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Breast

Optimizing the Pedicled Latissimus Dorsi Myocutaneous Flap in Breast Reconstruction: Lessons Learned from 110 Consecutive Flaps

Leandra Doan, BS*
Andre-Philippe Sam, BS†
Wai-Yee Li, MD, PhD, FACS‡

Background: The pedicled latissimus dorsi myocutaneous flap (LDMCF) in autologous breast reconstruction has been superseded by abdominal free tissue transfer. Common complaints of the LDMCF include the asymmetric back scar, need for prosthesis, and high seroma rates. We believe that the LDMCF remains versatile, with distinct advantages over other autologous options: the flap can be harvested unilaterally or bilaterally, not 'burning any bridges' for future reconstruction in unilateral breast reconstruction; the recovery is relatively easy, without complications such as risk of long-term abdominal wall weakness; and the aesthetic results are comparable, if not superior, leading to a more "youthful" result.
Methods: We performed a retrospective review over an 8-year period.
Results: A total of 106 patients underwent 110 breast reconstructions. Complications included four of 106 patients (3.8%) with seroma, three of 78 (3.8%) with periprosthetic implant infection, and one case of partial flap loss.
Conclusions: We learned the following: (1) Direct-to-implant can be performed in most LDMCF patients, avoiding the use of tissue expanders; (2) High BMI patients may not require an implant; (3) Back donor site aesthetics can be improved using a "bra-line-back-lift" approach; (4) Use of liposomal bupivacaine intercostal blocks and modified enhanced recovery after surgery protocol can reduce length-of-stay to overnight; (5) We achieved low seroma rates using topical fibrin glue and closed suction drains; (6) Low and high BMI patients who may not qualify for free tissue transfer are usually still surgical candidates with LDMCF; and (7) Short and long-term recovery are faster than free tissue transfer, with minimal long-term deficit.
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INTRODUCTION

Breast cancer is the most commonly diagnosed cancer among women in the United States. According to the World Health Organization, it accounts for 12% of all new annual cancer cases worldwide.[1] Patients diagnosed with breast cancer often undergo lumpectomy (breast conservation) or mastectomy, the removal of all breast tissue. These procedures can result in severe emotional distress, negatively impacting patients' quality of life and well-being.[2] Breast reconstruction following these procedures has been shown to improve patients' mental health, sexual health, and overall satisfaction.[2]

There are several surgical options for complete or partial breast reconstruction. The pedicled latissimus dorsi myocutaneous flap (LDMCF) is a versatile technique that can be used for delayed or immediate breast reconstruction, with prosthesis in the form of tissue expanders (TEs) or direct-to-implant (DTI), or alone as an autologous flap. In the 1970s, the LDMCF emerged as a staple technique in breast reconstruction. Its reliable anatomy, consistent vascular supply, and ability to cover large areas made it a preferred option and useful flap for surgeons.[3,4] The latissimus dorsi is a triangular-shaped muscle found on the back and functions to extend and adduct the humerus. Its insertion onto the humerus allows for ideal rotation

*From the *Kaiser Permanente Bernard J. Tyson School of Medicine, Pasadena, Calif.; †Riverside School of Medicine, University of California, Riverside, Calif.; and ‡Division of Plastic Surgery, Department of Surgery, City of Hope Medical Center, Duarte, Calif.*

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to the anterior chest. This sheet-like muscle provides vascularized coverage of chest wall and implant, whereas the adipose and fascia of the skin paddle provides bulk and shape to restore breast volume. Meanwhile, the skin paddle serves to replace scarred, irradiated and/or resected skin.[3] The thoracodorsal artery supplying the tissue has minimal anatomic variation and provides a reliable vascular supply, which is especially important in patients who have undergone radiation. Some studies have reported that the collateral circulation through the serratus branch may provide sufficient vascular supply in the event that the thoracodorsal pedicle has been injured from prior procedures.[3]

Despite these advantages, abdominal free tissue transfer, such as the transverse rectus abdominis muscle flap, began to supersede the use of LDMCF in the 1980s.[5] More recently, the deep inferior epigastric perforator flap has become the gold standard in autologous breast reconstruction.[6] Common concerns with LDMCF include donor site morbidity, reported high seroma rates, long-term functional deficit, the scar along the back, and the LDMCF's inability to provide sufficient volume to match the contralateral breast.[7] However, free tissue transfer has a higher risk of complete and partial flap loss, as well as risk of donor site morbidity, such as hernia and bulge (for abdominal flaps) and thigh dehiscence (profunda artery perforator flap).[8] Certain comorbidities may exclude a significant number of patients from any flap involving microsurgery. These include extremes of body mass index (BMI) (<18 or >40), active smokers, and hypercoagulable states.[9] Previous abdominal surgery, including abdominoplasty, may exclude patients, due to disruption of the blood supply to the skin paddle.[5] Comparatively, the only major contraindication to the LDMCF includes those whose thoracodorsal artery has been compromised in previous axillary dissections or surgery.[5] Most patients will have sufficient excess tissue on their back for reconstruction. The versatility of the LDMCF allows for modification, depending on the needs of the patient and experience of the surgeon.

The objective of our current study is to describe our experience with the LDMCF's versatility as a technique in breast reconstruction, as well as share our lessons learned to improve the patient experience and aesthetic outcome. This study analyzes 110 breast reconstruction cases, performed during the last 8 years, by a single surgeon, to determine rates of complications, aesthetic outcomes, and length of stay (LOS), which improved significantly during the study period.

Takeaways

Question: How can we improve the pedicled latissimus dorsi myocutaneous flap (LDMCF) in breast reconstruction?

Findings: We found that in most patients, tissue expanders can be avoided with the LDMCF and direct-to-implant can be safely performed; 25% of patients do not need a prosthesis. Use of a "bra-line-back-lift" technique can improve back aesthetics, length of stay can be reduced to overnight only, and patients who are not a candidate for microsurgical techniques may still be candidates for LDMCF.

Meaning: LDMCF is a versatile and relevant technique in breast reconstruction, with few complications, and length of stay can be reduced to overnight.

METHODS

Following institutional review board approval, we performed a retrospective review of all patients undergoing LDMCF reconstruction for immediate or delayed partial or complete breast reconstruction performed by the senior surgeon (W.-Y.L.) between 2015 and 2023, at a national comprehensive cancer center, with minimum 3 months follow-up. Of the cohort, three patients diagnosed with clinical anxiety were excluded because they experienced prolonged hospital stays due to challenges in anxiety and pain management, primarily attributed to their diagnosis of mental illness, and not the operation. Details regarding patient demographics, immediate or delayed breast reconstruction, use of implants, TEs or fully autologous, LOS, aesthetic outcome, complication rates, and secondary procedures were recorded. Details of surgical outcomes were collected, including rates of implant loss, wound infection, and seromas.

RESULTS

A total of 106 women with 110 breast reconstructions were included in this study. All operations were performed between 2015 and 2023. Patient demographics are given in Table 1. The average patient BMI was 27.5, ranging from 19 to 38, with 63% of patients with a BMI 30 or less. Average patient age was 51.0 years (range 29–80 y). Ninety-one percent of patients had undergone radiation therapy. Thirteen patients had prior partial breast defects, and 93 patients had prior mastectomies. Immediate reconstruction was performed in 25.4% of cases, whereas delayed reconstruction was performed in 74.6% of cases. The majority of cases were LDMCF with prosthesis reconstruction. Over time, the proportion of TEs versus DTI fell significantly. In 2016, nearly 75% of the cases using prosthesis utilized TEs (as opposed to DTI) compared with only 6% of those performed in 2021, and 0% of those performed in 2022–2023.

Over the 8-year study period, the average LOS was 2.1 days (range 1 to 6 days). From 2015 to 2019, all patients had LOS greater than one night. In 2020, 95% of patients had LOS greater than 24 hours after surgery compared with only 17% of patients in 2022–2023. Average LOS decreased steadily over time (Fig. 1). By 2022–2023, the majority (82.6%) of patients stayed only one night, compared with 42.9% in 2021. This difference was statistically significant ($P = 0.004$). Similarly, the proportion of patients who stayed only one night in 2021 increased significantly from the year prior in 2020 (42.9% versus 4.6%, $P = 0.002$). The percentage of patients in 2019 who stayed for over two nights in the hospital postoperatively was significantly less than those in

Table 1. Patient Demographics and Complications

Characteristic	N (%)
Total number of patients	106
Total number of LDMCFs	110
Average BMI	27.5
Average age	51.0
Patients with prior breast surgery	
Partial breast defects	13 (12.3)
Mastectomies	93 (87.8)
Surgical indications	
Invasive cancer	84 (79.2)
Ductal carcinoma in situ	18 (17.0)
Phyllodes tumor	4 (3.8)
Timing of LDMCF	
Immediate	28 (25.5)
Delayed	82 (74.5)
Type of LMDCF	
Autologous only	28 (26.4)
Prosthesis	78 (73.6)
Implant	59 (75.6)
TE placed before implant	19 (24.4)
Patients who underwent subsequent nipple reconstruction	13 (12.3)
Complications of surgery	
Seroma	4 (3.8)
Periprosthetic implant infection	3 (3.8)
Partial flap loss	1 (0.9)
Total flap loss	0 (0.0)

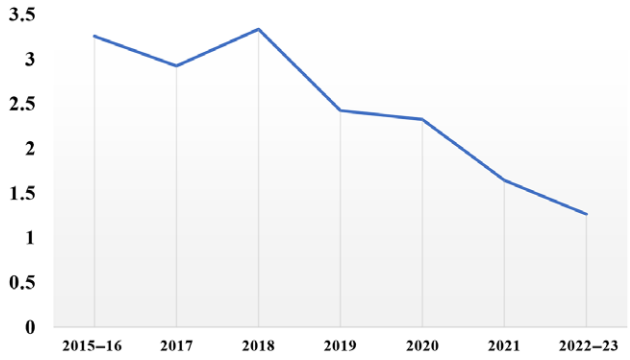

Fig. 1. Graph that shows average length of stay (days) vs year of surgery.

2018 (35.7% versus 88.9%, $P = 0.01$). Moreover, the proportion of patients in 2020 who stayed for three nights was less than in 2019 (18.2% versus 28.6%, $P = 0.04$). The shortened LOS can be attributed to surgeon confidence, patient preoperative counseling, and replacing the use of postoperative intravenous opioids with intraoperative intercostal blocks with bupivacaine liposome injectable suspension and modified enhanced recovery after surgery (ERAS) protocol for pain control management. We start our modified ERAS protocol postsurgery, with oral acetaminophen, celecoxib, and gabapentin. Oral oxycodone is given for breakthrough pain only. The urinary catheter is now removed at the end of the case, instead of next morning, and patients resume a regular diet the same night of surgery and are encouraged to start ambulation.

Minor complications that did not require further surgery included small volume seromas managed with in-office needle aspiration and breast binder, and minor wound dehiscence (Table 1). The senior author minimizes seroma formation with the use of topical fibrin glue and drains.[5] In every patient, 15 Fr closed channel suction drains, (two to the back and one to each breast) were used. The back drains remained a minimum of 10 days; median time to removal was 16.09 days. Four patients had persistent seromas that required return to the operating room for drainage. Three patients (3.8%) with suspected periprosthetic implant infection were taken back to surgery within 24–48 hours of presentation, for washout. The decision for immediate implant replacement was guided by intraoperative absence of purulent drainage and no-organisms on STAT gram stain. One patient with suspected implant infection did not wish to have implant replacement at the time of washout. Six months later, she reconsidered and underwent a delayed implant placement without any complications. In the remaining two patients, implants were successfully salvaged with new implant replacement and no subsequent complications.

DISCUSSION

Although the latissimus dorsi flap has received less attention in recent years in primary and secondary breast reconstruction, we propose that the pedicled LDMCF remains a versatile and relevant form of autologous breast reconstruction. In some patients, it may be the only option. Herein, we present 106 patients who highlight the flap's versatility and lessons learned from the senior surgeon's first 110 consecutive cases.

The LDMCF can be used for immediate or delayed, partial or complete unilateral or bilateral breast reconstruction. We have also found it to be very helpful for "salvage" cases, typically when patients have experienced complications from TEs or implants placed in radiated patients. Many of these patients present with severe capsular contraction, and others have experienced wound dehiscence and implant exposure/explantation. Two common scenarios are shown in Figures 2 and 3. In both cases, the patients underwent left tissue expansion after radiation, resulting in wound dehiscence, implant exposure, and explantation. The patient in Figure 3 requested right TE removal and to "go flat." Five years later, she requested bilateral delayed breast reconstruction, and this was performed with bilateral LDMCF with DTI, using a "bra-line-back-lift" approach. Figure 4 shows a patient with multiple failed attempts at reclosure for implant exposure on a radiated left breast by another surgeon. We performed salvage reconstruction of the left breast with LDMCF and new silicone implant and right TE exchange for silicone implant and scar revision.

The LDMCF is also an excellent option for patients needing mastectomy with large skin resection. Figure 5 shows a patient who underwent lumpectomy for malignant phyllodes tumor with positive margins. She underwent a left completion mastectomy with skin resection and underwent an immediate pedicled LDMCF without an implant.

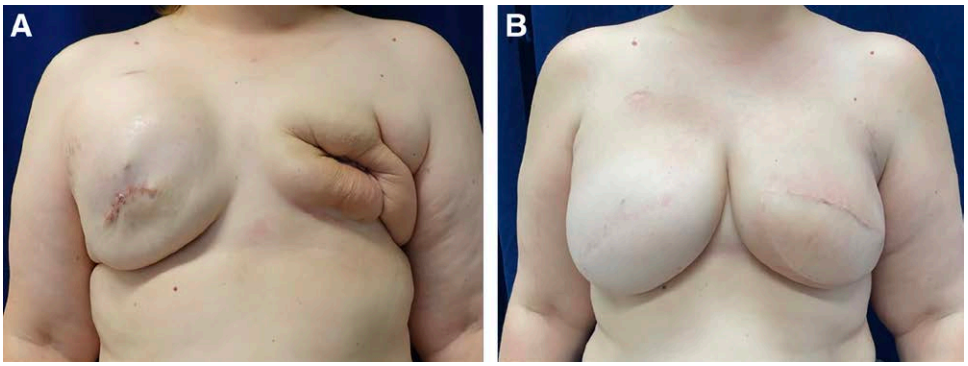

Fig. 2. LDMCF with direct-to-implant is an excellent option after radiation-induced implant complications, resulting in explantation. A 36–year-old woman with BRCA1 mutation and locally advanced left breast cancer. She underwent left SSM and right risk-reducing SSM with postmastectomy radiation to the left chest wall. She subsequently had bilateral delayed breast reconstruction with TE at an outside institution. A, During expansion, her postoperative course was complicated by left breast infection, and she had been explanted at the time of presentation to the senior surgeon. B, We performed a right breast TE exchange to silicone implant and left LDMCF with prepectoral silicone implant. SSM, skin-sparing mastectomy.

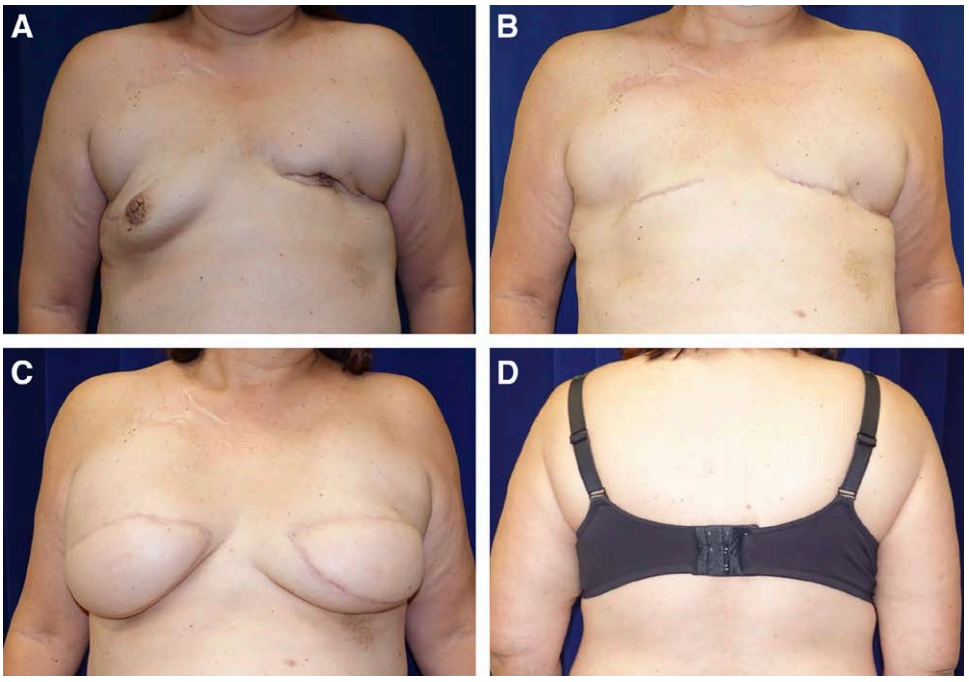

Fig. 3. LDMCF can be used if patients have a change of heart after requesting aesthetic flat closure. A, A 58-year-old woman with left breast cancer, bilateral nipple-sparing mastectomy and TEs, complicated by explantation for left breast implant infection at an outside institution. B, At her request, we performed right expander removal and bilateral flat closure. Five years later, she requested delayed bilateral breast reconstruction. C, She had bilateral LDMCF with DTI. D, Her back scars are hidden by her bra.

We found that a prosthesis can be avoided in some cases (26%), especially in patients with higher BMIs and/or who do not desire a very large cup size. Figure 6A shows a 60-year-old woman with right breast ductal carcinoma in situ who had bilateral nipple-sparing mastectomy and bilateral immediate pedicled LDMCF, without the need for any implants. Aside from adding volume, the other benefit of using a prosthesis is not only to increase the overall volume of the new breast but also to provide upper pole fullness. This is similar to simultaneous augmentation to enhance a mastopexy (Fig. 7). This patient elected to undergo right risk-reducing contralateral skin-sparing mastectomy and implant-based reconstruction, without the need for TEs. Furthermore, she had bilateral nipple

Fig. 4. The skin paddle from LDMCF offers excellent coverage of an unstable mastectomy wound with recurrent wound dehiscence. A 44-year-old woman with history of left breast cancer status post bilateral SSM with subpectoral TE and expansion. She was radiated 2 months later and TEs were switched for silicone implants. One month postoperative, the left implant was infected with methicillin-resistant Staphylococcus aureus and underwent explantation. She underwent subsequent left TE placement and exchange for silicone implant. On postoperative day 3, the left breast wound dehisced. There were four unsuccessful attempts at in-office resuturing of the wound (A), by her initial surgeon. To salvage, we performed revision of the left breast with LDMCF DTI and revision of the right breast with silicone implant exchange and scar revision. B, She has had no complications at 1 year postoperative.

Fig. 5. LDMCF can be used without any implants for 100% autologous reconstruction when patients have small to moderate sized breasts. A, A 50–year-old woman with left breast phyllodes tumor status post lumpectomy with positive margins. She underwent completion mastectomy with wide skin resection (B) and immediate pedicled LDMCF with total autologous reconstruction without the use of prosthesis (C).

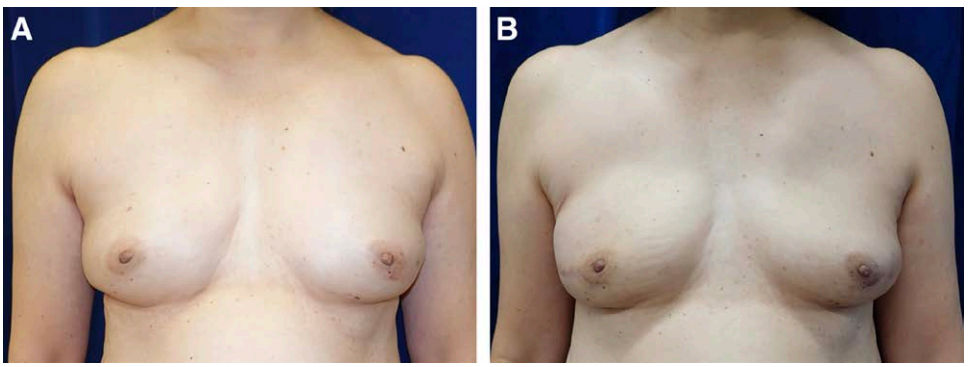

Fig. 6. Immediate LDMCF can offer excellent autologous-only breast reconstruction after bilateral nipple-sparing mastectomy. A, A 60-year-old woman with right breast ductal carcinoma in situ who underwent bilateral nipple-sparing mastectomies and did not want implants. B, She underwent immediate bilateral LDMCF without implants.

reconstruction and subsequent tattoo (Fig. 7C). Although all patients are offered nipple reconstruction, only 13% of patients elected to have this procedure. It should be noted that in patients with high BMI and a bulky skin paddle, tissue expansion can be challenging, and we occasionally need to use a spinal needle.

Fig. 7. LDMCF with direct-to-implant cosmesis can be improved with nipple areolar reconstruction and tattoo. A, A 45-year-old woman with recurrent left breast cancer after lumpectomy and declining radiation and chemotherapy. B, She then had bilateral mastectomy with right breast implant reconstruction and left chest wall radiation. This was followed by delayed left breast reconstruction with LDMCF with DTI and right silicone implant exchange. C, This was followed by bilateral nipple-areolar complex reconstruction and tattoo.

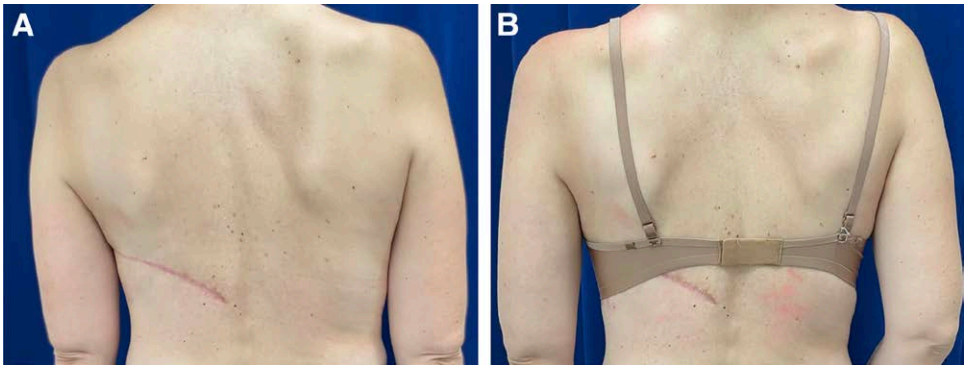

Fig. 8. A common oblique scar seen after harvesting of LDMCF. A 40-year-old woman with left locally advanced breast cancer and LDMCF performed by another surgeon. The flap design has led to an oblique scar (A), which clearly cannot be covered by her bra (B).

One of the most common concerns regarding the LDMCF is the scar along the back.[3] Typically, the resulting scar is obviously visible and in an oblique or vertical orientation, unable to be hidden by the patient's bra (Fig. 8).[3] In our experience, donor site aesthetics can be improved by approaching the flap harvest using a bra-line-back-lift design and lengthening the scar to mitigate lateral dog ears (Fig. 3D). In some cases, we have performed symmetrizing back lift with excellent results. An in-depth report will be provided in a future publication by the senior author (Li, unpublished data). All 106 patients had minimal long-term deficits after surgery. All patients went back to work; one patient went back to extreme sports, as a competitor in the Ironman Triathalon.

CONCLUSIONS

In conclusion, the LMDCF remains an incredibly versatile technique used in breast reconstruction that we feel still has a significant role in autologous breast reconstruction. Compared with abdominal free tissue transfer, the LDMCF offers less extensive preoperative workup and shorter operative times.[3] LOS can be reduced to overnight stay in many patients by using liposomal bupivacaine and modified ERAS protocol. Other studies reveal successful reduction in overall LOS with ERAS protocol including opioid-sparing analgesia, early ambulation, early oral feeding, and intercostal nerve blocks.[11]

Donor site seroma rates remain the most common complication after LDMCF procedures, with widely varying reported rates from 5% to 96% of cases.[12] Our low seroma rate of 3.8% is most likely due to the senior surgeon's aggressive use of closed suction drains. These are left in for a minimal period of 10 days before removal and only when outputs are less than 30 mL for 3 consecutive days. Although the literature supports drain usage decreasing seroma formation, there is currently no study specifically addressing the impact of topical fibrin glue, which we also use.[13] Most small volume seromas self-resolve and if persistent can be treated with in-office aspiration, typically occurring in patients with lower BMIs.[12] Interestingly, we did not have any patients with mastectomy skin flap necrosis, as reported by others.[10] This is likely multifactorial; working within a cancer center, we have the luxury of working with excellent breast surgeons, which produce reliable mastectomy flaps, especially in the case of immediate reconstruction. The senior author also has a strict mandatory smoking cessation policy; active smokers must quit at least 8 weeks before surgery, to be considered for reconstruction.

In salvage cases, with history of prior skin necrosis or delayed healing (Fig. 4), we use intraoperative indocyanine green perfusion imaging during surgery to assess the

viability of mastectomy flaps once elevated. This is particularly important in cases when there is a pre-existing TE or implant with severe radiation-induced capsular contraction because the capsule, and sometimes the old mastectomy skin, must be removed for optimal results. Finally, the senior surgeon's preference in the majority of cases is to place less projecting (avoiding high profile) implants at the time of latissimus dorsi flap reconstruction, thus decreasing any risk of excess tension on the mastectomy flaps and the freshly transposed flap.

Overall, patients were satisfied with the aesthetic outcomes. No patient in this series underwent fat grafting. Due to the larger than average volume flaps that are harvested by the senior surgeon, any volume increases are achieved with higher profile implants, which give the upper pole fullness some patients desire. The flap can be easily tailored to address complex breast deformities and is an attractive option for patients with significant comorbidities. When used with implants, this can lead to a commonly desired more "youthful" appearance compared with 100% autologous breast reconstruction. The frequent concern of an unsightly back scar can be addressed with use of the bra-line-back-lift procedure, allowing the scar to be hidden along a patient's bra line. A recent article in 2021 also proposed a technique with a minimal elliptical incision, resulting in a scar that can be hidden under the arm.[10] The results of this current study reflect that the LDMCF can be safely and effectively performed in a variety of breast reconstruction cases.

LIMITATIONS AND FUTURE STUDIES

There are several limitations of our study; in the future, we plan to collect data on a prospective basis and objectively collect patient reported outcomes after LDMCF. We are currently working on a more detailed analysis on how we reduced our LOS, as well as a paper focusing on the bra-line-back-lift latissimus dorsi flap design.

Wai-Yee Li, MD, PhD, FACS
Division of Plastic Surgery
City of Hope Medical Center
1500 E Duarte Road
Duarte, CA 91010
E-mail: drwaiyeeli@gmail.com

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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