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Autologous breast augmentation with the lateral intercostal artery perforator flap in massive weight loss patients

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Summary The body contour deformities that develop in morbidly obese patients following bariatric surgery often involve the breasts. Mastopexy is virtually always required in the female massive weight loss patient, and breast augmentation is often an important adjunct to breast-lifting procedures. The lateral intercostal artery perforator (LICAP) pedicled flap provides ample material for autogenous breast augmentation in such patients.

Between June 2001 and June 2005, bilateral LICAP flaps were used as a method of autologous breast augmentation in six patients after massive weight loss.

Of the 12 pedicled LICAP flaps raised, the average flap dimension was 23.6 × 10.6 cm. Mean flap harvesting time was 60 min (range 45–75 min) for a single flap. All but two flaps were based on one perforator. All donor sites were closed primarily. Complete flap survival was achieved in all cases. A minor wound dehiscence occurred in two cases both of which healed secondarily. Patient satisfaction with both the appearance of their breasts and lateral axillary-thoracic region was high. The improved contour of the lateral axillary region was frequently noted as a significant benefit.

In massive weight loss patients, harvesting the lateral skin-fat excess based on the LICAP provides supple tissue for breast augmentation, while simultaneously improving the contour of this area frequently affected by skin excess. Additionally, harvesting these flaps without sacrifice of the underlying muscle eases postoperative recovery and reduces donor site morbidity.

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Obesity and its associated medical morbidities carry a substantial health risk. While massive weight loss allows improvement in health status and lifestyle, physical sequelae due to symptomatic skin redundancy still require

treatment.¹ Areas affected include the arms, breasts, abdomen, back and thighs. To completely address the treatment of patients following massive weight loss, body-contouring procedures are performed, often in multiple stages and tailored to each patient, to correct the functional and aesthetic impairment from skin redundancy.²

Lateral skin redundancy or 'side rolls' in the axillary-lateral thoracic area are difficult to address with liposuction alone. Surgical excision is necessary in most cases in order to provide a satisfactory body contour.² During body-contouring surgery, large perforators are frequently encountered in different areas of the body. These large vessels typically develop in areas with thick subcutaneous adipose tissue. After a bariatric procedure, much of the adipose tissue is absorbed as a result of metabolic changes. However, the associated blood vessels maintain their large diameter, as is often noted during panniculectomies on massive weight loss patients. Therefore, skin-fat flaps can be designed and based on any of these perforators throughout the body. Using this concept the 'side-rolls' that are typically so undesirable in the massive weight loss patient can be used for autogenous breast augmentation.

As reported here, pedicled flaps based on intercostal (IC) perforators were designed over the redundant 'side rolls' and used for autologous breast augmentation in massive weight loss patients. These are termed lateral intercostal artery perforator (LICAP) flaps.³ Two cases are described in detail.

Patients and methods

Between June 2001 and June 2005, 13 LICAP pedicled flaps were used in seven patients for autogenous breast augmentation. Of this group, six patients were seeking body contour improvements after massive weight loss. One patient was operated on for unilateral breast augmentation to address breast asymmetry and was therefore excluded from this series. All six patients presented breast ptosis and volume loss, and requested both larger and uplifted breasts, necessitating a combined mastopexy/breast augmentation. In the beginning of this series, two patients asked for mastopexy together with the removal of skin-fat tissue at the sides. We suggested using the side rolls to improve the outcome and they agreed. Mastopexy/breast augmentation with implants was required by the other four patients. Similarly, we suggested using the side rolls as autogenous filling materials for breast augmentation. None of these patients had any major medical condition that

might be a contraindication for a longer surgical procedure (all patients were New York Heart Association classification II). All the patients underwent a general medical examination and they were referred by the morbid obesity board in our hospital. Patients' characteristics are summarised in Table 1.

Operative technique

The surgical markings are made before surgery in a standing position. Mastopexy procedures can be done at the time of breast augmentation or staged. In the case of combined procedures (LICAP flap + mastopexy), the mastopexy is first marked in a vertical scar mammoplasty pattern. As in any combined augmentation/mastopexy procedure, incision lines should be drawn conservatively, anticipating the added volume of the implant or, in this case, flap. The horizontal extent of the reduction pattern is determined during surgery, after harvesting and inseting the flap.

Flap marking

The flap is designed lateral to the breast over the axilla and lateral thoracic area. The anterior border of the flap should include the junction of the inframammary fold (IMF) with the anterior axillary line. This allows the donor site to be closed as an extension of the mastopexy scar at the IMF. The width of the flap depends on skin redundancy and varies between 9 and 13 cm. The flap is extended posteriorly following relaxed skin tension lines and generally parallels the orientation of the ribs. Flap length can be up to 25 cm.

The perforators are then located with a unidirectional Doppler. The closest perforator to the breast, the most anterior one, is the ideal one to include within the flap as this maximises the arc of rotation of the flap. The flap markings may need to change slightly depending on the location of the perforators.

Surgical technique

The patient is placed in a supine position. The arms are disinfected and placed at 90° abduction on side tables. The arms are kept free to be lifted in order to facilitate harvesting the distal part of the flap. A posterior approach is made first with an anterior extension at the inferior border of the flap to explore the perforators and to allow easy elevation of the flap. The incision is developed to expose the latissimus dorsi (LD) muscle. The dissection plane is above the muscle fascia. After visualisation of the

Table 1 Patients' characteristics

Patient no.	Age (years)	Type of bariatric surgery	Weight at breast augmentation surgery (kg)	Weight loss (kg)	Smoking history
1	54	Bypass	75	60	no
2	51	Gastric band	81	60	yes
3	51	Gastric band	74	45	yes
4	46	Gastric band	95	60	no
5	40	Bypass	88	55	yes
6	49	Gastric band	85	35	no

anterior border of the LD muscle, the smaller posterior branch of the LICAP is identified. According to our findings,⁴ this branch can be followed back to a larger anterior branch. Several intercostal perforators may be encountered between the LD and pectoral major muscle. No large perforators should be sacrificed until a similar or larger one is found closer to the pectoral major muscle. Once the largest perforator is found, surrounding tissue is freed. The serratus anterior muscle is split and the perforator is dissected until its exit above the rib. A pedicle length of 3–5 cm is usually adequate to both reach the medial area of the breast and to fold the flap on itself in order to fill the central part of the breast.

If a longer pedicle is required, dissection of the main pedicle can proceed within the costal groove. Once dissection of the perforator is complete, the rest of the flap is elevated easily above the muscle fascia. The inferior incision of the flap is then extended into the IMF. The breast gland is dissected and a retroglandular pocket is prepared for the flap. The flap can be folded or contoured to maximise breast aesthetics as in autologous breast reconstruction after mastectomy.

The donor site is closed primarily. If a mastopexy is planned simultaneously, a skin mastopexy technique can be safely used. In cases of simultaneous augmentation/mastopexy, the nipple–areola complex is raised and excess skin de-epithelialized following design of the mastopexy. Some glandular plication sutures may be added to increase breast projection if needed. Surgical drains are left in the breast and donor site. Pressure dressings should be avoided during the first 2–3 weeks to avoid any compression of the perforators.

Results

Twelve pedicled LICAP flaps were raised in six patients (Table 2). The average flap dimension was 23.6 × 10.6 cm. The dominant perforators were found near the junction of the IMF with the anterior axillary line (4th–6th ICS). The perforators were dissected through the muscles (serratus, intercostal) but no dissection was necessary within the costal groove. Mean flap harvesting time was 60 min (range 45–75 min) for a single flap. A combined autologous augmentation and mastopexy was performed in three patients. Total operative time (LICAP flap + mastopexy) was 3.5 h on average. All donor sites were closed primarily. Two drains were left in the donor site and the breast. Mean hospital admission was 4 days (range 3–5 days). Complete flap survival was achieved in all cases. Patient satisfaction

with both postoperative breast aesthetics and the axillary-lateral thoracic contour was high. Scar revision at the donor site was required in two patients 3–6 months postoperatively. Corrections were coordinated with other body-contouring procedures.

Case 1

A 40-year-old patient, status post gastric bypass surgery and 55-kg weight loss (Fig. 1a), presented with bilateral breast ptosis and poor skin elasticity. The nipple-to-sternal notch distance was 35 cm. A 24 × 11 cm LICAP flap was designed (Fig. 1b). Two intercostal perforators were identified with unidirectional Doppler in the 5th ICS (Fig. 1c). Both perforators were dissected within the serratus anterior muscle (Fig. 1d). The flaps were de-epithelialized and folded into a retroglandular pocket bilaterally (Fig. 1e). A mastopexy was performed with an L-scar extending to the donor site, which was closed primarily (Fig. 1f). The patient is shown at 6 months postoperatively (Fig. 1g). Pre- and postoperative views of the lateral thorax are shown in Fig. 1h and i.

Case 2

A 51-year-old female patient, who underwent gastric banding and lost 60 kg, presented requesting both a breast lift and augmentation together with excision of bilateral excess skin in the lateral thoracic region. We suggested using this skin-fat excess for bilateral breast augmentation based on perforators from the intercostal vessels. A large LICAP flap measuring 24 × 11 cm was outlined over this region (Fig. 2a). A large intercostal perforator was found at the junction of the IMF with the anterior axillary line (5th ICS). The flap was completely de-epithelialized and contoured as an anatomical implant (Fig. 2b). A few sutures were used to secure the flap in a retroglandular pocket and the donor site was closed primarily. A mastopexy was performed simultaneously. Limited wound dehiscence occurred at the left donor site but healed spontaneously. Total flap survival was achieved and no evidence of firmness or fat necrosis was noted at her 2-year follow up (Fig. 2c and d).

Discussion

Massive weight loss following bariatric surgery frequently results in body contour deformities such as ptotic and hypoplastic breasts. In addition, redundant skin and subcutaneous tissue often develops in the lateral thoracic

Table 2 Results of flap surgery

Patient no.	Flap dimension (cm)	No. of perforators	ICS	Simultaneous mastopexy	Complication
1	26 × 11	1	5	no	no
2	24 × 11	1	5	yes	Wound dehiscence
3	22 × 10	2	4 & 5	no	Wound dehiscence
4	24 × 11	1	5	no	Seroma/infection
5	24 × 11	2	4 & 5	yes	no
6	22 × 10	1	6	yes	no

ICS = Intercostal space.

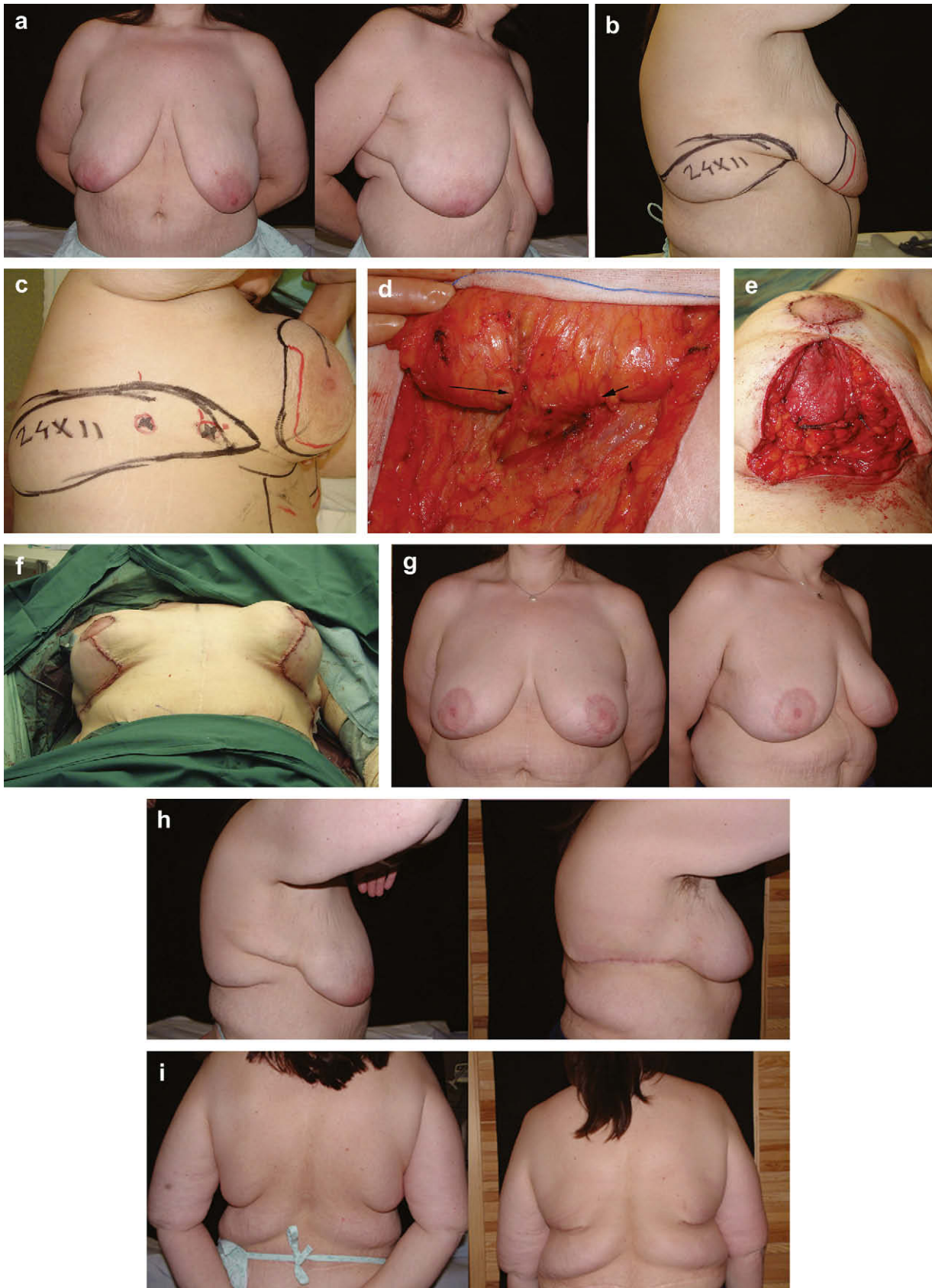


Figure 1 Simultaneous bilateral L-scar mastopexy with pedicled LICAP flap. a. Preoperative views. b. A 24 × 11 cm LICAP flap was designed on the side-back rolls. c. Two perforators were identified by Doppler in the 5th ICS on both sides. d. Dissection of perforators within the serratus muscle (arrows). e. The flap was de-epithelialized and positioned in a retroglandular pocket between the two glandular pillars of the mastopexy. f. Mastopexy with L-scar was performed at the end of surgery. g. Results at 6 months. h. Side rolls were excised by harvesting the LICAP flap. i. The back in pre- and postoperative views.

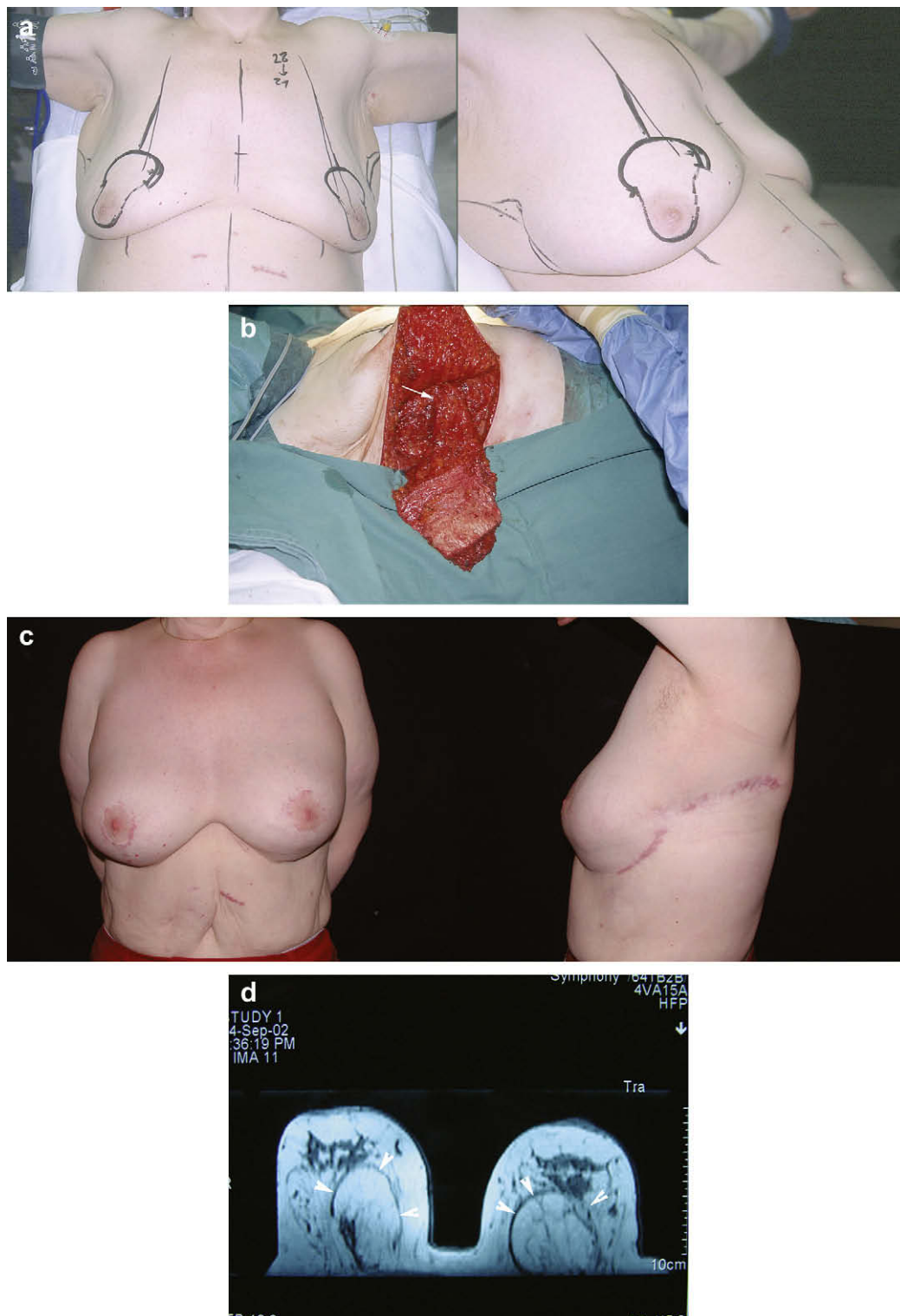


Figure 2 A simultaneous inverted-T mastopexy with pedicled LICAP flap. a. The flap designed over the skin-fat excess at the lateral sides. b. The (LICAP) flap was completely de-epithelialized and based on one perforator. c. The result at 2 years postoperatively. d. Magnetic resonance image shows survival of the flap without any fat necrosis.

and axillary regions of such patients. This excess tissue can be useful for autogenous breast augmentation in patients after massive weight loss. Multiple techniques including transfer of free gracilis musculocutaneous flaps⁵ have been described for breast augmentation in such patients.

Additionally, transfer of tissue from the lateral thoracic region on large dermal pedicles has been described without identification or dissection of axial blood vessels.¹⁰

While performing body-contouring surgery, large perforators are frequently encountered throughout the body.

These large vessels are frequently associated with areas of thick subcutaneous tissue, and seem to maintain their large calibre even after loss of associated subcutaneous fat following gastric bypass surgery. Therefore, fasciocutaneous flaps containing significant volumes of dermis and subcutaneous tissue can be designed over the lateral thorax and 'side rolls' near the breast, and used for autologous breast augmentation without the need for free tissue transfer. The LICAP was first reported in partial breast reconstruction within a clinical algorithm based on the location of the defect and the availability of these perforators.⁶ A case report of pedicled perforator flaps for breast augmentation was subsequently published.⁷ Recently, our clinical experience with ICAP flaps was reported.⁸ In this paper, we described the use of pedicled LICAP flaps in massive weight loss patients.

The largest or 'dominant' perforators are found between the 5th and 7th ICS in 84% of cases.⁴ The mean distance of these dominant perforators from the anterior border of the LD muscle varied between 2.77 and 3.68 cm⁴. Perforators located between the 4th and 6th ICS are usually chosen due to their ideal location for maximising the flap arc of rotation.

We recommend the simultaneous use of a superior pedicle vertical mastopexy and a LICAP flap, which is contoured and positioned similar to a retroglandular, anatomic implant. However, if the breast is very ptotic, a longer pedicle is necessary to re-position the areola–nipple complex. This may be a risky procedure because of the extensive glandular undermining from the pectoralis muscle that is required to position the LICAP flap in an appropriately retroglandular position. In these cases, it is safer to defer the mastopexy to a later stage. Secondary mastopexy can be planned and may not be inconvenient, as these patients often return for other body-contouring procedures.

Kwei et al. reported recently their experience in five patients after massive weight loss.⁹ The authors used a combination of a Wise-pattern mastopexy with a pedicled 'ICAP' flap for breast augmentation. We suggest use of the term 'LICAP' flap to more accurately describe the specific intercostal artery perforator being included within the flap, and to maintain consistent terminology with other perforator flap literature.^{3,8} The technique described by Kwei et al.⁹ does not include perforator dissection, and so it does not differ significantly from the technique described by Rubin et al.,¹⁰ in which the 'side rolls' are used in conjunction with a Wise-pattern mastopexy. Hurwitz and Agha-Mohammadi¹¹ described a similar technique with good results. A spiral flap, which was based on intercostal perforators, was extended on the lateral side of the breast. Identifying and dissecting the intercostal perforators was not required in both techniques.^{10,11} Rather the flap is dissected, de-epithelialized and rotated into position essentially as a random fasciocutaneous flap. Obviously, perforator dissection is not necessary if the flap can easily reach the desired pocket. However, it should be stressed that perforator dissection significantly increases the arc of rotation of the LICAP flap beyond the lateral breast, which is frequently the limit of flaps in which the perforator is not directly dissected. Perforator dissection allows rotation of the flap well into the superomedial portions of the breast, which are frequently precisely the areas of the breast most in need of augmentation following massive

weight loss. A careful preoperative evaluation of the breast will help determine where the volume deficiency is greatest, and therefore how extensive the perforator dissection needs to be. Dissection of the LICAP flap is quick, and does not increase the morbidity risk to patients since they often require excision of the redundant skin-fat tissue at the sides. Nevertheless, massive weight loss patients may have many underlying diseases that may be contraindications for long surgery or may compromise wound healing. A thorough preoperative general check up is mandatory before scheduling multiple body-contouring procedures.

In conclusion, the introduction of the perforator concept in flap surgery has resulted in significant progress in the field of reconstructive surgery during the last decade. The intercostal perforator flaps provide valuable options in both breast surgery and the reconstruction of challenging defects of the trunk. Indications of the LICAP flap can be expanded to patients after massive weight loss. The LICAP flap provides ample tissue for autogenous breast augmentation combined with mastopexy, with very limited donor site morbidity. Indeed, the impact on the donor site in the massive weight loss patient has been demonstrated here to be a significant advantage of this flap over prosthetic implants. We expect the combination of autologous breast augmentation with improved lateral thoracic contouring to result in a significant increase in the use of the LICAP flap in patients presenting for body contouring after massive weight loss.

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