

TRAM Flap for Immediate Post Mastectomy Reconstruction: Comparison between Pedicled and Free Transfer

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ABSTRACT

Breast reconstruction after mastectomy is primarily carried out to improve the patients' quality of life. The most commonly used autologous tissue for reconstruction is the transverse rectus abdominis musculocutaneous flap (TRAM). The TRAM flap could be transferred either as pedicled or a free flap with microvascular anastomosis. The following work was carried out to evaluate the two techniques.

Patients and Methods: Thirty-one female patients with operable breast cancer consented to immediate breast reconstruction during the period from June 1998 to December 2000. Fifteen patients had a free TRAM flap reconstruction. In sixteen patients, a pedicled TRAM flap was used. Three patients in the pedicled group underwent bilateral breast reconstruction, thus there were 19 pedicled flaps available for evaluation. Four patients in the pedicled flap group underwent reduction mammoplasty of the normal breast and in five other patients a bipedicled flap was used to achieve size matching with the reconstructed breast. Criteria for analysis included operative data, hospital stay, donor site morbidity, abdominal wall integrity, flap related complications, fat necrosis and final aesthetic result.

Results: There was no difference between the two groups as regards age and, operative time. The pedicled flap group had shorter hospital stay and less blood loss than the free flap group, which was statistically significant ($p=0.007$ and $p=0.001$, respectively). In the pedicled flap group, two patients (10.5%) experienced partial flap loss and fat necrosis was detected in two other patients. For the free flap group, two patients (13.3%) developed complete flap loss, but none suffered fat necrosis. Donor site morbidity was equal in both groups. The total number of complications was higher in the pedicled group (7/19) (36.8.8%) than in the free flap group (5/15) (33.3%) but this was not statistically significant ($p=0.27$). None of the patients in both groups developed abdominal wall hernia, but abdominal wall weakness was evident in eight patients in the pedicled flap group that gradually improved over 2-3 months. Aesthetic results were comparable in both

groups with a slightly better figure for the free flap group, but this was not statistically significant ($p=0.23$).

In Conclusion: Although free TRAM flap seems to provide several advantages over the pedicled group, namely skin volume available for harvesting, preservation of abdominal wall integrity, and better flap contouring, yet the pedicled TRAM flap is a reliable and easy technique that will produce matching aesthetic results.

Key Words: Breast reconstruction - TRAM flap.

INTRODUCTION

Rapid evolution of mammography together with increased awareness of breast cancer resulted in increased numbers of patients undergoing mastectomies. Accordingly, breast reconstruction is currently under several challenges with women requesting the best procedure that will restore their perfect body image [1]. Two principle reconstructive methods are being offered; artificial implants and autologous tissue transfer. Implants are being disfavored due to increased complication rates, namely capsular rupture and the unnatural look and feel of the implant [2]. Of autologous tissues used; the transverse rectus abdominis musculocutaneous (TRAM) flap has come to acquire the major role for breast reconstruction in recent years. Transfer of skin fat and muscle will provide a perfect matching complex to the normal breast [3]. TRAM flap can be used either as a pedicled flap based on the superior epigastric vessels or as a free flap based on the inferior epigastric vessels with microvascular anastomosis. There is still considerable debate on the superiority of either technique [4]. Pedicled TRAM is reliable, easy to harvest and does not require special

instruments or microvascular experience. Free TRAM, on the other hand, will provide larger skin volume with less donor site morbidity and is easily contoured for optimum breast reconstruction [5].

The following work was carried out to compare results and aesthetic outcome of these two different techniques.

PATIENTS AND METHODS

Thirty-one female patients with operable breast cancer were included in the study period from June 1998 to December 2000. Selection criteria included patients with operable breast cancer requesting reconstruction (a formal consent of the procedure was obtained). Very obese patients and those with an abdominal scar (other than appendectomy) were excluded. Immediate breast reconstruction with TRAM flap was carried out. The flap was transferred as a pedicled flap in sixteen patients and as a free flap with microvascular anastomosis in the remaining fifteen. Three patients in the pedicled group underwent bilateral breast reconstruction, thus the total number of pedicled flaps evaluated was 19 procedures (Table 1). Choice for either technique was randomized on admission date. Generally, in all patients, flap design and drawings were made on the night prior to surgery. Technical details of the procedures have been described elsewhere [5,6]. Pedicled TRAM technique was previously reported by our group [7]. In general, the flap is based on the superior epigastric vessels and the amount of skin available for harvesting extends from the anterior superior iliac spine to 1-2cm lateral to the midline over the contralateral rectus abdominis muscle. The vertical arc extends from 1-2cm above the umbilicus to include the important perforators and the inferior limit is situated 34cm above the symphysis pubis which roughly corresponds to the point of entrance of the inferior epigastric vessels into the rectus sheath. This area represents around 50-60% of the lower abdominal surface area (Fig. 1). After delineation of the flap, dissection begins starting from lateral to medial (extending deeply to the abdominal wall aponeurosis) until the lateral border of the rectus abdominis is reached. At that point, the rectus sheath is incised to expose the inferior epigastric vessels passing superiorly underneath the muscle, where they are ligated

and the flap is then elevated along the plane deep to the vascular pedicle and taking the entire rectus muscle and overlying rectus sheath with the skin island. The flap is then tunneled beneath the abdominal wall upwards till the xiphoid process where the superior epigastric vessels are carefully exposed; they usually enter the muscle 2-3cm lateral to the midline. The rectus muscle is severed from the xiphoid attachment to allow for flap rotation and inseting at the mastectomy bed. Final contouring of the flap is carefully carried out while the patient is in the sitting position to achieve symmetry with the normal breast. Particular attention should be experienced for the location and symmetry of the inframammary sulcus (Fig. 2).

For free TRAM flaps, we carried out the technique described by Grotting [5]. The entire lower abdominal skin is mobilized with the flap extending from one anterior superior iliac spine to the other (Fig. 3). The upper and lower extents are similar to those of the pedicled flap. Dissection proceeds in the same planes as with the pedicled counterpart, until the point where the inferior epigastric vessels enter the rectus sheath. Here, the anterior rectus sheath is incised at the junction of the lateral one third and medial two thirds and the rectus muscle is mobilized medially carefully exposing and following the vessels as they disappear inside the muscle. Only that part of the muscle, together with the overlying part of the rectus sheath, is mobilized with the flap. The rectus sheath is incised superiorly dividing the rectus muscle and ligating the superior epigastric vessels. The inferior epigastric vessels are next dissected towards their origin from the external iliac vessels gaining as much vascular pedicle length as possible. The pedicle is finally detached from the iliac vessels and the flap is freed ready for final contouring and placement at the mastectomy site. After the flap is perfectly fashioned, microvascular anastomosis is carried out with the thoracodorsal vessels (Figs. 4,5).

Four patients in the pedicled group had a reduction mammoplasty on the contralateral side to nullify size discrepancy and in five other patients; a bipedicled flap was used to allow importing the entire skin of the lower abdomen to achieve size matching with the other breast (Table 2). Repair of the donor defect necessitated the use of a synthetic mesh in nine patients of

the pedicled flap group while none of the patients in the free flap group required the application of a synthetic mesh.

Evaluation criteria included operative data, duration of hospital stay, donor site morbidity, abdominal wall integrity, flap related complications, fat necrosis (necrosis sufficient to induce a major disfigurement of the reconstructed breast or to result in patient's dissatisfaction). Cosmetic evaluation was subjective and included shape, contour, volume, ptosis, symmetry and patient's satisfaction. Each was graded on a 1-4 scale where 4 was excellent, 3 was good, 2 was fair and 1 was poor. Finally, a summation score was calculated for each procedure and a percentage from the total was used to describe the result as follows; 0-25 = Poor, 25-50 = Fair, 50-75 = Good and 75-100 = Excellent.

RESULTS

A total of 34 TRAM reconstructive procedures were available for evaluation and included 15 patients with a free flap transfer and 19 pedicled flaps due to three patients having bilateral breast reconstruction. There was no difference in the mean age between the two groups: 42 years (range 23-54 years) in the pedicled group and 40.1 years (range 23-50 years) in the free flap group. The operative time did not differ in both procedures; 5.23 hours in the pedicled group, and 5.93 hours in the free flap group ($p=0.07$) and the impact of increasing experience was evident with both techniques showing a tendency for operation time reduction towards the end of the study. Free flap group experienced a greater blood loss than the pedicled ones; 1073ml versus 640ml, respectively, which was statistically significant ($p=0.001$). The mean hospital stay was slightly longer in the free flap group, 11.6 days (range 9-19) versus 8.5 days (range 5-21) in the pedicled group ($p=0.007$) (Table 3).

None of the patients in both groups developed abdominal wall hernia. Abdominal wall weakness was evident in eight patients in the pedicled group which was demonstrated by failure to sit up from the supine position unaided by the arms. In these patients, bipedicled flap was used and there was gradual return of power over a time period of 3-4 months.

Complications (Table 4):

Pedicled Flap Group: Immediate postoperative complications were encountered in five out of nineteen pedicled flaps (26.3%). One patient developed axillary hematoma on the first postoperative day which was evacuated and the further course was uneventful. Two flaps (10.5%) developed ischemic changes (about one third of the total flap volume) at the most distal part which were evident one week postoperatively. The sloughed part was excised and later on the defect was sutured. Two patients suffered immediate donor site complications in the form of necrosis of the middle third of the abdominal wall skin and umbilicus (Fig. 6) and both were managed by debridement of the necrotic area and repeated dressing, none required grafting.

Two patients developed late complications in the form of fat necrosis of the transferred flap. Both presented with a suspected recurrent cancer at the outer part of the flap and fine needle aspiration cytology (FNAC) confirmed the presence of fat necrosis. Thus, the total number of complications for the pedicled flap group was seven out of nineteen procedures (36.8%).

Free Flap Group: Five out of fifteen patients with free TRAM procedures (33.3%) developed early postoperative complications but none experienced late problems. Complete flap loss occurred in two patients (13.3%); both were due to vascular thrombosis, and none could be salvaged, which dictated complete removal of the flap and primary suturing. This complication developed in patient number one and three in the group and was attributed to learning curve. Two patients suffered necrosis of the abdominal wall that were treated conservatively with debridement and repeated dressings. The fifth patient developed abdominal wound infection which was managed with drainage and antibiotics.

There was no statistically significant difference in the complication rate between the two groups ($p=0.27$).

The final aesthetic results are detailed in (Table 5). Good to excellent results were reported in ten procedures for both groups with no statistical difference ($p=0.18$).

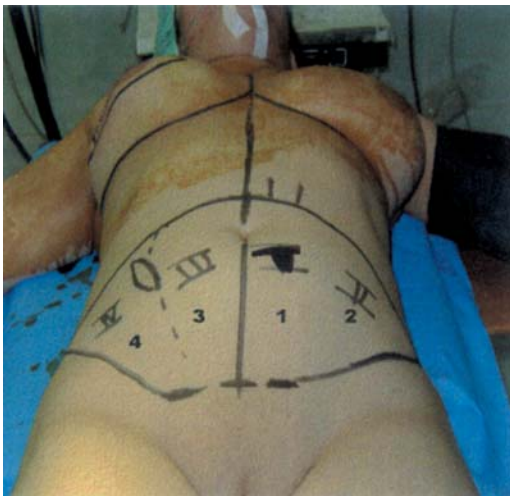


Fig. (1): Design of pedicled TRAM flap; zone IV and most of zone III must be removed.



Fig. (2): Pedicled TRAM flap one month following surgery.



Fig. (3): Free TRAM flap harvesting; the entire lower abdominal skin is mobilized.



Fig. (4): Free TRAM flap one month following surgery.



Fig. (5): Free TRAM flap showing symmetry with the normal breast.



Fig. (6): Sloughing of the abdominal wall skin.

Table (1): Indications for bilateral breast reconstruction.

Table (2): Types of pedicled TRAM flaps.

	No. of pts	%
Monopedicled TRAM	11	58
Bipedicled TRAM for one breast	5	26.3
Bipedicled TRAM for Bilateral breast reconstruction	3	15.7
Total	19	100

Table (3): Age and operative data comparison.

Criteria	Pedicled group	Free group	p-value
Age	42	40.6	
Operative time	5.23	5.93	0.07
Blood loss	642.1	1073.3	0.001
Hospital stay	8.5 (5-21)	11.6 (9-19)	0.007

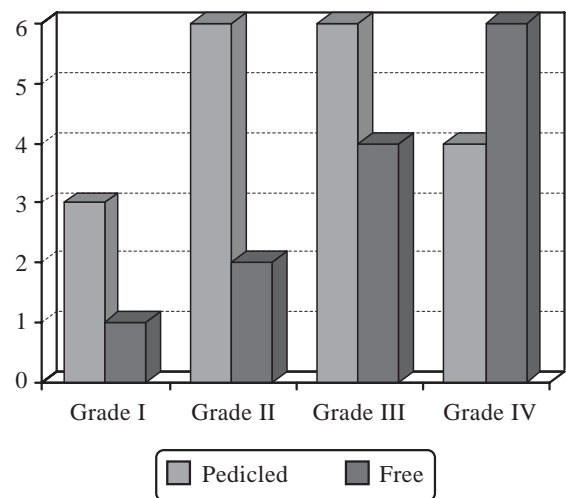
* $p \leq 0.05$: Statistically significant difference.

Table (4): Early and late complications.

Complication	Pedicled group	Free group
<i>Early:</i>		
Flap related		
• Total flap loss	0	2
• Partial flap loss (30%)	2	0
Donor site related		
• Necrosis of Abdominal Scar and umbilicus	2	2
• Wound infection	0	1
Hematoma	1	0
<i>Late:</i>		
Fat Necrosis	2	0
Total	7/19 (36.8%)	5/15 (33.3%)

Table (5): Final aesthetic results (two free flaps were completely lost and were not available for evaluation).

Aesthetic grade	Pedicled group	Free group
Grade 1 (poor)	3	1
Grade 2 (fair)	6	2
Grade 3 (good)	6	4
Grade 4 (excellent)	4	6
Total	19	13



DISCUSSION

TRAM flap is currently the most commonly used flap for breast reconstruction providing a near matching skin-fat complex to that of the normal breast.

Considerable debate still exists on the best way to transfer the flap [1]. Proponents of microsurgical technique continue to argue in favor of the free transfer of the flap and consider it as the natural evolution of the pedicled TRAM. The principle argument stems from the fact that the inferior epigastric vessels providing the vascular nourishment of free flaps are the dominant blood supply of the lower abdominal wall [8]. The entire lower abdominal skin can be harvested based on these vessels providing ample tissue which allows reconstruction of any mastectomy defect including the Very large and posed breasts [5]. On the other hand, the superior epigastric vessels, upon which the pedicled TRAM is based, are not the dominant blood supply of the lower abdominal skin [8]. Only around 50-60% of the regional skin can

be harvested with a monopedicled flap which corresponds to zones I and II and generally the most medial part of the flap should not extend into zone III for more than 1-2cm over the contralateral rectus muscle. This will impose volume restriction on the size of mastectomy defects that could be reconstructed with the pedicled TRAM flap [9]. However, surgeons who continue to harvest the flap in a pedicled fashion claim equivalent aesthetic results to those obtained by microvascular techniques with lesser morbidity and without the use of special microvascular instruments or experience and that all quoted shortcomings of the pedicled flaps could be addressed [10].

Our prospective randomized trial was carried out in an attempt to provide objective insight on this debate. The operative data analysis in our series showed a statistically significant difference as regards hospital stay and blood loss in favor of the pedicled flap group ($p=0.007$ and $p=0.001$ respectively). This, however, does not correspond with other series in the literature reporting less blood loss with the free TRAM as extensive abdominal dissection and tunneling are avoided [11]. The small sample size, together with a learning curve could account for this result in our series. Such an observation, however, does not have an impact on the final outcome of the procedure.

The incidence of local abdominal wound complications was equal in both groups and it corresponds with figures reported elsewhere [10,12]. Four important parameters are used in the comparison between the two techniques since they could greatly impact the final outcome of the procedure; namely flap loss with reliability of the surgical technique, the skin size available for harvesting, the donor site integrity and the incidence of fat necrosis [11].

We did not encounter any incidence of total flap loss in the pedicled group compared to two cases with total flap loss in the free flap group (13.3%). Both cases were encountered during the first three cases in the series with none developing thereafter. In a consecutive series of 211 free TRAM flaps, Schusterman et al. reported a total flap loss in 1%. [13]. The generally agreed upon figure for such a complication is below 3% and again a learning curve is observed with any new surgical endeavor [12,14]. We did not encounter any partial flap loss in

the free flap group, an almost "all or none rule". Partial sloughing was experienced in two patients in the pedicled group (10.5%). Other series reported similar figures [7,10].

Size limitation of pedicled TRAM flaps to around 50% of the lower abdominal skin has always been the major criticism for the technique [13]. Several procedures have been described to circumvent this shortcoming. Some authors recommend routine simultaneous reduction mammoplasty to minimize skin volume requirements in relatively large breasts. They claim that this, together with reduction of the abdominal girth will result in better body configuration, and will be best appreciated by the patient [15]. We did carry out reduction mammoplasty in four of our patients in the pedicled group. Although this seems to be a logical extension of the procedure, yet the addition of an extra procedure on the normal breast may subject the patient to extra morbidity and could aggravate her anxiety [16]. Extra skin may be harvested using a bipedicled flap taking both rectus muscles [15]. This was used in five of our patients and although such technique will allow utilization of the entire lower abdominal skin, yet this will be at the expense of further violation of abdominal wall integrity [17]. Most cases will require the use of a synthetic mesh to avoid abdominal wall herniation. Although the incidence of hernia is rare following such procedure, yet most patients will experience functional impairment with lost ability to sit up using the abdominal muscles alone [9,18]. None of our patients in both groups developed hernia, but there was a definite weakness observed in the bipedicled flap group (8 patients). Different series have reported gradual return of function over an extended period of one year, but then patient's assurance becomes a necessity to alleviate the discomfort of this morbidity [12]. Integrity of the abdominal wall is preserved with the free flap technique as much of the rectus sheath is left intact and only a small strip of the rectus muscle is harvested with the vascular pedicle [13]. We did not use a mesh in any of our free TRAM patients compared to nine patients in the pedicled group and none of the patients in the free flap group experienced abdominal wall weakness. The precarious blood supply of the pedicled TRAM flap could aggravate the risk of fat necrosis. The generally reported figure for such complication is in the

range of 12-25% [19]. It is, however, difficult to quantify such a complication accurately in the different series due to controversies over the definition of the extent of fibrosis [20]. Most series stratify this complication as major or minor depending on the size, with major being more than 5cm. Presence of a mass in the breast adds to the patient's worry and increases the anxiety, and accordingly patient's perception should be the most integral factor in evaluating this complication [21]. The generally reported incidence of fat necrosis with free flaps is in the range of 1-3% which is much lower than that of pedicled flaps [13]. We had two patients who developed this complication in the pedicled group (10.5%) compared to none in the free flap group.

The absence of rotation arcs with no fixation points are important for perfect contouring of the flap and is an added privilege for the free TRAM technique [14].

The final aesthetic results were comparable in both groups. Although the free flap group had a larger number of patients scoring greater than 75% (excellent category), yet this was not statistically significant ($p=0.23$) (Table 5). These results are similar to those reported by most large series comparing the two techniques. Most such series report a trend toward a better aesthetic outcome with free TRAM flaps but none could achieve statistical significance [6,11].

Considering the aspects evaluated in this study, there was no statistically significant difference between pedicled and free TRAM flaps with each expressing certain pros and cons. However, a larger sample size could result in more projection of the trends observed in this study namely related to better aesthetic outcome and lower morbidity (mainly abdominal wall integrity) with free TRAM flaps. Until such study is available, it can be left for the surgeons to choose the technique they feel confident with, since both methods will achieve the desirable aesthetic results.

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