

Indocyanine Green Angiography for Detecting Quantitative Perfusion Changes in DIEP Flap Breast Reconstruction with Second Venous Drainage

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Introduction

- In DIEP flap breast reconstruction (BR), **venous congestion** has emerged as a common complication, with an incidence as high as 15% → increases the risk of flap loss and fat necrosis²⁻⁴
- A retrospective study of 564 DIEP flaps showed that creating **two venous anastomoses significantly reduced the incidence of venous congestion** from 2.6% to 0.0% (p<0.01)⁵
- Yoshimatsu et al. showed that using intraoperative indocyanine green videoangiography (ICG-VA) accurately reveals flap congestion and ischemia⁶
- There is currently a **lack of quantitative understanding regarding the changes in flap perfusion after the creation of a second venous anastomosis**

Objective

To compare the perfusion dynamics of a DIEP flap before and after the creation of a second venous anastomosis between the superficial inferior epigastric vein (SIEV) and the retrograde internal mammary vein (IMV)

Methods

- A single-institution prospective cohort study of patients undergoing DIEP flap BR with second venous anastomosis between January 2023 to June 2023 was conducted
- DIEP flap perfusion was evaluated using ICG-VA (1) after the initial venous anastomosis and (2) following the creation of the second venous anastomosis (20 minutes after the first assessment)
- Regions of interest (ROI):** (1) directly above the perforators displaying the highest intensity (**complete perfusion zone**); (2) most distal lateral edge of the flap, where perfusion was present but not at maximal intensity (**partial perfusion zone**); and (3) area exhibiting the next lowest intensity compared to the rest (**ischemic zone**)
- For quantitative analysis, videos were fed into **ImageJ**⁶

Results

A total of 7 patients (n=10 breasts) underwent DIEP reconstruction, analyzed using ICG-VA.

Preoperative Characteristics

- Mean age was 54.5±12.4 years
- Mean BMI was 27.6±3.4 kg/m²
- Mean CCI was 5.7±3.1
- 5 (71.4%) patients underwent chemotherapy and 2 (28.6%) underwent radiation preoperatively

Operative Details

- Most breasts underwent delayed reconstruction (n=8, 80.0%)
- Mean flap weight was 503.4±129.1 g
- Mean operative and ischemia duration were 575.5±172.6 and 67.6±22.0 minutes, respectively
- Donors included **DIEV** (n=10, 100.0%), **SIEV** (n=9, 90.0%), and **SCIV** (n=1, 10.0%). All DIEVs were anastomosed to the **antegrade IMV** (n=10, 100.0%). SIEVs were anastomosed to the **retrograde IMV** (n=10, 100.0%). The SCIV was anastomosed to the retrograde IMV (n=1, 100.0%).
- Mean coupler sizes for DIEVs, SIEVs, and SCIV were 2.8±0.3 mm, 2.2±0.6 mm, and 2.5 mm, respectively
- Mean hospital length of stay was 1.6±0.5 days**

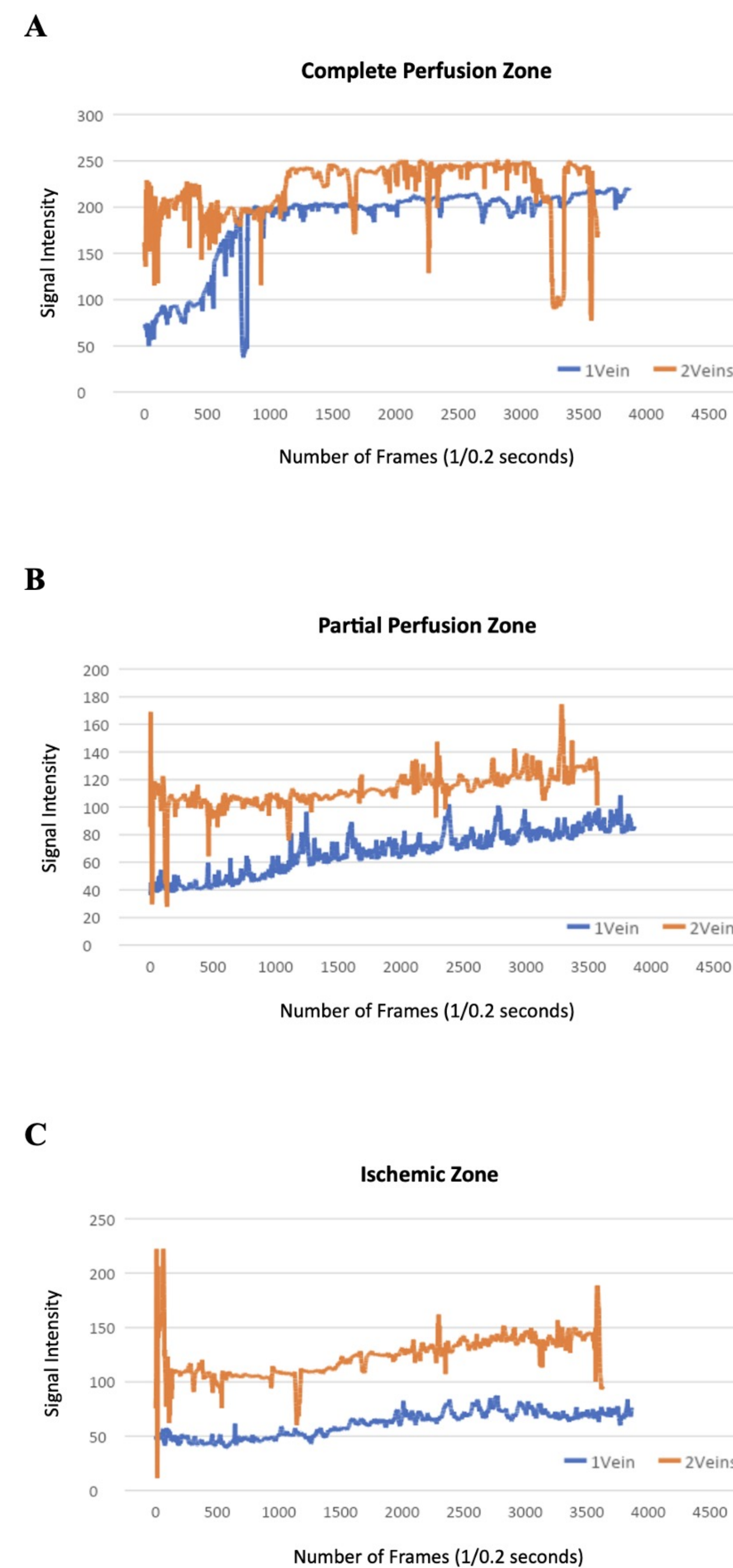


Figure 1. A, B, and C are graphs of complete perfusion, partial perfusion, and ischemic zones identified, respectively.

Table 1. Mean Peak Intensities by ROIs

Zone	One Vein	Two Veins	p-value
Complete Perfusion	160.7±42.1	188.2±42.1	0.163
Partial Perfusion	100.8±21.5	152.0±31.5	<0.001
Ischemic	90.4±37.4	143.4±45.3	0.012

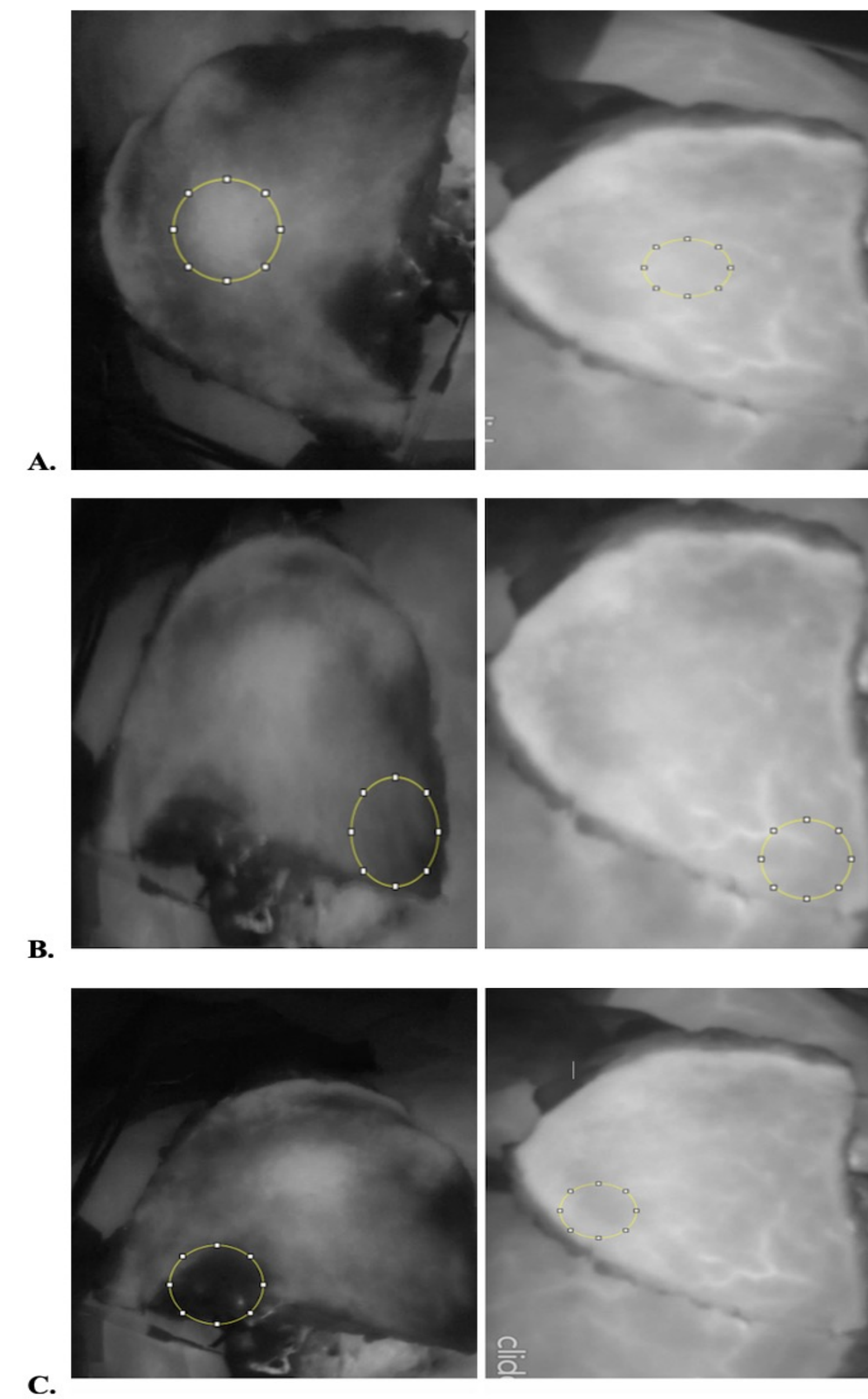


Figure 2. A, B, and C are complete perfusion, partial perfusion, and ischemic zones, respectively. The images on the left were taken after first venous anastomosis, and images on the right were taken after second venous anastomosis (≥20 minutes after first venous anastomosis).

Discussion

- The **super drainage technique enhanced ICG illumination in previously inadequate drained areas**, improving overall DIEP flap perfusion
- ICG-VA advantages include immediate visualization of flap perfusion dynamics, non-invasiveness, high sensitivity and specificity, ability for quantitative analysis, and cost-effectiveness
- In our institution, **we use two veins for the DIEP flap**, one in an antegrade and the other in a retrograde fashion → **provides a backup blood supply in case of clot formation and improves perfusion in less well-drained areas of the flap** → no longer use ViOptix, stop leaving skin paddles for monitoring, or using Cook-Swart Dopplers; patients can be discharged 1-2 days post-DIEP flap BR
- Improved flap perfusion following the addition of a second venous drainage was **not likely due to constricted choke veins** that might have opened later
- This study has several **limitations**: 1) single-institution, 2) definition of perfusion zones solely on initial expectations, and 3) mean follow-up duration of 2.6 months

Conclusion

This study demonstrates the **positive impact of incorporating a second venous anastomosis in DIEP flap BR**, as assessed by ICG-VA. These findings highlight the potential benefits of the **super drainage technique in enhancing perfusion and reducing complications**, emphasizing the need for further investigation and consideration of this technique in clinical practice.

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