

Optimizing DIEP Flap Insetting for Immediate Unilateral Breast Reconstruction: A Prospective Cohort Study of Patient-Reported Aesthetic Outcomes

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Patient-reported
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Background: To improve the aesthetic outcome of deep inferior epigastric perforator (DIEP) flap breast reconstruction, flaps should be tailored to the patient's characteristics. A single method of DIEP flap insetting will not suffice for all women seeking breast reconstruction. The authors share the outcomes of a prospective longitudinal study on DIEP flap insetting and present an algorithm for reconstruction.

Methods: Over 4 years, 70 consecutive immediate unilateral DIEP flap breast reconstructions were prospectively evaluated. DIEP insetting was based on the characteristics of the donor site and contralateral breast, according to the authors' algorithm. Baseline and outcome data were collected. Aesthetic outcomes were evaluated by a panel of three independent assessors, and patient-reported outcomes were quantified using the BREAST-Q at 1 year after reconstruction.

Results: Seventy women underwent reconstruction. There were no total or partial flap failures, four cases of fat necrosis, and 14 revision operations. Women reported a mean overall BREAST-Q score of 82 of 100, representing excellent satisfaction but poor satisfaction with sexual well-being. BREAST-Q scores were not associated with age or body mass index. Fat necrosis reduced satisfaction with the chest (absolute mean reduction, 13; 95 percent CI, 8 to 18; $p = 0.002$). Independent assessors scored the outcomes favorably, but there was no agreement between surgeons, nurses, and lay assessors.

Conclusions: The authors' algorithm can support surgeons in selecting individually tailored DIEP flap insetting to achieve excellent aesthetic outcomes. Further research is needed as to the relevance of scores from BREAST-Q in relation to interventions. (*Plast. Reconstr. Surg.* 143: 261e, 2019.)

CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, IV.

Immediate breast reconstruction is recognized as beneficial,¹ but high expectations over the aesthetic results and persistent concerns related to breast cancer leave some women with significant psychosocial distress.² The deep

inferior epigastric perforator (DIEP) flap is considered the first choice in free autologous breast reconstruction,³ and shaping the flap into an aesthetically pleasing breast is important, particularly in immediate procedures.

For many years, little attention has been given to flap insetting, and few techniques have been described.^{4,5} Flap insetting for breast reconstruction plays a central role in achieving a satisfactory result in terms of final shape, volume, and symmetry. There are many different natural breast phenotypes; therefore, a single insetting method

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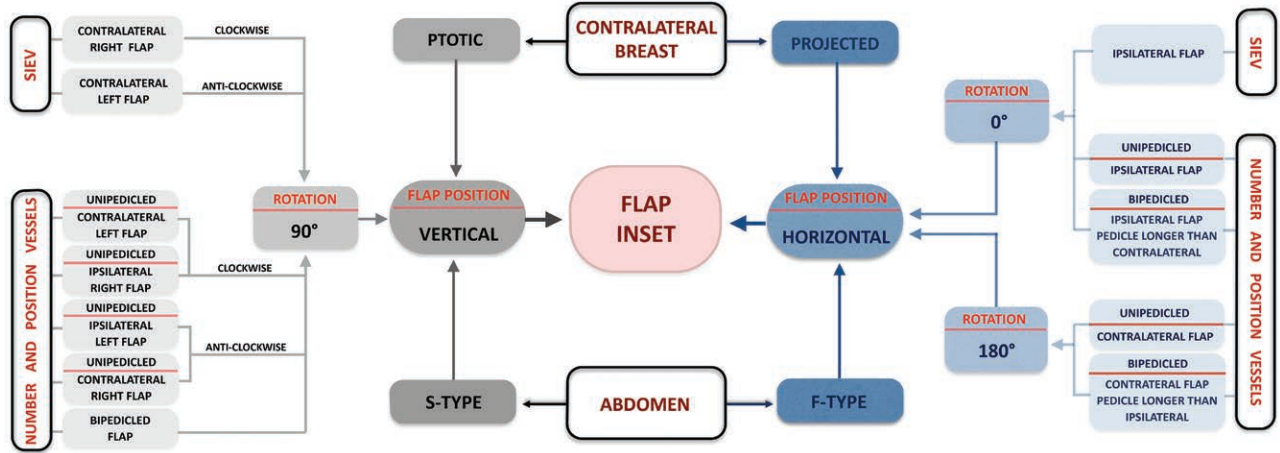


Fig. 1. Algorithm supporting the decision-making process during DIEP flap inseting in unilateral immediate DIEP flap breast reconstruction.

may be not sufficient. Donor-site characteristics and contralateral breast shape should be taken into account. We planned a prospective longitudinal study with the aim of standardizing DIEP flap inseting to improve the aesthetic outcome, giving consideration to the morphology of the breast and abdomen. An algorithm was developed to support the decision-making process during the planning of the DIEP flap inseting for unilateral immediate DIEP flap breast reconstruction. Our aim was to measure patient satisfaction using validated patient-reported outcome measures to investigate the effect of our DIEP flap inseting algorithm and generate population data for women seeking breast reconstruction.

PATIENTS AND METHODS

From January 1, 2012, to December 31, 2015, 176 unilateral DIEP flap breast reconstructions were performed under the care of a single surgeon (A.F.). Of these, 70 women underwent immediate reconstruction following mastectomy for breast cancer. We routinely prospectively input all perioperative patient data into an electronic database, and this was augmented with prospectively collected objective and patient-reported outcome data.

Mastectomy types were classified as skin-sparing mastectomies, subdivided according to Carlson et al.,⁶ and non-skin-sparing mastectomies. The internal thoracic vessels were used as recipients for all flaps. According to our algorithm (Fig. 1), DIEP flap inseting was planned preoperatively considering those variables that can affect the procedure categorized as abdomen-related and breast-related. Baseline parameters

are described in Table 1 and operative variables are listed in Table 2.

Abdomen Variables

Perforators

The choice of perforator(s) within the flap was based on intraoperative assessment of perforators mapped by preoperative duplex ultrasonography performed by an experienced radiologist. Whether the perforators were ipsilateral and contralateral was in reference to the mastectomy site. Where substantial projection or a large neobreast needed to be reconstructed, the flap was inset horizontally. If the ipsilateral perforators were chosen, 0 degrees of rotation was performed (Fig. 2); when contralateral perforators were chosen, 180 degrees of rotation was performed (Fig. 3). In both cases, inferior and lateral folding of the flap was carried out to deliver central and lower pole projection. When more breast ptosis was required,

Table 1. Baseline Data

Characteristic	Value (%)
No.	70
Mean age ± SD, yr	55 ± 8.6
Mean BMI ± SD, kg/m ²	26.6 ± 2.9
Current smoker	15 (21)
Ptosis	
Grade 0	5 (7)
Grade 1	14 (20)
Grade 2	19 (27)
Grade 3	32 (46)
Abdomen type	
Slim (type S)	15 (22)
Fat (type F)	55 (78)
Abdominal scars	
Appendectomy	2 (3)
Pfannenstiel	22 (31)

Table 2. Operative Data

Variable	Value (%)
No.	70
Type of mastectomy	
Non-skin-sparing mastectomy	6 (9)
Skin-sparing type 1	39 (56)
Skin-sparing type 2	17 (24)
Skin-sparing type 3	3 (4)
Skin-sparing type 4	5 (7)
Simultaneous contralateral symmetrization	29 (41)
Mastectomy weight, g	
Mean \pm SD	561 \pm 329
Range	218–1774
Unilateral DIEP raised	
Ipsilateral	29 (41)
Contralateral	41 (59)
DIEP flap weight	
Mean \pm SD	615 \pm 186
Range	226–1228
Bipedicled unilateral DIEP flap	5 (7)
DIEP flap inset rotation	
0 deg	13 (19)
90 deg	38 (54)
180 deg	19 (27)
SIEV	
Absent	4 (6)
Preserved, not used	58 (83)
Augmented for venous congestion	8 (11)
Ischemia time, min	
Mean \pm SD	30 \pm 13
Range	14–68
Operative time, hr:min	
Mean \pm SD	5:56
Range	3:16–9:07

SIEV, superficial inferior epigastric vein.

the flap was inset vertically with 90 degrees of rotation and inferior folding was performed (Fig. 4). The 90-degree rotation was planned to reduce tension on the pedicle in a medial position facing the internal thoracic vessels. Thus, an ipsilateral right DIEP flap was rotated clockwise and a contralateral right DIEP was rotated counterclockwise. An ipsilateral left DIEP flap was rotated counterclockwise and a contralateral left DIEP flap was rotated clockwise.

Venous Supercharge

If superficial inferior epigastric vein (SIEV) supercharging was required to relieve intraoperative venous congestion, a contralateral right DIEP flap was inset at 90 degrees clockwise and a left DIEP was inset at 90 degrees counterclockwise. An ipsilateral DIEP flap was always inset at 0 degrees, to let the SIEV reach the medial intercostal spaces without tension or kinking. However, intraflap anastomosis of the deep and superficial venous systems was always planned and preferred to improve venous drainage, reducing the need for the above flap rotation and allowing the inset of the flap according to the contralateral breast and abdomen shape.⁷

Bipedicled Flaps

We used bipedicled flaps when more than 70 percent of the lower abdominal tissue was required to match the contralateral breast or in cases of impaired cross-midline perfusion. In such cases, one pedicle was anastomosed to the internal thoracic vessels in a retrograde fashion and the other with anterograde flow. Bipedicled flap rotation was dictated by the length of the two pedicles to reduce tension. When projection was required or a breast with a large base had to be reconstructed, a 0- or 180-degree rotation was chosen. The longest pedicle was positioned laterally, away from the anastomosis site. If ptosis was required, 90 degrees of rotation was chosen.

Scars

When an appendectomy scar was present, we preferred to harvest a left DIEP flap first. However, umbilicopubis or Pfannenstiel scars did not influence our flap harvest.

Abdominal Tissue Thickness

The thickness of the DIEP flap was measured intraoperatively using a ruler. We selected a 2.5-cm depth of adiposity as our threshold to dichotomize our sample. Patients with a slim abdomen (fat thickness, <2.5 cm) were denoted as abdomen type S (skin predominance). Patients with abundance of subcutaneous (fat thickness, \geq 2.5 cm) were denoted as abdomen type F (fat predominance) because of the difference in thickness and consistency of flap tissues. We preferred to position slim flaps (type S) vertically (90 degrees) and thick flaps (type F) horizontally (0 or 180 degrees), unless the above-mentioned variables precluded this arc of rotation (Fig. 5)

Breast Variables

Breast Weight

Breast weight was defined as the weight of the mastectomy specimen in grams.⁸ Large contralateral breasts were usually reduced, enabling the DIEP flap to be positioned at 0 or 180 degrees, to fill the subcutaneous pocket and match the contralateral reduced breast.

Breast Ptosis

Breast ptosis was classified according to Regnault.⁹ In those with grade 1 breast ptosis, we inset the DIEP flap horizontally at 0 or 180 degrees with folding of the lateral and inferior portions. In patients with grade 2 and 3 breast ptosis, we inset the DIEP flap vertically at 90 degrees with folding of the inferior portion of the flap.

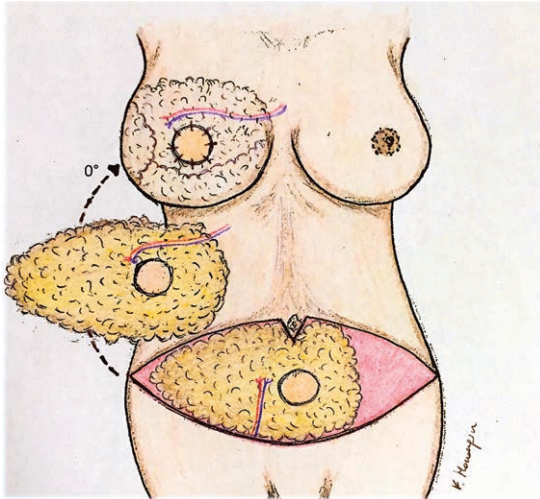


Fig. 2. Right breast reconstruction with the need for projection and ipsilateral perforator-based DIEP flap. Zero degrees of rotation was performed with lateral and inferior folding.

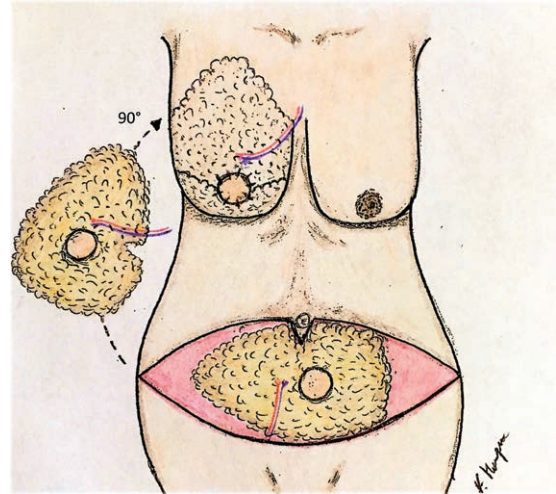


Fig. 4. Right breast reconstruction with the need for ptosis and an ipsilateral perforator-based DIEP flap. The medial zone III is deepithelialized and folded at the new inframammary fold to achieve the desired ptosis. Ipsilateral right DIEP flap is rotated clockwise.

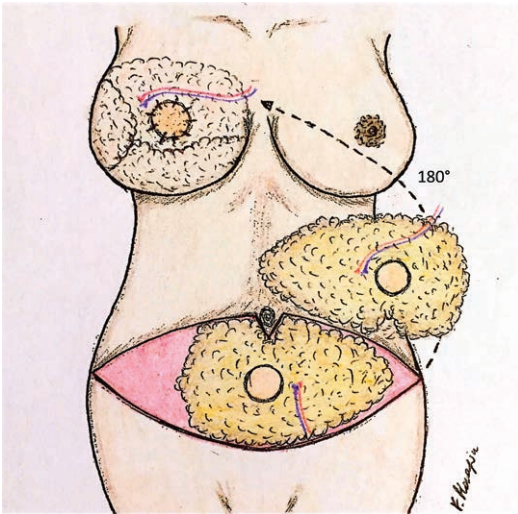


Fig. 3. Right breast reconstruction with the need for projection and a contralateral perforator-based DIEP flap. One hundred eighty-degree rotation was performed with lateral and inferior folding.

Contralateral Symmetrization

When contralateral symmetrization was planned, we performed balancing surgery at the time of reconstruction.¹⁰ We routinely perform contralateral breast reduction or mastopexy before flap inseting, to better allow the flap to be tailored to the contralateral reduced breast. Flap inseting was planned according to the projection and ptosis was obtained in the contralateral symmetrized breast.

Patient-Reported and Independently Assessed Outcomes

After 12 months postoperatively, patients were invited to complete the postreconstruction

module of the BREAST-Q to evaluate breast symmetry, projection, ptosis, shape, and volume.¹¹ This was delivered by an independent health care assistant (who was blinded to the treatment provided) in the outpatient clinic. The completed questionnaire was collected by the same independent health care assistant and enveloped to maintain anonymity. The completed questionnaire was annotated with a unique identification number to allow matching with clinical details. With informed consent, patients were sent to professional medical photographers for preoperative and 12-month postoperative photographs (Figs. 6 through 9). We showed these anonymized photographs to three independent assessors (i.e., one medical secretary, one breast surgeon, and one breast reconstruction specialist nurse) who were blind to the treatment received by each participant.

Statistical Analysis

This study was performed as an evaluation of service; therefore, there is no hypothesis to test and thus no power calculation. Data presented are descriptive and primarily constructed to be hypothesis generating. Anonymized BREAST-Q scores were input to the scoring template and compiled using the Q-Score (<https://webcore.mskcc.org/breastq/index.html>) into continuous data (highest possible score, 100). Data were analyzed blind to the treatment received. Continuous outcomes approximated the normal and thus are described using the arithmetic mean \pm SD, except

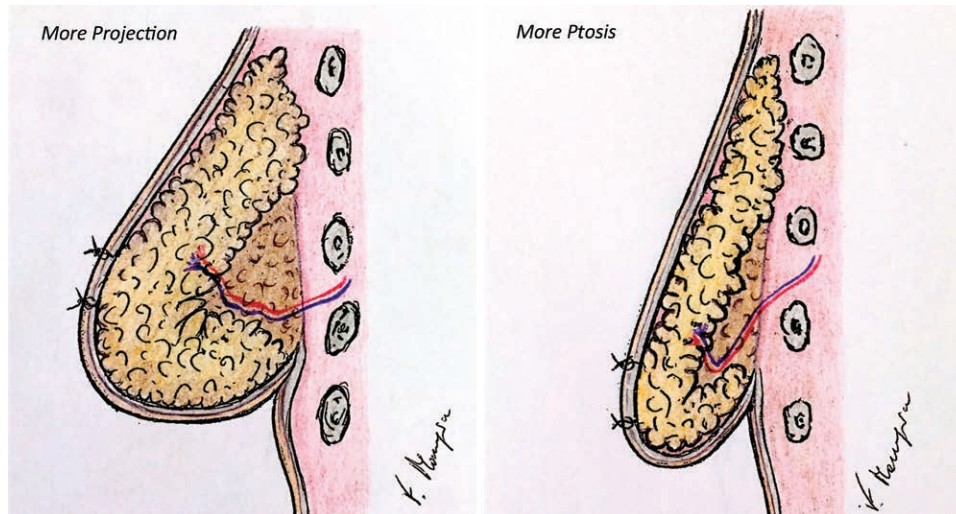


Fig. 5. Sagittal plane of DIEP flap–reconstructed breast. (Left) Type-F DIEP flap. Because of the characteristics of dense and thick fat, this is most suitable when projection is needed. (Right) A type-S DIEP flap is more suitable to reconstruct a breast with grade II or III ptosis in thin patients.

DIEP flap ischemia time and mastectomy weight, which were skewed, and thus the geometric means are given. Continuous data were compared using independent samples *t* tests or Mann-Whitney *U* tests as appropriate. Models were internally validated by nonparametric lossless bootstrapping by resampling with replacement, with 1000 iterations. Correlates are Pearson coefficients. Proportions were compared with the chi-square or Fisher's exact test as appropriate. Agreement between independent assessors is presented as the Fleiss kappa (κ). Confidence intervals are generated to the 95 percent level and significance is set at 5 percent.

RESULTS

Data from 70 consecutive cases were available for analysis (Tables 1 and 2). Breast cup size ranged from 32A to 42DD. All symmetrization procedures (contralateral reduction or mastopexy) were simultaneous to the reconstruction. Total or partial flap failure were not observed. Among four cases of fat necrosis (6 percent), two cases required surgical revision and the others were treated conservatively. Three patients developed abdominal hematomas (2 percent), whereas none developed clinically apparent seromas.¹² Four women requested flap remodeling (6 percent), whereas five required lipofilling (7 percent) and three underwent scar revision (4 percent). Follow-up ranged from 12 to 24 months, with a mean of 17.9 months. All patients had nipple reconstruction using a modified arrow flap followed by tattooing of the areola.

BREAST-Q scores are listed in Table 3. Scores show that satisfaction after DIEP flap breast reconstruction, according to our algorithm of flap inseting, conferred an excellent patient-reported outcome, with an overall score of 82. The highest reported scores were for satisfaction with surgeon, medical staff, and office staff. The lowest reported scores pertained to sexual well-being. Neither age nor body mass index was correlated with any domain of the BREAST-Q, suggesting that patient-reported outcomes were independent of these baseline characteristics. Unexpectedly, postoperative complications requiring a return to the operating room did not change the overall BREAST-Q score (mean difference, 0.35; 95 percent CI, -4.3 to 4.4 percent; $p = 0.9$) or any subdomain of the BREAST-Q. Conversely, fat necrosis reduced the reported satisfaction with the chest (mean reduction, 13; 95 percent CI, 8 to 18; $p = 0.002$) and psychosocial well-being of women (mean reduction, 14; 95 percent CI, 5 to 24; $p = 0.01$), but did not alter any other domain scores of the BREAST-Q. The need for revision surgery on the breast did not change the overall score or any domain of the BREAST-Q.

Of 70 patients, 51 completed the requested preoperative and postoperative photographic sessions. Scores from independent assessors are shown in Table 4. Overall, the three assessors scored the outcomes favorably, but there was no agreement among them (all kappa values were essentially 0). There was strong statistical evidence of no agreement (i.e., a systematic difference in the opinions) for breast symmetry and ptosis. However, there was no statistical evidence of a difference of opinion for

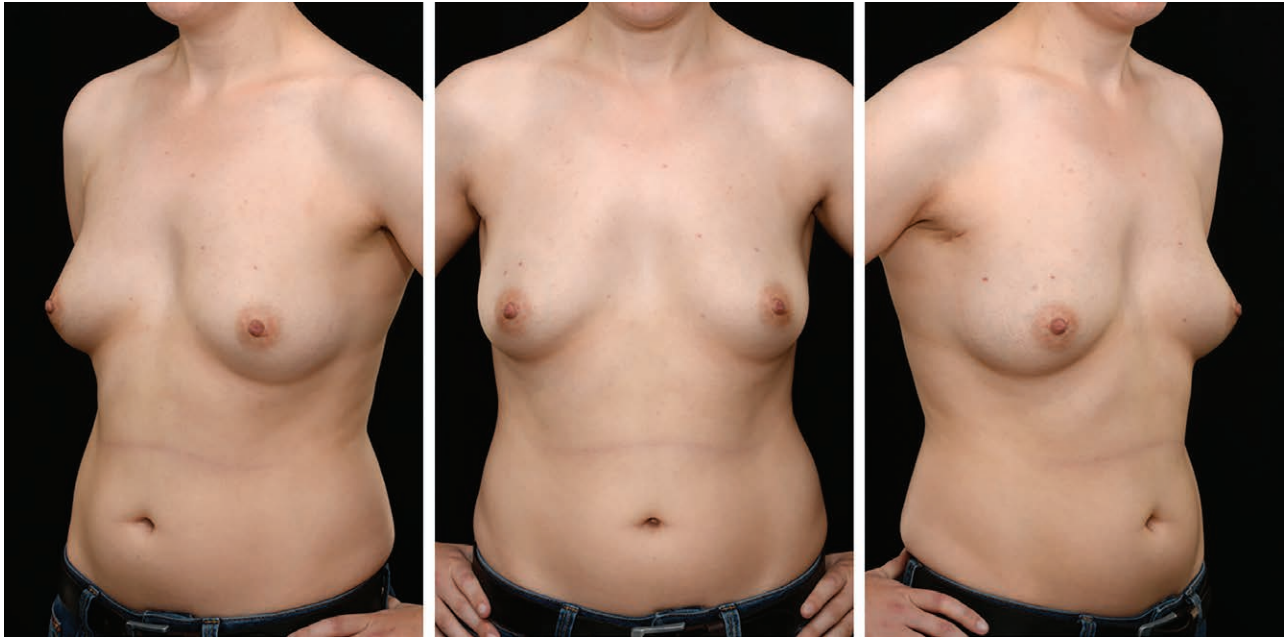


Fig. 6. Preoperative photographs of a 38-year-old patient with right breast cancer; no radiotherapy or chemotherapy was performed.

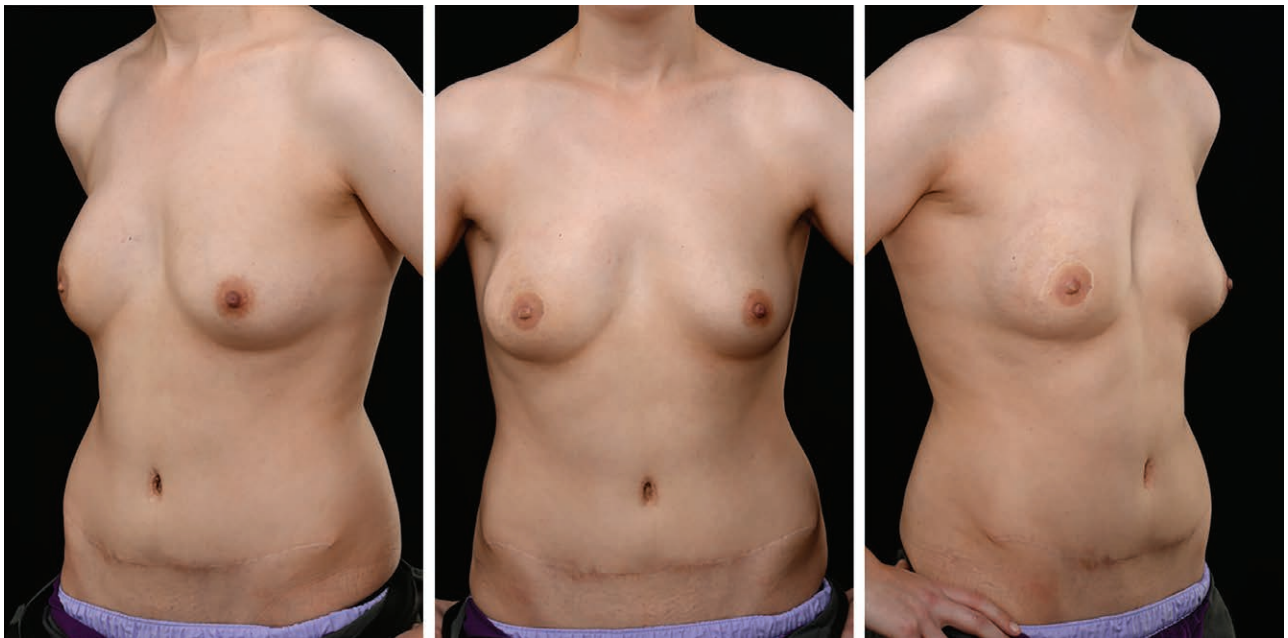


Fig. 7. Postoperative photographs of a 38-year-old patient at 12-month follow-up who underwent right skin-sparing mastectomy and reconstruction with a contralateral type-S DIEP flap, based on one medial row perforator and inset with 90-degree counterclockwise rotation. No SIEV was anastomosed and no contralateral breast symmetrization procedure was performed. Nipple reconstruction was performed after 6 months..

projection, shape, and volume. These relationships were preserved after bootstrapping.

DISCUSSION

In the United States and the United Kingdom, the number of DIEP flap breast reconstructions

has increased significantly.¹³ The aesthetic outcomes after breast reconstruction using DIEP flap(s) are superior when compared to implant-based reconstruction because of the natural appearance and consistency of the reconstructed breast.^{14,15} A reconstructed breast with appropriate

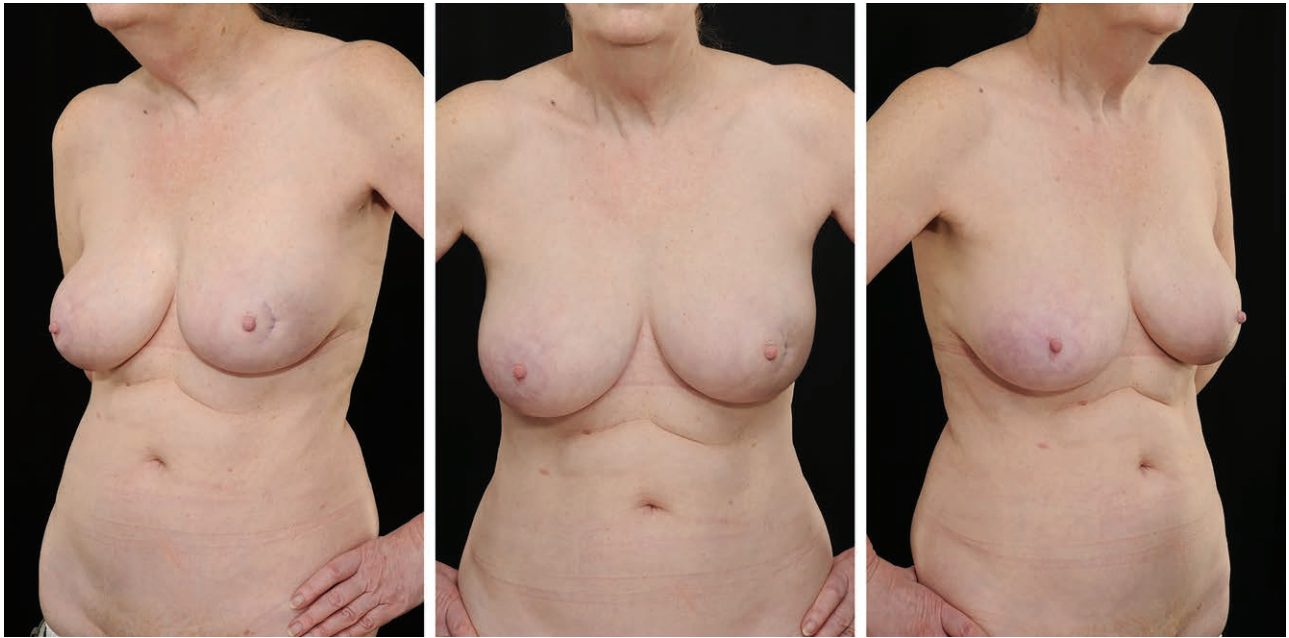


Fig. 8. Preoperative photographs of a 58-year-old patient with left breast cancer who underwent chemotherapy but no radiotherapy.

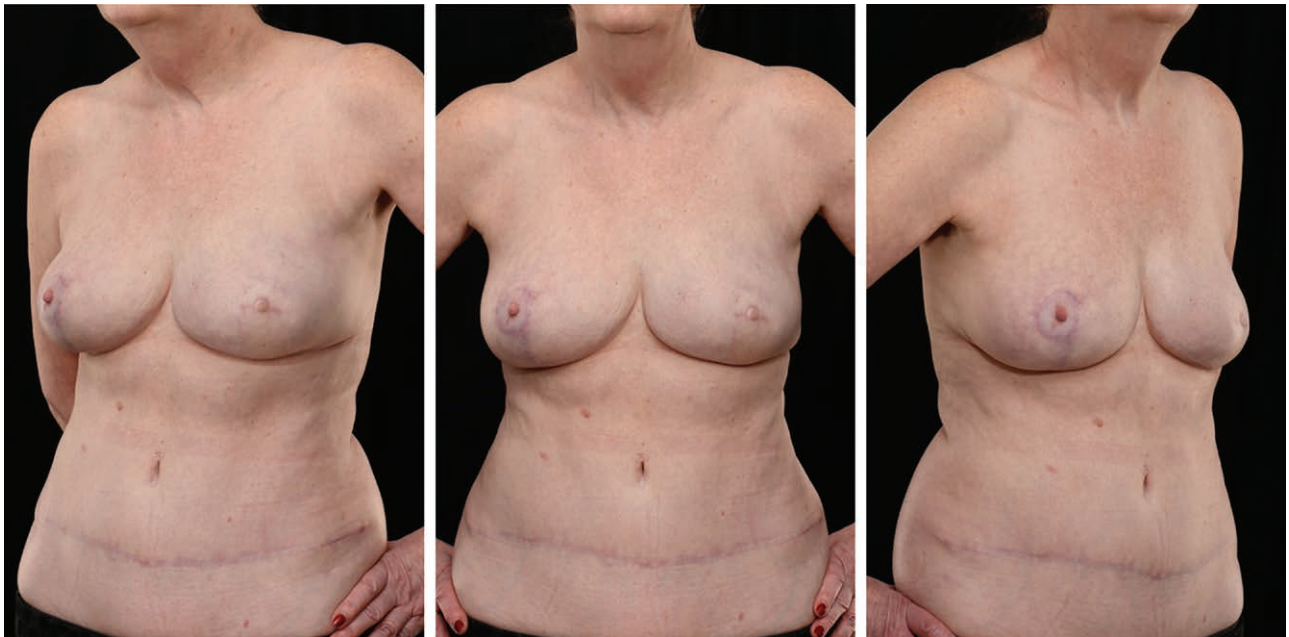


Fig. 9. Preoperative photographs of a 58-year-old patient at 12-month follow-up who underwent left skin-sparing mastectomy and reconstruction with an ipsilateral type-F DIEP flap, based on two medial row perforators. The flap was inset with 0-degree rotation. Contralateral immediate symmetrization was performed. Nipple reconstruction was performed after 6 months.

ptosis and shape improves the patient's psychological recovery and quality of life.² Immediate reconstruction reduces psychological distress and poor body image.¹⁶ A recent study of women undergoing DIEP flap breast reconstruction and postmastectomy radiotherapy showed highly satisfactory results with the BREAST-Q, reinforcing

the indication for immediate free flap breast reconstruction.¹⁷ In this scenario, the inset of the DIEP flap is becoming increasingly important, to offer each patient a breast reconstruction that suits her body. In delayed breast reconstruction, the skin deficit and the mastectomy scar mean that surgeons must inset the flap while addressing

Table 3. BREAST-Q Scores*

BREAST-Q Module	Mean ± SD	95% CI of the Mean
Satisfaction with Breasts	81 ± 15	76–86
Satisfaction with Outcome	88 ± 16	83–93
Psychosocial Well-being	74 ± 23	67–82
Sexual Well-being	66 ± 22	58–72
Physical Well-being: Chest	83 ± 16	78–88
Physical Well-being: Abdomen	87 ± 19	81–93
Satisfaction with Nipples	72 ± 19	66–77
Satisfaction with Information	77 ± 16	71–82
Satisfaction with Surgeon	91 ± 13	86–95
Satisfaction with Medical Staff	90 ± 23	82–97
Satisfaction with Office Staff	93 ± 13	89–97
Overall BREAST-Q	82 ± 12	78–86

*70 women.

the need for new skin. In immediate reconstruction, the native breast skin envelope may be preserved but the breast pocket is often larger than the contralateral breast. In fact, because of excision of the breast fibrous network and suspensory ligaments, the reconstructed breast may lack projection or ptosis compared with the contralateral breast, resulting in a flat breast of inadequately shaped volume.¹⁸ We feel that the skin envelope is not just a container to be filled; consideration must be given to how the final shape of the breast will appear in relation to the way the flap is inset within its pocket. Superior and medial pole fullness can be better achieved using the internal thoracic vessels as recipients, as this allows a more comfortable medialization of the flap.^{19,20} Blondeel et al.^{2,4-21} highlighted the importance of flap

inset, although significant limitations remain because of the wide range of natural breast shapes and sizes. We believe that a degree of versatility in DIEP flap inset for immediate breast reconstruction should be adopted by surgeons to achieve a better match to the contralateral breast.

Different factors need to be considered in DIEP flap inset for immediate unilateral breast reconstruction. The 180-degree rotation of the abdominal flap rotation provides the best possible projection, with the position of the umbilical vertical scar (if present) placed inferiorly at the 6-o'clock position. Instead, 90-degree flap counterclockwise rotation allows the pedicle to be placed in a more medial position for a more comfortable anastomosis to the internal thoracic vessels.²² If the SIEV needs to be anastomosed, the inset priority should be given to the SIEV position by rotating the flap to face the SIEV to the internal thoracic vessels, to achieve a tension-free supercharged venous anastomosis.^{23,24} However, we prefer intraflap venous anastomoses between superficial and deep venous systems.⁷

When the breast base is large or projection and fullness of the upper pole are needed, we found it more useful to rotate the flap 0 or 180 degrees, depending on the position of the perforators. When 90 degrees of rotation is chosen, better ptosis could be achieved by deepithelializing and folding the inferior margin of the inset flap at the new inframammary fold.

Table 4. Independent Assessors' Scores*

Characteristic	Frequency of Scores (%)				Interrater κ	p†
	Poor	Acceptable	Good	Very Good		
Symmetry						
Symmetry						
Breast surgeon	0 (0)	7 (14)	23 (45)	21 (41)		
Breast cancer specialist nurse	3 (6)	10 (20)	23 (45)	15 (30)		
Medical secretary	3 (6)	17 (33)	22 (43)	9 (18)	0.05	0.02
Projection						
Breast surgeon	0 (0)	3 (6)	21 (41)	27 (53)		
Breast cancer specialist nurse	1 (2)	8 (15)	22 (43)	20 (40)		
Medical secretary	3 (6)	12 (24)	16 (31)	20 (39)	0.03	0.08
Ptosis						
Breast surgeon	0 (0)	2 (4)	15 (28)	35 (68)		
Breast cancer specialist nurse	2 (4)	5 (10)	25 (49)	19 (37)		
Medical secretary	0 (0)	11 (22)	18 (35)	22 (43)	0.04	0.002
Shape						
Breast surgeon	0 (0)	0 (0)	10 (20)	41 (80)		
Breast cancer specialist nurse	2 (4)	13 (26)	18 (35)	18 (35)		
Medical secretary	2 (4)	11 (22)	18 (35)	20 (39)	0.03	0.12
Volume						
Breast surgeon	0 (0)	1 (2)	16 (31)	34 (67)		
Breast cancer specialist nurse	0 (0)	12 (24)	16 (31)	23 (45)		
Medical secretary	3 (6)	6 (12)	28 (55)	14 (27)	0	0.5

*Fifty-one women.

†Significant *p* < 0.05.

Another factor that can limit DIEP flap inset are preexisting abdominal scars.²⁵ Scars in the lower abdomen were present in 34 percent of cases, but this did not affect the flap harvesting or inset according to our algorithm. Donor-site vascular supply (unipedicled/bipedicled) may also impact the inset; however, when a bipedicled flap was needed, to avoid stretching the vessels, we chose to use 90 or 180 degrees of rotation, depending on perforator location. Similarly, abdominal thickness is an important factor in shaping of the DIEP flap; the abdomen type considerably influenced our flap positioning. We found abdomen type F was more suitable for reconstructing a breast with projection, rather than ptosis. Folding a DIEP flap from abdomen type F can be challenging, and a small portion of this flap can be folded laterally or inferiorly. We found that type-F flaps were easier to inset horizontally with lateral folding to allow good definition of the lateral border of the breast while pushing the flap into a medial position to increase the projection and fullness of the cleavage. An additional benefit is that folding technique allows the zone farthest from the perforators (most likely to undergo fat necrosis) to be positioned away from the cleavage.

Flaps from abdomen type S are more pliable and therefore more useful for reconstructing a ptotic breast when inset vertically with 90 degrees of rotation, especially those of grade 2 or 3 following weight loss or pregnancy. The degree of breast ptosis alters the desired rotation of the flap and equally may influence the patient's wishes regarding contralateral symmetrization. In our series, immediate symmetrization was associated with a reduced rate of revision surgery and no additional risks.^{8,10,26} We routinely perform contralateral breast-balancing surgery before flap inset, because the principle of our algorithm remains the same and so we shape the flap according to the contralateral breast that we want to match.

We are pleased to report excellent patient-reported outcomes from this series. We took numerous steps to minimize measurement bias and the Hawthorne effect by providing the BREAST-Q many months after reconstruction (delivered, collected, and analyzed by independent persons). Our BREAST-Q scores were compared with the referenced normative data.²⁷ Satisfaction with the breast was approximately 40 percent better than the reference value (81 versus 58). Scores for Physical Well-being: Abdomen were also higher (87 versus 78), and this could reflect our rigorous nerve-sparing perforator dissection. Psychosocial well-being was only slightly better than normative values (73 versus 71), and we feel this is

equivocal; however, how this translate to practice is unclear. Score for Sexual Well-being was the lowest reported outcome, consistent with the literature. Conversely, our scores for Physical Well-being: Chest, despite the high values, were lower than the referenced ones (83 versus 93), and we are unsure of the reason, particularly given the higher scores for Satisfaction with Breasts. We commend Pusic and colleagues for their important and practical contribution to the literature, producing these normative values for each module of their BREAST-Q.²⁸ The sample used to derive normative data was composed of 1201 women, with demographics similar to our sample, but we should note that the majority were white, non-Hispanic, married, well-educated, and wealthy women. Our outcomes are approximately 15 percent better than the data reported from the autologous reconstruction group in the mastectomy reconstruction consortium study²⁹ and approximately 20 percent better than in the cohort study by Ménez et al. of 42 women undergoing DIEP flap breast reconstruction in France.³⁰ Unfortunately, we did not collect data on income or education status, which may have confounded the outcome, and we did not adjust our estimates for other factors. Therefore, our methods may have failed to completely suppress information bias(es). We believe that our algorithm requires external validation to determine whether the superior outcomes are dependent on our methods or otherwise.

We were interested to see the lack of agreement in the assessment of outcomes between breast surgeons, specialist breast nurses, and lay medical secretaries. We observed very different scores between breast surgeons and nurses, although the data set is probably underpowered for a reliable agreement analysis. Surgeons' scores were higher than those from nurses and secretaries, which is unsurprising, as arguably they have better insight into what is achievable. More research is required to determine the interrater agreement and clinical value of independent assessments by expert surgeons, nurses, and lay individuals. Our results suggest that careful planning of the DIEP flap inset according to our algorithm confers predictable and satisfactory reconstructed breasts.

CONCLUSIONS

To improve aesthetic outcomes, DIEP flap inset should be tailored to the patient's characteristics and desires. Not all breasts are the same and, equally, every abdomen is different; our inset algorithm simplifies and

standardizes the decision-making process in unilateral immediate DIEP flap breast reconstruction. Objective evaluation and patient-reported outcomes suggest that our algorithm can support surgeons in selecting individually tailored DIEP flap inseting to achieve excellent aesthetic outcomes.

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REFERENCES

- Marín-Gutzke M, Sánchez-Olaso A. Reconstructive surgery in young women with breast cancer. *Breast Cancer Res Treat*. 2010;123(Suppl 1):67–74.
- Roth RS, Lowery JC, Davis J, Wilkins EG. Quality of life and affective distress in women seeking immediate versus delayed breast reconstruction after mastectomy for breast cancer. *Plast Reconstr Surg*. 2005;116:993–1002; discussion 1003–1005.
- Nahabedian MY, Tsangaris T, Momen B. Breast reconstruction with the DIEP flap or the muscle-sparing (MS-2) free TRAM flap: Is there a difference? *Plast Reconstr Surg*. 2005;115:436–444; discussion 445–446.
- Blondeel PN, Hijjawi J, Depypere H, Roche N, Van Landuyt K. Shaping the breast in aesthetic and reconstructive breast surgery: An easy three-step principle. *Plast Reconstr Surg*. 2009;123:455–462.
- Gravvanis A, Samouris G, Galani E, Tsoutsos D. Dual plane DIEP flap inset: Optimizing esthetic outcome in delayed autologous breast reconstruction. *Microsurgery* 2015;35:432–440.
- Carlson GW, Bostwick J III, Styblo TM, et al. Skin-sparing mastectomy: Oncologic and reconstructive considerations. *Ann Surg*. 1997;225:570–575; discussion 575–578.
- Davies AJ, O'Neill JK, Wilson SM. The superficial outside-flap shunt (SOS) technique for free deep inferior epigastric perforator flap salvage. *J Plast Reconstr Aesthet Surg*. 2014;67:1094–1097.
- Smith ML, Clarke-Pearson EM, Vornovitsky M, Dayan JH, Samson W, Sultan MR. The efficacy of simultaneous breast reconstruction and contralateral balancing procedures in reducing the need for second stage operations. *Arch Plast Surg*. 2014;41:535–541.
- Regnault P. Breast ptosis: Definition and treatment. *Clin Plast Surg*. 1976;3:193–203.
- Wade RG, Marongiu F, Sassoon EM, Haywood RM, Ali RS, Figus A. Contralateral breast symmetrisation in unilateral DIEP flap breast reconstruction. *J Plast Reconstr Aesthet Surg*. 2016;69:1363–1373.
- Pusic AL, Klassen AF, Scott AM, Klok JA, Cordeiro PG, Cano SJ. Development of a new patient-reported outcome measure for breast surgery: The BREAST-Q. *Plast Reconstr Surg*. 2009;124:345–353.
- Razzano S, Gathura EW, Sassoon EM, Ali R, Haywood RM, Figus A. Scarpa fascia preservation in abdominoplasty: Does it preserve the lymphatics? *Plast Reconstr Surg*. 2016;137:898e–899e.
- Pien I, Caccavale S, Cheung MC, et al. Evolving trends in autologous breast reconstruction: Is the deep inferior epigastric artery perforator flap taking over? *Ann Plast Surg*. 2016;76:489–493.
- Tønseth KA, Hokland BM, Tindholdt TT, Abyholm FE, Stavem K. Quality of life, patient satisfaction and cosmetic outcome after breast reconstruction using DIEP flap or expandable breast implant. *J Plast Reconstr Aesthet Surg*. 2008;61:1188–1194.
- Alderman AK, Wilkins EG, Lowery JC, Kim M, Davis JA. Determinants of patient satisfaction in postmastectomy breast reconstruction. *Plast Reconstr Surg*. 2000;106:769–776.
- Zhong T, Hu J, Bagher S, et al. A comparison of psychological response, body image, sexuality, and quality of life between immediate and delayed autologous tissue breast reconstruction: A prospective long-term outcome study. *Plast Reconstr Surg*. 2016;138:772–780.
- Pont LP, Marcelli S, Robustillo M, et al. Immediate breast reconstruction with abdominal free flap and adjuvant radiotherapy: Evaluation of quality of life and outcomes. *Plast Reconstr Surg*. 2017;140:681–690.
- Skillman J, Dionyssiou D, Ray A, Boorman J. Preplanned, autologous TRAM or DIEP reconstruction following mastectomy reduced the rate of contralateral surgery. Paper presented at: British Association of Plastic Surgeons, Winter Scientific Meeting, Royal College of Surgeons; December 1, 2004; London, United Kingdom.
- Temple CL, Strom EA, Youssef A, Langstein HN. Choice of recipient vessels in delayed TRAM flap breast reconstruction after radiotherapy. *Plast Reconstr Surg*. 2005;115:105–113.
- Sacks JM, Chang DW. Rib-sparing internal mammary vessel harvest for microvascular breast reconstruction in 100 consecutive cases. *Plast Reconstr Surg*. 2009;123:1403–1407.
- Blondeel PN, Hijjawi J, Depypere H, Roche N, Van Landuyt K. Shaping the breast in aesthetic and reconstructive breast surgery: An easy three-step principle. Part II—Breast reconstruction after total mastectomy. *Plast Reconstr Surg*. 2009;123:794–805.
- Lipa JE. DIEP flap breast reconstruction. In: Hall-Findlay E, Evans G, eds. *Aesthetic and Reconstructive Surgery of the Breast*. Philadelphia: Saunders Elsevier; 2010:117–146.
- Momeni A, Lee GK. A case of intraoperative venous congestion of the entire DIEP-flap: A novel salvage technique and review of the literature. *Microsurgery* 2010;30:443–446.
- Razzano S, Figus A, Marongiu F, Haywood R. Contralateral DIEP as an interpositional vein graft for venous supercharge in the salvage of a congested DIEP flap. *Microsurgery* 2016;36:263–264.
- Hsieh F, Kumiponjera D, Malata CM. An algorithmic approach to abdominal flap breast reconstruction in patients with pre-existing scars: Results from a single surgeon's experience. *J Plast Reconstr Aesthet Surg*. 2009;62:1650–1660.
- Hunter JE, Malata CM. Refinements of the LeJourn vertical mammoplasty skin pattern for skin-sparing mastectomy and immediate breast reconstruction. *J Plast Reconstr Aesthet Surg*. 2007;60:471–481.
- Mundy LR, Homa K, Klassen AF, Pusic AL, Kerrigan CL. Breast cancer and reconstruction: Normative data for interpreting the BREAST-Q. *Plast Reconstr Surg*. 2017;139:1046e–1055e.
- Payne RM, Siotos C, Manahan MA, Rosson GD, Cooney CM. Breast cancer and reconstruction: Normative data for interpreting the BREAST-Q. *Plast Reconstr Surg*. 2018;141:180e–181e.
- Pusic AL, Matros E, Fine N, et al. Patient-reported outcomes 1 year after immediate breast reconstruction: Results of the mastectomy reconstruction outcomes consortium study. *J Clin Oncol*. 2017;35:2499–2506.
- Ménez T, Michot A, Tamburino S, Weigert R, Pinsolle V. Multicenter evaluation of quality of life and patient satisfaction after breast reconstruction, a long-term retrospective study. *Ann Chir Plast Esthet*. 2018;63:126–133.