

# Pedicled Perforator Flaps in Breast Surgery: a new concept

**Authors** M. Hamdi, F. Thiessen, H. Depypere

**Key words** Breast cancer, surgery, pedicled perforator flaps

## Summary

The treatment of early stage breast cancer with tumorectomy followed by postoperative radiotherapy, often referred to as breast conservation therapy (BCT), may be considered as an oncological equivalent to mastectomy in selected cases. It can be recommended to perform an immediate breast reconstruction whenever it is feasible and indicated. Depending on the amount of gland resection and the size of the breast, different techniques can be applied. In partial breast reconstruction for defects less than 30%

of the breast volume, pedicled perforator flaps should be the method of choice. The technique is indicated as a multidisciplinary approach for patients with ( $T_1$ - $T_2$ ) tumors. The concept can be safely applied to a large spectrum of clinical indications with lower complication rate and minimal donor site morbidity because it spares the latissimus dorsi muscle. This article summarizes a scientific thesis about the pedicled perforator flaps, which have been presented as a new concept in breast surgery.

(*BJMO* 2008;vol 2;5:288-92)

## Introduction

During the last decades there has been a tremendous evolution in reconstructive breast surgery resulting in a myriad of techniques and applications. The field of reconstructive surgery has taken a significant leap forward with the introduction of perforator flap surgery. In perforator flap surgery, only skin and subcutaneous tissue is utilized for reconstruction of defects in a more precise fashion with preservation of fascia, muscles and nerves according to the basic plastic surgical principle of 'replacing like with like'. *Koshima et al* introduced the terminology 'perforator flap' in 1989 (*Figure 1* on page 288).<sup>1</sup> The most important advantage of the perforator flaps is that the muscle can be left in its native place to serve its original function and minimize donor site morbidity.

During the 1990s, the use of perforator flaps for autologous breast reconstruction was developed in an effort to perform a safe, reliable, reproducible reconstruction with low donor site morbidity. The skin and subcutaneous fatty tissue of the lower abdomen provides adequate volume to achieve sym-

metric breast reconstruction. *Koshima et al* were the first to report the clinical use of the abdominal skin and fatty tissue based on the deep inferior epigastric artery perforator (DIEAP) without sacrificing the rectus muscle.<sup>1</sup> Since that time the DIEAP flap has been the gold standard for post-mastectomy reconstruction.<sup>2-6</sup> The main advantage of the DIEAP flap, as compared to the rectus abdominis musculocutaneous (TRAM) flap, is the complete preservation of the rectus abdominis muscle and the anterior rectus sheath in order to reduce the incidence of abdominal morbidity such as bulging, hernia and weakness.<sup>3-6</sup> In 1995, *Angrigiani et al* introduced the concept of raising the cutaneous portion of the latissimus dorsi flap without the muscle.<sup>7</sup> Since then, the thoracodorsal artery perforator (TDAP) flap was reported as a free flap for reconstruction after trauma or burns.<sup>8,9</sup> However, the use of a pedicled TDAP flap in breast reconstruction was first reported by our group.<sup>10</sup> Donor site morbidity after raising a pedicled perforator flap is reduced to an absolute minimum since the underlying muscles are left intact with their functional motor innervation. During the harvesting of

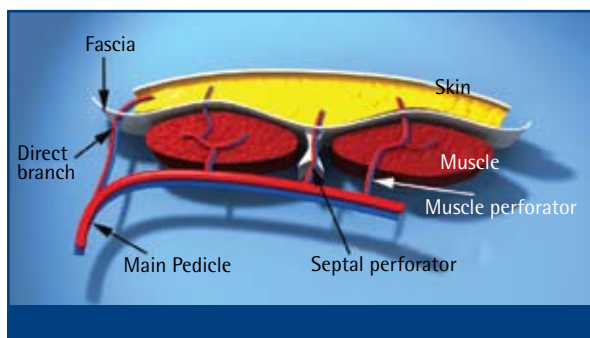


Figure 1. different types of perforators.

Table 1. Indications of pedicled perforator flaps

Immediate or delayed partial breast reconstruction following tumorectomy/quadrantectomy.
Post-mastectomy breast reconstruction in combination with an implant.
Breast augmentation with autologous tissue or correction of congenital asymmetry.
Reconstruction of shoulder and thoracic defects after oncological resections.

a perforator flap, the surgeon may change his initial plan and choose a different perforator, which arises from another vascular pedicle in the same territory. *Wei and Mardiri* referred to this strategy as free style flap harvesting.<sup>11</sup> Based on this concept, *Hamdi et al* reported several pedicled perforator flaps used in different indications.

In this thesis, the pedicled perforator flaps, which are considered as second generation perforator flaps, have been presented as a new concept in breast surgery. This concept can be safely applied to a large spectrum of clinical indications with lower complication rates as compared to the classical latissimus dorsi (LD) muscle flaps.

### Classification and indications of pedicled perforator flaps

Based on the ‘Ghent Consensus’, the pedicled perforator flaps that are commonly used for breast or thoracic reconstruction can be classified as follows:<sup>12</sup>

- the thoracodorsal artery perforator (TDAP) flap
- the intercostal artery perforator (ICAP) flap
- the serratus anterior artery perforator (SAAP) flap
- the superior epigastric artery perforator (SEAP) flap

Partial breast reconstruction is an original indication for the pedicled perforator flaps. Other indications are summarized in *Table 1*.

### Partial breast reconstruction with pedicled perforator flaps

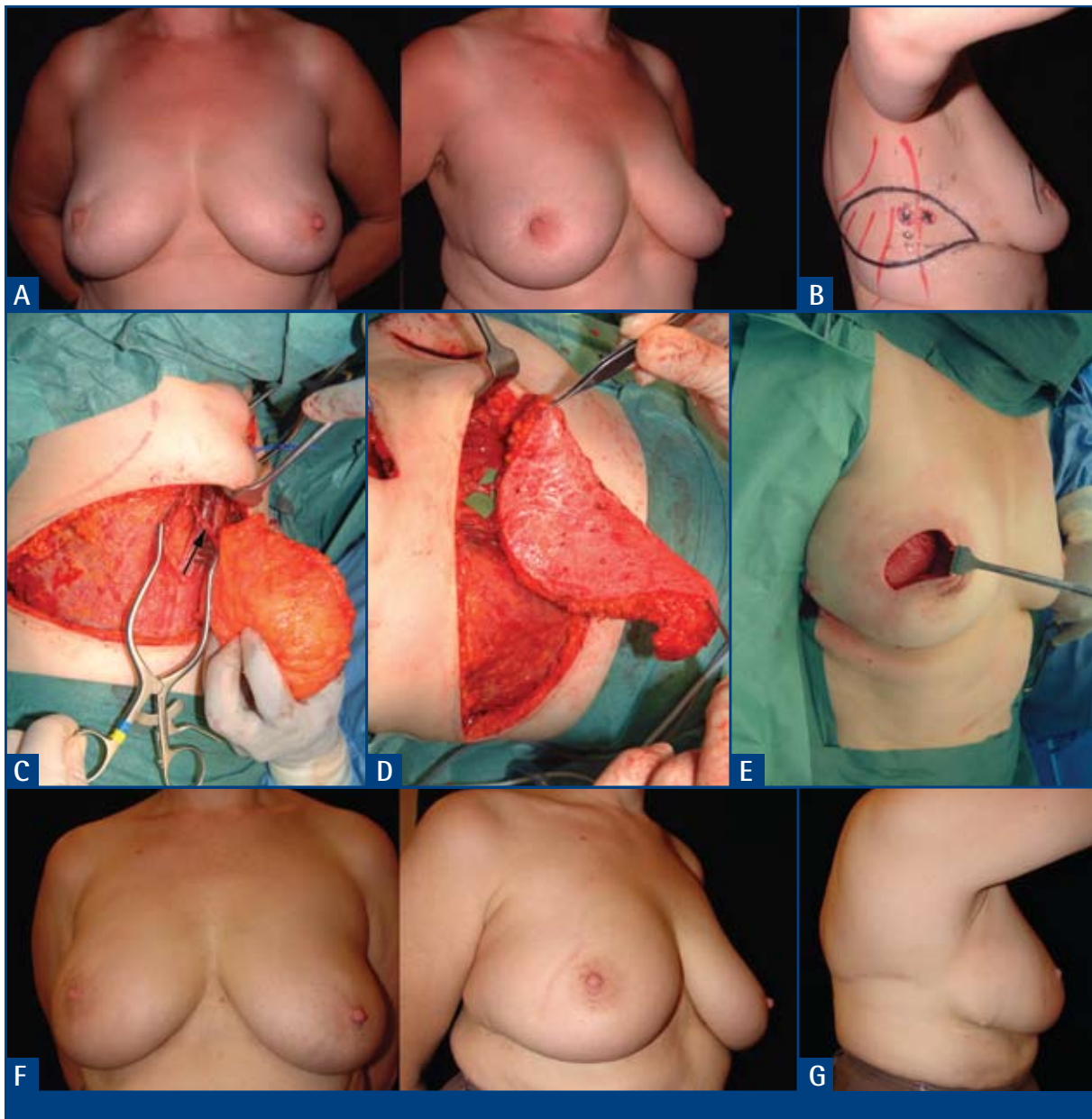
The treatment of early stage breast cancer by partial mastectomy followed by postoperative radiotherapy, often referred to as breast conservation therapy (BCT), may be considered as an oncological equivalent to mastectomy in selected cases.<sup>13,14</sup>

Most conditions that lead to the described poor aesthetic outcome following BCT are a result of the

surgical dilemma in the treatment of breast cancer. This dilemma arises because, on one hand wider excision is necessary to provide clear margins and better local control of breast cancer, whereas on the other hand sparing as much tissue as possible is necessary for defect closure and the resulting aesthetic outcome.<sup>15,16</sup>

Immediate reconstruction whenever it is feasible and indicated is preferred. To obtain a satisfactory aesthetic result, the created cavity should be filled with local or distant tissues before starting the irradiation, as operating on irradiated breasts has high complication rates and often yields poor aesthetic results.<sup>15-18</sup> During immediate reconstruction, the breast can be manipulated prior to irradiation, resulting in a lower complication rate and improved outcome.<sup>10,15-18</sup>

This technique is mainly indicated for T<sub>1</sub>-T<sub>2</sub> breast tumors. Depending on the amount of gland resection and the size of the breast, different techniques can be applied. When the defect does not exceed 30% of the breast volume, pedicled perforator flaps should be the method of choice in partial breast reconstruction. Pedicled perforator flap options include: the Thoraco-Dorsal Artery Perforator (TDAP) flap, the Lateral Intercostal Artery Perforator (LICAP flap), the Serratus Anterior Artery Perforator (SAAP) flap and the Superior Epigastric Artery Perforator (SEAP) flap.<sup>19-22</sup> In the presented clinical series, the TDAP flap was used most often (*Figure 2*). As previous surgery or radiotherapy can damage the thoracodorsal vessels, the vessels should be checked before the operation. Preoperative location of the perforator is essential for safe and straightforward flap dissection. Careful preoperative perforator mapping either by Doppler, or more recently using a multi-detector CT scan is one of the most important requirements for successful flap dissection.<sup>23</sup> The surgical technique of flap harvesting is generally accepted as a safe, reliable and reproducible



**Figure 2.** A case of a 53 year-old patient with a tumor (invasive ductal carcinoma), which was located in the right supero-lateral quadrant. (A) Preoperative views, (B) A pedicled (21 x 8 cm) TDAP flap was designed with a horizontal orientation over the lateral thoracic region with two perforators detected by unidirectional Doppler probe. (C) Intra-operative view shows dissection of one perforator (arrow) through the split LD muscle. The TD nerve branches to the LD muscle are spared. (D) The flap was completely de-epithelialized. (E) Setting the flap into the post-quadrantectomy defect (specimen weight 98g). (F) Postoperative views at 18 months postoperatively. (G) The donor site.

*From M. Hamdi Pedicled Perforator Flaps Reconstruction. In eds. Losken A, Hamdi M. Partial Breast Reconstruction: Techniques in Oncoplastic Surgery. St. Louis: Quality Medical Publishing. In press, Oct 2008. (\*Permission for figures obtained from publisher QMP)*

technique. The ability to convert the TDAP flap to different muscle sparing type of flaps in the case of an unfavorable anatomical situation is essential to avoid flap-related complications.<sup>19</sup> Functional evaluation of the shoulder after harvest-

ing the pedicled TDAP flap showed that the donor site morbidity was reduced to an absolute minimum.<sup>24</sup> In addition, seroma formation, which is a major postoperative complication after harvesting a latissimus dorsi flap, was not observed in any of the

## Key messages for clinical practice

1. Oncoplastic breast surgery is a nice illustration of the multidisciplinary approach to breast cancer, which offers wide and safe tumor resection together with an immediate breast reconstruction.
2. The pedicled TDAP flap is a reliable and safe flap and it should replace the classical latissimus dorsi flap in many indications in breast surgery.
3. Donor site morbidity after harvesting a TDAP flap is reduced to an absolute minimum.
4. New perforator flaps such as the LICAP, SAAP and SEAP represent the next era in perforator flaps.

donor sites of the TDAP flap.<sup>24</sup>

The LICAP flap has also been widely investigated in this thesis. The anatomy of the flap with the locations, distributions and relationships to the latissimus dorsi muscle and the serratus anterior vessels has been described.<sup>20-21</sup>

The location of the deformity influences the choice of flaps. Due to insufficient reach, laterally-based pedicled flaps (i.e., LD, LICAP, TDAP, lateral thoracic) are generally unsuitable for reconstruction of large defects of the medial breast quadrants. However, the pedicled Superior Epigastric Artery Perforator (SEAP) flap can be used in selected cases with small size defects.<sup>22</sup> The use of this SEAP flap in breast reconstruction has been also described in the presented thesis.

## Conclusion

During the past 7 years, the *concept of pedicled perforator flaps* has significantly refined the practice in breast surgery. Harvesting a flap without sacrificing the underlying muscle or the functional motor nerves characterizes this technique. Perforator flaps aim to reduce donor site morbidity to an absolute minimum, respecting one of the main adagios in medicine: *'primum non nocere'*. Partial breast reconstruction is an original indication for the pedicled TDAP flap. This technique is a nice illustration of the multidisciplinary approach for patients with breast cancer (tumors of less than 3 cm diameter). The close cooperation between the breast surgeon who does the resection and the plastic surgeon that performs the reconstruction has produced the best model in oncoplastic surgery.

## References

1. Koshima I, Soeda S. Inferior epigastric artery skin flaps without rectus abdominis muscle. *Br J Plast Surg* 1989;42:645.
2. Allen R, Treece P. Deep inferior epigastric perforator flap for breast reconstruction. *Ann Plast Surg* 1994;32:32.
3. Hamdi M, Weiler-Mithoff E, Webster M. Deep inferior epigastric perforator flap in breast reconstruction: experience with the first 50 flaps. *Plast Reconstr Surg* 1999;103:86-95.
4. Blondeel P. One hundred free DIEP flap breast reconstructions: a personal experience. *Br J Plast Surg* 1999;52:104-11.
5. Blondeel P, Vanderstraeten G, Monstrey S et al. The donor site morbidity of free DIEP flaps and free TRAM flaps for breast reconstruction. *Br J Plast Surg* 1997; 50:322.
6. Hamdi M, Blondeel P, Van Landuyt K, et al. Bilateral autogenous breast reconstruction using perforator free flaps: a single center's experience. *Plast Reconstr Surg* 2004;114(1):83-9.
7. Angrigiani C, Grilli D, Siebert J. Latissimus dorsi musculocutaneous flap without muscle. *Plast Reconstr Surg* 1995;96:1608-14.
8. Van Landuyt K, Hamdi M, Blondeel P, et al. The compound thoracodorsal perforator flap in the treatment of combined soft-tissue defects of sole and dorsum of the foot. *Br J Plast Surg* 2005;58(3):371-811.
9. Hamdi M, Van Landuyt K, Monstrey S, et al. A clinical experience with perforator flaps in the coverage of extensive defects of the upper extremity. *Plast Reconstr Surg* 2004;113(4):1175-83.
10. M. Hamdi, K. Van Landuyt, S. Monstrey et al. Pedicled perforator flaps in breast reconstruction: a new concept. *Br J Plast Surg* 2004;57(6):644-52.
11. Wei F, Mardini S. Free-style free flaps. *Plast Reconstr Surg* 2004;114(4):910-6.
12. Blondeel P, Van Landuyt K, Monstrey S, Hamdi M, Matton G, Allen R, et al. The "Ghent" consensus on perforator

tor flap terminology: preliminary definitions. *Plast Reconstr Surg* 2003;112(5):1378-83.

13. Veronesi U, Cascinelli N, Mariani L, et al. Twenty-year follow-up of a randomized study comparing breast-conserving surgery with radical mastectomy for early breast cancer. *N Engl J Med* 2002;347:1227-1232.

14. Fisher B, Anderson S, Bryant J. Twenty-year follow-up of a randomized trial comparing total mastectomy, lumpectomy, and lumpectomy plus irradiation for the treatment of invasive breast cancer. *N Engl J Med* 2002;347:1233-1241.

15. Berrino P, Campora E, Santi P. Postquadrantectomy breast deformities: classification and techniques of surgical correction. *Plast Reconstr Surg* 1987;79:567-571.

16. Clough K, Cuminet J, Fitoussi A, et al. Cosmetic sequelae after conservative treatment for breast cancer: classification and results of surgical correction. *Ann Plast Surg* 1998;41:471-481.

17. Hamdi M, Wolfli J, Van Landuyt K. Partial mastectomy reconstruction. *Clin Plast Surg* 2007;34:51-62.

18. Kronowitz S, Feledy J, Hunt K, et al. Determining the optimal approach to breast reconstruction after partial mastectomy. *Plast Reconstr Surg* 2006;117:1-11.

19. Hamdi M, Van Landuyt K, Hijawi J, et al. Surgical Technique in Pedicled Thoracodorsal Artery Perforator Flaps: A Clinical Experience with 99 patients. *Plast Reconstr Surg* 2008;121(5):1632-41.

20. Hamdi M, Van Landuyt K, de Frene D, et al. The versatility of the intercostal artery perforator ICAP flap. *J Plast Reconstr Aesth Surg* 2006;59(6):644-52.

21. Hamdi M, Spano A, Van Landuyt K, et al. The lateral intercostal artery perforators: anatomical study and clinical applications in breast surgery. *Plast Reconstr Surg* 2008;121(2):389-96.

22. Hamdi M, Van Landuyt K, Ulens S, et al. The Role of the

Multi-Detector CT Scan Images in Preoperative Perforator Mapping and Clinical Applications of the Superior Epigastric Artery Perforators Flaps. *J Plast Reconstr Aesthet Surg* 2008; in press.

23. Hamdi M, Van Landuyt K, Van Hedent E, et al. Advances in autogenous breast reconstruction: the role of preoperative mapping. *Ann Plast Surg* 2007; 58(1):18-26.

24. Hamdi M, Decorte T, Demuynck M, et al. Shoulder function after harvesting a thoracodorsal artery perforator flap. *Plast Reconstr Surg* 2008; in press.

## Correspondence address

Authors: M. Hamdi<sup>1</sup>, F. Thiessen<sup>1</sup>, H. Depypere<sup>2</sup>

<sup>1</sup>Department of Plastic and Reconstructive Surgery, University Hospital Ghent, Ghent, Belgium. <sup>2</sup>Breast and Menopause Clinic, University Hospital Ghent, Ghent, Belgium

Please send all correspondence to:

Prof. Dr. M. Hamdi

Department of Plastic and Reconstructive Surgery

University Hospital Ghent

De Pintelaan 185, 2K12C

B-9000 Ghent

Belgium

Tel: 0032 (0)9 332 60 40

Fax: 0032 (0)9 332 38 99

moustapha.hamdi@ugent.be

**Conflicts of interest:** the authors have nothing to disclose and indicate no potential conflicts of interest.