Thoracodorsal Artery Perforator Flap in Breast Reconstruction

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Abstract

Background: Breast reconstruction is a surgical procedure to restore the appearance of a breast for women who have had a breast removed (mastectomy) to treat breast cancer. Each year, more than 240,000 American women face the reality of breast cancer. Today, more women with breast cancer choose surgery that removes only part of the breast tissue. Immediate reconstruction is done at the same time as the mastectomy. Delayed reconstruction may be done at a later time. For some women, this may be advised after completion of radiotherapy treatment. Several types of operations can be done to reconstruct the breast such as: implant procedures, tissue flap procedures as Trance Rectus Abdominus Muscle (TRAM) flap, latissmus dorsi flap, Deep Inferior Epigastric artery Perforator (DIEP) flap, gluteal free flap and Thoracodorsal Artery Perforator Flap (TDAP). Thoracodorsal Artery Perforator (TDAP) flap harvests upper back skin and fat to create the breast(s).

Objectives: The aim of this work was to study and evaluate the role of thoracodorsal artery perforator flap in breast reconstruction as regard indications, contraindications, advantages and disadvantages.

Patients and Methods: This study was conducted on 20 patients with early breast cancer, in whom conservative breast surgery was indicated.

Results and Conclusion: Twenty patients with potentially curable breast cancer who are good candidates for TDAP were selected. Regarding Socio-demographic characteristics of the studied patients, they were studied regarding age, marital status, parity and lactation. Ages of patients in this study ranged from 24 to 56 years old with mean 42.35 years. Fifteen patients (75%) were married, 4 patients (20%) were single and one patient (5%) was divorced. Fourteen patients (70%) were multipara and six patients (30%) were nullipara. Fourteen patients (70%) were lactating and six patients (30%) were non lactating. Most of these patients had a relatively young age (average 42.35ys) and small to moderate size breasts. Patient motivations for breast reconstruction were studied. All patients (100%) preferred reconstruction to be satisfied morally and to avoid external prosthesis. Aesthetic purpose was the issue of concern in 40% of patients, However, non of patient had tendency for wearing free clothing styles. All patients were scheduled for conservative
breast surgery, where the breast mass was excised with safety margin and axillary dissection was undertaken for three levels. In six patients (30%), mass was located in left breast, while in fourteen patients (70%), the right breast was the side affected by the tumor. Regarding the site of the masses, seven patients (35%) had the mass in UOQ, five patients (25%) the mass was in UIQ, five patients (25%) the mass was in LOQ, and three patients (15%) had the mass in LIQ. Patients in the study were selected to have early stage breast cancer (stage I and II). TDAP was done for all patients (20 cases), eight patients (40%) had underwent TDAP for T1 tumors and twelve patients (60%) for T2 tumors. Regarding the nodal status, all patients were scheduled for complete axillary dissection including all axillary levels (I,II and III), seven patients (35%) had negative axillary nodes and thirteen patients (65%) had positive nodes. Flaps were successfully transferred with an average operative time of 145 minutes (range 120–180 minutes). The largest dimensions of TDAP flap used were 20 × 8 cm (range of 12–20 cm long and 5–10 cm wide). All the flaps were based on a single perforator artery (17 cases, 85%), except in 3 cases (15%) in which 2 perforators from the same vertical branch of the thoracodorsal artery were isolated and used. There was no any case had received blood transfusion. Hospital stay was calculated from the day of the operation to the day of discharge. The mean duration of hospital stay was 7.85 days with a range of 6-12 days. The complications were related to both the flap and the donor site. There was one case (5%) of partial flap necrosis. Hematoma under the flap was observed in two cases (10%) and was evacuated. Seroma was the commonest complication following TDAP flap reconstruction in the current study and occurred in four cases (20%) and was treated by repeated aspirations. Minor wound infection was observed in two cases (10%). hypertrophic back scarring was noticed after utilization of TDAP flap reconstruction in two cases (10%) and the patients were treated with local measures. The cosmetic results in this study were acceptable. Twelve patients (60%) were pleased with their new breasts. Six patients (30%) were satisfied with the reconstruction. Two patients (10%) were unsatisfied. Excellent results were observed in ten cases (50%). Good results were observed in eight cases (40%). Fair results were observed in two cases (10%). No poor result was reported after reconstruction.

Keywords: Breast Reconstruction; Thoracodorsal Artery Perforator Flap

Introduction

Breast cancer is a devastating illness both physically and emotionally for tens of thousands of patients and their families, who must confront this illness each year. It is one of the leading causes of cancer – related death in women within economically developed regions of the world. Breast cancer is considered a multifactorial disorder caused by non- genetic and genetic factors but it is highly curable if diagnosed at an early stage [1].

The surgical options for patients with breast cancer involve either breast conserving surgery or mastectomy, both of which can result in considerable asymmetry of the breasts. Breast reconstruction offers restoration of breast symmetry to such women. Breast reconstruction has become an important aspect of breast cancer management. The patient needs to be aware that the reconstructed breast will neither feel nor functions like a normal breast but may help in restoring body image and confidence [2].

The thoracodorsal artery perforator or TAP flap is a fasciocutaneous flap based on a musculocutaneous

perforator or perforators from the thoracodorsal vessel axis and/or its vertical branch derivative. In contrast to the other well-known DIEP (deep inferior epigastric perforator) and SGAP (superior gluteal artery perforator) flaps that provide bulk, the TAP flap provides a relatively thin and pliable skin paddle. In a reasonably thin person, the flap ranges from 1 – 2 cm in thickness. In heavier patients the flap may be thinned by delaminating the deep adipose layer from the superficial adipose layer at the level of the superficial fascia. The resulting thickness of the skin and superficial fat layer will be approximately 1 cm. The TAP flap is well suited for extremity, head and neck, and peri-articular resurfacing as well as for the contouring of shallow defects. As is the case with other perforator flaps, the surgical dissection can be difficult. A flap of dimensions 15 X 8 cm can be harvested on a single perforator. These dimensions allow for both primary closure of the donor site and avoidance of post-operative venous congestion in the flap [3].

Jain, et al stated that TDAP has a versatile utility and surgical ease of harvest and anastomosis [4]. It has several advantages over other perforator flaps. It may well form the work horse for most soft tissue reconstructions.

In this study, we study and evaluate the role of thoracodorsal artery perforator flap in breast reconstruction as regard indications, contraindications, advantages and disadvantages.

Patients and Methods

This prospective randomized controlled study was conducted on 20 patients with early breast cancer who has been subjected to a prospective selective study with conservative breast surgery and immediate breast reconstruction.

A fully informed consent was taken from the patients, discussing with them the operative procedure and the possible intraoperative and postoperative complications.

Inclusion Criteria

1. Patients with early stage breast cancer that prefers mastectomy and immediate reconstruction.
2. Patient with T1, or T2 lesions.
3. Isolated breast recurrence after breast conservation therapy.
4. Patients with DCIS necessitating mastectomy
5. Patients who are scheduled for prophylactic mastectomy.

Exclusion Criteria

1. Locally advanced breast cancer (T3, T4 lesions)
2. Metastatic disease
3. Inflammatory breast cancer.
4. Patients who have breast skin disease or systemic skin disease (Scleroderma-Tielangectazia)
5. Patient older than 60 yrs or with medical disease contraindicating prolonged anesthesia.
6. Patients who don’t prefer breast reconstruction.

Preoperative Assessment

Full clinical history taking: With special concentration on:

a. Family history
b. Medical disease as DM, Heart disease, skin disease
c. Smoking habits
d. History of previous abdominal operations

Clinical examination including:

a. Full general examination to exclude metastasis, skin disease, scars of previous operation and medical problems.
b. Local examination for

- Size and site (exact location of the tumor).
- Breast skin status and presence of any breast scar.
- Location of tumor or lumpectomy scar in relation to NAC.
- State of local tissue and possible donor site.
- Contralateral breast examination including size, contour, degree of ptosis, and shape.

Investigations

All the patients were subjected to the following investigations:

Laboratory investigations:

- CBC.
- Fasting Bl sugar.
- Urea, creatinine,
- SGOT, SGPT, alkaline phosphatase.
- Prothrombin time and concentration.
- Albumin, Globulin, A/G ratio.
- ECG for patient > 40y with history of cardiac troubles.

Metastatic work up:

- Abdominal Ultrasonography.
- Chest X-ray.
- Bone scan.
**Mammography on both breasts**
**Tissue diagnosis:**
Either cytology or tissue biopsy

**On the night of the operation:**
- All details of the operation were explained to the patient and patient counseling regarding the oncoplastic technique.
- Patients were asked to have warm shower with antiseptic solution.

**Operative Procedures:**

**Markings done pre-operatively anatomical landmarks used:**
1. Anterior axillary line (AAL).
2. Mid-axillary line (MAL).
3. Posterior axillary line (PAL).
4. Inferior angle of scapula.
5. Lateral border of latissimus dorsi (LD) muscle from posterior axillary fold to iliac crest.
6. Flap of required dimensions along the long axis of the muscle.

**For perforator localisation:**
Two or three perforators are marked using these guides (Figure 1):
1. Four cm below the inferior angle of scapula and 1-2 cm inside of the lateral muscle border.
2. Eight-ten cm below the apex of the axilla.
3. Handheld Doppler to localize the perforator.

**Evaluation of volume deficit and location:**
The best way to evaluate needed volume is to weight or measure the resected tissue. However, the volume is frequently underestimated as the retracted tissue may mislead the calculation. Contralateral comparison, if possible, may provide a good approximation (Figure 2).

**Flap Indication:**
The indications for the TDAP flap, which are similar to those of the LD-MC flap, are as follows: primary or additional volume for breast reconstruction; salvage procedure for exposed implants; primary or additional surface (envelop) reconstruction; and combined implant autologous tissue reconstruction. In this study; indication of TDAP is immediate breast reconstruction after conservative breast surgery (Figure 3).

**Flap design:**
The flap is designed with the patient in the standing position, with the arms at the sides and the hands on the waist. The patient is asked to actively contract her back muscles, at which time the anterior lateral border of the LD muscle appears clearly under the skin and is marked with a line. The absence of this obvious contraction in mastectomy sequelae cases is highly suspicious of a neurovascular muscle pedicle lesion.

A point “A” is marked on the anterolateral muscle line,
8 cm below the axillary fold. The descending branch of the proximal perforator artery runs parallel and approximately 2 cm lateral to that line. The proximal perforator branch of the descending thoracodorsal artery branch pierces the muscle in the line of the descending branch, at 8 cm or more from the axillary fold. However, in 20% of the cases, a direct cutaneous branch from the descending branch of the thoracodorsal artery is the most important cutaneous branch (based on diameter). This direct cutaneous branch does not pierce the muscle; instead, it passes immediately anterior to the lateral border of the muscle. Thus, the design of the flap must exceed the edge of the muscle to assure the presence of this branch in the raised flap. This is the main difference with the LD-MC flap; the skin island of the LD may be designed more posterior or inferior without including point “A” within the flap design. It can be safely nourished by other muscle perforators of the thoracodorsal artery, resulting in a more posteriorly placed final scar.

The piercing point of the perforator (or cutaneous branch) must be included in the flap design as its irrigation is necessary. The flap length reaches the union of the lateral 3/4 with the most medial quarter of the back. Achieving the maximum possible length can improve insetting in the breast mound. Clinical criterium is important for resection of the distal, under irrigated part of the flap, when it is fully elevated. The dimension of this distal under-perfused area is not related to only the perforator diameter; the subcutaneous vascular network status might also play an important role in the functional and physiological irrigation of the flap (Figure 4).

Single and Double Flap Harvesting: De-epithelialized TDAP may be applied in unilateral or bilateral cases, with variations in surgical technique depending on the case. In unilateral cases, the patient is placed in contralateral decubitus, with the arm prepared free hold by an assistant. This position allows easy access to the pedicle origin and direct transfer of the flap to the anterior thorax. In bilateral cases, the patient is placed in ventral decubitus, and the procedure is performed by two teams simultaneously.

The flap is raised in the distal to proximal direction, superficial to the deep fascia, while observing the fascia of the LD muscle. The perforator arteries are carefully observed, under 4× magnifications. Continuous and progressive control of the bleeding quality from the end of the flap is an excellent way to monitor the presence of a good perforator. If the flap has excellent perfusion by the time it is half separated from the LD muscle, the perforator is likely to be adequate (diameter >0.5 mm).

Dissection continues along the suprafascial plane to the anterior border of the muscle and proceeds superiorly up to the perforator entrance point. Locating the lateral edge of the muscle is important because the descending thoracodorsal artery branch runs parallel to that edge, at a distance of ≤2-4 cm. Therefore, the proximal perforator is found at approximately the same distance from the edge. In cases involving a direct cutaneous branch, this level is at the edge surrounding the muscle.

The proximal perforator artery also has an accompanying vein. Once this artery has been located, we perform complete dissection of the skin around the island itself. If the flap has good vascularization (bleeding from the skin edges and skin refilling), and no perforator is apparent when the lateral anterior border of the muscle is completely exposed, the direct cutaneous branch of the thoracodorsal artery should be carefully looked for. If it is not present, or is of a small diameter, then the lateral intercostal perforator must be present and is the main irrigating source of this flap. This rationale should be applied if the flap is well vascularized after passing the anterolateral border of the LD muscle. Neighboring cutaneous arteries may be of different calibers: if one has a large diameter, the other one is smaller, or vice versa, to compensate for the necessary blood flow of the skin. If the flap turns white or bluish, suggesting sluggish circulation, presence of a lesion of the muscle perforators must be assumed, and the flap should be discarded.

Once the perforator is completely exposed, there are several possibilities for continuing the surgical procedure, as described below:
• **Propeller flap:** The dissection around the perforating artery is minimal and serves to release the muscle and allow flap rotation along this axis, creating the “flap helix” (propeller). The procedure is simple and quick. A special dissection technique is not required. The main disadvantage is its shorter length. The flap does not reach the midline of the anterior chest wall. A substantial portion of the flap remains in the subaxillary area, where it is not necessary, while the medial portion of the breast does not receive adequate volume. If a longer flap is harvested to reach the medial part of the breast, tissue suffering as well as steatonecrosis might be observed. In cases of mastectomy sequelae, we release the scar and leave a gap to place the flap. The previous scar incision is made continuous with the flap incision. In immediate reconstructions, when performing skin-sparing mastectomy or when no scar at the breast side is present, the flap is de-epithelialized and tunneled, remaining under the skin below the tunnel. Donor site closure is performed in two planes. A suction drain is placed and removed 48-72 hours after surgery.

• **Flip-over flap:** The flap is raised in the same conventional manner, from distal to proximal. Once the muscle perforators corresponding to the descending branch of the thoracodorsal artery are visualized, the dissection is discontinued. The flap is de-epithelialized and turned over the anterior part of the thorax. This “turn over” or “flip-over” flap is very simple to harvest. There is an important portion of the flap volume that remains under the axillary area and lateral to the breast. It provides a good volume for reconstruction of a medium-sized breast or complements a partial mastectomy repair.

• **Muscle-sparing flap:** The flap is raised in the distal to proximal direction; once the lateral border of the LD is approached and the perforators of the descending branch are visualized, the muscle containing the perforators is sectioned-muscle sparing technique; the flap can be turned over or rotated to the breast area. This technique is a variation of the propeller but it partially damages the muscle innervation and has a reduced reaching point. It is used for partial volume deficit reconstruction on the lateral aspect of the breast.

• **Conventional TDAP flap:** In this procedure, the dissection begins from the anterior side in a suprafascial plane. The dissection must be beveled to include a maximum of fat (Figure 5).

Once a palpable pulsating perforator is found, we proceed to dissect the perforator intramuscular to the descending branch. If no palpable pulsating perforator is found, we dissect a small cuff of muscle to include a few smaller perforators. The vascular pedicle is dissected until enough length is achieved to allow placement of the flap at the defect site with no tension (Figure 6).
The nerve that is running along with the pedicle is dissected free and spared. A tunnel is made between the donor site and the defect, and then the flap is interpolated into the defect and secured (Figure 7).

**Figure 7: Thoracodorsal vessels dissected until enough length is achieved to allow insetting of the flap with no tension.**

**Treatment of donor area:**
The donor area is closed directly in two layers. Vicryl and monocryl internal sutures are utilized for approximation of wound edges, and interrupted 3-0 vicryl is used for the skin. Suction drainage is usually applied for 24-48 hours, but we leave them in place as long as necessary. They are removed when there is no more drainage. As the LD is not mobilized in this technique, wound drainage is generally moderate (Figure 8).

**Figure 8: Closure of donor area.**

**Flap transference:** When the flap incision is not in continuity with the breast wound, a tunnel is performed under the lateral breast mound and lateral thoracic wall for passage. The flap is left without final insetting; the back wound is covered, and the patient is turned to dorsal decubitus position, at which time the anterior area is prepared again.

**Insetting:** For flap insetting the patient is placed in a supine position to compare symmetry of both breasts. Both breasts are prepped and draped again and the flap is then inset. The flap is distributed under the breast, enveloped and fixed at the borders with interrupted absorbable sutures. If an implant or expander is needed for additional volume, a pocket is created in the subpectoral plane to accommodate their placement and the flap is inset above the pectoralis muscle. After insetting, appearance and symmetry are checked with the patient in a sitting position (Figure 9).

**Figure 9: Flap insetting and wound closure.**

**Postoperative Management**
1. Monitoring of the flap and the edges of the skin envelope of the breast for color and warmth.
2. Prophylactic anticoagulation in the form of I.V. heparin (5000IU/4hs) for 5 days postoperatively.
3. Avoidance of hypotension by I.V. fluid therapy till the patient starts adequate oral intake.
Follow up

All patients in the study were followed up for a period of 1 year to 2 years postoperatively for evidence of loco regional or distant failure. Regular clinical follow up was done every 2 months in the 1st year and every 3 months in the 2nd year and every 6 months then after. Mammography and sonography of the healthy breast together with sonography and MRI of the reconstructed breast was done once per year (Figure 10).

Radiation therapy has an important role to play in the loco regional management of the patient with breast cancer. For high risk patients, locoregional radiation therapy can enhance disease control. Radiation therapy and reconstruction are compatible. However, there does appear to be some increased risk of complications and adverse cosmetic results. For enhanced tumor control this decrease in cosmesis may be well tolerated by the patients. It does appear that the autogenous tissue transfer techniques as compared with implants are associated with better tolerance and cosmetic appearance when radiation is required. Postoperative adjuvant therapy was planned for most of our patients and the delivery time was determined to start 4 to 6 weeks postoperative to achieve maximum effect.

Statistical Analysis

The collected data were summarized in terms of mean ± Standard Deviation (SD) and range for quantitative data and frequency and percentage for qualitative data. This was carried out using STATA/SE version 11.2 for Windows (STATA Corporation, College Station, Texas).

Results

Patients in the study were studied regarding age, marital status, parity and lactation. Ages of patients in this study ranged from 24 to 56 years old with mean 42.35 years. Fifteen patients (75%) were married, 4 patients (20%) were single and one patient (5%) was divorced. Fourteen patients (70%) were multipara and six patients (30%) were nullipara. Fourteen patients (70%) were lactating and six patients (30%) were non lactating (Table 1).

Patients in the study were selected to have early stage breast cancer (stage I and II). TDAP was done for all patients (20 cases), eight patients (40%) had underwent TDAP for T1 tumors and twelve patients (60%) for T2 tumors. All patients were scheduled for complete axillary dissection including all axillary levels (I, II and III). All patients were scheduled for conservative breast surgery, where the breast mass was excised with safety margin and axillary dissection was undertaken for three levels. In six patients (30%), mass was located in left breast, while in fourteen patients (70%), the right breast was the side affected by the tumor. Regarding the site of the masses, seven patients (35%) had the mass in UOQ, five patients (25%) the mass was in UIQ, five patients (25%) the mass was in LOQ, and three patients (15%) had the mass in LIQ. Regarding the nodal status, seven patients (35%) had negative axillary nodes and thirteen patients (65%) had positive nodes (Table 2).
Regarding table 3, flaps were successfully transferred with an average operative time of 145 minutes (range 120–180 minutes). The largest dimensions of TDAP flap used were 20 × 8 cm (range of 12–20 cm long and 5–10 cm wide). All the flaps were based on a single perforator artery (17 cases, 85%), except in 3 cases (15%) in which 2 perforators from the same vertical branch of the thoracodorsal artery were isolated and used. There was no any case had received blood transfusion.

Hospital stay was calculated from the day of the operation to the day of discharge. The mean duration of hospital stay was 7.85 days with a range of 6–12 days. The complications were related to both the flap and the donor site. There was one case (5%) of partial flap necrosis. Hematoma under the flap was observed in two cases (10%) and was evacuated (Table 4).

In this study, some factors of patient motivations for breast reconstruction were studied. All patients (100%) decided breast reconstruction to be satisfied morally. Eight patients (40%) did so for aesthetic purposes. None of patients (0%) did reconstruction for wearing free clothing styles (Table 5).

The cosmetic results in this study were acceptable. Twelve patients (60%) were pleased with their new breasts. Six patients (30%) were satisfied with the reconstruction. Two patients (10%) were unsatisfied (Table 6).

Regarding table 7, excellent results were observed in ten cases (50%). Good results were observed in eight cases (40%). Fair results were observed in two cases (10%). No poor result was reported after reconstruction.

<table>
<thead>
<tr>
<th>Variable (no.=20)</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Mean ±SD; (range)</td>
<td>42.35±9.25; (24-56)</td>
</tr>
<tr>
<td>Marital status</td>
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<td></td>
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<tr>
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</tr>
<tr>
<td>Parity</td>
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</tr>
<tr>
<td></td>
<td>Nullipara</td>
<td>6</td>
</tr>
<tr>
<td>Lactation</td>
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<tr>
<td></td>
<td>Negative</td>
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Table 1: Socio-demographic characteristics of the studied patients.

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<tr>
<td></td>
<td>T2</td>
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<tr>
<td>Breast</td>
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<tr>
<td></td>
<td>Rt</td>
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<tr>
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</tr>
<tr>
<td></td>
<td>LOQ</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>UIQ</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>UQQ</td>
<td>7</td>
</tr>
<tr>
<td>Pathological axillary LN</td>
<td>Positive</td>
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<tr>
<td></td>
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Table 2: Clinical data of the studied patients.

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<th>Variable (no.=20)</th>
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<td>Operative time (min.)</td>
<td>Mean ±SD; (range)</td>
<td>145±19.87; (120-180)</td>
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<tr>
<td>Harvested flaps measurements (mm)</td>
<td>Mean ±SD; (range)</td>
<td>125.5±38.89; (65-200)</td>
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<tr>
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</tr>
<tr>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Bl. Transfusion</td>
<td>Positive</td>
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<tr>
<td></td>
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Table 3: Operative data of the studied patients.

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<td>Hospital stay</td>
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<td>7.85±1.46; (6-12)</td>
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<tr>
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<tr>
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<tr>
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Table 4: Postoperative follow up and complications.

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<tr>
<td>Moral</td>
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<td>100</td>
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<tr>
<td>Wearing free clothing styles</td>
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<td>0</td>
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Table 5: Factors influencing the decision to have breast reconstruction.
Discussion

Immediate breast reconstruction has become in many medical centers the standard of care for women who need or desire surgical restoration of a breast mound after surgical excision of breast cancer. The shift from delayed to immediate reconstruction has occurred for many reasons including patient preference, lower cost, improved patient convenience, reduced anesthetic risk, and the lessened emotional trauma associated with immediate reconstruction (provided that not affecting adjuvant therapy ,so not affecting survival or increasing incidence of local recurrence) [5].

Reconstruction with autogenous tissue avoids all of the potential complications of implants in terms of infection, dehiscence, exposure, distortion, deflation and contracture. The reconstructed breast mimics the normal breast far better than any prosthesis. While initially more complex and expensive, autogenous breast reconstructions are the most accepted and durable breast reconstruction that generally hold up well for the patient’s life. Because of this freedom from late problems, autogenous reconstructions have been found to be less cost than implant based reconstructions [6].

Immediate breast reconstruction does not interfere with the resumption of chemotherapy or the ability to detect loco regional recurrence. The cosmetic result was dependent on the initial outcome of the reconstruction. If fat necrosis was present however, irradiation tended to accentuate fibrosis and volume loss [6].

Autologous tissue breast reconstruction is considered a reliable surgical technique. The LD-MC flap has been the “workhorse” for treating difficult or complicated cases as well as for primary reconstruction. Lipotransference to the conventional LD-MC flap has been reported to increase its initial volume and improve autologous breast reconstruction. Morbidity of the donor area might be considered a disadvantage, albeit to a minimal extent, for this procedure. Muscle harvesting remains controversial, with conflicting favorable and negative reports on the technique [7].

The incorporation of the TDAP flap, a derivation of the perforator flap era and which was initially described as “the LD-MC flap without muscle”, permits harvesting of the same skin and subcutaneous tissue area normally obtained with the conventional LD-MC flap without the muscle, thereby avoiding the possible morbidities of this procedure. The presence of the muscle might be considered important considering the necessity of volume for the reconstruction. However, the most voluminous part of the muscle remains under the axilla after transferring the flap to the anterior area. The muscle transferred to the breast mound is quite thin, with minimal volume contribution [8].

The thoracodorsal artery perforator Flap (TDAP) was first described by Angrigiani in 1995 and perforator landmarks were established by him [9].

The lateral thoracic region has three types of perforators as described by Kim and Kim [10].
1. The musculocutaneous perforator from thoracodorsal artery: LD perforator flap.
2. The septocutaneous perforator from thoracodorsal artery: TDAP flap.
3. The direct cutaneous perforator from lateral thoracic artery: Lateral thoracic artery perforator flap.

TDAP flap has emerged as a workhorse flap for reconstruction of defects based on the following reasons [4]:
1. It has a long vascular pedicle, approximately 18 cm.
2. Allows a two-team approach.
3. Requires no position change as it can be harvested in supine position with sand bag/lateral tilt of the table.
4. The TDAP flap can be harvested as a chimeric flap with LD muscle, and serratus anterior muscle. It provides volume and cover while allowing primary closure of donor site.
5. TDAP and LD muscle flap can be harvested together and utilised to cover two defects on anatomically separate areas. Thus, in a single surgery with a single donor site, two anatomically separate defects can be reconstructed.
6. The presence of perforators is consistent and the length of perforators in itself is good enough and can be further increased by including the main artery.
7. The lateral thoracic region has provision for harvest of perforator flaps based on the lateral thoracic artery and thoracodorsal artery. In case the TDAP perforator is injured during surgery, a life boat is present in the same field.

This flap is versatile in its indications as it provides cutaneous cover that can be used anywhere. It can be used as a pedicled flap for lateral neck, for pharyngeal tubing, breast, axilla and arm up to the distal third Bilateral pedicled TDAP can be used for bilateral breast reconstructions [4].

This study was conducted on 20 patients with early breast cancer, in whom conservative breast surgery was indicated during the period from December 2014 to July 2016.

Findings of this study revealed that twenty patients with potentially curable breast cancer who are good candidates for TDAP were selected.

Regarding Socio-demographic characteristics of the studied patients, they were studied regarding age, marital status, parity and lactation (Table 1). Ages of patients in this study ranged from 24 to 56 years old with mean 42.35 years. Fifteen patients (75%) were married, 4 patients (20%) were single and one patient (5%) was divorced. Fourteen patients (70%) were multipara and six patients (30%) were nullipara. Fourteen patients (70%) were lactating and six patients (30%) were non lactating. Most of these patients had a relatively young age (average 42.35 ys) and small to moderate size breasts.

In a study done by Koutz, et al., they have focused on factors that influence the decision to have breast reconstruction [11]. Patients decided IBR to be able to wear free clothing styles in 83% to eliminate external prosthesis in 90%, to feel more balanced in 72%, to feel more feminine in 69%, and to be morally satisfied in 95%. They stated that breast reconstruction has been shown to lesser psychological disturbances and the number of women who have undergone reconstruction has increased dramatically.

In this study, patient motivations for breast reconstruction were studied. All patients (100%) preferred reconstruction to be satisfied morally and to avoid external prosthesis. Aesthetic purposes was the issue of concern in 40% of patients, However, non of patient had tendency for wearing free clothing styles.

In this study, all patients were scheduled for conservative breast surgery, where the breast mass was excised with safety margin and axillary dissection was undertaken for three levels (Table 2). In six patients (30%), mass was located in left breast, while in fourteen patients (70%), the right breast was the side affected by the tumor. Regarding the site of the masses, seven patients (35%) had the mass in U0Q, five patients (25%) the mass was in U1Q, five patients (25%) the mass was in L0Q, and three patients (15%) had the mass in L1Q. Patients in the study were selected to have early stage breast cancer (stage I and II) (table-2). TDAP was done for all patients (20 cases), eight patients (40%) had underwent TDAP for T1 tumors and twelve patients (60%) for T2 tumors.

Regarding the nodal status, all patients were scheduled for complete axillary dissection including all axillary levels (I,II and III), seven patients (35%) had negative axillary nodes and thirteen patients (65%) had positive nodes.

Oncological safety of conservative breast surgery and reconstruction with TDAP has not yet been fully demonstrated. Best available evidence suggests that patients should be selected based on study of breast duct anatomy by breast magnetic resonance imaging, mammographic distance between tumor and nipple and obligatory intra-operative frozen section from retroareolar tissue. Additional factors such as tumor size, axillary lymph node status, lymphovascular invasion and degree of intraductal component are also being used [12].

Hamdi, et al. reported in their study, the harvested flaps measured 23 × 8.8 cm (range of 20–30 long and 8–10 cm wide) [13]. The flaps were successfully transferred with an average operative time of 190 minutes (range 135–260 minutes). The flaps were harvested based on the perforator in all 4 patients.

Regarding table 3, flaps were successfully transferred with an average operative time of 145 minutes (range 120–180 minutes). The largest dimensions of TDAP flap used were 20 × 8 cm (range of 12–20 cm long and 5–10cm wide). All the flaps were based on a single perforator artery (17 cases, 85%), except in 3 cases (15%) in which 2 perforators from the same vertical branch of the thoracodorsal artery were isolated and used. There was no any case had received blood transfusion.

Jain, et al. reported in their study the maximum length of flap that can be taken based on a single perforator needs to be assessed [4].

Flaps of 15-20 cm can be safely harvested on a single
reliable perforator. Longer flaps can be harvested by using the various modifications to ensure perfusion:

1. Inclusion of more than one perforator from the same branch of thoracodorsal vessel: This is the easiest method and least morbid. The axis of flap is, thus, directed along the axis of the linking vessels which are responsible for interperforator flow.

2. Inclusion of perforators from different branches of thoracodorsal artery:
   - When the intervening muscle cuff between the point of origin of perforator is small, muscle is transected and sutured back after flap harvest.
   - When the intervening muscle cuff is very wide, the perforator from the horizontal branch is cut 2 cm distal to the hilum and after flap elevation it is reanastomosed to the stump.

3. Inclusion of the intercostal artery perforator at the distal end of the flap: The intercostals perforator is noted to join the thoracodorsal artery by a connecting vessel. This perforator can be included and cut at the distal end, that is, towards its origin from the intercostals artery. Flow into this perforator from the main vessel will ensure distal flap perfusion.

Hospital stay was calculated from the day of the operation to the day of discharge (table-4). The mean duration of hospital stay was 7.85 days with a range of 6-12 days.

Judkins and Singletary studied the advantages, disadvantages and results that can be expected after immediate breast reconstruction utilizing TDAP flap in 100 patients with an average length of follow up was 20 months (range 8 to 44 months) [14]. The major complications were rare (1% partial necrosis and 1% total necrosis). The minor complications were represented mainly with dorsal seroma and was the main drawback of the technique and occurred in 79% specially in obese patients. Donor site morbidity in terms of wound infection and scarring was relatively low and occurred in 4% of cases. They reported that the level of patient satisfaction was high 87% of the patients were deeply satisfied, 10% were satisfied and only 3% were poorly satisfied. The aesthetic results have been judged excellent by surgeons in 85%, good in 12% and poor in 3% and no results judged bad. They concluded that breast reconstruction after SSM by LD flap with implant was encouraging and brings a major advance in breast reconstruction.

Hamdi and Barone-Adesi reported in their study the postoperative period was uneventful. Wound healing was achieved [13]. A seroma formation did not occur in any case. None of the patients had any subjective functional impairment within an average follow-up of 12 months.

In this study, the complications were related to both the flap and the donor site (table-4). There was one case (5%) of partial flap necrosis. Hematoma under the flap was observed in two cases (10%) and was evacuated.

By far the most common complication is seroma at the back donor site. Significant flap necrosis is unusual and is nearly always associated with either recognized or unrecognized injury to the vascular pedicle. Infection and hematoma occur with a frequency equal to other plastic surgical procedures [15].

Seroma was the commonest complication following TDAP flap reconstruction in the current study and occurred in four cases (20%) and was treated by repeated aspirations. Minor wound infection was observed in two cases (10%), hypertrophic back scarring was noticed after utilization of TDAP flap reconstruction in two cases (10%) and the patients were treated with local measures.

The biggest drawback found during this work, was the inconsistency of perforator position and the mismatch of handheld Doppler mapping and the intra-operative finding of the perforator. But, nevertheless a perforator can be found. This flap is indeed versatile in designing of the skin flap based on perforator localisation without the fear of encroaching a different anatomical area or significantly affecting any landmark.

Nevertheless, the TDAP flap has not been used generally by plastic surgeons when compared with other perforator flaps for different reasons. First, the number of latissimus dorsi perforators’ branches is limited (3 at the most). Other perforator flaps, such as DIEP, the s-GAP, or the ALT (anterolateral), showed a greater diversity of perforators. Second, the distribution of these perforators has only been researched in a few anatomic studies. Although the measures and the constant presence of 2 more proximal perforators have been published, their location and distribution have not been described sufficiently. Third, the dissection of these perforators has been described as tedious due to their small diameter, long intramuscular track, and close proximity to the thoracodorsal nerve branches [16].

Hamdi and Barone-Adesi presented a series of 28 patients with mammary defects following quadrantectomies, reconstructed through perforator flaps of thoracodorsal artery [13]. An algorithm protocol for the election of these flaps was used, depending on the type of defect in the breast. In all the cases presented for
mammary reconstruction, the use of skin-muscle flap, an underlying implant to obtain a sufficient mammary volume, and the presence of a scar on the patient's back were considered disadvantages.

The cosmetic results in this study were acceptable (table-6). Twelve patients (60%) were pleased with their new breasts. Six patients (30%) were satisfied with the reconstruction. Two patients (10%) were unsatisfied.

Objective assessment: the cosmetic results were assessed according to subscale (volume – contour – placement and inframammary fold) using (0-2) scale for each item:

Regarding table-7, excellent results were observed in ten cases (50%). Good results were observed in eight cases (40%). Fair results were observed in two cases (10%). No poor result was reported after reconstruction.

The role of TDAP flap in breast reconstruction still needs to be established. Its potential advantages or disadvantages, when compared with latissimus dorsi flap reconstruction are yet in question. The versatility of TDAP has several advantages that make it a workhorse flap for most reconstructions requiring soft tissue cover. Further, the ease of harvest makes it a good perforator flap for beginners. Its use in chimerism with the underlying latissimus dorsi muscle provides reconstruction for coverage and volume replacement [4].

**Conclusion**

- Ages of patients in this study ranged from 24 to 56 years old with mean 42.35 years.
- All patients (100%) preferred reconstruction to be satisfied morally and to avoid external prosthesis.
- Regarding the nodal status, all patients were scheduled for complete axillary dissection including all axillary levels (I,II and III), seven patients (35%) had negative axillary nodes and thirteen patients (65%) had positive nodes.
- There was one case (5%) of partial flap necrosis. Hematoma under the flap was observed in two cases (10%) and was evacuated.
- Twelve patients (60%) were pleased with their new breasts. Six patients (30%) were satisfied with the reconstruction. Two patients (10%) were unsatisfied. Excellent results were observed in ten cases (50%).

**References**


