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Predictive Factors for Drainage Volume after Expander-based Breast Reconstruction

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Background: Closed suction drains are widely used in breast reconstruction, and the drains are removed based on a volume criterion. However, to the best of our knowledge, there has been no study analyzing predictive factors for drainage volume after breast reconstruction.
Methods: Data of daily drainage in cases with expander-based breast reconstruction between February 2013 and March 2015 (131 patients and 134 expanders) were retrospectively analyzed. Patient factors and operative factors were examined for their influences on total drainage using univariate and multivariate analyses.
Results: The total drainage was 557.3 ± 359.7 mL. A strong correlation was observed between total drainage and duration of drains (correlation coefficient, 0.908). Operative factors, such as mastectomy type, expander type, operative time, and blood loss, did not affect the total drainage. Patients with axillary lymph node dissection showed a higher total volume of drainage ($P < 0.001$). The weight of the resected specimen, body weight, and breast volume calculated preoperatively showed a strong correlation with total drainage (correlation coefficients, 0.454, 0.388, and 0.345, respectively). In multiple regression analysis with preoperative data, age ($P = 0.008$), body weight ($P = 0.018$), and scheduled axillary dissection ($P < 0.001$) were significant predictive factors for total drainage. Among postoperative data, age ($P = 0.003$), axillary dissection ($P = 0.032$), and weight of resected specimen ($P = 0.013$) were significant predictors.
Conclusions: Based on preoperative and/or postoperative information, plastic surgeons can predict the total drainage and duration of drains after expander-based breast reconstruction. Age, breast mass, and axillary lymph node dissection are important factors for this prediction. *(Plast Reconstr Surg Glob Open 2016;4:e727; doi: 10.1097/GOX.0000000000000752; Published online 1 June 2016.)*

Closed suction drains are widely used in breast reconstruction, and they are removed based on a volume criterion usually defined as less than 30 mL/d.[1,2] Higher drainage volume leads to longer duration of drains and disrupts the postoperative life of the patient. In general, as long as drains remain in position, antibiotics are administered and showering is restricted although these postoperative practices depend on physician preference.[1] Furthermore, some studies indicate that longer drainage time is a risk factor for surgical site infection.[3–5] Under these circumstances, it is important for plastic surgeons to be able to predict drainage volume in breast reconstruction.

Several factors seem to affect drainage volume after operation, including patient factors (obesity, past history, etc) and operative factors (operative time,

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blood loss, etc). In an expander-based breast reconstruction, expander type (smooth or textured) may also have an influence on drainage volume. However, to the best of our knowledge, there has been no study analyzing predictive factors for drainage volume in breast reconstruction.

In this study, we retrospectively reviewed daily drainage records after expander-based breast reconstruction. We also examined factors associated with drainage volume using univariate and multivariate analyses.

PATIENTS AND METHODS

Patients

All female patients who had a tissue expander placed immediately after mastectomy between February 2013 and March 2015 (131 patients and 134 expanders) were analyzed retrospectively. Patient characteristics are summarized in Table 1. Breast volume was calculated based on the preoperative measurement of width, height, and projection, assuming that the breast was a quadrangular pyramid.

Operative Technique

Mastectomy types included total mastectomy with skin resection, skin-sparing mastectomy with nipple resection, and nipple-sparing mastectomy. Expander types included smooth (PMT Corporation, Chanhassen, Minn.) and textured (Allergan, Inc., Irvine, Calif.). Operative factors are summarized in Table 2. Expanders were placed in a submuscular pocket. A flap of serratus fascia was elevated and sutured to the inferolateral border of the pectoralis major muscle. Acellular dermal matrix was not used. Two closed suction drains were placed, one beneath the pectoralis major muscle and the other beneath the skin (Fig. 1).

Table 1. Patient Characteristics

Age (y)	51.2 ± 10.4
Body height (cm)	157.1 ± 5.5
Body weight (kg)	54.4 ± 8.8
Body mass index (kg/m^2)	22.0 ± 3.2
Preoperative breast volume (mL)	174.0 ± 94.9
Preoperative chemotherapy, n (%)	24 (18.6)
Preoperative radiation, n (%)	0 (0)
Diabetes, n (%)	1 (0.8)
Smoking, n (%)	7 (5.4)

Table 2. Operative Factors

Operative time (min)	202.8 ± 46.1
Blood loss (mL)	100.3 ± 81.4
Mastectomy type, n (%)	
Skin resection	62 (47.0)
Skin sparing	37 (28.0)
Nipple sparing	33 (25.0)
Expander type, n (%)	
Smooth	74 (56.1)
Textured	58 (43.9)
Axillary lymph node dissection, n (%)	31 (23.5)
Weight of resected specimen (g)	349.7 ± 185.8

Postoperative Management

Prophylactic antibiotics (cefazolin, 2 g/d) were continued until removal of the final drain. Drainage volume in each drain was recorded every day until its removal. Each drain was removed when its output was less than or equal to 30 mL/d.

Statistical Analysis

All analyses were performed using Statcel version 3 (OMS, Tokorozawa, Japan). Data are expressed as mean ± SD. Values of $P < 0.05$ were considered statistically significant. Correlation coefficients were calculated between total drainage and each factor with a continuous variable. Comparisons between 2 groups were performed using the Mann–Whitney U test. Comparisons among 3 groups were performed using the Kruskal–Wallis test. Multivariate analyses were performed with multiple regression analysis, in which categorical variables were converted to dummy variables, such as 1 or 0 for patients with or without axillary lymph node dissection.

RESULTS

Two patients (2 expanders) suffered from infection postoperatively and had the expanders removed. Their drainage data were excluded from statistical

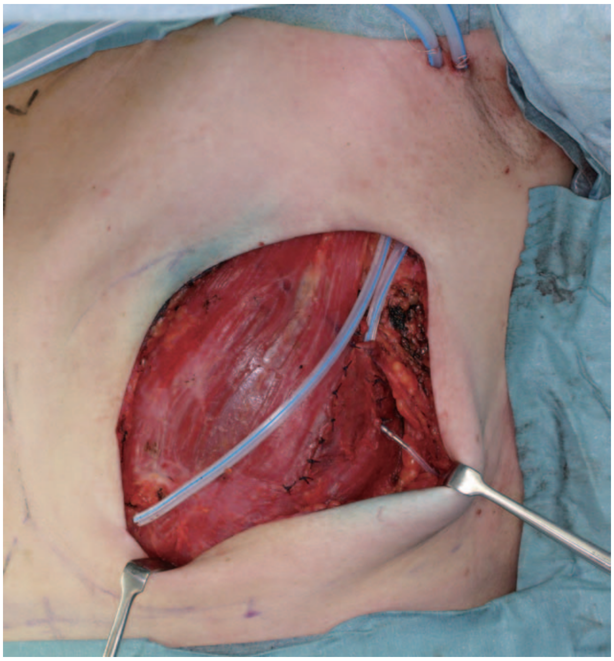

Fig. 1. Placement of closed suction drains. One was placed beneath the pectoralis major muscle, and the other was placed beneath the skin.

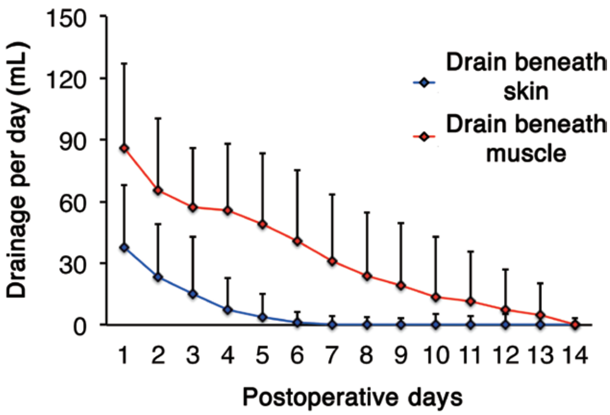

Fig. 2. Time course of daily drainage. Drains beneath the muscle are shown in red, and those beneath the skin are shown in blue.

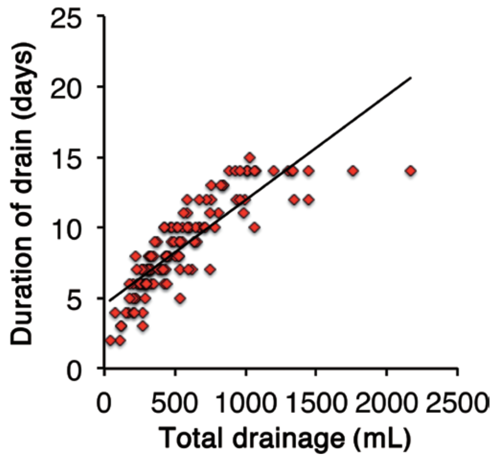

Fig. 3. Correlation between total drainage and duration of drains. The correlation coefficient was 0.908.

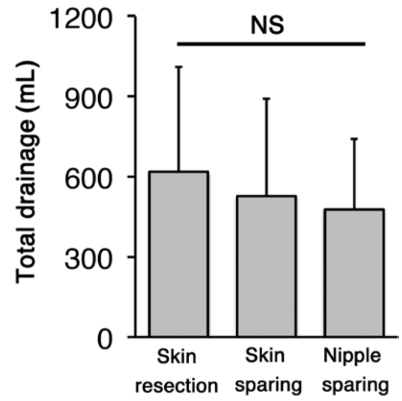

Fig. 4. Total drainage in 3 mastectomy types: total mastectomy with skin resection, skin-sparing mastectomy with nipple resection, and nipple-sparing mastectomy. There were no significant differences among the 3 groups. NS, nonsignificant.

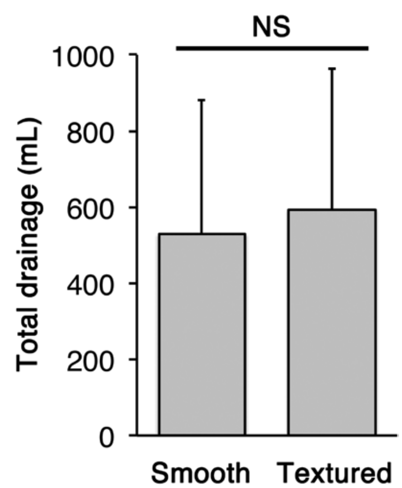

Fig. 5. Total drainage in 2 expander types: smooth and textured. There were no significant differences between the 2 groups. NS, nonsignificant.

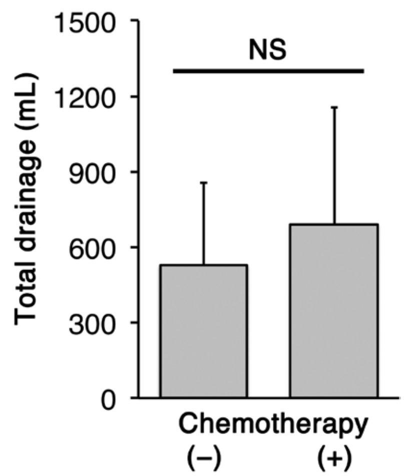

Fig. 6. Total drainage in patients with or without preoperative chemotherapy. There was no significant difference between the 2 groups. NS, nonsignificant.

analysis. There was no seroma formation observed in the study group. Drains beneath the muscle showed higher drainage volumes than those beneath the skin. Both types of drain showed a gradual decrease in volume postoperatively (Fig. 2). The average duration of the drain was 3.7 ± 1.7 days in the drains beneath the skin and 8.7 ± 3.1 days in those beneath the muscle. The total drainage was 557.3 ± 359.7 mL. A strong correlation was observed between total drainage and duration of drains (correlation coefficient, 0.908; Fig. 3).

Mastectomy type (skin resection, skin sparing, or nipple sparing) did not affect total drainage (Fig. 4) nor did expander type (smooth or textured; Fig. 5). Patients with preoperative chemotherapy showed a higher total volume of drainage, but the difference was not statistically significant ($P = 0.105$; Fig. 6). Patients with axillary lymph node dissection showed a higher total volume of drainage, and the difference was statistically significant ($P < 0.001$; Fig. 7). Other

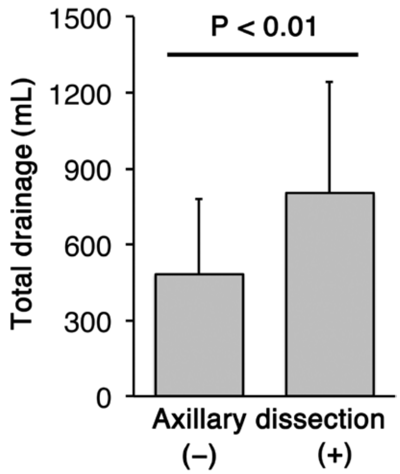

Fig. 7. Total drainage in patients with or without axillary lymph node dissection. Patients with axillary dissection showed a higher total volume of drainage ($P < 0.001$).

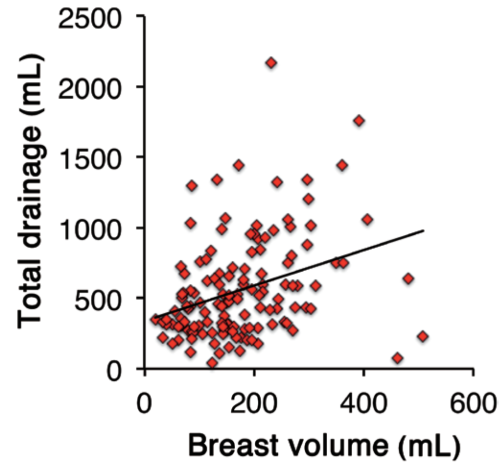

Fig. 9. Correlation between breast volume and total drainage. The correlation coefficient was 0.345.

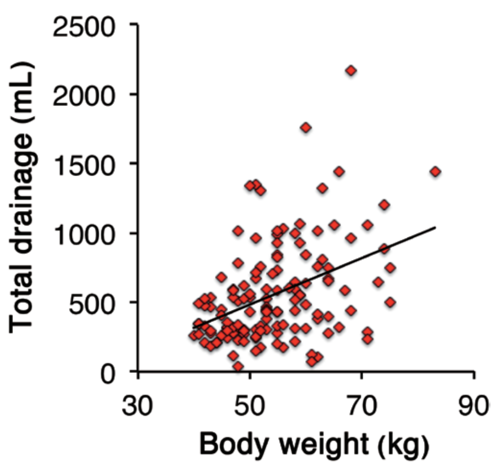

Fig. 8. Correlation between body weight and total drainage. The correlation coefficient was 0.388.

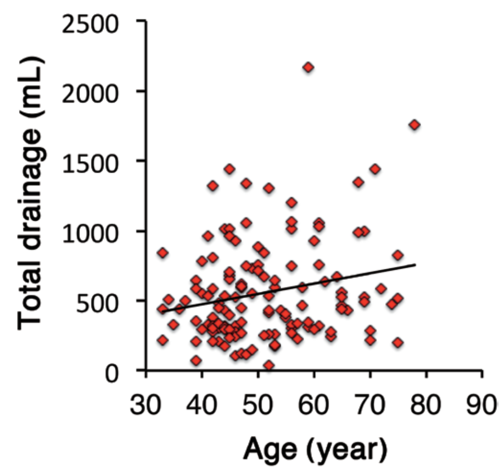

Fig. 10. Correlation between age and total drainage. The correlation coefficient was 0.155.

factors, such as history of diabetes or smoking, did not have a significant effect on total drainage.

Body weight showed a strong correlation with total drainage (correlation coefficient, 0.388; Fig. 8). Breast volume calculated based on the preoperative measurement of width, height, and projection also showed a strong correlation with total drainage (correlation coefficient, 0.345; Fig. 9). Age showed a weak correlation with total drainage (correlation coefficient, 0.155; Fig. 10). Among operative factors, the weight of the resected specimen showed a strong correlation with total drainage (correlation coefficient, 0.454; Fig. 11). Other factors, such as body height, operative time, and blood loss, had no significant correlation with total drainage.

In multiple regression analyses with preoperative data, age (standard partial regression coefficient, 0.216; $P = 0.008$), body weight (standard partial re-

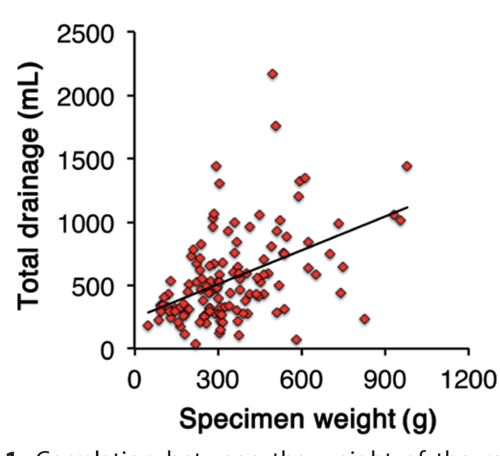

Fig. 11. Correlation between the weight of the resected specimen and total drainage. The correlation coefficient was 0.454.

Table 3. Multiple Regression Analysis of Preoperative Data for Total Drainage

Variable	Standard Partial Regression Coefficient	*P*
Age	0.216	0.008
Body height	0.050	0.585
Body weight	0.263	0.018
Preoperative breast volume	0.142	0.150
Preoperative chemotherapy	0.007	0.935
Scheduled axillary dissection	0.342	< 0.001

Table 4. Multiple Regression Analysis of Postoperative Data for Total Drainage

Variable	Standard Partial Regression Coefficient	*P*
Age	0.247	0.003
Body height	0.064	0.496
Body weight	0.193	0.093
Preoperative chemotherapy	0.068	0.474
Axillary dissection	0.210	0.032
Weight of resected specimen	0.267	0.013
Operative time	0.040	0.648
Blood loss	0.002	0.984

gression coefficient, 0.263; $P = 0.018$), and scheduled axillary dissection (standard partial regression coefficient, 0.342; $P < 0.001$) were significant predictive factors for total drainage (Table 3). Among postoperative data, age (standard partial regression coefficient, 0.247; $P = 0.003$), axillary dissection (standard partial regression coefficient, 0.210; $P = 0.032$), and the weight of the resected specimen (standard partial regression coefficient, 0.267; $P = 0.013$) were significant predictive factors for total drainage (Table 4).

DISCUSSION

Drainage management is important to prevent seroma and subsequent infection after breast surgery. A randomized study indicated that closed suction drainage is advantageous in decreasing the incidence and degree of seroma formation,[6] and another study reported an association between postoperative seroma formation and a drainage flow rate greater than 50 mL/d.[7] In the field of breast reconstruction, most plastic surgeons use closed suction drains and remove them when drain output is less than 30 mL/d.[1,2] We followed this volume criterion, and there was no seroma formation in our study group. Our data showed a gradual decrease in daily drainage and a higher volume of drains beneath the muscle than of those beneath the skin, which is consistent with a previous study.[8]

Axillary lymph node dissection was found to have a great influence on total drainage after expander-based breast reconstruction. The group with axillary dissection had a higher drainage volume by about 300 mL, which corresponded to 3 more days of drainage. A study comparing short-term and long-term drainage after mastectomy with axillary dissection reported a more frequent incidence of seroma in the short-term drainage group.[9] Another study showed that axillary dissection was associated with an increased risk of implant loss in prosthetic breast reconstruction.[10] We believe that seroma and subsequent infection can be prevented if the volume criterion (30 mL/d) is followed in deciding when to remove drains after mastectomy with axillary dissection. However, a patient with a scheduled axillary dissection should be informed that she is likely to have a higher drainage volume and a longer duration of drains than a patient without axillary dissection.

In univariate analysis, patients with preoperative chemotherapy showed a higher total volume of drainage although the difference was not statistically significant. This result is influenced by the confounding variable of axillary lymph node dissection. Indeed, many patients with preoperative chemotherapy (18 of 24 patients) underwent axillary dissection. Multivariate analysis excluded this confounding effect and showed that preoperative chemotherapy itself had no effect on total drainage. Previous studies also report that neoadjuvant chemotherapy did not increase the complication rate after immediate breast reconstruction.[11,12]

Body weight, calculated breast volume, and the weight of the resected specimen had a strong correlation with total drainage in univariate analysis. Multivariate analysis also showed that body weight as a preoperative factor and the weight of the resected specimen as a postoperative factor were significant predictive factors for total drainage. These results suggest that breast mass has a great influence on total drainage after expander-based breast reconstruction. The effects of breast mass in breast reconstruction have been studied from various points of view. Woerdeman et al[13] reported that implants were lost significantly more often in breasts that were more than average sized, and Duggal et al[14] reported that there was an increasing incidence of postoperative wound infections with increasing breast size. Furthermore, Wang et al[15] found that larger breast mass was associated with an increased risk of superficial nipple necrosis after nipple-sparing mastectomy, and Francis et al[16] noted that a breast size larger than a C cup was a risk factor for infection in expander-based breast reconstruction. We believe that patients with a larger breast mass should be informed that they are likely to have a higher drainage volume and a longer duration of drains in expander-based breast reconstruction.

Interestingly, age was found to be an independent predictive factor for total drainage, with older patients showing higher drainage volumes. Previous studies in autologous breast reconstruction have found that advanced age (older than 45 years in one study[17] and older than 65 years in another study[18]) was a risk factor for seroma formation. Other complications, such as surgical site infection[3] and venous thromboembolism,[19] have also been reported more frequently after breast surgery in patients with advanced age.

The main limitation of this study is the selection bias for breast reconstruction. Some patient factors, such as smoking and obesity, have been known to be associated with an increased risk of complications in breast reconstruction.[20] Patients with these risk factors may have been discouraged from undergoing breast reconstruction. Acellular dermal matrix was not used in our study because the use of acellular dermal matrix is not approved in our country. The use of acellular dermal matrix may have an influence on drainage volume after expander-based breast reconstruction.

CONCLUSIONS

Age, breast mass, and axillary lymph node dissection have significant influences on total drainage after expander-based breast reconstruction. Operative factors, such as mastectomy type, expander type, operative time, and blood loss, do not affect total drainage. Based on preoperative and/or postoperative information, plastic surgeons can predict the total drainage and duration of drains after expander-based breast reconstruction.

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