Comparison of different techniques in latissimus dorsi breast reconstruction: plain, immediately lipofilled and implant-enhanced

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Conflict of interest statement

None declared.

Abstract

Background: The latissimus dorsi (LD) flap is still a popular choice for breast reconstruction. Plain LD provides a good option for women with small breasts, but with bigger breasts the problem is insufficient volume. Traditionally, implants have been inserted to improve the volume, but due to problems associated with them, the use of fat grafting has gained popularity. Increased number of reports considering also immediate lipofilling have been published. This study aimed to evaluate and compare different techniques in LD reconstruction in association with complications, number of further operations and duration of reconstructive process.

Methods: A retrospective review of patients who had undergone LD reconstruction between 2008 and 2019 was performed. Demographic and operative features, complications and the duration of reconstruction process were analyzed.

Results: A total of 291 LD flaps were performed in 283 women, including 161 (55%) implant-enhanced, 73 (25%) immediate lipofilled and 57 (20%) plain flaps. Of these, 84% were delayed reconstructions. The median volume of immediately injected fat was 155 millilitres (range 50-296) and inserted implant 185 millilitres (range 80-420). Of plain LDs, 75% did not need further operations compared to 63% of implant and 49% of lipofilling groups ($p<0.001$). The median duration of reconstructive process was 10 months (range 4-86) in plain, 13 (range 5-58) in implant and 18 (range 5-80) in lipofilling group ($p<0.002$). No significant differences were observed in overall complication rates between groups ($p=0.228$). Most of the complications were minor, seroma being the most common. Of major complications, plain flaps were most commonly associated with donor site problems, lipofilling group with partial flap necrosis and implant-enhanced with deep infections in the breast. Shoulder problem was observed in 21 (7%) patients with no significant difference between groups ($p=0.395$).

Conclusions: LD flap is a versatile and safe breast reconstruction method, because it is associated most commonly only with minor complications. Careful patient selection is important when choosing between different techniques. This can have an impact on the number of further operations needed and the duration of reconstruction process. Immediate lipofilling is safe technique to avoid the use of implant and allow fully autologous reconstruction.

Key Words: LD flap, implant-enhanced, immediate lipofilling, complications

Introduction

Reconstructive surgeons have many alternative breast reconstruction techniques from which to choice the best suitable for the patient. Autologous reconstruction using abdominally based flaps is considered the mainstay (1-3), but sometimes abdominally based flap would not be appropriate. These cases include patients who are very thin or extreme obese, or ones who have undergone abdominal contouring or multiple abdominal surgeries (4). Alternative autologous microsurgical options include flaps from thigh or gluteal area (5). Sometimes, however, microsurgical reconstruction might not be the best option for the patient because of multiple comorbidities or patients are seeking autologous reconstruction without microsurgery. Therefore, a longstanding reconstructive technique, latissimus dorsi myocutaneous flap, is still very commonly used (1-3,5). LD is a reliable option which donor site morbidity is generally low, with seroma and wound dehiscence being the most common complications (6). However, a possible impact on shoulder function might also occur (7).

LD flap has been concluded to be an ideal choice for women with small and flat breasts (8,9), while in the women with larger breast size, the problem is a limited flap volume. The extended LD became popular during the 1990s (2), but sometimes even that cannot

provide sufficient volume. In addition, this approach involves more aggressive harvesting of subcutaneous tissue increasing the risk of seroma and wound problems (9). The LD flap volume has been traditionally increased by the addition of implants, which are, however, associated with many problems such as infection, extrusion, rupture, capsular contracture, and a recently suggested association with anaplastic large cell lymphoma (3). Lipofilling has established itself as a fully autologous procedure to correct contour deformities and improve volume (2). It has enabled the use of LD in fully autologous reconstruction also in patients with larger breasts (4). The majority of prior publications have described lipotransfer following LD reconstruction as a secondary procedure to correct contour deformities (10), but recently it has become popular also in immediate setting (2,10).

The aim of this study is to evaluate and compare different LD reconstruction methods, including plain, implant-enhanced and immediately lipofilled in association with complication rate, additional operations needed and the length of reconstruction procedure.

Patients and methods

This retrospective study was conducted using data from Tampere university hospital (Finland) prospectively maintained breast reconstruction database. We identified all performed latissimus dorsi (LD) breast reconstruction operations from January 1st, 2008, through December 31st, 2019. The follow-up was performed until July 31st, 2020. Permission to access the clinical records of the patients for the study was obtained from the scientific center of Tampere University Hospital. The study was reported according to STROBE guidelines. By reviewing the clinical records, we ensured that there were no duplicates.

We collected data on patient characteristics, reconstruction indication and complications. Patient characteristics included: age, body mass index (BMI), smoking status, comorbidities and radiation therapy. Age was calculated in years on the day of the reconstruction. BMI was calculated in kg/m^2. Smoking status was dichotomized as “smoker” or “non-smoker”. “Non-smokers” were patients who never smoked and “smokers” were patients who smoked or stopped for a period of four weeks prior to reconstruction. Comorbidities were divided to diabetes, cardiovascular disease (CVD) and other (including asthma, chronic obstructive pulmonary disease, hypothyreosis and other). Radiation therapy included radiotherapy before reconstruction. Reconstruction indications were delayed or immediate (including prophylactic procedures). All postoperative complications were scored using Clavien-Dindo classification. Minor complications included seroma or infection without surgical intervention, but requiring per oral antibiotics. Major complications included deep infection, hematoma, skin or fat necrosis requiring surgical intervention in operation theatre and life-threatening complication (e.g. pulmonary embolism). The possible problems with shoulder function were also recorded. To evaluate possible shoulder problem, we always test clinically shoulder and upper limb movement in postoperative clinic visit. If any dysfunction of the shoulder joint appear, we send patient to see a physiotherapist for active physiotherapy.

The volume of both immediately injected fat and inserted implant were recorded as well as the volume of contralateral breast reduction and number of further operations needed for better symmetry. No expander implants were used. The duration of reconstructive process was counted from the day of reconstruction to completed areola complex tattoo or the last clinic visit. Some of the patients did not want nipple reconstruction or NAC tattoo. They felt that the reconstruction was complete without them. In these cases, the last clinic visit

“closed” the reconstructive process. In patients who had tattoo, the last tattoo visit “closed” the reconstructive process.

In our clinic, transversely orientated skin paddle is used in LD flaps and the musculotendinous junction is totally released. A suction drain is placed in the donor site. In this study, the donor site for fat harvest was abdomen in all cases. All patients were informed and were aware that using abdominal flap is not possible if abdomen is used as the donor site for fat harvest. In immediately setting, fat was injected in a multi-layered fashion into pectoralis major, mastectomy skin flaps, LD muscle and the overlying skin paddle of the flap. In most cases, contralateral symmetrizing surgery was performed at the same operation as the breast was reconstructed.

The datasets analyzed during the current study are available from the corresponding author on reasonable request.

Statistics

Differences between reconstruction techniques were tested using Kruskall-Wallis test, Pearson Chi-Square test or Fisher’s Exact test. Univariable and multivariable logistic regression analyses were applied to estimate odds ratios (ORs) and 95% confidence intervals (CIs) to analyze the difference between reconstruction techniques. A p-value < 0.05 was considered statistically significant. IBM SPSS Statistics version 26.0 for Windows software (SPSS Inc. Chicago, Illinois) was used for statistical analyses.

Results

A total of 291 LD breast reconstructions were performed in 283 women during the study period. Of these flaps, 244 (84%) were delayed and 47 (16%) immediate reconstructions. Bilateral reconstruction was performed in 8 (3%) patients. LD with implant was the most common reconstruction (n=161, 55%) followed by immediate lipofilling (n=73, 25%), and

plain (n=57, 20%) reconstructions. Trends in LD-reconstruction techniques during the study period are presented in Figure 1. The detailed demographic features and medical record data are shown in Table 1. There were no significant differences between groups in median age, BMI, smoking, comorbidities or in a history of radiotherapy. The median follow-up time in plain LD group was 117 months (IQR 93-143), in lipofilling group 67 months (IQR 42-107) and in implant group 88 months (IQR 52-118).

The outcomes of reconstructions are presented in Table 2. The median volume of immediately injected fat was 155 millilitres (mL) (range 50-296) and of inserted implant 185 mL (range 80-420). The median volume of contralateral breast reduction was small in all groups. Of plain LDs, 75% did not need any further operations compared to 63% of implant and 49% of lipofilling groups. One corrective operation was usually sufficient in all groups, because only 7% (21/291 flaps) needed two or more corrective operations. Reconstructed breast was the most common target for esthetic retouching in lipofilling and implant groups, while donor site was most commonly corrected in plain LD group. Median of the total lipofilling volume was 200 mL (maximum 995mL) in lipofilling group and in implant group 0 mL (maximum of 545 mL). The duration of operative process was shortest in plain LD group ($p<0.002$).

Complications associated with different reconstruction techniques are shown in Table 3. There were no significant differences in overall complication rates between groups ($p=0.228$). Most of complications in all groups were minor complications, seroma being the most common. Of major complications, plain group was most commonly associated with postoperative hematomas, which occurred in the donor site. Partial flap necrosis was the most common major complication in the lipofilling group. These necrotic areas were observed in flap’s skin island and were all small in size. One total flap loss was observed in this study. It occurred in implant group. Deep infections were most commonly

associated with implant-enhanced LDs. These infections were observed in the reconstructed breast area and led to implant removal. Late implant problem occurred in 24 (15%) patients. These there mainly capsular contractures and led to change or removal of implant. Of the whole study cohort (n=283 patients), 21 (7%) had shoulder problem. There were no statistically significant difference in the number of shoulder problems between groups (p=0.395).

Discussion

This study has shown that LD flap is a versatile and safe option for breast reconstruction. Although abdominally based flaps have become a standard in breast reconstruction, there is still a need for other than microsurgical reconstruction in selected patients. In fact, the prior study of Pien et al. with over 19,000 breast reconstruction patients concluded that although the number of abdominally based flaps is continuously increasing, the absolute numbers of LD reconstructions exceeded that of abdominally based flaps (11). In our institution, DIEP reconstruction is the most used choice. However, if the patient is not a good candidate for microsurgery or is very thin with small breast size, have smaller fatty deposits and thin thigh area; we prefer LD flap.

Each reconstructive surgery should be patient-focused, taking into consideration both the size and shape of the woman’s natural breast (1). It has been reported in prior studies that plain LD flap is ideal for women with small breasts (8). In our study, the duration of reconstruction process was shortest and need for further corrective operations fewest in plain LD group. In our institution, however, the use of plain LD has diminished since 2012. Immediate lipofilling has become more popular and exceeded also the number of implant-enhanced reconstructions in 2019. The change from plain to fat-enhanced technique might be due to problems with donor site. In this study, donor site corrective operations were most common in plain flaps. Immediate lipofilling technique enables less aggressive

subcutaneous tissue harvesting in donor site. The suggested association of implants with anaplastic large cell lymphoma is most likely the reason for diminished use of implant-enhanced LDs.

LD flap is easy to harvest and is most commonly associated only with minor complications (1,6). In this study, the majority of complications were also minor, most commonly seroma formation. Our incidence of seroma is high compared to prior studies (2,3,12,13), in which the average occurrence of seroma is approximately 20 to 30 percent for common LD harvest (13). However, there were some differences between studies in recording of seromas. We counted all fluid collections requiring aspiration, while in some studies only recurrent seroma (>2 drainages) (2) was counted. We were also able to see all patients in our outpatient clinic and do the aspirations and record seromas, which might not be the case in all hospitals. Some reason for higher incidence of seroma might also be the surgical technique. We did not use quilting sutures or fibrin sealant, which may have had also an impact to the results. Rate of seroma formation did not differ significantly between study groups in this study.

Of major complications, lipofilled flaps had most commonly mild flap necrosis. In earlier studies (2), the incidence of mild flap necrosis and flap loss rate were both 4% compared to our study where the incidence of flap necrosis was same, 4%, but flap loss rate was 0.3%. We had one total flap loss and it occurred in implant-enhanced group. In that study, the volume and the layers of immediately injected fat were in same line with our study. In other studies (5,13), smaller volume of fat (70-100 mL) was injected immediately to same layers with no flap necrosis. On the other hand, in other study after the mean immediate fat grafting volume of 360 mL, no flap necrosis was reported (10).

The major concern in LD harvesting has been the effect on shoulder mobility (1). In our study, we had a possibility to have a long-term follow-up considering also the shoulder

problems after LD reconstruction. We report 7% rate of shoulder problems after operation. These all were dysfunction of the shoulder joint. This result is in the same line with Tenna et al, who reported 5.5% dysfunction postoperatively (6). In all of our cases, patients had active physiotherapy and no long-term problems existed. Our findings agree with prior studies, which conclude that in long-term follow-up LD harvesting does not have adversely impact on back and shoulder function (7,14) or significant loss of range of motion or movement limitations (1).

LD flap has had a resurgence in popularity mainly due to fat grafting, which enables fully autologous reconstruction even for women with bigger breasts. Traditionally, fat transfer has been used as a secondary contouring method, but an increasing number of publications considering immediate lipofilling of LD flaps have been also published (1-3,10). In our case series, half of immediately lipofilled and 40% of implant-enhanced group required one additional corrective operation, usually fat transfer, but two corrective operations were needed seldom. The difference in further operations and in the duration of reconstructive process between these two groups was not significant, which is in agreement with prior study by Leuzzi et al. (3).

In this study, the median volume of inserted implant was quite small (185 mL). Although the average estimated fat graft take is less than 100%, the mentioned volume could be gained with immediate fat transfer combined with one additional lipofilling procedure. This suggests that it might be possible to avoid the use of implant in most cases and allow fully autologous reconstruction by using lipofilling technique. At least, lipofilling allows the implant size to be reduced, which may decrease implant-related complications over the long term (1). It has been reported in the prior study that LD patients with lipofilling had a higher score in satisfaction than patients with implant-enhanced LD (3).

This study has several limitations. Retrospective study design may lead to inaccurate recording and representation of the study population. We did not have any patient-reported outcomes (PROs), which would have given more information in comparing different reconstructive techniques. The outcomes of this study are based on a single university hospital experience. Neither patients nor the reconstruction methods were randomized. However, even in a prospective study, randomization of patients might not be ethically acceptable because the reconstruction method is always chosen based on patient's unique characteristics.

Conclusions

LD flap is a versatile and safe breast reconstruction method, because it is associated most commonly only with minor complications. Careful patient selection is important when choosing between different techniques. Immediate lipofilling is safe and useful in different variations of LD reconstructions. It could help in: 1) avoiding donor site problems because aggressive subcutaneous tissue harvesting is not needed (extended-LDs), 2) avoiding the use of small implants allowing fully autologous reconstruction, and 3) allowing the implant size to be reduced in larger breasts, which may decrease implant-related complications over the long term.

Acknowledgements

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Table 1. Demographic features and medical record data (N=291).

	Plain (n=57)		Lipofilling (n=73)		Implant (n=161)		p-value
Age (years), Median (Range)	52	(29-72)	57	(30-72)	57	(29-76)	0.063
BMI (kg/m^2)							0.174
BMI <30	45	(79)	51	(70)	130	(81)	
BMI ≥30	12	(21)	22	(30)	31	(19)	
Smoking							0.561
No	50	(88)	67	(92)	140	(87)	
Yes	7	(12)	6	(8)	21	(13)	
Comorbidities							0.935
DM	1	(2)	0	(0)	3	(2)	
CVD	12	(21)	17	(23)	34	(21)	
Both	2	(3)	2	(3)	3	(2)	
Other	6	(11)	12	(16)	24	(15)	
Radiotherapy							0.058
No	55	(97)	66	(90)	157	(98)	
Yes	2	(3)	7	(10)	4	(2)	
Reconstruction							0.037
Immediate	13	(23)	16	(22)	18	(11)	
Delayed	44	(77)	57	(78)	143	(89)	
Follow-up (months), Median (Interquartile range)	117	(93-143)	67	(42-107)	88	(52-118)	<0.001

Kruskall-Wallis test, Pearson chi-square test and Fisher's exact test.

Follow-up time (months, from reconstruction to 31.7.2020) pairwise: lipofilling vs. implant p=0.014, lipofilling vs. plain p<0.001, implant vs plain p<0.001

Table 2. Outcomes of breast reconstruction (N=291).

	Plain (n=57)	Lipofilling (n=73)	Implant (n=161)	p-value: All groups	p-value: Lipofilling vs. Implant
Autologous fat injected or implant inserted immediately (mL), Median (Range)	0	155 (50-296)	185 (80-420)	-	0.002
Contralateral reduction (g), Median (Interquartile range)	0 (0-184)	80 (0-414)	43 (0-298)	0.120	-
Number of further operations, Median (Range)	0 (0-1)	1 (0-3)	0 (0-3)	-	-
Further operations, n (%)				0.014	0.135
No further operations	43 (75)	36 (49)	101 (63)		
One operation	14 (25)	28 (38)	48 (30)		
≥2 operations	0 (0)	9 (12)	12 (7)		
Further operations location, n (%)				<0.001	0.066
Breast	1 (2)	27 (37)	33 (20)		
Donor site	12 (21)	7 (10)	18 (11)		
Both	1 (2)	3 (4)	9 (6)		
Total Lipofilling volume (mL), Median (Interquartile range; Range)	0	200 (120-351; 0-995)	0 (0-0; 0-545)	-	<0.001
Duration of reconstructive process (months), Median (Range)	10 (4-86)	18 (5-80)	13 (5-58)	0.002	0.180

Kruskall-Wallis test and Pearson chi-square test.

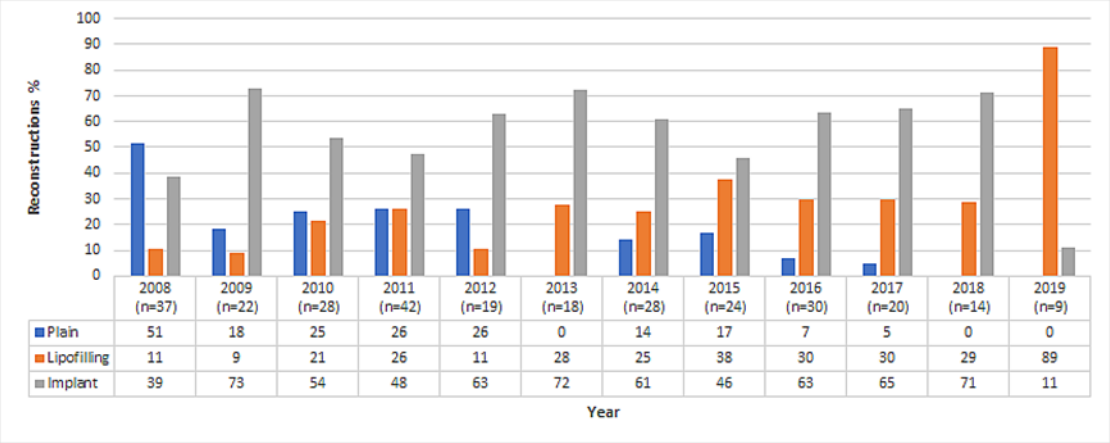
Duration of reconstructive process pairwise: lipofilling vs. implant p=0.180, lipofilling vs. plain p=0.001, implant vs plain p=0.007.

Table 3. Complications associated with different reconstruction techniques (N=291).

	Plain (n=57)		Lipofilling (n=73)		Implant (n=161)		
	n	(%)	n	(%)	n	(%)	p-value
Complications total	42	(74)	55	(75)	106	(66)	0.228
Minor complications total	37	(65)	43	(59)	80	(50)	0.179
Seroma	34	(92)	36	(84)	75	(95)	
Superficial infection	3	(8)	7	(16)	5	(6)	
Major complications total	5	(9)	12	(16)	26	(16)	0.264
Hematoma	4	(80)	4	(33)	15	(58)	
Necrosis	1	(20)	6	(50)	5	(19)	
Deep infection	0	(0)	2	(17)	6	(23)	
Total flap loss	0	(0)	0	(0)	1	(1)	
Late implant problem/removal of implant	0	(0)	0	(0)	24	(15)	-
Shoulder problem	6	(10)	6	(8)	9	(6)	0.395

Pearson chi-square test or Fisher's exact test.

Figure 1. Trends in LD reconstruction techniques during the study period.



	2008 (n=37)	2009 (n=22)	2010 (n=28)	2011 (n=42)	2012 (n=19)	2013 (n=18)	2014 (n=28)	2015 (n=24)	2016 (n=30)	2017 (n=20)	2018 (n=14)	2019 (n=9)
Plain	51	18	25	26	26	0	14	17	7	5	0	0
Lipofilling	11	9	21	26	11	28	25	38	30	30	29	89
Implant	39	73	54	48	63	72	61	46	63	65	71	11