OPEN

PRS GLOBAL OPEN

ORIGINAL ARTICLE
Breast

Deep Inferior Epigastric Perforator Flap Breast Reconstruction in Patients With or Without Previous Abdominal Surgery: A Systemic Review and Meta-analysis

Gauthier Zinner, MS
Jérôme Martineau, MD
Carlo M. Oranges, MD, PhD

Background: The deep inferior epigastric perforator (DIEP) flap is now considered the gold standard for autologous breast reconstructions (BRs). Previous abdominal surgery (PAS) is considered to be a potential contraindication to abdominal-based BR. This systematic review and meta-analysis aim to evaluate the impact of PAS following a DIEP flap BR comparing patients with or without PAS.
Methods: A systematic review of the literature and comparative meta-analysis were performed to assess the differences in abdominal donor-site and flap complication rates between patients with or without PAS. Only comparative studies that reported on postoperative complications following DIEP flap BR were included. Odds ratios and 95% confidence intervals were calculated using a random-effects model.
Results: Nine studies were included, representing 2440 patients with or without PAS corresponding to 3082 DIEP flap BR. There were no differences across groups in flap-related complication rates. However, PAS was associated with an increase in the overall rate of abdominal complications (odds ratio = 1.92; 95% confidence interval = 1.41–2.62; $P < 0.0001$).
Conclusions: PAS is not a contraindication to DIEP flap BR, and no increase in the flap complication rate has been found in association with PAS. However, our study shows that PAS is associated with a higher overall abdominal complication rate at the donor site. *(Plast Reconstr Surg Glob Open 2025;13:e6701; doi: 10.1097/GOX.0000000000006701; Published online 15 April 2025.)*

INTRODUCTION

The deep inferior epigastric perforator (DIEP) flap is widely regarded as the gold standard for autologous breast reconstruction (BR), offering numerous advantages, such as preservation of abdominal muscle function, favorable postoperative recovery, and a natural appearance and feel of the reconstructed breast.[1–6] However, many patients undergoing DIEP flap reconstruction have had previous abdominal surgery (PAS), which may pose challenges for reconstructive surgeons.[7] PAS can potentially compromise vascular integrity in both the flap and the abdominal wall, increasing the risk of donor-site and flap-related complications.[7–9]

The literature on the impact of PAS in DIEP flap reconstructions is varied. Although some studies report no significant increase in complication rates, leading many to no longer view PAS as a contraindication except in cases of previous abdominoplasty or liposuction, others suggest a heightened risk.[2,10,11] However, most existing studies are limited by small sample sizes and retrospective designs. Only 1 meta-analysis, by Bond et al,[12] explored complications at the donor-site or flap-related complications, finding a significant increase in delayed wound healing in patients with a PAS, although it included all types of autologous reconstructions.

Given the lack of studies specifically addressing the impact of PAS on DIEP flap reconstructions, we conducted this systematic review and meta-analysis to directly compare flap and abdominal complication rates in patients with and without PAS. Our goal is to provide surgeons with evidence-based insights for selecting the most suitable reconstruction approach for patients with PAS.

From the Department of Plastic, Reconstructive, and Aesthetic Surgery, Geneva University Hospitals, Geneva University, Geneva, Switzerland.

Received for publication November 20, 2024; accepted February 27, 2025.

DOI: 10.1097/GOX.0000000000006701

Disclosure statements are at the end of this article, following the correspondence information.

PATIENTS AND METHODS

A systematic review of PubMed, Embase, and Cochrane Library was conducted according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines on October 20, 2024.[13] The study protocol was prospectively registered on PROSPERO (registration ID: CRD42024596824). A combination of keywords synonyms of "deep inferior epigastric perforator flap" and "previous abdominal surgery," linked with Boolean operators were used to develop a search strategy across different databases (Table 1).

Article Selection

Before starting the review process, inclusion and exclusion criteria were defined according to the Population, Intervention, Comparison, Outcome, and Study (PICOS) design process (Table 2). This systematic review and meta-analysis included retrospective and prospective comparative studies comparing adult female patients who underwent DIEP flap reconstructions with or without PAS. Studies evaluating other types of BRs, such as transverse rectus abdominis muscle flap reconstructions, latissimus dorsi flaps, or implant-based reconstructions, were excluded. The primary outcome was to evaluate DIEP flap and abdominal donor-site postoperative complication rates. Studies that did not report the primary outcome were excluded. Case series, case reports, systematic reviews, meta-analyses, letters, and conference abstracts were excluded. Only English articles were included. Articles obtained from the search query were processed using Rayyan (https://www.rayyan.ai/; accessed October 20, 2024) to enable independent and blind screening by 2 authors (G.Z. and J.M.).[14] Initially, articles were screened by title and abstract, and in cases of divergent opinions, the senior author (C.M.O.) was consulted to resolve the discrepancies. Selected articles were then fully read, and those that met the inclusion criteria were added to a standardized spreadsheet file.

Data Extraction and Outcome Definition

Data on study characteristics and clinical outcomes were gathered independently by 2 authors (G.Z. and J.M.) and compiled into an Excel spreadsheet (version 16.30, Microsoft Corp., Redmond, WA). The results were subsequently cross-referenced to detect any discrepancies in reporting. Data compilation included demographic information, intraoperative characteristics, and flap and abdominal outcomes. Flap complications included total and partial flap loss and fat necrosis. Abdominal complications included seroma, hematoma, infection, wound dehiscence, abdominal bulge, and hernia. To be eligible for inclusion in the meta-analysis, a complication had to be reported in at least 3 articles. Complications associated with the flap were recorded on a per-breast basis, whereas abdominal complications were recorded on a per-patient basis.

Takeaways

Question: How does previous abdominal surgery (PAS) impact flap-related and abdominal donor-site complications after a deep inferior epigastric perforator (DIEP) flap breast reconstruction (BR)?

Findings: This comparative meta-analysis including 9 studies, representing 3082 DIEP flaps BR in 2440 patients, shows that there were no differences across groups in flap-related complication rates. However, PAS was associated with an increase in abdominal complication rate.

Meaning: PAS is not a contraindication to DIEP flap BR. However, PAS is associated with a higher donor-site complication rate.

Statistical Analysis

Data were analyzed for a comparative meta-analysis using Review Manager 5.4.1 software (The Cochrane Collaboration, The Nordic Cochrane Center, Copenhagen, Denmark). The Mantel–Haenszel method, a random effects model, was utilized to calculate the pooled odds ratios (ORs) between patients with or without PAS who had undergone DIEP flap BR. Heterogeneity among studies was assessed using the I^2 statistic and the Q statistic P value. An I^2 value of less than 30% was considered indicative of low heterogeneity, whereas values greater than 70% were deemed to represent significant heterogeneity.[15] Comparative outcomes are presented in forest plots illustrating the OR and their respective 95% confidence intervals (CIs). Statistical tests were all 2-sided, and statistical

Table 1. Search Strategy

Key Words	Database	No. Articles
("abdominal scar"/exp OR "abdominal scar" OR (abdominal AND ("scar"/exp OR scar)) OR "previous abdominal surgery" OR (previous AND abdominal AND ("surgery"/exp OR surgery)) OR "past abdominal surgery" OR (past AND abdominal AND ("surgery"/exp OR surgery))) AND ("diep flap"/exp OR "diep flap" OR (diep AND ("flap"/exp OR flap)))	PubMed	158
	Embase	158
	Cochrane Library	11
	Web of Science	210

Table 2. Selection Criteria

PICOS	Inclusion	Exclusion
Population	Adult female patients	Cadaver, animal, or experimental models
Intervention	DIEP flap for BR	Other flaps
Comparator	Patient with or without PAS	—
Outcomes	Flap and/or abdominal donor-site complications	Studies that do not report on flap or abdominal complications
Studies	Comparative, prospective, retrospective studies	Case reports, case series, abstract only, letters, reviews

SIEA, superficial inferior epigastric artery; TRAM, transverse rectus abdominis muscle.

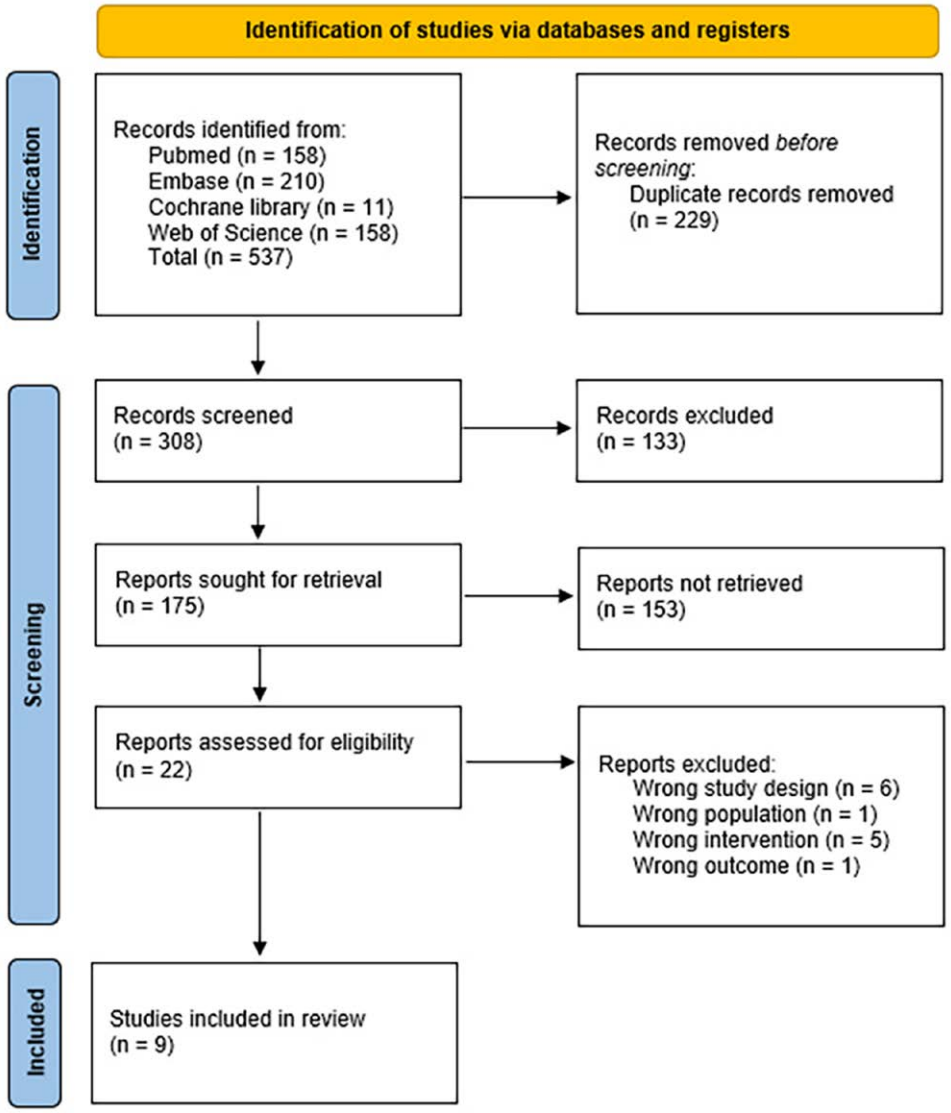

Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram.

significance was defined as a *P* value less than 0.05. The Newcastle-Otawa scale was used to assess the quality of nonrandomized studies included in the meta-analysis, ensuring to highlight study quality and potential biases. A high score (8–9 points) indicated a well-designed study with robust selection, adequate control for confounders, and reliable outcomes providing a low bias risk.

RESULTS

A total of 537 studies were identified through the initial database search (Fig. 1). After removing duplicates and screening titles and abstracts, 22 articles were thoroughly read, resulting in 9 studies that met all inclusion criteria.[1–3,7–9,11,16,17] The included studies were all monocentric and retrospective. A total of 2440 patients representing 3082 DIEP flaps were included in the analyzed studies. These patients were separated into a control group and a study group, which included patients without and with PAS, respectively. The control group comprised 1446 patients, corresponding to 1747 procedures, compared with 994 patients corresponding to 1335 procedures in the study group. The mean age ranged from 44 to 56.6 years in patients with no PAS and from 43.9 to 51.2 years for patients with PAS. The average body mass index (BMI) was reported in 8 studies and ranged from 23 to 28.9 kg/m² in the control group compared with 23.52 to 29.5 kg/m² in the study group. Other demographic characteristics such as active smoker rate, diabetes, or history of radiotherapy (RT) were recorded in Table 3.

Concerning the operative characteristic, the mean flap weight was reported in 5 studies, ranging from 646.2 to 724.9 g in the control group and 527 to 706.3 g in the study group. Reconstruction laterality was reported across all studies, and unilateral reconstruction occurred most of the time, ranging from 53.4% to 100% in the control group compared with 48.7% to 100% in the study group, with only 1 study with most of the bilateral

Table 3. Study and Clinical Characteristics of the Included Studies

	Study Characteristics			Patients			Breast		Demographic Characteristics									
									Age, Mean, y (SD/Range)		BMI, Mean, kg/m² (SD/Range)		Active Smoker		Diabetes		Previous Radiotherapy Treatment	
Authors	Year	Study Period	Study Design	Patients Total	Control Group, n	Study Group, n	Control Group, n	Study Group, n	Control Group	Study Group	Control Group	Study Group	Control Group, n (%)	Study Group, n (%)	Control Group, n (%)	Study Group, n (%)	Control Group, n (%)	Study Group, n (%)
Daly et al[8]	2020	2004–2015	Retrospective monocentric	818	393	425	547	640	51	51	*	*	45 (11.5)	65 (15.3)	13 (3.3)	19 (4.5)	172 (43.8)	158 (37.2)
Doval et al[11]	2018	2010–2016	Retrospective monocentric	358	219	139	321	223	51. 6 (49.8–52.1)	51.2 (49.6–52.5)	28.1 (27.4–28.8)	29.2 (28.3-30.1)	34 (15.6)	24 (17.3)	7 (3.2)	8 (5.8)	110 (50.2)	61 (43.9)
Henry et al[3]	2011	2000–2006	Retrospective monocentric	125	114	11	114	11	44 (36–48)	51 (41–61)	23 (20–26)	25 (24–26)	*	*	*	*	15 (13)	3 (27)
Kim et al[16]	2017	2010–2015	Retrospective monocentric	100	50	50	50	50	44.72	43. 94	23.39	23.52	0 (0)	2 (4)	0 (0)	0 (0)	3 (6)	2 (4)
Laporta et al[1]	2017	2004–2014	Retrospective monocentric	387	280	107	292	111	51.5 (29–75)	52.1 (31–78)	25.8 (19.2–31)	25.2 (19.9–31)	55 (18.8)	30 (27)	*	*	35 (12.5)	15 (14)
Mahajan et al[17]	2012	2006–2009	Retrospective monocentric	72	36	36	45	48	49.5 (33–69)	49.7 (34–73)	24.6 (19.7–33.7)	24.4 (19.7–35.2)	3 (8.3)	3 (8.3)	1 (2.8)	1 (2)	*	*
Nykiel et al[7]	2015	2008–2013	Retrospective monocentric	169	60	109	60	109	49	53	28	29	3 (5)	6 (5.5)	3 (5)	0 (0)	25 (41.7)	46 (42.2)
Parret et al[9]	2008	2004–2006	Retrospective monocentric	168	90	78	114	104	47.5	47.7	26.5	26.6	7 (7.8)	5 (6.4)	*	*	21 (23.3)	22 (28.2)
Yang et al[2]	2022	2014–2020	Retrospective monocentric	243	204	39	204	39	49.7 (10.3)	51.2 (10.5)	28.9 (4.8)	29.5 (4.4)	67 (32.8)	11 (28.2)	13 (6.4)	2 (5.1)	*	*

*Data not reported in the study.

Table 4. Operative Characteristics of the Included Studies

	Operative Characteristics							
	Flap Weight, Mean, g (SD/Interval)		Unilateral, n (%)		Bilateral, n (%)		No. Perforators, Mean (SD/Range)	
Authors	Control Group	Study Group	Control Group	Study Group	Control Group	Study Group	Control Group	Study Group
Daly et al[8]	646.2	693.2	238 (60.6)	208 (48.7)	155 (39.5)	217 (51.3)	2.4	2
Doval et al[11]	676.6 (641.5–714.6)	706.3 (659.2–755.6)	117 (53.4)	55 (39.6)	102 (46.6)	84 (60.4)	*	*
Henry et al[3]	*	*	114 (100)	11 (100)	0 (0)	0 (0)	1.8 (1–2.6)	1.6 (1.1–2.1)
Kim et al[16]	*	*	50 (100)	50 (100)	0 (0)	0 (0)	2.8	2.52
Laporta et al[1]	724.9 (410–1150)	583.1 (220–900)	274 (97.9)	103 (96.3)	6 (2.1)	4 (3.7)	1.9	1.9
Mahajan et al[17]	472.5 (164–1047)	527 (278–1100)	27 (75)	24 (66.7)	9 (25)	12 (33.3)	9.1 (5–16)	8.3 (3–15)
Nykiel et al[7]	*	*	60 (100)	109 (100)	0 (0)	0 (0)	*	*
Parret et al[9]	659	670	66 (57.9)	52 (50)	48 (42.1)	52 (50)	*	*
Yang et al[2]	*	*	204 (100)	39 (100)	0 (0)	0 (0)	*	*

*Data not reported in the study.

Table 5. Previous Abdominal Surgical Procedures

	Surgical Procedures					
Authors	Laparoscopy, n (%)	Midline Laparotomy, n (%)	Appendicetomy, n (%)	Subcostal Incision, n (%)	Paramedian Incision, n (%)	Cesarean Section, n (%)
Daly et al[8]	*	*	*	*	*	*
Doval et al[11]	103 (35.4)	46 (15.8)	20 (6.9)	4 (1.4)	2 (0.7)	116 (39.9)
Henry et al[3]	0 (0)	11 (100)	0 (0)	0 (0)	0 (0)	0 (0)
Kim et al[16]	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	50 (100)
Laporta et al[1]	15 (12.5)	11 (9.2)	31 (25.9)	32 (26.7)	0 (0)	52 (43.3)
Mahajan et al[17]	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	36 (100)
Nykiel et al[7]	*	*	*	*	*	*
Parret et al[9]	18 (19.4)	13 (14)	12 (12.9)	3 (3.2)	2 (2.2)	45 (48.4)
Yang et al[2]	0 (0)	39 (100)	0 (0)	0 (0)	0 (0)	0 (0)

*Data not reported in the study.

reconstruction performed in the study group (9). Regarding the mean number of perforators, 5 studies recorded it, with 1.8–9.1 perforators in the control group and 1.6–8.3 perforators in the study group (Table 4). Seven studies report on the type of previous surgical procedure. Among the studies reporting on operation type, cesarean sections accounted for the majority of procedures in all studies, with 299 operations in total (65% of patients), followed by laparoscopic procedures and midline laparotomy with 136 (29.6%) and 113 (24.6%) operations, respectively (Table 5). Our analysis using the Mantel–Haenszel method with a random effect indicated that the overall abdominal complication rate was higher in the study group (OR = 1.92; 95% CI = 1.41–2.62; $P < 0.0001$) (Fig. 2).

However, when analyzing the complication rates of the different flap complications, including fat necrosis (OR = 1.11; 95% CI = 0.78–1.58; $P = 0.55$), partial flap loss (OR = 1.10; 95% CI = 0.67–1.80; $P = 0.71$), and total flap loss (OR = 0.93; 95% CI = 0.37–2.35; $P = 0.87$), no difference was observed between the control and study groups (Fig. 3). Similarly, the rate of the different abdominal complications, including seroma (OR = 1.06; 95% CI = 0.53–2.14; $P = 0.87$), hematoma (OR = 0.24; 95% CI = 0.04–1.38; $P = 0.11$), infection (OR = 1.17; 95% CI = 0.68–2.02; $P = 0.56$), wound dehiscence (OR = 1.31; 95% CI = 0.79–2.15; $P = 0.29$), abdominal bulge (OR = 1.34; 95% CI= 0.71–2.54; $P = 0.37$), and abdominal hernia (OR = 3.59; 95% CI = 0.93–13.95; $P = 0.06$), show no significant difference when comparing control and study groups.

To interpret the quality and reliability of each study included in our meta-analysis, the Newcastle-Otawa scale was performed. All studies had a high score (8–9 points) except the studies by Doval et al[11] and Henry et al[3] which presented a score of 7, reflecting a generally sound study but with some limitations in control of confounders or follow-up completeness (Table 6).

DISCUSSION

In the field of BR, the DIEP flap is recognized as the gold standard of autologous reconstruction, offering well-vascularized tissue with a secure vascular anatomy, while providing low donor-site morbidity.[17–19] Over the years, technical advances have steadily reduced the number of contraindications to DIEP flap BR. Once considered a contraindication, PAS now represents a challenge.[19] Indeed, PAS may increase the risk of abdominal wall weakness; reduce the amount of tissue available; create adhesions, hence potentially making flap dissection complex; and alter abdominal vascularization.[10,20,21]

Few studies have specifically compared complication rates between patients undergoing DIEP flap BR with and without PAS, despite a significant number of patients in the population having PAS.[1,9] Most of these studies are retrospective in design, and only 1 meta-analysis on this

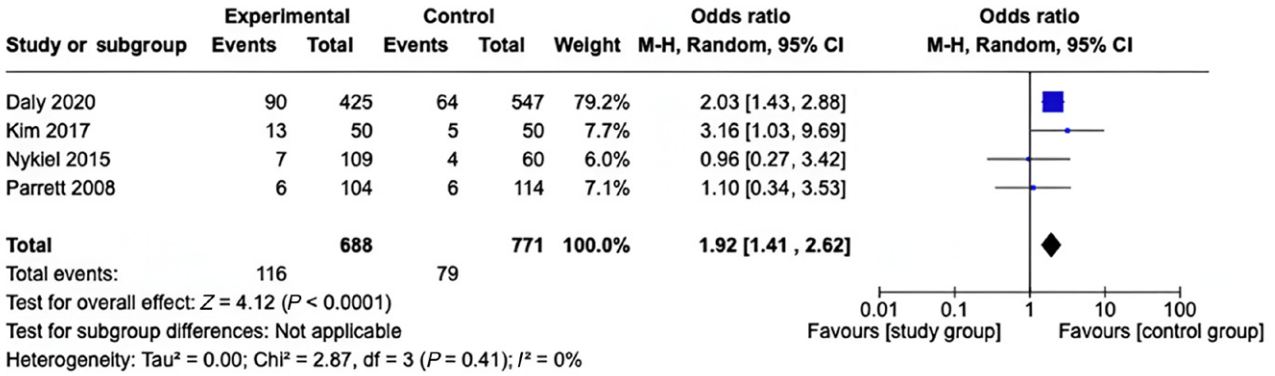

Fig. 2. Forest plot of overall abdominal donor-site complication rate. M-H, Mantel–Haenszel.

subject exists.[12] However, this meta-analysis includes BRs using DIEP, superficial inferior epigastric artery, or transverse rectus abdominis muscle flaps. We, therefore, conducted this study to specifically assess the impact of PAS on flap or abdominal complications following a DIEP flap BR.

Many risk factors for potential abdominal complications of the flap are well established as sources, such as age, BMI, hypertension, diabetes, and RT, and some authors also mention PAS as a risk factor.[22] In this study, we collected demographic characteristics to rule out confounding factors in our analysis. Indeed, a high BMI or diabetes is associated with postoperative complications after autologous BR, notably with donor-site abdominal complications.[11,23–25] Smoking is also well known to negatively impact tissue perfusion, clinically reflected by an increased rate of delayed healing, wound dehiscence, flap complications, and reoperation both at the recipient site and the donor site.[11,26] Similarly, neoadjuvant RT also harms tissue vascularization, leading to impaired healing.[27] The 9 studies included in our meta-analysis had similar demographic characteristics, except for the study by Henry et al,[3] which showed an older population in the study group, with a mean age of 51 years (41–61 y), compared with a mean age of 44 years (36–52 y) in the control group.

Regarding operative data, we collected the number of perforators, the rate of unilateral and bilateral reconstruction, and the weight of the flap. Except for the Daly et al[8] study, which showed a significantly higher rate of bilateral reconstruction in the study group (51.3% versus 39.5% in the control group), we did not find any potential confounding difference. Indeed, a higher flap weight seems to be associated with an increased risk of wound dehiscence at the donor site, particularly when the flap exceeds a weight of 667.5 g, according to some authors.[1,11,28,29] Regarding bilateral reconstructions, Wormald et al[30] conducted a systematic review in which they observed a significantly higher rate of total flap failure compared with unilateral BR using DIEP-type flaps and a similar abdominal donor-site complication rate.

In terms of flap complications, however, our meta-analysis showed no difference between patients who had or had not undergone PAS. We observed no significant difference between the 2 groups in terms of total or partial flap loss, and the rate of fat necrosis (Fig. 3). Some authors such as Chang[19] observed in their multivariate analysis an association between a history of gynecological surgery and an increased risk of flap complication during a DIEP flap BR. Numerous other studies have found results similar to ours, confirming that PAS was not associated with a greater risk of flap complications.[9,12,18,20,22,24,31] We can, therefore, affirm that PAS is not a significant risk factor for flap complications during DIEP flap BR. However, some smaller, underpowered studies observed an increase in certain flap-related complications. For instance, Khansa et al[32,33] found a 14.9% rate of fat necrosis in the PAS group, significantly higher than the 10.4% rate in their control group. Furthermore, the risk of fat necrosis is strongly associated with inadequate arterial perfusion or venous drainage, which may be linked to several factors, such as smoking, larger flap size, or perforator choice.[8,16,17,33] Similarly, the risk of partial or total flap loss seems to be more closely associated with a higher BMI or smoking, according to various studies.[23,27]

Our study revealed greater overall abdominal complications in patients with PAS, with an OR of 1.92. Conversely, we observed no statistically significant differences in the rate of hematoma, seroma, infection, wound dehiscence, abdominal bulge, or abdominal hernia (Fig. 2). Similar findings are found in the literature on the overall abdominal complication rate following BR using an abdominal flap.[1,8,9,18,19,34] Our meta-analysis, therefore, increases the level of evidence for the link between PAS and abdominal complication rate following DIEP flap BR. This may be explained by a variety of factors, including altered abdominal vascularity following abdominal or gynecological surgery.[8,16,31] Several studies have investigated the abdominal vascular network radiologically following abdominal surgery, using computed tomography scans. These found significant changes in the total number of communications between the superficial and deep venous network and between the superficial inferior epigastric vein and DIEP venae, as well as in the size of perforators, which were greater. However, the number of perforators does not seem to be affected by PAS.[16,21,31] Some authors even suggest potential protection against fat necrosis at the flap level due to larger caliber perforators and better venous drainage.[16]

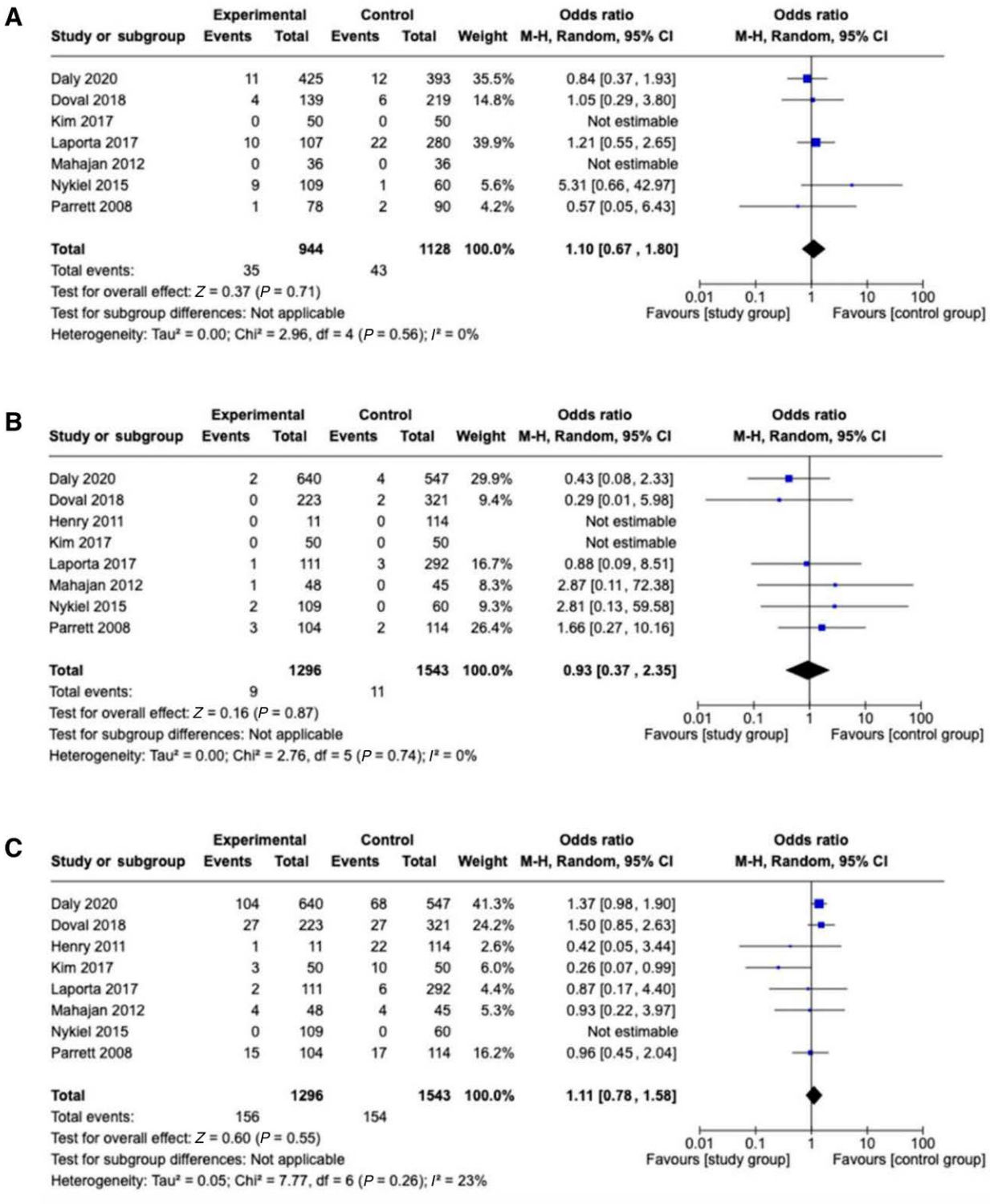

Fig. 3. Forest plot of flap complications. A, Partial flap loss. B, Total flap loss. C, Fat necrosis. M-H, Mantel–Haenszel.

Others go even further, asserting that the density of the flap's microvascularization would be increased, although a delay between abdominal surgery and BR would be necessary for the angiogenesis process to be complete.[1,35] On the other hand, after abdominal surgery, the skin's vascular network adopts a random pattern via collaterals that may affect healing.[7,12] Bond et al[12] observed a donor-site healing delay in patients with Pfannenstiel scars compared with the control group, although their study included several types of abdominal flap, unlike ours. Another frequently cited factor is the location of scars, which can lead to the formation of adhesions, making flap harvesting more complex.[17]

Table 6. Newcastle-Ottawa Scale

Studies	Selection (4)	Comparability (3)	Outcomes (3)	Total (9)
Daly et al[8]	2	2	3	9
Doval et al[11]	4	1	2	7
Henry et al[3]	4	1	2	7
Kim et al[16]	4	2	2	8
Laporta et al[1]	4	1	3	8
Mahajan et al[17]	4	2	2	8
Nykiel et al[7]	4	2	2	8
Parret et al[9]	4	1	3	9
Yang et al[2]	4	1	3	9

Several studies describe a higher rate of abdominal complications in patients with scars in the subcostal region.[17,36] For this reason, some authors have proposed modifications to the flap design in the presence of PAS, with algorithms based on the location of scars.[7,9] Others also suggest a careful assessment of abdominal vascularity using arterial computed tomography scan, especially when a scar crosses the midline, to assess vascular anatomy, adapt flap design accordingly, and reduce operative time.[2,20,24,34,37,38]

Our study has some limitations. Some of the included studies, although comparing a DIEP BR flap in patients with and without PAS, focused on studying the consequences of PAS on the abdominal vascular network. It should also be noted that the various studies rarely reported the timing of reconstruction and include patients undergoing different surgical procedures resulting in scars of different locations. Further research is needed to evaluate the impact of each procedure specifically, as well as the ideal timing between PAS and reconstruction, which could impact surgical outcomes. Nevertheless, in view of the results of previous research, our study offers a high level of evidence regarding outcomes in patients with a DIEP flap BR with or without PAS. It demonstrates that although PAS increases the rate of abdominal complication at the donor site, it does not increase the rate of flap complication. These results provide surgeons with an additional tool for planning and counseling patients with PAS.

CONCLUSIONS

In conclusion, our systematic review and meta-analysis show that PAS is not a contraindication to DIEP flap BR. The flap complication rate was not higher in patients with PAS undergoing DIEP flap BR. However, patients with PAS should be informed that the risk of overall donor-site abdominal complications is increased.

Carlo M. Oranges, MD, PhD
Department of Plastic, Reconstructive, and Aesthetic Surgery
Geneva University Hospitals, Geneva University
Gabrielle Perret-Gentil 4
1205 Geneva, Switzerland
E-mail: carlo.oranges@hug.ch

DISCLOSURE

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

REFERENCES

1. Laporta R, Longo B, Sorotos M, et al. Tips and tricks for DIEP flap breast reconstruction in patients with previous abdominal scar. *Microsurgery*. 2017;37:282–292.
2. Yang JH, Colakoglu S, Mureau MAM, et al. Midline epigastric scars can be associated with higher umbilical complications following DIEP flap harvest. *J Plast Reconstr Aesthet Surg*. 2022;75:1826–1832.
3. Henry SL, Chang CC, Misra A, et al. Inclusion of tissue beyond a midline scar in the deep inferior epigastric perforator flap. *Ann Plast Surg*. 2011;67:251–254.
4. Tanas Y, Tanas J, Swed S, et al. A meta-analysis comparing deep inferior epigastric perforator flaps and latissimus dorsi flaps in breast reconstruction. *Plast Reconstr Surg Glob Open*. 2024;12:e6206.
5. Martineau J, Kalbermatten DF, Oranges CM. Safety and efficacy of the superior gluteal artery perforator (SGAP) flap in autologous breast reconstruction: systematic review and meta-analysis. *Cancers*. 2022;14:4420.
6. Alves AS, Tan V, Scampa M, et al. Complications of immediate versus delayed DIEP reconstruction: a meta-analysis of comparative studies. *Cancers*. 2022;14:4272.
7. Nykiel M, Hunter C, Lee GK. Algorithmic approach to the design and harvest of abdominal flaps for microvascular breast reconstruction in patients with abdominal scars. *Ann Plast Surg*. 2015;74:S33–S40.
8. Daly LT, Doval AF, Lin SJ, et al. Role of CTA in women with abdominal scars undergoing DIEP breast reconstruction: review of 1,187 flaps. *J Reconstr Microsurg*. 2020;36:294–300.
9. Parrett BM, Caterson SA, Tobias AM, et al. DIEP flaps in women with abdominal scars: are complication rates affected? *Plast Reconstr Surg*. 2008;121:1527–1531.
10. Bond ES, Soteropulos CE, Poore SO. The impact of abdominal liposuction on abdominally based autologous breast reconstruction: a systematic review. *Arch Plast Surg*. 2022;49:324–331.
11. Doval AF, Lamelas AM, Daly LT, et al. Deep inferior epigastric artery perforator flap breast reconstruction in women with previous abdominal incisions: a comparison of complication rates. *Ann Plast Surg*. 2018;81:560–564.
12. Bond ES, Soteropulos CE, Yang Q, et al. The impact of prior abdominal surgery on complications of abdominally based autologous breast reconstruction: a systematic review and meta-analysis. *J Reconstr Microsurg*. 2021;37:566–579.
13. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71.
14. Ouzzani M, Hammady H, Fedorowicz Z, et al. Rayyan—a web and mobile app for systematic reviews. *Syst Rev*. 2016;5:210.
15. Higgins JPT, Thompson SG. Quantifying heterogeneity in a meta-analysis. *Stat Med*. 2002;21:1539–1558.
16. Kim SY, Lee KT, Mun GH. The influence of a Pfannenstiel scar on venous anatomy of the lower abdominal wall and implications

for deep inferior epigastric artery perforator flap breast reconstruction. *Plast Reconstr Surg.* 2017;139:540–548.
17. Mahajan AL, Zeltzer A, Claes KEY, et al. Are Pfannenstiel scars a boon or a curse for DIEP flap breast reconstructions? *Plast Reconstr Surg.* 2012;129:797–805.
18. Ngaage LM, Hamed R, Oni G, et al. The role of CT angiography in assessing deep inferior epigastric perforator flap patency in patients with pre-existing abdominal scars. *J Surg Res.* 2019;235:58–65.
19. Chang EI. Evaluation of free DIEP flap complications in the setting of previous gynecological operations. *Microsurgery.* 2023;43:437–443.
20. Di Candia M, Asfoor AA, Jessop ZM, et al. Previous multiple abdominal surgeries: a valid contraindication to abdominal free flap breast reconstruction?. *Eplasty.* 2012;12:e31.
21. Niumsawatt V, Chow K, Shen XY, et al. The Pfannenstiel scar and its implications in DIEP flap harvest: a clinical anatomic study. *Eur J Plast Surg.* 2016;39:41–48.
22. Gill PS, Hunt JP, Guerra AB, et al. A 10-year retrospective review of 758 DIEP flaps for breast reconstruction. *Plast Reconstr Surg.* 2004;113:1153–1160.
23. Wu SS, Raymer C, Culbert A, et al. Predictors of complications in autologous breast reconstruction using deep inferior epigastric perforator flaps: implications for management. *Plast Reconstr Surg.* 2023;152:566–577.
24. Chung JH, Yeo HD, Jung SP, et al. The effect of previous scar on breast reconstruction using abdominal flap: a retrospective analysis of 122 consecutive cases and a strategy to reduce complication rates. *Gland Surg.* 2021;10:1598–1608.
25. Zinner G, Martineau J, Lam GT, et al. Postoperative outcomes in prepectoral versus retropectoral immediate implant-based breast reconstruction across body mass index categories. *Plast Reconstr Surg Glob Open.* 2025;13:e6425.
26. Prantl L, Moellhoff N, Fritschen UV, et al. Impact of smoking status in free deep inferior epigastric artery perforator flap breast reconstruction: a multicenter study. *J Reconstr Microsurg.* 2020;36:694–702.
27. Prantl L, Moellhoff N, Von Fritschen U, et al. Effect of radiation therapy on microsurgical deep inferior epigastric perforator flap breast reconstructions: a matched cohort analysis of 4577 cases. *Ann Plast Surg.* 2021;86:627–631.
28. Lam G, Weichman K, Reavey P, et al. Analysis of flap weight and postoperative complications based on flap weight in patients undergoing microsurgical breast reconstruction. *J Reconstr Microsurg.* 2016;33:186–193.
29. Rubino C, Ramakrishnan V, Figus A, et al. Flap size/flow rate relationship in perforator flaps and its importance in DIEAP flap drainage. *J Plast Reconstr Aesthet Surg.* 2009;62:1666–1670.
30. Wormald JCR, Wade RG, Figus A. The increased risk of adverse outcomes in bilateral deep inferior epigastric artery perforator flap breast reconstruction compared to unilateral reconstruction: a systematic review and meta-analysis. *J Plast Reconstr Aesthet Surg.* 2014;67:143–156.
31. Unukovych D, Gallego CH, Aineskog H, et al. Predictors of reoperations in deep inferior epigastric perforator flap breast reconstruction. *Plast Reconstr Surg Glob Open.* 2016;4:e1016.
32. Khansa I, Momoh AO, Patel PP, et al. Fat necrosis in autologous abdomen-based breast reconstruction: A systematic review. *Plast Reconstr Surg.* 2013;131:443–452.
33. Peeters WJ, Nanhekhan L, Van Ongeval C, et al. Fat necrosis in deep inferior epigastric perforator flaps: an ultrasound-based review of 202 cases. *Plast Reconstr Surg.* 2009;124:1754–1758.
34. Hsieh F, Kumiponjera D, Malata CM. An algorithmic approach to abdominal flap breast reconstruction in patients with pre-existing scars—results from a single surgeon's experience. *J Plast Reconstr Aesthet Surg.* 2009;62:1650–1660.
35. Farid M, Nicholson S, Kotwal A, et al. DIEP breast reconstruction following multiple abdominal liposuction procedures. *Eplasty.* 2014;14:e47.
36. Voineskos SH, Frank SG, Cordeiro PG. Breast reconstruction following conservative mastectomies: predictors of complications and outcomes. *Gland Surg.* 2015;4:484–496.
37. Teunis T, Van Voss MRH, Kon M, et al. CT-angiography prior to diep flap breast reconstruction: a systematic review and meta-analysis. *Microsurgery.* 2013;33:496–502.
38. Chang CC, Huang JJ, Wu CW, et al. A strategic approach for DIEP flap breast reconstruction in patients with a vertical midline abdominal scar. *Ann Plast Surg.* 2014;73:S6–11.