

# Perforator Flaps Covering Alloplastic Materials in Full-Thickness Chest Wall Defects Reconstruction: A Safe Option?

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**Summary:** Large full-thickness chest wall reconstruction requires an alloplastic material to ensure chest wall stability, as well as a flap that provides good soft-tissue coverage. The choice not to use perforator flaps over any mesh or inert material is often based on the concern that the vascularization would be inadequate. However, perforator flaps have shown good results in several reconstructive fields, minimizing donor-site morbidity and offering versatility when local tissues are unavailable or affected by radiotherapy. In this study, we present 4 cases of patients with full-thickness chest wall defects that were repaired with a double Marlex mesh, acrylic cement (n = 2) or a double patch of Goretex (n = 2) in combination with perforator flaps (3 deep inferior epigastric artery perforators and 1 lumbar artery perforator flap). The results we obtained are encouraging, and we believe the use of perforator flaps in combination with alloplastic materials should be considered as a reliable option for full-thickness chest wall defect reconstruction. (*Plast Reconstr Surg Glob Open* 2017;5:e1289; doi: 10.1097/GOX.0000000000001289; Published online 25 May 2017.)

Large full-thickness chest wall defect reconstruction is based on 2 main pillars: an alloplastic material that ensures chest wall stability and provides adequate respiratory function and a flap that provides good soft-tissue coverage.<sup>1</sup> The selection of a particular synthetic material, among a vast array, is often dependent on a surgeon's preference.<sup>2</sup> However, the selection of a suitable flap for soft-tissue reconstruction continues to be a widely discussed issue. Historically, local pedicled muscle and myocutaneous flaps, including pectoralis major, latissimus dorsi, rectus abdominis, external oblique and trapezius flaps, have been utilized for this purpose.<sup>3</sup> Parallel to the progression of microsurgery, new options have begun to emerge, including perforator flaps.<sup>4,5</sup> However, these flaps are still underutilized in chest wall reconstruction, as it is assumed

that they have an inferior blood supply as compared with muscle flaps and are therefore not ideal for covering alloplastic materials used for bone reconstruction.<sup>3</sup>

The objective of this series of cases was to show that perforator flaps in combination with alloplastic materials could have a role in the restoration of full-thickness wall chest defects.

## CASE 1

A 48-year-old woman with an invasive ductal carcinoma (T4N1M0) on the left breast presented skin ulceration and rib invasion. After chemoradiotherapy, a modified radical mastectomy, axillary node lymph dissection, and chest wall resection with free surgical margins were performed including medial portions of the second to fifth ribs. The resulting 15-cm diameter defect was repaired with a double Marlex mesh with acrylic cement and covered by a deep inferior epigastric artery perforator (DIEP) flap of 36×22 cm, using both deep inferior epigastric pedicles. Receptor vessels were the thoracodorsal pedicle and a lateral thoracic vein and an intercostal artery (Fig. 1; Table 1).

## CASE 2

A 55-year-old woman with a long-standing history of bladder transitional cell cancer (T2b, N0, Mx) with mul-

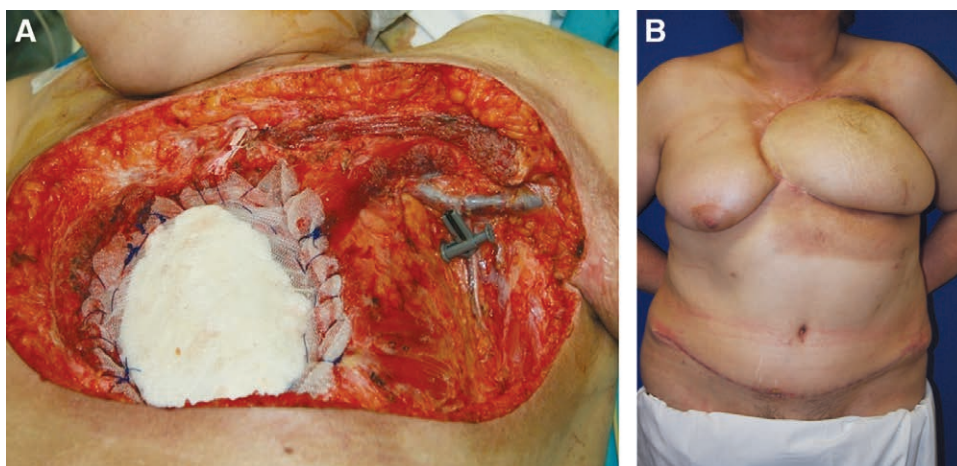
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**Fig. 1.** A 48-year-old woman with invasive ductal carcinoma on the left breast (T4N1M0). A, Chest wall defect after tumor resection with free margins. Skeletal reconstruction with a double Marlex mesh. B, Coverage with DIEP flap. One year postoperative.

tiple surgeries and chemoradiotherapy guide presented a recurrence in the left costal ridge detected 2 years after the last surgery. The chest wall resection included the posterior quarter of the tenth, eleventh, and twelfth ribs with a total defect of 25×10 cm. The thoracic wall was reconstructed with a double patch of Goretex covered by a propeller lumbar artery perforator flap of 24×10 cm. The donor site was primarily closed (Fig. 2; Table 1).

### CASE 3

A 73-year-old man with a history of malignant fibrous histiocytoma in the right axilla with a background of right scapulohumeral disarticulation and a long-standing treatment with chemoradiotherapy guide presented a recurrence 3 years later in the anterior chest wall. Resection of the mass with free margins included the medial third of the clavicle and the anterior third of the first and second ribs. The total defect was 11×10 cm that was repaired with a Goretex patch combined with a hemiDIEP flap of

24×14 cm. Receptor vessels were anastomosed to the contralateral internal mammary artery (Table 1).

### CASE 4

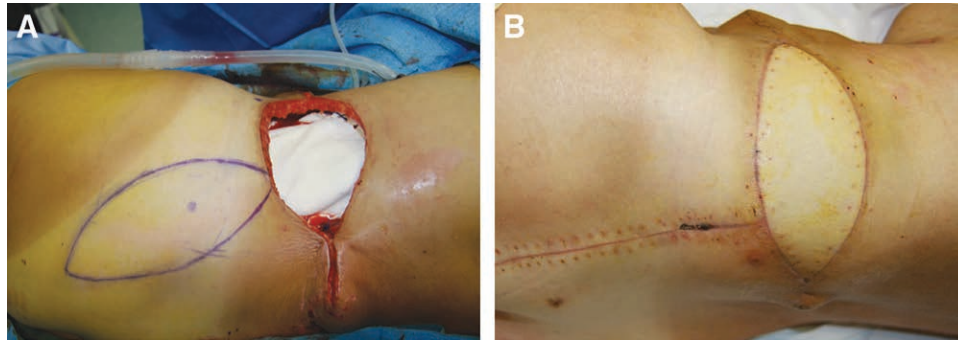
A 52-year-old woman with a history of left invasive ductal carcinoma (T2N2M0) treated by means of primary chemoradiotherapy and left radical mastectomy presented a chest wall recurrence after 6 months. The chest wall resection included part of the third, fourth, and fifth ribs with a resulting full-thickness chest wall defect of 8 cm in diameter and a soft-tissue defect of 20 cm in diameter. The bony reconstruction was performed with a double Marlex mesh with acrylic cement covered by a DIEP flap of 23×10 cm. The flap was transposed to cover the soft-tissue defect trying not to overlap the flap suture with the underlying sandwich suture (Table 1).

All patients had 2 years of follow-up except case 3 that had 6 months. Complications such as infection, partial or total flap necrosis, or wound dehiscence were not observed in any of the cases.

**Table 1. Summary of Most Relevant Data of the Cases**

Case	Sex	Age (y)	Pathology	Bone and Size Chest Wall Defect	Alloplastic Material	Type of Flap	No. Vascular Axis	Receptor Vessels	Complications	Follow-Up (y)
1	F	48	Breast cancer	Sternum + 4 ribs (15×14)	Marlex mesh + acrylic cement	DIEP	2 (Both deep inferior epigastric pedicle)	Thoracodorsal artery and vein—intercostal artery and lateral thoracic vein	Transitory respiratory distress syndrome	4
2	F	55	Bladder cancer	3 Ribs (25×10)	Goretex patch	LAP	1 (Perforator lumbar vessels)	—	None	2
3	M	63	Malignant fibrous histiocytoma	Clavicle + 2 ribs (11×10)	Goretex patch	HemiDIEP	1 (Deep inferior epigastric pedicle)	Internal mammary vessels	Partial necrosis in donor site	1
4	F	52	Breast cancer	3 Ribs (8×10)	Marlex mesh + acrylic cement	DIEP	1 (Deep inferior epigastric pedicle)	Internal mammary vessels	None	2

F, female; LAP, lumbar artery perforator; M, male.



**Fig. 2.** A 55-year-old woman with transitional bladder cancer metastasis in the left costal ridge (T2b, N0, Mx). A, Chest wall defect repaired by Goretex patch. Lumbar perforator propeller flap design. B, Final appearance 2 months after surgery.

### DISCUSSION

We reported 4 cases in which full-thickness chest wall defects were repaired by a very unusual technique: perforator flaps in combination with alloplastic material. Previous assertions have been limited to the muscle flaps for the coverage of alloplastic materials in chest wall reconstruction.<sup>6</sup> This asseveration is extended even when bony reconstruction is carried out employing osseous allograft instead of manufactured synthetic materials.<sup>7</sup> The main advantage of muscle flaps in these situations is the powerful blood supply they provide, preventing infection in the presence of inert materials. Moreover, they offer a heavy interface between skin and the synthetic mesh.<sup>3,6</sup> For this reason, perforator flaps are usually rejected for the reconstruction of this kind of defects. However, it remains a question if perforator flaps could provide a reliable and optimal blood supply even when inert material is present. Breast reconstruction field serves as a powerful example of the differences in the use of muscle and perforator flaps. During the last decade, we have witnessed how DIEP flaps have drastically substituted TRAM flaps. This fact means that the concern about the more precarious DIEP flaps' blood supply that could lead to a greater risk of vascular-related problems<sup>8</sup> is overcome by the advantages that perforator flaps offer: muscle sparing and less donor-site morbidity<sup>8</sup> and, most importantly, providing at the same time a reliable vascularization. Since Taylor described the concept of the perforator flap, a large number of articles have demonstrated the adequate blood supply of this type of flap.<sup>9</sup> Moreover, in breast reconstruction field, the use of perforator flaps (i.e., DIEP or superficial inferior epigastric artery) in combination with prosthetic material (breast implants), which represents a similar situation to that faced in this report, has shown no greater risk of infection nor complications related to vascularization.<sup>10</sup> Regarding thorax reconstruction, there is only 1 report in literature in which a full-thickness chest wall defect of 13 × 16.5 cm was repaired by a double Marlex mesh covered with 2 local perforator flaps with a successful outcome.<sup>11</sup> We have presented 4 cases in which perforator flaps (1 pedicled and 3 free) have been used for covering full-thickness chest wall defects successfully, despite the presence of inert material or radiotherapy. In all cases, perforators were identified using a handheld auditory Doppler at clinics and preoperative computed tomography angiography for confirma-

tion. Our experience suggests that they could have a more visible role in full-thickness chest wall reconstruction algorithm as a safe and effective option.

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### REFERENCES

1. Arnold PG, Pairolero PC. Chest-wall reconstruction: an account of 500 consecutive patients. *Plast Reconstr Surg.* 1996;98:804–810.
2. Deschamps C, Tirnaksiz BM, Darbandi R, et al. Early and long-term results of prosthetic chest wall reconstruction. *J Thorac Cardiovasc Surg.* 1999;117:588–591; discussion 591.
3. Losken A, Thourani VH, Carlson GW, et al. A reconstructive algorithm for plastic surgery following extensive chest wall resection. *Br J Plast Surg.* 2004;57:295–302.
4. Cordeiro PG, Santamaria E, Hidalgo D. The role of microsurgery in reconstruction of oncologic chest wall defects. *Plast Reconstr Surg.* 2001;108:1924–1930.
5. Geddes CR, Morris SF, Neligan PC. Perforator flaps: evolution, classification, and applications. *Ann Plast Surg.* 2003;50:90–99.
6. Bosc R, Lepage C, Hamou C, et al. Management of chest wall reconstruction after resection for cancer: a retrospective study of 22 consecutive patients. *Ann Plast Surg.* 2011;67:263–268.
7. Garcia-Tutor E, Yeste L, Murillo J, et al. Chest wall reconstruction using iliac bone allografts and muscle flaps. *Ann Plast Surg.* 2004;52:54–60.
8. Sailon AM, Schachar JS, Levine JP. Free transverse rectus abdominis myocutaneous and deep inferior epigastric perforator flaps for breast reconstruction: a systematic review of flap complication rates and donor-site morbidity. *Ann Plast Surg.* 2009;62:560–563.
9. Taylor GI, Palmer JH. The vascular territories (angiosomes) of the body: experimental study and clinical applications. *Br J Plast Surg.* 1987;40:113–41.
10. Figus A, Canu V, Iwuagwu FC, et al. DIEP flap with implant: a further option in optimising breast reconstruction. *J Plast Reconstr Aesthet Surg.* 2009;62:1118–1126.
11. Itano H, Andou A, Date H, et al. Chest wall reconstruction with perforator flaps after wide full-thickness resection. *J Thorac Cardiovasc Surg.* 2006;132:e13–e14.