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Breast

# Latissimus Dorsi and Immediate Fat Transfer (LIFT) for Complete Autologous Breast Reconstruction

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**Background:** Despite the popularity of latissimus dorsi (LD) flap in breast reconstruction, a breast implant is often necessary to achieve sufficient volume. Prior reports describe fat grafting to the LD flap as a secondary procedure to correct contour deformities and improve volume. Our institution has instituted autologous breast reconstruction with an LD flap and immediate fat transfer (LIFT).

**Methods:** A retrospective review of all patients undergoing the LIFT procedure was undertaken. Patient age, total volume of fat transfer, length of follow-up, need for adjuvant therapy, and complications were recorded. The procedure begins with harvest of the LD flap and fat. Prior to disorigination of the latissimus muscle, fat is injected into the flap. Flap harvest is then completed and inset to create a breast mound.

**Results:** Eighteen patients underwent LIFT procedures over 3 years with an average follow-up of 8.7 months (range, 2–24). Four breasts (22.2%) had previously received adjuvant radiation therapy. The mean total fat grafting volume was 515.5 mL (range, 325–730) per breast. The average estimated fat graft take was 66.8% (range, 50–80%). Four patients (22.2%) experienced complications.

**Conclusion:** Autologous augmentation of the LD flap with lipotransfer has been used to avoid placement of an implant. We improve the technique by performing lipotransfer during index reconstruction. Furthermore, we perform lipotransfer prior to disorigination of the LD muscle to minimize trauma to the flap and increase the efficiency of fat grafting. Our experience demonstrates that this technique is a viable autologous alternative to microsurgical breast reconstruction.

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## INTRODUCTION

The latissimus dorsi (LD) myocutaneous flap has long served as a useful source of autologous tissue in breast reconstruction due to its reliability and ease of harvest.[1–4] It is particularly suitable in the irradiated field or in secondary salvage operations following failed attempts at autologous free tissue transfer. Despite its widespread use, it is limited in volume and often requires augmentation with a breast implant to achieve an acceptable aesthetic result. The use of an implant, however, brings with it the risks associated with prosthetic-based breast reconstruction including capsular contracture, implant rupture, extrusion, infection, and the potential for reoperation to exchange the implant after the useful lifetime of the device has passed.[5,6]

Fat grafting has become a popular adjunct in breast reconstruction offering a natural and lasting way to contour and augment the breast mound. The majority of published cases to date have described autologous lipotransfer following LD flap breast reconstruction primarily as a secondary revision procedure to correct contour deformities and enhance volume.[7,8] More recently, however, fat grafting of the LD flap in the immediate setting has been described as a means of directly augmenting breast volume without the need for an implant.[9,10] Nevertheless, published cases of volume enhancement of the LD flap with fat grafting in the immediate setting remain limited. This study offers our experience with the LD and immediate fat transfer (LIFT) procedure to expand upon previously

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published reports and to offer technique modifications, which may assist in maximizing the volume of fat transfer that can be performed in a single setting.

## METHODS

### Study Design

A retrospective review of all patients undergoing breast reconstruction with LIFT by the senior author (D.H.S.) from August 2014 through March 2017 was undertaken. Patients were selected to undergo the LIFT procedure if they desired or required autologous breast reconstruction and either lacked an appropriate donor site for, failed, or declined free tissue transfer. Patients who underwent LIFT were unable to achieve adequate breast volume through LD flap alone. Patients who underwent traditional LD flap reconstruction without fat transfer were excluded from review. Demographic data, timing of reconstruction, total volume of fat transfer during index reconstruction and revision operations, length of follow-up, need for adjuvant radiation therapy, and complication rates were collected for all patients. An assessment of the proportion of volume of fat graft "take" was made by the senior author through comparison of immediate postoperative clinical images to those at final follow-up. Mean values were calculated for the aforementioned data points.

### Surgical Procedure

The technique for augmentation of the LD flap with fat transfer during breast reconstruction follows previously described techniques with notable modifications.[9] The LD flap is marked in the preoperative holding area with the patient in the standing position. A skin paddle is marked overlying the thoracolumbar fat pad, and using a pinch test, a suitable skin paddle width is determined in either a transversally or obliquely oriented pattern to ensure adequate closure of the flap donor site and a gentle arc of rotation for flap inset (Fig. 1). The orientation of the skin paddle is reassessed on the operating room table and any changes in orientation may be made at that time as in the case example provided (Figs. 1, 2). Skin paddle orientations may differ depending on the necessary soft-tissue coverage of the mastectomy defect with different types of mastectomies (ie, nipple-sparing versus skin-sparing) requiring different skin paddle requirements. The desires of the patient regarding donor-site scars are also taken into account. Donor sites for fat grafting are individualized based upon patient body habitus and adiposity. Fat harvest sites generally include the abdomen, flank, and thighs, which are also marked and outlined in the preoperative holding area.

The procedure commences in the supine position where the breast pocket is created through explantation of any previous breast implants and careful tissue undermining of the mastectomy skin flaps. A lateral thoracic tunnel is then created to allow for future transposition of the LD flap after harvest (Fig. 2). After successful creation of the breast pocket and lateral tunnel, liposuction is subsequently performed to harvest fat for transfer. A solution

**Fig. 1.** Intraoperative clinical image demonstrating LD flap landmarks and skin markings.

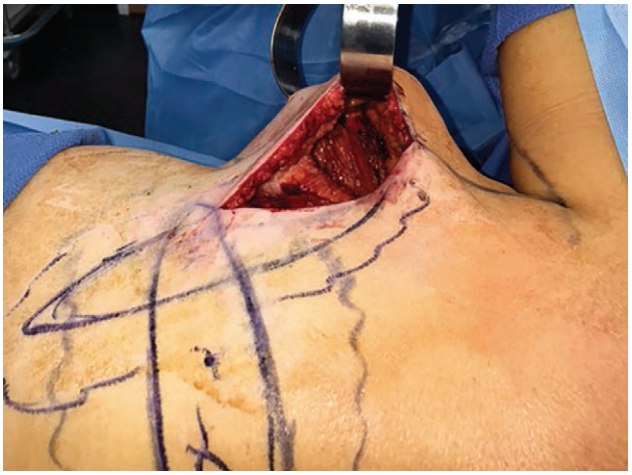

**Fig. 2.** Intraoperative clinical image demonstrating lateral thoracic tunnel through which the LD flap will be transposed.

of 50 mL of lidocaine 1% with epinephrine 1:100,000 diluted into 1 L of normal saline is injected into the previously marked fat donor sites. Fat is then aspirated with a 3-mm liposuction cannula directly into a REVOLVE fat processing system (LifeCell, Co., Bridgewater, N.J.). The fat is rinsed and processed according to manufacturer's instructions and then divided into 10 mL aliquots awaiting final fat transfer. The patient is then transferred to the lateral decubitus position to allow the LD flap harvest to proceed. The LD flap is raised as previously described but is not immediately released from its bony attachments.[11] This important modification allows fat transfer to occur in situ before disorigination of the LD muscle from the spinous processes. This is a notable modification of prior reports, as we believe that in situ lipotransfer provides a more stable fat recipient site and thus improves efficiency while allowing for optimal operator control (**see** video, Supplemental Digital Content 1, which demonstrates fat transfer to the LD flap in situ, ***http://links.lww.com/PRSGO/A658***). The processed fat is injected into the LD muscle and subcutaneous tissue in a retrograde and fan-


**Video Graphic 1.** See video, Supplemental Digital Content 1, which demonstrates fat transfer to the LD flap in situ, ***http://links.lww.com/PRSGO/A658***.

like fashion to disperse the fat within the entire muscle (Fig. 3). The fat is preferentially injected into the area that will become the future lower breast pole. Additional fat is also injected into the flap skin paddle, taking care to monitor for signs of flap congestion until the flap volume is sufficiently augmented (Fig. 4). Any residual fat may be transferred to the pectoralis muscle and/or mastectomy skin flaps before flap inset to gain additional breast volume (Figs. 5, 6). Once fat transfer is complete, the flap is then disoriginated, denervated, and interpolated through the previously created lateral thoracic tunnel. A final position change occurs to return the patient to the supine position, and the flap is inset onto the chest to create a breast mound (Fig. 7). Revision fat grafting is performed as necessary in the postoperative period at 3-month intervals if a determination is made that inadequate volume has been achieved (Figs. 8, 9).

## RESULTS

Eighteen patients (Table 1) underwent the LIFT procedure from August 2014 through April 2017 with an average follow-up of 8.7 months (range, 2–24). Thirteen patients (72.2%) underwent immediate reconstruction, whereas 5 patients (27.8%) underwent delayed reconstruction. All cases were unilateral. Mean patient age was 50.5 years (range, 40–62) at the time of index operation. Four breasts (22.2%) had received adjuvant radiation therapy before undergoing LIFT reconstruction. The mean initial

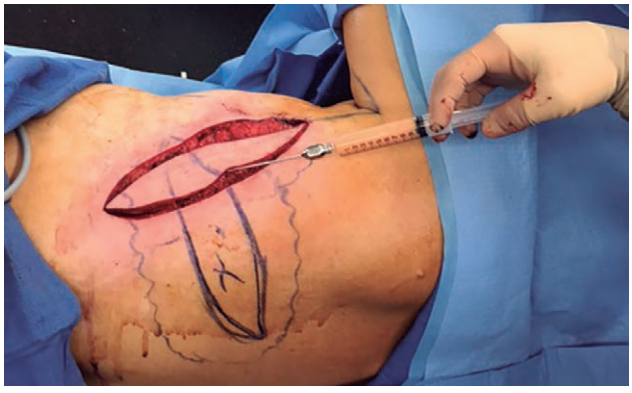

**Fig. 3.** Intraoperative clinical image demonstrating fat injection into the LD flap.

**Fig. 4.** Intraoperative clinical image demonstrating augmented volume of LD flap following fat injection.

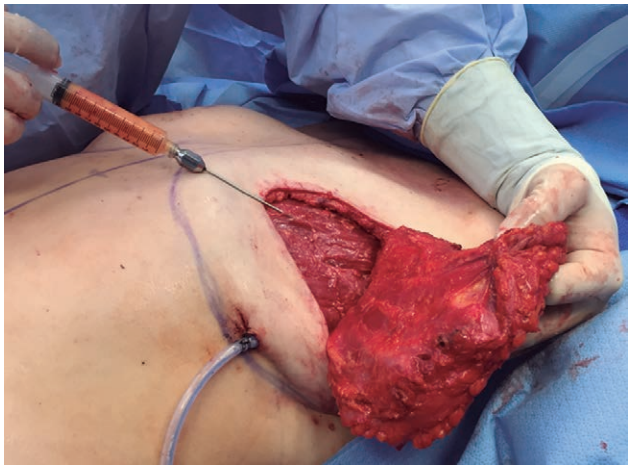

**Fig. 5.** Intraoperative clinical image demonstrating additional fat grafting to the pectoralis major muscle.

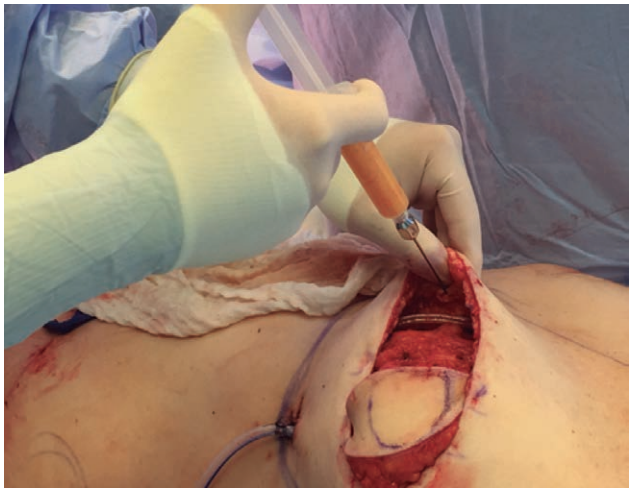

**Fig. 6.** Intraoperative clinical image demonstrating additional fat grafting to the mastectomy skin flaps.

**Fig. 7.** Intraoperative clinical image demonstrating augmented LD flap following LIFT procedure and inset onto breast mound.

**Fig. 8.** Preoperative clinical image of a patient prior to undergoing right breast skin-sparing mastectomy and LIFT reconstruction. Note: Patient has already undergone previous left mastectomy and abdominally based free flap reconstruction.

**Fig. 9.** Postoperative clinical image of a patient 3 months after undergoing right breast skin-sparing mastectomy and LIFT reconstruction. Note: Patient has already undergone previous left mastectomy and abdominally based free flap reconstruction.

fat grafting volume was 359.6 mL (range, 250–425). Fifteen patients (83.3%) required additional rounds of fat grafting on average 3.8 months (range, 3–6) following index operation. Of those, a further 6 patients (33.3%) required a third round of fat grafting, of which 4 (66.7%) had previous radiation therapy. The mean volume of additional fat grafting was 135.3 mL (range, 75–250), whereas the mean total fat grafting volume including revision operations was 515.5 mL (range, 325–730) per breast. The average estimated fat graft take was 66.8% (range, 50–80%). Four patients (22.2%) experienced complications, which included donor-site seroma (n = 3, 16.7%) and delayed wound healing (n = 1, 5.6%).

## DISCUSSION

Autologous breast reconstruction aims to achieve a permanent and natural-appearing breast mound without the longer term risks associated with prosthetic-based reconstruction. Advancements over the years in microsurgical free tissue transfer have led to numerous options for abdominally based and nonabdominally based flaps for autologous breast reconstruction.[12–17] Despite these advancements, the pedicled LD myocutaneous flap remains a fixture in the reconstructive breast surgeon's arsenal due to its reliability and ease of harvest. The LD flap is particularly useful in salvage procedures in cases of failed reconstructions, but is also widely used in the primary setting. Despite its widespread use, the flap is limited in volume and often requires the placement of a breast implant to achieve sufficient size. In these instances, the LD flap essentially serves as a skin carrier to cover the prosthetic device with viable soft tissue. Use of the flap in this manner negates the benefits of autologous reconstruction and subjects the patient to the risk of implant exposure, capsular contracture, infection, and future reoperation. A truly autologous option for reconstruction seeks to avoid these risks.

Autologous augmentation of the LD flap with lipotransfer has previously been reported as a means to avoid the need for a breast implant.[8,9] Most published series, however, have reported on secondary procedures to revise contour irregularities or to provide additional bulk.[8] The largest of these series published by Sinna et al.[8] described the technique of secondary lipomodeling in 200 patients who had previously undergone LD flap reconstruction in a prior setting. A mean volume of 176 mL of fat was injected into the previously reconstructed breast with satisfactory results in 94.5% of patients and minimal complications. Zhu et al.[9] built upon this work in a limited series of 10 patients to demonstrate the safety of immediate lipotransfer at the time of index LD flap reconstruction. Mean volume of fat grafting in that series was equivalent at 176 mL per breast. The authors were the first to introduce fat infiltration in a multilayer fashion involving the LD muscle, LD flap skin paddle, pectoralis muscle, and mastectomy skin flaps with no cases of flap loss. This technique demonstrated the safety of immediate fat grafting to the freshly harvested flap while maximizing the volume of fat transfer by incorporating multiple recipient sites involving all layers of the flap and mastectomy site.

We have demonstrated that a substantially higher volume of fat may be safely transferred to the LD flap during the ini-

**Table 1. Patient Characteristics**

| Patient | Age (y) | Follow-up (mo) | Timing | Initial Volume (mL) | Additional Grafting (mL) | Timing of Additional Grafting (mo Postoperatively) | Total Volume Injected (mL) | Radiation | Complications | Estimated Volume Take (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 40 | 12 | Delayed | 348 | 100 | 3 | 448 | N | | 75 |
| 2 | 50 | 24 | Delayed | 275 | 75 | 3 | 400 | Y | | 75 |
| | | | | | 75 | 6 | | | | |
| 3 | 60 | 17 | Immediate | 390 | 100 | 3 | 490 | N | | 70 |
| 4 | 51 | 13 | Immediate | 380 | 100 | 3 | 480 | N | | 50 |
| 5 | 48 | 12 | Immediate | 250 | 75 | 3 | 325 | N | Seroma | 65 |
| 6 | 51 | 8 | Delayed | 280 | 200 | | 730 | Y | Delayed healing | 50 |
| | | | | | 250 | | | | | |
| 7 | 51 | 7 | Immediate | 400 | 100 | 3 | 500 | N | | 75 |
| 8 | 56 | 10 | Immediate | 425 | 100 | 3 | 525 | N | | 70 |
| 9 | 47 | 10 | Immediate | 375 | 125 | 4 | 575 | N | | 70 |
| | | | | | 200 | | | | | |
| 10 | 42 | 6 | Immediate | 400 | 200 | 5 | 700 | N | | 60 |
| | | | | | 100 | | | | | |
| 11 | 41 | 9 | Delayed | 380 | 200 | 5 | 680 | N | Seroma | 50 |
| | | | | | 100 | | | | | |
| 12 | 62 | 5 | Immediate | 360 | 200 | 5 | 660 | Y | | 50 |
| | | | | | 100 | | | | | |
| 13 | 56 | 4 | Immediate | 375 | 200 | 5 | 575 | Y | | 75 |
| 14 | 51 | 4 | Immediate | 400 | 100 | 3 | 500 | N | | 75 |
| 15 | 50 | 3 | Immediate | 275 | 100 | 3 | 375 | N | | 75 |
| 16 | 51 | 2 | Immediate | 375 | | | 375 | N | | 75 |
| 17 | 52 | 2 | Immediate | 425 | | | 425 | N | | 75 |
| 18 | | | Delayed | 380 | | | 380 | N | Seroma | 80 |
| Mean | 50.5 | 8.7 | | 359.6 | 135.3 | 3.8 | 515.5 | | | 66.8 |

Y = yes; N = no.

tial reconstructive setting to more adequately and efficiently enhance breast volume. In our series of 18 patients who underwent the LIFT procedure, a mean volume of 359.6mL of fat was transferred at index reconstruction with no major complications. This value represents a nearly 2-fold increase in the volume of fat that may be safely transferred in the immediate setting with no instances of partial or total flap loss. To facilitate high volume fat transfer while minimizing trauma to the flap and maximizing operator control, we have modified our technique by performing lipotransfer in situ before disorigination of the LD muscle. Fat grafting in situ allows for a higher volume of fat to be transferred more consistently and efficiently by providing a stable, broad muscle bed into which fat may be precisely injected.

Given the higher volume of fat transferred in a single operative setting, the suitability of the recipient site to provide an adequate vascular bed for graft take is of the utmost importance. Prior animal models have demonstrated that muscle is an appropriate recipient site for fat grafting due to its robust bloody supply.[18,19] These reports have been bolstered by clinical studies in the cosmetic literature on volume augmentation of the gluteal muscles demonstrating satisfactory results following lipoaugmentation.[20] In a similar technique to the current study, Niddam et al.[21] reported on 20 patients undergoing fat transfer to the pectoralis muscle following LD flap breast reconstruction with sufficient volumes obtained in a single round of fat grafting in 90% of patients. Despite the high volume of fat transferred in our series, we estimated that roughly 66% of transferred fat remained at final follow-up. Although this estimate suffers from subjectivity in its assessment, we are reassured by the fact that only a minority of patients (33.3%) required more than 1 additional round of fat grafting. In addition, the majority of patients requiring multiple rounds of secondary fat grafting (66.7%) had previously undergone adjuvant radiation therapy, which may hinder successful lipotransfer.

Following the end of the moratorium imposed by the American Society of Plastic Surgeons on fat grafting in 2009, the intervening decade has seen this technique emerge as an increasingly popular adjunct in breast reconstruction with numerous studies demonstrating its safety, limited complication profile, and discernibility from malignancy on routine surveillance imaging.[22–26] Traditionally used to provide a more natural contour and subtle volume enhancement when combined with other reconstructive methods, this study demonstrates that lipoaugmentation of the LD flap may be performed safely in the immediate setting with higher volumes of fat than previous reports.[27–29] Augmentation of the LD flap with immediate fat grafting may serve as a useful alternative to microsurgical breast reconstruction in both primary and salvage operations. Notable limitations to this study exist including the small cohort of patients and the subjectivity of postoperative assessment of fat grafting take. These facts limit our ability to further analyze our results for statistical significance. Additionally, it should be noted that, although not seen in our cohort, the risk for complications such as fat necrosis may exist with higher volume fat transfer. Meticulous technique to ensure grafted fat is evenly spread within the recipient bed should be taken to allow for adequate neovascularization, and multiple rounds of fat grafting must still be taken for higher volume augmentation. Future investigations should build upon this and other reports to improve this technique for a completely autologous breast reconstruction without the use of microsurgical free tissue transfer.

## CONCLUSIONS

Autologous augmentation of the LD flap with lipotransfer has previously been reported as a means to avoid placement of a breast implant. We improve upon these initial reports by performing lipotransfer in the immediate setting during index reconstruction. Furthermore, we have refined this technique to perform lipotransfer before disorigination and denervation of the LD muscle to minimize trauma to the flap and increase the speed and efficiency of fat grafting. Our experience demonstrates that this technique is a viable autologous alternative to microsurgical breast reconstruction.

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