



# Contralateral unaffected breast augmentation using zone IV as a SIEA flap during unilateral DIEP flap breast reconstruction<sup>☆</sup>

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Received 10 November 2018; accepted 23 April 2019

## KEYWORDS

Breast reconstruction;  
Breast augmentation;  
Lower abdominal flap;  
DIEP flap;  
SIEA flap;  
SCIP flap

**Abstract** *Background:* Contralateral breast augmentation during unilateral breast reconstruction is a good option for women with small breasts. In patients with adequate lower abdominal tissues, the deep inferior epigastric perforator (DIEP) flap is often the first choice for unilateral autologous breast reconstruction. We use Zone IV, which is usually excised owing to its insufficient blood circulation, as a superficial inferior epigastric artery (SIEA) flap for contralateral breast augmentation.

*Methods:* Between October 2004 and January 2016, 32 patients underwent unilateral breast reconstruction using a DIEP flap and an attempted simultaneous contralateral breast augmentation with an SIEA flap. The unilateral DIEP flap attached to the contralateral SIEA flap was split into two separate flaps after indocyanine green angiography. In all patients, ipsilateral internal mammary vessels were used as recipient vessels for DIEP flap breast reconstruction. The SIEA flap pedicle was anastomosed to several branches of the deep inferior epigastric vessels. The SIEA flap was inset beneath the contralateral breast through the midline.

<sup>☆</sup> Presented at the Annual Meeting of the American Society for Reconstructive Microsurgery (ASRM), Phoenix, AZ, USA, January 16, 2016, and Plastic Surgery the Meeting (ASPS), Los Angeles, CA, USA, September 23, 2016.

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**Results:** Of 32 patients, 27 underwent DIEP flap breast reconstruction and simultaneous unaffected breast augmentation using 25 SIEA or 2 superficial circumflex iliac artery perforator (SCIP) flaps. All DIEP flaps survived, and total necrosis occurred in one SIEA flap. The mean weight of the final inset for DIEP flap reconstruction and SIEA or SCIP flap augmentation was 416 g and 112 g, respectively.

**Conclusions:** Unilateral DIEP flap breast reconstruction and contralateral SIEA flap breast augmentation may be safely performed with satisfactory results.

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## Introduction

Breast augmentation is generally practiced in the United States, primarily with silicone breast implants,<sup>1,2</sup> and more than 300,000 women, healthy and free from breast cancer, undergo breast augmentation annually.

In a patient with unilateral breast cancer and relatively small breasts desiring breast reconstruction after mastectomy, the first option is to reconstruct the breast to match the size and shape of the unaffected breast. The second option in this situation, depending on the patient's preferences and factors such as physical shape and body mass index, is to reconstruct the affected breast to a larger size while simultaneously augmenting the size of the healthy breast. Many patients with small breasts desire enlargement of both breasts and select the second option. Delayed augmentation of the unaffected breast with a breast implant is also reported,<sup>3</sup> using deep inferior epigastric perforator (DIEP) flaps<sup>4</sup> or fat grafting<sup>5</sup> for patients with unilateral DIEP flap breast reconstruction.

Free flap breast reconstruction with augmentation of the unaffected breast using a breast implant and fat grafting is a relatively easy operation. The use of free flaps allows for transplantation of an appropriate volume of well-vascularized tissue. Because the tissues used for both breasts are autologous, the shape and size can be easily controlled to achieve warm, soft, and overall impressive esthetic results.

The DIEP flap was developed as a standard breast reconstruction procedure, particularly for patients with adequate lower abdominal tissues.<sup>6</sup> Zone IV, according to Hartrampf et al.<sup>7</sup> is a contralateral poorly vascularized area of the DIEP flap, occasionally including distal Zone III, that is usually excised during the procedure because of its insufficient blood circulation. We used Zone IV as a superficial inferior epigastric artery (SIEA) flap<sup>8</sup> or superficial circumflex iliac artery perforator (SCIP) flap for simultaneous contralateral breast augmentation. The use of SIEA/SCIP flaps also reduces the level of invasion and morbidity at the abdominal donor site. In addition, because breast implants are not used in this method, there is no risk of complications from implants such as infection and capsular contracture.

This study reports the applicability and techniques of simultaneous breast reconstruction using a DIEP flap and augmentation of the unaffected breast using an SIEA/SCIP flap and provides a detailed analysis of the clinical results, the esthetic outcome, and the level of patient satisfaction.

In addition, the authors of this study have conducted a breast augmentation using fat grafting for both unaffected

breast and reconstructed breast to the 12 patients who completed the unilateral free flap breast reconstruction. The Cohort Study is also cited regarding the group that underwent augmentation of the unaffected breast using the SIEA/SCIP flap and the group that underwent enlargement of the unaffected breast using fat grafting.

## Patients and methods

This study was conducted according to the STROBE guidelines for cohort studies. In this retrospective study conducted between October 2004 and January 2016 at Yokohama City University Medical Center, Yokohama, Japan, we reviewed medical records of 32 patients who underwent unilateral breast reconstruction using DIEP flap and simultaneous augmentation of the unaffected breast with an SIEA or SCIP flap.

During the same period, we conducted delayed augmentation of the unaffected breast and reconstructed breast using fat grafting to the 12 patients who completed unilateral free flap breast reconstruction including 6 profunda artery perforator (PAP) flap, 4 DIEP flap, 1 SIEA flap, and 1 superior gluteal artery perforator (SGAP) flap, and we made a comparative study.

All procedures were performed by the senior head surgeon (T.S.). This study was approved by the institutional review committee and performed under the ethical guidelines of the Declaration of Helsinki. Information regarding patient demographics, intraoperative data, postoperative complications, nipple-areola reconstruction, and revision surgery was collected and analyzed. Esthetic results were assessed by a board-certified plastic surgeon other than the senior surgeon by using the Harris's method (i.e., poor, fair, good, or excellent).<sup>9</sup> The patient satisfaction level was evaluated on the basis of a standardized questionnaire provided to the patients (asking whether they were satisfied with both breasts in terms of projection, volume, décolleté, cleavage, softness, and symmetry) using a Likert scale (i.e., very dissatisfied, somewhat dissatisfied, somewhat satisfied, or very satisfied) as defined by the senior surgeons other than T.S. In this study, we referred to the survey of Patient Satisfaction given in the literature, "Immediate DIEP flap Breast Reconstruction after nipple-sparing mastectomy" by Levy et al.<sup>10</sup> and we modified our manuscript accordingly. Student's *t*-test was performed to analyze patients' age, body mass index, and flap weight final inset, whereas the chi-square test was applied to evaluate esthetic results. A value of  $p < 0.05$  was considered statistically significant.

Patients with small-sized breasts and ample abdominal tissue are ideal candidates for breast reconstruction to a larger size breast using the unilateral DIEP flap and unaffected breast augmentation using a contralateral SIEA/SCIP flap. Thigh perforator flaps such as the profunda artery perforator,<sup>11</sup> posterior medial thigh perforator,<sup>12</sup> and medial circumflex femoral artery perforator flap<sup>13</sup> are alternative procedures for patients with small breasts who undergo equal size breast reconstruction. These thigh flaps are particularly indicated for younger, nulliparous patients who have plans for future pregnancy and those patients with thin abdominal tissue, past histories of prior complex abdominal surgeries, or multiple liposuctions. In addition to these cases, breast reconstruction and unaffected augmentation using abdominal tissue are indicated for elderly and multiparous patients at our university medical center.

Many of our patients who underwent simultaneous breast reconstruction and augmentation of the unaffected breast either had small breasts by birth or had breasts with substantial shrinkage after breastfeeding or a shrunken unaffected breast due to postoperative hormone therapy.

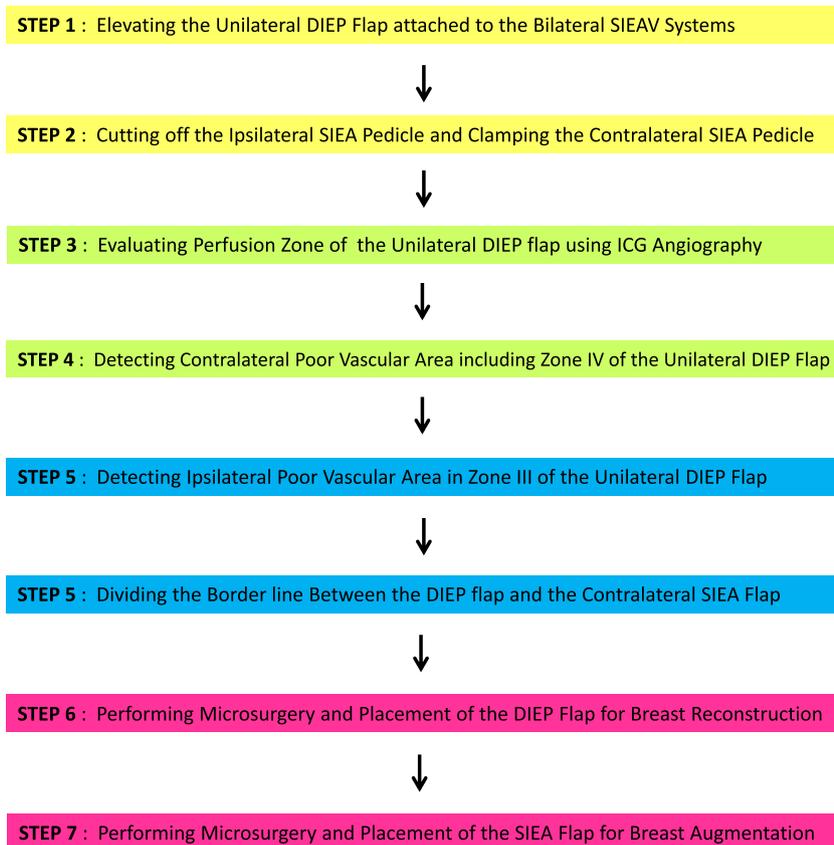
In this text, breast reconstruction timing and stage are classified into 3 types. Immediate two-stage breast reconstruction is performed after a tissue expander is sufficiently expanded. The tissue expander is placed at the time of mastectomy. Delayed one-stage breast reconstruction is performed sometime after mastectomy. Tissue expander is not

placed at the time of mastectomy. In delayed two-stage breast reconstruction, a tissue expander is placed sometime after mastectomy, and breast reconstruction is performed after the tissue expander is sufficiently expanded. Tissue expander is not placed at the time of mastectomy.

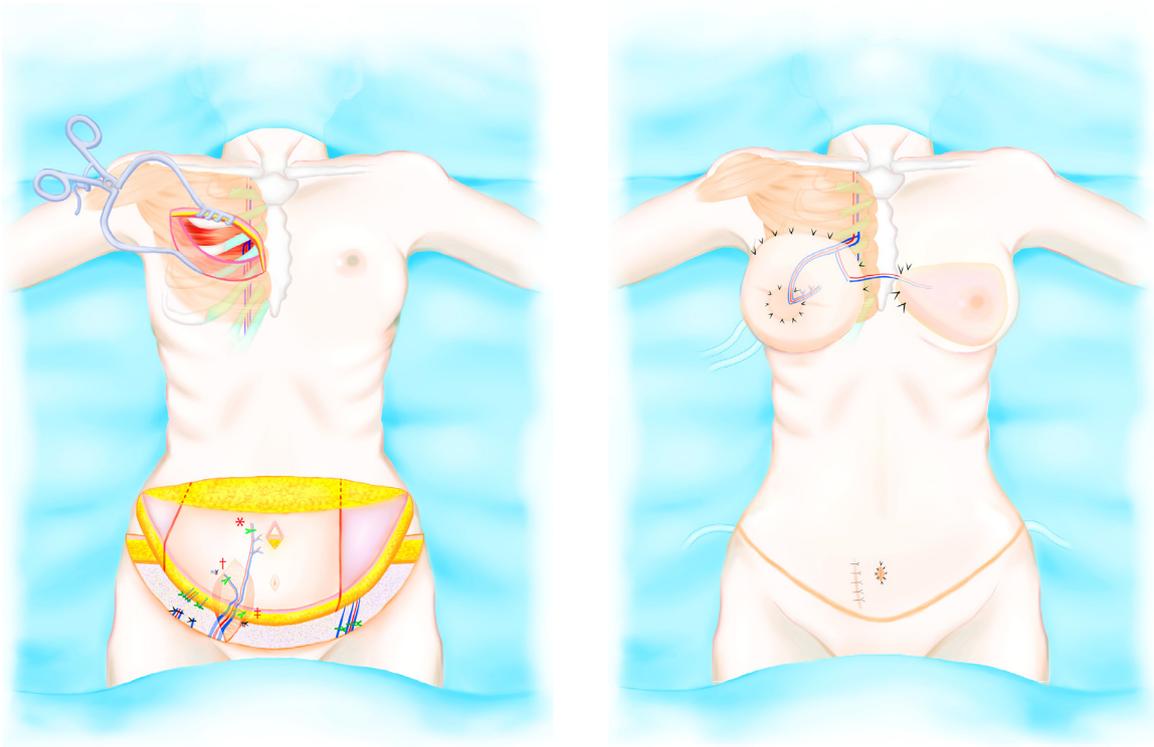
### Surgical technique

In this study, reconstruction of the affected breast is conducted using Zone I in its entirety and the proximal areas of Zone III and Zone II, which have stable vascular circulation for achieving a larger size than the original, while the unaffected breast is augmented using SIEA/SCIP flaps to achieve a good symmetrical balance in terms of size and shape. The poorly vascularized abdominal flap areas that are usually discarded are used as SIEA/SCIP flaps for simultaneous breast augmentation, avoiding the generation of additional scars outside of the abdominal region.

All patients underwent preoperative computed tomography angiography to identify both the SIEA and DIEA branching patterns. A fusiform skin paddle was drawn on the lower abdomen for preoperative marking. The borders of the entire abdominal flap located between the umbilicus and suprapubic crease, and bilateral mid-axillary lines beyond the anterior superior iliac spines, measured 10-12 cm in height and 35-45 cm in width.



**Figure 1** Intraoperative approach for breast reconstruction using the DIEP flap and simultaneous unaffected breast augmentation using Zone IV as an SIEA flap. If the contralateral SIEA/V is absent or its external caliber is small, SCIA/V is searched for to harvest a SCIP flap instead of the SIEA flap.



**Figure 2** (Left) After preparing the breast pocket and recipient vessels, the unilateral DIEP flap with the contralateral SIEA flap, the lower abdominal flap perfusion based on DIEP flap is evaluated with intraoperative ICG angiography. The entire abdominal flap is then divided into two separate flaps. The contralateral poor vascular area including Zone IV is separated from the DIEP flap (\*distal stump of the medial branch, †stump of the lateral branch, and ‡proximal muscle branch from the deep inferior epigastric vessels) and elevated as for the SIEA flap. (Right) The DIEP flap is transferred for breast reconstruction, and the SIEA flap is used for breast augmentation. The pedicle of the DIEP flap is anastomosed to the IMA/V of the affected side, and the SIEA flap pedicle is anastomosed to the branch of the DIEA/V. The SIEA flap is inset under the breast tissue of the unaffected side through a midline subcutaneous tunnel.

After preparing the breast skin pocket and confirming the internal mammary vessels (IMA/V) at the recipient bed of the affected side, a lower abdominal flap consisting of the unilateral DIEP flap with bilateral superficial inferior epigastric vessels (SIEA/V) was elevated (Figure 1). We first confirmed the DIEA/V perforator and SIEA/V on both sides during flap elevation. Depending on the presence and caliber of the SIEA/V vessel, and location of DIEA/V perforators, the harvesting side of the DIEP flap and the SIEA/SCIP flap may be interchanged during the surgery. Several branches such as the proximal muscle branch and distal terminal of the medial or lateral branch from the deep inferior epigastric vessels (DIEA/V)<sup>14</sup> were included in the DIEP flap as recipient vessels for an SIEA flap (Figure 2 left). We traced the SIEA/SCIP flap pedicle proximally to the level where we can perform microsurgical anastomosis to the branches of DIEA/V without significant difference in diameter. However, caution is needed when dissecting the pedicle artery by judging from its external diameter alone, as the internal diameter may be narrow. We believe it would be safer to dissect the SIEA/SCIP flap pedicle toward the femoral vessels and separate it at a thicker position. The ipsilateral SIEA/V was then cutoff by temporarily clamping the contralateral SIEA flap pedicle and dissecting proximally long and large enough for microsurgery and flap setting. Intra-

operative indocyanine green (ICG) angiography was used to evaluate the perfusion of the entire flap based on the DIEP pedicle. The borderlines between the early homogeneous stained area and the delayed heterogeneous or unstained area, including distal Zone III (ipsilateral tip of the skin paddle) and Zone IV (contralateral distal half of skin paddle) were marked (Figure 2 left).<sup>7</sup> The contralateral SIEA/V system was then declamped to resume perfusion of the SIEA flap. According to the results of this examination, the DIEP and SIEA flaps were divided at this marked contralateral borderline (Figure 3 left).

If a contralateral SIEA/V with a large enough caliber cannot be detected during the initial flap dissection, an SCIP flap<sup>15</sup> (Figure 4) or a DIEP flap<sup>4</sup> may be substituted for the SIEA flap. However, contralateral DIEP flap harvesting involves time-consuming pedicle dissection, and therefore, we do not use the contralateral DIEP flap for augmentation of the unaffected breast to reduce abdominal donor site morbidity.

After dissecting both abdominal free flaps before pedicle resection, a subcutaneous tunnel was dissected from the mastectomy site through the midline to the contralateral breast. The ipsilateral IMA/V was used as the recipient vessel for the DIEP flap in an end-to-end anastomosis fashion. Before the second microsurgery, the SIEA flap was



**Figure 3** (Left) Intraoperative photographs of a typical case in this series. The left DIEP flap was elevated for right breast reconstruction. The right SIEA flap was separated and denuded for left breast augmentation after ICG angiography (\*right superficial inferior epigastric vessels). (Right) The right IMA/V were used as the recipient vessels for the DIEP flap (†first microsurgical anastomosis). The SIEA flap pedicle was then anastomosed to the branches of the DIEA/V with end-to-end anastomosis (‡second microsurgical anastomosis). The final weight of the inset DIEP flap and SIEA flap was 360 g and 86 g, respectively.



**Figure 4** If the contralateral SIEA/V cannot be detected for the SIEA flap while harvesting the DIEP flap, the superficial branch of SCIA/V may instead be chosen for the pedicle of a SCIP flap (\*superficial circumflex iliac vessels and †superficial inferior epigastric vein).

de-epithelialized and temporarily placed beneath the unaffected breast tissue pocket. The pedicle of the SIEA flap was anastomosed end-to-end to several branches<sup>14</sup> of the DIEA/V (Figure 3 right). Both microsurgeries are relatively easy to perform, as the external diameters between the pedicle and the recipient in both flaps are similar and without size discrepancy.

After completing both microsurgeries, the patency between both flaps and recipient vessels was examined using ICG angiography. The augmentation SIEA flap was trimmed to balance the reconstructed breast size and shape. To emphasize the cleavage and prominence of the nipple-areola complex, the SIEA flap has been placed mainly under the lower pole of the breast tissue.

However, it is very important to eliminate pressure and tension to SIEA flap pedicle during flap placement, as the SIEA flap pedicle is short and small. The DIEP flap was again adjusted for symmetry, and any unnecessary skin is de-

epithelialized. All wounds were sutured with closed suction drains (Figure 2 right).

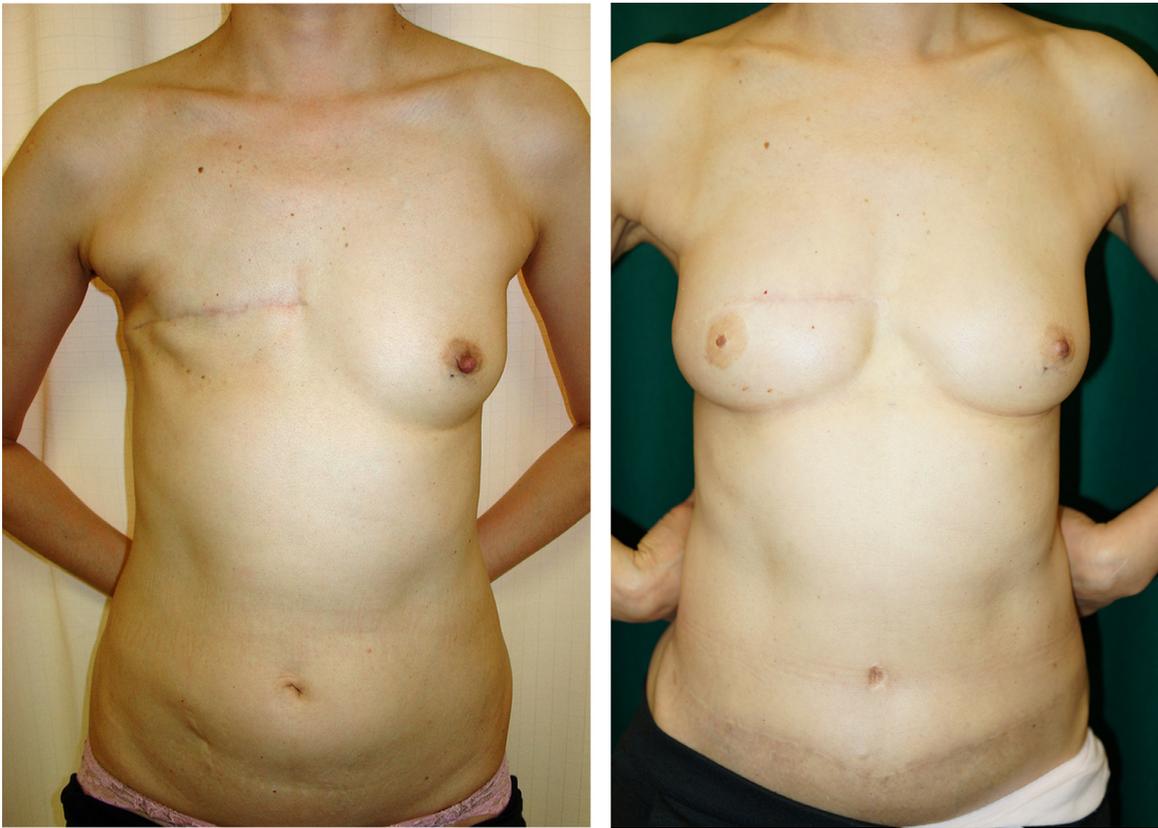
For postoperative microsurgical monitoring, a DIEP flap with a skin paddle was examined for skin color, temperature, size, capillary refill, and skin perforator signals using a handheld Doppler until postoperative day 5. Buried SIEA/SCIP flap and DIEP flap cases are confirmed with color duplex sonography,<sup>16</sup> every 3 h for the first 48 h, every 6 h for the next 24 h, and every 12 h for the following 48 h. In addition, the softness of the proximal SIEA flap could be monitored through a thin medial breast skin area where there is no breast tissue underneath on the cleavage simultaneously, as the SIEA flap pedicle is situated from beneath the midline to the unaffected lower medial breast.

At 1 year after the reconstruction and augmentation, patients who underwent a modified radical mastectomy received nipple-areola complex reconstruction according to their wish. At the same time, we corrected presternal fat tissue, consisting of the SIEA flap pedicle, as required, using the procedure chosen from excision through the mastectomy scar, or liposuction from the umbilicus (Supplementary Figure 1) or the inframammary fold. For further esthetic improvement, we performed liposuction, fat grafting, breast lift, and nipple-areola tattooing as desired for both breasts. The duration of surgery for these revision procedures is usually approximately 1 h.

Fat grafting is performed under general anesthesia. Fat is harvested from abdomen, anterior or posterior thigh, except for original flap donor site, using the tumescent technique with a 3 mm cannula and a 60 ml syringe. The lipoaspirate is manually centrifuged at 41-71 g for 4 min and then injected through small incisions made with an 18-gauge needle using a 1.6 mm blunt cannula and a 5 ml syringe.

## Results

During the study period, all 32 patients underwent unilateral breast reconstruction using the DIEP flap. Among the 32 patients, 25 SIEA flaps (Figures 5 and 6, and Supplementary



**Figure 5** (Left) Preoperative photograph of a 55-year-old patient who underwent right modified radical mastectomy (the same patient shown in Figure 3). To avoid patchwork-like appearance, this patient underwent right tissue expander placement before the reconstruction. (Right) A photograph obtained 36 months after the delayed two-stage right DIEP flap breast reconstruction and contralateral SIEA flap breast augmentation. At the time of nipple-areola reconstruction, she underwent liposuction to remove presternal fat tissue.

Figure 2) and 2 SCIP flaps (Figure 7) were used in 27 patients (age range 40-62 years) for augmentation of the unaffected breast (Table 1). The breast reconstruction procedures comprised 3 immediate two-stage procedures (Supplementary Figure 2), 10 delayed one-stage procedure (Figure 7), and 14 delayed two-stage procedures (Figures 5 and 6). In the remaining 5 patients, we could not detect an adequately sized SIEA or SCIA flap pedicle in 2 cases or there was a loss of these pedicles in 3 cases. There was no irretrievable damaged case during flap harvesting. For these patients, we performed breast reconstruction with a symmetrical shape and equal size, without any further breast augmentation.

All DIEP flaps survived, but one SIEA flap became totally necrotic. One patient required emergency reoperation because of arterial thrombosis of the DIEP flap on postoperative day 3, leading to flap salvage. The mean weight of the final inset flap in the DIEP flap reconstruction and the SIEA or SCIP flap augmentation was 416 g (range, 228-762 g) and 112 g (range, 46-196 g), respectively. The mean operative time for the approach by one team (one senior head surgeon, one junior, and one senior resident) was 9 h 8 min.

The recipient vessels for the DIEP flap were IMA/V in all breasts, and the majority of them were from the 3rd rib to the 3rd intercostal space level (Table 2). The recipient vessels for 25 SIEA flaps were the distal stump of the medial branch after branching perforators from DIEA/V in 12 flaps

(48.0%), the stump of a lateral branch in 10 flaps (40.0%), and the proximal muscle branch in 3 flaps (12.0%). Mean diameter of the SIEA flap and SCIP flap pedicle was about the same as that of the branch of the DIEA/V, whose minimal diameter difference allowed for easy microsurgical anastomosis.

Various corrective surgeries were performed at the time of the nipple-areola reconstruction at least 1 year after both breast reconstruction and augmentation (Supplementary Table 1). Of the 23 patients, 15 required either liposuction or fat excision above the midline of the sternum. Fat tissue to be reduced was from the pedicle region of the SIEA/SCIP flap passing through the sternum that includes the vascularized pedicle, but there was no case of subcutaneous hematoma or vascular complications of the SIEA/SCIP flap. Revision surgeries for breast reconstruction included 8 cases of liposuction for the excess portion, 5 cases of fat grafting into a concave area beneath the clavicle or nipple areola, and 4 cases requiring excision of the excess flap skin or scar revision. As for augmentation of the unaffected breast, fat grafting was performed in 4 cases, primarily to correct a level difference around the fringe of the SIEA flap. In 3 cases, peri-areolar doughnut mastopexy was performed to achieve a symmetrical balance between the two breasts. Among all 23 cases in which corrective measures were applied, no case required multiple fat grafting.



**Figure 6** (Left) Preoperative photograph of a 49-year-old patient who underwent left modified radical mastectomy (the same patient shown in Supplementary Figure 1). (Right) During the delayed two-stage DIEP flap breast reconstruction and SIEA flap breast augmentation, the final weight of the inset DIEP flap and SIEA flap was 312 g and 134 g, respectively. A photograph obtained 6 months after bilateral tattoo for areola marking 6 months after the left nipple-areola reconstruction, liposuction above the sternum, and a right breast lift using the Benelli procedure.

Esthetic evaluation was high, with 88.5% being “good” or “very good” and 3 cases (11.1%) that were either “poor” or “fair” (Figure 8 left). The level of patient satisfaction for 22 of 26 patients was relatively high in all aspects, but 2 to 3 cases expressed dissatisfaction with regard to the symmetrical balance and cleavage (Figure 8 right).

In the 12 cases (fat graft group) of augmentation of both breasts by fat grafting following completion of free flap breast reconstruction, the ratio of flap harvested from thigh, such as PAP flap, as the flap donor site was relatively high, the volume of transplanted flap used for reconstruction was an average of 293.3 g, which was smaller than the average weight 413 g of flap used in the reconstruction by DIEP flap in the SIEA/SCIP flap group ( $P < 0.05$ ) (Supplementary Table 2). Both groups were thin with a BMI  $< 21 \text{ kg/m}^2$ , and in the SIEA/SCIP flap group, there was only 1 occasion among the 4 cases (15.4%) that required fat grafting, with a modest average fat injection of 26.5 ml. On the other hand, the average volume of fat transplanted was 226.1 ml in fat grafting group. There were cases where a single fat injection was not enough to attain the intended size and shape, with 4 cases (41.7%) that required 2 sessions of fat grafting.

With regard to the esthetic evaluation and satisfaction rating, the fat grafting group was inferior to the SIEA/SCIP flap group. The fat grafting group has a higher proportion

of somewhat dissatisfied in the 2 items of projection and volume. (Supplementary Table 3).

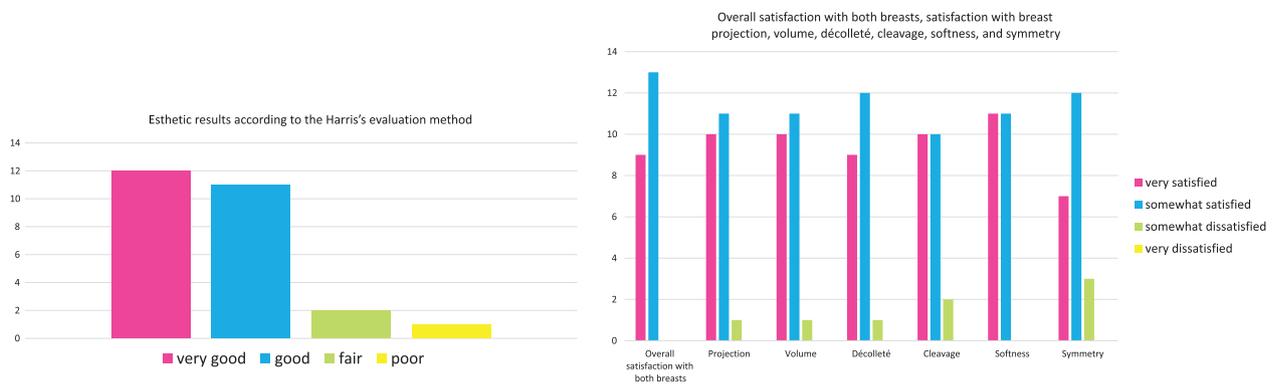
## Discussion

The fundamental concept of a unilateral breast reconstruction is to reconstruct the breast to match with the size and shape of the unaffected breast. However, for patients with breast ptosis, it is possible to modify the unaffected breast to a smaller size to match with the reconstruction of the affected breast. Laporta et al.<sup>17</sup> and Longo et al.<sup>18</sup> also advocate designing of mastectomy for achieving symmetry, DIEP flap breast reconstruction and the algorithm of reduction/mastopexy method for the unaffected breast based on referential factors such as the size of breast, shape, tumor location, past breast-conserving surgery, and smoking history. Likewise, for patients whose breasts are small, there are reports of adjustment of the unaffected breast to a slightly larger size to match with the size of the reconstructed breast.

There are various methods available for autologous breast augmentation, such as the transverse rectus abdominis musculocutaneous flap,<sup>19</sup> DIEP flap,<sup>4,20-24</sup> SIEA flap,<sup>20</sup> latissimus dorsi musculocutaneous flap,<sup>25</sup> thoracodorsal or



**Figure 7** (Left) Preoperative photograph of a 51-year-old patient who underwent right modified mastectomy with a wide scar on the chest skin (the same patient shown in Figure 4). During the delayed one-stage right breast reconstruction using a DIEP flap, SCIP flap was used for left breast augmentation, instead of the SIEA flap. The reconstructed breast skin was replaced with abdominal skin. The final weight of the inset DIEP flap and SCIP flap was 524 g and 92 g, respectively. (Right) A photograph obtained 6 months after a right areola tattooing 12 months after right nipple reconstruction using star flap technique and liposuction above the sternum.



**Figure 8** Graphs showing esthetic results and patient satisfaction (Left) Esthetic results were judged using Harris's evaluation method. (Right) Patient satisfaction according to different evaluation criteria.

intercostal artery perforator flap,<sup>26</sup> gluteal artery perforator flap,<sup>20,27</sup> and transverse gracilis myocutaneous flap.<sup>28</sup> In autologous tissue reconstruction, augmentation with autologous tissues such as free flaps<sup>4</sup> and fat grafting<sup>5</sup> is a good option for obtaining symmetric results,<sup>29</sup> contrary to breast implants, which require long-term management for capsular contracture, implant rupture, and other complications.<sup>30</sup>

Use of autologous tissues for breast augmentation may also help to achieve a better symmetrical balance. It is also much more efficient to harvest the flap from the same abdominal donor site, which can be performed without generating additional scars in a single step. We used Zone IV of the lower abdominal flap as the SIEA/SCIP flap, which requires quick dissection but is less invasive and painful for

**Table 1** Patient demographics and flap characteristics.

Parameter	Value
Total no. of patients	27
Patient age, year	
Mean	49.1
Range	40-62
Body mass index, kg/m <sup>2</sup>	
Mean	20.8
Range	18-22.8
Type of Mastectomy	
Modified radical mastectomy	23
Nipple-sparing mastectomy	4
Timing of Breast reconstruction	
Immediate two-stage reconstruction	3
Delayed one-stage reconstruction	10
Delayed two-stage reconstruction	14
Pre-reconstruction Therapy	
Irradiation	3
Chemotherapy	11
Abdominal Scars	
Appendectomy	4
Laparoscopic surgery	1
Laparotomy	3
No scars	19
Augmentation flap	
SIEA flap	25
SCIP flap	2
DIEP flap weight final inset, g	
Mean	416
Range	228-762
SIEA, SCIP flap weight final inset, g	
Mean	112
Range	46-196
Operative time	
Mean	9 h 8 min
Range	7 h 41 min-11 h 14 min
No. of flap complications	
Arterial thrombosis	1 DIEP flap
Venous thrombosis	0
Fat necrosis	0
Partial flap loss	0
Total flap loss	1 SIEA flap
No. of donor-site complications	
Seroma/hematoma	2/0
Hernia/bulge	0/0
Dehiscence	0
Mean hospital stay after surgery, days	8.4
Follow-up, months	
Mean	40.5
Range	12-66

DIEP, Deep inferior epigastric perforator; SIEA, Superficial inferior epigastric artery. SCIP, Superficial circumflex iliac artery perforator.

**Table 2** Recipient vessels, pedicle vessels and microsurgical anastomosis.

Parameter	DIEP flap (%)	SIEA flap (%)	SCIP flap (%)
<b>Total no. of flaps</b>	27	25	2
<b>Recipient vessels</b>			
<b>Internal mammary vessel</b>			
2nd ICS level	2 (7.4)	N / A	N / A
3rd Rib level	12 (44.4)	N / A	N / A
3rd ICS level	10 (37.0)	N / A	N / A
4th Rib level	3 (11.1)	N / A	N / A
<b>Deep inferior epigastric vessel</b>			
Proximal muscle branch	N / A	3 (12.0)	1 (50.0)
Medial branch	N / A	12 (48.0)	1 (50.0)
Lateral branch	N / A	10 (40.0)	N / A
<b>Microvascular anastomosis</b>			
one artery and one vein	4 (14.8)	23 (92.0)	2 (100)
one artery and two veins	23 (85.2)	2 (8.0)	N / A
<b>Total ischemic period, min</b>			
mean	66.7	65.0	72.0
range	50 - 96	41 - 212	33 - 111
<b>Pedicle vessel diameter, mm</b>			
Artery			
mean	2.33	1.06	1.40
range	1.8 - 3.1	0.5 - 1.8	1.0 - 1.8
Vein			
mean	1.89	1.46	1.90
Range	0.5 - 4.0	0.8 - 2.5	1.8 - 2.0
<b>Recipient vessel diameter, mm</b>			
Internal mammary artery			
Mean	2.35	N / A	N / A
Range	1.2 - 3.5	N / A	N / A
Internal mammary vein			
Mean	2.07	N / A	N / A
Range	0.9 - 4.0	N / A	N / A
Branching artery of deep inferior epigastric vessel			
mean		1.33	1.40
range		0.5 - 1.9	1.0 - 1.8
Branching vein of deep inferior epigastric vessel			
mean		1.42	1.75
range		0.5 - 2.5	1.5 - 2.0

ICS, Intercostal space; N/A, Not applicable.

preserving abdominal functions<sup>31,32</sup> than harvesting another DIEP flap as the augmentation material.

As for the flap setting, a DIEP flap is easier to use, as it has a long vascular pedicle. From our experience, although the SIEA flap pedicle has both short length and small external diameter, microsurgery is relatively easy to perform between the SIEA flap pedicle and the branches of the recipient DIEA/V without a remarkable difference in the caliber of the vessels. This procedure provides a well-defined cleavage without additional scars for breast augmentation. However, one case of total necrosis of the SIEA flap was complicated by arterial thrombosis, as the pedicle of the SIEA in this case was anastomosed to the branches of DIEA/V with

a remarkable caliber difference. We believe that the separation level should not be judged by the external diameter alone.

In a series of breast reconstruction and simultaneous breast augmentation conducted by Huang et al., a DIEP flap with a mean weight of 192 g was transplanted for augmentation of the unaffected breast.<sup>4</sup> In contrast, the mean weight of the SIEA/SCIP flap that we transplanted was 112 g, which is relatively small for breast augmentation. Owing to the original small breast size, even a small flap was sufficient to achieve a good esthetic improvement, with a relatively high satisfaction level indicated by the patients. None of the patients expressed a desire for additional augmentation.

Secondary correction of breast reconstruction or breast augmentation by fat grafting was recently developed. Laporta et al. used delayed fat grafting to augment the DIEP flap volume in insufficient donor site cases.<sup>33</sup> Uda et al. conducts augmentation of the unaffected breast in 1 or 2 stages by fat grafting, averaging 211 ml.<sup>5</sup> Fat grafting of the entire breast area can be conducted in the layers of the region beneath and within the pectoralis major muscle below the mammary gland and subcutaneous layer in accordance with observations of the breast size and shape on site. It can also be repeated as often as necessary. However, fat grafting requires another donor site such as the thigh or lumbar region. Additionally, patients with a low body mass index, under 21.0 kg/m<sup>2</sup>, may have had limited donor sites for fat grafting. Additionally, these regions will likely become the free flap donor sites in the event the unaffected side is later affected by new breast cancer. Fat grafting carries an inherent risk of fat necrosis such as oil cysts and induration, which requires long-term follow-up with imaging.

The breast augmentation technique that we perform using an SIEA/SCIA flap transplants the flap beneath the mammary gland that provides for easy detection of morphological changes within the mammary gland with imaging.

The mean surgery time of 9 h 8 min was relatively long, but this was due to the one-team approach obliged by the limited manpower resources at our facility. Nevertheless, this is not so excessive, considering that the average surgery time at our facility for secondary DIEP flap unilateral breast reconstruction by one team of 2-3 surgeons is approximately 8 h. The breast reconstruction and augmentation by Huang et al. using bilateral DIEP flaps required 12.6 h.<sup>4</sup> In Japan, the mean hospital stay is also quite long because the patient generally does not leave the hospital until all the drain tubes and stitches are removed and all wounds are healed.

Because the vascular pedicle of the SIEA/SCIP flap is short, there is a concern that the subcutaneous fat of the SIEA/SCIP flap pedicle above the sternum will protrude, temporarily causing symmastia.<sup>34,35</sup> This should be explained to the patient before the surgery, although it can easily be corrected in the second stage. The corrective surgery is not complex and is a minor adjustment by either liposuction or fat excision, requiring only approximately 1 h, including the nipple-areola reconstruction. While the long duration of the surgery is a disadvantage for simultaneous breast reconstruction and unaffected breast augmentation, the advantage is that the needed volume can be supplied in a single surgery. As a result, fat grafting as a corrective surgery is conducted with an objective of improving the shallow dint, for which generally 30 ml of graft is sufficient

without a need for repeated procedure. This is the biggest advantage of our method. At the time of breast reconstruction and augmentation, much time and care is allocated in developing the décolleté, cleavage, and projection. Rather than repeated sessions of more than 200 cc of delayed fat grafting, we think that DIEP flap breast reconstruction and unaffected SIEA/SCIP flap augmentation are much advantageous to the patients in terms of physical and economical burden.

We regularly conduct SIEA/SCIP flap placement through a subcutaneous tunnel in the sternum to avoid any scarring on the unaffected breast skin. However, sternal subcutaneous tunnel that is fairly low down near the internal mammary fold may help to prevent symmastia.

Symmastia may be avoided by several measures, such as by an incision through the inframammary fold of the unaffected breast and anastomosis of the vascular pedicle of the SIEA/SCIP flap to the IMA/V<sup>34</sup> or by anastomosis to the thoracodorsal blood vessels by external incision of the lateral chest or transplanting the flap as an extracorporeal pedicle flap without going through a sternal subcutaneous tunnel after anastomosis. These approaches, however, will ultimately leave a scar on the unaffected breast.

## Conclusions

Contralateral balancing surgery during breast reconstruction should be considered to achieve better symmetry in patients with small breasts. In some patients, unilateral DIEP flap breast reconstruction and simultaneous unaffected breast augmentation using Zone IV as an SIEA/SCIP flap is worth considering as an esthetic balancing procedure. This procedure may be performed safely with satisfactory results.

## Conflicts of interest

None.

## Funding

None.

## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.bjps.2019.04.011](https://doi.org/10.1016/j.bjps.2019.04.011).

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