Assessment of the technique of lipofilling of latissimus dorsi muscle flap for immediate breast reconstruction after mastectomy

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Background
Breast cancer is the commonest cancer among women, accounting for ~30.7% of all incident cancers among women. Conservative mastectomies such as skin-sparing mastectomy and nipple-sparing mastectomy aim for breast reconstruction, thus improving the quality of life and the psychological damages in patients with breast cancer. Breast reconstruction can be done either immediately or delayed, using prosthesis as implants or temporary expanders or autogenous tissue as flaps from the anterior abdominal wall as the transverse rectus abdominis myocutaneous flap (TRAM) or deep inferior epigastric artery perforator flap (DIEP) flaps or from the back as the latissimus dorsi (LD) flap.

Aim
The present study assesses the lipofilled LD muscle flap in immediate autologous breast reconstruction after mastectomy as regards feasibility, complications, and cosmetic outcome.

Patients and methods
The present study was conducted on 20 patients with breast cancer, who were candidates for skin-sparing mastectomy, nipple-sparing mastectomy, or skin-reducing mastectomy and aiming for complete autologous breast reconstruction. Patients were admitted to the Surgical Oncology Unit, Alexandria Main University Hospital.

Results
Majority of patients (12 patients) were of age less than 50 years with a BMI ranging from 23.2 to 35. Fourteen (70%) patients had moderate breast size (cup B) and 12 patients received neoadjuvant chemotherapy. Operative time ranged from 105 to 225 min. Size of the flap ranged from 150 to 300 cm^2 with the harvested fat ranging from 180 to 300 ml. Complications were detected in six patients mostly back seroma and one case of flap necrosis and wound dehiscence and one case of LD muscle twitches. Most of the patients were very to moderately satisfied with the final outcome with two cases needed relipofilling after a follow-up for about 18 months.

Conclusion
Lipofilling of the LD myocutaneous flap aiming for breast reconstruction following mastectomy is an easy, versatile technique that overcomes the drawback of the small-sized LD flap and need for implants. The technique shows excellence in terms of neoadjuvant setting and in correction of complication of implants.

Keywords:
breast cancer, breast reconstruction, lipofilled latissimus dorsi flap, modified radical mastectomy, nipple-sparing mastectomy, skin-reducing mastectomy, skin-sparing mastectomy

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Introduction

Modified radical mastectomy remains an integral surgical tool for breast cancer management indicated in cases of multicentricity, diffuse microcalcifications, inflammatory breast cancer, and prior radiation therapy to the breast or chest wall [1].

Skin-sparing (SSM) and nipple-sparing (NSM) mastectomies (often called conservative mastectomies) are relatively new conservative surgical approaches to breast cancer. In SSM, the whole breast tissue and parenchyma is removed, while most of the breast skin is conserved to create a pocket for immediate breast reconstruction with implant or autologous graft to achieve a proper cosmetic outcome. NSM is closely similar except that the nipple–areola complex (NAC) is also conserved [2]. Both techniques are associated with superior esthetic

outcomes and increased patient satisfaction in comparison to nonconservative mastectomies [3].

Following mastectomy, breast reconstruction reduces anxiety and improves the quality of life for many patients. Breast reconstruction can be done either immediately or delayed, using prosthesis or autogenous tissue [4].

Autologous reconstruction can be done though flaps from the anterior abdominal wall as transverse rectus abdominis myocutaneous flap (TRAM) or deep inferior epigastric artery perforator flap (DIEP) flaps or from the back as the latissimus dorsi (LD) flap. The TRAM flap employs the redundant excess lower abdominal tissue typically removed during a cosmetic abdominoplasty that is brought to the mastectomy defect as a pedicled flap. This flap provides considerable tissue bulk, but it is technically a difficult surgical procedure, and carries with it a greater risk of complications including flap necrosis, seroma, and wound dehiscence [4,5]. A DIEP flap is more technically difficult and requires the use of microvascular procedures [6].

Since its first description by Tansini in 1906 and contemporized by Bostwick in 1978, the LD flap is a popular choice for autologous breast reconstruction [7]. However its utility is limited by its inability to provide sufficient volume [8]. One common strategy for enhancing breast volume in LD flap procedures is inserting an implant, but this procedure is associated with inherent risks, including capsular contracture, infection, malposition, rupture, and extrusion, which may be more likely to occur if a patient has previously undergone radiation therapy [9]. Also, studies have shown an association between breast implants and anaplastic large-cell lymphoma [10].

Extended LD flap introduced by Hokin and Silfverskiold aimed for more augmentation of the LD flap. It includes harvesting the whole muscle and lumbar fascia with the largest possible skin paddle running obliquely along the back. The skin paddle could be partly or wholly de-epithelialized for added volume. ELD flaps also fails in some cases to provide sufficient volume to match the contralateral breast [11].

Lipofilling technique is a reconstructive and esthetic technique that depends on redistribution of fat from undesired areas to new sites aiming for remodeling of these sites. With the advent of liposuction in the 1980s, large amounts of unwanted fat could be removed from different body areas using small access incisions and a suction cannula [12]. Fournier was the first to describe the technique of breast augmentation by fat transfer, which was reserved for patients refusing prostheses through injection in the retro-glandular space [13].

Nowadays, the lipofilling technique in breast is used in breast-conserving surgeries either immediately to overcome poor cosmetic results following breast-conserving surgery in case of excision of relatively large masses or delayed several months especially after the effects of radiotherapy [14].

Lipofilled LD flap is a technique used to augment the volume of the LD flap to be used in complete autologous breast reconstruction, thus avoiding the use of implants with its finical cost and the complications accompanied its use [15–17].

Patients and methods

This study was conducted prospectively on 20 patients with breast cancer, who were candidates for SSM, NSM, or skin-reducing mastectomy and aiming for complete immediate autologous breast reconstruction. Admitted in the Surgical Oncology Unit at Alexandria Main University Hospital to undergo surgery from November 2020 till June 2022.

After a signed informed consent and approval of the medical ethics committee, the procedure was carried out first in supine position; SSM was done in majority of cases through either a circumareolar incision or small elliptical incision including only the NAC followed by in most of cases infiltration of the subcutaneous tissues with tumescent solution, a dilute solution of adrenaline and normal saline; this infiltration was performed over the whole breast skin to accentuate the subcutaneous layer and facilitate dissection of the breast with minimal bleeding. The mastectomy flaps were elevated either by dissecting scissors or diathermy till removal of all breast tissue from underlying muscles followed by axillary management either complete dissection or sentinel lymph node (LN) biopsy. Then the position of the patient was changed to lateral position; the LD myocutaneous flap was marked on the back as a skin ellipse over a fat roll on the back and oriented with the long axis along the relaxed skin tension lines; the skin ellipse was marked extended from the paravertebral line to the posterior axillary line with vertical dimensions ranging between 7.5 and 10 cm and the horizontal dimension ranging between 20 and 30 cm. The range of the size of the dimensions differs according to the BMI, height, and

width of the back of the patients. After marking the skin ellipse, the vertical and horizontal dimensions were calculated and multiplied to measure the size of the skin paddle of the LD flap as measuring the size of the skin paddle determined the amount of the fat needed to be harvested for augmenting the size to reach the optimal size for reconstruction (Fig. 1).

After skin incision, the dissection was done with preservation of majority of the subcutaneous fat remained on the muscle till the free superior and anterior edges of the LD muscle and proper separation of the trapezius muscle away from the superior medial edge of the LD muscle. Dissection continued medially till the thoracolumbar fascia that incised till exposure of the erector spinae muscle followed by incision of the muscle inferiorly at the level of the iliac crest. Elevation of the flap start medially with caution not to include the deep muscles as the erector spinae and serratus posterior inferior muscle till the tendentious insertion of the muscle to be mobilized through an axillary tunnel with preservation of the thoracodorsal bundle to the mastectomy space.

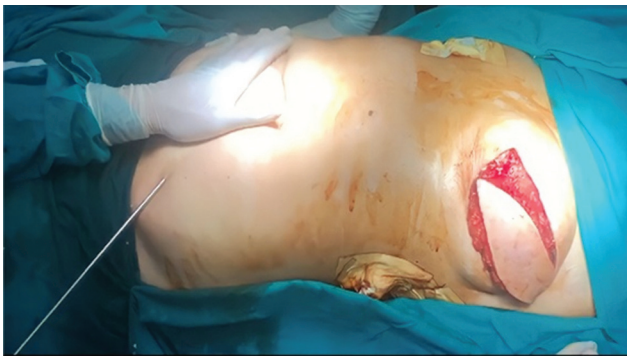
Harvesting of the fat was done in supine position mainly from the anterior abdominal wall fat. After infiltration of the whole abdominal wall subcutaneous fat with tumescent solution using a previously prepared solution in normal saline bag (NaCl 0.9%) with half ampoule (0.5 ml) of adrenaline (1 mg/1 ml ampoules) and 10 ml of lidocaine 2% for each 500 ml of normal saline. Liposuction was done by 4 mm cannulas (Fig. 2), and the collected fat is purified using gravity and the decantation technique till separation of the fat from tumescent solution and blood (Fig. 3).

The purified fat is injected in a multilayer and multisite manner into the mastectomy flaps, the pectoralis major muscle, the subcutaneous tissue of the LD flap, and the muscular part of the flap (Figs 4–8). Proper fixation of the flap to the mastectomy space was done using Vicryl 2-0 sutures after proper hemostasis and application of closed suction drains.

Figure 1

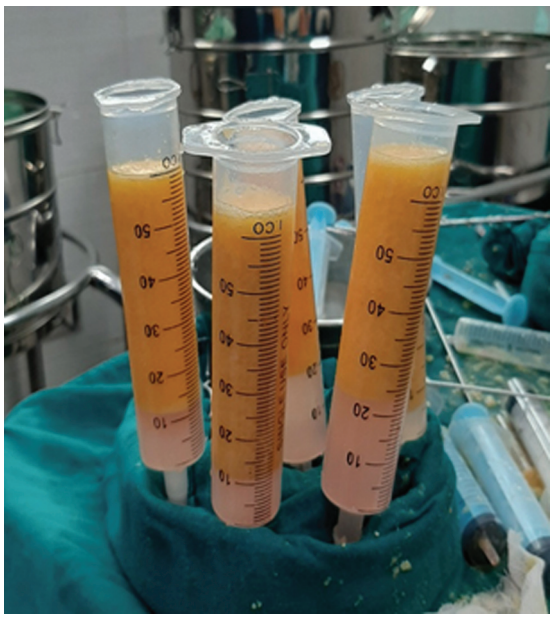
Marking of the skin ellipse on back with measuring vertical and horizontal dimensions.

Figure 2



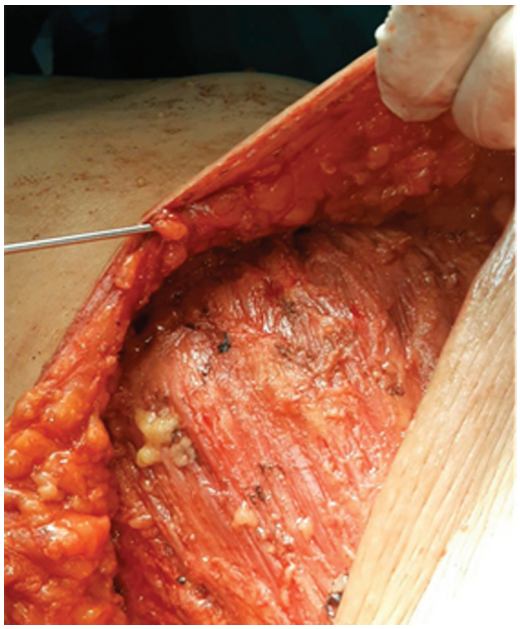
After completion of the SSM and LD flap elevation and transport to the mastectomy space with liposuction and harvesting fat from the anterior abdominal wall. LD, latissimus dorsi; SSM, skin-sparing mastectomy.

Figure 3



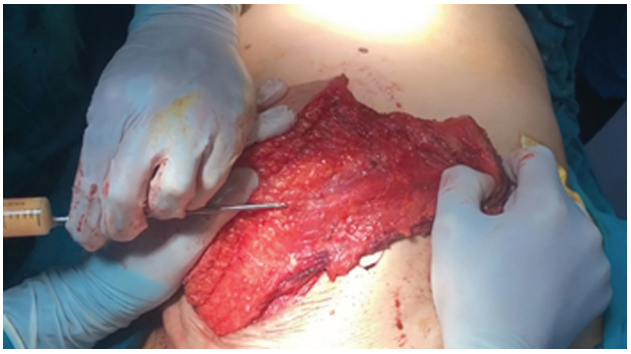
Preparation and purification of the harvest fat using decantation.

Figure 4



Injection of the purified fat into the mastectomy flap.

Figure 5



Injection of the purified fat into the LD muscle. LD, latissimus dorsi.

Similar to SSM, NSM was performed through the lateral sulcus incision with preservation of NAC and intraoperative assessment of the retroareolar disk for exclusion of malignant infiltration (Fig. 9).

One case of skin-reducing mastectomy was done, in which a wise pattern was drawn. The mastectomy was done with the area enclosed in the pattern below the NAC and over the inframammary fold, which was de-epithelized and a dermal flap is created (Fig. 10).

One of the cases was immediate–delayed breast reconstruction using expander after SSM and complicated by skin necrosis and exposure of the implant. Removal of the implant was done and the

Figure 6

Injection of the purified fat into the pectoralis major muscle.

Figure 7

Final result after complete injection of the purified fat.

lipofilled LD flap was used after proper irrigation of the breast pocket with saline and betadine (Fig. 11).

Results

Distribution of the cases was as follows: the age ranged from 29 to 65 years. The mean age was 48.10±8.90. However, the majority of the patients were under 50 years old (12 cases). Nineteen patients were married and only one patient was single. Eighteen (90%) patients were multiparous and two (10%) patients were nulliparous. The majority of patients had low

Figure 8

Breast reconstruction 2 weeks postoperatively.

Figure 9

Breast reconstruction after NSM with the lipofilled LD flap. LD, latissimus dorsi; NSM, nipple-sparing mastectomy.

Figure 10

Breast reconstruction after SRM with the lipofilled LD flap. LD, latissimus dorsi.

Figure 11

Case of complicated exposed implant replaced by lipofilled LD for continuation of reconstruction after NSM. LD, latissimus dorsi; NSM, nipple-sparing mastectomy.

BMI. The mean BMI of studied patients was 28.03 ±3.43 kg/m^2. The range was between 23 and 35 kg/m^2. Medical comorbidities were nine (45%) patients. Five patients were diabetics and four suffered from hypertension.

Bra cup size was used to assess the size of the breast; 14 (70%) patients had moderate breast size (cup B), four (20%) patients had large breast size (cup C), and two (10%) patients had small breast size (cup A). The tumor was found in the left side in 12 (60%) cases and in the right side in eight (40%) cases. According to axillary LN status (by clinical and radiological examination), 17 (85%) cases had palpable suspicious ipsilateral axillary LN and three (15%) cases had a negative axilla (clinically and radiologically). According to the type of receptors, 11 (55%) patients were luminal, six (30%) patients were Her2nu positive, and three (25%) patients were basal. Majority of cases: 16 (80%) cases were of grade II and four (20%) cases of grade III. Twelve (60%) cases received neoadjuvant chemotherapy to downstage tumor size and according to receptors, with good response in all patients while eight (40%) patients did not receive.

Operative data of the cases showed: The operative time range between 105.0 and 225.0 min with a mean of 165 ±36 min. According to the type of the mastectomy,

SSM was done in 13 (65%) patients, NSM in five (25%) patients, skin-reducing mastectomy in one (5%) patient, and implant removal in one (55) patient. The size of the skin paddle of the harvested LD flap ranged from 150 to 300 cm^2 with a mean of 215.0±35.91 cm^2; the size was calculated by measuring the vertical and horizontal dimensions of the skin ellipse preoperatively after marking the ellipse of skin. The amount of fat harvested ranged from 180 to 300 ml with a mean of 230.50±30.34 ml (Table 1).

Postoperative pathological findings revealed the diagnosis of invasive ductal carcinoma in 17 (85%) cases, ductal carcinoma in situ in one (5%) case, and mixed infiltrating ductal and infiltrating lobular carcinoma in two (10%) cases. Five (25%) cases had negative axillary LN metastasis after performing sentinel LN biopsy.

Twelve (60%) cases had less than three positive axillary LN metastases and three (15%) cases had more than three positive axillary LN metastases after axillary dissection.

Postoperative complications were encountered in six (30%) patients; four (20%) cases had seroma managed by frequent aspiration at weekly intervals in the outpatient clinic. One (5%) patient developed muscle twitch managed by a nerve block and one patient developed necrosis of the mastectomy flaps and wound dehiscence that needed frequent dressing till proper healing.

All cases were put on a follow-up for a period of 9 months to one-and-a-half years for the assessment of cosmetic outcome and oncological outcome. None of the 20 patients showed neither recurrence at the surgical bed nor systemic metastatic deposits. Regarding cosmetic outcome, it was evaluated by patient's self-evaluation by a questionnaire on general satisfaction of the appearance of the reconstructed breast, expectations before and after the procedure, presence of any chronic pain at the donor or recipient sites, and outcome after radiotherapy. Excellent outcome and very satisfied was reported in 12 (60%) patients, good outcome and moderately satisfied in six (30%) patients, and fair outcome and low satisfied in two (10%) patients; those two patients with muscle twitches and mastectomy flap necrosis. Two patients on follow-up wanted to do a contralateral mastopexy and ipsilateral nipple and areola reconstruction that was accompanied with ipsilateral relipofilling of the mastectomy and LD flaps (Fig. 12).

Table 1 Descriptive analysis of the cases according to the size of skin paddle of the flap and amount of fat

	Minimum–maximum	Mean ±SD	Median (IQR)
Size of skin paddle of the flap (cm^2)	150.0–300.0	215.0 ±35.91	215.0
Amount of fat (ml)	180.0–300.0	230.50 ±30.34	225.0

Discussion

In spite of the major changes in the management of breast cancer over the last century, mastectomy remains an integral part in the surgical management of breast cancer. Breast reconstruction following mastectomy plays an important physical and psychological role in the restoration of normality for those patients with mastectomy [18]. Reconstruction can be performed either implant-based or autologous flap-based reconstruction or by use of both techniques.

Autologous breast reconstruction started since the last 19th century by Vincent Czerny, who used a fist-sized lipoma in reconstruction after mastectomy for benign condition [19]. The first flap-based reconstruction was started by the Italian surgeon Tanzini [20] in 1906 in which the LD myocutaneous flap was used for coverage of the defect after radical mastectomy. This technique gained no popularity in breast surgery till 1970s, which was reintroduced by Schneider *et al.* [21] and then

Figure 12

Relipofilling of the reconstructed breast by the lipofilled LD flap with NAC reconstruction. LD, latissimus dorsi; NAC, nipple–areola complex.

further refinement till one stage reconstruction by the LD flap done by Bostwick and Scheflan [22]. Other autologous breast reconstruction is done using the TRAM flap that was introduced in 1982 by Hartrampf *et al*. [23], which in spite of harvesting a large tissue for the reconstruction resulted in more complication as there was more percentage of flap loss due to high tissue-to-blood supply as well as abdominal wall weakness and hernia [24]. To decrease the donor site morbidity with the TRAM flap and with the advances in microvascular surgeries, the DIEP flap was introduced by Koshima and Soeda [25] for reconstruction. The use of the LD flap in breast reconstruction faced a major problem that the size of the harvested tissue would not match the needed size; thus, in the choice of autologous reconstruction the TRAM flap was the choice despite the higher rate of complications. To maximize the volume of the LD flap an implant is used, but there were more risks of the implant use such as capsular contracture, infection, malposition, rupture, and extrusion especially in the presence of radiotherapy [26]. Fat grafting to the LD flap was first used several months after reconstruction as a corrective procedure [27]. Simultaneous fat harvesting and grafting with the LD flap harvest as well as fat injecting into multiple recipient sites in order to maximize the volume of the LD flap in its use in total autologous breast reconstruction was first described by Santanelli di Pompeo *et al*. [28] with good results. In Egypt due to financial and economic drawbacks, the wide use of implants in breast reconstruction is limited as well as there is limited accessibility to microvascular techniques and higher BMI among Egyptian females and also the higher complications with microsurgeries [29] make the use of free flaps much more limited.

On comparing our results with the Santanelli di Pompeo *et al*. [28] results it was performed on 23 patients with age ranging from 39 to 68 years and BMI ranging from 21.5 to 28.7 kg/m^2 while it was on 20 patients in our study with age ranging from 29 to 65 years and BMI ranging from 23 to 35 kg/m^2. Regarding operative data in the Santanelli study, the mean operative time was 2.62 h, ranging from 2.10 to 3.20 h; the size of the flap ranged from 180 to 252 cm^2 while the amount of harvested fat ranged from 90 to 180 ml. In our study, the mean operative time was 2.75 h, ranging from 1.75 to 3.75 h; the size of the flap was 150–300 cm^2, while the amount of the harvested fat ranged from 180 to 300 ml. Santanelli stated that no complications occurred in both the flap and the donor site, but in our study we noticed seroma in the donor site and mastectomy flap necrosis and LD muscle twitches.

In our study, we conducted this technique on 20 patients, excellent results were noticed with the majority of cases who received neoadjuvant chemotherapy and underwent axillary dissection, thus lowering the quality of mastectomy flaps and more liable to thoracodorsal bundle injury; also, cases with high BMI have got excellent results. Also, we noticed excellent results in correction complicated infected, extruded implant as a solution for continuation of reconstruction in such conditions and limit the option of mastectomy compilation. Large anterior abdominal fat in majority of Egyptian females allows several times of liposuction in case of need of relipofilling of the reconstructed breast especially after radiotherapy. We noticed in cases with relipofilling improvement in the quality of the skin of the reconstructed breast as these patients received radiotherapy after the procedure. This is concomitant with the findings of Sarfati *et al.* [30] that the adipose derived stem cells improve the vascularity of the irradiated skin through increasing the neovascularization of this skin. We also noticed that simultaneous injection of fat at the same time of LD harvesting is (in comparison of delayed LD lipofilling after reconstruction) much safer in point of blind injection, thus avoiding injuring the flap pedicle and the thoracic cavity or intravenous injection and also direct visualization of the injection allows proper injection at the desired sites. On follow up of the patients especially after radiotherapy, we noticed a decrease in the size of the reconstructed breast in which the volume became about 70–80% of the immediate postoperative volume. This has no effect on the cosmetic outcome from the patients' point of view except two patients who desired relipofilling of the reconstructed breast and mastopexy of the contralateral breast. Regarding the oncological outcome, no delay in starting adjuvant chemotherapy or radiotherapy except one case of necrosis of NSM (not from the lipofilling LD), and the delay was limited. Also, no case showed any local recurrence or distant metastasis.

Conclusion

Simultaneous multilayer multisite fat injection in LD myocutaneous flap aiming for volume augmentation of the flap and its use in immediate total breast reconstruction after mastectomy is a safe, simple, and versatile technique avoiding complications of other autologous flaps or implant-based

reconstruction especially in radiotherapy and neoadjuvant settings.

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Conflicts of interest
There are no conflicts of interest.

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