

Does a Latissimus Dorsi Flap Improve Surgical Outcomes of Implant-based Breast Reconstruction following Infected Device Explantation?

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Background: The goal of this study was to assess whether adding a latissimus dorsi (LD) flap to a secondary implant-based reconstruction (IBR) improves outcomes following explantation of the primary device due to infection.

Methods: We conducted a retrospective study of patients who underwent a second IBR with or without the addition of an LD flap during 2006–2019, following explantation due to infection. Surgical outcomes were collected and compared between reconstruction types.

Results: A total of 6093 IBRs were identified during the study period. Of these, 109 underwent a second attempt at breast reconstruction with IBR alone ($n = 86$, 79%) or IBR/LD ($n = 23$, 21%) following explantation of an infected device. Rates of secondary device explantation due to a complication were similar between the two groups (26% in the IBR/LD group and 21% in the IBR group; $P = 0.60$). Among the patients who underwent prior radiotherapy, the IBR/LD group had lower rates of any complication (38% versus 56%; $P = 0.43$), infection (25% versus 44%; $P = 0.39$), and reconstruction failure (25% versus 44%; $P = 0.39$); however, differences were not statistically significant.

Conclusion: Following a failed primary breast reconstruction due to infection, it may be appropriate to offer a secondary reconstruction. For patients with a history of radiotherapy, combining an LD flap with IBR may provide benefits over IBR alone. Although not statistically different, this outcome may have clinical significance, considering the magnitude of the effect, and may result in decreased complication rates and a higher chance of reconstructive success. (*Plast Reconstr Surg Glob Open* 2022;10:e4409; doi: 10.1097/GOX.0000000000004409; Published online 24 August 2022.)

INTRODUCTION

Infection is one of the most common complications following implant-based breast reconstruction (IBR), occurring in 6%–36% of reconstructions.^{1–4} Although mild infections may be managed conservatively with broad-spectrum oral antibiotics,⁵ intravenous antibiotics or device explantation is reserved for patients who initially present with severe or systemic symptoms or who do not improve on oral antibiotics.⁵ Several risk factors for IBR explantation due to infection have been identified, including obesity, smoking, and radiotherapy.^{6–8}

Although some women decide to forgo further breast reconstruction following IBR failure, current literature supports the safety of a second attempt at reconstruction.^{9–13} Potential reconstructive methods include a second IBR, a purely autologous reconstruction, or the combination of a permanent implant with a latissimus dorsi (LD) flap. However, there is a paucity of literature to elucidate the best reconstructive option in the setting of a previous device explantation due to infection.

Breast reconstruction with an LD flap has been a common option since its initial description by Olivari¹⁴ in 1976. In addition to restoring a natural appearance to the breast, the LD flap's robust vascularity has the potential to reduce the risk of infection.^{12,15} One limitation of this flap, however, is the relatively low tissue volume compared with other autologous options. For this reason, the LD flap is often used in conjunction with a device.^{16,17} However, there is a gap in supporting evidence about whether adding an LD flap to IBR translates to a higher success rate for secondary IBR after primary IBR failure.^{9,12}

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We hypothesized that following explantation of an infected device, secondary reconstruction with an LD and device reduces surgical complications and reconstruction failure compared with secondary IBR without an LD. To test our hypothesis, we conducted a retrospective study to assess the value of adding an LD flap to IBR after previous explantation due to infection.

METHODS

Using a prospectively maintained departmental database and electronic medical records, we conducted a retrospective evaluation of all consecutive patients who developed IBR infection requiring device removal during August 2007–July 2019. Patients were included if they underwent a second attempt at breast reconstruction with IBR alone or IBR plus LD (IBR/LD). Choice of reconstructive option was based on surgeon’s discretion. We excluded patients whose first reconstruction included an LD or autologous breast reconstruction, patients with complications other than infection resulting in IBR failure, and patients whose secondary reconstruction was purely autologous.

IBR was defined as breast reconstruction with a device [tissue expander (TE) or permanent implant]. The term “explantation” was used to indicate device removal even if a second reconstruction was performed immediately at the same surgery for device explantation. We used the term “primary reconstruction” to indicate the infected device that was explanted, and “secondary reconstruction” described the second attempt at breast reconstruction after explantation of the IBR. The secondary reconstruction was our point of reference when considering preoperative and postoperative events or treatments. A “major” complication was defined as one that required a reoperation or a reconstruction failure requiring explantation of the secondary IBR. This study was approved by our institutional review board.

Patient Characteristics

We evaluated patient characteristics, including age, body mass index, tobacco use (within 8 weeks of surgery), comorbidities at the time of surgery (ie, diabetes, coronary artery disease, and obesity), preoperative and postoperative chemotherapy, hormonal therapy, and radiotherapy on the ipsilateral breast. We also examined mastectomy type and type of nodal surgery on the ipsilateral side.

Surgical Characteristics

The following variables were collected in reference to the primary reconstruction: use of acellular dermal matrix, timing (immediate, defined as occurring within the same surgery as the mastectomy versus delayed, and defined as occurring at a later date than the mastectomy), the device that developed infection (TE with or without permanent implant versus direct-to-implant), and mean intraoperative TE fill volume. With respect to the explanted infected device, we noted whether

Takeaways

Question: The goal of this study was to assess whether adding a latissimus dorsi (LD) flap to a secondary implant-based reconstruction (IBR) improves outcomes following explantation of the primary device due to infection.

Findings: Among the patients who underwent prior radiotherapy, the IBR/LD group had lower rates of any complication, infection, and reconstruction failure; however, differences were not statistically significant.

Meaning: For patients with a history of radiotherapy, combining an LD flap with IBR may provide benefits over IBR alone.

capsulectomy was performed at the explantation procedure, as well as the presence of any concurrent complications such as necrosis or exposure of the infected device.

For the secondary reconstruction, we examined the type of breast reconstruction (IBR alone versus IBR/LD) and the timing (immediate, defined as exchange of device within the same operation versus delayed, and occurring at a later date). The decision to pursue delayed versus immediate secondary breast reconstruction is based on the infection severity, response to initial antibiotic treatment, intraoperative findings, presence of pus, and availability of soft tissue coverage. The decision is mainly surgeon-dependent, and we do not have a clear algorithm to guide that decision process at this time.¹⁰ For those patients who underwent delayed secondary reconstruction, we assessed the time period from explantation to secondary reconstruction.

Surgical Outcomes

Complications of the secondary reconstruction were compared between the two groups and included infection, seroma, hematoma, necrosis, capsular contracture, deflation/rupture, and implant exposure. A “major” complication was defined as one that required a reoperation or a reconstruction failure requiring explantation of the secondary IBR. Infection was defined according to the Centers for Disease Control and Prevention guidelines.¹⁷ Seroma and hematoma were defined as a collection of blood or serous fluid, respectively, in the breast envelope that necessitated drainage. Wound dehiscence was defined as greater than 1 cm of wound separation, and necrosis was defined as full-thickness skin loss. We also documented donor-site complications in the IBR/LD group. We documented the number of breast revisions, defined as a surgery to improve the breast cosmesis, such as mastopexy, fat grafting, and device repositioning. Our last follow-up was defined as the last visit with a plastic surgeon, breast surgeon, or breast medical oncologist.

Statistical Analysis

Continuous variables were reported as median [interquartile range (IQR)] or mean (\pm standard deviation)

and compared using a *t* test or Mann–Whitney U test. Categorical data were presented using percentages and analyzed using a chi-square or Fisher exact test. Data were analyzed by breast rather than by patient since some patients developed infections in both breasts and underwent bilateral secondary reconstructions. A *P* value of less than 0.05 was considered statistically significant. Statistical analysis was performed using JMP Pro 14 software (JMP, Pro 14, SAS Institute Inc, Cary, NC, 1989–2019).

RESULTS

A total of 6093 IBRs were identified during the study period. Of these, 298 (5%) were explanted owing to infection. Following explantation, in 97 (33%) cases, the patient opted not to pursue further reconstruction. We identified 109 cases that met our inclusion criteria and underwent a second attempt at breast reconstruction with IBR alone (*n* = 86, 79%) or IBR/LD flap (*n* = 23, 21%) following explantation of an infected device.

Patient and Surgical Characteristics

The IBR/LD group had a higher mean age than the IBR group (53±9 years versus 45±10 years, respectively; *P* = 0.0007). The mean body mass index was similar between the groups (27±7 kg/m² versus 28±6 kg/m², respectively; *P* = 0.1). Rates of both preoperative radiotherapy and preoperative chemotherapy were significantly higher in the IBR/LD group (70% versus 10%; *P* < 0.0001 and 78% versus 42%; *P* = 0.002, respectively; Table 1). In the IBR group, 17% (*n* = 15) had implants as their method of second reconstruction, 64% (*n* = 55) had TE followed by implant, and 19% (*n* = 16) had TE only. In the LD group, patients had TE followed by implants in 65% (*n* = 15), TE only in 9% (*n* = 2), or implants only in 26% (*n* = 6).

Primary Reconstruction Outcomes

In the primary reconstruction group, the TEs became infected more commonly than permanent breast implants. This predilection was shared among cases that went on to have secondary breast reconstruction with IBR alone or IBR/LD (*P* = 0.21; Table 2).

Secondary Reconstruction Outcomes

In the IBR/LD group, all but one patient (96%) had delayed secondary reconstruction, while secondary IBRs alone were split between immediate (52%) and delayed (48%; *P* < 0.0001). There were similar complication rates (35% versus 36%, respectively; *P* = 0.91), rates of any breast-related complication (30% versus 36%, respectively; *P* = 0.62), and rates of any major complication (26% versus 21%, respectively; *P* = 0.60) between the IBR/LD and IBR groups. The most common complication in both groups was infection, occurring in 22% of IBR/LD and 27% of IBR cases (*P* = 0.63). Deflation/rupture of the implant also occurred at similar rates between groups (4% versus 5%, respectively; *P* = 1.00), as did seroma formation (4% versus 6%, respectively; *P* = 1.00; Table 3).

Rates of secondary device explantation due to a complication were similar between the two groups (26% in the

Table 1. Patient Characteristics

Characteristic	IBR (n = 86)	IBR/LD (n = 23)	<i>P</i>
Age, years, mean ± SD	53±9	45±10	0.0007
BMI, kg/m ² , mean ± SD	28±6	27±7	0.1
Any comorbidity, n (%)	25 (29)	6 (26)	1.00
Tobacco use	1 (1)	1 (4)	0.38
Diabetes	1 (1)	2 (9)	0.11
Hypertension	25 (29)	3 (13)	0.12
CAD	2 (2)	1 (4)	0.51
Preoperative ipsilateral radiotherapy, n (%)	9 (10)	16 (70)	<0.0001
Postoperative ipsilateral radiotherapy, n (%)	3 (3)	0 (0)	1.00
Preoperative chemotherapy, n (%)	36 (42)	18 (78)	0.002
Preoperative hormonal therapy, n (%)	46 (53)	16 (70)	0.17
Postoperative chemotherapy, n (%)	5 (6)	0 (0)	0.58
Postoperative hormonal therapy, n (%)	53 (62)	16 (70)	0.48
Reconstruction on same side of cancer, n (%)	51 (59)	21 (91)	0.004
Mastectomy type, n (%)			
Simple	9 (10)	3 (13)	0.055
Skin-sparing	66 (77)	16 (70)	
Nipple-sparing	10 (12)	1 (4)	
Modified-radical	1 (1)	3 (13)	
Type of nodal surgery, n (%)			
ALND	29 (34)	3 (13)	<0.0001
SLNB	15 (17)	15 (65)	
None	42 (49)	5 (22)	

ALND, axillary lymph node dissection; BMI, body mass index; CAD, coronary artery disease; SLNB, sentinel lymph node biopsy; SD, standard deviation.

Table 2. Primary Reconstruction Characteristics

Characteristic	IBR (n = 86)	IBR/LD (n = 23)	<i>P</i>
ADM use, n (%)	53 (62)	13 (57)	0.66
Timing, n (%)			
Immediate	81 (94)	21 (91)	0.64
Delayed	5 (6)	2 (9)	
Implant that developed infection, n (%)			
TE	67 (78)	16 (70)	0.21
DTI	5 (6)	0 (0)	
Implant preceded by TE	14 (16)	7 (30)	
Intraoperative fill volume, ml, mean ± SD	340 ± 188	358 ± 232	0.74
Months between reconstruction and first explantation, median (IQR)*	1.7 (1.1–2.4)	2.8 (1.3–4.9)	0.009
Capsulectomy at time of explantation, n (%)	24 (28)	6 (26)	0.86
Concurrent complication, n (%)	26 (30)	11 (48)	0.11

ADM, acellular dermal matrix; DTI, direct-to-implant; SD, standard deviation. Values in boldface are statistically significant.

*Represents the time between insertion of the implant that got infected and its explantation.

IBR/LD and 21% in the IBR group; *P* = 0.60). Reasons for explantation in the IBR group included infection (*n* = 10), infection and device exposure (*n* = 2), necrosis (*n* = 1), deflation/rupture (*n* = 3), capsular contracture (*n* = 1), and wound dehiscence (*n* = 1). In the IBR/LD group, indications for explantation included infection (*n* = 4), deflation/rupture (*n* = 1), and hematoma (*n* = 1).

The median number of revisions was higher in the IBR/LD group (1 [IQR, 0–2] versus 0 [IQR, 0–1]; *P* = 0.006) compared with the IBR group. Median follow-up was 41 months (IQR, 10–72 months) in the IBR group and 28 months (IQR, 8–56 months) in the IBR/LD group (*P* = 0.73; Table 3).

Table 3. Secondary Reconstruction Characteristics and Outcomes

Characteristic	IBR (n = 86)	IBR/LD (n = 23)	P
Timing, n (%)			
Immediate	45 (52)	1 (4)	<0.0001
Delayed	41 (48)	22 (96)	
Months between first explantation and second reconstruction in delayed patients, median (IQR)	6 (4–9)	6 (3–8)	0.51
Any complication, n (%)	31 (36)	8 (35)	0.91
Any breast related-complication	31 (36)	7 (30)	0.62
Infection	23 (27)	5 (22)	0.63
Necrosis	2 (2)	0 (0)	1.00
Seroma	5 (6)	1 (4)	1.00
Hematoma	1 (1)	1 (4)	0.38
Implant exposure	2 (2)	0 (0)	1.00
Capsular contracture	2 (2)	0 (0)	1.00
Deflation/rupture	4 (5)	1 (4)	1.00
Any donor site related-complication	NA	2 (9)	
Any major complication, n (%)	18 (21)	6 (26)	0.6
Any major breast-related complication	18 (21)	6 (26)	0.6
Any major donor site-related complication	NA	1 (4)	
Reconstruction failure, n (%)	18 (21)	6 (26)	0.6
Readmission within 30-days, n (%)	10 (12)	2 (9)	1.00
No. revisions, median (IQR)	0 (0–1)	1 (0–2)	0.006
Follow-up, months, median (IQR)	41 (10–72)	28 (8–56)	0.73

DTI, direct-to-implant; NA, not applicable; SD, standard deviation. Values in boldface are statistically significant.

Radiotherapy and Delayed Reconstruction Subgroups

Among patients who underwent prior radiotherapy, those with IBR/LD had lower rates of any complication (38% versus 56%; *P* = 0.43), infection (25% versus 44%; *P* = 0.39), and any major complication (25% versus 44%; *P* = 0.39) than did those with IBR alone. However, while the magnitude of these differences was larger in this subgroup compared with the overall cohort, none of these differences were statistically significant, likely due to underpowering. Similarly, the reconstruction failure rate in the IBR/LD group was almost half that of the IBR group (25% versus 44%) among the previously irradiated patients but was also not statistically significant (*P* = 0.39; Fig. 1). Table 4 summarizes the surgical outcomes in the previously irradiated subgroup. Reconstruction outcomes in the delayed secondary reconstruction subgroup are summarized in Table 5. Within the delayed group, the median time from explantation to secondary reconstruction was 6 months (IQR, 3–8 and 4–9 months, in the IBR/LD and IBR groups, respectively) in both groups (Table 3).

DISCUSSION

Our results show that following explantation of an infected IBR, a second attempt at IBR yields success rates of 74% with an LD flap and 79% without an LD flap. Supplementing IBR with an LD flap did not decrease the complication and explantation rates in the overall cohort. However, in patients with a history of radiotherapy, the addition of LD was associated with clinically reduced rates of complication and explantation compared with IBR alone. These differences did not reach statistical significance, likely owing to a relatively low sample size in the IBR/LD flap group.

Several studies have demonstrated the effectiveness of an LD flap with implants for primary breast reconstruction.^{9,12,15,18–20} Mimoun et al¹⁹ demonstrated IBR/LD flap reconstructive success rates of 96.7% in their cohort of 30 women. Another study demonstrated major and minor complication rates of an IBR/LD flap to be 13.5% and 34.6%, respectively, and that the majority of patients (n = 31; 57%) perceived their aesthetic outcome as “excellent” or “good.”²⁰ Supplementing IBR with an LD flap offers several potential advantages, most obvious in patients who have been treated with radiotherapy. These include the addition of elastic nonirradiated skin to the chest wall, the creation of a virgin soft tissue plane for device placement, and the interposition of a protective soft-tissue layer between the implanted device and the irradiated skin. Proponents of the LD flap believe that these characteristics ultimately translate into a superior aesthetic result.^{12,15,18}

This is the largest study to date that evaluates the benefits of an LD flap for a secondary reconstruction following device explantation due to infection. Poppler et al⁹ reported the outcomes of 48 patients who underwent secondary IBR following a primary failed IBR for any indication. Complication and explantation rates were 29% and 21%, respectively. The authors also reported a 100% success rate in a subgroup of patients who underwent IBR/LD flap reconstruction, without presenting separate patient characteristics, indications for surgery, or follow-up in the IBR/LD group.⁹ Notably, that study focused on secondary IBR following any complication, including capsular contracture and deflation, rather than only infection, as in the present study. Another study evaluated the outcomes of IBR/LD flap reconstruction following failed primary breast reconstruction in the setting of radiotherapy.¹² Four cohorts were assessed: one-stage LD flap (n = 28), one-stage LD flap plus implant (n = 7), two-stage LD flap plus TE/implant (n = 8), and three-stage LD flap plus TE plus implant (n = 15). Complication rates were 14%, 29%, 52%, and 27%, respectively.¹² Our study evaluated only patients with infection resulting in explantation, which presents unique challenges not present in other types of IBR complications such as deflation or capsular contracture. In our study, we found similar complication and explantation rates between the IBR and IBR/LD groups for the overall cohort. However, these rates were higher than those reported in the literature for primary reconstruction.^{16,17} This result highlights the risk associated with a secondary attempt at IBR (with or without an LD flap) following infection compared with a primary IBR. Interestingly, the number of revisions was higher in the IBR/LD group, which could be a result of the higher rate of radiotherapy in the IBR/LD group.

Radiotherapy is a well-known risk factor for complications of IBR.^{6,13,17,21,22} Bennet et al¹³ found that 60% of their patients who experienced complications had undergone radiotherapy. Additionally, Selber et al⁶ demonstrated that women with a history of radiotherapy had greater than an eight-fold increased risk of TE explantation compared with women without radiotherapy. This finding is likely due to the fact that irradiated skin is up to 25% less

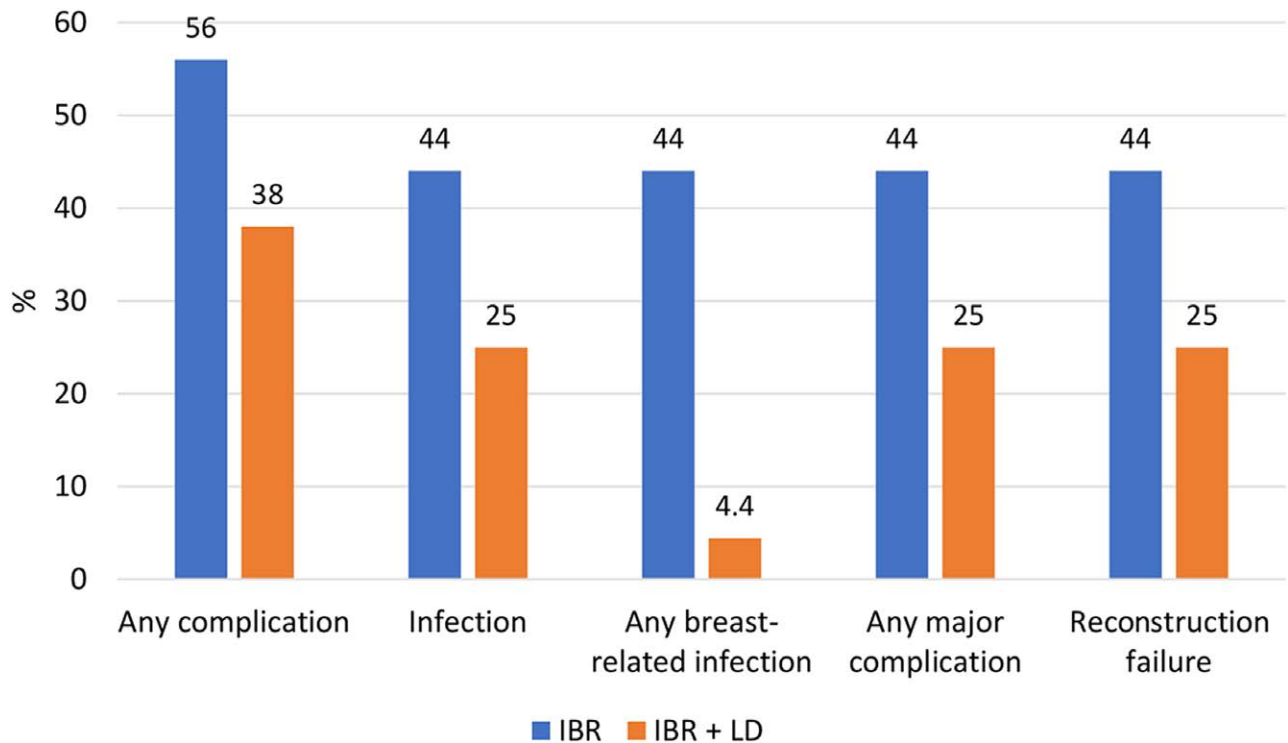


Fig. 1. Reconstruction outcomes in irradiated patients (none of the comparisons were statistically significant).

Table 4. Reconstruction Outcomes in Irradiated Patients

Outcome	IBR (n = 9)	IBR/LD (n = 16)	P
Total	9 (36)	16 (64)	
Any complication	5 (56)	6 (38)	0.43
Any breast related-complication	5 (56)	5 (31)	0.23
Infection	4 (44)	4 (25)	0.39
Any major complication	4 (44)	4 (25)	0.39
Reconstruction failure	4 (44)	4 (25)	0.39

Table 5. Surgical Outcomes of Delayed Reconstruction

Outcome	IBR (n = 41)	IBR/LD (n = 22)	P
Total	41 (65)	22 (35)	
Any complication	10 (24)	7 (32)	0.53
Any breast related-complication	10 (24)	6 (27)	0.8
Infection	7 (17)	4 (18)	1.00
Any major complication	5 (12)	5 (23)	0.23
Reconstruction failure	5 (12)	5 (23)	0.23

expandable, possibly contributing to implant exposure and to a 4.88-fold increased risk of infection.¹³ The fact that a much greater portion of our IBR/LD group underwent prior radiotherapy (70% versus 10% in IBR alone) reflects the surgeons' preference and potential bias for the IBR/LD procedure in patients with prior radiotherapy. The decision to use an LD flap in this patient population is often due to poor skin quality, lack of enough skin for an IBR alone, or a more severe device infection. That is to say, those who received an LD flap likely had a more severe condition than those who did not and, thus, were potentially at increased risk for complications. Following this

logic, the fact that IBR/LD patients did nonsignificantly better, and not worse, than IBR alone may suggest that indeed there is value in adding an LD flap in these situations. The benefit of adding an LD flap to irradiated tissue for primary breast reconstruction has been demonstrated in the previous studies.^{18,22,23} A meta-analysis determined that implant loss in irradiated patients is 4.33-fold more likely with IBR compared with IBR/LD ($P = 0.0003$).²³ In patients with prereconstruction radiotherapy, Chang et al¹⁸ reported higher rates of IBR failure in those who received IBR alone compared with IBR/LD (42% versus 15%, respectively; $P = 0.28$). This result is similar to the findings in the current study, where patients with a history of radiotherapy had higher rates of reconstruction failure with IBR alone compared with IBR/LD (44% versus 25%). This difference, however, was not statistically significant, likely owing to the small sample size of the irradiated IBR subgroup. The combination of the lower complication rate in the IBR/LD group with potentially more tissue damage and/or severe infections suggests that, although not statistically significant, this result is likely clinically significant.

The timing of reconstruction following infected device explantation is another controversial topic. All IBR/LD flap patients with the exception of one underwent delayed reconstruction (96%), while only roughly half of the IBR group underwent delayed reconstruction (48% versus 52%). Historically, delayed reconstruction is favored to allow time for resolution of the inflammatory and infectious processes.^{10,13} This approach decreases reinfection rates but can lead to increased scarring, additional operative procedures, and psychological distress

from temporarily leaving the patient without a breast mound.^{24,25} One study in particular examined the benefit of an LD for salvage of failed primary breast reconstruction (N = 17). Regardless of whether the patient underwent “acute salvage,” ie, LD performed during the same hospitalization, or “delayed salvage,” ie, LD performed at a later date, all salvages were successful.²⁶ The decision regarding the timing of reconstruction is generally based on the surgeon’s discretion and assessment of the infection severity and patient goals.¹⁰ Therefore, a detailed discussion with the patient regarding the risk and benefits of immediate versus delayed reconstruction should be conducted before pursuing reconstruction.

Our study has several limitations. First, the relatively small sample size, particularly in the IBR/LD group, may have limited the power to identify statistically significant differences, if, indeed, they existed. However, as previously mentioned, the fact that this patient cohort was selected from over 6000 IBRs performed during a 16-year period in a tertiary cancer center reflects the rarity of these situations. Additionally, we could not examine the severity of infections or degree of tissue damage from prior radiotherapy, which may have played a role in the decision between one reconstructive technique versus another, given the retrospective design of the study and limitations in the data of the electronic medical records. There was also potential for selection bias in choosing which patients received an LD flap compared with IBR alone. The differences in patient characteristics, particularly receipt of radiotherapy, almost certainly contributed to selection bias of the reconstructive procedure. As the goal of this study was to assess whether LD flaps improve surgical outcomes in patients with secondary IBR, we did not assess the outcomes of those who underwent autologous breast reconstruction, which is the reconstructive option preferred by many plastic surgeons and is the subject of a separate ongoing study by our group. Finally, we did not compare the patient-reported outcomes and aesthetic outcomes between the two groups; these outcomes are critical dimensions of assessing reconstructive success in plastic surgery.

CONCLUSIONS

Following a primary breast reconstruction failure due to infection, it may be appropriate to offer a secondary reconstruction. Despite the selection bias against an LD flap and the complexity of these patients’ conditions, LD flap patients performed at least similarly to those undergoing IBR alone. In patients with a history of radiotherapy, the addition of LD was associated with clinically reduced rates of complication and explantation compared with IBR alone. Therefore, for patients with a history of radiotherapy, combining an LD flap with IBR may very well provide benefits over an IBR alone. Although not statistically different, this outcome may have clinical significance, considering the magnitude of the effect, and may result in decreased complication rates and a higher chance of reconstructive success.

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