



### Case Report

pISSN 2586-3290 · eISSN 2586-3533  
Arch Hand Microsurg 2020;25(4):326-330  
<https://doi.org/10.12790/ahm.20.0074>

**Received:** November 12, 2020  
**Revised:** November 13, 2020  
**Accepted:** November 13, 2020

#### Corresponding author:

Il Jae Lee  
Department of Plastic and  
Reconstructive Surgery, Ajou University  
School of Medicine, Worldcup-ro 164,  
Yeongtong-gu, Suwon 16499, Korea  
Tel: +82-31-219-5614  
Fax: +82-31-219-5610  
E-mail: i00325@live.co.kr  
ORCID:  
<https://orcid.org/0000-0002-9478-6969>

## The Retrograde Limb of the Internal Mammary Artery: An Alternative Inflow Option for Free Flap Breast Reconstruction

Hyung Min Hahn, Bohwan Cha, Il Jae Lee

Department of Plastic and Reconstructive Surgery, Ajou University School of Medicine, Suwon, Korea

Autologous breast reconstruction using a free flap is a popular option for breast reconstruction after mastectomy. The internal mammary system is the recipient of choice in autologous breast reconstruction. We present our experience utilizing the caudal limb of the internal mammary artery as the recipient artery. A 44-year-old female patient with invasive ductal carcinoma in her right breast received total mastectomy and reconstruction with the deep inferior epigastric artery perforator flap was planned. During the operation, arterial insufficiency occurred three times; therefore, we decided to change the plan and to perform anastomosis to the caudal limb of the internal mammary artery. Retrograde blood flow of the internal mammary artery was successfully achieved. Immediate postoperative and long-term outcomes of the flap were satisfactory. This inflow option may be useful in cases with arterial insufficiency on conventional anastomosis or in cases with bipediced or stacked flaps for unilateral breast reconstruction.

**Keywords:** Mammoplasty, Free tissue flaps, Mammary arteries, Breast neoplasms

### INTRODUCTION

Autologous breast reconstruction with microsurgical flaps is commonly used after mastectomy in patients with breast cancer. This procedure is preferred because of better aesthetic outcomes which include softer, more ptotic, and natural-appearing breast mound [1]. Among the flaps, the deep inferior epigastric artery perforator flap has become increasingly popular over recent years.

As recipient sites for a free flap, internal mammary vessels and thoracodorsal vessels were utilized and internal mammary vessels were preferred due to low rates of vessel conversion and flap-related complications [2]. In the conventional method, the cranial limb of the internal mammary artery is used for anastomosis; however, successful arterial flow on anastomosis with the caudal limb of the internal mammary artery has been reported in several studies [3-5].

We present a case in which a salvaged deep inferior epigastric artery perforator

© 2020 Korean Society for Surgery of the Hand, Korean Society for Microsurgery, and Korean Society for Surgery of the Peripheral Nerve. All Rights reserved.

© This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial license (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

free flap was used in breast reconstruction with retrograde anastomosis to the caudal limb of the internal mammary artery due to repeated arterial insufficiency on conventional anastomosis to the cranial limb of the internal mammary artery.

## CASE REPORT

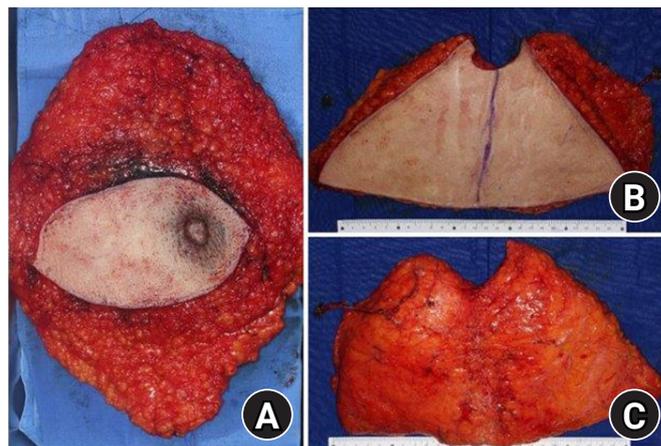
A 44-year-old woman was referred to our clinic for immediate breast reconstruction. She had invasive ductal carcinoma in the upper outer quadrant of her right breast and she was scheduled for total mastectomy. She had a history of cesarean section 7 years ago. We performed abdominal computed tomography scan for the evaluation of the internal mammary system and the deep inferior epigastric artery perforator and there were no abnormal findings in the arterial and venous systems (Fig. 1).

Total mastectomy was performed by the general surgeon and the mastectomy specimen weight was 505 g. The flap was elevated on two perforators of the deep inferior epigastric artery (Fig. 2). Recipient vessels, internal mammary artery and vein, were exposed by removal of a segment of the third costal cartilage. On arterial anastomosis to the cranial limb of the internal mammary artery with the end-to-end maneuver, arterial insufficiency occurred three times. After confirming that the cranial limb arterial pumping was good, anastomosis was performed, but the color of the flap was not good during flap inseting, so this process was repeated three times. We used the DeBakey vessel dilator to check vessel and the flow before the anastomosis was fine, but the flow after the anastomosis was consistently bad. The most likely cause is thought to be spasm, but further consideration is needed. We changed the recipient vessel to the caudal limb of the internal mammary artery and end-to-end anastomosis was performed. After arterial anastomosis, inflow

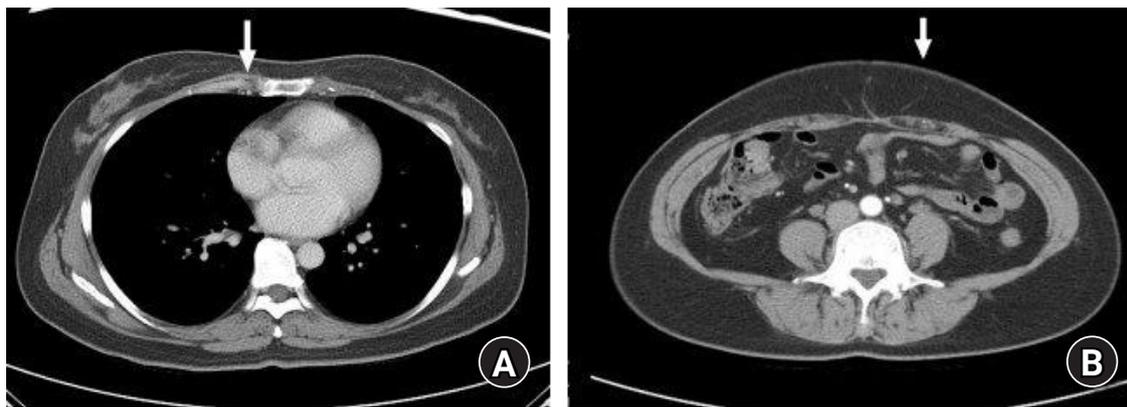
into the flap was successfully established (Fig. 3). When anastomosis was performed in caudal limb rather than cranial limb, the flow was maintained well, so we think it was not a technical problem. Venous anastomosis was performed between deep inferior epigastric veins and internal mammary veins with conventional end-to-end anastomosis.

There were no postoperative complications such as hematoma, seroma, infection, thrombosis, or flap necrosis. She had a favorable long-term outcome at postoperative 6 months (Fig. 4).

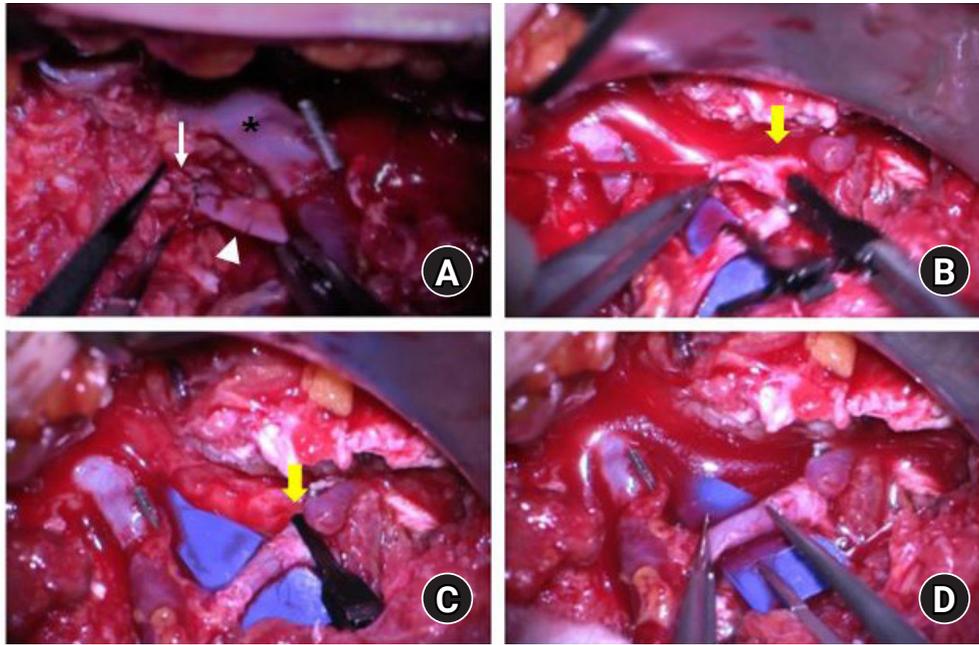
The study was approved by the Institutional Review Board of Ajou Medical Center (No. AJIRB-MED-MDB-16-308) and performed in accordance with the principles of the Declaration of Helsinki. Written informed consent, including publication of the clinical images, was obtained from the patient.



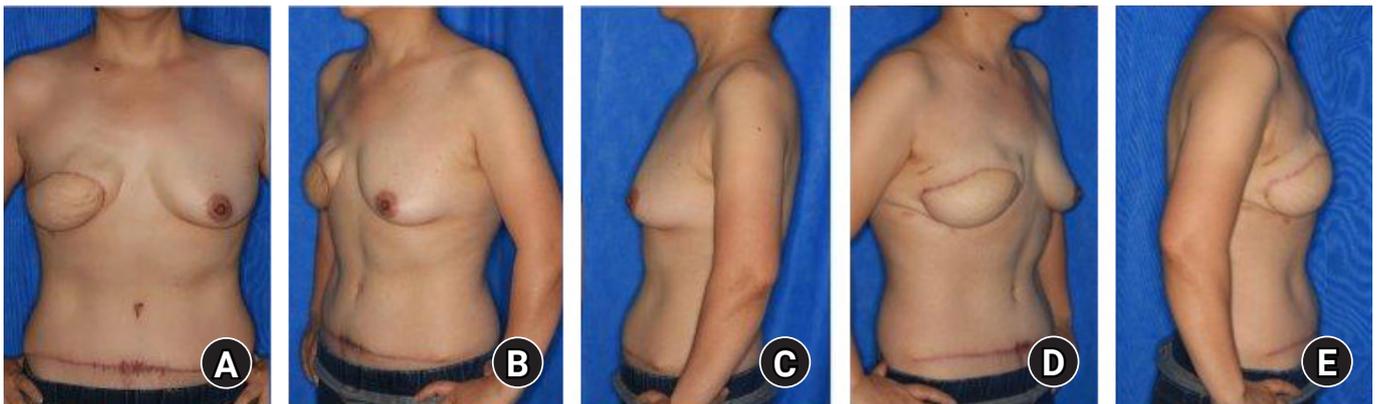
**Fig. 2.** (A) The mastectomy specimen weight was 505 g. (B, C) The flap was elevated on two perforators of the deep inferior epigastric artery.



**Fig. 1.** Preoperative computed tomography angiography for evaluation of the internal mammary arterial system and the deep inferior epigastric arterial system. (A) Vessels (arrow) are the internal mammary artery and vein in the third intercostal space. (B) Vessel (arrow) is the perforator vessel included in the flap.



**Fig. 3.** (A) On arterial anastomosis between the cranial limb of the internal mammary artery (white arrow) and the deep inferior epigastric artery (arrowhead) using the end-to-end maneuver, arterial insufficiency occurred three times. The deep inferior epigastric vein was anastomosed with the antegrade flow of the internal mammary vein (asterisk). (B, C) We changed the recipient vessel to the caudal limb of the internal mammary artery (yellow arrow) by using the end-to-end maneuver. (D) Patency was tested with the empty-and-refill test and the flow in arterial anastomosis was good.



**Fig. 4.** Long-term clinical photograph at postoperative 6 months. She had a favorable long-term outcome.

## DISCUSSION

After mastectomy, loss of the breast mound has psychosocial effects which are associated with anxiety and depression, and negative effects on body image and sexual activity [6]. After breast reconstruction, regardless of the timing and technique of reconstruction, patients showed high quality of life, better social adaptation and relationships, and sexual relationships [7]. According to the statistical report of American Society of Plastic Surgeons, the number of breast reconstruction surgeries in

USA increased by 39% from 2000 to 2016 [8].

The breast reconstruction method should be selected after considering the patient's preference, underlying diseases, patient's age, location and type of cancer, the type of adjuvant therapy, and the size and shape of the native breast. These methods are largely divided into two types; implant-based reconstruction or autologous reconstruction. The deep inferior epigastric artery perforator free flap has been the first choice for autologous breast reconstruction. Koshima and Soeda [9] reported the first clinical application of the inferior epigastric

artery perforator flap in 1989. It offers the advantage of preservation of the rectus abdominis muscle and results in less donor site morbidity such as herniation.

Use of the internal mammary system as the recipient vessel has become a common practice in autologous breast reconstruction. The internal mammary vessels are preferred over the thoracodorsal vessels because of their central location, reliability in terms of size and constancy, freedom in flap inseting, relative resistance to atherosclerosis, and preservation following radiation therapy and axillary surgery [10]. The conventional method uses the cranial end of the internal mammary artery for anastomosis. However, due to arterial insufficiency or need for an additional recipient in a bipediced flap, the caudal end of the internal mammary artery was used as the recipient in several cases [3-5,9].

In our case, antegrade flow of the internal mammary artery was too weak to supply the flap in repeated reanastomosis with an unknown cause. We changed the recipient site to the caudal end of the internal mammary artery and the flow was successfully reestablished. In the long-term follow-up, the aesthetic outcome was satisfactory without any evidence of fat necrosis.

The internal mammary artery splits into two main arteries, the deep superior epigastric artery and the musculophrenic artery; and during their course, they show anastomosis with the intercostal arteries, giving off perforating branches in each intercostal space. These collaterals and two main arteries were considered responsible for the retrograde flow of the internal mammary artery [4].

In conclusion, retrograde flow of the internal mammary artery could be a reliable recipient site when an alternate recipient site is needed in case of insufficient antegrade flow of the internal mammary artery or an additional recipient site is needed in case of a bipediced or stacked flap.

## CONFLICTS OF INTEREST

The authors have nothing to disclose.

## REFERENCES

1. Cordeiro PG. Breast reconstruction after surgery for breast cancer. *N Engl J Med*. 2008;359:1590-601.
2. Saint-Cyr M, Youssef A, Bae HW, Robb GL, Chang DW. Changing trends in recipient vessel selection for microvascular autologous breast reconstruction: an analysis of 1483 consecutive cases. *Plast Reconstr Surg*. 2007;119:1993-2000.
3. Li S, Mu L, Li Y, et al. Breast reconstruction with the free bipediced inferior TRAM flap by anastomosis to the proximal and distal ends of the internal mammary vessels. *J Reconstr Microsurg*. 2002;18:161-8.
4. Salgarello M, Visconti G, Barone-Adesi L, Cina A. The retrograde limb of internal mammary vessels as reliable recipient vessels in DIEP flap breast reconstruction: a clinical and radiological study. *Ann Plast Surg*. 2015;74:447-53.
5. Caulfield RH, Maleki-Tabrizi A, Mathur B, Ramakrishnan V. Salvage of a DIEP flap using a retrograde flow anastomosis. *J Plast Reconstr Aesthet Surg*. 2008;61:346-7.
6. Parker PA, Youssef A, Walker S, et al. Short-term and long-term psychosocial adjustment and quality of life in women undergoing different surgical procedures for breast cancer. *Ann Surg Oncol*. 2007;14:3078-89.
7. Rubino C, Figus A, Loretto L, Sechi G. Post-mastectomy reconstruction: a comparative analysis on psychosocial and psychopathological outcomes. *J Plast Reconstr Aesthet Surg*. 2007;60:509-18.
8. Miller AM, Steiner CA, Barrett ML, Fingar KR, Elixhauser A. Breast reconstruction surgery for mastectomy in hospital inpatient and ambulatory settings, 2009-2014 [Internet]. Rockville, MD: Agency for Healthcare Research and Quality; c2017 [cited 2020 Nov 1]. Available from: [https://www.ncbi.nlm.nih.gov/books/NBK481368/pdf/Bookshelf\\_NBK481368.pdf](https://www.ncbi.nlm.nih.gov/books/NBK481368/pdf/Bookshelf_NBK481368.pdf).
9. Koshima I, Soeda S. Inferior epigastric artery skin flaps without rectus abdominis muscle. *Br J Plast Surg*. 1989;42:645-8.
10. Salgarello M, Barone-Adesi L, Visconti G. Double-pedicle DIEP and SIEA flaps and their application in breast reconstruction. In: Salgarello M, editor. *Breast reconstruction-current techniques*. Rijeka, Croatia: InTek. p. 171-6.

## 속가슴동맥의 역행성 분지: 유리피판술을 이용한 유방재건에서의 대안적 방법

한형민, 차보환, 이일재

아주대학교 의과대학 성형외과학교실

자가조직을 이용한 유방 재건술은 유방절제술 후 널리 이용되는 재건방법이다. 속가슴동맥 시스템은 자가조직을 이용한 유방 재건술에서 주요한 수용동맥으로, 이러한 수용동맥으로서 속가슴동맥의 역행성 분지를 이용한 경험을 보고하고자 한다. 오른쪽 유방에 침윤성 유관암을 진단받은 44세 여성이 유방 전절제술을 받고 심하 복벽 천공지 유리피판으로 재건술을 계획했다. 수술 중 동맥 부전증이 세 차례 발생하여 계획을 변경하고 속가슴동맥의 역행성 분지로 문합을 실시하기로 하였다. 속가슴동맥의 역행성 혈류량이 충분하였기에 수술 후 피판의 장기적 결과는 만족스러웠다. 이러한 방법은 일반적인 문합에서 동맥 부전증이 있는 경우 또는 한쪽 유방 재건을 위해 양측 유경 또는 겹침 피판인 경우에 유용할 수 있다.

**색인단어:** 유방성형술, 유리피판술, 가슴동맥, 유방암

**접수일** 2020년 11월 12일 **수정일** 2020년 11월 13일 **게재확정일** 2020년 11월 13일

**교신저자** 이일재

16499, 수원시 영통구 월드컵로 164, 아주대학교 의과대학 성형외과학교실

**TEL** 031-219-5614 **FAX** 031-219-5610 **E-mail** i00325@live.co.kr

**ORCID** <https://orcid.org/0000-0002-9478-6969>