Latissimus Dorsi (LD) Flap with Immediate Fat Transfer versus Implant-Based LD Flap for Breast Reconstruction: A Retrospective Comparison of 402 Patients

Tiia Miettinen

Syventävien opintojen opinnäyte

Kevätlukukausi 2026

Turku

Latissimus Dorsi (LD) Flap with Immediate Fat Transfer versus Implant-Based LD Flap for Breast Reconstruction: A Retrospective Comparison of 402 Patients

Tiia Miettinen

Kliininen laitos

Kevätlukukausi 2026

Vastuuhenkilö: Professori Salvatore Giordano

TURUN YLIOPISTO
Lääketieteellinen tiedekunta

Oppiaine: Kliininen laitos, plastiikkakirurgia

Tekijä: Tiia Miettinen

Otsikko: Latissimus Dorsi (LD) Flap with Immediate Fat Transfer versus Implant-Based LD Flap for Breast Reconstruction: A Retrospective Comparison of 402 Patients
Ohjaajat: Professori Salvatore Giordano
Sivumäärä: 15 sivua

Päivämäärä: Maaliskuu 2026

Breast reconstruction following mastectomy can be performed using either implant-based or autologous techniques. Although abdominal free flaps are widely considered the gold standard for autologous reconstruction, not all patients are suitable candidates due to comorbidities, smoking status, or personal preferences. In such cases, the latissimus dorsi (LD) flap remains an important reconstructive option. Traditionally, LD reconstruction has often required an implant to achieve adequate breast volume. However, immediate fat transfer to the LD flap (fat-augmented latissimus dorsi, FALD) has emerged as an alternative that allows volume enhancement without implants.

This retrospective study compared outcomes of FALD and implant-assisted LD reconstruction in 402 patients treated at Turku University Hospital between 2009 and 2024. Demographic data, operative details, and postoperative complications were analyzed. Of the patients, 130 underwent FALD reconstruction and 272 implant-assisted LD recontruction. Overall complication rates were similar between the groups, and no statistically significant differences were observed in major or wound-related complications. Operative time was indentified as an independent predictor of postoperative complications.

Both techniques demonstrated comparable safety profiles. FALD offers a fully autologous alternative that avoids implant-related complications, whereas implant-assisted LD reconstruction may provide greater immediate breast volume. Further prospective studies are needed to optimize patient selection and evaluate long-term outcomes.

Avainsanat: Rintarekonstruktio, LD-rekonstruktio, implantti, postoperatiivinen komplikaatio

Latissimus Dorsi (LD) Flap with Immediate Fat Transfer versus Implant-Based LD Flap for Breast Reconstruction: A Retrospective Comparison of 402 Patients

Tiia Miettinen, BS, Salvatore Giordano MD, PhD.

Turku University Hospital and the University of Turku.

Abstract

Purpose: Free abdominal flaps are widely regarded as the gold standard for breast reconstruction, particularly in patients with prior irradiation. However, not all patients are suitable candidates for microsurgical reconstruction due to comorbidities, smoking, vascular risk factors, or preferences. In such cases, latissimus dorsi (LD) flap–based techniques remain valuable alternatives. Traditional LD reconstruction often requires an implant to achieve adequate volume, yet implant-related complications have fueled growing interest in autologous approaches. Immediate fat transfer to the LD flap (FALD) has emerged as a method to augment flap volume while reducing reliance on implants. Despite increasing adoption, direct comparisons between fat-augmented LD and implant-based LD reconstructions remain limited. We aimed to evaluate and compare the clinical outcomes of these two techniques at long-term postoperatively.

Methods: A retrospective review was conducted of 402 patients who underwent breast reconstruction using the latissimus dorsi (LD) flap between January 2009 and December 2024 at Turku University Hospital. Patients were categorized into fat-augmented LD (FALD) and implant-assisted LD (implant-LD) groups. Demographic data, comorbidities, oncologic history, operative details, and adjuvant therapies were collected. Surgical and procedure-specific complications, reoperation rates, and need for secondary fat grafting or implant revision were assessed. Comparative analyses were performed using Student's t-test or Mann–Whitney U test for continuous variables and Chi-squared test for categorical variables, with significance set at $p < 0.05$.

Results: Of 402 patients, 130 underwent FALD and 272 implant-LD reconstruction. Mean follow-up was 63.5 ± 55.7 months. The FALD cohort exhibited higher BMI and longer operative times (251 vs. 231 min, $p = 0.047$), but shorter hospital stays (2.9 vs. 3.0 days, $p = 0.008$). Overall complication rates were comparable (46.9% vs. 47.1%, $p = 0.980$), with no significant differences in wound-specific or major complications. Multivariable analysis identified operative time as an independent predictor of postoperative complications.

Conclusions: FALD and implant-LD reconstructions demonstrated equivalent safety and complication profiles. FALD provides a fully autologous alternative that avoids implant-related risks but requires longer operative time and potential secondary fat grafting. Implant-assisted LDF remains a reliable option when greater immediate volume is desired. Prospective studies are warranted to validate these findings and optimize patient selection criteria.

Level of Evidence: III

Introduction

Breast reconstruction following mastectomy has become a widespread procedure. Contemporary reconstructive strategies include both alloplastic approaches using tissue expanders and implants as well as autologous techniques utilizing patient-derived tissues (Friedman et al., 2019). Autologous reconstruction is widely regarded as the golden standard for selected patients due to its favorable long-term outcomes and durability (Banys-Paluchowski et al., 2023). Although abdominal-based flaps currently represent the most commonly performed autologous reconstruction method (Lee et al., 2021), the latissimus dorsi flap (LDF) has maintained an important role owing to its reliable vascular pedicle, consistent anatomy, and broad clinical applicability (Escandón ym., 2023; Merkkola-von Schantz & Kauhanen, 2022).

The resurgence of the LDF has been driven in part by the development of augmentation strategies, including implant-assisted reconstruction and fat-augmented techniques, which expand its applicability to patient populations with limited donor-site availability or elevated surgical risk, such as smokers and patients with obesity (Escandón et al., 2023). These approaches allow volume enhancement while preserving the biological advantages of the flap and, in selected cases, enable breast reconstruction without additional visible donor-site scarring, particularly in nipple-sparing mastectomy or two-stage reconstruction using tissue expanders (Maitani et al., 2021). Consequently, the LDF remains a versatile reconstructive option, particularly when microsurgical free flap reconstruction in not feasible or not desired. However, contemporary evidence highlights substantial heterogeneity in operative techniques, augmentation strategies, and outcome reporting in LDF-based breast reconstruction. Although institutional series demonstrate the feasibility and acceptable perioperative safety of fat augmentation techniques such as immediate fat transfer (LIFT), the current literature is largely composed of case series and technique-focused reports with variable endpoints and follow-up durations, making cross-study comparison challenging (Economides & Song, 2018).

Patient-reported outcome studies generally demonstrate acceptable satisfaction and quality-of-life outcomes following LDF-based reconstruction, although the availability of standardized patient-reported outcome measures remains limited (Peshel et al., 2023). Systematic reviews emphasize that patient-reported outcomes are inconsistently captured and that available PROM data remain comparatively sparse, limiting comprehensive assessment beyond surgical morbidity (Peshel et al., 2023). Donor-site morbidity, including potential reductions in shoulder strength and range of motion, has been reported. However, these functional effects are typically modest and tend to improve over

time, supporting the overall clinical acceptability of the procedure (Escandón et al., 2023; Højvig et al., 2022).

Despite the widespread use of implant-based breast reconstruction, device-specific risks such as infection, capsular contracture, rupture, and rare malignancies contribute substantially to long-term morbidity and the need for secondary procedures, underscoring the importance of vigilant postoperative surveillance and thorough patient counseling (Boyd et al., 2025; De Boniface et al., 2022; Sorenson et al., 2025). In particular, capsular contracture remains one of the most frequent indications for revision surgery, with systematic reviews consistently reporting clinically relevant rates of contracture and other implant-related complications across different implant types and follow-up durations (Christodoulou et al., 2024). Although fat-augmented reconstruction offers an autologous alternative to implant-based approaches, autologous fat grafting is associated with specific complications such as fat necrosis, oil cysts, calcifications, and variable volume retention that may complicate imaging interpretation and necessitate additional interventions (Rijkx et al., 2024; Seth et al., 2024; Ørholt et al., 2020). Systematic reviews have shown that fat necrosis represents a substantial portion of grafting-related morbidity, and repeat grafting procedures are observed in a minority of patients to optimize volume outcomes (Salibian et al., 2019; Yu et al., 2024).

Importantly, recent systematic reviews comparing fat-augmented LDF and implant-assisted LDF conclude that direct comparative evidence remains limited and heterogeneous, and they call for higher-quality comparative studies with standardized complication definitions, PROM integration, and sufficient follow-up to support technique selection and patient counseling (Tilkin et al., 2025). Moreover, long-term outcomes after breast reconstruction — particularly in patients exposed to radiotherapy — highlight the need to better characterize durable complication profiles and secondary procedure burden over time (Wattoo et al., 2021). Finally, emerging long-term patient-reported functional data underscore that morbidity assessment should extend beyond early surgical complications, further supporting standardized prospective data collection in LDF-based reconstruction (Löfstrand ym., 2024). Therefore, large cohort studies with standardized outcome assessment and adequate follow-up are needed to define the comparative safety and long-term morbidity of contemporary LDF-based reconstruction techniques and to strengthen evidence-based, individualized reconstructive decision-making.

The aim of this study is to investigate and compare the incidence of complications associated with the use of the latissimus dorsi flap in various contexts. Specifically, the study aims to compare complications arising from the combination of the latissimus dorsi flap and an implant (implant-LD),

and with fat transfer (FALD). Based on the differing mechanisms of volume augmentation and associated complication profiles, we hypothesized that fat-augmented latissimus dorsi flap (FALD) reconstruction would demonstrate overall postoperative complication rates comparable to those of implant-assisted latissimus dorsi flap (implant-LD) reconstruction. Secondarily, we hypothesized that FALD reconstruction would be associated with longer operative times, but shorter hospital stays compared with implant-assisted LD reconstruction, and that increased operative duration would be independently associated with a higher risk of postoperative complications regardless of reconstruction technique.

Materials and Methods

This study was designed as a retrospective comparative cohort study evaluating outcomes of two latissimus dorsi flap–based breast reconstruction techniques: fat-augmented latissimus dorsi flap (FALD) reconstruction and implant-assisted latissimus dorsi flap (implant-LD) reconstruction. The primary objective of this study was to compare postoperative complication rates between patients undergoing FALD reconstruction and those undergoing implant-assisted LD reconstruction. Secondary objectives were to evaluate differences between the two techniques in perioperative parameters, reoperation rates, and procedure-specific outcomes, and to identify patient- and procedure-related factors independently associated with postoperative complications following latissimus dorsi flap-based breast reconstruction.

We retrospectively reviewed consecutive patients who underwent breast reconstruction using the latissimus dorsi (LD) flap technique between January 2009 and December 2024 at Turku University Hospital, Finland. Patients were identified through the hospital's surgical registry. Two main reconstruction techniques were analyzed: fat-augmented latissimus dorsi (FALD) and implant-assisted latissimus dorsi (implant-LD). Data extracted from medical records included demographic information, body mass index (BMI), smoking status, comorbidities, oncologic history, preoperative assessments, operative details, and adjuvant therapies.

The primary endpoint was the overall postoperative complication rate, defined as the occurrence of at least one surgical, wound-related, or medical complication during the follow-up period. Secondary endpoints included the incidence of major postoperative complications, wound- and donor site–specific complications, and reoperation rates stratified as early (< 30 days) and late (> 30 days) postoperative events.

Perioperative parameters, including operative time and length of hospital stay, were evaluated. In addition, procedure-specific outcomes were assessed, including the need for secondary fat grafting procedures in patients undergoing fat-augmented LD reconstruction and implant-related revision or removal in the implant-assisted LD group. Finally, multivariable logistic regression analysis was performed to identify independent patient- and procedure-related predictors of postoperative complications.

Postoperative complications were classified according to predefined criteria. Hemorrhage was defined as bleeding requiring intraoperative or postoperative blood transfusion, surgical re-exploration, or radiologic intervention for hematoma evacuation. Wound, scar, and donor site complications included partial or total nipple necrosis, wound infection requiring drainage, hospitalization, or antibiotic therapy, and wound dehiscence resulting in delayed healing exceeding two weeks. Minor wound issues resolving without intervention were excluded. Scarring complications encompassed hypertrophic, painful, or surgically revised scars. Medical and anesthetic complications included intraoperative anesthetic difficulties and postoperative systemic events such as deep vein thrombosis or respiratory tract infections. Major complications were defined as clinically significant events including hemorrhage, complete nipple loss, infection or wound dehiscence requiring hospitalization, and any medical or anesthetic complication.

Statistical Analysis

Continuous variables were summarized as means with standard deviations (SD) and categorical variables as frequencies with percentages. Normality of continuous data was assessed using histograms, skewness, kurtosis, and the Kolmogorov–Smirnov test. Between-group comparisons between the fat-augmented latissimus dorsi (FALD) and implant-assisted latissimus dorsi (implant-LD) groups were performed using Student's t-test or Mann–Whitney U test for continuous variables, and Pearson's Chi-square or Fisher's exact test for categorical variables, as appropriate. Multivariable logistic regression analysis was applied to identify independent predictors of postoperative complications, with results expressed as adjusted odds ratios (ORs) and 95% confidence intervals. Model calibration was evaluated using the Hosmer–Lemeshow test, which confirmed adequate fit ($p = 0.990$). All tests were two-sided, with statistical significance set at $p < 0.05$.

Results

Patient Characteristics and Baseline Data

A total of 402 patients were included in the study, with 130 undergoing FALD and 272 undergoing implant-based LD reconstruction over a 15-year period. The overall mean follow-up was 63.5 ± 55.7 months. Baseline demographic and clinical characteristics were largely comparable between the two groups (Table 1). Patients in the FALD group had a significantly higher body mass index compared with those undergoing implant-assisted LD reconstruction. No significant differences were observed with respect to age, smoking status, comorbidities, oncologic characteristics, or adjuvant therapies.

Table 1. Demographics of patients at time of study.

	Group A: FALD (n=130)	*Group B: LD-Implant (n=272)*	*p-value*
Age (mean ± SD)	54.7±12.6	53.9±11.1	0.531
Mean BMI (kg/m^2)	27.3±5.0	25.2±4.0	<0.001
Any comorbidity	51 (39.2%)	95 (34.9%)	0.401
Diabetics	9 (6.9%)	10 (3.7%)	0.151
Hypertension	34 (26.2%)	58 (21.3%)	0.281
Pulmonary disease	8 (6.2%)	12 (4.4%)	0.452
Depression	9 (6.9%)	18 (6.6%)	0.909
Smokers	39 (30.0%)	78 (28.7%)	0.785
Herbal supplement	7 (5.4%)	9 (3.3%)	0.319
Neo-Adjuvant radiotherapy	0	2 (0.7%)	1.000
Neo-Adjuvant chemotherapy	3 (2.3%)	8 (2.9%)	0.716
Radiotherapy	70 (54.3%)	131 (48.2%)	0.357
Chemotherapy	73 (57.0%)	172 (81.1%)	0.121
Previous/Immediate Axillary Lymphadenectomy	58 (45.0%)	129 (48.0%)	0.575
Follow-up (months)	62.9±54.8	71.0±54.3	0.234

Perioperative Parameters

Perioperative outcomes are summarized in Table 2. Operative time was significantly longer in the FALD group compared with the implant-LD group (251 vs. 231 minutes, p = 0.047). In contrast, the

length of hospital stay was slightly but significantly shorter among patients undergoing FALD reconstruction (2.9 vs. 3.0 days, p = 0.008). The frequency of immediate contralateral symmetrization did not differ significantly between the groups. The mean volume of fat grafted in the FALD group was significantly lower than the mean implant volume used in the implant-LD group (159 vs. 207 cc, p < 0.001).

Table 2. Comparison of peri-operative parameters in the two groups of patients.

	Group A: FALD (n=130)	*Group B: LD-Implant (n=272)*	*p-value*
ASA Score (mean ± SD)	1.88±0.66	1.81±0.63	0.423
Operative time (min, mean ± SD)	251.0±76.9	231.5±71.0	**0.047**
Bilateral Reconstructions	11 (8.5%)	24 (8.8%)	0.904
Resection weight (g, mean ± SD)	565.1±334.9	499.2±262.8	0.056
Immediate Symmetrization	44 (34.4%)	105 (39.2%)	0.356
Blood loss (ml, mean ± SD)	313.6±263.9	264.1±205.5	0.114
Fat Injected (cc, mean ± SD)	159.3±85.3		
Implant Size (cc, mean ± SD)		207.0±77.9	**<0.001**
Hospital stay (days, mean ± SD)	2.90±1.30	3.05±1.30	**0.008**

Postoperative Complications

Overall postoperative complication rates were comparable between the two reconstruction techniques, occurring in 46.9% of patients in the FALD group and 47.1% in the implant-LD group (p = 0.980) (Table 3). No statistically significant differences were observed in wound- or donor site–specific complications between groups. Major complications occurred at similar rates in both cohorts. Likewise, rates of medical and anesthetic complications did not differ significantly between reconstruction techniques.

Table 3. Postoperative complications at follow-up.

	Group A: FALD (n=130)	*Group B: LD-Implant (n=272)*	*p-value*
Patients with complications (medical included)	61 (46.9%)	128 (47.1%)	0.980
Complications			
Superficial wound infection (received antibiotics <30 days)	10 (7.7%)	22 (8.1%)	0.891
Deep wound infection (revision in local anaesthetics or general)	1 (0.8%)	6 (2.2%)	0.303
Wound dehiscence (need for revision -local/general)	3 (2.3%)	18 (6.6%)	0.146
Fat necrosis (need for operation)	1 (0.8%)	1 (0.4%)	0.592
Hematoma (need for operation)	4 (3.1%)	18 (9.6%)	0.069
Seroma (requiring aspiration after drains removal)	58 (44.6%)	101 (37.1%)	0.151
Reoperation <30 days	5 (3.8%)	22 (8.1%)	0.112
Implant removal <30 days		9 (3.3%)	
Capsular contracture		5 (1.8%)	
Implant Changes/Removal >30days		8 (2.9%)	
Reoperation at follow up, more than 30 days post operatively	64 (49.2%)	125 (46.0%)	0.538
Mean number or operations	1.5±0.8	1.4±0.8	0.261
Mean number of Fat Grafting procedures	0.73±0.93		
Re-admissions <30 days	3 (2.3%)	17 (6.3%)	0.089
Reoperation for dog-ear / scar revision	16 (12.3%)	23 (8.5%)	0.222

Reoperations and Procedure-Specific Outcomes

Early reoperations (< 30 days postoperatively) occurred at comparable rates between the two groups, although a nonsignificant trend toward higher early readmission was observed in the implant-LD group (6.3% vs. 2.3%, p = 0.089). Later reoperation rates (> 30 days) were similar between groups.

Procedure-specific outcomes differed by reconstruction type. Patients undergoing FALD reconstruction more frequently required secondary fat grafting procedures, whereas implant-related revision or removal occurred exclusively in the implant-LD group.

Multivariable logistic regression analysis was performed to identify independent predictors of postoperative complications (Table 4). Longer operative time was independently associated with an increased risk of postoperative complications (OR 1.01, 95% CI 1.00–1.01, p = 0.007). A history of pulmonary disease showed a nonsignificant trend toward increased complication risk (OR 2.4, 95% CI 0.75–7.84, p = 0.137). Reconstruction type (FALD vs. implant-LD) was not independently associated with postoperative complications.

Table 4. Multivariable logistic regression was used to assess independent risk factors for **complications** based on whether technique was used, with adjusted odds ratios provided.

	Odd Ratios	*95% Confidence Interval*	*p-value*
Pulmonary disease	2.43	0.75-7.84	0.137
Bilateral Reconstruction	1.80	0.72-4.50	0.207
Hypertension	1.72	0.88-3.35	0.114
Smoking	1.69	0.95-3.00	0.074
Axillary Lymphadenectomy	1.24	0.74-2.06	0.417
Implant use	1.21	0.69-2.11	0.513
Age	1.02	0.99-1.05	0.102
Operative time	1.01	1.00-1.01	**0.007**
BMI	1.01	0.94-1.07	0.868
Blood loss	1.00	0.99-1.00	0.786
Diabetes	0.87	0.27-2.71	0.793
Depression	0.81	0.29-2.29	0.698
ASA score	0.72	0.43-1.18	0.192

Discussion

This large single-center retrospective study compared outcomes of fat-augmented latissimus dorsi flap (FALD) and implant-assisted latissimus dorsi flap (implant-LD) breast reconstruction over a 15-year period. The principal finding was that both reconstruction techniques demonstrated comparable overall postoperative complication rates and similar profiles of wound-related and major complications. Although operative time was no longer in the FALD group and hospital stay was marginally shorter, reconstruction type itself was not independently associated with postoperative complications. Instead, operative duration emerged as an independent predictor of postoperative morbidity.

These findings are consistent with previously published institutional series evaluating LD flap-based reconstruction. Banys-Paluchowski et al. (2023) and Escandón et al. (2023) reported overall complication rates in the range observed in the present cohort, supporting the continued reliability of the LD flap across diverse patient populations. With respect to fat-augmented LD reconstruction, prior studies have demonstrated that immediate fat grafting does not substantially increase perioperative risk (Lee et al., 2021; Maitani et al., 2021). Similarly, implant-assisted LD reconstruction has been associated with acceptable short-term complication rates, although long-term implant-related morbidity remains a recognized concern (Friedman et al., 2019). Friedman et al. (2019) reported increased rates of capsular contracture and implant-related revision procedures during extended follow-up after implant-assisted LD reconstruction. While capsular contracture severity was not separately quantified in the present study, the exclusive occurrence of implant-related revision procedures in the implant-LD group is consistent with these observations and highlights one of the principal motivations for the increasing interest in fully autologous LD-based reconstruction techniques.

The exclusive occurrence of implant-related revision procedures in the implant-LD group in this cohort reflects these previously reported long-term device-related risks and provides further rationale for the growing interest in fully autologous LD-based reconstruction techniques. Nevertheless, implant-assisted LD reconstruction continues to represent a valuable option, particularly when immediate volume restoration is prioritized or when donor-site fat availability is limited.

From a clinical perspective, the comparable safety profiles observed between FALD, and implant-assisted LD reconstruction emphasize the importance of individualized reconstructive planning. Fat-augmented LD reconstruction may be particularly advantageous for patients seeking autologous reconstruction who are not candidates for microsurgical free flaps, including patients with prior

radiotherapy, smokers, or individuals with significant comorbidities. However, the longer operative time and potential need for secondary fat grafting procedures should be discussed preoperatively. Conversely, implant-assisted LD reconstruction offers procedural efficiency and predictable early volume restoration, although patients should be counseled regarding the potential for long-term implant-related complications.

The identification of operative duration as an independent predictor of postoperative complications highlights the relevance of procedural efficiency and careful operative planning, as prolonged operative time has consistently been associated with increased postoperative morbidity across surgical populations, including plastic and reconstructive surgery (Cheng ym., 2018; Haddock ym., 2022; Hardy ym., 2014; Shtarbanov ym., 2023). Standardized surgical workflows and optimization of perioperative protocols may represent modifiable factors to reduce postoperative morbidity regardless of reconstruction modality.

This study has several strengths. The inclusion of a relatively large cohort of consecutive patients over a 15-year period provides real-world data reflecting routine clinical practice. The extended follow-up duration allows for assessment of both early and late postoperative outcomes, including reoperations and procedure-related complications. The single-center design contributed to consistency in surgical techniques, perioperative management, and follow-up protocols, which may have reduced variability in treatment delivery. Furthermore, the availability of detailed clinical data permitted multivariable analyses to explore potential independent predictors of postoperative complications, thereby supporting a more comprehensive evaluation of the study objectives.

Despite these strengths, several limitations should be acknowledged. The retrospective study design is inherently subject to selection bias and unmeasured confounding. Reconstruction technique selection was based on clinical judgment and patient-specific factors rather than randomization, which may have influenced baseline characteristics and outcomes. Although multivariable adjustment was performed, residual confounding cannot be excluded.

Another limitation is the heterogeneity of surgical techniques and perioperative management over the extended study period. Advances in fat grafting techniques, implant technology, and perioperative care may have influenced complication rates and operative outcomes. In addition, standardized patient-reported outcome measures were not systematically collected, limiting evaluation of aesthetic outcomes and patient satisfaction. Future prospective studies incorporating validated patient-reported outcome instruments would allow a more comprehensive assessment of reconstructive success.

Finally, complication ascertainment relied on clinical documentation, which may have led to underreporting of minor events not requiring medical intervention. However, the use of predefined complication criteria and consistent institutional follow-up protocols likely reduced this risk.

Future research should focus on prospective, multicenter studies with standardized outcome reporting to validate these findings and improve generalizability. Incorporation of validated patient-reported outcome instruments would allow a more comprehensive evaluation of reconstructive success. Further studies evaluating long-term volume stability, cumulative secondary procedures, and cost-effectiveness may also help refine patient selection and optimize reconstructive algorithms.

Conclusions

Fat-augmented and implant-assisted latissimus dorsi flap breast reconstruction demonstrated comparable safety and postoperative complication profiles in this large single-center cohort. The FALD technique offers a fully autologous alternative that avoids implant-related morbidity and may be particularly suitable for selected patients who are not candidates for microsurgical reconstruction. Implant-assisted LD reconstruction remains a reliable and efficient option when immediate volume restoration is desired. Both techniques represent complementary components of contemporary breast reconstruction practice. Prospective studies are warranted to further define optimal patient selection and long-term outcomes.

References

Banys-Paluchowski, M., Brus, L., Krawczyk, N., Kopperschmidt, S. V., Gasparri, M. L., Bündgen, N., Rody, A., Hanker, L., Hemptenmacher, F., & Paluchowski, P. (2023). Latissimus dorsi flap for breast reconstruction: A large single-institution evaluation of surgical outcome and complications. *Archives of Gynecology and Obstetrics*, *309*(1), 269–280. https://doi.org/10.1007/s00404-023-07186-3

Boyd, C. J., Hemal, K., Sorenson, T. J., Amro, C., Lu, S., Miller, B., Karp, N. S., & Choi, M. (2025). Assessing Perioperative Complications and Cost of Nipple-Areolar Complex Neurotization in Immediate Implant-Based Breast Reconstruction Following Nipple-Sparing Mastectomy: A Matched-Paired Comparison. *Annals of Plastic Surgery*, *94*(4S), S118–S120. https://doi.org/10.1097/SAP.0000000000004177

Cheng, H., Clymer, J. W., Po-Han Chen, B., Sadeghirad, B., Ferko, N. C., Cameron, C. G., & Hinoul, P. (2018). Prolonged operative duration is associated with complications: A systematic review and meta-analysis. *Journal of Surgical Research*, *229*, 134–144. https://doi.org/10.1016/j.jss.2018.03.022

Christodoulou, N., Secanho, M., Kokosis, G., Malgor, R. D., Winocour, J., Yu, J. W., Mathes, D. W., & Kaoutzanis, C. (2024). Capsular contracture in breast reconstruction: A systematic review and meta-analysis. *Journal of Plastic, Reconstructive & Aesthetic Surgery*, *98*, 131–143. https://doi.org/10.1016/j.bjps.2024.08.057

De Boniface, J., Coudé Adam, H., Frisell, A., Oikonomou, I., Ansarei, D., Ljung Konstantinidou, A., Liu, Y., Abo Alniaj, B., Wallmon, P., Halle, M., Johansson, A. L. V., & Sackey, H. (2022). Long-term outcomes of implant-based immediate breast reconstruction with and without radiotherapy: A population-based study. *British Journal of Surgery*, *109*(11), 1107–1115. https://doi.org/10.1093/bjs/znac283

Economides, J. M., & Song, D. H. (2018). Latissimus Dorsi and Immediate Fat Transfer (LIFT) for Complete Autologous Breast Reconstruction. *Plastic and Reconstructive Surgery - Global Open*, *6*(1), e1656. https://doi.org/10.1097/GOX.0000000000001656

Escandón, J. M., Manrique, O. J., Christiano, J. G., Mroueh, V., Prieto, P. A., Gooch, J. C., Weiss, A., & Langstein, H. N. (2023). Breast reconstruction with latissimus dorsi flap: A comprehensive review and case series. *Annals of Translational Medicine*, *11*(10), 355–355. https://doi.org/10.21037/atm-23-469

Friedman, O., Fliss, E., Inbal, A., Arad, E., Frand, J., & Barnea, Y. (ei pvm.). *Latissimus Dorsi Flap: A Winning Hand for Breast Reconstruction Salvage*.

Haddock, N. T., Wen, Y. E., Steppe, C., Shang, Z., & Teotia, S. S. (2022). Operative Time Predicts Postoperative Outcomes in Bilateral DIEP Flap Reconstruction: Multivariate 1000 Flap Analysis. *Plastic and Reconstructive Surgery - Global Open*, *10*(12), e4713. https://doi.org/10.1097/GOX.0000000000004713

Hardy, K. L., Davis, K. E., Constantine, R. S., Chen, M., Hein, R., Jewell, J. L., Dirisala, K., Lysikowski, J., Reed, G., & Kenkel, J. M. (2014). The Impact of Operative Time on Complications After Plastic Surgery: A Multivariate Regression Analysis of 1753 Cases. *Aesthetic Surgery Journal*, *34*(4), 614–622. https://doi.org/10.1177/1090820X14528503

Højvig, J. H., Henriksen, M., Bartholdy, C. R., & Bonde, C. T. (2022). Donor-site morbidity following breast reconstruction with a latissimus dorsi flap – A prospective study. *Journal of Plastic, Reconstructive & Aesthetic Surgery*, *75*(7), 2205–2210. https://doi.org/10.1016/j.bjps.2022.01.036

Lee, H. C., Lee, J., Park, S.-H., & Yoon, E.-S. (2021). The Hybrid Latissimus Dorsi Flap in Immediate Breast Reconstruction: A Comparative Study With the Abdominal-Based Flap. *Annals of Plastic Surgery*, *86*(4), 394–399. https://doi.org/10.1097/SAP.0000000000002565

Löfstrand, J., Paganini, A., Grimby-Ekman, A., Lidén, M., & Hansson, E. (2024). Long-term patient-reported back and shoulder function after delayed breast reconstruction with a latissimus dorsi flap: Case–control cohort study. *British Journal of Surgery*, *111*(1), znad296. https://doi.org/10.1093/bjs/znad296

Maitani, K., Tomita, K., Taminato, M., & Kubo, T. (2021). Scarless Total Breast Reconstruction with a Fat-augmented Latissimus Dorsi Flap. *Plastic and Reconstructive Surgery - Global Open*, *9*(10), e3887. https://doi.org/10.1097/GOX.0000000000003887

Merkkola-von Schantz, P. A., & Kauhanen, M. S. C. (2022). The versatile latissimus dorsi flap: Old and reliable or outmoded—with or without an add on? *Annals of Breast Surgery*, *6*, 13–13. https://doi.org/10.21037/abs-21-29

Peshel, E. C., McNary, C. M., Barkach, C., Boudiab, E. M., Vega, D., Nossoni, F., Chaiyasate, K., & Powers, J. M. (2023). Systematic Review of Patient-Reported Outcomes and Complications of Pedicled Latissimus Flap Breast Reconstruction. *Archives of Plastic Surgery*, *50*(04), 361–369. https://doi.org/10.1055/a-2045-8122

Rijkx, M. E. P., Bernardi, E., Schop, S. J., Heuts, E. M., Lobbes, M. B. I., Hommes, J. E., De Grzymala, A. P., & Van Nijnatten, T. J. A. (2024). Radiologic findings in women after Autologous Fat Transfer (AFT) based breast reconstruction: A Systematic Review. *JPRAS Open*, *42*, 113–132. https://doi.org/10.1016/j.jpra.2024.08.002

Salibian, A. A., Frey, J. D., Bekisz, J. M., Choi, M., & Karp, N. S. (2019). Fat Grafting and Breast Augmentation: A Systematic Review of Primary Composite Augmentation. *Plastic and Reconstructive Surgery - Global Open*, *7*(7), e2340. https://doi.org/10.1097/GOX.0000000000002340

Seth, I., Bulloch, G., Gibson, D., Chow, O., Seth, N., Mann, G. B., Hunter-Smith, D. J., & Rozen, W. M. (2024). Autologous Fat Grafting in Breast Augmentation: A Systematic Review Highlighting the Need for Clinical Caution. *Plastic & Reconstructive Surgery*, *153*(3), 527e–538e. https://doi.org/10.1097/PRS.0000000000010614

Shtarbanov, P., Ioannidi, L., Hamilton, S., Ghali, S., Mosahebi, A., Ahmed, Z., & Nikkhah, D. (2023). Prolonged operative time is a risk factor for adverse postoperative outcomes in the unilateral deep inferior epigastric perforator (DIEP) flap surgery: A retrospective cohort study. *Journal of Plastic, Reconstructive & Aesthetic Surgery*, *87*, 180–186. https://doi.org/10.1016/j.bjps.2023.07.048

Sorenson, T. J., Boyd, C. J., & Karp, N. S. (2025). Hot Topics in Implant-Based Breast Reconstruction. *Journal of Clinical Medicine*, *15*(1), 263. https://doi.org/10.3390/jcm15010263

Tilkin, J., Paternoster, J., Cooreman, A., Nevens, T., Neven, P., & Vranckx, J. J. (2025). Fat-augmented latissimus dorsi flap and implant-based latissimus dorsi flap: A systematic review. *Journal of Plastic, Reconstructive & Aesthetic Surgery*, *105*, 136–147. https://doi.org/10.1016/j.bjps.2025.04.003

Wattoo, G., Nayak, S., Khan, S., Morgan, J., Hocking, H., MacInnes, E., Kolar, K. M., Rogers, C., Olubowale, O., Rigby, K., Kazzazi, N. H., & Wyld, L. (2021). Long-term outcomes of latissimus dorsi flap breast reconstructions: A single-centre observational cohort study with up to 12 years of follow up. *Journal of Plastic, Reconstructive & Aesthetic Surgery*, *74*(9), 2202–2209. https://doi.org/10.1016/j.bjps.2020.12.058

Yu, W., Wang, Z., Dai, Y., Zhao, S., Chen, H., Wang, S., & Xie, H. (2024). Autologous fat grafting for postoperative breast reconstruction: A systemic review. *Regenerative Therapy*, *26*, 1010–1017. https://doi.org/10.1016/j.reth.2024.10.007

Ørholt, M., Larsen, A., Hemmingsen, M. N., Mirian, C., Zocchi, M. L., Vester-Glowinski, P. V., & Herly, M. (2020). Complications after Breast Augmentation with Fat Grafting: A Systematic Review. *Plastic & Reconstructive Surgery*, *145*(3), 530e–537e. https://doi.org/10.1097/PRS.0000000000006569