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Strategic Approaches to Intraflap Anastomosis: Navigating Conjoined DIEP Flap Reconstruction—A Comprehensive Roadmap

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Background: For patients desiring autologous breast reconstruction without adequate abdominal tissue volume, the deep inferior epigastric perforator (DIEP) flap may be stacked or combined with other flaps for bilateral reconstruction. Various combinations of anastomoses have been described in the literature. We sought to describe a framework for intraflap anastomoses.

Methods: A retrospective review of 17 patients who underwent conjoined DIEP flaps with intraflap anastomoses with a single surgeon was performed. Patient demographics, comorbidities, operative details, and complications were reviewed. A framework scheme was developed for the type of intraflap anastomosis performed.

Results: Between 2016 and 2020, 17 patients underwent conjoined DIEP flaps for unilateral breast reconstruction. Fourteen patients had delayed reconstruction. Eleven patients underwent an intraflap anastomosis in which a medial perforator on the left hemiabdomen flap was anastomosed with a distal lateral row perforator in the right hemiabdomen flap (type A). Four patients underwent an intraflap anastomosis in which a left lateral perforator was anastomosed to a right distal lateral row perforator (type B). Two patients underwent an intraflap anastomosis in which the left superficial inferior epigastric vessel was anastomosed to a right lateral row perforator (type C). Complications included reoperation (11.8%), partial flap loss (5.9%), seroma (23.5%), and hematoma (11.8%).

Conclusions: We report a detailed framework for intraflap anastomoses of conjoined DIEP flap reconstruction including superficial inferior epigastric artery/superficial inferior epigastric vessel options. Knowledge of this comprehensive framework will allow surgeons to identify the type of intraflap anastomoses required for the anatomy they encounter and will standardize reporting of surgical technique in the literature. *(Plast Reconstr Surg Glob Open 2024; 12:e5627; doi: 10.1097/GOX.0000000000005627; Published online 23 February 2024.)*

INTRODUCTION

In recent years, the deep inferior epigastric perforator (DIEP) flap has emerged as the gold standard for autologous breast reconstruction in the United States, epitomizing the fusion of aesthetic restoration with patient-specific anatomical considerations.[1,2] This evolution in reconstructive surgery has been marked by significant advancements in technique, notably the utilization of both hemiabdomen flaps for single breast reconstruction. This approach has opened new horizons for patients who desire autologous reconstruction but lack adequate tissue in one hemiabdomen, thereby expanding the applicability of DIEP flap procedures.[3,4] There are three main methods for using two hemiabdomen flaps to reconstruct one breast. The first method, known as stacked flaps, involves the complete separation of both hemiabdomen flaps. Predominantly, in these procedures, the deep inferior epigastric vessels are anastomosed to the internal mammary vessels in both antegrade and retrograde fashions.[5,6] In the second method, called a bipedicle flap, the flap is not divided, and a retrograde/anterograde anastomosis is made to the internal

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mammary vessels. Finally, a third technique, termed the conjoined flow-through flap, represents a paradigm shift. In this method, the hemiabdomen flaps remain undivided, using an intraflap anastomosis. Intraflap anastomoses can be performed between the medial or lateral row vessels or to the superficial inferior epigastric (SIE) vessels. This technique singularizes the vascular anastomosis to the internal mammary vessels, similar to a standard DIEP flap reconstruction.[7–9] This article aims to delineate a comprehensive framework for intraflap anastomoses, tailored to the diverse anatomical landscapes encountered intraoperatively. By describing a framework for intraflap anastomosis options, we hope to equip surgeons with a strategic guide to enhance decision-making during the critical phases of flap dissection. A thorough understanding of these anastomotic variations is beneficial in guiding the surgeon during DIEP flap surgery, offering the ability to design the flap depending on the anatomy encountered, ultimately contributing to optimized patient outcomes.

Takeaways

Question: How can we help surgeons performing conjoined deep inferior epigastric perforator (DIEP) flap breast reconstruction to make intraoperative decisions on how to make their intraflap anastomosis.

Findings: We describe a detailed classification system for intraflap anastomosis during conjoined DIEP flap breast reconstruction and share our outcomes of conjoined DIEP flap breast reconstruction with intraflap anastomosis using our classification system.

Meaning: By having a framework in mind of the possible intraflap connections that are feasible, the surgeon can assure adequate vessel length during his/her dissection. This can save valuable time in the operating room (and consequently cost) by preventing unnecessary dissections.

METHODS

We retrospectively reviewed 17 patients who underwent conjoined DIEP flap breast reconstruction at our institution between June 2016 and December 2020. Patient factors (including age, comorbidities, smoking status, type of prior breast surgery, prior abdominal surgery, and history of neoadjuvant or adjuvant chemoradiotherapy) were obtained. Flap characteristics noted included number of perforators, perforator distribution, number of intraflap anastomosis, type of intraflap anastomosis, and concurrent lymph node transfer. Outcomes examined included operative time, length of stay, total flap loss, partial flap loss, nipple areolar complex necrosis, fat necrosis, seroma, hematoma, wound dehiscence, and reoperation. We also noted donor site complications including infection, hematoma, seroma, bulge, hernia, and wound dehiscence. Median follow-up was 11.5 months. Statistical analysis was performed using Microsoft Excel (Microsoft Corp., Redmond, Wash.).

There are six possible permutations for intraflap anastomoses in conjoined flaps (Figs. 1 and 2). These were categorized into types A through F. A type A configuration was one in which a medial row on the left hemiabdomen flap was anastomosed with a distal lateral row in the right hemiabdomen flap (Fig. 3). A type B configuration was one in which a left lateral row was anastomosed to a right distal lateral row (Fig. 4). A type C configuration was one in which the left superficial inferior epigastric vessels (SIEVs) were anastomosed to the right lateral row (Fig. 5). A type D configuration was one in which a left medial row was anastomosed to the right distal medial row (Fig. 6). A type E configuration was one in which a left lateral row was anastomosed to the right distal medial row (Fig. 7). A type F configuration was one in which the left SIEV were anastomosed to a right distal medial row (Fig. 8).

RESULTS

Between June 2016 and December 2020, seventeen patients underwent conjoined DIEP flaps for unilateral breast reconstruction. Mean patient age was 47.6 years, and

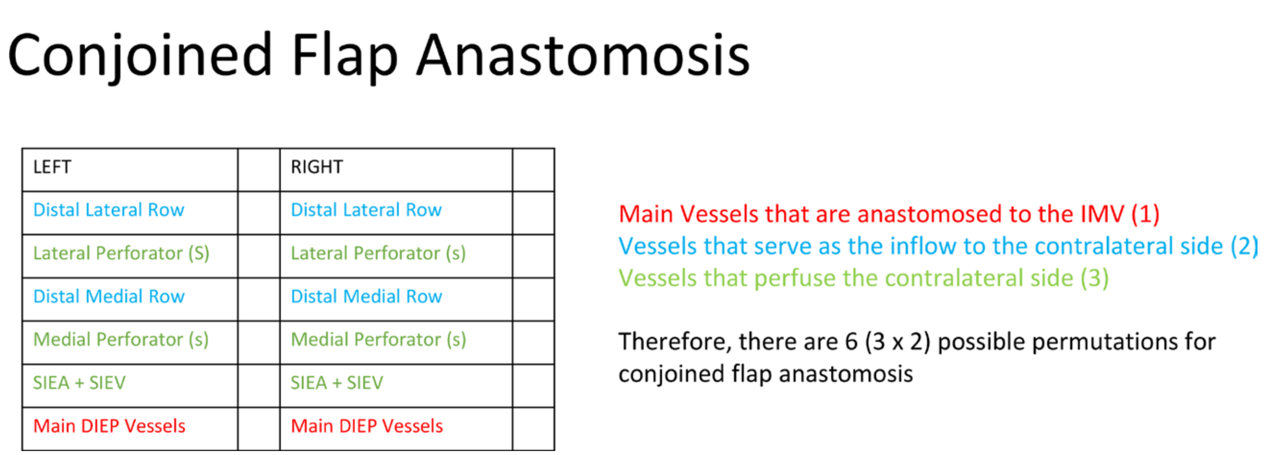

Fig. 1. In red are the main vessels that are anastomosed to the IMV (internal mammary vessels); in blue are the vessels that serve as the inflow to the contralateral side; and in green are the vessels that perfuse the contralateral side. Therefore, there are six (3 × 2) possible permutations for conjoined flap anastomosis.

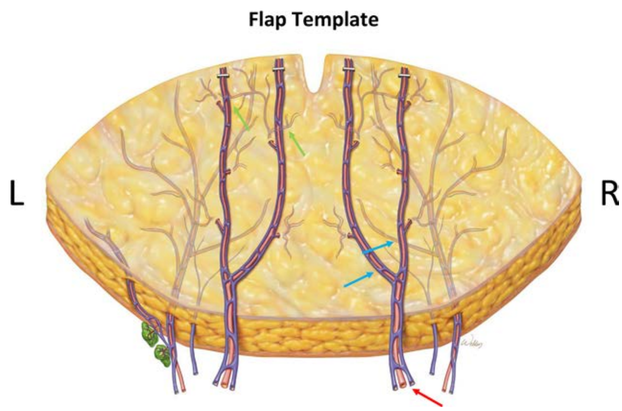

Fig. 2. The green arrows point to the contralateral lateral and medial perforators; the blue arrows point to the distal medial and distal lateral perforator row, which are part of the main DIEP vessels that will be anastomosed to the internal mammary vessels.

mean BMI was 24. Two patients had hypertension and one patient was an active smoker (Table 1). Fourteen patients (82%) had delayed reconstruction. Forty-seven percent (n = 8) underwent simple mastectomy, whereas 23.5% each underwent nipple-sparing (n = 4) and skin-sparing mastectomies (n = 4). Eleven patients had prior breast surgery. In our population, 53% received neoadjuvant chemotherapy and 71% received radiation after mastectomy but before conjoined DIEP flap reconstruction (Table 2). All patients had flaps with at least two perforators with 10 patients having two perforator flaps, four having three perforator flaps, and three having four perforator flaps. Eleven patients underwent a type A intraflap anastomosis, four patients underwent a type B intraflap anastomosis, and two patients underwent a type C intraflap anastomosis. We did not have any patients that underwent a type D, E or F intraflap anastomosis. Nine patients underwent concomitant lymph node transfer. Operative time ranged from 313 minutes to 555 minutes (mean 429 minutes). Median length of stay was 3 days (Table 3). Flap-related complications included reoperation (11.8%), partial flap loss (5.9%), recipient site seroma (23.5%), and recipient site hematoma (11.8%). Donor site wound dehiscence occurred in 11.8% of patients. Two patients required reoperation for a small hematoma compressing the pedicle. One of those patients had partial flap loss and required operative debridement (Table 4).

DISCUSSION

In abdominal-based autologous breast reconstruction, the terms "conjoined" and "stacked" are frequently used, often interchangeably, leading to a certain degree of ambiguity. This confusing nomenclature extends to the term "bipedicle flaps," which some articles use without differentiating between "stacked" and "conjoined" flaps.[9] The interpretation of these terms can vary among surgeons, further complicating the picture. For instance, "stacked flaps" might refer to a divided abdominal flap for some, whereas others may apply the same term to undivided flaps.[10]

For clarity, our definition of a stacked flap is when the flap is divided and two separate anastomoses are made to the internal mammary vessels (usually in an antegrade and retrograde fashion).[11] We define conjoined flaps as flaps that are not divided, have an intraflap anastomosis, and thus have a single anastomosis to the internal mammary vessels. We recognize that a conjoined flap can also be one that is not divided and two separate anastomoses are made to the internal mammary vessels. We call this a bipedicle flap. Using our definition of a conjoined flap, we believe that conjoined flaps have several theoretical advantages. First, conjoined flaps offer a greater degree of freedom during inset, especially lateral tissue reach, which is helpful when skin is required post radiation therapy. Second, the conjoined flap is a flow-through flap, where

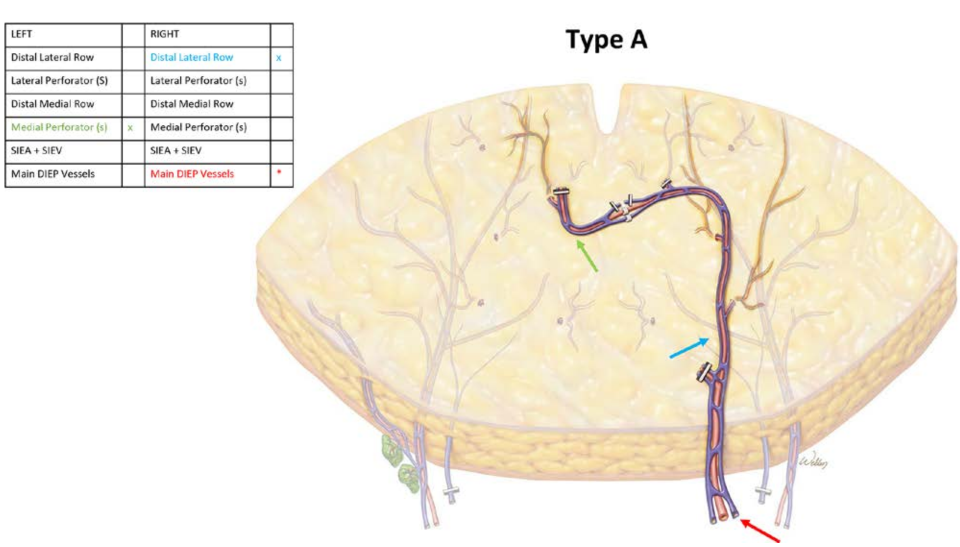

Fig. 3. Type A is characterized by anastomosing the medial perforator(s) (green arrow) on the left hemiabdomen flap with the distal lateral perforator row (blue arrow) on the right hemiabdomen flap.

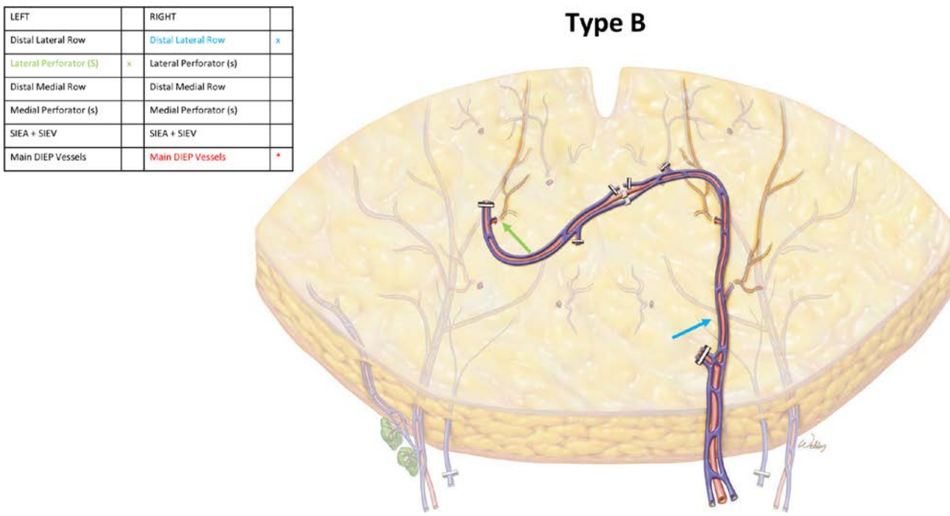

Fig. 4. Type B involves anastomosing the lateral perforator(s) (green arrow) on the left hemiabdomen flap to the distal lateral perforator row (blue arrow) on the right hemiabdomen flap.

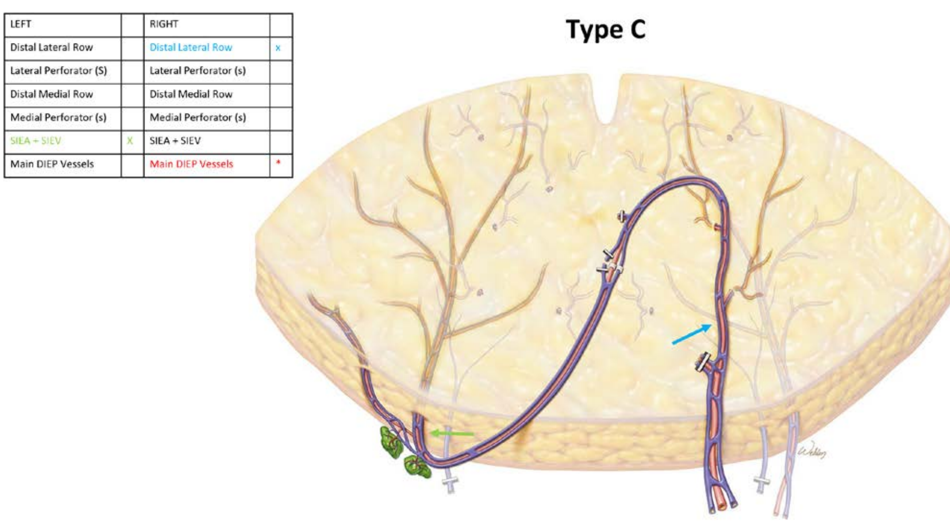

Fig. 5. Type C involves anastomosing the left SIEVs (green arrow) to the distal lateral perforator row (blue arrow) on the right hemiabdomen flap.

the direction of flow is always antegrade, which eliminates any potential issues caused by retrograde flow. Finally, conjoined flaps benefit from cross flap perfusion because they are not divided.

In our cohort, 64.7% had a type A configuration, 23.6% had a type B configuration, and 11.7% had a type C configuration. We found that the type A configuration is the most common. Types C and F are the least common, as the SIEVs are not usually of large enough caliber to be useful. Although we did not have any type D or E configurations, this is likely due to our small sample size.

Most of our complications occurred in one patient who had a history of Smart liposuction of the abdomen. She underwent a three-perforator conjoined DIEP flap with a type A configuration. Her postoperative course was complicated by a hematoma and seroma, which resulted in infection and partial flap necrosis as well as flap wound dehiscence. These complications were likely attributable to her history of Smart liposuction. Smart liposuction is a type of laser-assisted liposuction that is more aggressive than other liposuction methods or cryolipolysis because it induces more postprocedure scarring.[12,13] The scarring made perforator dissection extremely difficult. In addition, lymphatic disruption in the abdominal tissue resulted in significant flap edema, which compromised perfusion to the flap. This in turn led us to initiate anticoagulation, likely resulting in the hematoma. This illustrates the spiraling course of complications as a result of prior laser liposuction. Our patient eventually recovered

LEFT		RIGHT	
Distal Lateral Row		Distal Lateral Row	
Lateral Perforator (S)		Lateral Perforator (s)	
Distal Medial Row		Distal Medial Row	x
Medial Perforator (s)	x	Medial Perforator (s)	
SIEA + SIEV		SIEA + SIEV	
Main DIEP Vessels		Main DIEP Vessels	*

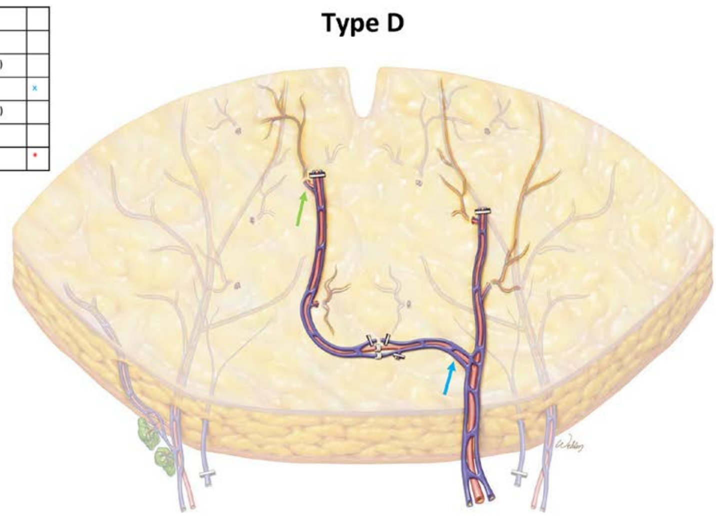

Fig. 6. Type D is characterized by anastomosing the left medial perforator(s) (green arrow) from the left hemiabdomen to the distal medial perforator row (blue arrow) on the right hemiabdomen flap.

LEFT		RIGHT	
Distal Lateral Row		Distal Lateral Row	
Lateral Perforator (S)	x	Lateral Perforator (s)	
Distal Medial Row		Distal Medial Row	x
Medial Perforator (s)		Medial Perforator (s)	
SIEA + SIEV		SIEA + SIEV	
Main DIEP Vessels		Main DIEP Vessels	*

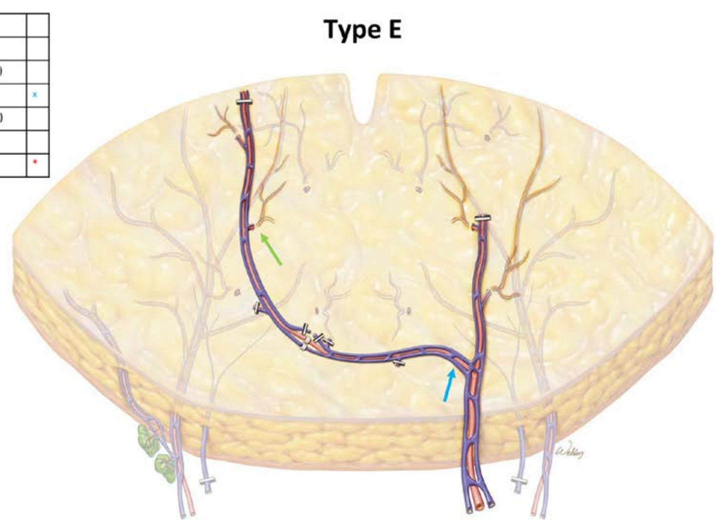

Fig. 7. Type E involves anastomosing the left lateral perforator(s) (green arrow) to the right distal medial perforator row (blue arrow) on the right hemiabdomen flap.

and had a good aesthetic result but required multiple operations for fat grafting. We would caution against DIEP flap reconstruction in patients with a history of laser-assisted liposuction.

The proposed framework for vascular anatomy of DIEP flaps is designed to be a versatile tool, benefiting surgeons regardless of their reliance on preoperative imaging. For those who use preoperative CT angiography of the abdomen, this framework becomes particularly instrumental. By identifying the largest perforator in the dominant hemiabdomen through imaging,[14,15] surgeons can efficiently plan the surgical approach. Equipped with knowledge about various anastomosis options, they can effectively determine the optimal row for anastomosis in the nondominant hemiabdomen. Such preoperative planning can significantly expedite the perforator dissection process, thereby saving valuable operative time.[16] Conversely, for surgeons who do not routinely incorporate preoperative imaging into their practice, our framework still offers substantial benefits. In these cases, the initial step involves identifying the largest perforator on the dominant side intraoperatively. With a clear understanding of potential anastomotic connections, surgeons can streamline their focus during the dissection on the nondominant side. This approach not only enhances efficiency but also aids in decision-making during the critical phases of surgery. It is important to note that the dominant and nondominant sides may vary among surgeons, influenced by the specific configuration of inset (ipsilateral versus contralateral). Additionally, we have included the superficial inferior epigastric artery and superficial inferior epigastric vein in our framework for completeness. However, these vessels are infrequently used in practice, due to their higher failure rates.[17–19]

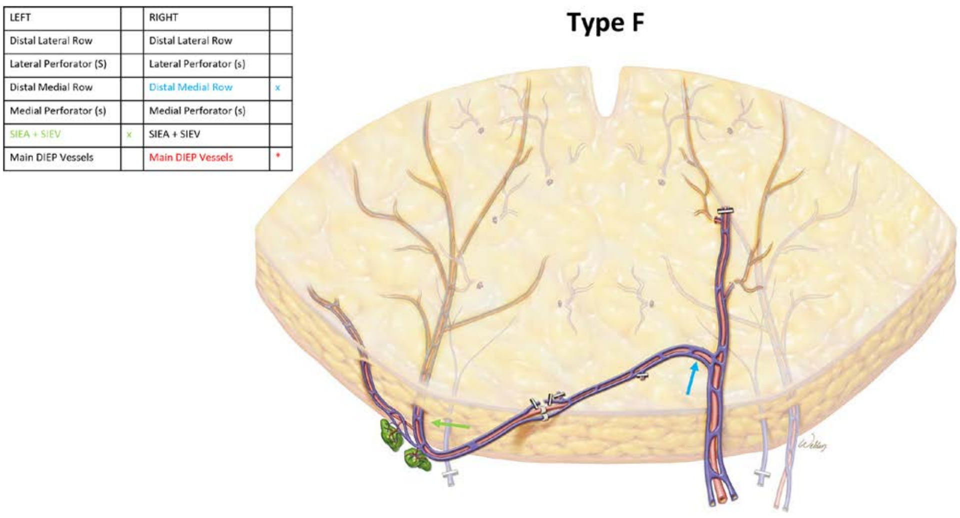

Fig. 8. Type F involves anastomosing the left SIEV (green arrow) to the right distal medial perforator row (blue arrow) on the right hemiabdomen flap.

Table 1. Demographics

Variables		Patients (n = 17)
Mean age, y, range ± SD		47.6 (35.8–67.1) ± 9.6
Mean BMI, kg/m², range ± SD		24.0 (19.8–30.9) ± 2.9
Hypertension (%)		2 (11.8)
Coronary artery disease (%)		0 (0.0)
Diabetes mellitus (%)		0 (0.0)
Chronic obstructive pulmonary disease (%)		0 (0.0)
Coagulopathy (%)		0 (0.0)
Smoker (%)	Yes	1 (5.9)
	Former	0 (0.0)
	Never	16 (94.1)
Median follow-up time (mo), range [IQR]		11.5 (4.7–44.8) [9.2]

Table 2. Preoperative Variables

Variables		Conjoined Flaps (n = 17)
Reconstruction (%)	Unilateral	17 (100.0)
	Bilateral	0 (0.0)
Timing of reconstruction (%)	Immediate	3 (17.6)
	Delayed	14 (82.4)
Prior lumpectomy (%)		4 (23.5)
Prior breast reconstruction (%)		7 (41.2)
Mastectomy (%)*	Nipple sparing	4 (23.5)
	Skin sparing	4 (23.5)
	Simple	9 (53)
Prior abdominal surgery (%)		8 (47.1)
Neoadjuvant radiotherapy (%)		0 (0.0)
Neoadjuvant chemotherapy (%)		9 (52.9)
Adjuvant radiotherapy (%)*		12 (70.6)

*Radiotherapy after mastectomy, but before conjoined DIEP.

Table 3. Intraoperative Variables

Variables		Conjoined Flaps (n = 17)
No. perforators (%)	1	0 (0.0)
	2	10 (58.8)
	3	4 (23.5)
	4	3 (17.6)
	>4	0 (0.0)
Intraflap anastomosis type (%)	Type A	11 (64.7)
	Type B	4 (23.6)
	Type C	2 (11.7)
Lymph node transfer (%)		9 (52.9)
Mean operative time, min, range, ±SD		429.1 (313–555) ± 75.5
Median length of hospital stay, d, range, [IQR]		3 (3–9)[1]

Table 4. Postoperative Complications

Variables	Conjoined Flaps (n = 17)
Conjoined DIEP Flap Complications	
Total flap loss (%)	0 (0.0)
Partial flap necrosis (%)	1 (5.9)
NAC necrosis (%)	0 (0.0)
Fat necrosis (%)	1 (5.9)
Flap infection (%)	1 (5.9)
Seroma (%)	4 (23.5)
Hematoma (%)	2 (11.8)
Flap wound dehiscence (%)	1 (5.9)
Reoperation due to complication (%)	2 (11.8)
Abdominal–Donor Site Complications	
Donor site wound dehiscence (%)	2 (11.8)
Donor site infection (%)	0 (0.0)
Donor site hematoma (%)	0 (0.0)
Donor site bulge (%)	0 (0.0)
Donor site hernia (%)	0 (0.0)

CONCLUSIONS

In this article, we introduce a comprehensive framework detailing the common anatomical variations encountered during the harvest of DIEP flaps. The utility of such a structured approach extends beyond mere academic interest, offering tangible benefits in clinical practice. Primarily, this framework can benefit surgeons to ensure adequate vessel length during dissection. By enabling a more targeted approach, it significantly reduces the need for extensive, potentially unnecessary dissections and saves valuable time in the operating room. Moreover, assigning a definitive name to this framework enhances communication within the surgical community, both in clinical settings and academic articles. Such standardization paves the way for more effective comparisons of surgical outcomes, facilitates the pooling of data for more robust research studies, and promotes uniformity in reporting practices across publications. Importantly, given the recognized advantages of conjoined flaps over stacked flaps, our framework offers a strategic "road map." This guide assists surgeons in confidently integrating intraflap anastomoses into their breast reconstruction repertoire.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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