The use of Thoracodorsal Artery Perforator Flap in Oncoplastic Procedures

A thesis presented by

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Abstract

Objective: To evaluate the outcome of thoracodorsal artery perforator flap in oncoplastic procedures regarding operative time, post operative complications and cosmetic outcome.

Background: The advent of oncoplastic surgery in the early 1990s has revolutionized the concepts of breast reconstruction for breast cancer. This has been paralleled by a steep evolution of our understanding of the vascular anatomy of the various flaps used for reconstruction. Earlier when mastectomies where prevailing, it made perfect sense to look for flaps with large volumes of tissue and muscle bulk such as the TRAM or the conventional LD flaps. The harvest of these flaps often left significant morbidities such as the abdominal wall weakness and the seroma in the back.

Nowadays the breast surgeon is more than often faced with smaller defects for which such bulky flaps offer a surplus of tissue with unacceptable morbidities compared to the smaller defects these flaps have to reconstruct. Moreover the aesthetic result is often jeopardized by the bulge of the muscle. The advent of perforator flaps has enabled us to reconstruct these smaller breast defects with more limited flaps based on perforating branches of the main thoracodorsal pedicle. Thus the major part of the muscle with its main pedicle is saved for potential further reconstruction in case the patient develops recurrence requiring a total mastectomy.
**Methods:** the study included 40 patients of stage I or II breast cancer who underwent partial or total mastectomy at the National Cancer Institute between 2011 and 2014. The patients were divided into two groups. Group A included 20 patients who underwent Thoracodorsal artery perforator flap reconstruction and group B included 20 patients who underwent latissimus dorsi flap reconstruction. Operative time and complication rates were recorded. The cosmetic and functional outcome were subjectively assessed through a questionnaire.

**Results:** The mean operative time in group A was 227 minutes while that for groups B was 242 minutes. The total complication rate for Group A was 55% with flap congestion as the most common complication, in group B complications occurred in 65% of patients with seroma in the back wound as the commonest complication. The cosmetic outcome was comparable for both techniques with 80% of patients of both groups rating their outcome as either good or excellent. The subjectively assessed functional outcome was favorable for the thoracodorsal artery perforator flap group with mean time of 15 days postoperative for patients to regain their full range of shoulder movements. Patients who underwent latissimus dorsi reconstruction needed on average 21 days to regain their full range of shoulder motion. The difference was however statistically not significant.

**Conclusion:** Thoracodorsal artery perforator flap can play a significant role in oncoplastic surgery and breast reconstruction with acceptable cosmetic and functional outcome.
Introduction

The significant developments in the surgical management of breast cancer have been paralleled by similar advancements in reconstructive surgery. Improvements in our knowledge of the vascular anatomy have enabled the design of a new type of fasciocutaneous flaps which are based on perforating vessels only.

Koshima and Soeda coined the terminology “perforator flaps” in 1989. In two cases, the authors had used a paraumbilical skin and fat island based on a muscular perforator to reconstruct the groin and the tongue. In 1995 Angigiani et al first described the Thoracodorsal Artery Perforator flap (TDAP). However, Hamdi et al were the first to describe the use of TDAP in breast reconstruction.

Aim of Work

The aim of this study is to define the role of thoracodorsal artery perforator flap in oncoplastic breast surgery and explore the reconstructive options that this flap can offer to breast cancer patients. In order to outline this role, the TDAP flap will be compared to the latissimus dorsi myocutaneous flap, which is not only one of the most frequently utilized flaps in breast reconstruction but also bears the same anatomical donor site.

Patients and Methods

The study included 40 patients who underwent partial or total mastectomy for breast cancer or Phylloides tumour and had reconstruction using either TDAP flap or LD flap. Patients were divided into two groups. Group A included 20 patients who underwent TDAP flap reconstruction. This group was compared to another group of 20 patients who had breast reconstruction using the latissimus dorsi myocutaneous flap, which was designated as group B. The patients were operated upon between the years 2011 - 2014 at the National Cancer Institute of Cairo University.

Inclusion criteria

- Pathologically proven breast cancer cases of stage I or II who will undergo partial or total mastectomies and who will seek reconstruction and who will consent to a dorsal donor site.
- Breast cancer patients of stage III who will be downstaged by neoadjuvant chemotherapy to stage I or II.
- Pathologically proven phylloides tumour patients who will require partial mastectomy and reconstruction
- Patients requiring skin excision such as those:
  - With tumours close or attached to but not infiltrating the skin.
  - With misplaced scars of previous open biopsies, who needed wider excision due to inadequate or infiltrated margins.
- Patients who needed excision of 20% or more of their breast volume.
- Patients younger than 60 years of age and free of medical comorbidities.

**Exclusion criteria**
- Patients who will need excision of less than 20% of breast volume
- Patients who will not need skin excision (and still with a resultant volume loss of less than 20%) i.e small lesions away from skin.
- Inflammatory breast cancer.
- Surgically inoperable and metastatic breast cancer.
- Severe uncontrolled medical comorbidities.
- Smokers.

**Methods**
All forty patients of both groups underwent:

- History and physical examination
- Routine labs
- Metastatic work up for breast carcinoma patients
- Preoperative counseling session by the operating surgeon to explain the operative procedure and expected complications. Patients undergoing TDAP flap were also explained that if perforators were found insufficient intraoperatively, a conventional latissimus dorsi myocutaneous flap might be harvested.
- Patients who had TDAP flap planned underwent a handheld Doppler mapping and marking of the thoracodorsal artery perforators on the night before surgery by the operating surgeon.
- Preoperative marking of the area to be resected and the area of flap harvest with dimensions being recorded.
- Preoperative photographing with a digital camera in three views: front or anteroposterior, oblique and lateral with arms to the sides and elevated.
- Intraoperatively during TDAP flap harvest it was recorded if the perforators found were compatible in number and distribution to those marked by the preoperative Doppler mapping or not.
- Operative time was recorded.
- Postoperatively during hospital stay flaps were followed up for colour, temperature and capillary circulation and drains for colour and amount of output and early complications were recorded.
- All patients were discharged with their drains.
- Patients were reviewed by operating surgeon one week then two weeks postoperatively and postoperative photographs were taken in three views and all complications that have developed were recorded and dealt with.
- Drains were removed when their output was equal to or less than 50 cc.
- Patients with breast cancer were then referred to receive their adjuvant treatment according to their final pathology report.
- After finishing their adjuvant treatment patients were invited again to be reviewed by the operating surgeon where they were photographed in three views and were asked to answer a five scale subjective questionnaire evaluating the cosmetic outcome of their reconstructive procedure. This was graded as: excellent (5), good (4), fair (3), poor (2) or very poor (1). The criteria they were asked to evaluate were symmetry, colour match, consistency of the flap, the appearance of their scars and overall satisfaction.
- The functional effects of both techniques were generally assessed in a subjective manner through asking the patients in the same questionnaire about the time elapsed until they regained the full range of motion of their shoulder movements.
- The preoperative and postoperative pictures for each patient were shown on a computer screen to a panel composed of a breast surgeon, a radiotherapist and a nurse. The panel was asked to evaluate the cosmetic outcome of each case and give it a grade on a scale of 5 similar to the questionnaire answered by the patients. Again the criteria the panel had to evaluate were symmetry in shape and size, visibility of scars (raised or depressed, hyper or hypopigmentation, narrow or wide), symmetry of both inframammary folds and overall appearance.

- Patients were then followed up oncologically every 3 months for the first 3 years then every 6 months thereafter for the occurrence of local or distant relapse.

- Data were statistically described in terms of mean ± standard deviation (± SD), and, or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study groups was done using Student t test for independent samples in normally distributed data and Mann Whitney U test for independent samples in not normal data. For comparing categorical data, Chi square ($\chi^2$) test was performed. Exact test was used instead when the expected frequency is less than 5. $p$ values less than 0.05 was considered statistically significant. All statistical calculations were done using computer program SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) release 15 for Microsoft Windows (2006).

**Results**

**Group A (TDAP flap)**

**Technical results**

**Operative time:**

The mean operative time was 227 minutes or three hours and forty seven minutes (range 310- 180 minutes). The operative time included excision of breast tumour, flap harvest and insetting. It is noteworthy that there was a trend towards a less operative time by time of completion of this study.
**Flap Characteristics**

The average flap size was 17 x 9 cm (range length 14 to 23 cm and range of width 7 to 12 cm).

Two flaps (10%) were harvested completely based on the perforator vessels while 90% (eighteen flaps) were converted to a muscle sparing technique.

According to Hamdi's algorithm the remaining muscle sparing flaps harvested were of type I (including a 2cm piece of muscle) in 13 cases (65% of the total), type II (including a 4-5cm piece of muscle) in four cases (20%) and one case (5%) of type III (including a piece of muscle more than 5cm).

The flaps were based on a single perforator in two cases (10%), on two in 17 cases (85%) and on three vessels in one patient (5%).

**Perforator distribution**

Preoperative Doppler mapping detected 2 perforators in 16 (80%) patients and only one in three patients (15%). One case (5%) had three perforators detected preoperatively. So in total 38 perforator vessels were located by Doppler preoperatively.

Fourteen perforators (36.8%) were found between 9 and 9.9cm downwards from the posterior axillary fold. Another 15 perforators (39.5%) were detected between 10 and 10.9cm.

Thus, the area between 9cm and 10.9cm downwards from the posterior axillary fold contained 29 perforators (14+15) which constitutes the majority of perforators (76.3%) that were detected by Doppler mapping.

15.8% (6) of the vessels were found 8 to 8.9cm and 7.9 % (3) were detected between 7-7.9cm from this landmark. All perforators were detected in a distance not less than one cm and not more than 4cm from the anterior border of the latissimus dorsi.
Complications of Group A

Table 7: Early complications (Group A)

<table>
<thead>
<tr>
<th>Early Flap and recipient site complications</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematoma</td>
<td>1(5%)</td>
</tr>
<tr>
<td>Minor wound infection</td>
<td>2(10%)</td>
</tr>
<tr>
<td>Superficial sloughing of flap</td>
<td>1(5%)</td>
</tr>
<tr>
<td>Superficial sloughing of native skin flaps</td>
<td>1(5%)</td>
</tr>
<tr>
<td>Flap congestion</td>
<td>4(20%)</td>
</tr>
<tr>
<td>Reversible</td>
<td>3/4 (75%)</td>
</tr>
<tr>
<td>Leading to sloughing</td>
<td>1/4 (25%)</td>
</tr>
</tbody>
</table>

Table 8: Late complications (Group A)

<table>
<thead>
<tr>
<th>Late Flap and recipient site complications</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat necrosis</td>
<td>1(5%)</td>
</tr>
<tr>
<td>Hypertrophic scar</td>
<td>1(5%)</td>
</tr>
</tbody>
</table>

| Donor site complications                  | Nill            |

Cosmetic Outcome

Patients' evaluation

10% of patients found their cosmetic results excellent while 70% evaluated their final result as good. Another 15% found their cosmetic results fair. Only 5% were not satisfied with the cosmetic outcome and gave it a poor grading.

Table 9: Cosmetic results Group A (patients)

<table>
<thead>
<tr>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
<th>Very Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>70%</td>
<td>15%</td>
<td>5%</td>
<td>-</td>
</tr>
</tbody>
</table>
Panel's evaluation

The panel evaluated only 5% as an excellent outcome while 45% of cosmetic results were found good. 40% were evaluated as fair and 10% were found poor.

Table 10: Cosmetic results Group A (panel)

<table>
<thead>
<tr>
<th></th>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
<th>Very Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>5%</td>
<td>45%</td>
<td>40%</td>
<td>10%</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Functional outcome (subjective)

The average time patients needed to regain the full range of motion of their shoulder joints after this operation was 15 days with a range of 10 to 28 days postoperatively.

Group B (Latissimus Dorsi)

Technical results

Operative time

The mean operative time was 242 minutes or four hours and two minutes (range 219-264 minutes). The operative time included excision of breast tumour, flap harvest and insetting. The operative time was more or less steady during the course of the study.

Flap Characteristics

The mean flap dimensions were 20x12cm (range length 17-25cm, range width 10-15cm.)

The flap was harvested as a Mini-flap (based on the main thoracodorsal pedicle and containing the whole segment of the muscle underlying the skin paddle) in twelve patients. In the remaining nine patients it was harvested as an extended flap, containing the whole muscle and overlying fascia and sub Scarpa’s fat.

Hospital stay

Hospital stay ranged from 3 to 5 days with an average of four days.
**Complications of Group B**

Table 11: Summary of complications of Group B

| Early Flap and recipient site                      | Number  
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor wound infection</td>
<td>2(10%)</td>
</tr>
<tr>
<td>Flap congestion(transient)</td>
<td>1(5%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Early Donor site</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe wound infection+wound dehiscence</td>
<td>1(5%)</td>
</tr>
<tr>
<td>Seroma</td>
<td>8 (40%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Late flap and recipient site</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertrophic scar</td>
<td>1(5%)</td>
</tr>
<tr>
<td>Capsular contracture</td>
<td>1(5%)</td>
</tr>
</tbody>
</table>

**Cosmetic Outcome**

**Patients' evaluation**

15% (3) of patients had an excellent result while 65% (13) evaluated their outcome as good. Another 15% had a fair outcome and one patient (5%) was not satisfied with the final outcome rating it as poor.

Table 12: Cosmetic results Group B (patients)

<table>
<thead>
<tr>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
<th>Very Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>15%</td>
<td>65%</td>
<td>15%</td>
<td>5%</td>
<td>-</td>
</tr>
</tbody>
</table>

**Panel's evaluation**

The panel found that 10% (2) had an excellent outcome while 35% (seven) had a good result. Another 45% (9) had fair cosmetic outcome and 10% (2) had a poor outcome.
Table 13: Cosmetic results Group B (panel)

<table>
<thead>
<tr>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
<th>Very Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>35%</td>
<td>45%</td>
<td>10%</td>
<td>-</td>
</tr>
</tbody>
</table>

Functional outcome (subjective)

The average time elapsed after the operation until patients regained their full range of motion of their shoulder joint was 21 days with a range of 14 to 30 days postoperatively.

Conclusion

Pedicled TDAP flaps or other versions of flaps with minimal LD muscle use are additional tools at the disposal of the breast reconstructive surgeons. This study demonstrates that pedicled TDAP flaps can be safely harvested to cover a wide range of defects. Careful surgical planning by preoperative perforator mapping is essential for successful harvesting of the TDAP flap. Using this tool, when available, in addition to a sound grasp of vascular anatomy, provides a safe approach to avoid complications related to flap design or dissection.

We encourage using these flaps whenever adequate perforators can be identified and safely dissected. We feel that perforator flaps can safely replace the classical LD muscle/muscocutaneous flap in many clinical situations with an attendant reduction in morbidity to the patient.

Summary

The aim of this study is to evaluate the outcome of thoracodorsal artery perforator flap in oncoplastic procedures regarding operative time, postoperative complications and cosmetic outcome.

The study included 40 patients of stage I or II breast cancer who underwent partial or total mastectomy at the National Cancer Institute between 2011 and 2014. The patients were divided into two groups. Group A included 20 patients who underwent Thoracodorsal artery perforator flap reconstruction and group B included 20 patients who underwent latissimus dorsi flap reconstruction. Operative time and
complication rates were recorded. The cosmetic and functional outcome were subjectively assessed through a questionnaire.

The results showed a mean operative time in group A which was 227 minutes while that for groups B was 242 minutes. The total complication rate for Group A was 55% with flap congestion as the most common complication; In group B complications occurred in 65% of patients with seroma in the back wound as the commonest complication. The cosmetic outcome was comparable for both techniques with 80% of patients of both groups rating their outcome as either good or excellent. The subjectively assessed functional outcome was favorable for the thoracodorsal artery perforator flap group with mean time of 15 days postoperative for patients to regain their full range of shoulder movements. Patients who underwent latissimus dorsi reconstruction needed on average 21 days to regain their full range of shoulder motion. The difference was however statistically not significant.
الملخص العربي

ان هذه الدراسة هي دراسة بحثية الغرض منها تقييم استخدامات سديلة الصدر الخلفية في جراحات اورام الثدى التحفظية التجميلية. وتعد هذه السديلة احدث التطورات الجراحية في عمليات إعادة البناء بصورة عامة وفي عمليات إعادة بناء الثدى بصورة خاصة حيث تتكون هذه السديلة فقط من الجلد والدهون الموجودة بمنطقة الصدر الخلفية حيث كان يتم الاعتماد قبل ذلك على سديلة عضلية من عضلات الظهر مما كان يسبب في حدوث مضاعفات ابرزها تجمع سوائل بمنطقة الظهر وتأثير للحركة بمفصل اليد. وقد اشتملت هذه الدراسة على اربعين مريضة بمرحلة مبكرة لسرطان الثدي والتي عادة ما يتم فيها استئصال جزئى أو تحقفي للثدى وقد تم استخدام السديلة الجديدة لإعادة بناء الجزء المستأصل في مجموعة مكونة من عشرين مريضة ومقارنة نتائج هذا الاسلوب الجراحي الجديد مع مجموعة أخرى مكونة من عشرين مريضة أخرى تم لديهم إعادة البناء الجزئى للثدى باستخدام السديلة المعتمدة على عضلة الظهر. تبين من خلال النتائج ان هذا الاسلوب الجراحي الجديد يمكن من خلاله إعادة بناء الجزء المستأصل من الثدى بصورة مرضية من الناحية الجمالية حيث تم عمل استبيان للمرضى من كلتا المجموعتين ليبيان مدى رضاء كل مريضة عن النتيجة الجمالية للثدى بعد إعادة البناء. وجاءت نتائج كلتا المجموعتين مشابهة وحقق كلا الاسلوبين الجراحيين نسبة كبيرة من رضاء المرضى عن النتيجة الجمالية. اما بالنسبة للمضاعفات فقد سجلت أكبر نسبة مضاعفات في المجموعة التي استخدمت فيها سديلة عضلة الظهر بنسبة 65% من الحالات كان أكثر شيوعًا هو حدوث تجمع لسوائل بمنطقة الظهر بينما بلغت نسبة المضاعفات في مجموعة سديلة الصدر الخلفية 55% ولم يحدث في أي من الحالات تجمع لسوائل بالظهر.
استخدامات سديلة الصدر الخلفية في جراحات أورام الثدي التحفظية التجميلية

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2015