Complications and oncologic outcomes of pedicled transverse rectus abdominis myocutaneous flap in breast cancer patients

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Background: There are several techniques for harvesting the pedicled transverse rectus abdominis myocutaneous (TRAM) flap after mastectomy in breast cancer patients. We examined the whole muscle with partial sheath sparing technique and determined factors associated with its complications and oncological outcomes.

Methods: We retrospectively reviewed the results of 168 TRAM flaps performed between January 2003 and December 2010, focusing on complications and oncologic outcomes.

Results: Among the 168 pedicled TRAM flap procedures in 158 patients, flap complications occurred in 34%. Most of the flap complications included some degree of fat necrosis. There was no total flap loss. Flap complications were associated with elderly patients and the presence of major donor site complications. Abdominal bulging and hernia occurred in 12% of patients. The bi-pedicled TRAM flap and higher body mass index (BMI) were significant factors associated with increased donor site complications. Seven patients (4%) developed loco-regional recurrence. Within a median follow-up of 27 months, distant metastasis and death occurred in 6% and 4% of patients, respectively.

Conclusions: The pedicled TRAM flap using the whole muscle with partial sheath sparing technique in the present study is consistent with the results from previous studies in flap complication rates and oncological outcomes.

Keywords: Breast reconstruction; transverse rectus abdominis myocutaneous flap (TRAM flap); abdominal wall bulging; abdominal wall hernia; donor site complications

Introduction

The transverse rectus abdominis myocutaneous (TRAM) flap is the most popular technique for breast reconstruction, but its oncological effects and donor-site complications, when the rectus muscle is harvested, remain major concerns. Various modifications of surgical techniques (1), such as whole muscle with sheath pedicled TRAM flap, whole muscle with sheath sparing pedicled TRAM flap, muscle sparing pedicled TRAM flap, and free TRAM flap, have been tested, and the complications of each technique are different (2,3), with incidences ranging from 0 to 35 percent (4-9). These differences are most likely related to the various techniques of harvesting flaps and the closure of the abdominal wall. However, the most important principle of breast cancer surgery is oncological safety, which should

be balanced with aesthetic outcome. The purposes of the present study were to determine the complications of whole muscle with partial sheath sparing pedicled TRAM flap, including donor site complications and flap complications, and to identify factors associated with these complications as well as oncological outcomes.

Methods

From January 2003 to December 2010, 158 patients who underwent pedicled TRAM flap procedures by the whole muscle with partial sheath sparing technique in our hospital were included in this study. Patients' ages, weights, heights, body mass indexes (BMI), smoking histories and associated comorbidities (diabetes mellitus, hypertension, and dyslipidemia) were abstracted from the medical records. Previous abdominal surgeries, modes of reconstruction, duration of operations, and outcomes of reconstruction were also recorded. In our series, patients with previous radiotherapy or neo-adjuvant chemotherapy were also included. Patients with history of previous abdominoplasty, inadequate tissue in the lower abdomen, and substantial weight loss were excluded. Surgical outcomes focused on the incidence of abdominal hernia, bulge, fat necrosis, and flap loss. Abdominal hernia was defined as a protrusion of the abdominal wall with dehiscence of the fascial closure, while an abdominal bulge was defined as any asymmetrical abdominal contour developed after the procedure without an associated fascial defect (10,11). Mild fat necrosis was defined as any palpable firmness of less than one-third of the flap that persisted for more than 3 months after surgery without cancer recurrence, and severe fat necrosis was defined as skin and fat necrosis of more than one-third of the flap that persisted for more than 3 months after surgery without cancer recurrence. Partial flap loss was defined as skin and fat necrosis of one-third to two-thirds of the flap, and complete flap loss was defined as skin and fat necrosis of more than two thirds of the flap (3).

Operative technique

Flap elevation
TRAM flap harvesting was performed through a standard elliptical incision of the lower abdomen (*Figure 1A*). We harvested the TRAM flap from lateral to medial, looking for perforators. The upper abdominal skin flap was elevated above the fascia to the level of the costal margin (*Figure 1B*). We routinely identified the lateral border of the rectus

muscle, leaving 2 cm of the lateral anterior rectus fascia on the pedicle side and leaving 1 cm of the linea alba or the first visible perforator (*Figure 1C*). This preserved the linea semilunaris and its fibrous part for mesh fixation during abdominal closure. Before harvesting the flap at the cut distal edge of the rectus muscle, it was important to determine the location of the arcuate line. The incision was continued to approximately 1 cm below the arcuate line (*Figure 1D*). At this level, the inferior epigastric pedicle was visible and doubly clipped, while the anterior fascia and rectus abdominis were transversely divided.

Closure of the abdominal wall defect
After dissecting the upper flap, we closed the abdominal flap without tension. The anterior sheath fascial defect was closed using polyester mesh. In most cases, we preferred to close the medial remnant of sheath primarily in layers beginning with a continuous running suture. We fixed the lateral remnant of the rectus sheath with 3 or 4 interrupted sutures at the edge of the posterior layer and incorporated a part of the anterior layer of the rectus sheath (*Figure 1E*). This closure goes down to the distal cut edge of the rectus muscle and up to the costal margin. All closures were reinforced with polyester mesh. The distal mesh was either fixed to the cut distal edge of the rectus muscle and the posterior rectus sheath ("technique 1") or fixed to Cooper's ligament ("technique 2"), depending on the surgeon's preference. Other important points of our technique include the abdominal fascial defects plicated in two layers with a running horizontal mattress suture followed by an over and over stitch at the lateral margins of the rectus sheath over the mesh and the posterior fascia (*Figure 1F,G,H*).

Statistical analysis

Data analysis was performed using Stata version 12 (Stata Corp, College Station, TX, USA). Continuous variables were summarized as mean and standard deviation or median and range. Categorical variables were summarized as counts and percentage. Tests for differences between continuous variables were done using unpaired *t*-tests or rank tests. Differences between categorical variables were tested using chi-square tests. Factors related to various types of operative complications were identified using multiple logistic regressions. Survival after cancer treatment was estimated using the Kaplan-Meier method, and factors associated with survival were identified using Cox proportional hazards regressions. A two-side P value of 0.05 or less was
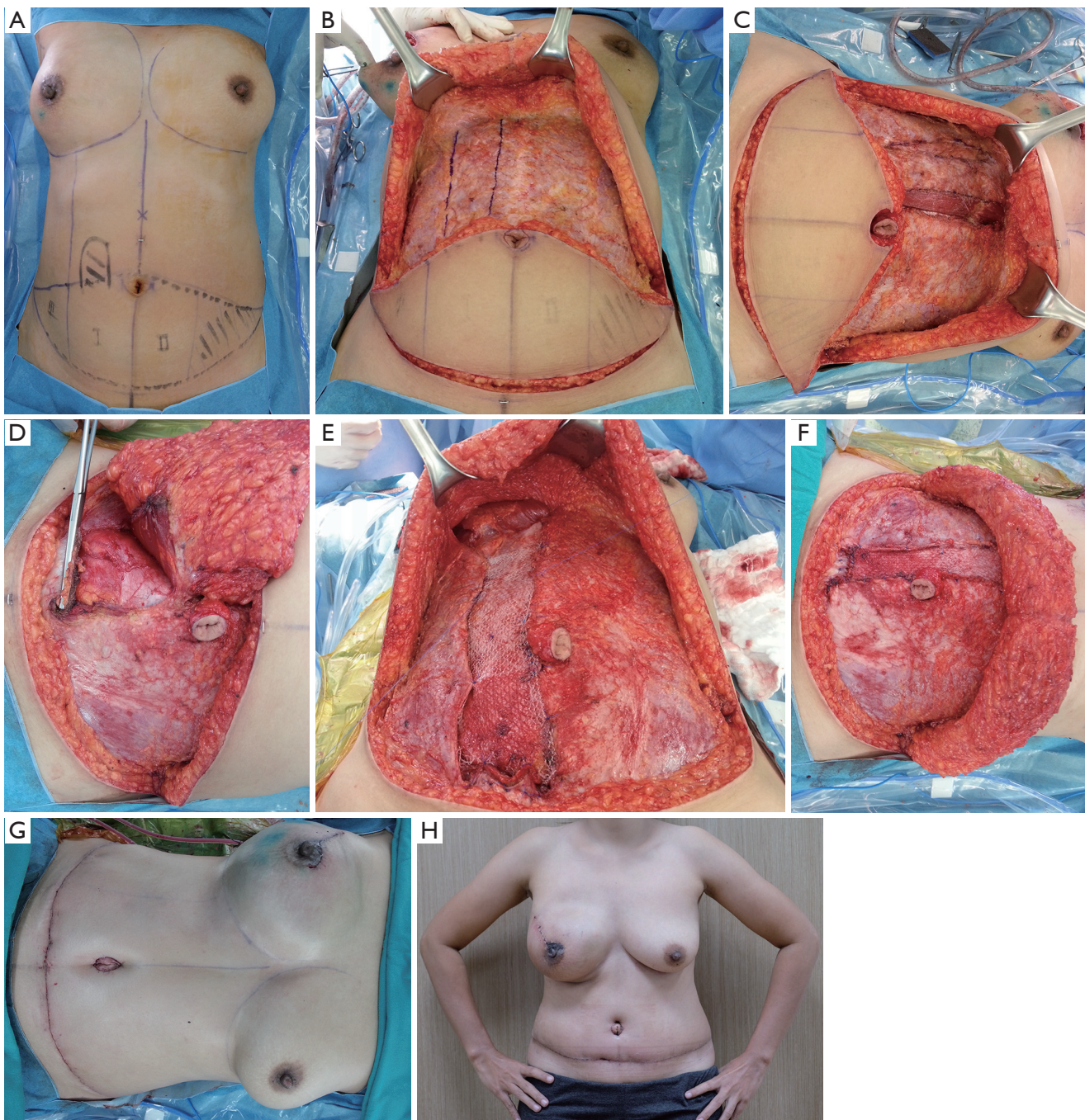

Figure 1 The operative technique of the pedicled transverse rectus abdominis myocutaneous (TRAM) flap; (A) Preoperative planning photographs showing the area of flap design and the ipsilateral muscle pedicle site; (B) the upper abdominal flap is elevated above the fascia to the level of the costal margin. The lower abdominal skin flap is designed with the suprapubic skin crease, in line with the typical transverse cesarean section incision; (C) we leave 2 cm of the lateral anterior rectus fascia on the pedicle side and leave 1 cm of the linea alba or the first visible perforator; (D) the anterior fascia and rectus abdominis are transversely divided approximately 1 cm below the arcuate line; (E) we fixed the lateral remnant of the rectus sheath with 3 or 4 interrupted sutures at the edge of posterior layer and incorporated a part of an anterior layer of the rectus sheath; (F) the abdominal fascial defects plicated in two layers at the lateral margins of the rectus sheath; (G) immediate post-operative view after the pedicled TRAM flap; (H) the one-month postoperative follow-up.
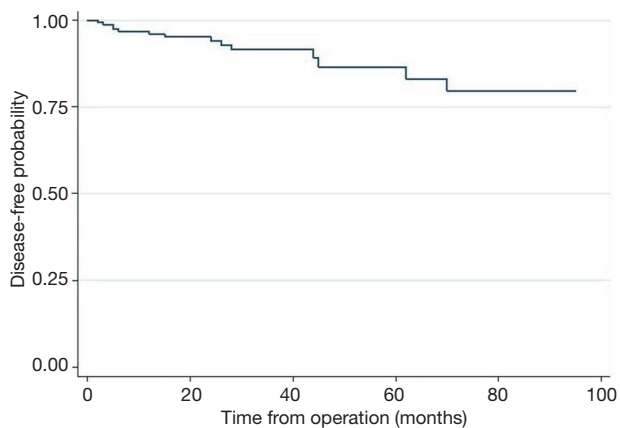
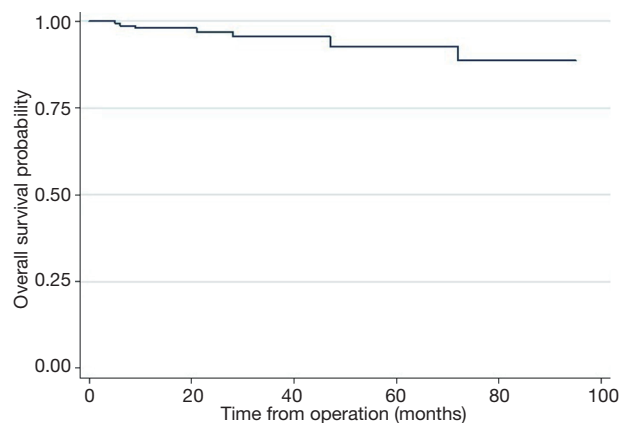**Figure 2** Disease-free survival of all patients in the study.

Figure 3 Overall survival of all patients in the study.

Table 1 Five-year survival probabilities based on the Kaplan-Meier estimates

Type of survival	Probability, percent (95% CI)
Disease-free survival at 5 years	86.5 (75.4–92.9)
Overall survival at 5 years	92.7 (81.8–97.2)

considered statistically significant.

Results

The probability of disease-free and overall survival for our patients was comparable to the probabilities seen in other studies (*Figures 2,3*) (*Table 1*: mostly early breast cancer). Our patients were relatively young with normal builds (BMI <25 in 76% of patients), had very few underlying diseases, and had almost no histories of smoking. Only 27% had previous abdominal surgeries. Most had early stage breast cancer (77%). 89% of the cancers were invasive ductal carcinoma (IDC), 71% were hormone receptor-positive, 76% were HER2 negative, and only 17% were triple negative. Most patients underwent ipsilateral unilateral TRAM flap reconstruction (82%), and only 6% had bilateral TRAM (*Figures 4-6*). Chemotherapy was given in 71% of patients, of which 4% were given neoadjuvant therapy. Radiotherapy was administered in 27% of patients (*Table 2*).

Patients were observed for a median time of 27 months. Flap complications occurred in 32% of patients (*Table 3*),

Figure 4 Presentation of right breast cancer. Moderate ptosis can be seen in the left breast. (A) Preoperative view in preparation for skin-sparing mastectomy (SSM) with pedicled transverse rectus abdominis myocutaneous (TRAM) flap at right breast and vertical mastopexy at left breast; (B) anterior view of the results at 6 weeks after performing right SSM with pedicled TRAM flap and vertical mastopexy of the opposite breast; (C) lateral view of the results at 6 weeks.

Figure 5 Presentation of right breast cancer. Moderate ptosis can be seen in the left breast. (A) Preoperative view in preparation for skin-sparing mastectomy (SSM) with pedicled transverse rectus abdominis myocutaneous (TRAM) flap at right breast and vertical mastopexy at left breast; (B) anterior view of the results at 6 weeks after performing right SSM with pedicled TRAM flap and vertical mastopexy of the opposite breast; (C) anterior view of the results at 3 months.

Figure 6 Postoperative view after performing right skin-sparing mastectomy (SSM) with pedicled transverse rectus abdominis myocutaneous (TRAM) flap for three patients. (A) Anterior view of the results at 3 months after performing right SSM with pedicled TRAM flap; (B) lateral view of the results at 6 months after performing right SSM with pedicled TRAM flap and nipple reconstruction; (C) anterior view of the results at 2 years after performing right SSM with pedicled TRAM flap and nipple reconstruction with tattooing.

and most of these complications were some degree of fat necrosis. Extensive fat necrosis and flap necrosis requiring secondary surgery occurred in 11% of patients. Sixteen percent of patients had early donor site complications, of which 7% were seroma formations and not considered serious complications. Nine percent of patients had more serious donor site complications, which included surgical site infection and dehiscence and umbilical necrosis. Longer-term donor site complications, defined here as abdominal bulging and hernia formation, occurred in 13% of patients.

Factors related to various types of complications as identified in the present study were as follows. Flap complications were significantly associated with older ages

and the presence of major donor site complications (odds ratios of 1.06 per year and 3.15, respectively) (*Table 4*). Higher BMI was of borderline significance. Type of flap was not related to flap complications and neither was the administration of chemotherapy or radiation therapy. High volume surgeons, defined as those performing more than 30 TRAM procedures per year, were slightly and non-significantly associated with fewer flap complications (*Table 5*).

Early major donor site complications were significantly related only to higher BMI (odds ratio, 1.23 per unit increase) (*Tables 6,7*).

Abdominal bulging or hernia occurred significantly more frequently with bipedicled unilateral TRAM (*Table 8*). Other factors, including type of mesh repair, BMI, age, and

Table 2 Summary of patient characteristics

Characteristic	Summary (n=158)
Age (years): mean ± SD, [range]	43.6±7.5, [21–72]
BMI (kg/m^2): mean ± SD, n [%]	22.7±3.3
<25 (normal, underweight)	120 [76]
25–29.9 (overweight)	33 [21]
>30 (obese)	5 [3]
Smoker: n [%]	1 [1]
DM: n [%]	1 [1]
HT: n [%]	4 [3]
Previous abdominal incision: n [%]	43 [27]
Low transverse	20 [13]
Low midline	12 [8]
Periumbilical	8 [5]
Others (2 low paramedian & 1 subcostal)	3 [2]
Bilateral cancer: n [%]	5 [3]
Immediate reconstruction: n [%]	140 [89]
Types of pedicled flaps: n [%]	
Ipsilateral unilateral TRAM	130 [82]
Contralateral unilateral TRAM	13 [8]
Bipedicled unilateral TRAM	5 [3]
Bipedicled bilateral TRAM	10 [6]
Operative time (minutes): mean ± SD	288.8±60.7
Length of hospital stay (days): median [range]	7 [4–66]
Tumor stage (AJCC): n [%]; n=152	
DCIS	11 [7]
I	49 [32]
II	57 [38]
III & IV	35 [23]
Primary tumor	
DCIS	11 [7]
IDC (include special types)	141 [89]
Phyllodes tumor	6 [4]
ER positive (yes): n [%]; n=147	90 [61]
PR positive (yes): n [%]; n=147	87 [59]
HER-2/neu: n [%]; n=147	
Negative (1+)	112 [76]
Equivocal (2+)	15 [10]
Positive (3+)	20 [14]
Triple negative cancer: n [%]; n=133	22 [17]

Table 2 (*continued*)

Table 2 (*continued*)

Characteristic	Summary (n=158)
Chemotherapy: n [%]	
None	45 [29]
Neoadjuvant	7 [4]
Adjuvant	106 [67]
Radiotherapy: n [%]	42 [27]
Preoperative radiotherapy	5 [3]
Postoperative radiotherapy	37 [24]
Mesh placement technique: n [%]	
No Cooper ligament sutures (technique 1)	86 [54]
With Cooper ligament sutures (technique 2)	72 [46]
High volume surgeon (30/year): n [%]	99 [63]

TRAM, transverse rectus abdominis myocutaneous; SD, standard deviation; DM, diabetes mellitus; HT, hypertension; DCIS, ductal carcinoma in situ; IDC, invasive ductal carcinoma.

Table 3 Outcomes of interest

Outcome	Summary (n=158)
Follow up time (months): median [range]	27 [2–95]
Early donor site complications: n [%]	
None	133 [84]
Seroma (not serious complication)	11 [7]
Wound dehiscence	6 [4]
Infection	4 [3]
Umbilical necrosis	4 [3]
Donor site bulge or hernia: n [%]	20 [13]
Total donor site complication: n [%]	45 [28]
Flap complications: n [%]	
None	108 [68]
Flap or skin necrosis	8 [5]
Fat necrosis, minor	33 [21]
Fat necrosis, extensive	9 [6]
Total flap complication: n [%]	50 [32]
Recurrence: n [%]	
None	145 [92]
Locoregional	5 [3]
Distant	8 [5]
Death, any cause: n [%]	7 [4]

Table 4 Factors related to flap complications: multiple logistic regression

Variable	Odds ratio (95% CI)	P value
Age (per year increase)	1.06 (1.01–1.11)	0.023
Presence of major donor complications	3.15 (1.01–9.80)	0.048

Table 5 Comparison between patients with and without flap complications (n=158)

Selected variable	No flap complications (n=108)	With complications (n=50)	P value
Age (years): mean ± SD	42.6±6.9	45.7±8.4	0.016
BMI (kg/m²): mean ± SD	22.4±3.1	23.4±3.6	0.068
Type of TRAM flaps: n [%]			0.911
Ipsilateral unilateral	90 [83]	40 [80]	
Contralateral unilateral	9 [8]	4 [8]	
Bipedicled unilateral	3 [3]	2 [4]	
Bipedicled bilateral	6 [6]	4 [8]	
Donor site complications: n [%]			0.007
None	91 [84]	42 [84]	
Wound infection or dehiscence	3 [3]	7 [14]	
Umbilicus necrosis	3 [3]	1 [2]	
Seroma	11 [10]	0 [0]	
Chemotherapy: n [%]			0.331
None	31 [29]	14 [28]	
Neoadjuvant	3 [3]	4 [8]	
Adjuvant	74 [69]	32 [64]	
Radiotherapy: n [%]	30 [28]	13 [26]	0.815
High volume surgeon: n [%]	69 [64]	30 [60]	0.638

TRAM, transverse rectus abdominis myocutaneous; SD, standard deviation; BMI, body mass index.

Table 6 Comparison between patients with and without major donor site complications (excluding seroma) (n=158)

Selected variable	No donor site complications [n=144]	With donor site complications [n=14]	P value
Age (years): mean ± SD	43.5±7.6	44.8±6.8	0.542
BMI (kg/m²): mean ± SD	22.5±3.1	25.1±4.2	0.005
Prior abdominal incision (yes)			
N [%]	37 [26]	6 [43]	0.168
Type of TRAM flap: n [%]			
Ipsilateral unilateral	120 [83]	10 [71]	0.100
Contralateral unilateral	12 [8]	1 [7]	
Bipedicled unilateral	3 [2]	2 [14]	
Bipedicled bilateral	9 [6]	1 [7]	
Flap complications: n [%]	42 [29]	8 [57]	0.032
Length of hospital stay (day)			
Median [range]	7 [4–66]	7.5 [4–37]	0.041
Chemotherapy: n [%]			
None	41 [29]	4 [29]	0.872
Neoadjuvant	6 [4]	1 [7]	
Adjuvant	97 [67]	9 [64]	
Radiotherapy: n [%]	39 [27]	4 [29]	0.905
Mesh technique 2: n [%]	49 [45]	23 [46]	0.941
High volume surgeon: n [%]	92 [64]	7 [50]	0.305

BMI, body mass index; TRAM, transverse rectus abdominis myocutaneous; SD, standard deviation.

Table 7 Factors related to major donor site complications: multiple logistic regression

Variable	Odds ratio (95% CI)	P value
BMI (per unit increase)	1.23 (1.06–1.43)	0.007

BMI, body mass index.

chemotherapy did not appear to influence bulging and hernia formation. However, the presence of a previous abdominal surgical incision was of borderline significance (*Table 9*). Early donor site complications appeared not to be related to later abdominal wall complications.

Regarding Cox regression analysis, only tumor staging was significantly related to disease-free survival. No surgical complications were related disease-free survival (*Table 10*).

Table 8 Factors related to abdominal bulging or hernia: multiple logistic regression

Variable	Odds ratio (95% CI)	P value
Ipsilateral unilateral TRAM	1.00 (reference category)	NA
Contralateral unilateral TRAM	1.51 (0.30–7.50)	0.617
Bipedicled unilateral TRAM	12.40 (1.19–80.90)	0.008
Bipedicled bilateral TRAM	0.92 (0.11–7.82)	0.940

TRAM, transverse rectus abdominis myocutaneous flap; NA, not available.

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Table 9 Comparison between patients with and without abdominal wall complications (bulging and hernia) (n=158)

Selected variable	No abdominal wall complications (n=138)	With abdominal wall complications (n=20)	P value
Age (years): mean ± SD	43.4±7.6	45.2±6.9	0.314
BMI (kg/m^2): mean ± SD	22.6±3.2	23.6±3.9	0.214
Prior abdominal incision (yes): n [%]	34 [25]	9 [45]	0.056
Type of TRAM flap: n [%]			
Ipsilateral unilateral	116 [84]	14 [70]	0.013
Contralateral unilateral	11 [8]	2 [10]	
Bipedicled unilateral	2 [1]	3 [15]	
Bipedicled bilateral	9 [7]	1 [5]	
Operative time (min): mean ± SD	292.0±61.8	266.7±47.9	0.082
Chemotherapy: n [%]			
None	41 [28]	4 [200]	0.339
Neoadjuvant	7 [5]	0 [0]	
Adjuvant	90 [65]	16 [80]	
Early donor complication: n [%]	12 [9]	1 [10]	0.848
Mesh technique 2: n [%]	62 [45]	10 [50]	0.670
High volume surgeon: n [%]	83 [69]	16 [80]	0.086

TRAM, transverse rectus abdominis myocutaneous; SD, standard deviation; BMI, body mass index.

Table 10 Factors related to disease-free survival: univariable Cox regression

Variable	Hazard ratio (95% CI)	P value
Staging (per higher stage)	3.00 (1.39–6.50)	0.005
Flap complications	1.87 (0.65–5.43)	0.249
Major donor site complication	0.98 (0.13–7.60)	0.987
Abdominal bulging or hernia	0.38 (0.05–2.96)	0.358
Triple negative tumor (n=133)	1.83 (0.50–6.72)	0.360

Discussion

In our series, few patients had histories of smoking with few comorbidities, when compared with patients in other studies from Western countries (1,3,12). The oncologic outcomes (DFS, OS, and locoregional recurrent rate) of breast cancer patients who underwent pedicled TRAM flap were not different when compared with the oncologic outcomes of breast conserving surgery or mastectomy (13-15). Oncologically, therefore, pedicled TRAM flap is a safe option for breast cancer patients after mastectomy.

The overall incidence of TRAM flap complications was 34% in the present study, a rate similar to the rates seen in previous reports, which ranged from 24.6% to 55.4%

for pedicled TRAM flaps (1-3,12,16), and from 23.4% to 49.3% for free TRAM flaps (2,3,17) (*Table 11*). The overall incidence of fat necrosis in our series was 32%, a rate higher than the 14.2% in a large series reported by Kim *et al.* (16). This difference might be because we kept zones 1–3 of the TRAM flap in most patients, whereas in the study of Eun Key Kim *et al.*, only zones 1 and 3, which had better blood supply, were used for reconstruction.

The overall incidence of donor site complications was 34% in the present study, a rate similar to those seen in previous reports, which ranged from 7.7% to 38% of pedicled TRAM flaps and from 17.9% to 24.7% of free TRAM flaps. The overall incidence of bulging or hernia in our series was 12%, higher than those seen in previous reports, which were from 1.5% to 7.8% of pedicled TRAM flaps, and from 3.9% to 11.9% of free TRAM flaps. The incidence of bulging or hernia in our series was higher than that reported by Kim *et al.* (16), which found an incidence of only 3%. The high incidence in our series could be due to a higher proportion of bilateral pedicled TRAM flaps (9.5% *vs.* 1%). No patient in the present series developed mesh infections or required mesh removal.

Risk factors related to flap complications identified in the present study included older ages and the presence of major donor site complications (odds ratios of 1.06 per

Table 11 Comparative total complication of various technique of TRAM flap that published after 2000

Study/year	Type of study	Number of flaps	Flap technique	Donor complication (%)		Flap complication (%)		
				Total	Bulge/Hernia	Total	Fat necrosis/partial flap loss	Flap loss
Alderman et al. [2002] (2)	Prospective	190	Pedicled TRAM	19.0	7.8	32.9	16.2	1.10
		77	Free TRAM	17.9	11.9	49.3	14.9	1.50
Ducic et al. [2005] (1)	Retrospective	224	Muscle sparing pedicle TRAM	38.0	1.5	55.4	26.8	0.90
Ascherman et al. [2008] (12)	Retrospective	117	Whole muscle with sheath sparing pedicled TRAM	7.7	2.6	NR	NR	NR
Andrades et al. [2008] (3)	Retrospective	207	Pedicled TRAM	29.9	7.5	42.9	18.4	1.00
		192	Free TRAM	24.7	3.9	23.4	7.7	0.00
Sailon et al. [2009] (17)	Systematic review (six studies)	812	Free TRAM	NR	11.3	NR	12.9	1.59
	Systematic review (five studies)	329	Free DIEP	NR	8.1	NR	29.0	4.15
Kim et al. [2009] (16)	Retrospective	500	Whole muscle with sheath sparing pedicled TRAM	16.4	3.0	24.6	14.2	0.20
Ramathibodi Hospital, 2012	Retrospective	168	Whole muscle with sheath pedicled TRAM	34.0	12.0	34.0	32.0	0.00

TRAM, transverse rectus abdominis myocutaneous flap; NR, not recorded.

year and 3.15, respectively). Donor site complications were not causally related to flap complications, but rather both complications shared common risk factors. Higher BMI was of borderline significance—a result also found in previous studies (1,18). Preoperative radiation therapy was not related to flap complications in the present study, which may be due to our use of a contralateral TRAM flap for reconstruction. Our findings thus confirmed that postoperative radiotherapy did not increase the risk of flap complications. Prior abdominal incisions, such as lower transverse, lower paramedian, lower midline, or periumbilical incisions, were not related to flap complications, a result also similar those seen in previous reports (19). However, in patients with prior lower midline incision, we preferred to excise zones 2 and 4 of the TRAM flap to decrease the incidence of flap necrosis.

Early major donor site complications were significantly related only to higher BMI (odds ratio, 1.23 per unit increase), corroborating the findings in previous reports (1,18). No other factors, besides the presence of flap complications, which were noted previously, were of significance. One type of flap reconstruction, the bi-pedicled unilateral TRAM flap, had a relatively higher donor complication rate, but the number of such flaps performed was too small to draw generalizations from.

Chemotherapy administration was not related to early donor site complications.

Abdominal bulging or hernia occurred significantly more frequently in bipedicled unilateral TRAM flaps, possibly because patients in this group had prior lower midline incisions as well as more extensive surgeries. However, with such a small number of patients, this finding could also be chance. Although the presence of a previous abdominal surgical incision was of borderline significance in relation to bulging or hernia, the surgeon must be more careful when operating on patients with previous abdominal surgeries.

Limitations of the present study include its retrospective design, which inevitably introduced confounding biases due to lack of information on confounding factors not available in the medical records. Also, we did not evaluate patients' satisfaction and abdominal muscle strength during the preoperative and postoperative period. Further prospective studies comparing complications between different autologous flap techniques would be the best way to identify the ideal flap for breast reconstruction.

Conclusions

The complication rate after pedicled TRAM flap reconstruction by whole muscle with partial sheath sparing

technique in breast cancer patients undergoing mastectomy was acceptable and comparable to other techniques. The oncologic outcome was not different when compared with mastectomy or BCT. We continue to offer this technique because of the predictability in survival of transferred tissue.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: The study was approved by ethics board of the Committee on Human Rights Related to Research Involving Human Subjects, based on the Declaration of Helsinki, Faculty of Medicine Ramathibodi hospital, Mahidol University (No. 02-51-44) and written informed consent was obtained from all patients.

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