Satisfaction following Unilateral Breast Reconstruction: A Comparison of Pedicled TRAM and Free Abdominal Flaps

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Background: The purpose of this study was to compare patient satisfaction following unilateral pedicled transverse rectus abdominis myocutaneous (TRAM) and free abdominal flap reconstruction.

Methods: Patients who underwent unilateral breast reconstruction using pedicled TRAM or free abdominal flaps (muscle-sparing TRAM or deep inferior epigastric perforator flap) and completed the BREAST-Q were identified from 2 prospectively maintained databases. BREAST-Q scores were assessed and compared for Satisfaction with Breasts, Outcome, and Physical Well-being Chest/Abdomen.

Results: Of the 138 patients who completed the BREAST-Q, 84 underwent pedicled TRAM flap reconstruction and 54 underwent free abdominal flap reconstruction. Overall, pedicled TRAM flap patients scored higher than free abdominal flap patients on all 4 BREAST-Q scales. This difference reached statistical significance in Satisfaction with Breasts (+7.74; P = 0.02). Similar results were found among patients who completed the BREAST-Q at <3 years postoperation. However, among patients at ≥3 years postoperation, there were no statistically significant differences between the 2 groups, with the pedicled flap cohort scoring higher in Satisfaction with Breasts and Physical Well-being Chest and the free abdominal flap cohort scoring higher in Satisfaction with Outcome and Physical Well-being Abdomen scores.

Conclusions: Patients who underwent unilateral pedicled TRAM flap reconstruction experienced greater initial breast satisfaction than patients who underwent unilateral free abdominal flap reconstruction, but satisfaction equalized between the two over time, suggesting that long-term satisfaction may be equivalent between the 2 methods of reconstruction.

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The beneficial effects of breast reconstruction on quality of life and psychosocial well-being are well documented. A variety of studies have shown that women who undergo reconstruction following mastectomy demonstrate improvements in self-image, sexuality, and decreased rates of depression.1–6 Additionally, recent reports have shown that patients who undergo reconstruction with autologous tissues have improved long-term quality of life when compared with those who have undergone reconstruction with tissue expanders/implants.7–9 Although it is clear that autologous reconstruction generally results in better long-term quality of life outcomes, it is less clear if there are intrinsic differences between the various autologous options.

Since their introduction over 30 years ago by Hartrampf et al.,10 abdominal flaps have remained the workhorse for autologous reconstruction. Recent statistics from the American Society of Plastic Surgery demonstrated that in 2013 more than 63% of autolo-
gous breast reconstructions performed in the United States used the abdominal donor site, accounting for over 12,000 reconstructions. Over the last 2 or 3 decades, these procedures have evolved with an aim toward decreasing abdominal morbidity, augmenting blood supply, and improving aesthetic outcomes. As a result, a variety of flap options have been described, including the free and/or muscle-sparing (MS) transverse rectus abdominis myocutaneous (TRAM) flap, the pedicled TRAM flap, the deep inferior epigastric perforator (DIEP) flap, and the superficial inferior epigastric artery flap.

A large number of studies have examined aesthetic and functional outcomes among different variants of the TRAM flap. However, more information regarding patient-reported outcomes comparing unilateral pedicled TRAM flaps and microvascular abdominal flaps is needed. This is important because although recent advances in microsurgical techniques and education have increased adoption of microvascular breast reconstruction, a large proportion of patients undergoing unilateral pedicled TRAM flap and free abdominal flap reconstruction, specifically MS-TRAM or DIEP flap, using the BREAST-Q, a validated condition-specific patient-reported outcome (PRO) instrument that measures postsurgical body image and health-related quality of life in the breast reconstruction patient.

PATIENTS AND METHODS

As part of the BREAST-Q validation study and routine clinical care, a retrospective review of all patients who underwent postmastectomy unilateral autologous breast reconstruction using pedicled TRAM or free abdominal flaps (MS-TRAM or DIEP flaps) and had completed the BREAST-Q postoperatively was identified from 2 prospectively maintained databases at 2 sites in North America, New York and Vancouver, between 2008 and 2013. For patients who completed the BREAST-Q at multiple postoperative visits, the most recent BREAST-Q completed was used. Institutional review board approval was obtained before study initiation.

Chart review was performed at both institutions to obtain the following demographic information: age at time of surgery, body mass index, follow-up time (time from reconstruction to BREAST-Q completion), timing of reconstruction (immediate or delayed), history of chemotherapy or radiation, history of previous reconstruction, and whether the mastectomy was prophylactic or not.

Questionnaire

The following BREAST-Q Reconstruction module scales were used for the purposes of this study: (1) Satisfaction with Breasts—addresses satisfaction with breast appearance, shape, symmetry, comfort, and feel; (2) Satisfaction with Outcome—addresses the overall satisfaction with breast surgery outcome (expectations, impact, decision, and regrets); (3/4) Physical Well-Being (Chest and Abdomen)—addresses postoperative pain, symptoms, and function. BREAST-Q scales were scored (range, 0–100), with higher scale scores indicating greater satisfaction with outcome, superior physical function, or better quality of life.

Data Analysis

Demographic characteristics and mean BREAST-Q scale scores were compared between the 2 cohorts of reconstruction patients. Means were compared using t test for continuous variables, whereas categorical data were evaluated using the Pearson chi-square or Fisher’s exact test as appropriate. Additionally, a stratified analysis was performed to compare BREAST-Q scores based on the length of time from reconstruction surgery to BREAST-Q completion. Specifically, scores were compared among patients who completed the BREAST-Q at < or ≥3 years from the time of reconstruction surgery. A multivariate linear regression model (MVA) was used to identify independent predictors of patient satisfaction with breasts (dependent variable). Independent variables used in the multivariate analysis were significant variables identified in univariate analysis and/or confounders identified a priori to affect patient satisfaction. P values ≤ 0.05 were considered statistically significant. Data analy-
sis was conducted using SPSS Version 21.0 software (IBM, Armonk, N.Y.).

**RESULTS**

**Overall Patient Demographics and Characteristics**

One hundred thirty-eight patients who had undergone either unilateral pedicled TRAM flap or free abdominal flap breast reconstruction and completed the BREAST-Q postoperatively were identified from the 2 sites (Table 1). Eighty-four patients (60.9%) underwent pedicled TRAM flap reconstruction, of which the majority was from Vancouver (78.6%), whereas 54 (39.1%) underwent free abdominal flap reconstruction, all of whom were from New York ($P < 0.01$). The pedicled TRAM flap cohort patients had approximately 1 year additional mean length of time from breast reconstruction to BREAST-Q completion ($P < 0.01$), were older by approximately 3 years ($P = 0.047$), and were more likely to have undergone immediate reconstruction ($P = 0.04$). Free abdominal flap patients were more likely to be obese ($P = 0.02$) and have undergone chemotherapy and radiotherapy treatment ($P < 0.01$ for both). There were no statistically significant differences between the 2 cohorts in race or history of prior breast reconstruction.

**BREAST-Q Scores: Overall**

Among patients overall, the unilateral pedicled TRAM flap patients scored higher on all 4 BREAST-Q scales (Table 2), including Satisfaction with Breasts (+7.74), Satisfaction with Outcome (+1.09), Physical Well-being Chest (+4.70), and Physical Well-being Abdomen (+0.60). However, this difference reached statistical significance in only Satisfaction with Breasts ($P = 0.02$), reflecting greater patient satisfaction with breast appearance, size, and feel.

**BREAST-Q Scores: <3 Years and ≥3 Years Postreconstruction**

To adjust for the statistically significant difference between the 2 cohorts in time from reconstruction to BREAST-Q completion, BREAST-Q scores were compared for patients who completed the questionnaire at < and ≥3 years postoperation. Among patients <3 years postoperation (Table 3), the pedicled TRAM flap patients scored higher in all 4 scales, with this difference reaching statistical significance in Satisfaction with Breasts (+11.5; $P < 0.01$). However, among patients at ≥3 years postoperation (Table 4), there were no statistically significant differences between the 2 groups of patients on any of the scales, with pedicled TRAM flap patients scoring higher on 2 of the scales (Satisfaction with Breast and Physical Well-being Chest) and the free abdominal flap patients scoring higher on the other 2 scales (Satisfaction with Outcome and Physical Well-being Abdomen).

**Multivariate Analysis: Satisfaction with Breasts**

Multivariate regression analysis (Table 5) controlling for flap type, site, time of BREAST-Q completion, obesity, timing of reconstruction, and radiation therapy confirmed that mean Satisfaction with Breasts scores differed significantly between pedicled TRAM flap and free abdominal flap recipients ($P < 0.01$), with no independent statistically significant predictors of breast satisfaction identified in this model.

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**Table 1. Demographic and Clinical Sample Description**

|                      | Unilateral Pedicled TRAM Flap | Unilateral Free Abdominal Flap | $P$   |
|----------------------|-------------------------------|--------------------------------|-------|
| $N$ (%)              | 84 (60.9)                     | 54 (39.1)                      |       |
| Site, %              |                               |                                |       |
| New York             | 18 (21.4)                     | 54 (100)                       | <0.01*|
| Vancouver            | 66 (78.6)                     |                                |       |
| Age at surgery, y    | Mean (SD)                     |                                |       |
|                      | 54.3 (8.1)                    | 51.5 (8.4)                     | 0.047*|
| Time from reconstruction surgery to BREAST-Q completion | Mean (SD), y | <0.01* |
|                      | 4.0 (1.6)                     | 2.9 (1.9)                      |       |
| Obese (BMI ≥ 30), %  | Yes                           | 15 (17.9)                      |       |
|                      | No                            | 68 (81.0)                      | 0.02* |
|                      | Missing                       | 1 (1.2)                        | 1 (1.9)|
| Race, %              | Nonwhite                      | 13 (15.5)                      |       |
|                      | White                         | 69 (82.1)                      |       |
|                      | Missing                       | 2 (2.4)                        |       |
| Previous breast reconstruction, % | No | 65 (77.4) | 0.27 |
|                      | Yes                           | 13 (15.5)                      | 13 (24.1)|
|                      | Missing                       | 5 (6.0)                        | 1 (1.9)|
| Timing of reconstruction, % | Immediate | 65 (77.4) | 33 (61.1) | 0.04* |
|                      | Delayed                       | 19 (22.6)                      | 21 (38.9)|
| Chemotherapy, %      | No                            | 55 (63.1)                      | <0.01*|
|                      | Yes                           | 30 (35.7)                      | 33 (61.1)|
|                      | Prereconstruction             | 29 (76.7)                      | 19 (57.6)| 0.05 |
|                      | Postreconstruction            | 3 (10.0)                       | 12 (36.4)|
|                      | Mastectomy but prereconstruction | 3 (10.0) | 2 (6.1)|
|                      | Pre- and postreconstruction   | 1 (3.3)                        |       |
|                      | Missing                       | 1 (1.2)                        | 1 (1.9)|
| Radiation therapy, % | No                            | 61 (72.6)                      | <0.01*|
|                      | Yes                           | 22 (26.2)                      | 22 (59.3)|
|                      | Prereconstruction             | 18 (81.8)                      | 22 (68.8)| 0.53 |
|                      | Postreconstruction            | 1 (4.5)                        | 5 (15.6)|
|                      | Mastectomy but prereconstruction | 3 (13.6) | 5 (15.6)|
|                      | Missing                       | 1 (1.2)                        | 1 (1.9)|

*P-value is statistically significant (<0.05).

BMI, body mass index.
DISCUSSION

As the plastic surgery community moves toward greater implementation of evidence-based medicine, reliable information on procedural outcomes and surgical success must be available to increase procedural transparency. Breast reconstruction patients often rely on the guidance of surgeons when making decisions regarding methods of reconstruction, as they typically do not have a point of reference for choosing which type to undergo. Patients deserve PROs data to complement the advice of their surgeon in the decision-making process.

Many patients and physicians prefer autologous reconstruction rather than alloplastic reconstruction, and specifically the use of abdominal flaps, as autologous reconstruction tends to produce a more natural appearing and feeling reconstruction that will have an aging process similar to unreconstructed breasts.41–44 In deciding which abdominal flap to use, many surgeons prefer microsurgical abdominal flaps, as they do not require harvest of the entire transverse rectus abdominis muscle (or any of the muscle at all in the case of DIEP flaps), which has been shown to decrease postoperative pain and improve abdominal function particularly following bilateral reconstruction.12,22,45 However, other surgeons prefer the pedicled TRAM flap because of its relative ease and lower rates of total flap loss compared with free abdominal flaps.46 Given conflicting preferences for free versus pedicled abdominal flaps, the results of this study can be used to aid surgeon preferences regarding these 2 types of reconstruction.

In this study, patients who underwent unilateral pedicled TRAM flap reconstruction scored higher than patients who underwent unilateral free abdominal flap reconstruction on the 4 BREAST-Q scales, although this difference reached statistical significance in only Satisfaction with Breasts.41–44 In deciding which abdominal flap to use, many surgeons prefer microsurgical abdominal flaps, as they do not require harvest of the entire transverse rectus abdominis muscle (or any of the muscle at all in the case of DIEP flaps), which has been shown to decrease postoperative pain and improve abdominal function particularly following bilateral reconstruction.12,22,45 However, other surgeons prefer the pedicled TRAM flap because of its relative ease and lower rates of total flap loss compared with free abdominal flaps.46 Given conflicting preferences for free versus pedicled abdominal flaps, the results of this study can be used to aid surgeon preferences regarding these 2 types of reconstruction.

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Table 2. BREAST-Q Scores: Overall

| BREAST-Q Scale | N  | Mean Score | Δ    | SD  | P    |
|----------------|----|------------|------|-----|------|
| Satisfaction with Breasts |     |            |      |     |      |
| Unilateral pedicled TRAM flap | 84  | 69.87      | +7.74| 19.89| 0.02*|
| Unilateral free abdominal flap | 54  | 62.13      |     | 16.66|      |
| Satisfaction with Outcome |     |            |      |     |      |
| Unilateral pedicled TRAM flap | 84  | 76.26      | +1.09| 23.62| 0.79 |
| Unilateral free abdominal flap | 54  | 75.17      |     | 21.13|      |
| Physical Well-being Chest |     |            |      |     |      |
| Unilateral pedicled TRAM flap | 83  | 75.76      | +4.70| 14.09| 0.10 |
| Unilateral free abdominal flap | 53  | 71.06      |     | 17.51|      |
| Physical Well-being Abdomen |     |            |      |     |      |
| Unilateral pedicled TRAM flap | 82  | 73.60      | +0.60| 21.75| 0.88 |
| Unilateral free abdominal flap | 53  | 73.00      |     | 23.03|      |

*P value is statistically significant (<0.05).
Δ, mean difference.

Table 3. BREAST-Q Scores: <3 Years Postreconstruction

| BREAST-Q Scale | N  | Mean Score | Δ    | SD  | P    |
|----------------|----|------------|------|-----|------|
| Satisfaction with Breasts |     |            |      |     |      |
| Unilateral pedicled TRAM flap | 24  | 72.6       | +11.5| 15.2 | <0.01*|
| Unilateral free abdominal flap | 31  | 61.1       |     | 16.2 |      |
| Satisfaction with Outcome |     |            |      |     |      |
| Unilateral pedicled TRAM flap | 23  | 80.8       | +9.2 | 18.4 | 0.13 |
| Unilateral free abdominal flap | 30  | 71.6       |     | 23.2 |      |
| Physical Well-being Chest |     |            |      |     |      |
| Unilateral pedicled TRAM flap | 23  | 73.1       | +4.2 | 15.1 | 0.38 |
| Unilateral free abdominal flap | 31  | 68.9       |     | 18.8 |      |
| Physical Well-being Abdomen |     |            |      |     |      |
| Unilateral pedicled TRAM flap | 23  | 74.7       | +5.4 | 19.8 | 0.40 |
| Unilateral free abdominal flap | 31  | 69.3       |     | 25.4 |      |

*P value is statistically significant (<0.05).
Δ, mean difference.

Table 4. BREAST-Q Scores: ≥3 Years Postreconstruction

| BREAST-Q Scale | N  | Mean Score | Δ    | SD  | P    |
|----------------|----|------------|------|-----|------|
| Satisfaction with Breasts |     |            |      |     |      |
| Unilateral pedicled TRAM flap | 60  | 68.8       | +5.2 | 21.5 | 0.30 |
| Unilateral free abdominal flap | 23  | 63.6       |     | 17.6 |      |
| Satisfaction with Outcome |     |            |      |     |      |
| Unilateral pedicled TRAM flap | 58  | 74.5       | −5.3 | 25.3 | 0.36 |
| Unilateral free abdominal flap | 23  | 79.8       |     | 17.5 |      |
| Physical Well-being Chest |     |            |      |     |      |
| Unilateral pedicled TRAM flap | 60  | 76.8       | +2.7 | 13.7 | 0.45 |
| Unilateral free abdominal flap | 22  | 74.1       |     | 15.3 |      |
| Physical Well-being Abdomen |     |            |      |     |      |
| Unilateral pedicled TRAM flap | 59  | 73.2       | −5.1 | 22.6 | 0.35 |
| Unilateral free abdominal flap | 22  | 78.3       |     | 18.6 |      |

Δ, mean difference.
at <3 years postoperation at the time of BREAST-Q completion, and the second included only patients who were at ≥3 years postoperation at the time of BREAST-Q completion. In the first of these analyses, the pedicled flap cohort again scored higher in all 4 scales and significantly higher in Satisfaction with Breasts. However, in the second of these analyses, there were no statistically significant differences in any of BREAST-Q scales. In fact, the pedicled flap patients scored higher in Satisfaction with Breasts and Physical Well-being Chest, whereas the free flap cohort scored higher in Satisfaction with Outcome and Physical Well-being Abdomen. Based on these results, unilateral pedicled TRAM flap reconstruction patients may have greater initial satisfaction with the results of their breast reconstruction surgery compared with unilateral free abdominal flap reconstruction patients. However, patient satisfaction appears to equalize between the 2 groups over time. Therefore, patients can be reassured that over time they may be equally satisfied with the results of either method of reconstruction.

A possible explanation for the greater level of Satisfaction with Breasts seen in the pedicled flap cohort, especially the greater level of initial satisfaction, is that the pedicled TRAM flap patients were more likely to have undergone immediate breast reconstruction and less likely to have undergone radiation therapy, allowing preservation of the mastectomy skin envelope without secondary skin changes. However, the free abdominal flap patients were more likely to have undergone delayed breast reconstruction and radiation therapy, potentially leading to large breast skin paddles and secondary skin changes, respectively, which may produce a less aesthetically pleasing result. Additionally, the pedicled TRAM flap patients were less likely to be obese compared with the free abdominal flap patients, although recent reports have similar rates of patient satisfaction with breast reconstruction among obese and nonobese patients. Regardless, it should be noted that multivariate linear regression analysis (Table 5), which adjusted for timing of reconstruction (immediate vs delayed), radiation therapy, and obesity, found that the unilateral pedicled TRAM flap patients had a statistically significant greater level of Satisfaction with Breasts compared with the unilateral free abdominal flap patients.

Comparing these 2 sets of scores [<3 years postoperation (Table 3) and ≥3 years postoperation (Table 4)], there is a general trend in which the scores of the pedicled TRAM flap cohort decrease over time (Table 6), including in Satisfaction with Breasts (~3.8), Satisfaction with Outcome (~6.3), and Physical Well-being Abdomen (~1.5) (exception: Physical Well-being Chest). Conversely, the scores of the free abdominal flap cohort increase over time, including in Satisfaction with Breasts (+2.5), Satisfaction with Outcome (+8.2), Physical Well-being Chest (+5.2), and Physical Well-being Abdomen (+9.0). Given these 2 opposing trends, in which patient satisfaction with pedicled TRAM flap reconstruction decreased over time and satisfaction with free abdominal flap reconstruction increased over time, future studies should be conducted that follow patients for even longer follow-up time periods, as one might find that free abdominal flap patients in fact reach a statistically significant greater level of satisfaction with their breast reconstruction compared with their pedicled TRAM flap counterparts.

Since its publication in 2009, the BREAST-Q has been used to measure patient satisfaction following postmastectomy breast reconstruction in numerous studies. One of the most significant and relevant findings has been that patients are generally happier and more satisfied with autologous reconstruction than they are with alloplastic implant–based reconstruction, especially when satisfaction is measured over time. Another BREAST-Q study conducted by Hu et al also found that patients undergoing TRAM reconstruction have much greater aesthetic satisfaction than patients undergoing alloplastic reconstruction, especially when measured in the long term. Therefore, it is not surprising that despite differences seen between pedicled TRAM flap and free abdominal flap patients in this study, ultimately

| Table 5. Multivariate Regression Analysis: Satisfaction with Breasts |
|---------------------------------------------------------------|
|                                                                 |
| Change in Score (β) | SE  | 95% CI        | P  |
| Flap type (reference, pedicled)   | −14.2 | 5.3 | −24.7, −3.7 | <0.01* |
| Site (reference, Vancouver)       | −9.2  | 6.1 | −21.3, 3.0  | 0.14   |
| Time from reconstruction to BREAST-Q completion                | 1.4   | 1.1 | −0.8, 3.5   | 0.20   |
| Obese (reference, yes)           | 2.1   | 3.9 | −5.7, 9.9   | 0.59   |
| Timing of reconstruction (reference, immediate)                 | −6.3  | 3.9 | −14.1, 1.5  | 0.11   |
| Radiation therapy (reference, none)                              | 4.9   | 3.8 | −2.7, 12.5  | 0.20   |
| *P value is statistically significant (<0.05). CI, confidence interval. |
both groups demonstrated high levels of satisfaction with the results of the reconstruction, as autologous reconstruction has consistently been shown to produce superior PRO results.

A potential limitation of this study is patient site, as the majority of the pedicled TRAM flap cohort originated from Western Canada, whereas the entire free abdominal flap cohort originated from New York City. Although multivariate linear regression analysis (Table 5) found that site was not an independent predictor of patient satisfaction with breasts (reference Vancouver, −9.2; \( P = 0.14 \)), regional variation cannot be completely ruled out as a partial explanation for the results seen in this study, as it is possible that perhaps, in general, Western Canadians may be more likely to rate their outcomes higher than New Yorkers.

The size of this study’s patient population is also potentially a limitation. This may especially be relevant in terms of comparing abdominal well-being between the 2 cohorts of patients. For example, among patients at ≥3 years postoperation at the time of BREAST-Q completion, the unilateral free abdominal flap patients scored higher in Abdominal Well-being compared with the unilateral pedicled TRAM flap patients (78.3 vs 73.2). However, the \( P \) value was not statistically significant (\( P = 0.35 \)), possibly due to the small size of free abdominal flap patients compared with pedicled TRAM flap patients (22 vs 59). It is likely that with a greater number of patients, this difference might have been statistically significant. Therefore, future studies should be conducted with larger cohorts of patients as it may demonstrate statistically significant differences in abdominal morbidity between the different methods of unilateral autologous abdominal tissue–based reconstruction.

Based on the findings in this study, patients report high breast satisfaction with both unilateral pedicled TRAM flap and free abdominal flap breast reconstruction, and as a result, surgeons should feel comfortable offering both methods of reconstruction to their patients.

### CONCLUSIONS

Decision making in breast reconstruction can be difficult as patients are often offered many options, including pedicled TRAM flap and free abdominal flap reconstruction. In this study, patients who underwent unilateral pedicled pedicled flap reconstruction had greater initial satisfaction compared with those who underwent unilateral free abdominal flap reconstruction, although this satisfaction equalized between the 2 over time. The results of this study demonstrate that patients may be equally satisfied with either method of reconstruction. These findings can be used to facilitate clinical and patient decision making in the setting of autologous breast reconstruction.

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