Esthetic outcomes of using latissimus dorsi flap for breast reconstruction after breast-conserving surgery

Mahmoud Abdelbaky Mahmoud[a], Mohamed A. Amin Saleh[b]

Departments of [a]General Surgery, [b]Plastic Surgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt

Correspondence to Dr. Mahmoud Abdelbaky Mahmoud, MD, Department of General Surgery, Faculty of Medicine, Ain Shams University, Postal/zip code: 653298. Mob: 01011832904; fax: 0236598569; e-mail: mahmoudhamza2222@gmail.com

Received 15 March 2019
Accepted 21 April 2019

The Egyptian Journal of Surgery
2019, 38:643–655

Background
Lesion location and the volume of breast excised in correlation to the total breast volume are cornerstone issues in oncoplastic surgery after surgical breast-conserving surgery affecting the esthetic management plan and protocol implemented.
Aim of the study
Verifying the value of using latissimus dorsi (LD) myocutaneous flaps in secondary breast reconstruction after surgical breast conservation.
Patients and methods
A total of 73 cases that have undergone unilateral surgical breast conservation and postoperative radiotherapy, subsequently followed by secondary reconstruction of the breast using the latissmus dorsi as a myocutaneous flap at Ain Shams University Hospital and Bahya Hospital of Breast Cancer between January 2015 and January 2018.
Results
Binary logistic regression statistical analysis have shown that preoperative overall esthetic score was the only significant predictor of having postoperative excellent/very good esthetic score ($P<0.005$). Neither age, BMI, location of the tumor, nor duration between surgical breast conservation and LD myocutaneous flap was statistically significantly correlated with postoperative esthetic outcomes.
Conclusion
The current research study verifies the usefulness of LD flap in the restoration of adequate esthetic outcomes required after surgical conservative manner of breast tumor removal; however racial, ethnic, and anatomical differences should be considered in future research

Keywords:
breast reconstruction, breast conservative surgery, latissimus dorsi flap

Egyptian J Surgery 38:643–655

1110-1121

Introduction

Surgical breast conservation procedures in conjunction with radiation is recently considered the best standard mode of management for low-grade breast cancer as it provides satisfactory overall survival as mastectomy procedures [1–5].

Cosmetic outcomes after surgical breast conservation relies on two cornerstone issues: the lesion location and the volume of breast excised in correlation to total breast volume; therefore, if volume of breast excised is above 10–20%, esthetic outcomes and cases satisfaction are considerably affected. It could be linked to poor psychological levels of adjustment after performance of breast cancer management protocol [6–9].

Acceptable esthetic clinical results could be accomplished by innovating techniques after tumor excision with good guarantees for suitable and safe oncologic mass resection [10].

This mode of management is named oncoplastic surgical techniques interventions and it is recently continuously various in European breast management units. Researchers believe that oncoplastic surgical interventions could broaden the surgical and clinical value of surgical breast conservation and enhance the esthetic outcomes with affordable economic levels, subsequently causing a reduction in total mastectomies conducted [11].

Furthermore, surgical breast conservation in conjunction with latissimus dorsi (LD) flaps are well proven to provide better cosmetic impact, in comparison to radical modes of management, a considerable clinical gain for cases affected, if tumors are of grades I and II are put into consideration [12].

Aim of the study

The aim of this research study is to confirm the value of implementing latissimus dorsi myocutaneous flaps (LDMF) in breast reconstruction after surgical breast conservation.

Patients and methods

Patients with large breasts may accept or even welcome the option of a reduction in breast volume as a result of tumor excision, and the local defect may be best managed with a displacement technique and contralateral symmetrizing surgery. The study was approved by the ethical and scientific committee of the General Surgery Department, Ain-Shams University. But if the patient is keen to avoid contralateral surgery, volume replacement is an option. Smaller-breasted women who wish to avoid local defects and global loss of breast volume are better suited to volume replacement procedures. By choosing this rather than total mastectomy and immediate breast reconstruction, a woman is more likely to preserve the normal shape and sensation of most of her breast but must accept the need for adjuvant breast radiotherapy [13].

An LD miniflap can readily be used to fill a defect not only in the lateral aspect of the breast, but also in the central, medial, or lower pole of the breast with sufficient mobilization. Full dissection of the flap inferiorly to the costal margin and posteriorly beyond the scapula, combined with thorough division of all surrounding attachments, is essential in order to capitalize on the full potential of this flap to reconstruct a wide range of resection defects in almost any location.

forator flaps tend to have less range, although thoracodorsal artery perforator (TDAP) flap replacement of volume is reported in all quadrants. The intercostal artery perforator (ICAP) flap is best suited to the lateral aspect of the breast, but defects in the superior pole can be addressed if a pedicle of 3–5 cm can be harvested, as this allows rotation of the flap through 180° without torsion of the perforator [14].

The volume of the tissue required also affects the choice of flap. Hamdi and colleagues state that a muscle-sparing LD type III flap (i.e. most of the muscle is included with the flap) is used if the muscle is needed for volume. Most case series of perforator flaps do not provide details of the oncological surgery, but the median specimen weight in a series of LD miniflaps (equivalent to muscle-sparing LD type III flap) was 207 g compared with 164 g in a series of ICAP flaps [15].

Although the importance of prevention of cosmetic deformity after breast conservation is emphasized, there will always be a cohort of patients with a suboptimal result who require revisional surgery in the delayed setting [16].

Partial breast reconstruction with volume replacement is a mainstay of management in this situation. Patients must be informed of the full range of options available to them (including completion mastectomy and immediate whole breast reconstruction), and counseled carefully to allow them to make an informed choice about their treatment in the knowledge of the likely range of outcomes. Partial mastectomy/breast-conserving surgery (BCS) and reconstruction with LD concept BCS has become the 'standard of care' when breast cancer can be completely excised without significant loss of breast volume. The risk of major local deformity with distressing cosmetic results increases in step with the proportion of breast tissue excised. The larger the defect, the greater the chance of an unacceptable cosmetic result [17].

Immediate reconstruction of these defects with a subcutaneous LD miniflap prevents deformity and has extended the availability of BCS to a group of women traditionally treated by mastectomy. The technique questions the logic of removing the whole breast in a patient when at least 50% of the breast is entirely normal, with normal sensation, movement, and consistency. It compares favorably with skin-sparing mastectomy and immediate reconstruction, with fewer complications, less sensory loss, fewer revisional procedures, and better physical and cosmetic outcomes [13].

LDMF in which the surgeon makes an incision in the back near the shoulder blade and passes the oval section of the skin, fat, blood vessels, and muscle via a tunnel underneath the skin and arm to the chest. Once it is properly positioned, the mass is fashioned into a breast shape and is considered a privileged option when the breast size does not allow local tissues to be implemented, since it provides sufficient skin and volume for restoration of the breast to its original initial size. A priori it was concluded by oncoplastic research teams that LD flap procedures are adequate and suitable for volume and skin replacement of all breast quadrants; this practice protocol could be implemented for usage of this procedure for tumors situated in the lower half of the breast. On the other hand, oncoplastic surgeons in case scenarios of central tumors or those located behind the nipple–areola

complex skin-sparing mastectomy is a better surgical option in which the surgical procedure that involves the removal of all breast tissue and glands leaving the skin of the breast mostly intact. The skin is then used in breast reconstruction to make the breast look more natural [4].

When the LD flap is used for immediate breast reconstruction, the mastectomy or partial mastectomy must be completed before beginning the reconstruction. The mastectomy wound is packed with moist laparotomy pads, and isolated with a vinyl drape.

Positioning: one of the most important steps in the procedure is to ensure that the patient is correctly positioned and fixed on the operating table. The patient is turned on her side and placed in the lateral decubitus position, providing the surgeon with easy access to the LD muscle and the surrounding tissues. The patient is secured in the lateral decubitus position with the ipsilateral shoulder fixed at 90° of abduction, using a suitable arm rest. A support placed behind the scapulae helps to prevent lateral movement when the table is tilted to improve access to the deeper cavities which are developed when harvesting the flap. The surgeon normally stands behind the patient, facing the assistant, who stands in the front. Careful draping enables the surgeon to move freely from side to side, and also to gain access to the operation site from the head end of the table [18].

A paravertebral block with local anesthesia and urinary catheterization will support monitoring and early recovery. Repositioning of the patient to the lateral position of the patient (Ain Sham University Hospital and Bahya Specialized Breast Cancer Hospital).

The partial or complete mastectomy defect is created with the patient supine. In this position, the reconstructive surgeon is able to begin the harvesting of the LD muscle. The anterior border of the LD muscle is identified and the thoracodorsal neurovascular bundle is identified. From this vantage point, the thoracodorsal nerve may be ligated here. If stimulated, it will clearly show the LD muscle contracting and will eliminate any concern as to the identity of the nerve.

Once the neurovascular bundle to the LD muscle is identified, it is now time to place the patient in the lateral decubitus position for a unilateral reconstruction. Once the patient is repositioned, an elliptical incision is made on the previously marked surface of the skin paddle overlying the LD muscle. The skin island is then incised in a circumferential pattern down to the fascia of the LD muscle. Some authors recommend leaving a layer of deep adipose tissue below the superficial fascia. This technique is helpful for adding volume to the LDMF or for softening the contours of an implant-based reconstruction. The LD flap is mobilized incising the muscle along its margins, which are superior and lateral to the teres major muscle and superior and medial to the trapezius muscle. Anterolaterally, the LD muscle is adjacent to the serratus anterior muscle and inferior the muscle tapers and continuing the dissection posteriorly, using fingers to bluntly dissect the muscle off the underlying rib cage. When the posterior attachments of the flap are freed, its peripheral attachments are severed by sharp dissection at the level of the thoracolumbar fascia, using the unipolar or bipolar cautery to help limit thermal injury. Along the superior aspect of the dissection, care should be taken to identify and preserve the thoracodorsal pedicle, which should have been previously exposed during the axillary dissection. Preservation of the thoracodorsal pedicle is critical, as it provides the blood supply to the LD flap. Once the superficial dissection is completed and the LD muscle is delineated, dissection of the back must be performed in the deep plane. Once the scapula tip is reached, it is often necessary to release some attachments to the teres major muscles. At this point, the skin paddle is checked for capillary refill. It is helpful to suture the dermis of the skin paddle to the LD muscle fascia, preventing any potential shearing of the skin; with blunt dissection, a tunnel is created from the mastectomy defect into the axilla, and the tunnel enlarged sufficiently to allow the pedicle of the LD flap to be rotated into the mastectomy defect [19]. The donor site is typically closed after the LDMF is harvested and prior to transposition. The back wound is closed primarily over suction drains brought out the lateral caudal portion of the wound. The wound is generally closed in two layers' Scarpa's fascia is closed with interrupted 3–0 absorbable sutures along with the dermis in a separate layer, followed by a running 3–0 subcuticular Monocryl stitch placed superficially. A sterile occlusive dressing is applied. Once the back wound is closed, the patient is again rotated to the supine position to complete the reconstruction on the anterior chest wall. The vinyl drape overlying the mastectomy wound is removed, the patient is reprepped. A subcutaneous tunnel is created from the back through the upper portion of the axilla and into the anterior chest wall. This subcutaneous tunnel should be wide enough to permit the passage of

the LDMF but not too narrow to constrict the pedicle or muscle flap. Once the LDMF is transposed through the axillary tunnel and into the partial or complete mastectomy defect, it is now appropriate to inset the flap for reconstructive breast reconstruction [20].

The contralateral breast is used as a template for what would be considered appropriate volume and shape. The breast has three components that are critical to examine when performing reconstruction: the skin envelope, the volume of tissue, and how these two variables interact and create levels of breast ptosis. The LDMF for partial mastectomy defects can be tunneled subcutaneously into almost any portion of the breast for skin and parenchymal volume reconstruction. Lateral defects of the breast are relatively easier to reconstruct than medial defects, but the latter can be performed as well. Excess skin from the skin paddle can be deepithelialized, and the subcutaneous tissue along with the muscle can be used to reconstruct partial mastectomy defects. For skin-sparing mastectomies or standard mastectomies, the LDMF can be used to create small-sized to medium-sized breasts on the basis of the amount of subcutaneous adipose tissue that is transferred with the LDMF. Typically, a prosthetic implant in the form of a tumor excision (TE) or postoperative adjustable implant is recommended, but for some patients, this is not an option based on personal preference. The flap is then inset, using absorbable stitches to tack the muscle into the defect, and the skin paddle is then 'tailortacked' into the partial mastectomy defect. Next, the perfusion to the skin paddle is assessed. If there is any evidence of venous congestion or increased capillary refill, it is important to make sure that the axillary tunnel is wide enough to permit the transposition of the LDMF or the vascular pedicle is not under any tension or twisted. The patient is then placed in the sitting position almost to 90° to recreate normal anatomical landmarks. Once this is done, the symmetry and the volume of the reconstructed breast can be compared with that of the contralateral native breast. Final adjustments are then made between the skin paddle and the partial mastectomy defect. For defects that do not require skin reconstruction, the skin paddle can be deepithelialized and then the dermis and the muscle can be buried into the defect. In the situation where the LDMF is used to close a mastectomy defect without an implant, the LD muscle is typically inset over the pectoralis major muscle and fixed into place by using absorbable sutures. LDMF breast reconstruction without a prosthetic device is typically reserved for very small-breasted women, women who chose not to undergo prosthetic reconstruction, or situations where all that is required is chest wall coverage.

Methodology

We reviewed consecutive 73 cases that have undergone unilateral surgical breast conservation at Ain Shams University Hospital and Bahya Hospital for Breast Cancer between January 2015 and January 2018.

Inclusive research criteria implemented as regards the surgical secondary breast reconstruction using LDMF were cases having a mammary defect of more than around 20% and considerable nipple–areola complex positional asymmetry. Exclusive research criteria are cases having damaged thoracodorsal vessels in the preliminary breast conservative surgical intervention.

Outcomes were assessed using the specified esthetic scoring for the five implemented criteria (breast size symmetry, breast shape, breast scar appearance, position of nipple–areola complex, and most inferior breast point); the scores were determined by using the mode of values of two expert plastic surgery consultants, two junior plastic surgery residents, and a breast surgery nurse practitioner.

Results

A total of 73 women who underwent BCS for breast cancer were included in the current research study.

Table 1 shows the characteristics of the recruited study participants. The mean±SD age of the involved women was 56.2±11.1 years (range, 38–72 years). The mean ±SD of BMI was 26.7±4.1 kg/m^2 (range, 21.1–38.3 kg/m^2). In 29 (39.7%) cases of the recruited 73 study participants, the tumor was located within the upper region, in 21 (28.8%) cases, the tumor was in the

Table 1 Characteristics of the included women

Age (years)	
Range	38–72
Mean±SD	56.2±11.1
BMI (kg/m^2)	
Range	21.1–38.3
Mean±SD	26.7±4.1
Tumor location	
Upper	29 (39.7)
Central	21 (28.8)
Lower	23 (31.5)
Duration between BCS and LDMF (months)	
Range	3–39
Median (IQR)	22 (14–33)

Data presented as range, mean±SD; *n* (%); or range, median (IQR). BCS, breast-conserving surgery; IQR, interquartile range; LDMF, latissimus dorsi myocutaneous flap.

central region, whereas in 23 (31.5%) cases, the tumor was located within the lower region. The median duration between the surgical breast conservative procedure and LDMF performance have been 22 months (range, 3–39 months).

Table 2 shows that there was statistically significant improvement in the esthetic scoring for the five implemented criteria (breast size symmetry, breast shape, breast scar appearance, position of nipple–areola complex, and most inferior breast point), whereas the improvement has not been statistically significant for the nipple–areola complex size and shape, and color. The overall scoring level was statistically significantly improved [median (interquartile range) 7 (6–8) vs. 3 (2–4), consecutively, $P<0.001$]. There have been statistically significant improvement in the percentage of cases that had excellent/very good esthetic scoring [10 (13.7%) and 28 (38.4%) vs. 0 (0%) and 0 (0%), respectively, and consecutively, $P<0.001$].

Table 3 shows that binary logistic regression statistical analysis have shown that the overall preoperative esthetic score was the only significant predictor of having postoperative excellent/very good esthetic score ($P<0.005$). Neither age, BMI, location of the tumor, nor duration between surgical breast conservation and LDMF was statistically significantly correlated with postoperative esthetic outcome ($P=0.422$, 0.142, 0.598, 0.218, respectively) (Figs 1–4).

Table 2 Outcomes of latissimus dorsi myocutaneous flap in the included women

	Preoperative	Postoperative	*P*
Symmetry of breast size	0 (0–1)	2 (1–2)	<0.001[a]
Breast shape	1 (0–1)	1 (1–2)	<0.001[a]
Appearance of breast scar	0 (0–1)	1 (1–2)	<0.001[a]
NAC size and shape	1 (0–1)	1 (0–1)	0.098[a]
NAC color	1 (0–1)	1 (0–1)	0.121[a]
NAC position	0 (0–1)	1 (0–1)	<0.001[a]
Most inferior point of breast	0 (0–1)	1 (1–1)	<0.001[a]
Overall score	3 (2–4)	7 (6–8)	<0.001[a]
Overall score			
Excellent	0 (0)	10 (13.7)	
Very good	0 (0)	28 (38.4)	
Good	7 (9.6)	32 (43.8)	<0.001[b]
Fair	39 (53.4)	3 (4.1)	
Poor	27 (37)	0 (0)	

Data presented as median (interquartile range) or *n* (%). NAC, nipple–areola complex. [a]Analysis using Wilcoxon signed rank test. [b]Analysis using χ^2 test.

Table 3 Predictors of outcome of latissimus dorsi myocutaneous flap in the included women

Predictors of excellent or very good esthetic scores	OR (95% CI)	*P*
Age (years)	1.02 (0.97–1.07)	0.422
BMI (kg/m^2)	0.91 (0.83–1.04)	0.142
Tumor location	1.19 (0.63–2.24)	0.598
Duration between BCS and LDMF	1.03 (0.98–1.08)	0.218
Preoperative overall score	2.11 (1.25–3.57)	0.005

BCS, breast-conserving surgery; CI, confidence interval; LDMF, latissimus dorsi myocutaneous flap; OR, odds ratio. Analysis using binary logistic regression.

Discussion

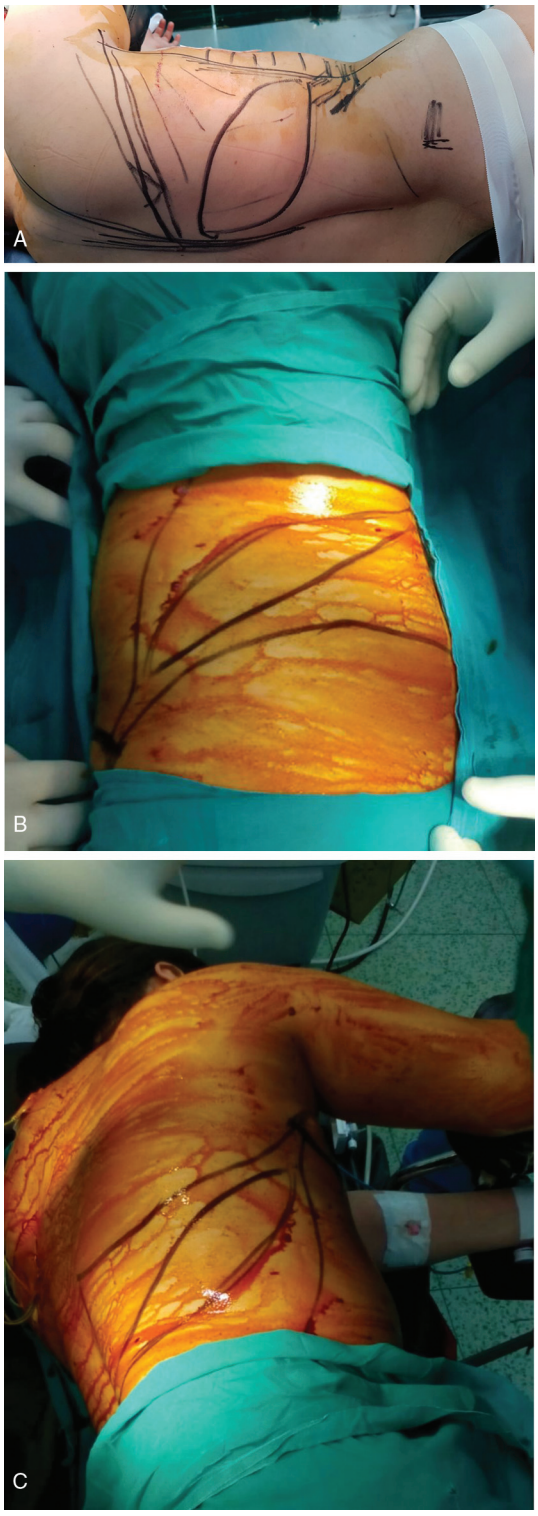
Neither size nor multifocality is an absolute contraindication for surgical breast conservation on the prerequisite that surgical excision margins are fully safe.

On the other hand, caution should be implemented to prevent unjustified extensive surgical practice of surgical breast conservation in the case scenarios of tumors above 4 cm. In a prior research series, five study participants investigated were observed to have multifocal tumors with four and two foci located within the same quadrant [10].

The current research study involved a total of 73 cases that have undergone surgical reconstruction after the breast conservation procedure for breast cancer using LDMF cases that were obtained from Ain Shams University Hospital and Bahya Oncology Hospital. The mean±SD age of the involved women was 56.2 ±11.1 years (range, 38–72 years). The mean±SD of BMI was 26.7±4.1 kg/m^2 (range, 21.1–38.3 kg/m^2). In 29 (39.7%) cases of the recruited 73 study participants, the tumor was located within the upper region, in 21 (28.8%) cases, the tumor was in the central region, whereas in 23 (31.5%) cases, the tumor was located within the lower region. The median duration between surgical breast conservative procedure and LDMF performance have been 22 months (range, 3–39 months).

Interestingly, there was a statistically significant improvement in the esthetic scoring for the five implemented criteria (breast size symmetry, breast shape, breast scar appearance, position of the nipple–areola complex, and most inferior breast point), whereas the improvement has not been

Figure 1



(a, b, c) Landmark of latissimus dorsi flap.

statistically significant for the nipple–areola complex size and shape, and color. The overall scoring level was statistically significantly improved [median (interquartile range) 7 (6–8) vs. 3 (2–4), consecutively, $P<0.001$]. There has been a statistically significant improvement in the percentage of cases that had excellent/very good esthetic scoring [10 (13.7%) and 28 (38.4%) vs. 0 (0%) and 0 (0%), respectively, and consecutively, $P<0.001$].

Binary logistic regression statistical analysis has shown that the preoperative overall esthetic score was the only significant predictor of having postoperative excellent/very good esthetic score ($P<0.005$). Neither age, BMI, location of the tumor, nor duration between surgical breast conservation and LDMF was statistically significantly correlated with postoperative esthetic outcomes ($P=0.422$, 0.140, 0.598, 0.218, respectively).

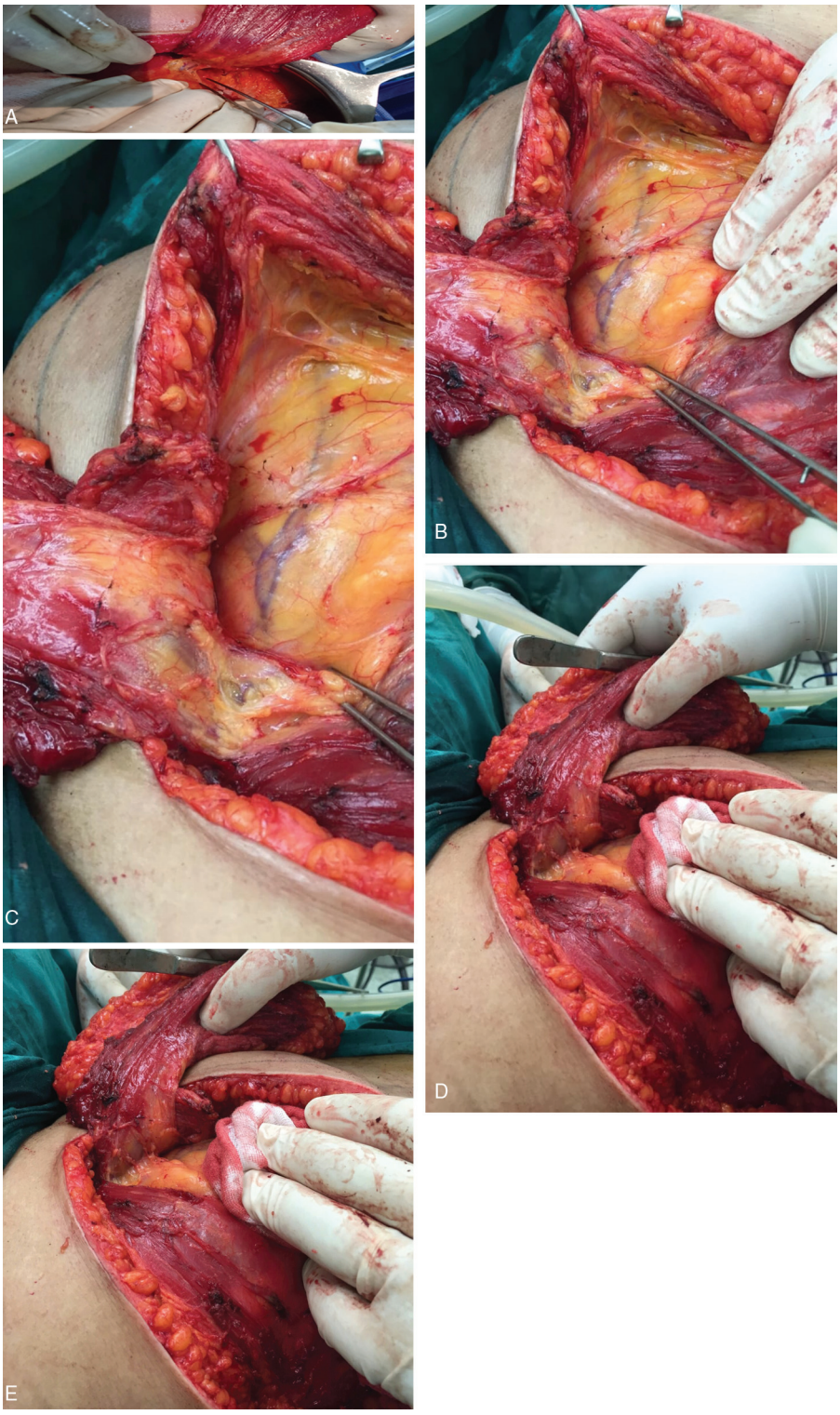
In a research study similar to the current study researchers obtained free surgical margins in all implemented cases as the study participants. The mean margin width has been 7.7 mm; only two study participants had a 'close margin.' Another research group implemented different protocols (e.g. skin tattoo marks) to calculate the resection required precisely, the percentage of incomplete margins had a range from 10 to 30%. This justifies why a two-stage surgical procedure is preferred by various researchers : to be capable as an oncoplastic surgeon to perform a second intervention that focuses on breast reconstruction once satisfactory margins are verified [11].

One of the chief privileges of oncoplastic surgical intervention is the probability of decreasing the number of surgeries; for that cause various surgical research groups support a one-stage surgical procedure, so long as adequate safe surgical margins are obtainable [1–3].

Patients with large breasts may accept or even welcome the option of a reduction in breast volume as a result of tumor excision, and the local defect may be best managed with a displacement technique and contralateral symmetrizing surgery. But if the patient is keen to avoid contralateral surgery, volume replacement is an option. Smaller-breasted women who wish to avoid local defects and global loss of breast volume are better suited to volume replacement procedures. By choosing this rather than total mastectomy and immediate breast reconstruction, a woman is more likely to preserve the normal shape and sensation of most of her breast but must accept the need for adjuvant breast radiotherapy [13].

An LD miniflap can readily be used to fill a defect in the lateral aspect of the breast, but also in the central, medial, or lower pole of the breast with sufficient

Figure 2

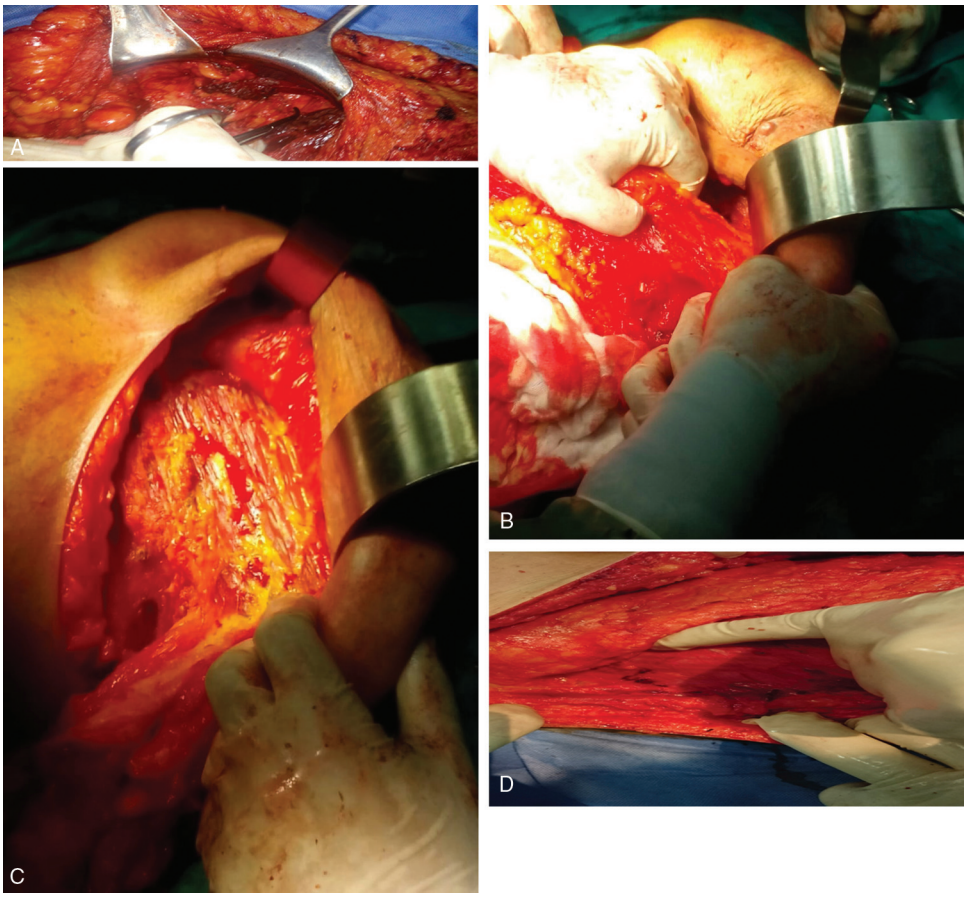


(a, b, c, d, e) Latissimus dorsi pedicle.

mobilization. Full dissection of the flap inferiorly to the costal margin and posteriorly beyond the scapula, combined with thorough division of all surrounding attachments, is essential in order to capitalize on the full potential of this flap to reconstruct a wide range of resection defects in almost any location.

Perforator flaps tend to have less range, although TDAP flap replacement of volume is reported in all quadrants. The ICAP flap is best suited to the lateral aspect of the breast, but defects in the superior pole can be addressed if a pedicle of 3–5 cm can be harvested, as this allows rotation of the flap through 180° without torsion of the perforator [14].

Figure 3



(a, b, c, d) Dissection of latissimus dorsi muscle.

The volume of tissue required also affects the choice of flap. Hamdi and colleagues state that a muscle-sparing LD type III flap (i.e. most of the muscle is included with the flap) is used if the muscle is needed for volume. Most case series of perforator flaps do not provide details of the oncological surgery, but the median specimen weight in a series of LD miniflaps (equivalent to muscle-sparing LD type III flap) was 207 g compared with 164 g in a series of ICAP flaps [15].

Although the importance of prevention of cosmetic deformity after breast conservation is emphasized, there will always be a cohort of patients with a suboptimal result who require revisional surgery in the delayed setting [16].

Partial breast reconstruction with volume replacement is a mainstay of management in this situation. Patients must be informed of the full range of options available to them (including completion mastectomy and immediate whole breast reconstruction), and counseled carefully, to allow them to make an informed choice about their treatment in the knowledge of the likely range of outcomes. Partial mastectomy/BCS and reconstruction with LD concept BCS has become the 'standard of care' when breast cancer can be completely excised without significant loss of breast volume. The risk of major local deformity with distressing cosmetic results increases in step with the proportion of breast tissue excised. The larger the defect, the greater the chance of an unacceptable cosmetic result. [17].

Immediate reconstruction of these defects with a subcutaneous LD miniflap prevents deformity and has extended the availability of BCS to a group of women traditionally treated by mastectomy. The technique questions the logic of removing the whole breast in a patient when at least 50% of the breast is entirely normal, with normal sensation, movement, and consistency. It compares favorably with skin-sparing mastectomy and immediate reconstruction, with fewer complications, less sensory loss, fewer revisional procedures, and better physical and cosmetic outcomes [13].

LDMF in which the surgeon makes an incision in the back near the shoulder blade and passes the oval section of

Figure 4

(a, b, c, d, e) Postoperative scar.

the skin, fat, blood vessels, and muscle via a tunnel underneath the skin and arm to the chest. Once it is properly positioned, the mass is fashioned into a breast shape and is considered a privileged option when the breast size does not allow local tissues to be implemented, since it provides sufficient skin and volume for restoration of the breast to its original initial size. A priori it was concluded by oncoplastic research teams that LD flap procedures are adequate and suitable for volume and skin replacement of all breast quadrants; this practice protocol could be implemented for usage of this procedure for tumors situated in the lower half of the breast. On the other hand, oncoplastic surgeons in case scenarios of central tumors or those located behind the nipple–areola complex skin-sparing mastectomy is a better surgical option in which the surgical procedure that involves the removal of all breast tissue and glands leaving the skin of the breast mostly intact. The skin is then used in breast reconstruction to make the breast look more natural [4].

When the LD flap is used for immediate breast reconstruction, mastectomy or partial mastectomy must be completed before beginning the reconstruction. The mastectomy wound is packed with moist laparotomy pads, and isolated with a vinyl drape.

Positioning: one of the most important steps in the procedure is to ensure that the patient is correctly positioned and fixed on the operating table. The patient is turned on her side and placed in the lateral decubitus position, providing the surgeon with easy access to the LD muscle and the surrounding tissues. The patient is secured in the lateral decubitus position with the ipsilateral shoulder fixed at 90° of abduction, using a suitable arm rest. A support placed behind the scapulae helps to prevent lateral movement when the table is tilted to improve access to the deeper cavities which are developed when harvesting the flap. The surgeon normally stands behind the patient, facing the assistant, who stands in the front. Careful draping enables the surgeon to move freely from side to side, and also to gain access to the operation site from the head end of the table [18].

A paravertebral block with local anesthesia and urinary catheterization will support monitoring and early

recovery. Repositioning of the patient to the lateral position (Ain Sham University Hospital and Bahya Specialized Breast Cancer Hospital).

The partial or complete mastectomy defect is created with the patient supine. In this position, the reconstructive surgeon is able to begin the harvesting of the LD muscle. The anterior border of the LD muscle is identified and the thoracodorsal neurovascular bundle is identified. From this vantage point, the thoracodorsal nerve may be ligated here. If stimulated, it will clearly show the LD muscle contracting and will eliminate any concern as to the identity of the nerve.

Once the neurovascular bundle to the LD muscle is identified, it is now time to place the patient in the lateral decubitus position for a unilateral reconstruction. Once the patient is repositioned, an elliptical incision is made on the previously marked surface of the skin paddle overlying the LD muscle. The skin island is then incised in a circumferential pattern down to the fascia of the LD muscle. Some authors recommend leaving a layer of deep adipose tissue below the superficial fascia. This technique is helpful for adding volume to the LDMF or for softening the contours of an implant-based reconstruction. The LD flap is mobilized incising muscle along its margins, which are superior and lateral to the teres major muscle and superior and medial to the trapezius muscle. Anterolaterally, the LD muscle is adjacent to the serratus anterior muscle and inferior the muscle tapers and continuing the dissection posteriorly, using fingers to bluntly dissect the muscle off the underlying rib cage. When the posterior attachments of the flap are freed, its peripheral attachments are severed by sharp dissection at the level of the thoracolumbar fascia, using the unipolar or bipolar cautery to help limit thermal injury. Along the superior aspect of the dissection, care should be taken to identify and preserve the thoracodorsal pedicle, which should have been previously exposed during the axillary dissection. Preservation of the thoracodorsal pedicle is critical, as it provides the blood supply to the LD flap. Once the superficial dissection is completed and the LD muscle is delineated, dissection of the back must be performed in the deep plane. Once the scapula tip is reached, it is often necessary to release some attachments to the teres major muscles. At this point, the skin paddle is checked for capillary refill. It is helpful to suture the dermis of the skin paddle to the LD muscle fascia, preventing any potential shearing of the skin; with blunt dissection, a tunnel is created from the mastectomy defect into the axilla, and the tunnel enlarged sufficiently to allow the pedicle of the LD flap to be rotated into the mastectomy defect [19]. The donor site is typically closed after the LDMF is harvested and prior to transposition. The back wound is closed primarily over suction drains brought out the lateral caudal portion of the wound. The wound is generally closed in two layers, Scarpa's fascia is closed with interrupted 3–0 absorbable sutures along with the dermis in a separate layer, followed by a running 3–0 subcuticular Monocryl stitch placed superficially. A sterile occlusive dressing is applied. Once the back wound is closed, the patient is again rotated to the supine position to complete the reconstruction on the anterior chest wall. The vinyl drape overlying the mastectomy wound is removed, and the patient is reprepped. A subcutaneous tunnel is created from the back through the upper portion of the axilla and into the anterior chest wall. This subcutaneous tunnel should be wide enough to permit the passage of the LDMF but not too narrow to constrict the pedicle or muscle flap. Once the LDMF is transposed through the axillary tunnel and into the partial or complete mastectomy defect, it is now appropriate to inset the flap for reconstructive breast reconstruction [20].

The contralateral breast is used as a template for what would be considered appropriate volume and shape. The breast has three components that are critical to examine when performing reconstruction: the skin envelope, the volume of tissue, and how these two variables interact and create levels of breast ptosis. The LDMF for partial mastectomy defects can be tunneled subcutaneously into almost any portion of the breast for skin and parenchymal volume reconstruction. Lateral defects of the breast are relatively easier to reconstruct than medial defects, but the latter can be performed as well. Excess skin from the skin paddle can be deepithelialized, and the subcutaneous tissue along with the muscle can be used to reconstruct partial mastectomy defects. For skin-sparing mastectomies or standard mastectomies the LDMF can be used to create small-sized to medium-sized breasts on the basis of the amount of subcutaneous adipose tissue that is transferred with the LDMF. Typically, a prosthetic implant in the form of a TE or a postoperative adjustable implant is recommended, but for some patients, this is not an option based on personal preference. The flap is then inset, using absorbable stitches to tack the muscle into the defect, and the skin paddle is then 'tailortacked' into the partial mastectomy defect. Next, the perfusion to the skin paddle is assessed. If

there is any evidence of venous congestion or increased capillary refill, it is important to make sure that the axillary tunnel is wide enough to permit the transposition of the LDMF or the vascular pedicle is not under any tension or twisted. The patient is then placed in the sitting position almost to 90° to recreate normal anatomical landmarks. Once this is done, the symmetry and the volume of the reconstructed breast can be compared with that of the contralateral native breast. Final adjustments are then made between the skin paddle and the partial mastectomy defect. For defects that do not require skin reconstruction, the skin paddle can be deepithelialized and then the dermis and the muscle can be buried into the defect. In the situation where the LDMF is used to close a mastectomy defect without an implant, the LD muscle is typically inset over the pectoralis major muscle and fixed into place by using absorbable sutures. LDMF breast reconstruction without a prosthetic device is typically reserved for very small-breasted women, women who chose not to undergo prosthetic reconstruction, or situations where all that is required is chest wall coverage. The latter clinical situations arise in the instance of inflammatory breast cancer where the adjuvant radiation therapy will be required. The partial or complete mastectomy skin flaps are then closed primarily or to the skin paddle under no tension. Typically one closed-suction drain is placed below the LDMF and brought out high in the axilla for optimal cosmoses. Breast reconstruction using the LDMF plus the insertion of a prosthetic device is a reliable and safe procedure with a relatively low complication rate. When complications occur, they originate either from the back donor site or at the site of the breast reconstruction site. The donor site complications such as seroma is a late complication that is initially managed with appropriate drain placement. Drains can remain up to 4–6 weeks after flap harvest. If the collection of serous fluid persists during routine postoperative visit, aspiration of the collection can be performed under sterile conditions. Interventional radiology can be helpful here for the proper placement of seroma drainage catheters.

Chronic seroma can lead to a serous cavity, in a small percentage of times requiring operative intervention to ameliorate.

Widened scars can occur at the donor site secondary to increased tension on the healing dermis. Appropriate maneuvers must be taken to not close the wound under tension. Placing the skin paddle in an oblique orientation parallel to Langer lines can lessen the tension on the closure of the wound.

Poor wound healing can occur at the donor incision site if too much soft tissue, that is (autologous) extended LD, is harvested by placing undue tension at the incision line. In addition, in this situation, the potential for seroma formation is higher.

If there are recipient site complications such as arterial or venous insufficiency of the skin paddle, the only way to monitor the vascularity of the LDMF is by clinically examining the skin paddle of the LD muscle. If the flap shows evidence of decreased inflow or compromised outflow, this situation must be acutely interrogated. Often times, the arm must be abducted as not to put pressure on an already swollen axillary tunnel. If positioning the patient does not improve the vascularity of the skin paddle, then urgent operative exploration must be undertaken. The vascular pedicle can be compressed or kinked. In addition, the skin paddle can be inset under too much tension. It is critical to confirm the thoracodorsal pedicle continuity before committing to flap harvest. Flap necrosis can occur but is a rare finding with the LDMF, as the blood supply to the muscle and skin paddle are extremely robust if harvested correctly. Partial flap necrosis requires operative debridement and closure as typically this will result in exposure of the implant if not appropriately addressed.

Complications related to the prosthetic device such as capsule formation, infection, migration, and rupture could all occur. Prosthetic infection is treated with culture-specific antibiotics but a low threshold for a removal must be considered especially in patients who have had previous radiation therapy or are undergoing chemotherapy. Creating a stable submuscular pocket at the time of the initial breast reconstruction prevents migration of the breast implant. Capsular contracture over a TE or permanent implant can occur and is treated by performing a partial or complete capsulectomy to recreate a soft tissue envelope around the implant. Adjuvant radiotherapy can lead to fibrosis of the skin envelope and potentially increase capsular contracture around the prosthetic implant.

Brachial plexus injuries occur from improper padding or positioning of the patient during the operative procedure. The axilla must be padded appropriately and care must be taken not to hyperextend the arm during dissection [21].

A frequent complication is donor-site seroma, with a rate of 20%; as reported by various research teams seromas appear after drain removal and require consecutive dorsal puncture and aspiration. This rate is not high taking into account that cases undergo nodal dissection; this surgical practice is considered a risk factor for seroma formation. Despite that, this complication could be easily handled and does not need additional surgical procedures. Complications involve tissue breakdown due to tissue necrosis, lumps in the reconstructed breast due to replacement of fatty tissue by the fibrous tissue due to deficient blood supply, muscle weakness due to loss of muscle mass making it difficult for patients to lift heavy objects on the affected side [5,6].

Prior research teams mentioned that trained observers accomplish statically significantly higher scoring levels than untrained ones. The scar of the breast reconstructed and its symmetrical appearance with the contralateral normal breast are cornerstone issues on the quantitative evaluation of overall cosmetic results than other research criteria. The surgeon should try to obtain adequate symmetry whereby preventing an apparent breast scar. [7,8].

Another research study similar to the current research in methodology shows no major recipient-site-related or donor-site-related complication within early and late course of the disease course of management, approving the safety of the usage of the LDMF on an irradiated breast. The research team observed that the nipple–areola complex was conserved in all cases; however, obvious deformities of the breast occurred before reconstruction due to considerable contracture, with 13 (87%) cases classified as poor or fair. In surgical reconstruction, scar contracture release followed by enhancement using LDMF considerably reestablished breast symmetry in a manner similar to the current research study findings that was verified by the postoperative result that 13 (87%) cases were classified as excellent, very good, or good. Furthermore, scoring for breast scar was raised in 14 study participants despite skin paddle exposure to the surface observed in 13 cases. This denotes that deformities of the breast can negatively influence breast scars. Among the seven research criteria, scoring for nipple–areola complex size/shape and color did not reveal or display any statistically significant change before and after breast surgical reconstruction. It is not difficult to justify this similar finding present in the current research as nipple–areola complex was conserved in all cases in both studies [12].

Conclusions and recommendations

The current research study innovatively explores oncoplastic breast reconstruction surgery using LD flap procedures; however, future research should take into consideration racial, ethnic, and initial breast size differences to verify further the usefulness of this intervention. Innovative implementation of technology by using a computer software to calculate accurately the breast volume and the volume required to be replaced by LD flap could upgrade the procedure effectiveness by accustoming the management according to the case scenario in which anatomical and shape variability of the breast should be respected by the surgeon.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Urban C, Lima R, Schunemann E, Spautz C, Rabinovich I, Anselmi K. Oncoplastic principles in breast conserving surgery. Breast 2011; 20 (suppl 3):S92–S95.

2 Tomita K, Yano K, Masuoka T, Matsuda K, Takada A, Hosokawa K. Postoperative seroma formation in breast reconstruction with latissimus dorsi flaps: a retrospective study of 174 consecutive cases. Ann Plast Surg 2007; 59:149–151.

3 Tomita K, Yano K, Matsuda K, Takada A, Hosokawa K. Esthetic outcome of immediate reconstruction with latissimus dorsi myocutaneous flap after breast-conservative surgery and skin-sparing mastectomy. Ann Plast Surg 2008; 61:19–23.

4 Tomita K, Yano K, Hosokawa K. Recovery of sensation in immediate breast reconstruction with latissimus dorsi myocutaneous flaps after breast-conservative surgery and skin-sparing mastectomy. Ann Plast Surg 2011; 66:334–338.

5 Berry MG, Fitoussi AD, Curnier A, Couturaud B, Salmon RJ. Oncoplastic breast surgery: a review and systematic approach. J Plast Reconstr Aesthet Surg 2010; 63:1233–1243.

6 Clough KB, Thomas SS, Fitoussi AD, Couturaud B, Reyal F, Falcou MC. Reconstruction after conservative treatment for breast cancer: cosmetic sequelae classification revisited. Plast Reconstr Surg 2004; 114:1743–1753.

7 Hirsch EM, Seth AK, Dumanian GA, Kim JY, Mustoe TA, Galiano RD, Fine NA. Outcomes of tissue expander/implant breast reconstruction in the setting of preconstruction radiation. Plast Reconstr Surg 2012; 129:354–361.

8 Kronowitz SJ, Robb GL. Radiation therapy and breast reconstruction: a critical review of the literature. Plast Reconstr Surg 2009; 124:395–408.

9 Hartzell TL, Hornicek FJ, Austen WG Jr. Latissimus dorsi flap closure of the irradiated clavicular wound. J Shoulder Elbow Surg 2008; 17:875–880.

10 Spear SL, Boehmler JH, Taylor NS, Prada C. The role of the latissimus dorsi flap in reconstruction of the irradiated breast. Plast Reconstr Surg 2007; 119:1–9; discussion 10-11.

11 11.Hernanz F, Regano S, Redondo-Figuero C, Orallo V, Erasun F, Gómez-Fleitas M. Oncoplastic breast-conserving surgery: analysis of quadrantectomy and immediate reconstruction with latissimus dorsi flap. World J Surg 2007; 31:1934–1940.

12 12.Tomita K, Yano K, Nishibayashi A, Fukai M, Miyasaka M, Hosokawa K. The role of latissimus dorsi myocutaneous flaps in secondary breast reconstruction after breast-conserving surgery. Eplasty 2013; 13:e28.

13 Gendy RK, Able JA, Rainsbury RM. Impact of skin-sparing mastectomy with immediate reconstruction and breast sparing reconstruction with mini flaps on the outcomes of oncoplastic breast surgery. Br J Surg 2003; 90:433–439.

14 Hamdi M, Van Landuyt K, Hijjawi JB, Roche N, Blondeel P, Monstrey S. Surgical technique in pedicled thoracodorsal artery perforator flaps: a clinical experience with 99 patients. Plast Reconstr Surg 2008; 121:1632–1641.

15 Munhoz AM, Montag E, Arruda E, Brasil JA, Aldrighi JM, Gemperli R, Ferreira MC. Immediate conservative breast surgery reconstruction with perforator flaps: new challenges in the era of partial mastectomy reconstruction?. Breast 2011; 20:233–240.

16 Van Geel AN, Lans TE, Haen R, Tjong Joe Wai R, Menke-Pluijmers MB. Partial mastectomy and m. latissimus dorsi reconstruction for radiation-induced fibrosis after breast conserving cancer therapy. World J Surg 2011; 35:568–572.

17 Cochrane RA, Valasiadou P, Wilson AR, Al-Ghazal SK, Macmillan RD. Cosmesis and satisfaction after breast conserving surgery correlates with the percentage of breast volume excised. Br J Surg 2003; 90:1505–1509.

18 Rainsbury RM. Immediate latissimus dorsi mini flap volume replacement for partial mastectomy: use of intra operative frozen sections to confirm negative margins. Am J Surg 2008; 196:512–518.

19 Munhoz AM, Montag E, Gemperli R. Current aspects of therapeutic reduction mammaplasty for immediate early breast cancer management: an update. World J Clin Oncol 2014; 5:1–18.

20 Ismail J, Manfred K, Jean Y. Petit atlas of breast surgery. Ismail J, Manfred K, Jean YP. Atlas of breast surgery, plastic and reconstructive breast surgery. Berlin Heidelberg: Springer-Verlag; Springer E-Book; 2006.

21 Laws SA, Cheetham J, Rainsbury RM. Temporal changes in breast volume after surgery for breast cancer and the implications for volume replacement with the latissimus dorsi myosubcutaneous mini flap. Eur J Surg Oncol 2001; 27:790–795.