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The lateral thoracic vessels: A novel recipient site for breast reconstruction with DIEP flap



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KEYWORDS

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Summary *Background:* Adequate selection of recipient vessel to minimize recipient site morbidity is essential for a successful breast reconstruction. The authors explored the clinical use of the lateral thoracic vessels as recipient vessels in the deep inferior epigastric artery perforator (DIEP) flap breast reconstruction.

Methods: This study included 63 patients with breast cancer. The age of patients ranged from 26 to 67 years (43.23 ± 8.63). All patients received an immediate DIEP flap breast reconstruction using the lateral thoracic vessels as recipient vessels in the authors' department from 2014 May to 2018 September. The flap blood supply, complications, and outcomes were assessed.

Results: The patients were followed up for 6 to 29 months with satisfactory results. All the flaps had stable blood supply except for two cases, which had an event of partial skin necrosis and were repaired by debridement.

Conclusions: Lateral thoracic vessels are not only easy to explore but also have reliable blood supply, which present a safe and reliable choice for immediate DIEP flap breast reconstruction.

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The deep inferior epigastric artery perforator (DIEP) flap has become the gold standard for autologous breast re-

construction. It can provide an esthetically perfect shape and long-lasting natural reconstruction, especially for the women who both need postoperative radiotherapy and breast reconstruction. To minimize recipient site morbidity, the adequate selection of recipient vessels is essential for the success of breast reconstruction.

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Plastic surgeons have done much work to determine the suitable recipient vessels,¹⁻⁹ such as the internal mammary vessel, the thoracodorsal vessel, the circumflex scapular vessels, and the internal mammary perforator vessel. However, all these vessel types have several disadvantages. For example, to explore the internal mammary vessel, we need to split the pectoralis major muscle and excise part of costal cartilage or intercostal muscles. In some studies, the internal mammary vessel was replaced by the internal mammary perforator vessel, but it should be noted that the internal mammary perforator vessel is absent in some cases.

By using sentinel lymph node biopsy (SLNB),¹⁰ an increasing number of patients do not need to have their axilla examined. The advantages of using the lateral thoracic vessels include more simplified procedure, less invasive recipient vessel preparation, the facilitation of microvascular surgery, and so on. We presume that these advantages result in the increase of patients' satisfaction and decrease of recipient sites morbidity. However, the reliability of the lateral thoracic vessels is unclear. In this research, we will discuss whether the lateral thoracic vessels will increase the rate of necrosis.

Patients and methods

From 2014 May to 2018 September, 63 patients with breast cancer, whose age ranged from 26 to 67 years (43.23 ± 8.63), received an immediate DIEP flap breast reconstruction with their lateral thoracic vessels as recipient vessels. None of the patients had undergone previous axillary surgery other than for SLNB. None of the patients had received previous radiotherapy. The operations were done in authors' department. The patients' flap blood complications and outcomes were assessed (Table 1).

All the patients underwent computed tomographic angiography (CTA) and/or color Doppler ultrasound of the abdomen and chest to check for the vessel and perforator presence preoperation. The skin markings were made in the breast and the abdominal skin (Figure 1). When the modified radical mastectomy or the nipple-sparing mastectomy was performed by the oncologic surgeon, we simultaneously dissected the DIEP flap. The length of the vascular pedicle of the flap was 9-11 cm (10.91 ± 0.35) so that there was enough length for the microanastomosis procedure. After the mastectomy, the remaining superior and inferior breast skin was lifted to create a pocket for the flap.

During the mastectomy or the SLNB, the lateral thoracic vessels were carefully dissected. Both the axilla and the lateral margin of the pectoralis major muscle were explored. The lateral thoracic vessels were carefully dissected to determine their origin. The lateral thoracic vessels were found to descend along the anterior axillary line or the mid-axillary line to the skin and the intercostal muscle. There were 1 artery and 1 or 2 veins (Figure 2).

The DIEP free flap was transferred and sutured to the anterior chest wall. A conventional end-to-end microanastomosis was performed with 9-0 interrupted nylon sutures under surgical microscopic magnification. At the same time, a microvascular anastomotic coupler¹¹ was used to ensure the patency rate of venous anastomoses (Video 1). In all cases,

these vessels were long enough for the microanastomosis and breast plasticity procedures to be performed.

Case report

Case 2

A 35-year-old female had right breast invasive carcinoma. The patient had undergone a modified radical mastectomy. The DIEP flap was performed for breast reconstruction. A 26×14 -cm free DIEP flap was performed with an end-to-end anastomosis to the lateral thoracic artery and vein. When unclamping the nontraumatic vascular clamp, a venous congestion occurred and the superficial epigastric vein began to fill. We added an end-to-end anastomosis between the superficial epigastric vein and the thoracoacromial vein. Unfortunately, there was a complication due to venous congestion and part of skin necrosis on the sixth day postoperative. An area of approximately 1×3 -cm was debrided and primarily closed. The flap survived completely, and the patient was satisfied with the shape of the breast (Figures 1-5).

Results

Tables 1 and 2 show the lateral thoracic vessels were used in immediate breast reconstructions in 63 cases during the study period. The ages of the patients ranged from 26 to 67 years (43.23 ± 8.63). The sizes of the flaps ranged ($12-14$) cm \times ($22-36$) cm. The length of the pedicle varied from 9 to 11 cm (10.91 ± 0.35). The diameter of the artery varied from 1.5 to 2 mm (1.54 ± 0.14). The number of accompanying veins was 1 or 2, and the diameter of the artery varied from 2 to 2.5 mm (2.38 ± 0.21). Ischemia time was from 60 to 80 min (62.54 ± 4.74), and the operative time was from 5.3 to 8 h (5.76 ± 0.47). All flaps survived. Only two cases experienced a complication due to part skin necrosis after the operation, and these were healed with debridement.

Discussion

Taylor and Daniel¹² reported that the location of the lateral thoracic artery is variable. It arose from the axillary, the subscapular, the thoracodorsal or the acromiothoracic arteries, and it was found to be absent in 3 of 20 cadaver dissections. Harrii et al.¹³ reported that the lateral thoracic artery could not be seen in 2 of 11 clinical cases. Loukas et al.¹⁴ reported that the lateral thoracic artery was found in 96.7% of 420 adult human cadavers. Soares¹⁵ identified the lateral thoracic vein in 98 of 100 cases and the lateral thoracic artery in 55 of 100 cases.

Fortunately, we found the lateral thoracic vessels in all of our cases (Possibly, the lateral thoracic vessels were one of the blood supplying vessels of the breast, and all of the cases in our research were female.¹³) and then chose them to be the recipient vessels. During the operation, we were also mentally prepared to use the internal mammary vessels or the thoracodorsal vessels as recipient vessels. The

Table 1 Patients' information and operation data.

Cases	Age (years)	Side	Flap size (cm)	No. of perforators	Diameter of the LTA ^a (mm)	No. of veins	Diameter of the LTV ^b (mm)	Additional recipient vein	Length of vessel pedicles (cm)	Operative time (min)	Ischemic time (min)	Complications	Follow-up (months)
1	34	L	28 × 13	2	2	1	2.5	No	9	6.5	70	No	6
2	35	R	26 × 14	2	1.5	2	2	TV ^c	11	6.0	70	PSN ^e	6
3	41	L	28 × 12	2	2	2	2.5	No	11	6	70	No	12
4	57	L	28 × 12	1	1.5	1	2.5	No	11	5.5	60	No	18
5	28	L	30 × 13	1	2	2	2.5	SV ^d	11	5.3	60	No	15
6	45	R	28 × 12	2	1.5	2	2	No	11	6.5	70	No	9
7	47	L	28 × 12	1	1.5	2	2	No	11	6.3	70	No	6
8	52	L	28 × 12	1	1.5	2	2	No	11	5.5	60	No	9
9	54	R	28 × 12	2	1.5	2	2.5	No	11	5.3	60	No	18
10	45	R	28 × 12	1	1.5	2	2	No	11	5.7	60	No	6
11	37	R	28 × 12	2	2	2	2.5	SV	10	5.4	60	No	6
12	57	R	28 × 12	2	1.5	2	2	No	11	6.0	60	No	6
13	43	R	28 × 12	1	1.5	2	2	No	11	5.7	60	No	9
14	37	L	28 × 12	2	1.5	2	2	No	9.5	6.5	70	No	6
15	52	R	28 × 12	1	1.5	1	2.5	No	11	5.5	60	No	9
16	51	L	28 × 12	1	1.5	2	2.5	No	11	5.4	60	No	18
17	46	R	28 × 12	1	1.5	2	2	No	11	5.3	60	No	12
18	37	L	28 × 13	1	1.5	2	2	No	11	5.4	60	No	14
19	52	R	28 × 12	1	1.5	2	2	No	11	5.6	60	No	12
20	51	R	28 × 12	1	2	2	2.5	No	11	5.3	60	No	18
21	48	L	28 × 12	2	1.5	2	2	No	10	6.4	70	No	18
22	41	R	28 × 12	1	1.5	2	2.5	No	11	5.4	60	No	18
23	49	L	28 × 12	1	1.5	2	2	No	11	6.2	70	No	9
24	38	R	28 × 14	1	1.5	2	2.5	No	11	5.6	60	No	12
25	36	L	28 × 12	1	1.5	2	2.5	No	11	5.4	60	No	18
26	39	L	28 × 12	1	1.5	2	2.5	No	11	5.6	60	No	24
27	52	L	28 × 12	1	1.5	2	2	SV	11	6.5	70	No	18
28	55	R	28 × 12	1	1.5	2	2.5	No	11	5.6	60	No	12
29	40	R	28 × 14	1	1.5	2	2	No	11	5.5	60	No	18
30	51	R	28 × 12	1	1.5	2	2.5	No	11	5.6	60	No	20
31	38	R	28 × 12	1	1.5	2	2.5	No	11	5.5	60	No	18
32	35	L	28 × 12	1	1.5	2	2.5	No	11	5.6	60	No	18
33	39	L	28 × 12	1	1.5	2	2.5	No	11	5.7	60	No	12
34	52	L	28 × 12	1	1.5	2	2.5	No	11	6.0	60	No	18
35	35	R	28 × 12	1	1.5	2	2.5	No	11	5.6	60	No	12
36	36	R	28 × 12	1	1.5	2	2.5	No	11	5.8	70	No	21
37	63	R	28 × 12	1	1.5	2	2.5	No	11	6.3	70	No	18

(continued on next page)

Table 1 (continued)

Cases	Age (years)	Side	Flap size (cm)	No. of perforators	Diameter of the LTA ^a (mm)	No. of veins	Diameter of the LTV ^b (mm)	Additional recipient vein	Length of vessel pedicles (cm)	Operative time (min)	Ischemic time (min)	Complications	Follow-up (months)
38	44	R	28 × 12	1	1.5	2	2.5	No	11	5.7	60	No	24
39	41	L	22 × 12	1	1.5	2	2.5	No	11	5.6	60	No	18
40	41	R	28 × 13	1	1.5	2	2.5	No	11	5.4	60	No	12
41	51	R	28 × 12	1	1.5	2	2.5	No	11	5.6	60	No	18
42	34	L	28 × 12	2	1.5	2	2.5	No	11	5.3	60	No	12
43	40	R	28 × 12	1	1.5	2	2.5	No	11	5.5	60	No	18
44	40	L	28 × 12	1	1.5	2	2.5	No	11	5.4	60	No	18
45	39	L	28 × 12	1	1.5	2	2.5	No	11	5.6	60	No	24
46	45	L	36 × 15	2	1.5	2	2.5	No	11	8.0	80	No	12
47	33	R	28 × 12	1	1.5	2	2.5	No	11	5.7	60	No	12
48	44	R	28 × 12	2	1.5	2	2.5	No	11	5.5	60	No	12
49	67	L	28 × 12	1	1.5	2	2.5	No	11	5.7	60	No	18
50	41	R	28 × 12	1	1.5	2	2.5	No	11	5.6	60	No	18
51	41	R	28 × 12	1	1.5	2	2.5	No	11	5.5	60	No	24
52	47	R	28 × 12	2	1.5	2	2.5	No	11	6.2	60	No	12
53	45	L	28 × 12	1	1.5	2	2.5	No	11	5.7	60	No	9
54	26	L	28 × 12	1	1.5	2	2.5	No	11	6.5	70	No	9
55	49	L	28 × 15	2	1.5	2	2.5	SV	11	6.5	70	No	18
56	46	R	28 × 12	1	1.5	2	2.5	No	11	5.5	60	No	9
57	38	R	28 × 12	2	1.5	2	2.5	No	11	5.4	60	PSN ^e	12
58	26	R	28 × 12	1	1.5	2	2.5	No	11	5.7	60	No	18
59	57	L	28 × 14	1	1.5	2	2.5	No	11	5.5	60	No	29
60	37	L	28 × 12	1	1.5	2	2.5	No	11	6.4	70	No	12
61	35	R	28 × 12	1	1.5	2	2.5	No	11	5.5	60	No	18
62	41	R	28 × 12	1	1.5	2	2.5	No	11	5.6	60	No	18
63	28	L	28 × 12	1	1.5	2	2.5	No	11	5.5	60	No	9

^a LTA, lateral thoracic artery.

^b LTV, lateral thoracic vein.

^c TV, thoracoacromial vessels.

^d SV, serratus anterior (SA) muscle's vascular pedicle.

^e PSN, partial skin necrosis.

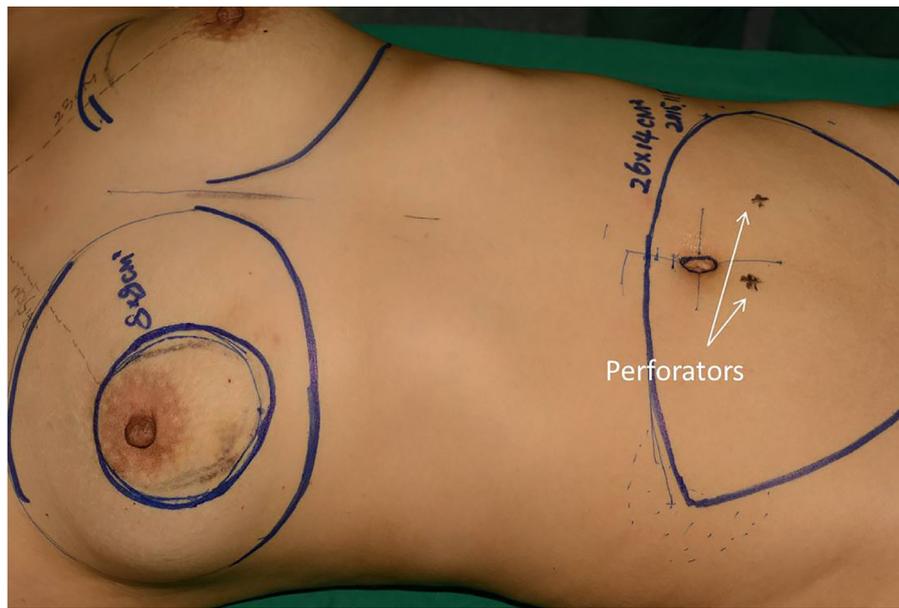


Figure 1 A 35-year-old female had right breast invasive carcinoma. The patient had undergone a modified radical mastectomy. A 26×14 cm free DIEP flap was performed for breast reconstruction. The skin markings were made in the breast and the abdominal skin, including the margin of the skin resection and the location of the perforators.

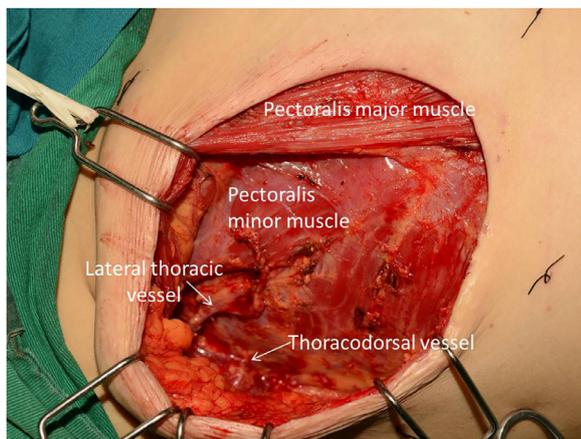


Figure 2 The lateral thoracic vessels were exported clearly after the mastectomy. The lateral thoracic vessels were found to descend along the anterior axillary line or the mid-axillary line to the skin and the intercostal muscle.

color Doppler ultrasound¹⁶ or CTA^{17,18} could be used preoperatively to evaluate the appearance and the diameter of the lateral thoracic artery. In our cases, all of the patients accepted an immediate DIEP flap breast reconstruction, and the lateral thoracic vessels were exported during the mastectomy. Therefore, we did not perform the preoperative color Doppler ultrasound and the CTA in the abdomen for positioning perforators.¹⁸

As the lateral thoracic artery is well established, there have been reports about the clinical use of the lateral thoracic flap.^{13,19} The clinical use of the lateral thoracic vein includes the use of the DIEP flap^{20,21} and the lateral thoracic vein graft for connecting the superficial inferior epigastric vein (SIEV) and the deep inferior epigas-



Figure 3 Postoperative immediately.

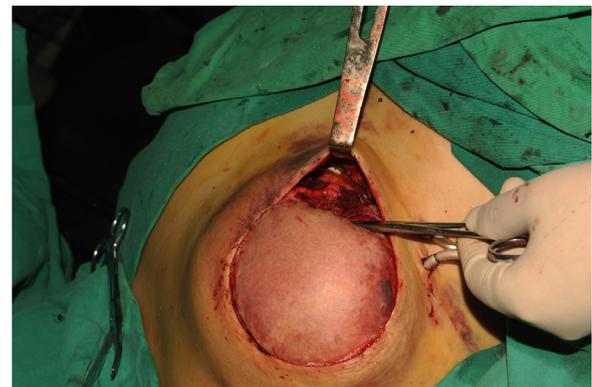


Figure 4 An area of approximately 1×3 cm was debrided and primarily closed.



Figure 5 Preoperative and postoperative photo of the patient. The flap survived, and the patient was satisfied with the result.

Table 2 Information of the patients and operation data.

	Value
No. of patients	63
Right sides	34(54%)
Left sides	29(46%)
Mean age \pm SD (years)	43.23 \pm 8.63
Flap size (cm)	(12 to 14) \times (22-36)
No. of perforators \pm SD	1.22 \pm 0.41
Diameter of the lateral thoracic artery \pm SD (mm)	1.54 \pm 0.14
No. of veins \pm SD	1.95 \pm 0.21
Diameter of the lateral thoracic vein \pm SD (mm)	2.38 \pm 0.21
Length of vessel pedicles \pm SD (cm)	10.91 \pm 0.35
Operative time \pm SD (min)	5.76 \pm 0.47
Ischemic time \pm SD (min)	62.54 \pm 4.74
Complication	Partial skin necrosis (2 cases)
Follow-up times \pm SD (months)	14.47 \pm 5.38

tric vein to relieve venous congestion.²² Satake et al.²³ reported the use of the lateral thoracic vessel as a recipient vessel for the lumbar artery perforator flap. However, in this case, their diameters were 0.66 mm (the lateral thoracic artery) and 1.6 mm (the lumbar artery), and the external caliber ratio between the recipient and flap arteries was higher than 1:2. The researcher used a remnant of the lateral thoracic vein as an interposition graft to add length of to the artery. In our case, we choose an area of the artery with a diameter of approximately 1.5 mm for the anastomoses. Furthermore, we found that although the average caliber of the lateral thoracic vessels is smaller than that of the internal thoracic or the thoracodorsal vessels, the vessels can also be used for microvascular anastomoses.

We examined 63 cases that involved the lateral thoracic vessels. All the flaps survived. Although there were two cases with venous congestion, the major part of the flap survived with a debridement and was primarily closed. The factors related to the venous problem including the size of

venous perforators, the degree of midline crossover by the branches of SIEV, and the communication between the perforating vein(the deep venous system) and the SIEV (the superficial venous system) are not uniform.²⁴ Venous congestion²⁵ often occurs in cases of inadequate perforator selection and anatomic superficial venous system dominance without sufficient communication by the veins to the deep system. The cases had a dominant anatomic superficial venous system, and we anastomosed the SIEV with the thoracoacromial vein for additional venous drainage. We can also use indocyanine green angiography²⁶ to evaluate the blood supply and to determine the need for another venous anastomose. Subsequently, none of the flaps had venous congestion.

With the use of SLNB,¹⁰ fewer patients will have to get their axillae explored. Compared to the internal mammary vessel and the thoracodorsal vessel, the lateral thoracic vessel has several advantages. First, the use of the lateral thoracic vessels is simple and easy, and it provides a less invasive recipient vessel preparation. It can be exposed by the modified radical mastectomy or the nipple-sparing mastectomy. Second, the location of the lateral thoracic vessels for the microvascular anastomoses is between the anterior axillary line and the midline of clavicle. It is closer to the midline of the body and is a very comfortable location for surgeons. Third, we present not only the internal mammary vessel for its potential in coronary artery bypass grafting²⁷ but also the use of thoracodorsal vessels in a future recurrence.^{28,29} Additionally, the use of the lateral thoracic vessels allows for a shorter pedicle and is easier for the microvascular anastomoses. The lateral thoracic vessels could become a choice of the recipient sites for free flap breast reconstruction

Although we used the lateral thoracic vessels as the recipient site for our cases, we noted the following problems. The small diameter of the vessel requires the higher technical skills for the surgeon who performed the anastomosis. Moreover, the lateral thoracic artery was variable. We still need to have mental preparation for the use of the internal mammary vessels or the thoracodorsal vessels as alternative recipient vessels. Further studies are necessary to assess the variable of lateral thoracic artery in female.

Conclusions

Based on our experience, the lateral thoracic vessels have reliable blood supply and are easy to explore. It can reduce recipient site morbidity and present a safe choice for immediate breast reconstruction with DIEP flap.

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Disclosure

None of the authors has a financial interest in any of the products, devices, or drugs mentioned in this article.

Supplementary material

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.bjps.2019.05.012](https://doi.org/10.1016/j.bjps.2019.05.012).

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