Bipedicle-Conjoined Deep Inferior Epigastric Perforator Flaps for Unilateral Breast Reconstruction in Overweight and Obese Patients: Do the Benefits Outweigh the Risks?

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Abstract

Background Some surgeons have advocated for the use of bipedicle-conjoined deep inferior epigastric perforator (DIEP) flaps in unilateral autologous breast reconstruction in thin patients in whom a hemiabdominal flap is deemed insufficient. There have been no studies to date, however, exploring complication rates for bipedicle-conjoined DIEP flaps for unilateral reconstruction in overweight or obese patients.

Methods The authors performed a retrospective review of two senior authors' patients from 2013 until 2018. In this time period, 71 patients underwent unilateral breast reconstruction with bipedicle-conjoined DIEP flaps. The patients were divided into normal weight (body mass index [BMI] < 25, $n = 30$), and overweight/obese (BMI > 25, $n = 41$) groups. Outcomes were reviewed for both major and minor complications.

Results The average BMI of the normal group was 23.1 ± 1.3 kg/m^2, while the average BMI of the overweight/obese group was 28.9 ± 4.0 kg/m^2 ($p < 0.01$). There were no significant differences in demographics or comorbidities between the two groups. There were no statistically significant differences in the overall incidence of major or minor complications between the two groups (major: overweight/obese $= 12.1\%$, normal BMI $= 10.0\%$, $p = 0.39$; minor: overweight/obese $= 39.0\%$, normal BMI $= 36.7\%$, $p = 0.47$). The rate of moderate fat necrosis was significantly higher in the overweight/obese group (overweight/obese $= 9.8\%$, normal BMI $= 0\%$, $p = 0.04$).

Keywords
► breast reconstruction
► stacked flaps
► deep inferior epigastric perforator microsurgery

Conclusion Unilateral breast reconstruction with bipedicle-conjoined DIEP flaps can be performed safely in overweight and obese patients. The use of bipedicle-conjoined DIEP flaps in this population allows surgeons to provide overweight or obese patients with reconstructions that are commensurate with their body habitus and/or contralateral breast.

The use of two abdominally-based flaps for unilateral breast reconstruction is a valuable tool that was first described in 1985 by Ishii et al.[1] The majority of patients in Ishii's series had large soft-tissue requirements owing to radical mastectomies or radiation necrosis of the chest wall. The authors reconstructed defects using both sides of the lower abdominal wall as pedicled flaps based on the left and right superior epigastric vessels. This technique was refined by Spear who proposed burying one of the two flaps below the other in situations when the skin from a single flap would be sufficient to restore the breast skin envelope, but the volume of a single flap would be insufficient.[2]

More recently, some surgeons have used both hemiabdomens as either "stacked" deep inferior epigastric perforator (DIEP) flaps (two separate DIEP flaps used to reconstruct one breast) or bipedicle-conjoined DIEP flaps (both hemiabdomens transposed with their respective inferior epigastric pedicles as a single conjoined unit) for unilateral breast reconstruction in patients in whom the volume or quantity of skin of a single flap is inadequate to create a breast mound that approximates that of the unaffected contralateral breast.[3–5] This technique has been applied primarily to patients with a low body mass index (BMI) and accordingly, the volume of flaps used in such reconstructions has been relatively small.[6–10] DellaCroce et al, for instance, published a series of 55 patients who underwent stacked DIEP flaps for unilateral breast reconstruction over a 3-year period. In their series, the average weight of the patient was 138 pounds (range: 108–190 pounds), and the average weight of the two DIEP flaps combined for each reconstruction was 596 g.[11]

Despite the preferential use of bipedicle-conjoined flaps for breast reconstruction in patients with a low-to-normal BMI, the authors believe that many patients on the other end of the BMI spectrum, those in the overweight and obese categories, can also benefit from this technique. In contrast to normal weight patients who present a particular challenge that results from a paucity of donor tissue, many obese and overweight patients possess a premastectomy breast size and morphology that is difficult to replicate with standard reconstructive techniques. These patients, especially those in the obese category (BMI > 30), are considered by many to be poor candidates for autologous reconstruction because of observed increases in complication rates when compared with non-obese patients.[12] As such, many overweight and obese patients are offered only implant-based reconstruction or no reconstruction at all.[13,14] This series examines the safety and efficacy of bipedicle-conjoined DIEP flaps for unilateral breast reconstruction in overweight and obese patients.

Methods

The authors conducted a retrospective review of the two senior authors' patients from 2013 until 2018. In this time period, 71 consecutive patients were identified as having undergone unilateral breast reconstruction with bipedicle-conjoined DIEP flaps. These patients were divided into two cohorts: normal weight or underweight (BMI < 25, $n = 30$) and overweight or obese (BMI > 25, $n = 41$). The two cohorts were then compared based on demographic factors, comorbidities, and complications.

Demographics and comorbidities evaluated include age at time of reconstruction, medical comorbidities, and previous abdominal or breast surgery. Medical comorbidities include BMI, hypertension, diabetes, history of chemotherapy, history of prereconstruction radiation, and the use of nicotine within one year of surgery (►**Table 1**). Operative details reviewed include mastectomy weight and flap weights (initial and final). In addition, the rate of delayed reconstructions and concomitant contralateral procedures were reviewed (►**Table 2**).

Complications were categorized as either major or minor. Major complications included reoperation for any reason during the initial hospitalization, partial or complete flap loss, deep venous thrombosis/pulmonary embolism, and symptomatic bulge formation. Minor complications included wound infection or wound breakdown managed without additional surgery, and seroma formation. Fat necrosis was diagnosed clinically and was categorized as mild (<2 cm) or moderate (>2 cm).

The cohorts were compared head to head and comparisons were performed using the student's t-test. A value of $p < 0.05$ was considered statistically significant. All reported p-values correspond to a two-sided test.

Results

The average BMI in the normal BMI group was 23.1 ± 1.3 kg/m^2, while the average BMI in the overweight/obese group was

Table 1 Demographics and comorbidities

	Normal	Overweight/ obese	p-Value
Number	30	41	NA
Age at reconstruction (y)	52.8 ± 7.9	53.2 ± 8.9	0.42
BMI (kg/m^2)	23.1 ± 1.3	28.9 ± 4.0	<0.01
Medical comorbidities (%)			
Smoking (within 1 y)	2 (6.7)	4 (9.8)	0.34
Coronary artery disease	2 (6.7)	2 (4.9)	0.46
Hypertension	5 (16.7)	14 (34.1)	0.06
Diabetes	1 (3.3)	3 (7.3)	0.25
Previous abdominal surgery (%)	15 (50.0)	22 (53.6)	0.44
Previous breast surgery (%)	19 (63.3)	22 (53.6)	0.16
Chemotherapy (%)	14 (46.7)	20 (48.7)	0.44
Radiation therapy (%)	12 (40.0)	20 (48.7)	0.27
Average follow-up (mo)	31.6 ± 15.9	27.2 ± 16.5	0.15

Abbreviations: BMI, body mass index; NA, not available.

Table 2 Operative details

	Normal (n = 30)	Overweight/ obese (n = 41)	p-Value
Mastectomy weight (g)	472.8 ± 181.8	692.8 ± 261.1	<0.01
Flap weight: initial (g)	559.6 ± 179.6	1,059.3 ± 445.7	<0.01
Flap weight: final (g)	533.5 ± 183.8	813.9 ± 242.7	<0.01
Perforators per flap (n)	1.5 ± 0.5	1.6 ± 0.5	0.30
Second flap anastomosed to retrograde IMA (%)	23 (76.7)	30 (73.1)	0.34
Second flap anastomosed to primary flap (%)	7 (23.3)	11 (26.8)	0.34
Concurrent contralateral procedure (%)	6 (20.0)	15 (36.6)	0.10
Delayed reconstruction (%)	15 (50.0)	21 (51.2)	0.42

Abbreviation: IMA, internal mammary artery.

Table 3 Major complications

	Normal (n = 30)	Overweight/ obese (n = 41)	p-Value
Return to OR (%)	3 (10.0)	3 (7.3)	0.39
Partial flap loss (%)	0 (0)	1 (2.4)	0.20
Total flap loss (%)	0 (0)	0 (0)	NA
Pulmonary embolism (%)	0 (0)	1 (2.4)	0.19
Symptomatic bulge (%)	0 (0)	0 (0)	NA
Total (%)	3 (10.0)	5 (12.2)	0.39

Abbreviations: NA, not available; OR, odds ratio.

Table 4 Minor complications

	Normal (n = 30)	Overweight/ obese (n = 41)	p-Value
Breast (%)			
Wound	3 (10.0)	5 (12.1)	0.39
Hematoma	0 (0)	0 (0)	NA
Seroma	4 (13.3)	0 (0)	<0.01
Infection	1 (3.3)	2 (4.9)	0.11
Persistent edema	2 (6.7)	1 (2.4)	0.19
Donor site (%)			
Wound	2 (6.7)	5 (12.2)	0.22
Hematoma	1 (3.3)	1 (2.4)	0.41
Seroma	2 (6.7)	4 (9.8)	0.32
Infection	0 (0)	0 (0)	NA
Total percentage (n)	36.7% (11)	39.9% (16)	0.47

Abbreviation: NA, not available.
Note: Certain patients experienced more than one minor complication; the total percentage of complications reflects the number of patients who experienced at least one minor complication.

$28.9 \pm 4.0 \, kg/m^2$ ($p < 0.01$). Age at reconstruction was similar in both groups (normal BMI = 52.8 ± 7.9, overweight/obese = 53.2 ± 8.9; $p = 0.42$). The only difference in comorbidities that approached statistical significance was in the rate of hypertension as the normal BMI patients were less likely to be hypertensive at baseline than were the overweight or obese patients (normal BMI = 16.7%, overweight/obese = 34.1%; $p = 0.06$). Diabetes was more prevalent in the overweight/obese group as well, but this finding did not reach statistical significance (normal BMI = 3.3%, overweight/obese = 7.3%; $p = 0.25$). There was no statistically significant difference in the rate of chemotherapy or radiotherapy between groups (►**Table 1**).

Mastectomy specimen weights were greater in the overweight/obese group than in the normal BMI group (normal BMI = 472.8 ± 181.9 g, overweight/obese = 692.8 ± 261.1 g; $p < 0.01$). Similarly, the weight of the conjoined flaps at the time of harvest, as well as the final weight of each conjoined DIEP flap, following shaping and insetting were greater in the overweight/obese group. Patients in the overweight/obese group were more likely to have concomitant contralateral procedures but this difference did not achieve statistical significance (►**Table 2**).

Overall, the rate of major complications observed in the two groups was similar (normal BMI = 10.0%, overweight/obese = 12.1%; $p = 0.39$). Three patients in each group required return to the operating room during their initial hospitalization. There was one partial flap loss and one pulmonary embolism in the overweight/obese group. There were no partial flap losses or pulmonary emboli in the normal group. There were no total flap losses in either group (►**Table 3**). The same holds true when examining only obese

patients (BMI > 30, $n = 8$), as there was only one major complication (partial flap loss) observed in this subgroup.

There was a trend toward the occurrence of more minor complications in the overweight/obese group, but this difference did not reach statistical significance (normal BMI = 36.7%, overweight/obese = 39.0%; $p = 0.47$). More wound complications at both the donor site and the recipient site were observed in the overweight/obese group than in the normal BMI group; neither finding reached statistical significance. More breast seromas were observed in the normal BMI group than in the overweight/obese group (normal BMI = 13.3%, overweight/obese = 0.0%; $p < 0.01$). There were no other statistically significant differences in the minor complications between the two groups (►**Table 4**).

A trend toward a higher rate of mild fat necrosis was observed in the overweight/obese group, but this trend did not reach statistical significance. However, we did observe a statistically significant increase in the rate of moderate fat necrosis in the overweight/obese group (►**Table 5**).

Table 5 Fat necrosis

	Normal (n = 30)	Overweight/ obese (n = 41)	p-Value
Mild <2 cm (%)	5 (16.7)	8 (19.5)	0.38
Moderate >2 cm (%)	0 (0)	4 (9.8)	0.04
Total (%)	5 (16.7)	12 (29.3)	0.12

Discussion

The incidence of major complications of approximately 10% experienced by both normal and overweight/obese BMI cohorts who underwent unilateral bipedicle-conjoined DIEP flap breast reconstruction was nearly identical (►**Table 3**). This observation (~10%) is consistent with published norms for microsurgical breast reconstruction.[15,16] These findings suggest that using bipedicle-conjoined DIEP flaps for unilateral breast reconstruction is safe across a wide spectrum of body mass indices. It is, however, prudent to recognize that certain minor complications will likely be more prevalent in overweight or obese patients. The overweight and obese patients in our series experienced more frequent wound complications in their reconstructed breasts and at their abdominal donor sites. Similarly, they were more likely to develop both mild and moderate fat necrosis. Though only the difference in the rate of moderate fat necrosis reached statistical significance, the observed trends suggest that one should expect more wound complications and fat necrosis in overweight and obese patients than in patients with a BMI ≤ 25. Higher rates of complications in patients with a BMI ≥ 25 undergoing breast reconstruction has been well documented and is not exclusive to any particular technique.[12–14,17] Patients should be counseled accordingly with particular attention paid to proper risk
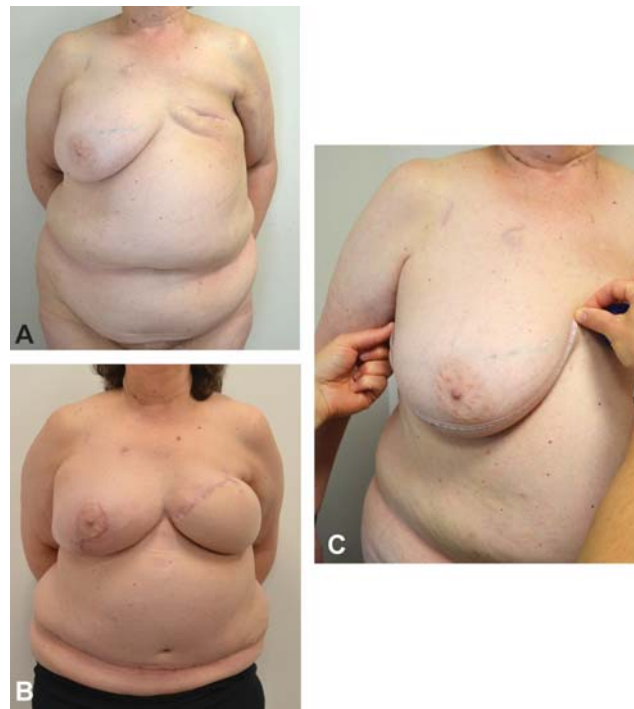
Fig. 2 This patient (BMI = 33.9) presented for delayed breast reconstruction following mastectomy and subsequent radiation therapy (A). The senior authors' preoperative assessment includes topographic surface measurements to determine the dimension of skin required to create an adequately projected and ptotic breast. In this case it was determined that the reconstruction would necessitate approximately 40 cm of skin in its greatest dimension (B). Despite the patient's large abdominal pannus, it was clear that a hemi-abdominal flap would not provide adequate skin nor volume to allow for reconstruction to match that of the contralateral breast. The postoperative position of the umbilical aperture in the bipedicle-conjoined flap is illustrative in this case of how deficient of skin a hemi-abdominal flap would have been. The patient is shown following revision of her left breast reconstruction and balancing reduction of the contralateral breast (C). BMI, body mass index.
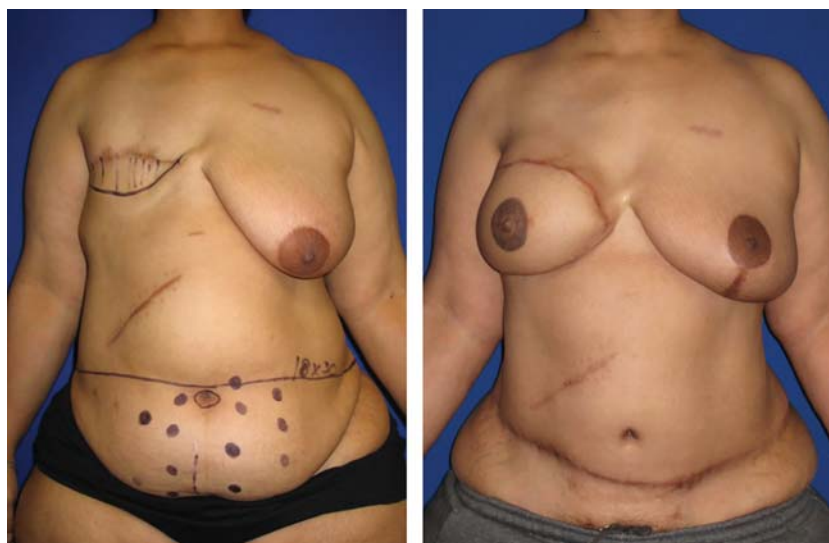
Fig. 1 This patient (BMI = 34.8) presented for delayed breast reconstruction in 2008, 3 years after her mastectomy. At the time of her reconstruction, the senior authors did not perform bipedicle-conjoined DIEP flaps in overweight patients. As such, she underwent unilateral reconstruction with a left DIEP flap (777 g; mastectomy weight unknown). Despite her overhanging pannus, her reconstruction is deficient of both volume and skin when compared with the contralateral side (even after subsequent contralateral reduction). In the authors' current practice, this patient would be reconstructed using bipedicle-conjoined flaps. BMI, body mass index; DIEP, deep inferior epigastric perforator.

Fig. 3 This patient (BMI = 31.0) presented for immediate breast reconstruction. It was determined preoperatively that she would require a bipedicle-conjoined flap to restore adequate volume to her reconstructed breast, despite her significant pannus and a planned concurrent contralateral mastopexy. Her left mastectomy weight was 937 g. Her bipedicle-conjoined flap weight was 1,484 g initially and 1,026 g after trimming. She is shown postoperatively (below) following a single revision of her abdominal donor site scar and nipple-areola complex creation. BMI, body mass index.

stratification and prophylaxis for thromboembolic events using the Caprini's Risk Assessment score.

Despite the increased prevalence of minor complications in overweight and obese patients, we believe that the use of bipedicle-conjoined DIEP flaps for unilateral reconstruction is of great utility in this population and that the benefits frequently outweigh the risks.

The modern approach to reconstructing a breast in an aesthetic fashion was laid out in a four-part series in 2009 by Blondeel et al.[18–21] In this series, the authors stress importance of restoring three essential elements of the breast: the footprint, conus, and skin envelope. Adoption of approaches that satisfy these criteria has undoubtedly led to refinements in bipedicle-conjoined DIEP flap reconstruction for unilateral defects and to the use of four-flap solutions for bilateral breast reconstruction.[22–27] Published reports suggest that these techniques have thus far been applied predominantly to patients with a normal or low BMI. While many overweight and obese patients possess what many surgeons would consider "adequate" abdominal tissue for standard reconstruction, many of these recon-

structions will fall short in restoring one or more of the three essential parameters necessary to achieve an aesthetic reconstruction when only a single pedicle flap is utilized. A three-zone single-pedicle flap may transpose adequate tissue for reconstruction; however, it is the experience of the authors that perfusion in this configuration is less reliable than that of a bipedicle-conjoined flap.

Patients with a higher BMI often have breasts characterized by a large volume of parenchyma and a wide base diameter. These patients therefore have a correspondingly large breast footprint and/or conus required to achieve an aesthetically pleasing reconstruction. For unilateral reconstruction, it has been the experience of the senior authors that a single pedicle DIEP flap frequently does not provide adequate skin, and soft tissue volume, in the optimal and proportions and dimensions, to reconstruct the anatomic elements of the breast needed to achieve aesthetically acceptable results, and/or to match the contralateral breast, even when the contralateral breast is reduced (►Fig. 1). It has therefore become the standard of practice of the authors, regardless of a patient's preoperative BMI, to employ bipedicle-conjoined flaps to improve outcomes
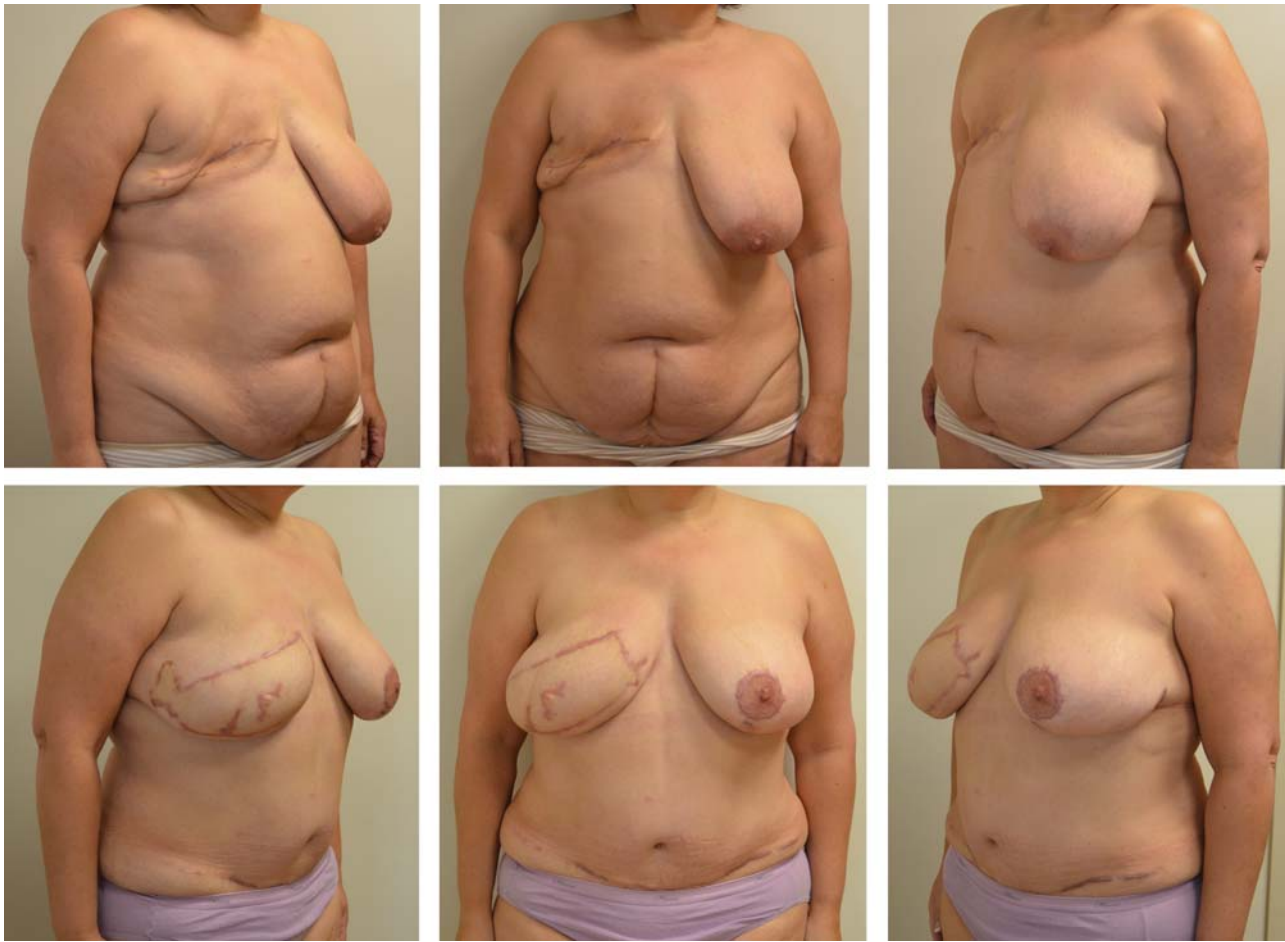
Fig. 4 This patient (BMI = 39.0) presented for delayed breast reconstruction. It was determined preoperatively that she would require a bipedicle-conjoined flap to restore both her skin envelope and an adequate volume to create a symmetric conus, despite her significant pannus and a planned concurrent contralateral mastopexy. Additionally, she had a prior lower midline laparotomy that would decrease the reliability of a single-pedicle three-zone flap. Her mastectomy weight was unknown. Her bipedicle-conjoined flap weight was 1,603 g initially and 1,215 g after trimming. She is shown postoperatively (below) following a single revision consisting of excision of a small area (<2 cm) of fat necrosis, abdominal scar revision with donor site liposuction and nipple creation. BMI, body mass index.

in situations where a single-pedicle flap is deemed insufficient to restore the footprint or conus (►**Fig. 2**).

Overweight or obese patients that are reconstructed in an immediate fashion may require bipedicle-conjoined flaps to restore adequate volume of the reconstructed breast (►**Fig. 3**). The same cohort of patients reconstructed in a delayed fashion may require not only more volume than a hemiabdominal flap may provide, but a larger area of skin as well. Inadequate reconstruction of the skin envelope leads to flattening of the breast and a lack of natural appearing ptosis. The senior authors therefore routinely employ bipedicle-conjoined flaps in these cases (►**Fig. 4**).

Conclusion

For many overweight or obese patients with unilateral reconstructive requirements, single-pedicle flaps or implant-based reconstruction will be inadequate. Our data demonstrate that bipedicle-conjoined DIEP flap reconstruction can be performed safely in overweight and obese patients with morbidity on par with that observed in

"normal" weight patients. As the average BMI of women continues to increase nationally, it is imperative that plastic surgeons expand the indications for autologous reconstruction to parallel this demographic shift and better meet the needs of our patients.[28]

Note
None of the authors has financial interest in any of the products, devices, or drugs mentioned in this manuscript.

Conflict of Interest
None declared.

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