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Breast

Secondary Revision after Breast Reconstruction with Free Abdominal Perforator Flap: Flap Liposuction and Inframammary Fold Reconstruction

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Background: In breast reconstruction using the abdominal perforator flap, if the flap capacity is too large, secondary revision procedures can be performed to reduce flap volume and reconstruct the inframammary fold (IMF). We examined the various revision methods and cosmetic results.

Methods: This study included 28 patients who underwent secondary revision among 216 patients who had breast reconstruction using the abdominal perforator flap between April 2012 and March 2019. The revision method, removal ability, and the inferior breast point (IBP) were analyzed using medical records.

Results: Revision methods included incision resection in 4 cases, liposuction (LS) in 22 cases, LS and simultaneous IMF reconstruction in 2 cases, and post-LS IMF reconstruction in 1 case. The average LS amount was 317 mL (range, 100—700 mL). In 22 patients who underwent LS, the difference in preoperative IBP was 1 cm or more in 19 (86.4%) cases and 1 cm or less in 3 (13.6%) cases. The difference in postoperative IBP was 1 cm or more in 12 (54.5%) cases and 1 cm or less in 10 (45.5%) cases. The receiver operating characteristic curve analysis revealed that the cutoff LS amount for a postoperative IBP difference of 1 cm or less was 375 mL.

Conclusions: The IBP was increased due to the decrease in flap volume. Revisions were completed with no difference in the LS-only IBP, especially when the LS amount was less than 375 mL. If the removal of 375 mL or more is necessary, removal or reformation of the IMF can be considered. These findings can potentially guide the planning of surgical procedures. *(Plast Reconstr Surg Glob Open 2024; 12:e6336; doi: 10.1097/GOX.0000000000006336; Published online 5 December 2024.)*

INTRODUCTION

The goal of breast reconstruction is to achieve a symmetrical breast shape to improve the patient's quality of life. Breast symmetry depends on several factors, including the volume of the breast, the position of the inframammary fold (IMF), and other outlines of the breast. The IMF is considered a key component in achieving breast symmetry.

In breast reconstruction with the free deep inferior epigastric artery perforator flap, the reconstructed breast frequently has a larger volume and lowered IMF compared with the contralateral breast. In such cases, the imbalance of the reconstructed and healthy breasts can be attributed to the large volume of the flap, lower positioning of the IMF, or both. It is often difficult to determine why this imbalance can occur and what is the most efficient approach to achieve symmetry with the secondary revision.

Our basic approaches for the secondary revision of autologous breast reconstruction are to reduce the volume with liposuction (LS) and reanchor the IMF through suturing or an adipofascial flap transfer. In most cases, a

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combination of these approaches is applied after assessing the differences between the healthy and affected breasts. In this study, we analyzed the various revision methods and their cosmetic results based on our case series, and determined the combination of revision methods.

MATERIALS AND METHODS

Data Collection

This retrospective survey was performed using the medical records of patients with the approval of the institutional ethical review board. This study included 28 patients who underwent secondary revision surgery among 216 patients who had unilateral breast reconstruction using the deep inferior epigastric artery perforator flap between April 2012 and March 2019.

The following information was collected and analyzed: age, preoperative body mass index, excised mammary gland weight, timing of breast reconstruction, method of revision, difference in the inferior breast point (IBP) and size between the reconstructed breast before revision and the contralateral breast, and excised fat volume in the revision surgery. Size assessments were made by both the patient and the authors.

Measurement of the Difference in IBP

The ratio was calculated by measuring the body width at the IMF level and the difference in IBP in a frontal view photograph with a pixel ruler (GAME-INDEX.net Co, Ltd, Japan). The body width measured on the computed tomography image was used as the actual diameter, and the actual difference in IBP was calculated from that ratio. Detailed steps for calculating the difference in IBP are as follows.

Actual body width at the IMF level was measured based on the computed tomography image (A).

Using a frontal view photograph, the body width (B), and difference in IBP (C) were measured with the pixel ruler.

The actual difference in IBP equals (C) × (A) / (B), where the difference was calculated as an actual value. (**See figure, Supplemental Digital Content 1,** which shows measuring the difference in IBP, **http://links.lww.com/PRSGO/D653**.)

The Difference in IBP

The left–right difference in IMF position has reportedly been recognized by the naked eye when it exceeds 5 mm.[1] On the basis of this finding, we considered more than 1 cm to be appropriate for the revision, so the difference in IBP was divided by 1 cm when the difference between the contralateral breast and the reconstructed breast was readily recognizable.

Cutoff Values for Fat Volume by LS

When comparing the LS amount and the postoperative size, receiver operating characteristic curve analysis revealed a cutoff value of 375 mL, at which point the distance to the upper left corner was the smallest.

Takeaways

Question: What is the appropriate revision procedure after breast reconstruction using a free abdominal perforator flap?

Findings: We devised a combination for the secondary revision using volume reduction and inframammary fold remodeling based on the timing of the first surgery and the planned liposuction amount.

Meaning: We devised a combination for the secondary revision based on the timing of the first surgery and the planned liposuction amount.

Operative Procedure

Secondary revisions were performed using a combination of LS and IMF reconstruction.

LS Procedure

Before LS, 150–200 mL of saline with 1/100,000% epinephrine-added Xylocaine was injected into the subcutaneous layer of the flap. LS was then performed with the ARC Cannulae, Liposuction Unit FMO-55 (Four Medics Co, Ltd, Tokyo), through 2 small incisions made outside the breast. (**See figure, Supplemental Digital Content 2,** which shows the LS and IMF reformation methods as operative procedures, **http://links.lww.com/PRSGO/D654**.)

As its shape in the sitting position was checked several times, the reconstructed breast was liposuctioned until it became approximately the same size and shape as the contralateral breast. After the operation, the patient's chest was slightly compressed using and elastic tubular bandage (Tubicot; ALCARE Co, Ltd, Tokyo).

IMF Reconstruction Procedure

An incision of 10–15 cm was made on the line that would eventually become the new IMF. Below the incision, the adipofascial flap was raised by 2 cm, rolled and flipped, and fixed to the new IMF line at the lower end of the reconstructed breast flap. When a deep IMF line was required, the dermis at the incision line was fixed to the chest wall (**Supplemental Digital Content 2, http://links.lww.com/PRSGO/D654**).

Statistical Analysis

All statistical analyses were performed using BellCurve for Excel, version 3.21 (SSRI, Tokyo, Japan).

RESULTS

In 28 patients who underwent secondary revision, the mean age was 54 (range, 43–69) years, the mean body mass index was 25 kg/m^2 (range, 20.2–33.2), and the mean amount of mammary gland removed was 424.8 (range, 130–1158) g (Table 1).

The mean follow-up period after the secondary revision was 38 (range, 7–85) months. No complications were observed due to the secondary revision surgery. During this study, there were 162 cases of immediate reconstruction

Table 1. Patient Characteristics

	Age	BMI	Mastectomy Volume (Excluding Unknown)
Average (range)	54 (43–69) y	25 kg/m² (20.2–33.2)	424.8 g (130–1158)

BMI, body mass index.

Table 2. Number of Secondary Revisions Based on Timing of Reconstruction

	Yes	No
Delayed reconstruction (n = 54)	11	43
Immediate reconstruction (n = 162)	17	145
Total number (n = 216)	28	188

χ^2 Test ($P = 0.0613$).
No statistical significance.

and 54 cases of delayed reconstruction. Secondary revision was performed in 17 patients (17 of 162, 10.5%) in the immediate reconstruction group and 11 patients (11 of 54, 20.4%) in the delayed reconstruction group. There was a tendency for more revisions to be performed in the delayed reconstruction group, although no statistical significance was found with the χ^2 test ($P = 0.0613$) (Table 2).

The secondary revision methods included incision resection in 4 cases, LS in 22 cases, simultaneous LS and IMF reconstruction in 2 cases, and IMF reconstruction after LS in 1 case. Interestingly, IMF reconstruction was performed only in delayed reconstruction cases (Table 3). The mean amount of LS was 306 mL (range, 100–700 mL) (Table 4).

One resection patient had postoperative radiation. This patient underwent a second revision 18 months after the completion of irradiation. No patients with LS received postoperative radiation therapy. The difference in IBP and the difference in breast size were compared before and after LS for the 22 patients who received the revision surgery including LS. The IBP before LS was greater than or equal to 1 cm in 19 (86.4%) cases and less than or equal to 1 cm in 3 (13.6%) cases. After LS, it was greater than or equal to 1 cm in 12 (54.5%) cases and less than or equal to 1 cm in 10 (45.5%) cases.

Regarding the difference in breast size, 90% of patients had similarly sized breasts when the difference in IBP was less than or equal to 1 cm, although 50% of patients had a larger reconstructed breast, and 50% had similarly sized breasts when the difference in IBP was greater than or equal to 1 cm (Fig. 1).

In the immediate reconstruction group, when the difference in MDP after LS was greater than or equal to 1 cm, 63% of patients had a larger reconstructed breast and 37% had similarly sized breasts. In the delayed reconstruction group, 25% of patients had a larger reconstructed breast and 75% had similarly sized breasts when the difference in IBP after LS was greater than or equal to 1 cm.

In the immediate reconstruction group, there were many cases where the difference in IBP was greater than or equal to 1 cm and the reconstructed breast size was larger. In addition, in the delayed reconstruction group, there were many cases where the difference in IBP was greater than or equal to 1 cm even with similarly sized breasts. However, in the Fisher exact test, there was no significant difference with a P value of 0.27 (Fig. 2).

If the suction amount is less than 375 mL, similar breast sizes can be easily achieved with 1 suction. However, if a suction amount higher than 375 mL is required, it may be difficult to achieve the same breast size with just 1 suction (Fig. 3).

DISCUSSION

Secondary revision of the reconstructed breast is often required in all reconstruction methods. Previous studies have investigated whether reoperation or correction by weight loss is required after breast reconstruction in autologous tissue, but no detailed report has been found on the content of the correction. Details of the revision were also not provided in studies analyzing flap revision.[2–4] LS reduction has additionally been reported in ptosis and giant breast reduction[5] but not in reconstructed breasts.

LS is beneficial for IMF reconstruction. However, several studies have reported fat transplantation when the volume of the reconstructed breast is insufficient. To date, there have been no reports on any volume loss when the reconstructed breast is larger.[2–4]

Our initial correction method involved making an incision around the skin flap and directly removing adipose tissue to reduce the breast volume; however, evenly removing this tissue can be challenging. Because it is possible to reduce the volume in a well-balanced manner by using LS, this has become our preferred correction method.

There have been several reports on IMF remodeling methods[6] in the modification of reconstructed breasts. One method involves approaching the breast from the outside and reforming it as we did,[7–12] and another method involves approaching and reforming the breast from the inside.[13] The second method has been used frequently, but attention must be paid to the appearance of scars, and there is a possibility of relapse through the use of sutures.

In our study, because of autologous tissue reconstruction, scars arising from the external approach are not

Table 3. Secondary Revision Method

	Excision	LS	LS + IMF Reconstruction Same Time	LS + IMF Reconstruction Another Time	LS No. Times: 2
Immediate reconstruction	3	14	0	0	1
Delayed reconstruction	1	8	2	1	0
Total number	4	22	2	1	1

noticeable in the frontal view because there is considerable ptosis due to abdominal flap reconstruction. Because we have observed relapses in IMF remodeling when approaching the breast from the inside and have reoperated using the external approach, we will continue to use the external method for IMF remodeling after abdominal flap reconstruction.

When the reconstructed breast was larger, it was difficult to determine whether the IMF was pushed down due to the large volume or whether it was removed via the mastectomy. We considered why the difference in IBP does not disappear with LS alone. In cases of immediate reconstruction, if the IMF is present at the time of the mastectomy, it may only be pushed down by the large volume of the flap, so the IBP is likely to return if a similar breast size is achieved through LS. In cases where the IBP has not returned, the amount of

Table 4. LS Amount

	LS Amount
Average (range)	306 mL (100–700)

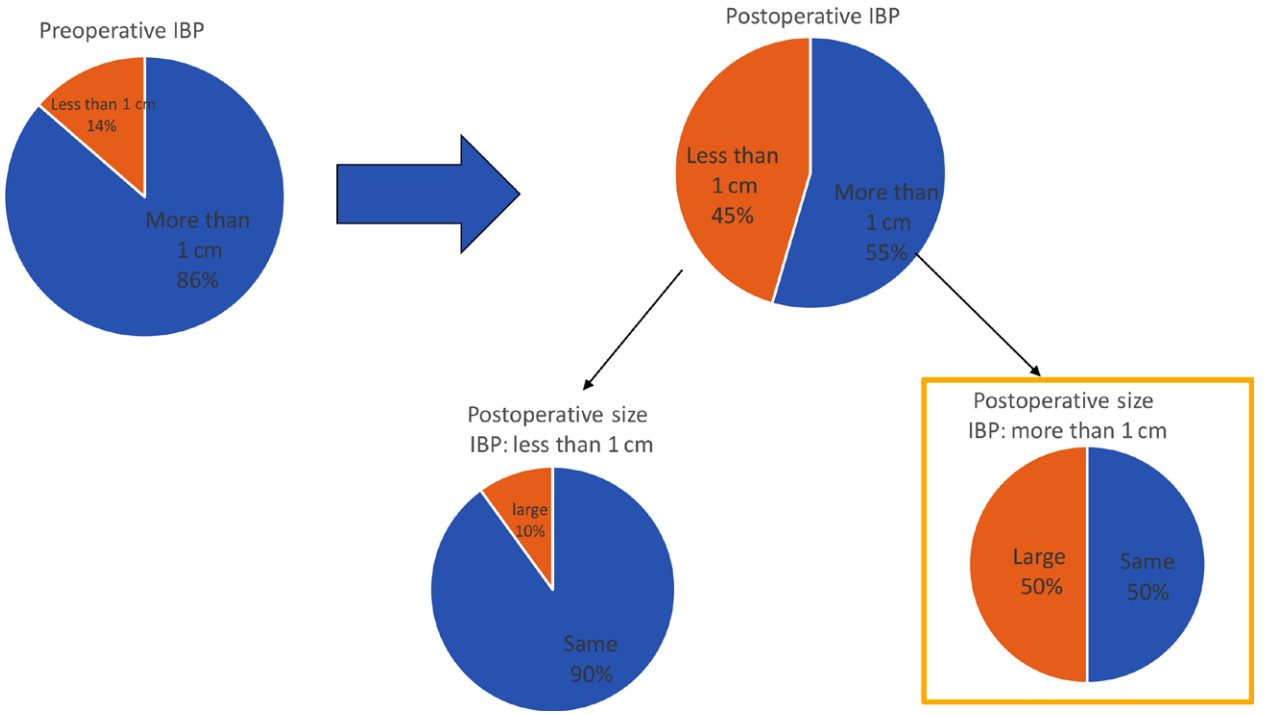
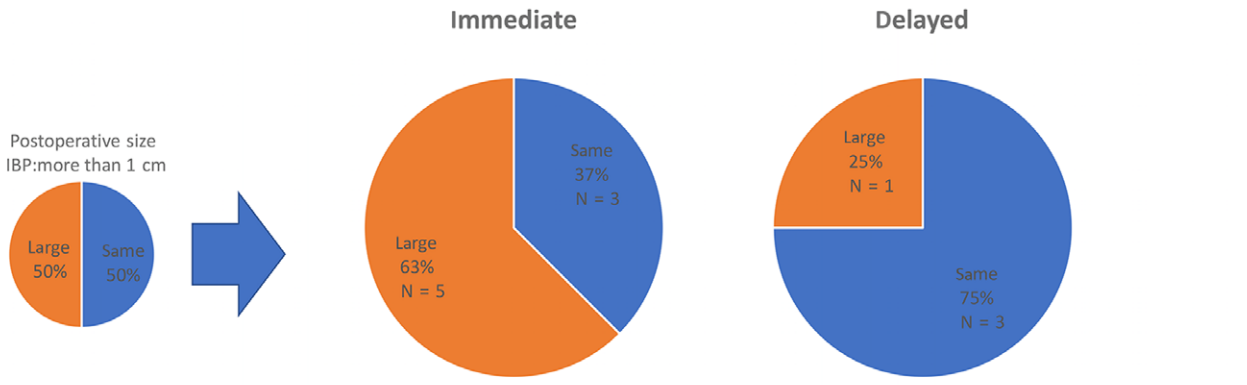


Fig. 1. IBP and size changes after LS.



- In immediate reconstruction, there are many cases where the difference in IBP remains and the reconstructed breast size is larger
- In delayed reconstruction, there are many cases where the size is the same but the difference in IBP remains

Fisher exact test
No statistical significance

Fig. 2. Grouped by timing of reconstruction.

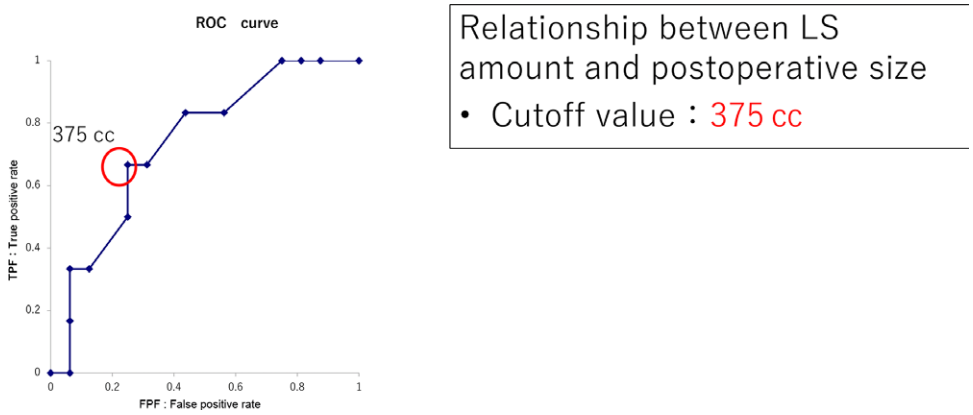


Fig. 3. Relationship between LS amount and postoperative size. ROC, receiver operating characteristic.

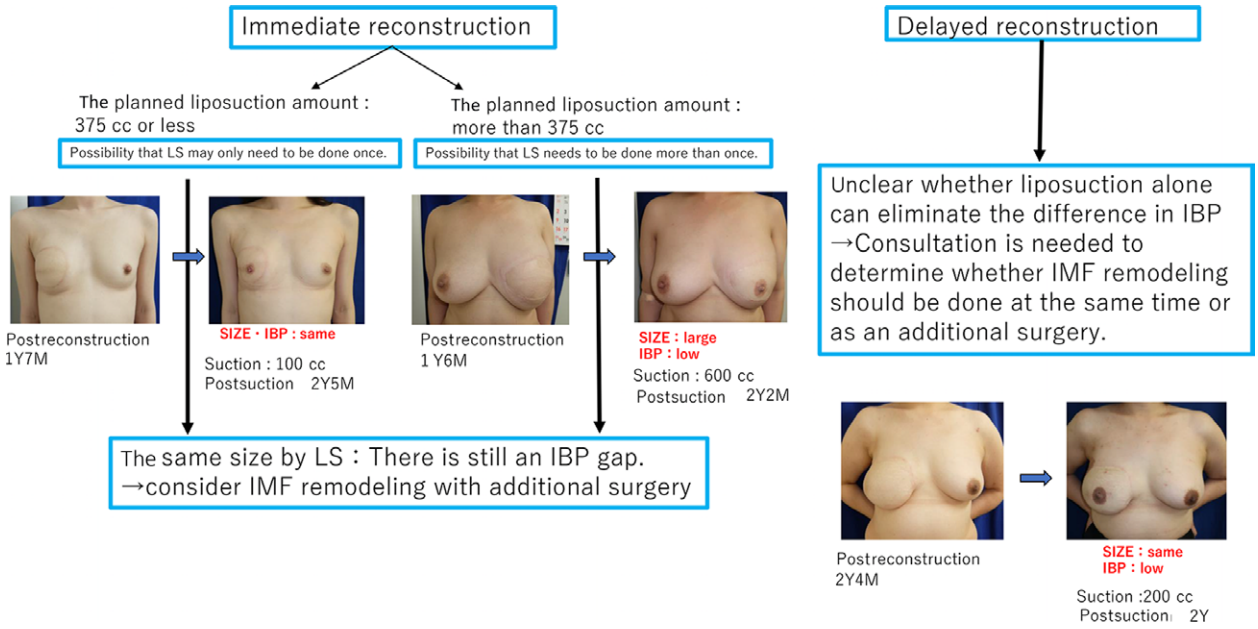


Fig. 4. A combination for secondary revision.

LS may be insufficient. In delayed reconstruction, the IMF is often gone at the time of the previous mastectomy, and it is possibly fixed at the lowered position during the delayed breast reconstruction. In that case, it would be difficult for the IMF position to return only through LS; thus, IMF reformation would be required.[12]

In this study, in cases of immediate reconstruction, the IBP position rises when the volume is reduced. Especially, when the LS amount is less than 375 mL, the difference in IBP disappears only with LS, and the correction can be completed. If the removal of 375 mL or more is required, the difference in IBP is likely to remain, in which case reliposuction or IMF remodeling can be considered.

We believe that the planned amount of LS may potentially guide the development of the surgical plan. On the basis of our findings, we devised a combination for planning a second revision surgery. In immediate reconstruction, if the planned LS amount is 375 mL or less, the correction can be performed all at once. If, however, the planned LS amount is greater than 375 mL, several LS procedures may be required. Clinicians must also consider the possibility that the IBP will decrease as a result of the LS. In this case, IMF remodeling should be considered with additional surgery. If the IBP is lowered even after the size is adjusted, it is a removed IMF that was not noticed intraoperatively, so additional revision should be considered. In delayed reconstruction, because it is unclear whether LS alone can eliminate the difference in IBP, it is necessary to consult with the patient to determine whether IMF remodeling should be performed at the same time as the first secondary revision surgery or if additional surgery is needed (Fig. 4).

Although there are various methods of revision, we hope that in the future we can better perform the surgery with reference to patient-reported outcome measures and other methods.[14–17]

LIMITATIONS

The difference in IBP would be more accurate if it could be measured. However, because this was a retrospective study, the difference in IBP was only an approximation because it was a calculated value.

In this study, the amount of fat resection was done by visual inspection of the measurement line on the suction bottle after suctioning, which is thought to read more than the actual amount of fat resection. In fat injection procedures, we experience that the fat volume after centrifugation of the harvested fat is about half of the volume before centrifugation. From this, we estimate that the actual tissue resection volume is one-third to half of the suctioned fat. The relatively small sample size may also limit the ability to identify statistically significant differences if they are actually present.

CONCLUSIONS

The goal of breast reconstruction surgery is to achieve symmetry, but the stability of blood flow in the flap is the highest priority, so if the abdominal fat is thick, the reconstructed breast will often be larger than the contralateral breast. Among the various methods of secondary revision surgery, we devised a combination for the secondary revision using volume reduction and IMF remodeling based on the timing of the first surgery and the planned LS amount.

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DISCLOSURE

The authors have no financial or personal relationships to disclose in relation to the content of this article.

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