

# Predictors of Reoperations in Deep Inferior Epigastric Perforator Flap Breast Reconstruction

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**Background:** The deep inferior epigastric perforator (DIEP) procedure is regarded a safe option for autologous breast reconstruction. Reoperations, however, may occur, and there is no consensus in the literature regarding the risk factors. The aim of this study was to identify factors associated with reoperations in DIEP procedure.

**Patients and Methods:** A retrospective study of consecutive patients undergoing DIEP breast reconstruction 2007 to 2014 was performed and included a review of 433 medical charts. Surgical outcome was defined as any unanticipated reoperation requiring return to the operating room. Multivariate regression analysis was utilized to identify predictors of reoperation. The following factors were considered: age, body mass index, comorbidity, childbearing history, previous abdominal surgery, adjuvant therapy, reconstruction laterality and timing, flap and perforator characteristics, and number and size of veins.

**Results:** In total, 503 free flaps were performed in 433 patients, 363 (83.8%) unilateral and 70 (16.2%) bilateral procedures. Mean age was 51 years; 15.0% were obese; 13.4% had hypertension; 2.3% had diabetes; 42.6% received tamoxifen; 58.8% had preoperative radiotherapy; 45.6% had abdominal scars. Reoperation rate was 15.9% (80/503) and included flap failure, 2.0%; partial flap loss, 1.2%; arterial thrombosis, 2.0%; venous thrombosis, 0.8%; venous congestion, 1.2%; vein kinking, 0.6%. Other complications included bleeding, 2.2%; hematoma, 3.0%; fat necrosis, 2.8%, and infection, 0.2%. Factors negatively associated with reoperation were childbearing history (odds ratio [OR]: 3.18,  $P = 0.001$ ) and dual venous drainage (OR: 1.91,  $P = 0.016$ ); however, only childbearing remained significant in the multivariate analyses (OR: 4.56,  $P = 0.023$ ).

**Conclusions:** The history of childbearing was found to be protective against reoperation. Number of venous anastomoses may also affect reoperation incidence, and dual venous drainage could be beneficial in nulliparous patients. (*Plast Reconstr Surg Glob Open* 2016;4:e1016; doi: 10.1097/GOX.0000000000001016; Published online 29 August 2016.)

The deep inferior epigastric perforator (DIEP) flap is a workhorse for autologous breast reconstruction worldwide. The DIEP procedure is regarded a safe option with high success rate and satisfactory outcomes; however, the learning curve is steep, and complications and reoperations may occur. Perioperative factors associated with complications after abdomen-based microsurgical procedures have been addressed in numerous

studies, but the conclusions vary among the institutions and series. Apart from the generally accepted risk factors such as smoking, diabetes, and obesity, some studies also identified associations between flap complications and flap characteristics (eg, perforator selection and number, number of veins and their size) or adjuvant treatment (eg, radiotherapy).<sup>1-10</sup> Despite missing consensus and insufficient evidence on the predictors of complications, data on potential risk factors are helpful for patient selection and preoperative planning.

Optimizing the results and standardizing the procedure by reducing risks are essential as the request for autologous reconstruction is increasing.<sup>11</sup> Overall, the majority of articles addressing surgical outcomes in larger series of abdomen-based breast reconstructions show low

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Received for publication May 2, 2016; accepted July 5, 2016.

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DOI: 10.1097/GOX.0000000000001016

**Disclosure:** The authors have no financial interest to declare in relation to the content of this article. This study was supported by Uppsala County Council (ALF grant). The Article Processing Charge was paid for by the authors.

incidence of total flap failures and partial flap necrosis (0%–3% and 0%–11%, respectively).<sup>2,5,9,12–14</sup> Complications such as venous congestions and/or fat necrosis are seen to a higher extent, and the reasons for these events are often difficult to explain, being partly related to the flap vascularity and perfusion.<sup>5,15,16</sup> The substantial impact of the revision procedures on patients' well-being and also healthcare burden call for further research to minimize the need of these reoperations.

The aim of this study was to critically evaluate perioperative predictors of complications and reoperations in DIEP breast reconstruction.

## PATIENTS AND METHODS

A retrospective analysis of a consecutive series of patients undergoing DIEP breast reconstruction at Uppsala University Hospital between October 2007 and December 2014 was performed. Patients were identified through the local operation registry where all surgical procedures performed at the Department of Plastic and Maxillofacial Surgery are registered prospectively. All relevant data were retrieved into a study-specific database manually by 2 independent doctors from the hospital-based medical chart system where all preoperative, operative, and postoperative notes are maintained. In total, 436 medical charts were evaluated and the following demographic and preoperative information was collected: date of birth, body mass index (BMI), active smoking, medical comorbidities (hypertension, diabetes, obesity, and others), childbearing, previous abdominal surgery, preoperative radiotherapy, chemotherapy, and tamoxifen treatment.

The operative and reconstructive characteristics included date of the procedure, timing of reconstruction (immediate vs delayed), side of reconstruction, flap (perforator) side, perforator(s) number and row, number of veins, venous drainage, coupler size, flap weight, ischemic time, length of surgery, and number of operating microsurgeons. The postoperative and follow-up data comprised surgical and systemic complications, date and type of reoperation(s), perioperative medications, and date of discharge.

Complication was defined as any unanticipated event requiring return to the operating room and general anesthesia. Anticipated reoperations due to asymmetry (eg, scar correction, lipofilling, liposuction) and also nipple-areola reconstructions were excluded from the analyses. All complications were further divided into flap circulation-related and others (eg, hematoma, bleeding). Fat necroses were considered clinically significant and registered in the study if they were treated with reoperation. Reoperations due to fat necrosis and other aesthetic adjustments were offered to all patients who would opt for the corrections.

All systemic complications were registered and described separately.

The study was approved by the Regional Research Ethics Committee in Uppsala (2014/354).

### Surgical Procedure

All patients scheduled for the DIEP breast reconstruction routinely undergo computed tomography (CT) an-

giography to identify and assess deep inferior epigastric artery perforator vessels. CT scans are further reviewed by the members of the microsurgical team. Candidates for autologous reconstruction should strictly comply with perioperative smoking cessation (6wk before and after the surgery) according to the routines of the department.

The harvest of the DIEP flap begins with the identification and preservation of the superficial inferior epigastric veins (SIEVs). The internal mammary vessels are the first-choice recipient vessels at our institution. The use of the SIEV as an extra vein is at the discretion of the operating surgeon. An implantable Cook-Swartz probe was used in most cases to monitor the flap postoperatively.<sup>10</sup> Flap monitoring is performed according to the local guidelines including clinical evaluation, invasive Doppler and handheld Doppler.<sup>10</sup> A single dose of antibiotics (cloxacillin 2g, intravenously) is given perioperatively. Anticoagulation therapy includes a prophylactic dose of dalteparin 2500 IU subcutaneously the night before surgery and 5000 IU/d 10 days after surgery. In addition, 75mg/d acetylsalicylic acid orally is prescribed 30 days postoperatively.

Routinely, the patient is seen back 1 week, 6 weeks, and 3 months postoperatively at the department (first 2 visits are to a specialist nurse). All patients are offered nipple-areola reconstruction and/or symmetrizing surgery of the contralateral breast as an outpatient procedure at a later stage.

### Statistical Analyses

All available data were collected into a study-specific database that was designed before variables collection and further transferred to STATA 13.1 for Mac OS (StataCorp; College Station, Tex.) for statistical analyses.

Reoperation was chosen as an appropriate outcome variable because of its statistical robustness and major clinical relevance compared with other surgical outcome endpoints as, for example, complication or readmission to the hospital.

All reoperations were registered and analyzed *per flap*. For the purpose of data analyses, all bilateral reconstructions were considered as 2 separate flaps. In cases with more than 1 reoperation (repeated events), only 1 reoperation was included in the regression model to avoid statistical dependence. Pearson's chi-square or Student's *t* test, when appropriate, was utilized for the assessment of possible differences in cases with and without reoperation.

Univariate and multivariate logistic regression models were performed to test the association of reoperation after DIEP flap procedures and potential confounders. In the univariate models, reoperation (yes vs no) was analyzed in relation to the following patient characteristics: age at procedure, BMI: <25 versus  $\geq 25$  kg/m<sup>2</sup>; hypertension: no versus yes; diabetes: no versus yes; smoking: no versus yes; laterality: unilateral versus bilateral; childbearing history: yes versus no; abdominal scars: no versus yes and treatment variables [calendar year: 2011–2014 vs 2007–2010; preoperative radiotherapy: no vs yes; preoperative chemotherapy: no vs yes; tamoxifen: no vs yes; operating microsurgeons: team vs one; number of perforators; flap weight; number of veins: one vs >one; vein (coupler) size: <median vs  $\geq$ median].

For the purpose of the analyses, the following variables were dichotomized at the mean after they were tested as continuous variables with no marked differences: age, flap weight, flap ischemia time, operative time, and length of surgery. Coupler size and length of stay were dichotomized at the median.

The associations between reoperation and potential categorical risk factors were presented as odds ratios (OR) with 95% CI and *P* value. Reported *P* values from these models refer to the Wald test. A 2-tailed *P* < 0.05 was considered significant in all statistical tests.

## RESULTS

In total, 436 patients underwent breast reconstruction with a free flap procedure during the study period and were considered eligible. Two patients with the superior gluteal artery perforator flap technique were excluded, and also 1 woman with a complex bipedicled DIEP chest wall reconstruction for breast sarcoma. Thus, 433 patients were included in the study as undergoing either unilateral (*n* = 363, 83.8%) or bilateral (*n* = 70, 16.2%) procedure, accounting for 503 flaps in total. The mean follow-up was 5.2 years (range: 1.1–8.3).

Patients' mean age was 51 years (range: 27–72) and BMI = 26.2 kg/m<sup>2</sup> (range: 19.5–40.0). The distribution of comorbidities in the whole group (*n* = 433) was obesity (*n* = 65, 15%), hypertension (*n* = 58, 13.4%), and diabetes (*n* = 10, 2.3%). Three patients (0.7%) were smokers, 184 (42.6%) received tamoxifen, 254 (58.8%) had preoperative radiotherapy, and 197 (45.6%) had abdominal scars.

The other relevant demographic and clinical characteristics are presented *per flap* in Table 1 and stratified for 2 groups: flaps with no reoperation (*n* = 423) and with reoperation (*n* = 80). There were no significant differences in patient characteristics between the 2 groups, except for history of childbearing where the reoperation group was nulliparous more often (25.4% vs 10.7%, *P* = 0.002).

Of the total of 503 flaps, 484 (96.2%) were DIEPs and 19 (3.8%) were superficial inferior epigastric artery (SIEA) flaps, with more frequent use of the SIEA flap in the reoperation group (Table 2). The majority of reconstructions were delayed (*n* = 401, 79.9%). Mean operative time was 302.4 minutes (range: 132–558) with mean flap ischemic time of 56 minutes (range: 14–124). Mean flap weight was 622 g (range: 150–1700), and more than one vein was used in 218 (43.4%) flaps as shown in Table 2.

Median length of stay after the procedure was 7 days (range: 3–18). Systemic complications included 2 cases of pulmonary embolism and 1 case of deep venous thrombosis. All were diagnosed and treated during the early postoperative period.

Data on complications and reoperations are presented in Table 3. Among the 80/503 flaps with reoperation, 10 (2.0%) total flap failures were observed. In 6 cases, a latissimus dorsi reconstruction was performed at the time of flap removal; 2 other cases were managed with delayed expander-implant reconstructions. Two remaining patients refused any secondary reconstruction.

In the univariate analyses of the DIEP flaps (*n* = 484), factors negatively associated with reoperation were childbearing history (OR: 3.18, 95% CI: 1.62–6.26, *P* = 0.001) and dual venous drainage (OR: 1.91, 95% CI: 1.12–3.25, *P* = 0.016), Table 4. Only childbearing remained a negative predictor of reoperation in the multivariate analyses (OR: 4.56, 95% CI: 1.23–16.9, *P* = 0.023).

From the available data on childbirth (*n* = 298), 216 (72.5%) had vaginal delivery and 82 (27.5%) had a cesarian section, and no statistically significant difference in flap reoperation was revealed between the groups (13.9% vs 15.9%, *P* = 0.666, respectively).

The presence of the Pfannenstiel incision (*n* = 93) did not correlate with the reoperation incidence, flap weight, vein size, or operational time (all *P* > 0.05, data not shown).

In the nulliparous subgroup (*n* = 51), there was a trend toward lower probability of reoperation in DIEP flaps with more than 1 vein (31.3% vs 68.8%, *P* = 0.946), although the difference did not reach statistical significance.

No association between the incidence of fat necrosis and flap weight, number of veins, vein size, or abdominal scars was found in the subset analyses of the flaps with fat necrosis (data not shown).

## DISCUSSION

The findings of this study suggest previous childbearing to be a protective factor against reoperations in patients undergoing DIEP flap procedures.

The implications of childbearing for patients opting for abdominal flap procedures have been sparsely discussed in the literature. A study by Santanelli et al<sup>7</sup> was the first to include data on previous childbearing in their review of the DIEP flaps. The authors found an association between nulliparity and perfusion-related flap complications, explaining their findings by a potentially favorable superficial abdominal perfusion in pluriparous women. This assumption is also in line with the published articles that show that venous drainage of the lower abdominal wall mainly relies on the superficial venous system<sup>17,18</sup> and that the venous territory of the SIEV is different from that of deep inferior epigastric vein.<sup>19,20</sup>

To the best of our knowledge, there are no studies specifically addressing changes in the abdominal wall associated with pregnancy. In the light of our findings, we consider that previous childbearing leads to complex anatomic and physiologic changes in the abdominal wall and its hemodynamics, which could be beneficial in abdomen-based free flap procedures. Apart from the known expansion-related changes in tissues,<sup>21–23</sup> pregnancy might lead to certain rearrangements in arterial and venous hemodynamics.

The growing abdominal pressure may increase perfusion via perforators, extending the axially of the blood flow and creating connections between the adjacent perforators by activation of the linking vessels.<sup>24</sup> According to the study by Saint-Cyr et al, perforators give off vertical and oblique branches to the subdermal plexus, and recurrent flow to adjacent perforasomes is possible through the oblique branches. Theoretically, this pathway of blood

**Table 1. Demographic and Patient Characteristics Stratified for Reoperation**

Characteristics	All Flaps <i>n</i> = 503	No Reoperation Group <i>n</i> = 423	Reoperation Group <i>n</i> = 80	<i>P</i>
Calendar year surgery				
2007–2010	266 (52.9)	224 (53.0)	42 (52.5)	—
2011–2014	237 (47.1)	199 (47.0)	38 (47.5)	0.940
Patient age				
<Mean	242 (48.1)	199 (47.0)	43 (53.8)	—
>Mean	261 (51.9)	224 (53.0)	37 (46.2)	0.271*
Patient BMI				
Normal	202 (40.2)	171 (40.4)	31 (38.8)	—
Overweight	301 (59.8)	252 (59.6)	49 (61.2)	0.779*
Active smoking				
No	498 (99.2)	419 (99.3)	79 (98.8)	—
Yes	4 (0.8)	3 (0.7)	1 (1.3)	0.619
Missing	1	1	—	—
Comorbidity				
Hypertension	—	54 (12.8)	11 (13.8)	0.816
Diabetes	—	9 (2.1)	3 (3.8)	0.385
Obesity	—	61 (14.4)	14 (17.5)	0.478
Preoperative radiation				
No	222 (44.7)	186 (44.5)	36 (45.6)	—
Yes	275 (55.3)	232 (55.5)	43 (54.4)	0.983
Missing	6	5	1	—
Preoperative chemotherapy				
No	249 (50.8)	212 (51.5)	37 (47.4)	—
Yes	241 (49.2)	200 (48.5)	41 (52.6)	0.515
Missing	13	11	2	—
Tamoxifen				
No	293 (58.4)	246 (58.3)	47 (58.8)	—
Yes	209 (41.6)	176 (41.7)	33 (41.2)	0.940
Missing	1	1	—	—
Childbearing history				
No	51 (13.1)	35 (10.7)	16 (25.4)	—
Yes	339 (86.9)	292 (89.3)	47 (74.6)	0.002
Missing	113	96	17	—
Prior abdominal surgeries/scars				
No	262 (52.7)	216 (51.8)	46 (57.5)	—
Yes	235 (47.3)	201 (48.2)	34 (42.5)	0.349
Missing	6	—	6	—
Laterality				
Unilateral	363 (72.2)	302 (71.4)	61 (76.3)	—
Bilateral	140 (27.8)	121 (28.6)	19 (23.8)	0.374
Operating microsurgeons				
Single microsurgeon	154 (31.3)	130 (31.4)	24 (30.8)	—
Team	338 (68.7)	284 (68.6)	54 (69.2)	0.912
Missing	11	9	2	—
Operative time, mean (SD), h				
Unilateral	—	4.37 (0.97)	4.24 (0.92)	0.347
Bilateral	—	6.90 (1.11)	7.30 (0.99)	0.165
Length of stay				
≤Median	421 (83.7)	373 (88.2)	48 (60.0)	—
>Median	82 (16.3)	50 (11.8)	32 (40.0)	<0.001*

\*Also tested as continuous variables with no marked difference.

flow could be activated at later stages of pregnancy leading to potential perfusion changes in the superficial system compared with a nonpregnant abdomen.

Veins of the abdominal wall, being capacitance vessels, represent one of the largest reservoirs of blood in the human body. During the pregnancy, blood volume expansion may rise up to 50% in the third trimester, leading to an increased cardiac output, venous pressure, and vasodilation.<sup>25,26</sup>

The influence of estrogens and progesterone on the superficial venous system is also well documented in the literature and confirmed in the studies on the veins of the lower extremities.<sup>27,28</sup> Interestingly, an imaging study on pregnancy-induced changes in the superficial veins of the lower limbs showed that the veins do not seem to return to their initial diameter after the pregnancy.<sup>27</sup>

In some cases, later gestational changes in the circulation may be caused by the growing uterus resulting in the compression of the inferior vena cava, the iliac veins, and the inferior epigastric veins. In this scenario, the development of the collateral circulation in the deep and superficial systems of the epigastric veins may take place. The importance of collateral venous pathways of the abdominal wall was demonstrated in a comprehensive anatomic CT angiography review of compressions of the inferior vena cava caused by pathologic conditions.<sup>29</sup> An involvement of the superficial tributaries of the paraumbilical veins may also play a role thus potentially improving the vascularity in certain parts of the future flaps.<sup>17,18</sup>

Finally, an increase of the BMI and the amount of abdominal fat during childbearing may also lead to vasculature

**Table 2. Flaps and Technical Characteristics of the Procedure Stratified for Reoperation**

Characteristics	All Flaps <i>n</i> = 503	No Reoperation Group <i>n</i> = 423	Reoperation Group <i>n</i> = 80	<i>P</i>
Flap type				
DIEP	484 (96.2)	411 (97.2)	73 (91.3)	—
SIEA	19 (3.8)	12 (2.8)	7 (8.7)	0.011
Timing reconstruction				
Delayed	401 (79.9)	333 (78.9)	68 (85.0)	—
Immediate	101 (20.1)	89 (21.1)	12 (15.0)	0.213
Missing	1	1	—	—
Breast reconstruction side				
Left	255 (50.7)	210 (49.7)	45 (56.3)	—
Right	248 (49.3)	213 (50.3)	35 (43.7)	0.279
Side hemiabdomen				
Left	254 (52.3)	218 (53.3)	36 (46.8)	—
Right	232 (47.7)	191 (46.7)	41 (53.2)	0.291
Missing	17	14	3	—
Flap to breast side				
Contralateral	349 (71.8)	293 (71.6)	56 (72.7)	—
Ipsilateral	137 (28.2)	116 (28.4)	21 (27.3)	0.845
Missing	17	14	3	—
Perforator row				
Medial	201 (53.0)	171 (52.8)	30 (54.5)	—
Lateral	149 (39.3)	128 (39.5)	21 (38.2)	0.827*
Medial and lateral	29 (7.7)	25 (7.7)	4 (7.3)	0.970
Missing	124	99	25	—
Perforator number				
1	280 (66.2)	237 (65.5)	43 (70.5)	—
>1	143 (33.8)	125 (34.5)	125 (99.5)	0.443
Missing	80	61	19	—
Flap weight				
<Mean	131 (57.7)	113 (59.2)	18 (50.0)	—
>Mean	96 (42.3)	78 (40.8)	18 (50.0)	0.307†
Missing	276	232	44	—
Flap ischemic time				
<Mean	254 (50.9)	216 (51.4)	38 (48.1)	—
>Mean	245 (49.1)	204 (48.6)	41 (51.9)	0.587†
Missing	4	3	1	—
Anastomosis				
Artery first	384 (76.3)	326 (77.1)	58 (72.5)	—
Vein first	119 (23.7)	97 (22.9)	22 (27.5)	0.378
Vein number				
1	284 (56.6)	230 (54.5)	54 (67.5)	—
>1	218 (43.4)	192 (45.5)	26 (32.5)	0.032
Vein system(s)				
DIEV only	272 (54.2)	223 (52.9)	49 (61.3)	—
DIEV + SIEV	211 (42.0)	187 (44.3)	24 (30.0)	0.043‡
SIEV only	19 (3.8)	12 (2.8)	7 (8.7)	0.006
Vein size§				
≤Median	141 (59.0)	113 (58.3)	28 (62.2)	—
>Median	98 (41.0)	81 (41.7)	17 (37.8)	0.62†
Missing	45	36	9	—

\**P* value for medial versus lateral perforator comparison.

†Also tested as continuous variables with no marked difference.

‡*P* value for DIEV only versus DIEV + SIEV.

§Analyzed using coupler size in 1-vein flaps (*n* = 284).

DIEV indicates deep inferior epigastric vein.

rearrangements. Studies on patients after massive weight loss confirmed that the superficial veins in obese population were significantly larger than in the control group.<sup>30</sup> Our study could not reveal any differences in the SIEV size between the groups stratified for childbearing or for BMI (data not shown). Yet, measurements of the vein diameter were indirect and relied upon the venous coupler dimensions.

The selection of perforators required to adequately perfuse the DIEP flap is judgmental and the decision is taken intraoperatively along with the decision to augment the venous drainage.

The beneficial role of a second vein anastomosis to improve venous drainage and reduce the incidence of venous

congestion was first demonstrated by Enajat et al.<sup>12</sup> A recent systematic review on the perfusion-related complications in DIEP flaps supercharged with SIEV confirmed a significant decrease in postoperative flap congestion in the superdrainage group. There was also a trend toward decreasing of the incidence of partial flap loss and fat necrosis, but the difference was not statistically significant.<sup>31</sup> In our study, the SIEV was used in almost half of the DIEP flaps, and the dual venous drainage was associated with lesser probability of reoperation. In fact, when analyzing the subset of nulliparous women, there was a clear trend toward lower probability of reoperation in the subgroup of DIEPs with more than 1 vein—31.3% versus 68.8%, although the difference did

**Table 3. Complications Requiring Reoperation and Number of Reoperations per Flap**

Complications	All Flaps n = 503	
	n	%
Flap related		
Flap failure	10	2.0
Partial flap loss	6	1.2
Arterial thrombosis*	10	2.0
Venous thrombosis	4	0.8
Venous congestion	6	1.2
Vein kinking	3	0.6
Others		
Hematoma	15	3.0
Bleeding	11	2.2
Infection	1	0.2
Fat necrosis	14	2.8
No. reoperations (per flap)		
0	423	84.1
≥1	80	15.9
1	62	12.3
2	16	3.2
3	2	0.4

\*Including simultaneous arterial and venous thrombosis in 5 flaps.

not reach statistical significance. This finding could have an important clinical implication, suggesting the advantage of dual venous drainage in nulliparous patients and should be addressed in a larger series.

The results of our reoperation analyses also indicated that the presence of the additional routes of venous drainage could be more critical than the single vein caliber, which is also supported by other studies.<sup>12,32</sup>

SIEA flap was anecdotally used at our institution (19 of 503 flaps, 3.8%) and has predominantly been performed by one of the experienced microsurgeons in selected bilateral reconstructions. Higher complication rates in this subgroup however are in line with other publications from the centers where SIEA flaps are not performed regularly<sup>33-35</sup> and may be attributed to vessel caliber and flap thrombosis.

The role of scars and previous incisions in the lower abdomen for the future abdomen-based microsurgical breast reconstruction was addressed in several articles.<sup>2,4,36,37</sup> Pa-

tients with prior abdominal and/or gynecological surgery do not seem to have an increased risk for the DIEP flap-related complications. These studies, however, have a retrospective design and are not specific to scar location in relation to flap perfusion zones or other CT angiography landmarks. A recent anatomic CT imaging study<sup>38</sup> showed that the presence of the Pfannenstiel scar was associated with the larger deep inferior epigastric artery perforator size (0.96 vs 0.85 mm). Clinical implication of this subtle difference seems uncertain. In fact, the analysis would benefit from an adjustment for childbearing, which could shed light on if it is the pregnancy per se or the cesarian section that is associated with larger perforator size.

The strengths of this study include its detailed data collection, robust statistical analysis, and sample size, where all consecutive patients operated at the same institution were included in the study with no patients lost to follow-up. The same local guidelines were used in all abdomen-based microsurgical breast reconstructions over the study period of 7 years. Furthermore, we were able to analyze the role of the traditional childbearing and also the scar after cesarian section on the surgical outcomes of DIEP breast reconstruction.

The limitation of the study may lie in its retrospective nature, where some of the data in the medical charts were not available. Thus, we could not incorporate the data on multiple pregnancies, and some other intraoperative information was not recorded. The majority of the patients in this study had had a history of one or more childbearing, and the generalization to other patient populations would require confirmation. Another methodological weakness could be the low number of negative outcomes (ie, complications), which might result in a lower statistical power to detect differences. This could also partially explain why no more associations between reoperations and other potential risk factors have been identified in the regression analysis.

### CONCLUSIONS

In our study, the history of childbearing was found to be a protective factor against complications in abdomen-

**Table 4. Univariate and Multivariate Regression Analyses for Reoperation in DIEP Flaps (n = 484)\***

	Univariate			Multivariate†		
	Odds Ratio	95% CI	P	Odds Ratio	95% CI	P
Age	0.79	0.48–1.31	0.367	0.72	0.22–2.38	0.595
Calendar year	0.91	0.56–1.50	0.721	1.38	0.41–4.58	0.602
BMI	1.05	0.63–1.74	0.854	1.48	0.41–5.3	0.544
Hypertension	1.12	0.54–2.31	0.765	0.61	0.12–3.19	0.556
Radiotherapy	1.04	0.63–1.72	0.891	1.55	0.43–5.65	0.504
Chemotherapy	1.17	0.71–1.94	0.536	0.79	0.20–3.19	0.740
Tamoxifen	0.97	0.58–1.60	0.891	0.81	0.24–2.68	0.730
Abdominal scars	0.81	0.49–1.34	0.414	0.38	0.12–1.18	0.094
Childbearing history	3.18	1.62–6.26	0.001	4.56	1.23–16.9	0.023
Laterality	0.79	0.45–1.41	0.429	0.85	0.21–3.41	0.818
No. microsurgeons	1.05	0.60–1.82	0.863	0.97	0.19–4.81	0.966
Flap weight	1.28	0.61–2.66	0.514	1.22	0.35–4.30	0.757
No. perforators	1.26	0.70–2.28	0.444	0.82	0.31–2.16	0.685
No. veins	1.91	1.12–3.25	0.016	3.14	0.85–11.48	0.084
Vein size‡	0.41	0.13–1.27	0.122	0.87	0.21–3.57	0.843

\*Smoking and diabetes were excluded from the analysis because of low number of observations.

†All factors from the univariate analysis were included in the multivariate model.

‡Analyzed in 1-vein flaps.

based microsurgical breast reconstruction. These findings require further evaluation, but we consider that pregnancy leads to complex anatomic and physiologic changes in the abdominal wall and its hemodynamics, which could be beneficial in abdomen-based flap procedures. According to the study results, the usage of the dual venous drainage could be favorable in nulliparous patients undergoing DIEP breast reconstruction.

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