Clinics in Surgery

Research Article
Published: 16 Oct, 2023

Supercharging DIEP Flaps Using Contralateral Superficial Inferior Epigastric Vein Grafts

Pereira G, Ribeiro D, Saraiva L and Freitas H*

Department of Plastic Surgery, Centro Hospitalar Universitário Lisboa Norte, Portugal

Abstract

Introduction: Venous congestion, even with a patent deep venous anastomosis, can afflict some DIEP (Deep Inferior Epigastric Perforator) flaps and various techniques of superficial venous supercharging have been described, although the indications for its use are not consensual. The main goal of this study is to confirm that superficial venous supercharge of DIEP flaps, utilizing the contralateral Superficial Inferior Epigastric Vein (SIEV) as an interposition vein graft, is feasible and functional.

Materials and Methods: We retrospectively reviewed all DIEP flap breast reconstruction patients treated at our institution between June 2016 and December 2017 and that met all the inclusion criteria: Unilateral breast reconstruction with a DIEP flap; flap weighing more than 750 gm; supercharging of the ipsilateral superficial venous system; contralateral SIEV interposition graft; implantable doppler probe in the superficial system for at least 5 days. In the technique described here, the contralateral SIEV graft was harvested and anastomosed to the ipsilateral SIEV, obtaining this way a long vein that easily reaches the recipient vein (distal end of the Internal Mammary Vein - IMV). A Doppler probe was implanted in the superficial system, for at least 5 postoperative days, to monitor the function of this supercharging. We also analyzed the patient's history, flaps weight, number and perforator rows, recipient vessels, SIEV graft length and diameter and all perioperative complications.

Results: Ten patients met all inclusion criteria. They were treated using this technique and analyzed. Two patients had some type of alteration of the Doppler signal and clinical signs of venous congestion. They were surgically revised with success and were analyzed in detail. No total or partial flap failures were found. Clinical fat necrosis was also absent.

Conclusion: This technique seems to be feasible, functional and adds an extra length to ipsilateral SIEV to reach a recipient vein. This way, the flap inset is not compromised by a short SIEV. No further significant morbidity is added for SIEV harvest that is in the same operative field, unlike the saphenous or cephalic veins. In selected patients, it could be an alternative supercharging technique.

Keywords: Mastectomy; Microsurgery; Free tissue flaps; Vascular grafting

OPEN ACCESS

Correspondence:
Gustavo Neves Pereira, Department of Plastic Surgery, Centro Hospitalar Universitário Lisboa Norte, Av. Egas Moniz, Lisboa, Portugal

Received Date: *20 Sep 2023*
Accepted Date: *09 Oct 2023*
Published Date: *16 Oct 2023*

Citation:
Pereira G, Ribeiro D, Saraiva L, Freitas H. Supercharging DIEP Flaps Using Contralateral Superficial Inferior Epigastric Vein Grafts. Clin Surg. 2023; 8: 3667.

Introduction

Microsurgical autologous breast reconstruction after mastectomy has been recognized as one of the best methods of reconstruction in the last two decades. The lower abdominal area is one of the favorite donor sites because of the excess of skin and fat with a consistency similar to the breast and is suitable in most patients. Among all types of lower abdominal flaps, the Deep Inferior Epigastric Perforator (DIEP) flap has become the most popular because of its reliability and low morbidity of the abdominal wall [1-6]. However venous congestion can afflict some of these flaps, even with a patent venous anastomosis [4,7-9] and numerous techniques have been described to overcome this problem [10,11]. Here the author reviews his technique of superficial venous supercharging DIEP flaps in unilateral breast reconstruction with Superficial Inferior Epigastric Vein (SIEV) interposition grafts. We used it prophylactically and not in congested flaps as the main goal of the study is the confirmation that superficial venous supercharge through a SIEV graft is functional.

Materials and Methods

We retrospectively review all patients treated in Hospital de Santa Maria-Lisbon, by the same senior author (Freitas H) between June 2016 and December 2017 that meet the following inclusion criteria:

- Unilateral breast reconstruction
- DIEP flap breast reconstruction
- Flaps weighing more than 750 gm
- Venous supercharging of the ipsilateral superficial system
- Contralateral SIEV interpositional grafts (to the venous supercharging).

Written informed consent was obtained from all the patients included in this article. The patient's age, significant comorbidities, time of reconstruction (immediate, delayed or tertiary after implant failure) and past breast irradiation were analyzed. All active smokers were asked to quit smoking 6 weeks before surgery. Surgical charts were also reviewed with respect to the flap's weight (before in setting), number and perforator rows, recipient vessels, SIEV graft length and diameter. All perioperative complications were also analyzed. Clinical examination (color, turgor, capillary refill and pinprick test) of the flaps was done every 2 h for the first 48 h and then every 4 h. All patients had an implantable Doppler probe for monitoring the supercharged recipient vein for at least 5 postoperative days. This ultrasound device was also implanted in the deep vein in 3 patients. In the fourth month, all patients had a clinical evaluation by two plastic surgeons to analyze the softness of the breast and detect any potential areas of induration or nodules related to fat necrosis.

Surgical Technique

We began dissection of the DIEP flap [3] by the inferior incision and dissection on the SIEV on both sides. With a vertical retraction of the inferior abdominal skin, we could dissect a long segment of the SIEV's, frequently more than 6 cm. After the flap has been raised and still attached to the vessels in the donor site, we use the contralateral SIEV as an interposition vein graft (Figure 1) (that is in the same surgical field) to anastomose to the ipsilateral SIEV with an anastomotic coupler device (Figure 2).

In the recipient area, we removed the third costal cartilage and dissected the Internal Mammary Vein (IMV) in all the space between the second and fourth costal cartilages. All this space is necessary when we utilize both ends of the IMV. The deep inferior epigastric vessels were anastomosed to the proximal end of the internal mammary vessels. The SIEV graft was anastomosed to the distal end of the IMV [12,13] with a coupler device and with special care to avoid twisting or kinking (Figure 3, 4). In this way, we had a long supercharging vein that didn't compromise our flap in setting. Perfusion zone IV was discarded in all patients.

Results

We could find 10 patients that meet all inclusion criteria. The patient's age, comorbidities, time of reconstruction and flap weight were resumed in Table 1. In Table 2 the number and perforator rows, the length and diameter of the SIEV graft were analyzed. All patients were subjected to radiation of the breast.

The superficial venous system Doppler signal was normal and without abnormal silence in the postoperative period in 8 patients. Two patients (patients 2 and 7) had some type of alteration in the doppler monitoring signal that was next exposed.

Patient 2 demonstrated signs of venous congestion and a significant decrease in Doppler's signal (superficial system) 4 h after the surgery. At surgical exploration, the supercharged veins seemed normal but a kinking of the main pedicle was revealed and was revised with success.

Figure 1: Graft of the SIEV contralateral to the pedicle of the flap to be anastomosed.

Figure 2: Deep side of the flap. In the lower part of the picture, there is the deep inferior epigastric pedicle. In the upper part of the picture, there is the SIEV ipsilateral (to the pedicle of the flap to be anastomosed) anastomosed to the graft of the contralateral SIEV- total length of 11.5 cm.

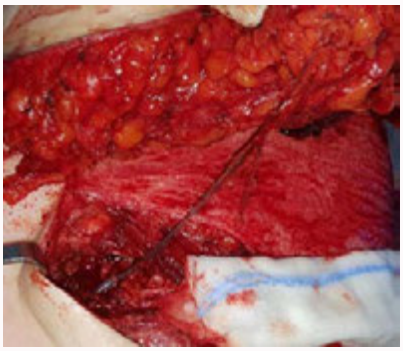

Figure 3: Superficial system (quite long) anastomosed to the distal end of the internal mammary vein.

Patient 7, who had a double doppler monitoring for the superficial and deep systems, revealed a silent doppler signal for the superficial system 9 h after surgery (with a good doppler signal for the deep system and a clinically well-perfused flap). At 12 h she revealed the first clinical signs of venous congestion in a small area of Holm´s zone 3 [14] with the remainder of the flap normal (Figure 1). During surgical exploration, we found a thrombotic anastomosis between the SIEV graft and IMV. We ligated the vein and discarded the congested

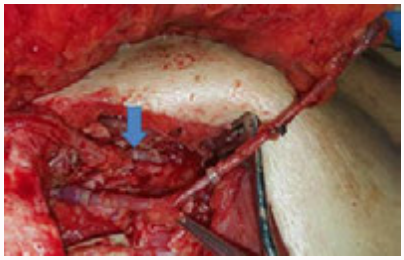

Figure 4: Deep epigastric system (arrow) anastomosed to the proximal end of the internal mammary vessels; SIEV (held by the forceps) anastomosed to the distal end of the internal mammary vein. Also shown is the graft of the contralateral SIEV to all extent.

Table 1: Age, comorbidities, time of reconstruction (immediate, delayed or secondary after implant failure) and total flap weight.

	Age	Comorbidities	Time of Reconstruction	Flap Weight (g)
Patient 1	40	Overweight	Delayed	1045
Patient 2	58	Overweight	Delayed	920
Patient 3	47	Diabetes Mellitus type 2 Overweight	Tertiary	1060
Patient 4	49	Obesity Class I	Delayed	1270
Patient 5	63	Diabetes Mellitus type 2 Peripheral vascular disease Obesity Class I	Delayed	1445
Patient 6	53	Smoker	Tertiary	890
Patient 7	51	Diabetes Mellitus type 2	Delayed	785
Patient 8	61	Obesity Class I	Delayed	1610
Patient 9	39	Smoker Overweight	Immediate	1565
Patient 10	65	Diabetes Mellitus type 2 Asthma Obesity Class I	Delayed	1780
Average	52.6			1237

Overweight (Body Mass Index: BMI - between 25 and 29.9) and Obesity Class I (BMI between 30 and 34.9)

area. The remainder of the postoperative period was uneventful.

One patient (patient 9) had a partial mastectomy flap necrosis that was surgically debrided and closed primarily and, in another patient, (patient 10) a seroma was drained at the office.

At the fourth month evaluation, all patients demonstrated a soft reconstructed breast with no indurated or palpable nodes noticeable in clinical examination and this way no imaging tests were required.

Discussion

Venous congestion in DIEP flaps (with a patent venous anastomosis) occurs with a frequency between 3 and 27 percent of cases, and although we don't understand the exact mechanism of it we believe that it's because the absence of interconnections between the superficial and deep venous systems or a predominance of the superficial system [1-9]. The most logical option for treating these congested flaps seems to be the drainage of the superficial system [7,10,11]. Numerous techniques to drain the superficial venous system have been described, like the anastomosis of the SIEV to a second IMV or large internal mammary perforating vein [15], the SIEV to a comitant DIEV [16], the contralateral SIEV to the ipsilateral SIEV [17] and the SIEV to the distal end of the IMV. This last option is very similar to our technique, but we use a contralateral SIEV as an interposition vein graft. The advantage of using the SIEV graft is that we have a long superficial vein that really facilitates the inset of the flap

Table 2: Number and perforators rows, length and diameter of the SIEV graft.

	Perforators	Graft Length (cm)	Graft Diameter (mm)
Patient 1	1 medial row	7.5	2.5
Patient 2	1 medial row	6	2
Patient 3	1 central row	9	2.5
Patient 4	1 medial row	7	2.5
Patient 5	2 medial rows	8.5	3
Patient 6	1 medial row	9	2
Patient 7	1 medial row	7	2.5
Patient 8	1 medial row (pararectal)	6.5	2.5
Patient 9	1 medial row	7.5	2.5
Patient 10	2 medial rows	8.5	3
Average	-	7.7	2.5

and helps the primary goal of the surgery which is the reconstruction of an aesthetically pleasant breast mound. This is especially true in overweight and obese patients when the height and thickness of the flap difficult the reach the SIEV to the IMV. We could harvest the vein in the same surgical field avoiding unnecessary morbidity and extra-operative time for harvesting in other donor sites (like the saphenous or cephalic veins) [18]. Also, the discrepancy between the SIEV and the SIEV graft was minimal and a coupler anastomotic device was used in all cases. Although we use the distal end of the IMV as the recipient's vein, we believe that other veins (like the thoracodorsal, intercostals or the serratus branch) could also be utilized. In our calculations, the extra time needed for doing a superficial venous supercharging with a contralateral SIEV graft is about 45 min. The main disadvantage of this technique is that it's only applicable in unilateral breast reconstruction (obviously it can be used in one flap in bilateral reconstruction if we sacrifice the SIEV of the other flap or if we have two great caliber superficial veins in each hemiabdomen).

In this study, our main goal is to confirm that the contralateral SIEV graft is feasible, functional and gives extra drainage to the flap. It wasn't used in congested flaps, like many other studies, but prophylactically in patients that needed a medium to large size reconstructed breast. Also, the majority of these patients had some type of risk factor for wound healing complications and fat necrosis and would benefit from an extra-drainage [19-25].

In this little sample of 10 patients, 8 had a good postoperative audible doppler signal in the superficial venous system and taking into account that these implantable ultrasound probes normally have a false-negative rate of around 0% [26-29], we can have some evidence that this type of supercharging trough the SIEV graft is functional. Patient 7, also may show us, how important is the superficial supercharging. After thrombosis of the anastomosis between the SIEV graft and the recipient vein (immediately detected by doppler monitoring) and with the main pedicle patent, the flap appears congested in distal Holm's zone 3. Probably the venous drainage of this zone was dependent on the superficial system and after the failure of the venous supercharge, this zone became congested. We simply discarded this congested zone and made the reconstructed breast smaller.

We had no total or partial flap losses, wound healing problems or clinical evidence of fat necrosis. Although the absence of total flap losses had little to say about the effectiveness of this venous supercharging, the absence of partial flap necrosis, dehiscence or fat

necrosis could be an indirect signal of the better drainage of these flaps, especially in this moderate to large size reconstructed breasts in patients with some type of risk factors [19-25].

This study has some relevant limitations. The sample is small and heterogeneous. The patients could be better stratified according to their risk factors. Also, the incidence and extent of fat necrosis could be evaluated in a more sensitive way by ultrasound or magnetic resonance imaging instead of clinical evaluation. Nevertheless, we collect some important clues: Superficial venous supercharging of DIEP flaps utilizing the contralateral SIEV as an interpositional vein graft is technically easy and feasible, with no donor site morbidity and seems to be functional. It may be useful in clinically congested flaps or prophylactically in high-risk patients. More studies are needed to clarify the indications for superficial venous supercharging. The SIEV interposition graft is only one more weapon in the armamentarium of the reconstructive surgeon who needs to supercharge a DIEP flap.

Conclusion

Superficial venous supercharging of DIEP flaps through a contralateral SIEV interposition vein graft seems to be functional and adds an extra length to ipsilateral SIEV to reach a recipient's vein. In this way, the flap inset is not compromised by a short SIEV and no further morbidity is added to its harvest.

References

1. Allen RJ, Treece P. Deep inferior epigastric perforator flap for breast reconstruction. Ann Plast Surg. 1994;32(1):32-8.
2. Blondeel N, Vanderstraeten GG, Monstrey SJ, Landuyt KV, Tonnard P, Lysens R, et al. The donor site morbidity of free DIEP flaps and free TRAM flaps for breast reconstruction. Br J Plast Surg. 1997;50(5):322-30.
3. Blondeel PN. One hundred free DIEP flap breast reconstructions: A personal experience. Br J Plast Surg. 1999;52(2):104-11.
4. Gill PS, Hunt JP, Guerra AB, Dellacroce FJ, Sullivan SK, Boraski J, et al. A 10-year retrospective review of 758 DIEP flaps for breast reconstruction. Plast Reconstr Surg. 2004;113(4):1153-60.
5. Guerra AB, Metzinger SE, Bidros RS, Rizzuto RP, Gill PS, Nguyen AH, et al. Bilateral breast reconstruction with the Deep Inferior Epigastric Perforator (DIEP) flap: An experience with 280 flaps. Ann Plast Surg. 2004;52(3):246-52.
6. Hamdi M, Weiler-Mithoff EM, Webster MH. Deep inferior epigastric perforator flap in breast reconstruction: Experience with the first 50 flaps. Plast Reconstr Surg. 1999;103(1):86-95.
7. Wechselberger G, Schoeller T, Bauer T, Ninkovic M, Otto A, Ninkovic M. Venous super drainage in deep inferior epigastric perforator flap breast reconstruction. Plast Reconstr Surg. 2001;108(1):162-6.
8. Tran NV, Buchel EW, Convery PA. Microvascular complications of DIEP flaps. Plast Reconstr Surg. 2007;119(5):1397-405.
9. Blondeel PN, Arnstein M, Verstraete K, Depuydt K, Landuyt KHV, Monstrey SJ, et al. Venous congestion and blood flow in free transverse rectus abdominis myocutaneous and deep inferior epigastric perforator flaps. Plast Reconstr Surg. 2000;106(6):1295-9.
10. Sbitany H, Mirzabeigi MN, Kovach SJ, Wu LC, Serletti JM. Strategies for recognizing and managing intraoperative venous congestion in abdominally based autologous breast reconstruction. Plast Reconstr Surg. 2012;129(4):809-15.
11. Galanis C, Nguyen P, Koh J, Roostaeian J, Festekjian J, Crisera C. Microvascular Lifeboats: A stepwise approach to intraoperative venous congestion in DIEP flap breast reconstruction. Plast Reconst Surg. 2014;134(1):20-27.
12. Kerr-Valentic MA, Gottlieb LJ, Agarwal JP. The retrograde limb of the internal mammary vein: An additional outflow option in DIEP flap breast reconstruction. Plast Reconstr Surg. 2009;124(3):717-21.
13. Stalder MW, Allen RJ, Sadeghi A. Using the retrograde internal mammary system for stacked perforator flap breast reconstruction: 71 breast reconstructions in 53 consecutive patients. Plast Reconstr Surg. 2016;137(2):265e-77e.
14. Holm C, Mayr M, Ninkovic M. Perfusion zones of the DIEP flap revisited: A clinical study. Plast Reconstr Surg. 2006;117(1):37-43.
15. Boutros SG. Double venous system drainage in deep inferior epigastric perforator flap breast reconstruction: A single-surgeon experience. Plast Reconstr Surg. 2013;131(4):671-6.
16. Liu TS, Ashjian P, Festekjian J. Salvage of congested deep inferior epigastric perforator flap with a reverse flow venous anastomosis. Ann Plast Surg. 2007;59(2):214-7.
17. Xin Q, Luan J, Mu H, Mu L. Augmentation of venous drainage in deep inferior epigastric perforator flap breast reconstruction: Efficacy and advancement. J Reconstr Microsurg. 2012;28(5):313-8.
18. Barnett GR, Carlisle IR, Gianoutsos MP. The cephalic vein: An aid in free TRAM flap breast reconstruction. Report of 12 cases. Plast Reconstr Surg. 1996;97(1):71-6; discussion 77-8.
19. Khouri RK, Cooley BC, Kunselman AR, Landis JR, Yeramian P, Ingram D, et al. A prospective study of microvascular free-flap surgery and outcome. Plast Reconstr Surg. 1998;102(3):711-21.
20. Rao SS, Parikh PM, Goldstein JA, Nahabedian MY. Unilateral failures in bilateral microvascular breast reconstruction. Plast Reconstr Surg. 2010;126(1):17-25.
21. Sanati-Mehrizy P, Massenburg BB, Rozehnal JM, Ingargiola MJ, Rosa JH, Taub PJ. Risk factors leading to free flap failure: Analysis from the National Surgical Quality Improvement Program Database. J Craniofac Surg. 2016;27(8):1956-64.
22. Las DE, de Jong T, Zuidam JM, Verweij NM, Hovius SER, Mureau MAM. Identification of independent risk factors for flap failure: A retrospective analysis of 1530 free flaps for breast, head and neck and extremity reconstruction. J Plast Reconstr Aesthet Surg. 2016;69(7):894-906
23. Massenburg BB, Sanati-Mehrizy P, Ingargiola MJ, Rosa JH, Taub PJ. Flap failure and wound complications in autologous breast reconstruction: A national perspective. Aesthetic Plast Surg. 2015;39(6):902-9.
24. Hofer SOP, Damen THC, Mureau MAM, Rakhorst HA, Roche NA. A critical review of perioperative complications in 175 free deep inferior epigastric perforator flap breast reconstructions. Ann Plast Surg. 2007;59(2):137-42.
25. Khansa I, Momoh AO, Patel PP, Nguyen JT, Miller MJ, Lee BT. Fat necrosis in autologous abdomen-based breast reconstruction: A systematic review. Plast Reconstr Surg. 2013;131(3):443-52.
26. de la Torre J, Hedden W, Grant 3rd JH, Gardner PM, Fix RJ, Vásconez LO. Retrospective review of internal doppler probe for intra- and postoperative microvascular surveillance. J Reconstr Microsurg. 2003;19(5):287-9.
27. Smit JM, Whitaker IS, Acosta R. Post operative monitoring of microvascular breast reconstructions using implantable Cook-Swartz doppler system: A study of 145 probes & technical discussion. J Plast Reconstr Aesthet Surg. 2009;62(10):1286-92.
28. Rozen WM, Chubb D, Whitaker IS, Acosta R. The efficacy of postoperative monitoring: A single surgeon comparison of clinical monitoring and the implantable doppler probe in 547 consecutive free flaps. Microsurgery. 2010;30(2):105-10.
29. Um GT, Chang J, Louie O, Colohan SM, Said HK, Neligan PC, et al. Implantable Cook-Swartz doppler probe versus Synovis Flow coupler for the postoperative monitoring of free flap breast reconstruction. J Plast Reconst Aesthet Surg. 2014;67(7):960-6.