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## Three-layer primary closure of the bipedicled TRAM flap donor site for unilateral breast reconstruction: a 15-year experience with 124 consecutive patients

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## Three-layer primary closure of the bipediced TRAM flap donor site for unilateral breast reconstruction: a 15-year experience with 124 consecutive patients

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**Background/aim:** The pedicled transverse rectus abdominis myocutaneous (TRAM) flap remains widely used as a breast reconstruction technique. The bipediced TRAM flap is not as preferable as it was formerly, mainly because of its donor site complications. However, in a number of situations, a bipediced TRAM flap may be the only alternative. Therefore, a three-layer primary closure technique used with bipediced TRAM flap breast reconstructions that can avoid donor site complications without using a mesh is presented.

**Materials and methods:** A retrospective study was performed that included patients who underwent bipediced TRAM flap breast reconstruction with the three-layer primary closure technique. Between 2000 and 2015, 124 breast reconstruction patients were reviewed for donor site morbidity.

**Results:** During the 15-year study period, 106 patients had conventional bipediced TRAM flaps and 18 had bipediced TRAM flaps with a surgical delay procedure. For all groups, none of the patients developed abdominal wall hernia, but three patients had bulging. Partial flap loss was the most common flap complication, present in 6 flaps (4.8%).

**Conclusion:** The suturing technique studied provided abdominal wall closure without the use of a mesh even when utilizing a bilateral pedicle with very low complication rates.

**Key words:** Abdominal hernia, donor site complication, pedicled transverse rectus abdominis myocutaneous flap, primary closure, TRAM flap

### 1. Introduction

Despite the increasing number of surgical procedures for breast reconstruction, use of autologous tissue has remained the most commonly preferred technique in recent years because of its various advantages, such as a more natural appearing breast and low complication rates (1,2). Abdominal-based flaps such as the transverse rectus abdominis myocutaneous (TRAM) flap are commonly used for autologous breast reconstruction. Donor site morbidity is the main limitation to the use of pedicled TRAM flaps and thus various modifications of the flap, such as the free TRAM, muscle-sparing TRAM, and deep inferior epigastric artery perforator flap, decrease or eliminate the amount of rectus abdominis muscle and the overlying anterior rectus sheath fascia that needs to be harvested with the flap. However, in a number of situations, the patient may not be suitable for microsurgery and a pedicled TRAM flap can be the best reconstructive option.

A bipediced TRAM flap is reliable, easy to harvest, and does not require special instruments or microvascular experience. However, potential abdominal wall morbidity, which includes abdominal hernia, bulging, decreased ability to perform some physical activities, and fullness at the pedicle site, is the main disadvantage of bipediced TRAM flaps.

In order to decrease abdominal wall morbidity following bipediced TRAM flap harvest, the authors used a three-layer primary closure technique without a mesh. The aim of the current study is to present our clinical experience with a three-layer primary suturing technique for abdominal wall closure in bipediced TRAM flap breast reconstruction.

### 2. Materials and methods

Between 2000 and 2015, 124 patients underwent breast reconstruction with a bipediced TRAM flap and the three-layer primary closure technique. The patient's risk

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factors for flap surgery were collected retrospectively (Table 1). While selecting a patient for a TRAM flap, a careful history and physical examination was performed to determine risk factors that might predispose the patient to increased complications (3). These included smoking, previous radiation therapy, previous abdominal surgery, significant systemic disease (e.g., diabetes, hypertension, hyperlipidemia, cardiovascular disease, vascular disease, thyroid disorders, lung disease), and obesity (3). Nine operations were performed as immediate reconstructions following mastectomy and 115 were performed as delayed reconstructions. A surgical delay procedure before the bipediced TRAM flap was performed for 18 patients who had had three or more risk factors while 106 patients had conventional bipediced TRAM flaps without surgical delay (Table 1).

Patients' data were assessed retrospectively according to abdominal wall integrity, donor and flap complications, and limitations in physical activity. For describing the abdominal bulging and hernia, abdominal bulging was defined as abdominal wall bulging without a fascial defect as assessed by physical examination, and abdominal hernia was defined as a fascial defect identified by physical

examination or the need for surgical repair qualified any defect as a hernia (3,4). Final outcomes were assessed at least 1 year after surgery.

### 2.1. Surgical delay procedure

Two weeks before the pedicled TRAM flap operation, the deep and superficial inferior epigastric vessels were ligated under spinal or general anesthesia.

### 2.2. Bipediced TRAM flap technique

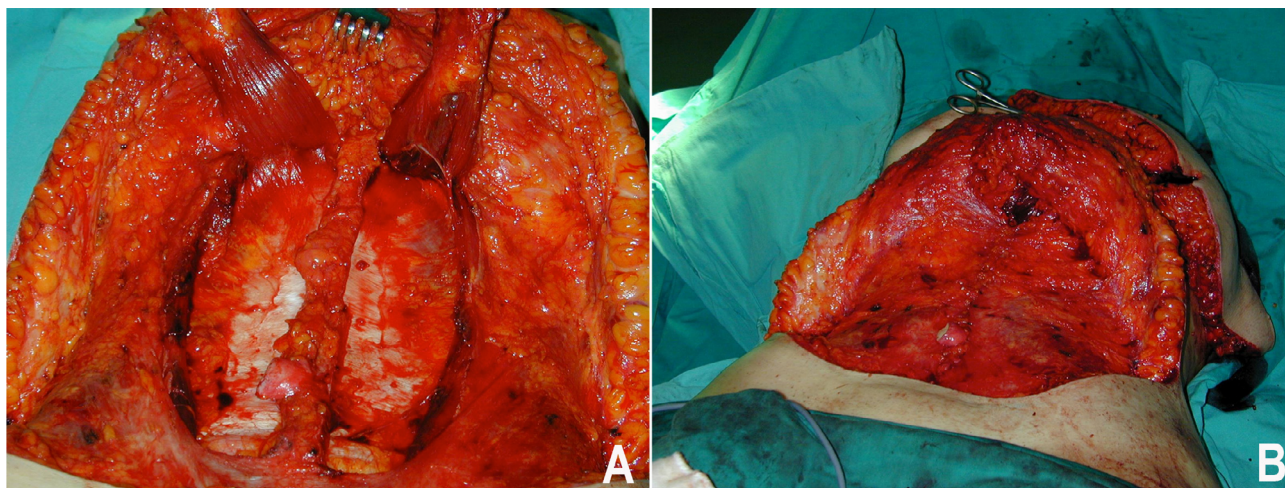
Briefly, the flap was planned as a horizontal spindle extended between the superior anterior iliac spines. After the flap was harvested, including the entire muscles and the anterior rectus fascia sheet surrounding the perforators to the skin island, mobilization of each muscle pedicle was achieved up to the costal margin leaving a lateral 1- or 2-cm strip of the muscle (Figure 1a). The flap was passed through the prepared tunnel to the recipient site.

### 2.3. Three-layer primary closure technique

The donor site was closed primarily, using the remaining edges of the anterior rectus fascia and part of the subsiding fascia from the external and internal oblique muscle laterally and the linea alba medially, with a running PDS\*II 0 loop suture (Ethicon). The anterior rectus sheath

**Table 1.** Patient risk factors and selected type of flap surgery.

	Patients with no risk factors	Patients with one or two risk factors	Patients with three or more risk factors	Total patients
Bipediced TRAM flap	17	89	-	106
Bipediced TRAM flap with surgical delay	-	-	18	18



**Figure 1.** The flap was harvested, including the entire muscles and the anterior rectus fascia sheet (a). The donor site was closed with three-layer primary closure technique without using a mesh (b).

was sutured to the linea alba using a 0 loop PDS suture (Ethicon) reciprocally one-by-one by using continuous horizontal bite sutures. These sutures were continued up to the arcus costarum. After leaving a finger-width hole at the top for the pedicle, one of the sutures was turned caudally for another layer of closure as a continuous horizontal mattress-type suture and was tied at the end. Thereafter, another suture was turned caudally as a continuous running-type suture. In this way, the abdominal wall was closed in 3 layers. Direct closure of the anterior rectus sheath was possible in every case and a synthetic mesh was not employed in any of the cases (Figure 1b).

All patients were instructed to wear compression garments for 6 to 8 weeks postoperatively.

### 3. Results

During the 15-year period, of the 124 patients who underwent breast reconstruction, 106 had a bipedicle TRAM flap and 18 had a bipedicle TRAM flap with a surgical delay procedure (Figure 2). Patients ranged in age from 32 to 64 years. All patients included in this study were followed for at least 12 months. The mean follow-up time was 26.3 months (range: 12–72 months). Donor site and flap complications are summarized in Table 2. There was no need for any materials like polypropylene mesh to support the abdominal wall in any of the cases.

None of the patients in any of the groups developed abdominal wall hernia, though three patients had bulging. However, abdominal wall weakness was evident in 5 patients demonstrated by failure to sit up from the supine position. In these patients, there was a gradual return of power over a time period of 6 months. The significant reasons for dissatisfaction were partial flap loss and hypertrophic scarring.

### 4. Discussion

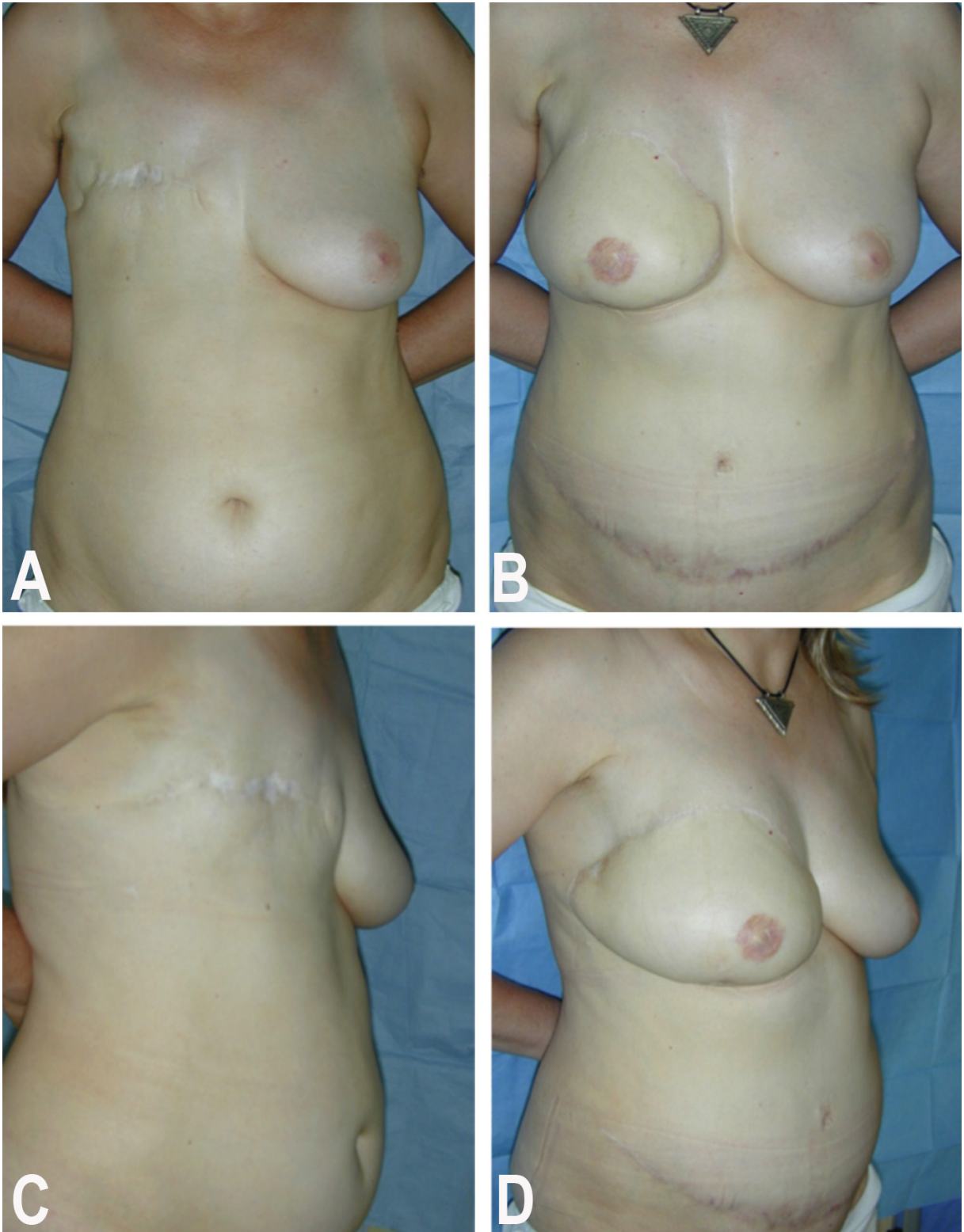
The TRAM flap is the versatile and frequently utilized flap in breast reconstruction (5). TRAM flaps may be used either as a pedicle flap based on the deep superior epigastric vessels or as a free flap according to the deep inferior epigastric vessels. There is still considerable debate on which technique is superior. Based on the possible donor site complications of pedicle TRAM flaps, various modifications, including the DIEP flap and muscle-sparing free TRAM flap, have been employed (6). Still, these microsurgical techniques carry the additional risk of total flap loss. The complication rates reported for the free TRAM flap range from 2% to 4% for fat necrosis and 5% to 8% for total flap loss (7–11). Consequently, despite the recent popularity of free tissue transfer for breast reconstruction, the pedicle TRAM flap remains regularly used. It is thought that total flap loss is disastrous for patients, already sensitized and psychologically vulnerable

because of breast cancer (7). Breast cancer victims are postulated to potentially tolerate the partial loss that may take place with pedicle flaps, but not total loss during the free flap procedure or late fat necrosis (12).

Among the reconstructions, patients with multiple risk factors had three times the incidence of flap-related complications versus patients with one or no risk factors (13). A careful preoperative history and physical examination is essential to evaluate patients for possible TRAM flap reconstruction. Multivariate analysis revealed that smoking, history of chest wall irradiation, significant abdominal scarring, hypertension, hyperlipidemia, cardiovascular disease, vascular disease, thyroid disorders, lung disease, and obesity were associated with an increased complication rate for TRAM flap (7,12). Therefore, various TRAM flap modifications have been developed to increase flap vascularity according to patient risk factors. Among them, the most accepted are the bipedicle technique, vascular delay, super-charged or super-drained flaps, and free flap applications. It is the opinion of the authors that a double-pedicle technique in cases with one or two risk factors and added vascular delay 2 weeks prior to this procedure in cases with more risk factors by considering Bostwick's principles is preferred (7,14). The advantage of the bipedicle TRAM flap is improvement and increase of flap vascularity with double arterial inflow and double venous outflow, meaning greater safety and diminished possibility of partial necrosis.

Although the pedicle TRAM flap has historically been one of the common autologous breast reconstruction methods, there have been increasing concerns regarding potential abdominal morbidity (15). Abdominal morbidity is considered the greatest problem from the pedicle TRAM flap (16). This concern is exacerbated following a bipedicle TRAM flap breast reconstruction where both rectus abdominis muscles are harvested (4). The limitation of the current study is that the functional results were not evaluated. However, there are many instances in the literature where the functional results of TRAM flaps are discussed. Indeed, morbidity caused by the lack of rectus abdominis muscles is not as high as might be expected. Kind et al. reported that abdominal strength at 6 weeks and 3 months was significantly higher among patients who had undergone free TRAM flap reconstruction than in patients who had undergone pedicle TRAM flap reconstruction; however, there was no significant difference in abdominal strength between these groups after 6 months (17). Kim et al. found that transient loss of abdominal strength and decreased sit-up performance were essentially regained after 1 year regardless of the pedicle type. With this, the incidence of subjective weakness in their study was only 1.2% (16). Furthermore, Simon et al. concluded that decreased abdominal muscle





**Figure 2.** Breast reconstruction with bipediced TRAM flap. Preoperative (a, c) and postoperative (b, d) 2-year view. Nipple reconstruction was performed 6 months after the surgery and nipple and areolar tattooing began 2 months after nipple reconstruction.

**Table 2.** Donor site and flap complications.

Complications	Bipedicled TRAM flap (n = 106)	Bipedicled TRAM flap with surgical delay (n = 18)
Donor site		
Hernia	-	-
Abdominal bulge	2	1
Infection	1	1
Seroma	1	-
Hematoma	-	-
Partial skin loss	1	-
Hypertrophic scar	4	1
Limitations in physical activity	-	-
Flap		
Infection	1	-
Seroma	-	-
Hematoma	1	1
Partial necrosis	6	-

strength after a pedicled TRAM flap is not as critical a factor as previously supposed. The patients reported no untoward effect postoperatively on their workday performance, physical recreation, abdominal appearance, standing posture, or back pain. They also did not report any statistically significant differences between single pedicle and bipedicle TRAM flap patients (18). According to another study, with reference to donor site morbidity in free TRAM flaps versus DIEP flaps, 29% of patients in the free TRAM group and 22% of the patients in the DIEP group discontinued sports as a consequence of the reconstruction (19). Most of the patients could go back to their previous lives without restrictions on daily activities independent of the type of flap (TRAM or DIEP) (18,20).

Hernia or bulging formation at the flap donor site is another issue with donor site morbidity of pedicled TRAM flaps. However, the number of pedicles used (unipedicled or bipedicled) was not considered to be a risk factor for hernia and bulge formation by Kroll et al. (2). Although Vyas et al. reported a 17.6% rate of abdominal hernia/bulging in their series of free TRAM flaps, muscle-sparing free TRAM flaps, and DIEP flaps (21), Ascherman et al. reported a low abdominal hernia rate of 0.85% and a low epigastric bulging rate of 1.7% in 117 patients undergoing pedicled TRAM flap breast reconstruction. However, the authors' series included only 12 cases of bilateral reconstruction (22). In the series of 105 bilateral pedicled TRAM flaps of Yoon et al., there was 2.9% hernia and 2.9% abdominal bulging. It is worth noting that the authors made use of polypropylene mesh for donor site closing (4). In a large clinical series of 103 patients, which employed a mesh for bipedicled TRAM flap donor site closure, by Rossetto et al., the incidence of abdominal wall hernia and

bulge were significantly reduced from 5.9% to 2.5% and 17.3% to 9.9%, respectively, with the mesh (23). In their 10 years of clinical experience with 556 patients, Watterson et al. found 4.0% abdominal hernia among 250 patients who had primary closure performed (3). In the series presented here, no patients developed abdominal wall hernia, but epigastric bulge was a unique problem after bipedicled TRAM. Most patients, however, were not concerned, and it did not affect their satisfaction.

There are several methods to preventing donor site complications, including human acellular dermal matrix and synthetic mesh (24,25). The most favored technique is inclusion of a mesh at the donor site to minimize bulge and hernia formation (15,24). However, synthetic mesh can cause foreign body reactions and infection, especially if a wound-healing problem occurs. In particular, bulge formation is a possible complication when a human acellular dermal matrix is used (26). The meshes may not be able to control the tension in the fascia, and that can lead to fascial laxity and bulge formation (15). In a study comparing the rates of donor site complications with various techniques of abdominal fascia closure after harvesting of the TRAM flap, it was revealed that the primary fascia closure method resulted in the lowest rates of bulge formation and complications in general (26). Here, the TRAM flap donor site was repaired mostly with a three-layer primary closure technique without using a mesh.

Instead of using a mesh, the three-layer primary closure created a more natural anterior abdominal wall and better preserved the sustentacular function of the rectus muscles. Presumably, mesh application does not provide much strength in terms of support to the abdominal wall as

much as a primary closure does (3). As Watterson et al. emphasized, patients who require a mesh may have had extremely tight closures or attenuated fascia. Thus, a higher incidence of hernias could be expected (3). To overcome this problem, many propose creative modifications of the mesh closure, such as the “two mesh buttress closure”, “three mesh buttress closure” (27), and “double mesh fold over technique” (28). Although Paterson et al. (27) described that they had not needed to correct incisional hernias, their series was small and included only 7 patients. In the latter study (28), Bharti et al. reported no hernias and only 2 cases (5.7%) of abdominal bulge in their series of 35 patients.

Although a bipediced TRAM flap may not be the first choice in terms of surgical methods, it might be the only choice available in certain instances. Hernia and bulge formation, unwanted complications, can be minimized with a three-layer primary closure technique. At the same time, one can avoid the possible complications of a mesh by using it. The findings from this study demonstrate that the bipediced TRAM flap is a safe and reliable procedure with minimal donor site morbidity rates. Ultimately, pediced TRAM flap breast reconstruction should be at the forefront of the expanding number of options for reconstructive surgery in breast cancer patients.

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