

The Deep Inferior Epigastric Perforator Flap for Breast Reconstruction: Is this the Ideal Flap for Asian Women?

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Abstract

Introduction: This study aims to evaluate the outcome and safety of the deep inferior epigastric perforator (DIEP) flap for breast reconstruction in a group of Southeast Asian women treated in our unit and to identify risk factors for breast reconstruction using the DIEP flap in this population. **Materials and Methods:** This is a prospective study on 50 consecutive DIEP flap breast reconstructions by a single surgeon in an academic institution between July 1999 and July 2006. Data on patient demographics, diagnosis, procedure type, adjuvant and neoadjuvant treatments, risk factors and complications were prospectively collected and registered in a clinical database. Outcome variables include total flap loss, partial flap loss, fat necrosis and minor complications related to the donor site or flap. Known risk factors are analysed to determine if they affect outcome in terms of complication rate in this group of patients. **Results:** Total flap loss, partial flap loss and fat necrosis complication rates were 6%, 4% and 10%, respectively. Flap complication rates were comparable to those quoted by previous studies done worldwide. Obesity (BMI >27) is a statistically significant factor associated with development of DIEP flap complications in our population. **Conclusion:** Breast reconstruction with DIEP flap is a safe and reliable method when used in Southeast Asian women, offering optimal results with less donor-site morbidity. Obesity increases the incidence of flap complication in this group of patients.

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Introduction

Breast reconstruction is an integral part of breast cancer management.¹ One of the aims of breast reconstruction is the creation of a new breast that is aesthetically appealing and symmetrical to the opposite breast. This can be achieved with autologous tissue, implants, or a combination of both. The reconstruction takes into consideration the availability of donor tissues as well as the contralateral breast (right form, projection, ptosis, size and level on the chest).

The lower abdominal flap in many women provides ample adipose tissue and skin for this purpose, hence the transverse rectus abdominis myocutaneous (TRAM) flap and later the deep inferior epigastric perforator (DIEP) flap, became the most versatile and commonly used flaps

in breast reconstruction. Microvascular free tissue transfer using the DIEP flap is considered by many to be the preferred choice for autologous breast reconstruction.²⁻⁵ By preserving the rectus muscle and its sheath, the DIEP flap has the added advantage of leaving behind an intact rectus muscle and sheath, reducing donor-site morbidity to that of an abdominal lipectomy. The patient has less postoperative pain, recovers faster with good aesthetic and functional results at the donor site.

The safety of the DIEP flap reconstruction has been extensively studied and established in many centres with Caucasian population. To date, there has been no such large-scale study done on Southeast Asian population. We aim to evaluate the outcome and safety of the DIEP flap for

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breast reconstruction in a group of Southeast Asian women treated in our unit. The primary aim is to provide baseline data of DIEP flap for breast reconstruction and determine if they are comparable to centres elsewhere. The secondary aim is to identify risk factors associated with complications in our population.

Materials and Methods

All data of patients of Southeast Asian origin who underwent breast reconstruction with DIEP flap between July 1999 and July 2006 at National University Hospital (Singapore) were prospectively collected in this study. A total of 50 consecutive breast reconstructions by DIEP flap were performed in 46 consecutive patients under the care of our service during this study period. All patients of Southeast Asian ancestry were included in the study and defined as those originating from the following countries: Singapore, Malaysia, Philippines, Thailand, Vietnam, Myanmar, Cambodia, Laos, Brunei and Indonesia. Patients of non Southeast Asian origin were excluded from the study.

Four patients had bilateral breast reconstruction with DIEP. There were 40 immediate and 10 delayed breast reconstructions. The DIEP free flap was offered to all patients who requested for autologous breast reconstruction and who were fit for free flap transfer. Known risk factors for complication were identified. The mean age of the patients was 42.1 years (range, 19 to 56 years). The mean follow-up period was 3 years and 2 months (range, 18 months to 7 years).

Data including patient demographics, diagnosis, surgical details, risk factors and flap complications were registered in Breast Reconstruction Clinical database. Risk factors include adjuvant chemotherapy, preoperative radiotherapy, obesity, presence of previous abdominal surgery scar, age >50, smoking. Standardised breast and chest wall measurements and photographs were taken preoperatively, at 3 weeks, 6 months, 1 year, 2 years and 3 years postoperatively.

The DIEP flap was raised on the side with the suitable perforators identified preoperatively using Doppler ultrasound probe and confirmed intraoperatively. Microvascular anastomoses were performed either to the thoracodorsal or internal mammary vessels. The abdominal donor site was closed primarily. No antithrombotic drug was used intraoperatively or postoperatively. Flaps were monitored clinically according to a standard chart every hour for 3 days, and the follow-up was done at the standard intervals by the surgeon.

Flap-related complications including total flap loss, partial flap loss and fat necrosis as well as minor complications and donor site morbidity were recorded. Total flap loss is defined as complete necrosis of the skin and fat and is usually

caused by compromised circulation at the anastomosis. In our study, partial flap necrosis is defined as loss of a portion (at least one-third) of the cutaneous and fat components. Fat necrosis is defined as less than one-third of flap loss and usually presenting as a hardening of a portion of the fat component with complete viability of the cutaneous component. Major flap complications are total or partial flap loss. Minor flap complications include haematoma, seroma, fat necrosis and wound dehiscence. Donor site morbidities include abdominal wound dehiscence and hernia.

Variables related to flap morbidity are analysed. These include age, timing of reconstruction, chemotherapy, radiotherapy (pre-reconstruction for delayed reconstruction and post-reconstruction for immediate reconstruction), obesity (BMI >27 by Southeast Asian standard⁶), smoking, presence of abdominal scars, operative time, ischaemic time, zones used, absence of a single good perforator and recipient vessels used.

Statistical analysis was done using Statistical Package for Social Sciences Windows version 12-2005. The risk factors are evaluated using multivariate analysis. A *P* value of less than 0.05 was considered statistically significant.

Results

Demographics and Risk Factors (Table 1)

The average age of the patients was 42.1 years (range, 19 to 56). The mean body mass index was 22.8 kg/m² (range, 16.6 to 32.3). Thirteen patients (28.3%) were considered obese (BMI >27). The ethnicities of the patients were Chinese

Table 1. Patient Demographics and Risk Factors

No of patients	n = 46 (no of flaps = 50)
Average age	42.1 years (range, 19 to 58)
Average Body Mass Index	22.8 kg/m ²
Breast reconstruction	
Unilateral	42 (91.3%)
Bilateral	4 (8.7%)
Immediate	36 (78.3%)
Delayed	10 (21.7%)
Risk factors	
Adjuvant chemotherapy	33 (71.7%)
Preoperative radiotherapy	15 (32.6%)
Obesity	15 (32.6%)
Abdominal surgery scar	14 (30.4%)
Age >50	9 (19.6%)
Smoking	3 (6.5%)

(69.6%), Malay (19.6%), Eurasian (4.3%), Indian (4.3%) and Filipino (2.2%). The reasons for mastectomy were invasive ductal carcinoma in 36 (78.3%), ductal carcinoma in situ (DCIS) in 9 (19.6%), prophylactic mastectomy in 3 (6.5%), malignant Phyllodes tumour in 1 (2.2%) and giant fibroadenoma in 1 (2.2%).

Several risk factors are identified in our study population. Of the patients, 71.7% had adjuvant chemotherapy and 32.6% had preoperative radiotherapy. The percentages of the patients who were obese and had abdominal scar from previous surgery were 32.6% and 30.4%, respectively. Close to 20% of our patients were above 50 years old and 6.5% were smokers.

Technical Flap Data

The mean ischaemic time was 1 hour and 43 minutes. The average length of the operation was 9 hours 35 minutes for unilateral reconstruction and 16 hours 26 minutes for bilateral reconstructions. Forty percent of the flaps used Hartrampf Perfusion Zones I to IV, 30% use Zones I to III, 20% use Zones I and II and 10% use Zones I and III. The thoracodorsal artery and vein were used in 56% of the patients and the internal mammary artery and vein were used in the remaining patients. For patients where the internal mammary vessels were used as recipient site, the approach was through the 3rd or 4th rib or costal cartilage approximately 1 cm lateral to its junction with the sternum, which was removed to expose the recipient vessels.

Twenty-five flaps (50%) were based on a single perforator from the deep inferior epigastric vessels. The remaining flaps had 2 perforators (46%) or 3 perforators (4%). The pedicle length was adequate in all the DIEP flaps harvested and no vein graft was used in this study. The size of the perforators in our patients was less than 0.5 mm.

The average blood loss in patients who underwent unilateral reconstruction was 250 ml while bilateral reconstruction had blood loss of 600 ml. The mean hospital stay was 7.7 days (range, 5 to 12).

Complications

The incidence of total flap loss was 6%. Immediate re-exploration was performed for one patient with thoracodorsal vein thrombosis. There was kinking of the venous anastomosis resulting in congestion, thrombosis and subsequent total flap loss. Of the 3 cases with total flap loss, no subsequent reconstruction was performed after removal and debridement of the failed flap in 2 patients and the remaining one opted for a saline implant.

Partial flap loss occurred in 2 flaps (4%). Five flaps (10%) had fat necrosis, the most common complication in our population. Minor complications occurred in 8 flaps (16%) and included haematoma, seroma and wound dehiscence,

of which 5 were related to flap site and 3 were related to donor site. There was no incidence of abdominal hernia in our patients at the end of our study. Flap necrosis was not related to the difference in zones used. The results are found in Table 2.

Table 2. Complications

Complications	Incidence
Total flap loss	3 (6%)
Partial flap loss	2 (4%)
Fat necrosis	5 (10%)
Minor complication – Flap	5 (10%)
Minor complication – donor site	3 (6%)

n = 50

Multivariate Analysis

Patient factors (age, race and timing of reconstruction), risk factors (chemotherapy, radiotherapy, obesity, smoking and abdominal scars) and flap factors (operative time, ischaemic time, zones used, absence of a single good perforator and recipient vessels used) are predictors of flap morbidity. These factors are analysed using multivariate analysis to determine independent risk factors associated with complications.

The analysis shows that obesity ($P = 0.015$) is the only statistically significant risk factor associated with major and minor complication in our study (Table 3). There are trends for higher complication rates in patients with previous history of smoking and in cases where a single perforator is insufficient and more than one perforator was used for the anastomosis. However, they are not statistically significant in our analysis. There is no evidence to show that the incidence of major complications is associated with these factors.

Table 3. Variables Associated with Flap Morbidity

Variables	P value
Obesity	0.015
Smoking	0.076
Absence of a single good perforator	0.099

Statistical analysis done using SPSS Version 12

Discussion

Breast reconstruction is a safe and reliable operation that does not adversely affect survival and oncologic outcome.¹ The psychological benefits for the breast cancer patient are immense; many felt “healed” only after the reconstruction.² Reconstruction can be achieved with implants, autologous tissue or both. Autologous breast reconstruction techniques including pedicle flap like TRAM flap and latissimus dorsi flap or free tissue transfer of TRAM flap, DIEP flap, superior gluteal artery perforator (SGAP), anterior lateral thigh (ALT) flap can be performed. Of late, the DIEP flap has emerged as the preferred method of autologous breast reconstruction in many centres.³

The DIEP flap was first described by Koshima and Soeda⁴ in 1989 and popularised by Allen⁵ and Blondeel in 1994 for breast reconstruction. The preservation of the rectus and its sheath and neurovascular bundle preserve abdominal wall competence and is associated with lower incidence of donor site hernias, bulges and asymmetry⁷ compared to free TRAM and muscle sparing TRAM flaps. Abdominal wall musculature integrity is preserved in DIEP flaps along with respective segmental innervations and rectus sheath continuity.^{7,8} The patient experiences less pain⁹ and faster recovery, resulting in a shorter hospital stay with lower cost.¹⁰ The longer pedicle allows for easier inset of the flap. Less flap volume diminution occurs as no muscle atrophy is involved.¹¹ All these give better aesthetic results and fewer re-operations. There is initial concern about the trend towards a higher incidence of total flap loss in patients with a DIEP flap reconstruction.¹² Recent study shows no increase in immediate postoperative complications in the DIEP group when compared to the free TRAM group.¹³

The use of the DIEP flap in breast reconstruction has been extensively studied in the Western population.^{2,14-19} The published rates of partial and total flap loss for DIEP flaps range from 0% to 46% and 0% to 5.0%, respectively.^{2,14-21}

Risk factors associated with poor outcome have also been identified mainly in Caucasian population.^{18,22,23} No large-scale studies evaluating risk factors for flap failure in the Southeast Asian patients undergoing DIEP flap breast reconstruction have been reported so far. The Southeast Asian population is generally shorter in stature with a lower body mass index and smaller breast size.^{24,25} Risk factors unique to this group were also identified. By examining the incidence of postoperative complications, we hope to address the safety and feasibility of the DIEP flap as a practical option for autologous breast reconstruction in our patients.

The results of our study show that our flap complication rates are similar to those reported in major publications on breast reconstruction using DIEP flap in Caucasians (Table 4).^{3,14-20} It is also comparable to previous studies done in largely Chinese population in China and Taiwan.^{19,20}

We found no significant differences in complication rates between immediate and delayed breast reconstruction in patients who had DIEP flap reconstruction. Immediate reconstruction has become more popular because of the potential benefits of fewer operations and less psychological impairment by avoiding a period of disfigurement. Previous cost analysis studies show no statistical differences in resource costs between DIEP flaps in both the immediate and delayed breast reconstruction groups.²⁶ Immediate breast reconstruction is preferred by our population as the majority of breast reconstruction patients are unwilling to undergo additional surgery for the reconstructive procedure. This is evident as few of our breast reconstruction patients return for nipple construction (16% had nipple reconstruction). The fat necrosis rate in patients who underwent adjuvant radiotherapy following immediate reconstruction is similar to that of delayed reconstruction. Fat necrosis in these patients resulted in flap contracture and fibrosis in the same areas.²⁷

Table 4. Comparison of Outcomes

Author	Year	No of flaps	Total flap loss (%)	Partial flap loss (%)	Fat necrosis (%)
Yan (China) ²⁰	2007	43	5	5	9
Cheng (Taiwan) ¹⁹	2006	74	0	2.7	13.5
Allen (US) ¹⁸	2004	758	1	3	13
Nahabedian (US) ¹⁷	2002	20	5	0	10
Keller (US) ¹⁶	2001	148	1	0	7
Kroll (US) ¹⁵	2000	31	0	46	80
Hamdi (UK) ¹⁴	1999	50	2	6	6
Blondeel (Belgium) ³	1999	100	2	7	6
This study	-	50	6	4	10

Using multivariate analysis, obesity, smoking and the absence of a single good perforator were independently associated with the occurrence of complications. This is similar to data from studies in the Caucasian population. Obesity is the only statistically significant risk factor ($P = 0.015$) found in our study. Obesity is defined as BMI $>27\text{kg}/\text{m}^2$ by our population standards.⁵

Garvey²⁸ in 2005 studied the use of DIEP flap for breast reconstruction in overweight and obese patients. He found no increased incidence of fat necrosis in these patients. Increasing body mass index did not affect the rate of delayed complications of the abdominal wall, such as abdominal wall hernia or bulging. There is however a trend toward increased wound-healing complications with increasing body mass index.²⁹ Our findings show an increased incidence of overall complications in the obese Asian patients consistent with findings from the previous Caucasian study.

Although there was evidence of trends for higher complication rate in patients with previous history of smoking and for whom more than 1 perforator was used for the anastomosis, they are not statistically significant likely due to the small number of patients. Multiple perforators tend to be included if there is absence of a single good perforator. We observed that our population has smaller perforator vessels ($<0.5\text{ mm}$) in comparison to Caucasian. Perforator vessels can vary in size in relation to the patient's blood pressure and pharmacological agents used. Dissection of smaller perforator vessels is time consuming. However, there seem to be no influence of perforator vessel size on complication rates from this study as we are able to achieve comparable results.

Our approach to perforator insufficiency includes exploring the opposite side for suitable perforators and basing the DIEP flap on this system. In a small number of patients, the superficial system (superficial inferior epigastric vessels) can be dominant. The superficial inferior epigastric vessels are preserved and the flap can be raised based on this system if there is an absence of a good deep inferior epigastric perforator. However, the pedicle is usually shorter and is more suitable for anastomosis to the internal mammary recipient vessels rather than the thoracodorsal recipient vessels. Conversion to a muscle-sparing TRAM can also be considered.

Smoking has long been a relative contraindication to many reconstructive procedures. The scientific literature has described the harmful effects of smoking on surgical wounds and flap survival.^{30,31} Additional accrual research is needed to assess the impact of these clinical factors on the risks of breast reconstruction in our patients.

As with all cohort studies, the effects observed might be attributable to unknown confounding variables not considered in the study. The strength of this study includes

the use of a prospective design that facilitates the systematic data collection and patient follow-up. Patients are surveyed at fixed intervals, minimising recall bias and allowing consistent tracking of changes in outcomes over time.

Conclusion

In our experience, the DIEP flap is a safe and reliable method of autologous breast reconstruction when used in Southeast Asian women, offering optimum results with less donor-site morbidity. Our results and complications are comparable to major leading centres. Obesity is the only statistically significant risk factor associated with complication in our local population.

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