 28–56 |
| Diabetes [*n* (%)] | |
| No | 16 (80.0) |
| Yes | 4 (20.0) |
| HTN [*n* (%)] | |
| No | 17 (85.0) |
| Yes | 3 (15.0) |
| IHD [*n* (%)] | |
| No | 19 (95.0) |
| Yes | 1 (5.0) |
| Neoadjuvent [*n* (%)] | |
| No | 4 (20.0) |
| Yes | 16 (80.0) |
| Tumor location [*n* (%)] | |
| UOQ | 16 (80.0) |
| LOQ | 4 (20.0) |
| Tumor size (TNM) | |
| T1 | 7 (35.0) |
| T2 | 12 (60.0) |
| T3 (dropped out) | 1 (5.0) |
| Lymph node (TNM) final pathology [*n* (%)] | |
| N1 | 20 (100.0) |
| Pathology [*n* (%)] | |
| IDC G2 | 20 (100.0) |

**Figure 1**

Preoperative and intraoperative identification of perforator (using pen-Doppler).

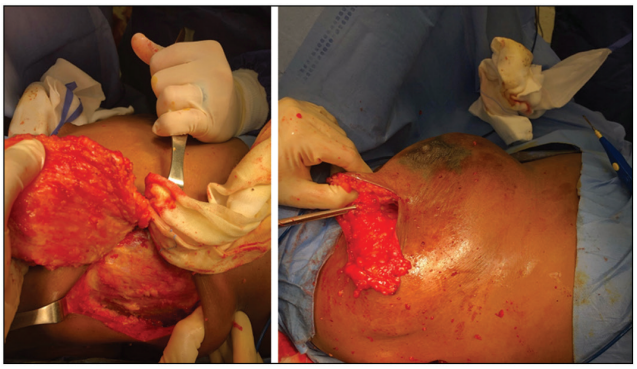
In four cases, a muscle flap (1–2 cm) was included in our pedicle to protect the harvested flap due to small perforator size 0.5 cm in diameter (but pulsating) known as MS-LD TYPE 1, while the other cases' dissection of the whole perforator was successful (Fig. 2).

The mean operative time was 200 min.

Complications occurred in five (25%) patients with the rest passed with no complications.

In total, three patients suffered from minimal seroma mostly related to the back where the flap was harvested in-between muscles and was aspirated smoothly with no further interventions (<50 ml), one patient suffered from mild wound infection managed conservatively by intravenous antibiotics in the same-hospital stay for 4 days (Table 2).

**Figure 2**



Flap harvesting and defect filling.

**Table 2 Our postoperative assessment in the study**

| Postoperative complications | Total no.=20 [*n* (%)] |
|---|---|
| Not complicated | 14 (70.0) |
| Complicated | 5 (25) |
| Infection | 1 (5.0) |
| Seroma | 3 (15.0) |
| Fat necrosis | 1 (5.0) |
| Outcome | Total no.=20 |
| Satisfaction | |
| Mean±SD | 7.45 ± 1.00 |
| Range | 5–9 |
| Satisfaction | |
| Good | 9 (45.0) |
| Excellent | 11 (55.0) |
| Postoperative pain | |
| Mean±SD | 4.4 ± 0.60 |
| Range | 3–5 |
| Local recurrence | |
| No | 20 (100.0) |

Postoperatively, pain was assessed using a pain score from 0 to 10, where 0 is least pain and 10 the most, the mean pain score [4] immediately postoperatively, and was markedly improved on the second day postoperatively reaching a score of 3 in 90% of cases.

Patient satisfaction (subjectively assessed) ranged from good to excellent as regards cosmetic outcome in follow-up 1 week postoperative and 2 months postoperative (on a scale ranging from poor to excellent) (scale of satisfaction shown below) (results shown in Figs 3,4,5).

| Excellent | Good | Fair | Poor | Very poor |
|---|---|---|---|---|
| 11 | 9 | X | X | X |

## Discussion

Nowadays, BCS followed by radiotherapy is considered a standard of care in treatment of early breast cancers, and so, the reconstructive surgeries have evaluated by time. The resultant defects in many instances require one of the tissue-replacement techniques [10].

The perforator flaps have played an important part in reconstructive oncoplastic surgeries, thus, we tried to evaluate the role of TDAP flap as oncoplastic technique.

This was a pilot study, including a limited number of patients [11] with a short period of follow-up, and this was one of the limitations as we are early in the learning curve of this technique, so more cases are required in order to give better reliable conclusion.

One of our cases was dropped out after the final pathology being T3, however, its initial staging was T2

**Figure 3**

Case-1 outcome.

case of borderline size (4.8 cm in sonomammography) and that is why it was included in our criteria of the study. The postoperative follow-up of this case passed uneventful with no complications.

Angrigiani and colleagues first reported the perforator anatomy and use of the free TDAP flap. It has since been used for various reconstructions, both as a free and pedicled flap. The pedicled TDAP flap is a versatile flap for reconstruction of defects of the anterior chest wall, breast, axilla, and around the shoulder. Flaps as large as 25 × 15 cm have been safely harvested, further increasing the utility of the flap [12,13].

In our study, the mean operative time was 200 min, similar to Lee *et al*. [14] and Jacobs *et al*. [15], and 20–30 min more than Hamdi *et al*. [7].

In this series, the largest flap harvested was 10 × 14 cm, which is similar to most studies done for this TDAP-flap procedure [7,14,16,17], however, Jacobs and colleagues reported larger flap size reaching 11 × 37 cm.

This was not associated with any flap loss as reported by most studies implementing this technique [7,14–16], the amount of flap volume provided by the flap was adequate to fill the defect in all cases, precluding the need for larger flaps or implants.

An important topic here in this study was locating the perforators and studying the anatomy of TDAPs. Usually after arising from subscapular trunk, the thoracodorsal artery runs downward inside the lateral border of LD muscle (within 2 cm from the edge) and then gives two branches (transverse branch and descending branch) at 45° from each other. Usually, the perforators arise from the descending vertical branch around three to four perforators, but only one to two were identified and considered to be the main blood supply for the flap. This agrees with other authors' description of their location [7,9,14–18].

Hamdi and colleagues found that perforators were located between 7 and 10 cm downward from the posterior axillary fold and within 5 cm inward from the lateral edge of the LD muscle. They further confirmed the accuracy of preoperative Doppler study, which was up to 90% in their series [12].

Here in this study, preoperative Doppler was used for all cases to identify the site of those main perforators, which was about inferior and lateral to the tip of the scapula and about 8–10 cm from the posterior axillary fold. An intraoperative pen-Doppler was used to identify the main perforator(s).

We succeeded in identifying the main perforators in 18 cases, however, in two of them, we used a small muscle-harvesting technique (that was early in the learning process) to avoid injury of smaller-sized perforators and preserve the flap vascularity and this method was also described by Hamdi and colleagues as when tiny but pulsating perforators were found, the TDAP flap was converted to an MS-LD flap, including 2–4 cm of muscle around the vessels (MS-LD type I) [7,13].

**Figure 4**

Case-2 outcome.

**Figure 5**

Case-3 outcome.

As regards the postoperative seroma, it is a very common complication following large defect replacements as traditional LD FLAP due to the larger potential dead spaces. In this study, donor-site seroma was recorded three times (15%), which is a slight increase in incidence to that reported by other authors such as Hamdi *et al*. [7] (12%) and Abdelrahman *et al*. [19] (10%), however, it was very minimal and managed conservatively and this is one of the advantages of this technique as it is associated with much less seroma than LD flap (50%) and other larger flaps or reconstruction techniques, and is considered a noisy complication for both surgeon and patient.

Patients with no skin involvement and good breast volume were managed using only the subcutaneous fat with de-epthilialization of the flap as purposed by some authors such as Hamdi *et al*. [9] and Kijima *et al*. [16], allowing for better cosmetic outcome in the recipient area of the breast with a linear scar in the bra line.

In all cases, a transverse paddled flap and oblique ones were preferred as to the final esthetic appearance of the scar, as well as better vascularity and less tension on the flap pedicle similar to multiple authors [7,9,14–19].

As regards postoperative infection, it was a mild infection with minimal wound redness, hotness, and there was no wound dehiscence, it was managed conservatively in a single case with intravenous antibiotics as reported by Abdelrahman *et al*. [19] and less than other authors [20]. The cosmetic outcome was assessed subjectively twice according to patients' evaluation on a grading scale after 1 week and after 2 months from the procedure, depending on patient questionnaire, 55% rated their outcome as excellent, while 40% were considered as good, which comes in accordance with multiple studies [17,19,21], other authors' satisfactory results ranged between 75 and 81% [9].

So, although this technique is more time consuming than others such as LD flaps (with average time of 170 min) [11], it is much more appealing as it is associated with less complication rates (despite being in an early phase of our learning curve), much less seromas, hematomas, and infections [22].

This technique showed postoperative return to daily-life activities about 7 days and similar range of movement and power compared with contralateral side as described by other authors with much less postoperative limitation of movement [20,22].

## Conclusion

TDAP flap is a reliable and safe method that can be added to the large group of oncoplastic surgeries with excellent patient cosmetic satisfaction and no need for contralateral breast reduction, also, it avoids the limitation of shoulder movement postoperatively and has very low rate of donor-site morbidity as seroma. However, it needs meticulous dissection to avoid injury of the perforators intraoperatively, which caused more time consumption. Preoperative Doppler localization of the perforators aids in its intraoperative localization.

Finally, the study limitations included a small number of patients [11] and short follow-up period, thus, more patients and longer follow-up period is needed in further studies for better reliable data.

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Nil.

### Conflicts of interest

There is no conflict of interests.

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