

# 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  $\geq 3$  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. (*Plast Reconstr Surg Glob Open* 2015;3:e482; doi: 10.1097/GOX.0000000000000458; Published online 19 August 2015.)

**T**he beneficial effects of breast reconstruction on quality of life and psychosocial well-being are well documented. A variety of studies have

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shown that women who undergo reconstruction following mastectomy demonstrate improvements in self-image, sexuality, and decreased rates of depression.<sup>1–6</sup> 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.<sup>7–9</sup> 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,<sup>10</sup> 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.<sup>11</sup> 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,<sup>12,13</sup> the pedicled TRAM flap,<sup>10</sup> the deep inferior epigastric perforator (DIEP) flap,<sup>14–16</sup> and the superficial inferior epigastric artery flap.<sup>17,18</sup>

A large number of studies have examined aesthetic and functional outcomes among different variants of the TRAM flap.<sup>12,13,19–33</sup> 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 abdominal flap breast reconstructions performed in the United States is still performed as pedicled TRAM flaps despite the fact that the pedicled TRAM flap requires harvest and transfer of the entire muscle, while the MS-TRAM and DIEP flaps do not, which potentially results in less abdominal morbidity.<sup>20,34–37</sup>

Patient-reported data can be used by clinicians and patients to make informed decisions when selecting the method of breast reconstruction to perform following mastectomy. Therefore, the purpose of this study was to evaluate and compare patient-reported satisfaction and quality of life outcomes between 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.<sup>38–40</sup>

## 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.<sup>38</sup> 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-

**Disclosure:** The BREAST-Q® is owned by Memorial Sloan Kettering Cancer Center and the University of British Columbia. Dr. Pusic is a codeveloper of the BREAST-Q® and, as such, receives a share of any license revenues based on the inventor sharing policies of these 2 institutions. Neither of the other authors has any financial disclosures. The Article Processing Charge was paid for by the authors.

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 ( $P = 0.047$ ), 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 $\geq 3$ 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  $\geq 3$  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  $\geq 3$  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

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

	Unilateral Pedicled TRAM Flap	Unilateral Free Abdominal Flap	<i>P</i>
<i>N</i> (%)	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	4.0 (1.6)	2.9 (1.9)	<0.01*
Obese (BMI $\geq 30$ ), %			
Yes	15 (17.9)	19 (35.2)	0.02*
No	68 (81.0)	34 (63.0)	
Missing	1 (1.2)	1 (1.9)	
Race, %			
Nonwhite	13 (15.5)	12 (22.2)	0.35
White	69 (82.1)	42 (77.8)	
Missing	2 (2.4)	—	
Previous breast reconstruction, %			
None	65 (77.4)	40 (74.1)	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	53 (63.1)	20 (37.0)	<0.01*
Yes	30 (35.7)	33 (61.1)	
Prereconstruction	23 (76.7)	19 (57.6)	0.05
Postreconstruction	3 (10.0)	12 (36.4)	
Postmastectomy 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)	21 (38.9)	<0.01*
Yes	22 (26.2)	32 (59.3)	
Prereconstruction	18 (81.8)	22 (68.8)	0.53
Postreconstruction	1 (4.5)	5 (15.6)	
Postmastectomy 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.

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.

**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.

## 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

**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.

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.<sup>41-44</sup> 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.<sup>12,22,45</sup> 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.<sup>46</sup> 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. However, as the pedicled TRAM flap cohort had approximately 1-year longer follow-up time from breast reconstruction to BREAST-Q completion, 2 secondary analyses were conducted stratifying for postoperative time, the first of which included only patients



**Table 5. Multivariate Regression Analysis: Satisfaction with Breasts**

	Satisfaction with Breasts			
	Change in Score ( $\beta$ )	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

\*Pvalue is statistically significant (<0.05).

CI, confidence interval.

at <3 years postoperation at the time of BREAST-Q completion, and the second included only patients who were at  $\geq 3$  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.<sup>47,48</sup> Regardless, it should be noted that multivariate linear regression analysis (Table 5), which adjusted for timing of reconstruc-

tion (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  $\geq 3$  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.<sup>49,50</sup> Another BREAST-Q study conducted by Hu et al<sup>7</sup> 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 6. BREAST-Q Scores: Trends Over Time**

BREAST-Q Scale	<3 Years	≥3 Years	Δ	P
Satisfaction with Breasts				
Unilateral pedicled TRAM flap	72.6	68.8	−3.8	0.43
Unilateral free abdominal flap	61.1	63.6	+2.5	0.59
Satisfaction with Outcome				
Unilateral pedicled TRAM flap	80.8	74.5	−6.3	0.28
Unilateral free abdominal flap	71.6	79.8	+8.2	0.17
Physical Well-Being Chest				
Unilateral pedicled TRAM flap	73.1	76.8	+3.7	0.29
Unilateral free abdominal flap	68.9	74.1	+5.2	0.29
Physical Well-Being Abdomen				
Unilateral pedicled TRAM flap	74.7	73.2	−1.5	0.79
Unilateral free abdominal flap	69.3	78.3	+9.0	0.16

Δ, mean difference.

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 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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## REFERENCES

1. Al-Ghazal SK, Fallowfield L, Blamey RW. Comparison of psychological aspects and patient satisfaction following breast conserving surgery, simple mastectomy and breast reconstruction. *Eur J Cancer* 2000;36:1938–1943.
2. Dean C, Chetty U, Forrest AP. Effects of immediate breast reconstruction on psychosocial morbidity after mastectomy. *Lancet* 1983;1:459–462.
3. Elder EE, Brandberg Y, Björklund T, et al. Quality of life and patient satisfaction in breast cancer patients after immediate breast reconstruction: a prospective study. *Breast* 2005;14:201–208.
4. Rowland JH, Holland JC, Chaglassian T, et al. Psychological response to breast reconstruction. Expectations for and impact on postmastectomy functioning. *Psychosomatics* 1993;34:241–250.

5. Andrade WN, Baxter N, Semple JL. Clinical determinants of patient satisfaction with breast reconstruction. *Plast Reconstr Surg*. 2001;107:46–54.
6. Eltahir Y, Werners LL, Dreise MM, et al. Quality-of-life outcomes between mastectomy alone and breast reconstruction: comparison of patient-reported BREAST-Q and other health-related quality-of-life measures. *Plast Reconstr Surg*. 2013;132:201e–209e.
7. Hu ES, Pusic AL, Waljee JF, et al. Patient-reported aesthetic satisfaction with breast reconstruction during the long-term survivorship Period. *Plast Reconstr Surg*. 2009;124:1–8.
8. Saulis AS, Mustoe TA, Fine NA. A retrospective analysis of patient satisfaction with immediate postmastectomy breast reconstruction: comparison of three common procedures. *Plast Reconstr Surg*. 2007;119:1669–1676; discussion 1677–1678.
9. Yueh JH, Slavin SA, Adesiyun T, et al. Patient satisfaction in postmastectomy breast reconstruction: a comparative evaluation of DIEP, TRAM, latissimus flap, and implant techniques. *Plast Reconstr Surg*. 2010;125:1585–1595.
10. Hartrampf CR, Schefflan M, Black PW. Breast reconstruction with a transverse abdominal island flap. *Plast Reconstr Surg*. 1982;69:216–225.
11. Wild D, Eremenco S, Mear I, et al. Multinational trials—recommendations on the translations required, approaches to using the same language in different countries, and the approaches to support pooling the data: the ISPOR Patient-Reported Outcomes Translation and Linguistic Validation Good Research Practices Task Force report. *Value Health* 2009;12:430–440.
12. Nahabedian MY, Dooley W, Singh N, et al. Contour abnormalities of the abdomen after breast reconstruction with abdominal flaps: the role of muscle preservation. *Plast Reconstr Surg*. 2002;109:91–101.
13. Nahabedian MY, Momen B, Galdino G, et al. Breast reconstruction with the free TRAM or DIEP flap: patient selection, choice of flap, and outcome. *Plast Reconstr Surg*. 2002;110:466–475; discussion 476–477.
14. Allen RJ, Treece P. Deep inferior epigastric perforator flap for breast reconstruction. *Ann Plast Surg*. 1994;32:32–38.
15. Blondeel PN, Boeckx WD. Refinements in free flap breast reconstruction: the free bilateral deep inferior epigastric perforator flap anastomosed to the internal mammary artery. *Br J Plast Surg*. 1994;47:495–501.
16. Koshima I, Soeda S. Inferior epigastric artery skin flaps without rectus abdominis muscle. *Br J Plast Surg*. 1989;42:645–648.
17. Grotting JC. The free abdominoplasty flap for immediate breast reconstruction. *Ann Plast Surg*. 1991;27:351–354.
18. Allen R. The superficial inferior epigastric artery free flap: an anatomic and clinical study for the use in reconstruction of the breast. Paper Presented at the 33rd Annual Meeting of the Southeastern Society of Plastic Surgeons. June 3, 1990, Kiawah Island, South Carolina, USA.
19. Selber JC, Fosnot J, Nelson J, et al. A prospective study comparing the functional impact of SIEA, DIEP, and muscle-sparing free TRAM flaps on the abdominal wall: Part II. Bilateral reconstruction. *Plast Reconstr Surg*. 2010;126:1438–1453.
20. Selber JC, Nelson J, Fosnot J, et al. A prospective study comparing the functional impact of SIEA, DIEP, and muscle-sparing free TRAM flaps on the abdominal wall: part I. Unilateral reconstruction. *Plast Reconstr Surg*. 2010;126:1142–1153.
21. Bajaj AK, Chevray PM, Chang DW. Comparison of donor-site complications and functional outcomes in free muscle-sparing TRAM flap and free DIEP flap breast reconstruction. *Plast Reconstr Surg*. 2006;117:737–746; discussion 747.
22. Blondeel N, Vanderstraeten GG, Monstrey SJ, et al. The donor site morbidity of free DIEP flaps and free TRAM flaps for breast reconstruction. *Br J Plast Surg*. 1997;50:322–330.
23. Bottero L, Lefaucheur JP, Fadhul S, et al. Electromyographic assessment of rectus abdominis muscle function after deep inferior epigastric perforator flap surgery. *Plast Reconstr Surg*. 2004;113:156–161.
24. Edsander-Nord A, Jurell G, Wickman M. Donor-site morbidity after pedicled or free TRAM flap surgery: a prospective and objective study. *Plast Reconstr Surg*. 1998;102:1508–1516.
25. Futter CM, Webster MH, Hagen S, et al. A retrospective comparison of abdominal muscle strength following breast reconstruction with a free TRAM or DIEP flap. *Br J Plast Surg*. 2000;53:578–583.
26. Kind GM, Rademaker AW, Mustoe TA. Abdominal-wall recovery following TRAM flap: a functional outcome study. *Plast Reconstr Surg*. 1997;99:417–428.
27. Nahabedian MY, Tsangaris T, Momen B. Breast reconstruction with the DIEP flap or the muscle-sparing (MS-2) free TRAM flap: is there a difference? *Plast Reconstr Surg*. 2005;115:436–444; discussion 445–446.
28. Schaverien MV, Perks AG, McCulley SJ. Comparison of outcomes and donor-site morbidity in unilateral free TRAM versus DIEP flap breast reconstruction. *J Plast Reconstr Aesthet Surg*. 2007;60:1219–1224.
29. Selber JC, Samra F, Bristol M, et al. A head-to-head comparison between the muscle-sparing free TRAM and the SIEA flaps: is the rate of flap loss worth the gain in abdominal wall function? *Plast Reconstr Surg*. 2008;122:348–355.
30. Suominen S, Asko-Seljavaara S, Kinnunen J, et al. Abdominal wall competence after free transverse rectus abdominis musculocutaneous flap harvest: a prospective study. *Ann Plast Surg*. 1997;39:229–234.
31. Wu LC, Bajaj A, Chang DW, et al. Comparison of donor-site morbidity of SIEA, DIEP, and muscle-sparing TRAM flaps for breast reconstruction. *Plast Reconstr Surg*. 2008;122:702–709.
32. Alderman AK, Kuzon WM Jr, Wilkins EG. A two-year prospective analysis of trunk function in TRAM breast reconstructions. *Plast Reconstr Surg*. 2006;117:2131–2138.
33. Man LX, Selber JC, Serletti JM. Abdominal wall following free TRAM or DIEP flap reconstruction: a meta-analysis and critical review. *Plast Reconstr Surg*. 2009;124:752–764.
34. Lejour M, Dome M. Abdominal wall function after rectus abdominis transfer. *Plast Reconstr Surg*. 1991;87:1054–1068.
35. Mizgala CL, Hartrampf CR Jr, Bennett GK. Assessment of the abdominal wall after pedicled TRAM flap surgery: 5- to 7-year follow-up of 150 consecutive patients. *Plast Reconstr Surg*. 1994;93:988–1002; discussion 1003–1004.
36. Petit JY, Rietjens M, Ferreira MA, et al. Abdominal sequelae after pedicled TRAM flap breast reconstruction. *Plast Reconstr Surg*. 1997;99:723–729.
37. Kroll SS, Marchi M. Comparison of strategies for preventing abdominal-wall weakness after TRAM flap breast reconstruction. *Plast Reconstr Surg*. 1992;89:1045–1051; discussion 1052–1053.
38. Pusic AL, Klassen AF, Scott AM, et al. Development of a new patient-reported outcome measure for breast surgery: the BREAST-Q. *Plast Reconstr Surg*. 2009;124:345–353.
39. Cano SJ, Klassen AF, Scott AM, et al. The BREAST-Q: further validation in independent clinical samples. *Plast Reconstr Surg*. 2012;129:293–302.

40. Cano SJ, Klassen AF, Scott AM, et al. A closer look at the BREAST-Q(®). *Clin Plast Surg*. 2013;40:287–296.
41. Clough KB, O'Donoghue JM, Fitoussi AD, et al. Prospective evaluation of late cosmetic results following breast reconstruction: II. TrAM flap reconstruction. *Plast Reconstr Surg*. 2001;107:1710–1716.
42. Kroll SS, Baldwin B. A comparison of outcomes using three different methods of breast reconstruction. *Plast Reconstr Surg*. 1992;90:455–462.
43. Kroll SS, Coffey JA Jr, Winn RJ, et al. A comparison of factors affecting aesthetic outcomes of TRAM flap breast reconstructions. *Plast Reconstr Surg*. 1995;96:860–864.
44. Cederna PS, Yates WR, Chang P, et al. Postmastectomy reconstruction: comparative analysis of the psychosocial, functional, and cosmetic effects of transverse rectus abdominis musculocutaneous flap versus breast implant reconstruction. *Ann Plast Surg*. 1995;35:458–468.
45. Garvey PB, Buchel EW, Pockaj BA, et al. DIEP and pedicled TRAM flaps: a comparison of outcomes. *Plast Reconstr Surg*. 2006;117:1711–1719; discussion 1720–1721.
46. Israeli R, Funk S, Reaven NL. Comparative analysis of 18-month outcomes and costs of breast reconstruction flap procedures. *Plast Reconstr Surg*. 2014;133:471–479.
47. Atisha DM, Alderman AK, Kuhn LE, et al. The impact of obesity on patient satisfaction with breast reconstruction. *Plast Reconstr Surg*. 2008;121:1893–1899.
48. Kulkarni AR, Katz S, Hamilton AS, et al. Patterns of use and patient satisfaction with breast reconstruction among obese patients: results from a population-based study. *Plast Reconstr Surg*. 2012;130:263–270.
49. Eltahir Y, Werners LL, Dreise MM, et al. Which breast is the best? Successful autologous or alloplastic breast reconstruction: patient-reported quality-of-life outcomes. *Plast Reconstr Surg*. 2015;135:43–50.
50. Liu C, Zhuang Y, Momeni A, et al. Quality of life and patient satisfaction after microsurgical abdominal flap versus staged expander/implant breast reconstruction: a critical study of unilateral immediate breast reconstruction using patient-reported outcomes instrument BREAST-Q. *Breast Cancer Res Treat*. 2014;146:117–126.