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Title
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Permalink
https://escholarship.org/uc/item/3z82q271

Journal
Plastic & Reconstructive Surgery Global Open, 2(10)

ISSN
2169-7574

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Publication Date
2014-10-01

DOI
10.1097/gox.0000000000000111

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ORIGINAL ARTICLE
Breast

The Number of Operations Required for Completing Breast Reconstruction

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Background: Breast reconstruction often requires multiple surgeries, which demands additional expense and time and is often contrary to the patient's expectation. The aim of this study was to review the number of operations that were needed for completion of breast reconstruction and to determine patient and clinical factors that influenced this number.
Methods: We retrospectively reviewed the medical records of 254 cases of breast reconstructions (in 185 patients) that were performed between February 2005 and August 2009. We investigated the numbers of operations that were performed for individual case of breast reconstruction and analyzed the influence of variable factors. The purpose of the additional operations was also analyzed.
Results: The mean number of operations per breast was 2.37 (range, 1–9). The mean number of operations for mound creation was 2.24. Factors associated with an increased number of operation were use of an implant, contralateral symmetrization, complications, and nipple reconstruction. Considering the reconstruction method, either the use of a primary implant or the use of free abdominal tissue transfer demonstrated fewer surgeries than the use of an expander implant, and the number of operations using free transverse rectus abdominis musculocutaneous or deep inferior epigastric perforator flaps was less than the number of operations using pedicled transverse rectus abdominis musculocutaneous flaps.
Conclusions: These data will aid in planning breast reconstruction surgery and will enable patients to be more informed regarding the likelihood of multiple surgeries. *(Plast Reconstr Surg Glob Open 2014;2:e242; doi: 10.1097/GOX.0000000000000111; Published online 30 October 2014.)*

Reconstruction of the breast after mastectomy is a common procedure, providing physical and psychological benefits to breast cancer patients.[1–3] Contrary to the patient's expectation, breast reconstruction usually requires multiple operations, creating additional expenses and adding to the burden on patients and physicians.[4,5] To our knowledge, there are no reports in the literature that have detailed the average number of operations required for breast reconstruction or examined the patient and clinical factors associated with a higher number of operations. Generally, breast reconstruction is regarded by surgeons as requiring multiple surgeries,[6] but the number of operations often exceeds the expected number. Furthermore, many patients are unaware of the number of operations that might be required at the beginning of their treatment. The

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Received for publication July 2, 2013; accepted April 7, 2014.
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DOI: 10.1097/GOX.0000000000000111

Disclosure: *The authors have no financial interest to declare in relation to the content of this article. The Article Processing Charge was paid for by the authors.*

number of operations may vary according to the type of mastectomy, the method of reconstruction, and the surgeon's preference. Nipple-sparing mastectomies combined with immediate reconstruction with autologous tissue are associated with a lower number of operations.[6,7] More complicated conditions have been associated with an increased number of operations.[8,9]

The aim of this study was to determine the average number of operations required to complete breast reconstruction and to assess patient and clinical factors that influence this number.

MATERIALS AND METHODS

The medical records of patients who underwent breast reconstruction between February 2005 and August 2009 were retrospectively reviewed following approval by the Institutional Review Board of the University of California, Irvine Medical Center. Patients with confirmed recurrence of breast cancer were excluded.

A breast reconstruction was deemed to be complete if the primary reconstruction was performed 2 years before the data collection. The demographic and clinical characteristics of each patient were recorded, as well as the date and purpose of the operations.

For each case, the number of operations required to accomplish the breast reconstruction was recorded. Bilateral reconstruction was separated into 2 individual cases. Tattooing for areolar reconstruction was not counted as a separate operation. Factors that influenced the number of the operations were analyzed: smoking, radiation, type of mastectomy, timing of reconstruction (delayed or immediate), use of autologous tissue, use of an implant, use of dermal substitute, a contralateral symmetrization procedure, complications, and nipple reconstruction. The influence of each factor was analyzed with the Mann-Whitney *U* test or Kruskal-Wallis test. Methods of reconstruction were assessed using multiple comparisons performed with the post hoc test. The purposes of the additional operations were also recorded and listed in order of frequency.

Because a large portion of cases were completed without nipple reconstruction, the average number of operations required for breast mound creation was also reported, as well as the influence that the aforementioned patient and clinical factors had on the number of operations for breast mound creation.

We followed the ethical principles for medical research involving human subjects declared by World Medical Association.

RESULTS

A total of 254 cases of breast reconstruction in 185 patients were collected, with all reconstructions performed by 4 plastic surgeons within the facilities of the University of California, Irvine Medical Center.

The mean number of operations per individual breast reconstruction case was 2.37 (range, 1–9), and the mean number of operations for breast mound creation was 2.24 (range, 1–9). Smoking and radiation were not found to increase the number of operations (Table 1). The mean number of operations for modified radical mastectomy was higher than that for skin-sparing mastectomy, but the difference was not significant. There was no difference between the mean number of operations for immediate and delayed reconstructions. The mean number of operations when using autologous tissue was 2.04, compared to 2.71 for implant-based reconstruction, and 2.58 for simultaneous use of autologous tissue and an implant; these differences were significant ($P < 0.001$). The mean number of operations increased from 2.25 to 2.90 when contralateral symmetrization procedures were performed. If the patient had breast complications, the mean number of operations increased from 1.96 to 3.09; however, donor-site complications did not increase the number of operations. Nipple reconstruction increased both the mean overall number of operations (from 1.98 to 3.08) and the number of breast mound creation operations. Considering the reconstruction method, either the use of a primary implant or the use of free abdominal tissue transfer including free transverse rectus abdominis musculocutaneous (TRAM) or deep inferior epigastric perforator (DIEP) flaps demonstrated fewer surgeries than the use of an expander implant (Table 2). The number of operations using free TRAM or DIEP flaps was less than the number of operations using pedicled TRAM flaps. The most common reasons for the additional operations were tissue expander removal and permanent implant placement, nipple reconstruction, and breast shape enhancement. In the TRAM or DIEP flaps group, the most common secondary procedure was flap revision for shaping, which was performed in 42.0% of all TRAM or DIEP flap cases; the second most common reason for a secondary procedure was nipple reconstruction (26.9%) (Table 3). Other reasons for repeated procedures included abdominal deformity correction (25.2%), implant insertion (16.9%), and vessel exploration (2.5%). In the implant-based group, scheduled expander removal and permanent implant insertion were the most common reasons for a repeat procedure, which was performed in 79.6% of all implant-based reconstruction cases. Nipple reconstruction was

Table 1. Comparison of Number of Operations

Factors	No. cases	Average No. Total Operations (Without Nipple Reconstruction)	*P*
Smoking			
Yes	35	2.20 (2.06)	0.223 (0.210)
No	219	2.40 (2.27)	
Radiation			
Yes	58	2.40 (2.22)	0.716 (0.966)
No	196	2.37 (2.24)	
Method of mastectomy			
MRM	82	2.55 (2.33)	0.270 (0.685)
SSM	172	2.31 (2.20)	
Side of mastectomy			
Left	127	2.39 (2.26)	0.920 (0.829)
Right	127	2.37 (2.20)	
Timing of reconstruction			
Immediate	182	2.34 (2.24)	0.690 (0.683)
Delayed	72	2.46 (2.24)	
Autologous or implant*			
Autologous	122	2.04 (1.91)	<0.001 (<0.001)
Implant-based	108	2.71 (2.58)	
Autologous + implant	24	2.58 (2.38)	
Method of reconstruction*			
Direct implant	29	2.34 (2.34)	<0.001 (<0.001)
Tissue expander	77	2.90 (2.71)	
Free TRAM or DIEP	112	1.96 (1.84)	
Pedicled TRAM	7	3.14 (2.86)	
Latissimus dorsi	29	2.41 (2.24)	
Use of dermal substitute			
Yes	30	2.50 (2.43)	0.465 (0.256)
No	224	2.36 (2.21)	
Symmetrization operation			
Yes	51	2.90 (2.63)	<0.001 (<0.001)
No	203	2.25 (2.14)	
Breast complication			
Yes	94	3.09 (2.96)	<0.001 (<0.001)
No	160	1.95 (1.82)	
Donor complication			
Yes	41	2.54 (2.37)	0.160 (0.119)
No	213	2.35 (2.22)	
Nipple reconstruction			
Yes	91	3.08 (2.69)	<0.001 (<0.001)
No	163	1.98 (1.98)	
Total	254	2.37 (2.24)	

Average total numbers and *P*-values in parentheses are for the operation number without nipple reconstruction.
**P*-values are based on the Mann-Whitney *U* test or Kruskal-Wallis test.
MRM, modified radical mastectomy; SSM, skin-sparing mastectomy.

performed as a repeat procedure in 25.0% of cases in the implant-based group (Table 4). Other reasons for surgery in this group included implant exchange (14.8%), a free TRAM flap (10.2%), tissue expander exchange (8.3%), and capsular surgery (6.5%).

DISCUSSION

It is well recognized that breast reconstruction is a multistage process,[10] which was confirmed in our study where the mean number of the total operations was greater than 2. This finding reflects the

Table 2. Multiple Comparison Operation of Number among the Methods of Reconstruction

	Tissue Expander	Free TRAM or DIEP	Pedicled TRAM	Latissimus dorsi
Direct implant	0.004 (0.47)	0.160 (0.52)	0.054 (0.094)	0.406 (0.883)
Tissue expander		<0.001 (<0.001)	0.416 (0.334)	0.058 (0.072)
Free TRAM or DIEP			0.009 (0.04)	0.018 (0.035)
Pedicled TRAM				0.121 (0.111)
Latissimus dorsi				

Methods of reconstruction were assessed using multiple comparisons performed with the post hoc test.
P-values are based on the Mann-Whitney *U* test and Bonferroni correction [significance level (α) = 0.05].
P-values in parentheses are for the operation number without nipple reconstruction.

Table 3. Additional Procedures following TRAM or DIEP Flap Breast Reconstruction

Name of Procedure	Frequency (%)
Flap revision for shaping	42
Nipple reconstruction	26.9
Abdominal deformity correction	25.9
Implant insertion	16.9
Vessel exploration	2.5

complexity of breast reconstruction compared with other breast surgeries. Knowledge of the factors associated with an increase in the number of operations, and the reasons for the additional operations, will help to minimize the number of operations and assist in surgical planning and patient information.

The factors related to an increase in the number of operations were the method of reconstruction, contralateral symmetrization procedures, complications, and nipple reconstruction. Factors with no relation were smoking, radiation, type of mastectomy, side of breast cancer, timing of reconstruction, and use of dermal substitute. While the superiority of autologous reconstruction over implant-based reconstruction can be compared in several ways including complication rates, aesthetic outcomes, and cost,[11–13] we also demonstrated that autologous reconstruction using free TRAM or DIEP flaps was associated with a lower number of operations than pedicled TRAM flap and latissimus dorsi musculocutaneous flap reconstruction. The most common additional procedure after TRAM or DIEP flap breast reconstruction was flap revision for shape enhancement, which was even more common than nipple reconstruction. Another common additional procedure after TRAM or DIEP flap breast reconstruction was correction of abdominal deformity. Implant insertion after TRAM or DIEP flap breast reconstruction was performed in 16.9% of cases. An abdominal flap was not always able to provide enough volume to match the contralateral breast or satisfy the patient's expectation.

Considering implant-based reconstruction, the direct implant method required fewer operations than the tissue expander, as expected. Although the fact that implant-based reconstruction is usually performed as a 2-staged procedure[14] may account for its increased number of operations, implant-related problems, which include capsular contracture, implant exposure, and infection, can also contribute to an increased number of additional operations.

Table 4. Additional Procedures following Implant-based Reconstruction

Name of Procedure	Frequency (%)
Expander removal and permanent implant insertion	79.6
Nipple reconstruction	25.0
Implant change	14.8
TRAM or DIEP flap	10.2
Tissue expander change	8.3
Capsular surgery	6.5

If a symmetrization procedure was performed in the primary operation, the total number of operations was also increased. This may be because the contralateral breast surgery is also an independent procedure, which requires a secondary correction for cosmetic reasons and may have associated complications. Complications of the reconstructed breast clearly increased the total number of operations, whereas donor-site complications did not. Donor-site complications usually subside spontaneously and do not require further surgical management, whereas breast complications are often more serious, requiring surgical intervention. No difference was observed between immediate and delayed reconstruction. Delayed reconstruction might be more challenging, and their final result might not be comparable to that of immediate reconstruction. With that point in mind, however, surgeons tend to choose more reliable methods for delayed reconstruction like use of autologous tissue and possibly succeed in reducing the number of operations.

Nipple reconstruction also clearly increased the mean number of operations. Interestingly, however, patients who underwent nipple reconstruction had a larger number of operations for breast mound creation than patients who did not. The difference between the number of total operations and that for breast mound creation in these patients was not exactly one because the nipple reconstruction may have been performed with other additional procedures such as flap revision or implant change. These patients had reached the end point of the breast reconstruction process and can be regarded as highly motivated and compliant patients in agreeing to undergo additional procedures. It should be noted that there was an unexpectedly low number of patients who wished to accept a further operation for nipple reconstruction. This may reflect the desire of patients to minimize the number of operations and focus instead on their oncologic treatment or personal life. This further highlights the need to limit the number of operations for breast reconstruction patients whenever possible.

CONCLUSIONS

These data will aid in planning breast reconstruction surgery and will enable patients to be more informed regarding the likelihood of multiple surgeries. Further,

this information may be instructive in reducing the number of operations for breast reconstruction.

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