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Breast

The Preferential Use of Subcutaneous Arteries (SCIA-SB and SIEA) in Abdominal-based Autologous Breast Reconstruction with a Modified Flap Design

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Background: Despite its many advantages, the deep inferior epigastric artery perforator flap requires fascial incision and intramuscular dissection, which can lead to pain and weakening of the abdominal wall. The superficial inferior epigastric artery (SIEA) flap offers an alternative to avoid this damage but is often considered unreliable due to its variable anatomy. In this study, we report our experience in autologous breast reconstruction using either the superficial branch of the superficial circumflex iliac artery (SCIA-SB) or the SIEA as the sole flap pedicle.
Methods: A retrospective study was conducted from August 2022 to December 2023. A total of 17 patients underwent breast reconstruction with 18 flaps (1 bilateral and 16 unilateral reconstructions). The SCIA-SB (14 flaps) or SIEA (4 flaps) served as the exclusive arterial sources. Preoperative vessel identification was performed using color-coded duplex sonography, and the flap design was adjusted accordingly. Intraoperative flap perfusion was assessed via indocyanine green angiography. Demographic, intraoperative, and postoperative data were recorded.
Results: The mean follow-up was 5.7 months (range: 3–17 mo). Of the 18 flaps, 1 was lost due to arterial insufficiency. Partial flap necrosis requiring revision occurred in 1 case, whereas minor complications (seroma, wound dehiscence, mastectomy skin necrosis, and infection) were observed in 7 patients.
Conclusion: In our experience, either the SCIA-SB or SIEA can be successfully used as a pedicle in autologous breast reconstruction, provided that the abdominal flap design is modified to include their functional angiosomes. *(Plast Reconstr Surg Glob Open 2024; 12:e6252; doi: 10.1097/GOX.0000000000006252; Published online 28 October 2024.)*

INTRODUCTION

The deep inferior epigastric perforator (DIEP) flap represents the gold standard in autologous breast reconstruction.[1–3] However, its harvesting implies different degrees of rectus fascia incision and intramuscular dissection with consequent weakening of the abdominal wall and increased postoperative pain.[4]

The superficial inferior epigastric artery (SIEA) flap, on the other hand, preserves the fascia and muscle but is considered less reliable: variability of the angiosome, tiny vessels, and overall higher complication rate are documented in the literature.[5,6] In a landmark article from Holm et al,[7] successful SIEA flap breast reconstructions were possible in just 56% of the cases. In the remaining cases, the angiosome was not considered sufficient to perfuse enough tissue to reconstruct a breast.

Other vascular sources, such as the superficial circumflex iliac artery (SCIA), deep circumflex iliac artery, and superficial external pudendal artery, supply the abdominal skin. However, their territories have less clinical relevance in autologous breast reconstruction due to their off-center position and minor contribution to the vascularity of the central abdominal bulk.[8] Although there are

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some publications in the literature documenting the utilization of the SCIA in breast reconstruction,[9–11] our search of the literature failed to find reports on the use of the superficial branch of the superficial circumflex iliac artery (SCIA-SB) as the only arterial source of abdominal flaps for breast reconstruction.

After the enormous popularity achieved by the superficial circumflex iliac perforator flap in recent years,[12] we have gathered extensive experience with this flap, especially with the flap based on the SCIA-SB, for the reconstruction of various body regions. Observing a broad area of perfusion through indocyanine green angiography (ICGA), we decided to explore its application in breast reconstruction.

The aim of our study is to report our findings on the use of subcutaneous arteries (SIEA and SCIA-SB) as the vascular basis for abdominal free flaps in the context of breast reconstruction.

Takeaways

Question: Can breast reconstruction consistently be performed using abdominal free flaps based on subcutaneous arteries (either superficial inferior epigastric artery or superficial branch of the superficial circumflex iliac artery) instead of deep inferior epigastric artery perforators, thus avoiding fascial incisions and intramuscular dissection?

Findings: Yes. In our study, we successfully transferred an abdominal flap based on a subcutaneous artery (either superficial branch of the superficial circumflex iliac artery or superficial inferior epigastric artery) in all but 1 case. Preoperative identification of the subcutaneous artery using color-coded duplex sonography improved flap design and optimized perfusion.

Meaning: Breast reconstruction using subcutaneous arteries is feasible for most patients.

MATERIALS AND METHODS

Study Design

A retrospective study was performed in accordance with the Declaration of Helsinki of 1964 (revised 2008) and with the approval of the local ethics committee.

From August 2022 to December 2023, all patients scheduled for immediate or delayed autologous breast reconstruction were assessed for abdominal flap reconstruction utilizing a subcutaneous artery of the abdomen, either the SCIA-SB or SIEA. Preoperative planning and surgical procedures were performed by the first author (A.F.). All patients with adequate abdominal volume for breast reconstruction were primarily offered a flap based on a subcutaneous pedicle (SCIA-SB or SIEA). In cases where patients exhibited an abundance of tissue in other donor sites, profunda artery perforator or superior gluteal artery perforator flaps were offered as reconstructive alternatives. Those presenting with insufficient donor sites were advised to consider either prosthetic or autologous reconstruction with stacked free flaps. For patients opting for abdominal-based breast reconstruction with subcutaneous pedicles, the DIEP flap was kept as a backup option in case the subcutaneous pedicles were found to be inadequate.

The presence of the subcutaneous arteries was tested preoperatively via color-coded duplex sonography (CCDS) and intraoperatively via ICGA.

Definitions

Clear and collectively recognized definitions in the literature regarding the SIEA and SCIA-SB are still absent.[13] According to our findings, the definitions mostly overlap, as what some authors refer to as the SIEA,[9,14–18] others call the SCIA-SB.[19–22]

In this study, we will refer to the SCIA-SB as a subcutaneous artery that from the femoral triangle travels cranially superficial to the inguinal ligament, exclusively when it branches from the SCIA or has a shared origin with it, thus allowing the distinction between the superficial and deep branches of the SCIA. Conversely, we will define the SIEA as an artery with the same characteristics as the SCIA-SB but with an origin separate from the SCIA, that is, arising directly from the femoral artery.[13]

Preoperative Planning

The same preoperative routine was performed. The patient was first marked while standing and was instructed to pull the abdominal skin cranially and medially with both hands during the markings, similar to planning a "high lateral tension abdominoplasty"[23,24] (Fig. 1A, B).

Subsequently, with the patient lying supine, color-coded duplex sonography (CCDS) was performed using a 6- to 15-MHz linear probe to identify the subcutaneous arteries coursing over the inguinal ligament in a cranial direction and confirming its inclusion in the flap planning (Fig. 1C, D). Due to the challenge of determining the exact origin of the vessel with ultrasound, the identified vessel was temporarily referred to as the "subcutaneous artery of the abdomen." The definitive name, SIEA or SCIA-SB, was assigned only after intraoperative direct visualization of the pedicle and its origin. Both inguinal regions were investigated preoperatively with CCDS and inspected directly during the operation. The artery with greater caliber was always selected as a preferential pedicle. Superficial veins were identified preoperatively by direct visual inspection of the skin or with the aid of CCDS in B-mode. Deep inferior epigastric artery (DIEA) perforators were also mapped with CCDS.

The upper margin of the marking, and therefore, the amount of skin that could be harvested with the flap, was evaluated by pinch test with the patient lying in a semi-Fowler position. The final drawing was adjusted according to the identified vessels and checked again in standing for symmetry. Because both the SIEA and SCIA-SB predominantly follow a lateral course,[14,15,19,22] the design was extended laterally, maximizing the use of adipocutaneous tissue at the flank region lateral and superior to the anterior superior iliac spine (ASIS).

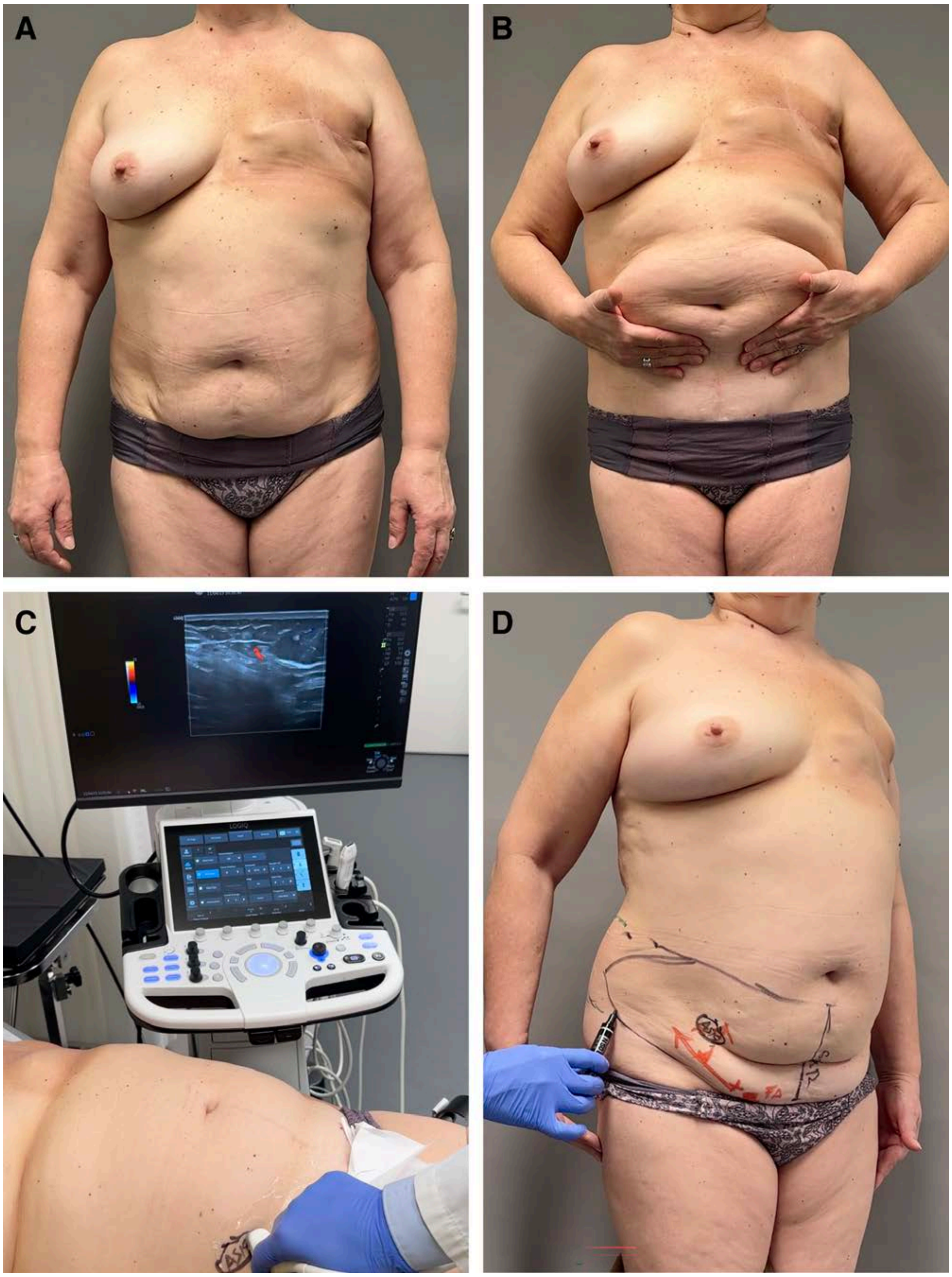

Fig. 1. Preoperative flap planning. A and B, The patient's skin is lifted upward to position the scar caudally and laterally, ensuring the inclusion of the SIEA/SCIA-SB angiosomes and allowing for concealment. C and D, The CCDS is used to identify the subcutaneous vessels and adjust the flap markings accordingly. Although the ASIS serves as a critical bony landmark for the inguinal ligament's position, its marking on the skin is less useful due to the skin's significant mobility in this area. The femoral artery, from which the subcutaneous vessels originate, is the most crucial landmark.

Surgical Technique

The initial incision was made where the artery with a larger caliber had been preoperatively identified by CCDS. Most of the flap elevation was performed using monopolar cautery. Once identified, the subcutaneous artery and accompanying veins were traced caudally into the femoral triangle, preserving all the branches contributing to the vascular supply of the planned abdominal flap. The subcutaneous artery and its branches were also traced cranially to increase pedicle length, extending beyond the flap margins. No caliber cutoff was set regarding the artery, and the artery pulsation was visible in all cases at the time of identification. If more than 1 main subcutaneous artery was found, both were equally traced proximally and preserved. Superficial veins were dissected in a similar way down to the saphenofemoral junction. One or more DIEA perforators were always preserved as backup options in the case of inadequate perfusion through the subcutaneous pedicle. To obtain an adequate flap volume, generous beveling was performed in cranial and lateral directions.

After flap elevation, ICGA was performed to assess flap perfusion from the subcutaneous artery with DIEA perforators temporarily clamped[25] (Fig. 2). If the perfused volume of tissue was considered adequate for a successful breast reconstruction, DIEA perforators were ligated, and the flap was transferred to the chest based on the subcutaneous pedicle.

The arterial anastomosis was performed either to a side branch of the internal mammary artery or to the internal mammary artery itself. When more than a 2 to 1 mismatch was encountered, arterioplasty of the recipient artery was carried out to minimize potential blood flow turbulence (Fig. 3). Flap veins were anastomosed to the antegrade internal mammary vein (IMV). When more than 1 vein anastomosis was required, the bigger vein was anastomosed to the antegrade IMV, and the second, smaller vein (eg, comitant vein or superficial inferior epigastric vein [SIEV] or superficial circumflex iliac vein [SCIV]) was anastomosed to a side branch of the first vein (intraflap anastomosis[26]). The venous anastomoses were always carried out with a coupler device.

At the donor site, rectus plication was performed using a PDS 0 loop suture in a U-running fashion when clinically needed. Vacuum drains were placed and removed when the outputs were less than 30 mL/24 hours or at the patient's discharge. All patients received thrombosis prophylaxis with enoxaparin (Clexane) at 20 or 40 mg/d,

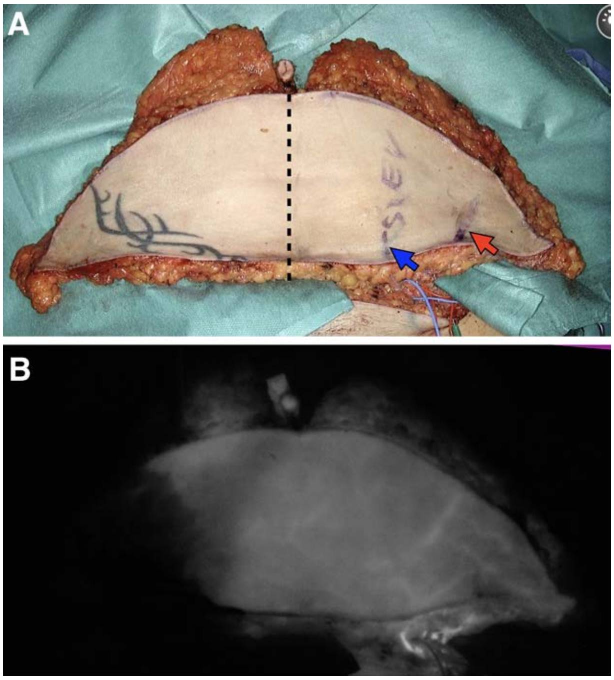

Fig. 2. A, An example of an abdominal flap harvested using the superficial branch of the SCIA, preoperatively marked on the skin (red arrow). The superficial inferior epigastric vein is also marked (blue arrow). B, ICGA indicates perfusion extending across the midline (dotted line).

according to the Caprini score, throughout their hospitalization starting at postoperative day 1.

Data Collection

Demographics data were recorded, as well as comorbidities, eventual concurrent therapies, smoking habits, intraoperative data, and complications.

Follow-up evaluations were scheduled at 1 and 3 weeks and then at 3, 6, and 12 months after discharge. Additional outpatient appointments were arranged for patients with complications or requiring additional surgical procedures.

Complications were classified as major when they required operation under general anesthesia (such as in cases of flap vascular compromise, hematoma, partial or total flap necrosis, and wide wound dehiscence). Minor complications were those managed conservatively or treated under local anesthesia in an outpatient setting.

RESULTS

Patient Characteristics

Patients' characteristics are shown in Table 1.

A total of 17 consecutive patients underwent microvascular breast reconstruction using 18 abdominal flaps, relying solely on subcutaneous arteries.

Immediate reconstruction was performed in 12 breasts (7 following nipple sparing mastectomy and 5 following skin sparing mastectomy) and delayed reconstruction in 6 breasts. Unilateral breast reconstruction was carried out in 16 patients and bilateral breast reconstruction in 1 patient. The mean follow-up was 5.7 months (range: 3–17 mo).

Preoperative Planning

In all but 1 patient, the CCDS evaluation correctly identified a subcutaneous vessel crossing the inguinal ligament from the femoral triangle, which was confirmed intraoperatively with 94% accuracy.

In 1 case, a caudal musculocutaneous perforator was erroneously interpreted as a subcutaneous artery by CCDS examination. Intraoperatively, this vessel was ligated, and a subcutaneous artery was identified through direct surgical exploration.

Surgical Procedures

In all the patients, the subcutaneous artery was dissected down to the femoral artery to obtain the maximal pedicle length and caliber. In 4 inguinal regions, the subcutaneous artery originated independently from the SCIA; in 13 cases, the identified subcutaneous artery originated from or with the SCIA. In 1 patient, 2 sizable subcutaneous arteries were intraoperatively detected and traced to the femoral triangle (Fig. 4). After ICGA evaluation, the SIEA was clipped, and the flap was transferred using the SCIA-SB as a pedicle.

In no cases were DIEA perforators used as flap pedicles because tissue perfusion via the subcutaneous pedicle was always deemed adequate.

A good flap perfusion, assessed by ICGA, clearly crossed the midline in 6 of 18 flaps, reached the midline in 7 flaps,

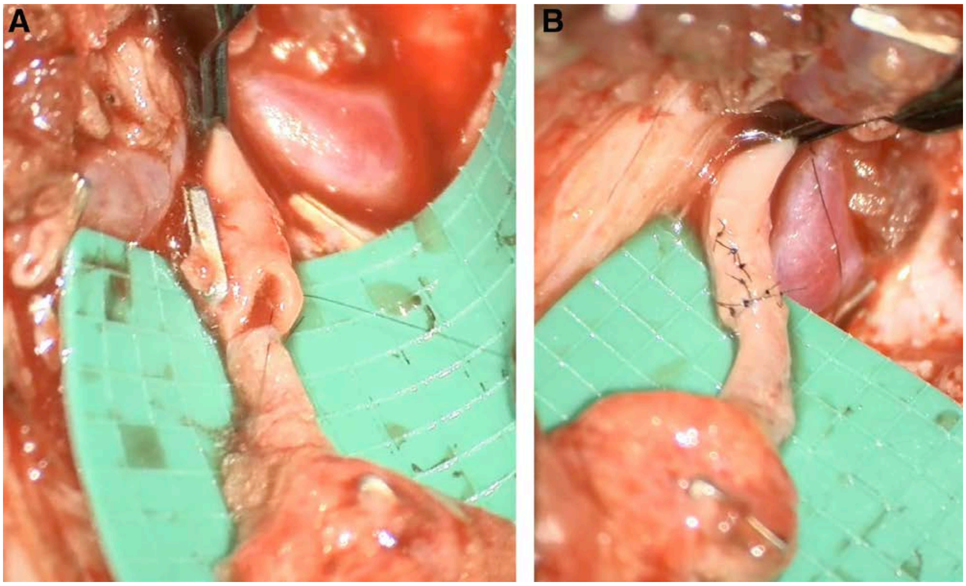

Fig. 3. Arterioplasty. The arterial anastomosis is completed on the back wall first. When redundancy of the anterior wall is encountered, a wedge excision of the recipient artery is performed as needed (A). The walls are then sutured in a conventional method (B).

and did not extend to the midline in the remaining 5 flaps, with perfusion ending 1–3 cm from the midline. However, this subdivision was not precise, as the demarcation line of perfusion was not perfectly vertical but rather oblique. After this assessment, only clearly vascularized tissue was maintained in the flap. Flap characteristics such as flap weight, pedicle characteristics, and anastomosis pattern are reported in Table 1.

Seventeen flaps had a dual venous drainage ensured by variable combinations of comitant veins, SIEV and SCIV (eg, comitant vein + SIEV or comitant vein + SCIV or SIEV + SCIV or all together as in Fig. 5). In 6 cases, a single coupler anastomosis to the IMV was needed because the SIEV and/or SCIV and/or comitant veins converged in a common trunk before reaching the saphenofemoral junction. In the remaining 11 flaps, a superficial vein (SCIV or SIEV) was anastomosed to the IMV, and the second was anastomosed to a side branch of the first superficial vein (intraflap anastomosis[26]). A comitant vein served as the only venous drainage of the flap in only 1 case (due to its dominance and absence of separate SCIV/SIEV).

Complications

A total of 11 minor complications were recorded in 7 patients, including 4 seromas at the donor site, 2 cases of donor site dehiscence, 3 donor site wound infections, and 2 instances of partial necrosis of the mastectomy skin flap (Table 2).

Complete flap loss occurred in a heavy smoker patient and was due to recurrent arterial occlusion: the first occurred on the third postoperative day (successfully revised), and the second arterial occlusion occurred on the sixth postoperative day. At this point, no further salvage attempts were carried out and the flap was removed.

Partial flap necrosis was observed in the patient with class III obesity. However, it did not affect the outcome, as the reconstructive flap was considerably larger than the contralateral side, and simple excision of the necrotic part led to a good shape and volume of the breast.

In all the treated patients but the one who lost the flap, a good functional and aesthetic result was obtained in monolateral and bilateral cases (Figs. 6–8).

DISCUSSION

Due to the significant vascular variability of the SIEA,[5,6,27] our institution, like many others worldwide, has favored the DIEP flap as the preferred option for autologous breast reconstruction in the past decades. However, with the increasing popularity of the superficial circumflex iliac perforator flap in recent years,[12] we extensively revisited the femoral region as a donor site for free flaps and reconsidered its use in breast reconstruction.

We observed that by modifying the standard abdominal flap design, expanding it laterally, and keeping it low, similarly to the planning of a high lateral tension abdominoplasty,[23,24] it is possible to optimize the abdominal tissue perfusion, maximizing the amount of tissue vascularized by subcutaneous vessels. Although this modified flap design significantly extends the scar toward the lumbar and gluteal regions compared with a traditional DIEP flap, it facilitates concealment of the scar beneath the underwear line.

Nevertheless, a potential risk of such a flap design closer to the femoral triangle is the increased risk of lymphatic damage, which may account for the increased postoperative drainage observed in our series. To avoid this,

Table 1. Patient Characteristics

Treated patients, n	17
Age, y (range)	47 (36–62)
Patients comorbidities	
Obesity class III (BMI ≥ 40 kg/m²)	1
Smoking	3
Hypertension	3
DVT history	1
Type of reconstruction	
Immediate, after nipple sparing mastectomy	7
Immediate, after skin sparing mastectomy	5
Delayed, after simple mastectomy	6
Treated breasts, n	
Bilateral reconstruction	1
Monolateral reconstruction	16
Adjuvant radiation therapy	5
Delayed reconstruction	3
Immediate reconstruction	2
Follow-up, mo (range)	5.7 (3–17)
Operating time, min (range)	
Bilateral reconstruction	590
Monolateral reconstruction	342 (264–455)
Flap weight, g (range)	435 (370–750)
Arterial caliber, mm (range)	1.2 (0.7–2.2)
Length of the artery, cm (range)	7.3 (5.5–9.0)
Venous caliber, mm (range)	
SCIV	3.0 (2.3–4.5)
SIEV	3.5 (2.5–5.0)
Comitant vein	1.4 (0.9–2.0)
Common vein	4.0 (2.9–6.0)
Arterial pedicle of the flap, n (%)	
SCIA-SB	14 (78)
SIEA	4 (22)
DIEP	0 (0)
Venous pedicle of the flap, n (%)	
Comitant vein only	1 (6)
SIEV and/or SCIV and/or comitant vein after joining	6 (33)
SIEV and/or SCIV and/or comitant vein with intraflap anastomosis	11 (61)
Recipient vessels, n (%)	
IMA with arterioplasty	9 (50)
IMA without arterioplasty	4 (22)
IMA side branch	5 (28)
IMV antegrade	18 (100)
Hospital length of stay, d (range)	6.2 (4–15)
Drains duration, d (range)	6.5 (4–10)
Major complications, n (%)	4 (23)
Minor complications, n (%)	7 (41)

BMI, body mass index; DVT, deep vein thrombosis; IMA, internal mammary artery.

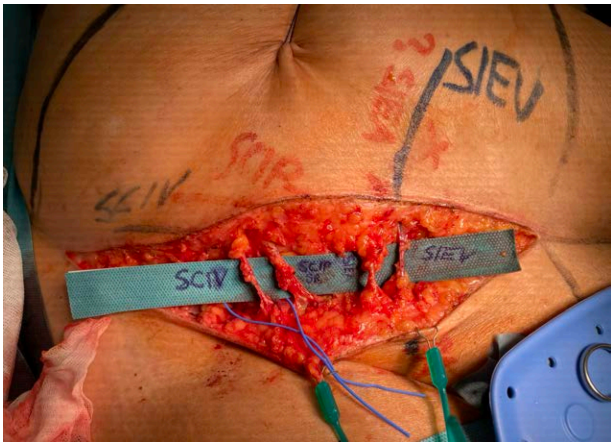

Fig. 4. In 1 patient, 2 sizable subcutaneous arteries were identified at the right groin level. The vessels were labeled from left to right in the image as follows: SCIV, SCIA-SB, SIEA, and SIEV. In this case, the SIEA was divided and the flap transferred based on the SCIA-SB.

Fig. 5. Close-up picture of a flap pedicle after its detachment from the femoral region. The superficial branch of the SCIA is divided (*) and its accompanying vein (#) is joining the SIEV (§). The SCIV (°) is joining the SIEV more caudally. The common vein trunk is closed with a clamp. Mean vessel calibers are reported in Table 1.

Table 2. Complications

Minor complications, n (%)	11 (61)
Seroma in the donor site	4 (22)
Wound dehiscence in the donor site	2 (11)
Partial mastectomy skin necrosis	2 (11)
Wound infection	3 (16)
Major complications, n (%)	4 (23)
Partial flap necrosis	1 (5)
Venous thrombosis	0
Arterial thrombosis	1 (5)
Hematoma requiring intervention	2 (12)

we found that respecting the lymphoadipose tissue surrounding the pedicle is mandatory.

Unlike the previous series on the SIEA flap,[28–31] we successfully transferred enough well-perfused tissue based on a subcutaneous artery (either SIEA or SCIA-SB) in all the cases. As already mentioned, creating a wider flap laterally, including the ASIS in the design, allows for the inclusion of more branches of the SIEA/SCIA-SB, which, despite being located laterally, have significant potential to perfuse toward the midline.

Another crucial aspect is the delicate handling required for these small vessels. Even minimal pressure, traction, or desiccation can induce spasm, significantly reducing or eliminating their flow, making it difficult for the surgeon to assess their usability. If the pedicle is mishandled, intraoperative evaluation with ICGA can be severely compromised.

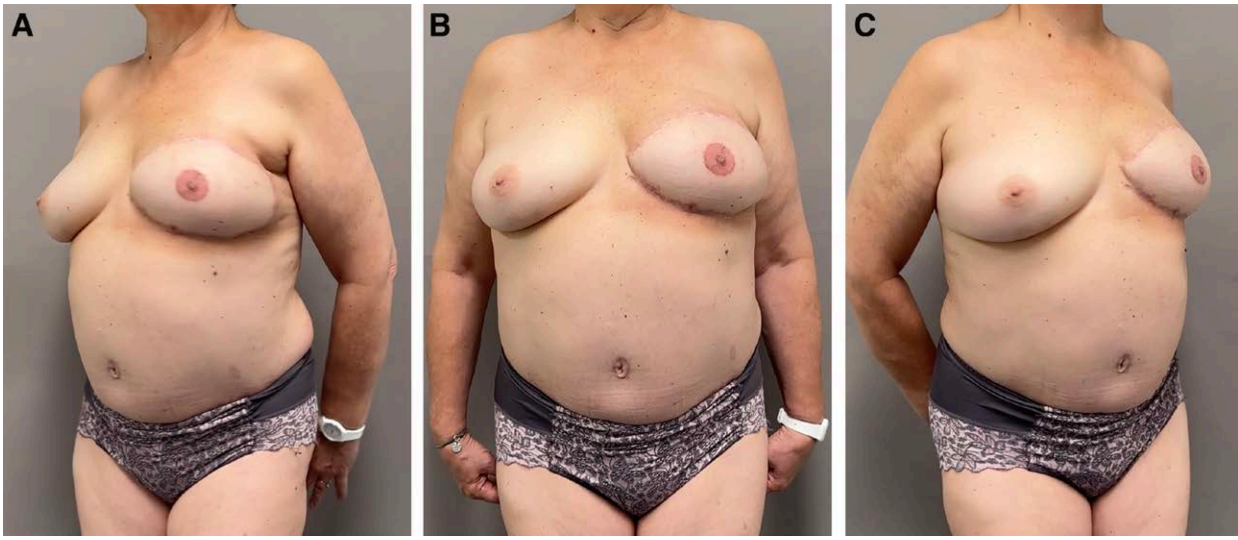

Fig. 6. The patient shown in Figure 1, 5 months after left breast reconstruction and 1 month after nipple-areola reconstruction (A, B and C). The patient expressed satisfaction with the outcome and did not require additional symmetrization procedures. The scar at the donor site is effectively concealed beneath the panty line.

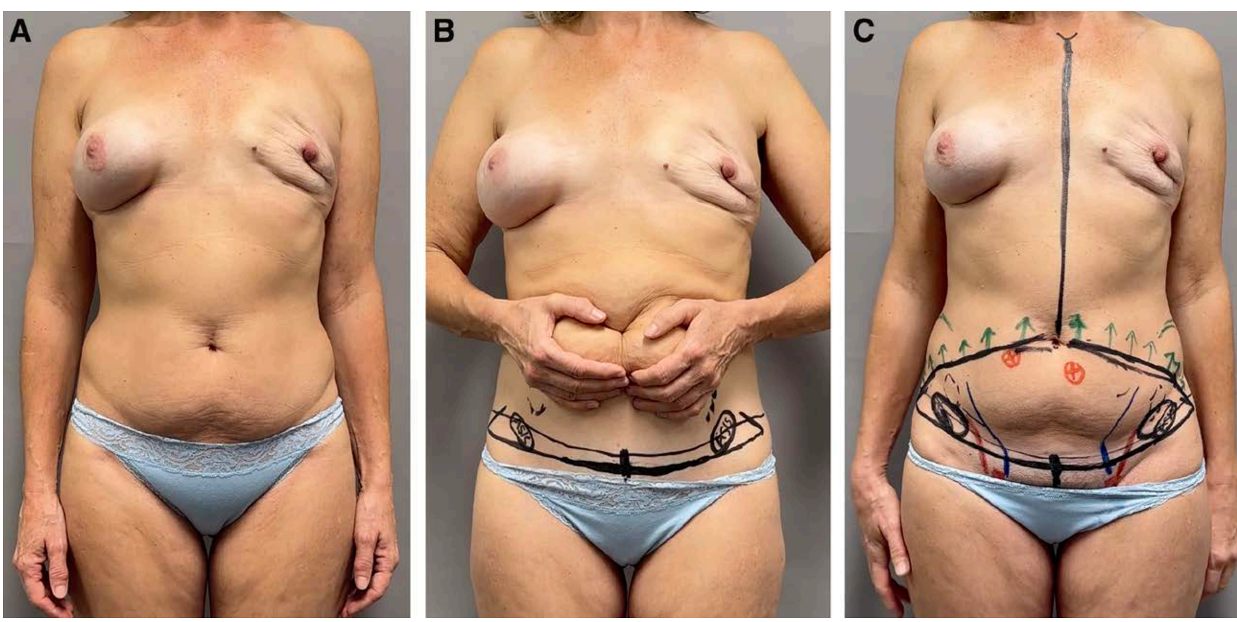

Fig. 7. Planning of a bilateral breast reconstruction with a bilateral abdominal flap based on subcutaneous arteries. The patient had history of bilateral breast reconstruction with prepectoral implants. The left implant was previously explanted due to postoperative infection. The patient wanted to undergo bilateral autologous breast reconstruction, mainly because the right implant was painful and visible, with poor cosmetic outcomes (A). In the donor site, flap markings were designed low and extending laterally to include the ASIS, ensuring the scar remained concealed by underwear (B). CCDS is used to confirm the inclusion of the vessels (arteries in red and veins in blue). DIEA perforators were also marked (red crosses) as a bailout procedure in case the subcutaneous vessels were insufficient. Green arrows indicated incision beveling to include additional fat tissue in the flap (C).

A third critical factor for flap perfusion is the inclusion of at least 2 draining veins, combining the comitant veins of the artery, the SIEV, and the SCIV, depending on the patient's anatomy (Table 1). We consistently observed that improved venous drainage significantly increased the perfusion area of the abdominal flap, as demonstrated by ICGA. Intraoperative ICGA also revealed that the use of subcutaneous pedicles such as the SIEA or SCIA-SB might be particularly useful in cases of bilateral breast reconstruction. The more lateral perfusion of these vessels compared with the DIEP allows for the optimization of abdominal tissue, which can be divided into 2 halves with less angiosome overlap (Fig. 9).

Regarding the definitions of SIEA and SCIA-SB, we noted that many authors tend to broadly define SCIA-SB,

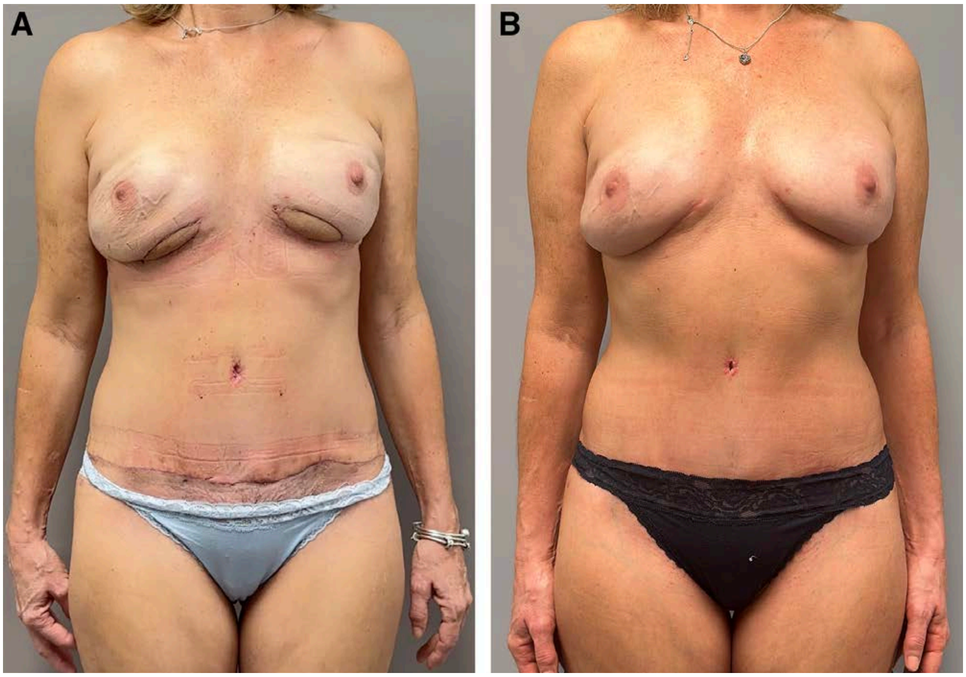

Fig. 8. Postoperative results after bilateral reconstruction. Patient depicted in Figure 7, 1 month after bilateral breast reconstruction (A) and 1 month after flap monitoring island removal (B).

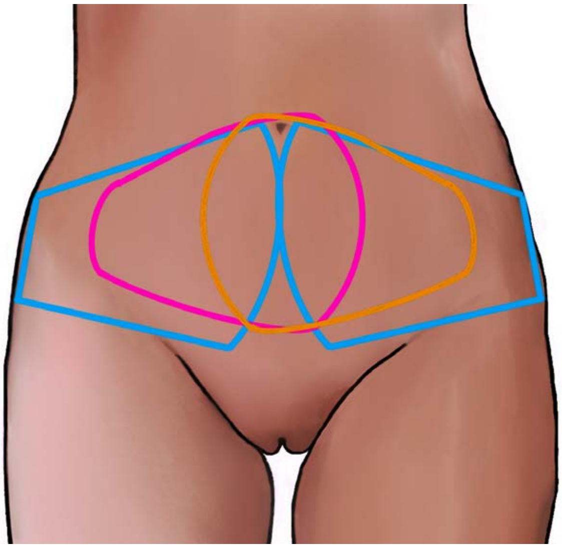

Fig. 9. Vascular zones served by left and right SCIA-SB/SIEA (blue), right DIEP (pink), and left DIEP (orange). The overlapping of DIEP vascular zones and the maximum optimization of abdominal tissues perfused by subcutaneous pedicles can be noted.

to the extent that most abdominal subcutaneous vessels could be classified as SCIA-SB, relegating the name SIEA to rare exceptions. For instance, Fuse et al[20] defined the SCIA-SB as "either a superficial artery that shares a common trunk with the deep branch or a superficial artery that runs toward the ASIS without sharing a common trunk with the deep branch" and SIEA as "a superficial artery running medially along the linea semilunaris." According to these definitions, all 18 flaps in our study should be classified as SCIA-SB because every artery was found lateral to the linea semilunaris. However, we do not completely agree with this classification because it contradicts previous authoritative descriptions of the SIEA[9,14–18] where this vessel is described to have a predominantly lateral course.

Based on these definitions, we report, to our knowledge, the largest series of breast reconstructions utilizing the SCIA-SB. However, rather than focusing on vessel nomenclature, the primary goal of our study is to emphasize that a vessel with a lateral course, irrespective of its name, can perfuse a significant amount of medial and lateral abdominal tissue, thus allowing its use for harvesting large abdominal flaps. Modification of flap design, aided by aesthetic surgical principles and imaging devices such as CCDS and ICGA, was fundamental to achieving this goal.

Avoiding fascial incisions and damage to the rectus abdominis muscle minimizes weakening of the abdominal musculofascial system, which is particularly important in patients with obesity, those with compromised abdominal walls, and those with elevated intraabdominal pressure. Although our follow-up is limited, we recorded no cases of bulging or hernia. Patients, especially those who did not undergo rectus plication, experienced less postoperative pain and faster recovery. Rectus plication was performed in some patients with significant fascial laxity; however, although it improves abdominal contour, it tends to increase postoperative pain, diminishing the initial benefit of not violating the fascia.

Although our experience demonstrated the capability of subcutaneous vessels to vascularize sufficient tissue for breast reconstruction in most cases, we cannot assert that this technique should always be preferred. The SIEA and SCIA-SB vessels are usually small and delicate, making every phase of preparation and transfer challenging, time-consuming, and at risk of complications. In our study, we aimed to utilize the subcutaneous vessels (SIEA/SCIA-SB) in all cases to demonstrate their perfusion capacity regardless of their caliber. However, as previously suggested by other authors regarding the SIEA flap,[27–31] we will consider using SCIA-SB and SIEA pedicles only in cases of adequate caliber (eg, ≥1 mm) at their origin. In our opinion, the DIEP flap may still prove to be more cost-effective and safer when the subcutaneous artery is considered too small. Moreover, the DIEA perforators are the main supply for the central abdominal bulk and are better suited than the SIEA/SCIA-SB pedicle when more volume is needed.

CONCLUSIONS

Based on our experience, both the SCIA-SB and SIEA can serve as viable pedicles for harvesting abdominal flaps for autologous breast reconstruction. Regardless of the terminology applied to subcutaneous abdominal arteries, our experience shows that even vessels with a distinctly lateral course can vascularize an adequate amount of tissue if the flap design is adequately adapted. However, the small caliber of SIEA/SCIA vessels makes this technique challenging in most cases.

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DISCLOSURE

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

ETHICAL APPROVAL

Institutional review board approval was obtained (IRB: 2024-00306).

DECLARATION OF HELSINKI

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Declaration of Helsinki of 1975, as revised in 2008.

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