Patient-Reported Satisfaction and Quality of Life following Breast Reconstruction in Thin Patients: A Comparison between Microsurgical and Prosthetic Implant Recipients

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Background: Patients undergoing autologous breast reconstruction have higher long-term satisfaction rates compared with those undergoing prosthetic reconstruction. Regardless, most patients still undergo prosthetic reconstruction. The authors compared outcomes of microsurgical reconstruction to those of prosthetic reconstruction in thin patients and evaluated the effect of reconstructive type on quality of life.

Methods: After institutional review board approval was obtained, the authors reviewed all patients undergoing breast reconstruction at a single institution from November of 2007 to May of 2012. Thin patients (body mass index <22 kg/m^2) were included for analysis and divided into two cohorts: microsurgical reconstruction and tissue expander/implant reconstruction. Once identified, patients were mailed a BREAST-Q survey for response; a retrospective chart review was also conducted.

Results: A total of 273 patients met inclusion criteria: 81.7 percent (n = 223) underwent tissue expander/implant reconstruction and 18.3 percent (n = 50) underwent microsurgical reconstruction. Of the patients undergoing microsurgical reconstruction, 50 percent (n = 25) responded to the BREAST-Q survey, whereas 48.4 percent of patients (n = 108) with implant reconstruction were responders. Microsurgical patients required more secondary revision [48 percent (n = 12) versus 25.9 percent (n = 28)] and autologous fat grafting [32 percent (n = 8) versus 16.9 percent (n = 19)] and a greater volume of fat per injection (147.85 ml versus 63.9 ml; $p < 0.001$). Furthermore, BREAST-Q responses showed that these patients were more satisfied with their breasts (71.1 percent versus 64.9 percent; $p = 0.004$), but had similar overall satisfaction with reconstruction (73.0 percent versus 74.8 percent; $p = 0.54$).

Conclusions: Microsurgical breast reconstruction is efficacious in patients with a body mass index less than 22 kg/m^2 and, when compared with prosthetic reconstruction, results in higher satisfaction with breasts. However, it requires more secondary revision surgery and the use of autologous fat grafting as an adjunct. (*Plast. Reconstr. Surg.* 136: 213, 2015.)

CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, III.

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Breast reconstruction after mastectomy has significant benefits for patient quality of life, self-esteem, and sexuality.[1,2] Patients undergoing autologous breast reconstruction have higher overall long-term satisfaction and quality of life compared with patients who undergo implant-based reconstruction.[1–5] Despite this fact, nationally, implant-based breast reconstruction continues

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to rise as much as 11 percent per year, whereas microsurgical breast reconstruction remains stable over time.[6–10] Some theories to account for these trends include increasing bilateral reconstructions, economic factors, and challenges associated with performing autologous reconstruction on thin patients with limited donor sites.

Currently, the most common types of microsurgical breast reconstruction are abdominally based. These include transverse rectus abdominis myocutaneous (TRAM), muscle-sparing TRAM, superficial inferior epigastric artery, and deep inferior epigastric perforator (DIEP) flaps.[11–14] Recently, alternate donor-site flaps such as the profunda artery perforator, transverse upper gracilis flap, superior gluteal artery perforator, inferior gluteal artery perforator, and lateral femoral cutaneous circumflex artery perforator flaps have been described with excellent results.[15–19] In addition, increased use of autologous fat grafting in conjunction with microsurgical breast reconstruction has been demonstrated to both augment the reconstruction and address contour irregularities.[20] Given advances, microsurgical reconstruction may now be indicated for patients who historically were not considered candidates because of limited donor sites.[16–19,21,22]

The World Health Organization uses body mass index to classify adults based on an index between height and weight, and a normal body mass index is between 18.5 and 24.9 kg/m^2. Outcomes of thin patients with a low-normal body mass index, as defined by body mass index between 18.5 and 22 kg/m^2, undergoing microsurgical breast reconstruction have yet to be delineated.[23–25] These thin women pose unique challenges in microsurgical breast reconstruction. First, the abdomen is often limited as a donor site, especially in nulliparous women. Second, reconstructing large-breasted women in this cohort proves difficult, particularly in patients requiring bilateral reconstruction. Finally, although breast weight and flap weight can likely be matched, an attempt at increasing breast volume from baseline with free flaps alone is often not possible.

Despite these challenges, based on clinical observations, we hypothesized that thin patients undergoing microsurgical breast reconstruction would display greater satisfaction than patients undergoing implant-based reconstruction. To prove this hypothesis, we used the BREAST-Q, a validated patient-reported outcome and quality-of-life measure, to compare patient-reported outcomes of microsurgical breast reconstruction to those of implant-based breast reconstruction.[26]

PATIENTS AND METHODS

After institutional review board approval was obtained (S# 12-03035), a retrospective review of all patients undergoing breast reconstruction at a single institution between November of 2007 and May of 2012 was conducted. Patients were included for analysis if they had a preoperative body mass index of less than or equal to 22 kg/m^2, reconstruction using either microvascular free flap or tissue expander/implant reconstruction, and follow-up of at least 6 months. Patients were excluded from analysis if they had a preoperative body mass index of greater than 22 kg/m^2; if they were without documented body mass index; lacked 6 months' follow-up; or had a reconstruction with one-stage direct-to-implant reconstruction, pedicled flaps alone, or a combination of pedicled flaps and implants. Patients were then divided into two cohorts: those undergoing microsurgical reconstruction and those undergoing tissue expander/implant reconstruction.

Once patients were identified, the following demographic information was compiled: patient age, race, laterality of reconstruction (unilateral versus bilateral), history of neoadjuvant/adjuvant chemotherapy and radiation therapy, timing of reconstruction (immediate versus delayed), incidence of nipple-areola–sparing mastectomy, indication for surgery (cancer versus prophylaxis), need for lymph node dissection (sentinel lymph node biopsy versus axillary lymph node dissection), stage of breast cancer, smoking history, and medical comorbidities. Complications were also evaluated and included seroma formation, mastectomy skin flap necrosis, infection (major and minor), reconstructive failure, and need for reoperations. In patients with microsurgical reconstructions, information regarding incidence of arterial thrombosis, venous thrombosis, fat necrosis, and abdominal morbidity was collected. Also, secondary and tertiary revision operations including implant exchange and need for autologous fat grafting were analyzed. Patient-reported data collected from the BREAST-Q questionnaire included marital status, income, and level of education.

Breast reconstruction was performed by using either two-stage tissue expander–to-implant reconstruction or microsurgical free flap reconstruction. Patients undergoing both delayed and immediate reconstruction were included for analysis, and in patients undergoing tissue expander/implant reconstruction, AlloDerm (LifeCell Corp., Branchburg, N.J.) may have been used. Overall, five breast surgeons provided mastectomies for both implant and microsurgical breast reconstructions. In patients undergoing radiation therapy, all tissue expanders were irradiated after maximum rapid expansion was reached. Exchange of tissue expander for permanent implants was accomplished at least 6 months after radiation therapy, and delayed primary microsurgical reconstruction was performed at least 1 year after irradiation.

Using a cross-sectional study design, after patients were identified, they were sent an introduction letter, the BREAST-Q questionnaire, a self-addressed envelope with postage in place, a refusal card, and a $5 Starbucks gift card. After 3 weeks, patients were sent a reminder postcard. One additional packet was sent to the patients who had not responded 3 months after the initial mail-out.

The BREAST-Q questionnaire is a validated instrument developed at Memorial Sloan Kettering Cancer Center and the University of British Columbia that measures patient satisfaction and health-related quality of life following different breast surgical procedures.[27] We used the breast reconstruction module in this study, which incorporates seven scales: satisfaction with overall outcome, satisfaction with breasts, physical well-being, sexual well-being, psychosocial well-being, and satisfaction with care (information and surgeon). The questionnaire is scored using Q-Score software, which was developed using the Rasch model and results in a score on a scale of 0 to 100, with higher numbers equating with greater satisfaction.

Baseline patient characteristics were compared between the two cohorts: implant reconstructions and microsurgical breast reconstructions. Continuous variables were compared using *t* test and categorical variables were assessed using Fisher's exact test or Pearson chi-square test based on sample size. The mean BREAST-Q scores calculated using the Q-Score software (0 to 100) were also compared using *t* tests. An alpha value of 0.05 was set to denote statistical significance. Statistical analysis was performed using GraphPad software (GraphPad Software, Inc., La Jolla, Calif.).

RESULTS

During the study period, a total of 273 patients met the inclusion criteria. Fifty patients (18.3 percent) underwent 81 microsurgical breast reconstructions and 223 patients (81.7 percent) underwent 348 tissue expander/implant reconstructions. Of the patients undergoing microsurgical reconstruction, 50 percent ($n = 25$) responded to the BREAST-Q survey, whereas 48.4 percent of patients ($n = 108$) with implant reconstruction were responders. The overall response rate for the survey was 49.2 percent, and retrospective chart review was conducted on all 140 nonresponders. Patients undergoing microsurgical breast reconstruction had a mean time from initial reconstructive surgery to survey of 31.5 months (range, 7.4 to 61.6 months), and patients undergoing tissue expander/implant reconstruction had a similar average time from surgery to survey of 28.6 months (range, 7.3 to 61.2 months) ($p = 0.3902$).

When comparing patients undergoing microsurgical breast reconstruction to patients undergoing implant reconstruction, patients were similar in average age, incidence of bilateral and unilateral reconstructions, indication for surgery, and smoking status (Table 1). However, patients undergoing implant reconstruction were more likely to undergo immediate reconstruction [100 percent ($n = 348$)] compared with microsurgical reconstruction [74.1 percent ($n = 60$)] ($p = 0.001$). Conversely, microsurgical reconstructions were more likely to be performed in a delayed fashion. In addition, patients undergoing implant reconstruction had a slightly smaller body mass index at 20.22 ± 1.4 kg/m^2, compared with 21.2 ± 1.4 kg/m^2 ($p = 0.0033$). Patients undergoing implant reconstruction were more likely to have income greater than $100,000, with 58.3 percent of patients ($n = 63$) compared with 12 percent ($n = 3$) in the microsurgical group.

Patients undergoing microsurgical breast reconstruction were most likely to have DIEP flap reconstruction [53.1 percent ($n = 43$)], followed by profunda artery perforator [17.3 percent ($n = 14$)], muscle-sparing TRAM [14.8 percent ($n = 12$)], transverse upper gracilis [9.9 percent ($n = 8$)], superior gluteal artery perforator [3.7 percent ($n = 3$)], and stacked DIEP flaps [1.2 percent ($n = 1$)]. The median flap weight was greater than the median mastectomy weight at 350 g (range, 165 to 1090 g) versus 280 g (range, 128 to 880 g).

When comparing complications in the free flap cohort to the implant cohort, patients had similar incidences of mastectomy skin flap necrosis at 8 percent ($n = 2$) versus 10.1 percent ($n = 11$) ($p = 1.00$). However, patients undergoing implant reconstruction had higher incidences of infectious complications at 12 percent ($n = 13$) versus 0 percent ($n = 0$) ($p = 0.1268$), but this observation failed to reach statistical significance (Table 2).

Patients undergoing autologous free tissue transfers were more likely to undergo secondary revision operations [48 percent ($n = 12$) versus 25.9 percent ($n = 28$)], autologous fat

Table 1. Baseline Demographic and Surgical Characteristics by Procedure Type*

Characteristics	Microsurgical	Implant	*p*
Patients	50	223	N/A
Breasts	81	348	N/A
Laterality			
Unilateral	19 (38)	98 (44.4)	0.53
Bilateral	31 (62)	125 (55.5)	
Timing			
Immediate	60 (74.1)	348 (100)	0.0001
Delayed	21 (25.9)	0 (0)	
Average time to follow-up, mo	25.8 (16.13)	22.87 (16.58)	0.45
Average mastectomy specimen weight, g	317.8 (160.4)	299.4 (159.7)	0.53
Age, yr	47.3 (9.3)	47.6 (9.9)	0.84
Body mass index, kg/m^2	21.2 (1.4)	20.3 (1.4)	0.0001
Mastectomy type			
Skin-sparing	54 (66.7)	249 (71.6)	0.43
Nipple-areolar–sparing	27 (33.3)	99 (28.4)	
Indication			0.02
Prophylactic	40 (49.3)	120 (34.4)	
Therapeutic	41 (49.7)	228 (65.6)	
Chemotherapy			
Neoadjuvant	19 (23.5)	25 (7.1)	0.0001
Adjuvant	6 (7.4)	80 (23.0)	0.0011
Radiation therapy			
Neoadjuvant	15 (18.5)	29 (8.3)	0.0013
Adjuvant	0 (0)	26 (7.4)	0.007
Current smoker	0 (0)	26 (7.4)	0.001
Marital status			
Married	20 (80)	66 (61.1)	0.10
Divorced/widowed/single/separated	5 (20)	42 (38.8)	
Level of education			
High school	0 (0)	1 (0.9)	NS
College	8 (32)	52 (48.1)	0.18
Masters	17 (68)	55 (51.0)	0.18
Income			
<$20,000	0 (0)	4 (3.7)	0.0001
$20,000–$100,00	22 (88)	41 (37.9)	
>$100,000	3 (12)	63 (58.3)	
Employment			
Homemaker	6 (24)	8 (7.4)	0.35
Retired	3 (12)	14 (12.9)	
Full-time	11 (44)	64 (60.1)	
Part-time	5 (20)	18 (16.7)	
Unemployed	0 (0)	2 (1.8)	
Disabled	0 (0)	2 (1.8)	
Ethnicity			
Caucasian	21 (84)	95 (88.9)	0.59
Asian	3 (12)	10 (9.3)	
Hispanic	1 (4)	1 (0.9)	
Black	0 (0)	2 (1.8)	

N/A, not applicable.
*All cell values are expressed as no. (%), except for age, follow-up time, specimen weight, and body mass index, which are expressed as mean (SD).

Table 2. Postoperative Complications by Reconstructive Type*

Complication	Microsurgical ($n = 81$)	Implant ($n = 348$)	*p*
Hematoma	1 (1.2)	1 (0.3)	0.34
Seroma	0 (0)	12 (3.4)	0.13
Infection	0 (0)	35 (10.1)	0.0010
Reconstructive failure	0 (0)	6 (1.7)	0.60
Mastectomy skin flap necrosis	4 (4.9)	29 (8.3)	0.48

*All cell values are expressed as no. (%).

grafting [32 percent ($n = 8$) versus 16.9 percent ($n = 19$)], and a greater volume of autologous fat per injection (147.85 ml versus 63.9 ml) ($p < 0.001$) compared with tissue expander/implant reconstructions. Responders and nonresponders undergoing microsurgical breast reconstruction displayed similar baseline demographics. They also had similar average mastectomy specimen weights and smoking history. However, the incidence of delayed reconstruction was greater in the nonresponder cohort at 44 percent ($n = 11$) compared with 16 percent ($n = 4$) ($p = 0.0622$),

Table 3. BREAST-Q Comparisons

Scale (range, 0–100)	No. Completing	Mean Q-Score	SD	Mean Score Difference	*p*
Satisfaction with breasts					
Microsurgical	25	73.8	19.8		
Prosthetic	108	63.7	15.2	10.1	0.005
Satisfaction with outcome					
Microsurgical	25	76.0	27.1		
Prosthetic	108	73.1	19.1	2.9	0.54
Psychosocial well-being					
Microsurgical	25	82.3	21.6		
Prosthetic	108	74.2	19.1	8.1	0.05
Sexual well-being					
Microsurgical	25	63.8	21.7		
Prosthetic	108	56.7	21.6	7.1	0.15
Physical well-being					
Microsurgical	25	83.6	17.8		
Prosthetic	108	78.8	14.7	4.8	0.20
Satisfaction with information					
Microsurgical	25	75.6	19.5		
Prosthetic	108	69.4	19.3	6.2	0.17
Satisfaction with surgeon					
Microsurgical	25	89.6	20.7		
Prosthetic	108	84.4	20.8	5.2	0.27

but this observation also failed to reach statistical significance. Responders and nonresponders in the implant cohort group had similar baseline characteristics, with no differences in incidence of unilateral and bilateral reconstructions, age at surgery, indications for surgery, or body mass index.

The BREAST-Q scores of the seven subscales for microsurgical reconstruction versus implant reconstruction were compared. Patients in the microsurgical cohort had greater satisfaction with their breasts, showing a mean score of 73.8, compared with prosthetic reconstruction, with a mean score of 63.7 ($p = 0.005$) (100 = highest degree of satisfaction). They also expressed higher psychosocial well-being at 82.3 versus 74.2 ($p = 0.05$). In addition, patients displayed similar overall satisfaction, sexual well-being and physical well-being, satisfaction with information, and satisfaction with surgeon (Table 3).

DISCUSSION

The female breast has been of central importance across countries and cultures since earliest times. Its absence or alteration in size and shape has a significant impact on a woman's perception and function in society, and also her personal well-being and self-esteem. As early as 3000 BC, women used primitive brassieres and corsets to enhance the appearance of their breasts.[28] Although long-term satisfaction is greater with autologous breast reconstruction, national trends show increasing numbers of prosthetic reconstructions, with stable numbers of autologous reconstructions.[7,8,29]

There are several theories to account for this difference in trends. Changing mastectomy patterns have been observed, with increasing incidence of bilateral mastectomy because of increased contralateral prophylactic mastectomy.[30,31] It has also been demonstrated that there are increased costs with microsurgical reconstructions, particularly in low-volume centers, combined with declining reimbursements.[32] Outside of major medical centers, microsurgical breast reconstruction can be challenging and only attempted with the ideal surgical candidate, and patients with low-normal body mass index (18.5 to 22 kg/m^2) are often not considered because of an apparent lack of adequate donor sites. These factors lead to the false perception that implant-based reconstruction is the preferred choice in thin patients.

In this study, we directly compared outcomes of implant-based breast reconstruction to microsurgical breast reconstruction in the unique low-normal body mass index population. Two hundred seventy-three patients met inclusion criteria for the investigation; 50 patients (18.3 percent) underwent microsurgical breast reconstruction and 223 patients (81.7 percent) underwent tissue expander/implant reconstruction. Approximately 50 percent of patients in both cohorts completed the BREAST-Q survey. From this survey, we found that patients in the microsurgical cohort had greater satisfaction with their reconstructed breasts, showing a mean score of 73.8 compared with prosthetic reconstruction, with a mean score of 63.7 ($p = 0.005$). This finding supports previous studies, confirming overall higher long-term patient satisfaction when comparing autologous with implant-based reconstructions.[29] Interestingly, the minimal important difference for the BREAST-Q in the breast augmentation scale has been shown to be between 6 and 10 Q-Score points. Although the minimal important difference for the BREAST-Q breast reconstruction module has not been delineated, here the difference reported is a minimal important difference of nearly 2, which can correlates with a large effect size.[33] Patients undergoing autologous reconstruction also expressed higher psychosocial well-being at 82.3 versus 74.2 ($p = 0.05$) and, although not statistically significant, the difference in Q-Score likely exceeds a minimal important difference of 1.

Interestingly, in this patient population, the abdomen continues to be the most commonly used donor site for microsurgical breast reconstruction at 69.1 percent (n = 56), whereas alternative donor-site flaps were used 30.9 percent (n = 25) of the time. There have been increasing reports in the past 10 years of secondary donor sites, starting with the superior gluteal artery perforator/inferior gluteal artery perforator flaps in the 1990s, transverse upper gracilis flaps in the late 2000s, and profunda artery perforator flaps in 2010.[34] These flaps, although not preferred to the abdomen, have been used in this study and have been shown in several series to provide a valuable alternative for patients who do not have adequate abdominal donor sites.

Other studies have shown similar results with alternative donor-site flaps. For example, Baumeister et al., in their series of superior gluteal artery perforator reconstructions, reported an average body mass index of 22.5 kg/m^2 and lauded it as a safe and reliable flap.[35] The review of 170 superior gluteal artery perforator flaps by Granzow et al. found an average flap weight 124 percent of the average mastectomy weight, proving that adequate tissue can be gained from this location.[36] The transverse upper gracilis flap, which was first described by Yousif in 1992, demonstrated the medial thigh as a donor site. Locke et al. describe an average flap weight of 312 g (range, 167 to 480 g) in their transverse upper gracilis flap series, but did not mention either the mastectomy specimen weight or the body mass index of the patients in their investigation. They did, however, point out a higher need for lipofilling in patients undergoing transverse upper gracilis flaps, likely because of loss of volume over time and persistent contour abnormalities.[37] In our cohort, the average flap weight was 370.8 g for this low-normal body mass index population, which is similar to the mean found by Locke et al. for their cohort of transverse upper gracilis flaps. Similarly, the average body mass index described in patients undergoing profunda artery perforator flap reconstruction as described by Allen et al. was shown to be 23.2 kg/m^2 (range, 18.2 to 27.5 kg/m^2), with a mean flap weight of 385 g (range, 235 to 695 g).[16]

Patients undergoing autologous free tissue transfers were more likely to undergo secondary revision surgery [25.9 percent (n = 28) versus 48 percent (n = 12)] or autologous fat grafting [16.9 percent (n = 19) versus 32 percent (n = 8)], and had a greater volume of autologous fat per injection (147.85 ml versus 63.9 ml) ($p < 0.001$) compared with implant-based reconstruction. This is not surprising, as the obtainable overall flap volume in low–body mass index patients tends to be less than in higher body mass index patients, and because implant volumes can be more readily matched to the desired size, making single-stage reconstruction highly coveted by many surgeons.

Although it is important to note that in our series low–body mass index patients who chose to undergo autologous reconstruction tended to require more additional secondary operations, mostly related to lack of volume and remaining contour irregularities, these additional operations apparently did not influence the long-term overall satisfaction of the patients. Interestingly, though, and contrary to what one might expect given the more extensive surgery and additional surgical sites, complication rates did not increase significantly in the autologous reconstruction group.

In a previous study, we compared breast reconstruction patients with low-normal body mass index (body mass index <22 kg/m^2) to normal weight (body mass index of 22 to 25 kg/m^2) and overweight patients (body mass index >25 kg/m^2), and found that low-normal patients were more likely to be younger (44 years versus 50 years versus 51 years), received alternative donor-site flaps (profunda artery perforator, superior gluteal artery perforator, and transverse upper gracilis), and had a higher ratio of fat graft volume to flap volume (0.42 versus 0.32).[38] This series shows that patients with a very low body mass index may initially not have adequate amounts of flap tissue to entirely reconstruct a breast mound; however, the flaps provide an ideal matrix for future fat grafting with the adjunct of which sufficient volumes may be generated. As such, one may argue that patients that were formerly not considered potential candidates may now be offered autologous reconstruction. Moreover, recent cost-efficiency data revealed microsurgical breast reconstructions to be superior to traditional two-stage tissue expander/implant and direct-to-implant reconstructions.[39]

This investigation had several limitations. First, it was a retrospective review with multiple surgeons, and inherent bias cannot be avoided. In addition, one of the senior authors popularized the use of alternative donor-site flaps with the use of profunda artery perforator, superior gluteal artery perforator, and inferior gluteal artery perforator flaps; therefore, our sample may not be representative of other centers around the country.[16,18,34] Moreover, there was insufficient power to complete subgroup analysis for each type of autologous reconstruction (DIEP, muscle-sparing TRAM, profunda artery perforator, or transverse upper gracilis flap). Furthermore, the overall number of autologous reconstructions compared with implant-based reconstructions was relatively small (n = 50 versus n = 223, respectively). This can influence the power when attempting to determine a difference between the cohorts. In addition, 100 percent of patients undergoing implant-based breast reconstruction underwent immediate reconstruction, whereas only 74.1 percent of microsurgical reconstructions were immediate. This was a possible confounding factor, as 76.6 percent of patients (n = 16) undergoing delayed reconstruction had previous implant reconstructions with either capsular contractures or complications resulting in implant failures. These patients were likely unhappy with their breast preoperatively, and thus the responses to BREAST-Q questions may be significantly different from those of a patient undergoing immediate reconstruction. Moreover, the incidences of neoadjuvant and adjuvant irradiation in both cohorts were statistically different. Patients undergoing microsurgical reconstruction had a greater incidence of neoadjuvant radiation therapy (18.5 percent versus 8.3 percent), and no patients in the microsurgical cohort had adjuvant radiation therapy. Albornoz et al. have shown that patients undergoing implant reconstruction with irradiation have significantly lower satisfaction with breasts compared with nonirradiated patients.[40] The effect of radiation therapy on our cohort is unknown and may falsely lower satisfaction with breasts in the prosthetic cohort. Finally, a 50 percent response rate for this survey study is undoubtedly low. Although characteristics of responders and nonresponders in both groups were analyzed and there were no statistically significant differences, the survey responses may not be a true representation of the entire thin patient population.

Despite these limitations, based on our analysis, both implant-based and microsurgical autologous breast reconstruction appears feasible in low-normal body mass index (thin) patients. BREAST-Q responses showed that patients undergoing autologous free tissue transfer were minimally equally satisfied with their breasts and possibly more satisfied with their breasts, making it an important consideration in preoperative discussion with patients.

CONCLUSIONS

Breast reconstruction patients are increasingly demanding superior aesthetic results. This study demonstrates the feasibility of performing both autologous and implant-based breast reconstruction in thin patients, with few complications overall. Implant-based reconstruction tends to be associated with higher rates of infectious complications, whereas adequate volumes can generally be generated in autologous reconstruction using the abdomen and alternative donor sites. However, low–body mass index patients undergoing autologous reconstruction tend to require more secondary operations, including the adjunct of autologous fat grafting. Ultimately, this study helps to improve patient education during the preoperative period to individualize treatment approaches.

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REFERENCES

1. Alderman AK, Kuhn LE, Lowery JC, Wilkins EG. Does patient satisfaction with breast reconstruction change over time? Two-year results of the Michigan Breast Reconstruction Outcomes Study. *J Am Coll Surg.* 2007;204:7–12.
2. Christensen BO, Overgaard J, Kettner LO, Damsgaard TE. Long-term evaluation of postmastectomy breast reconstruction. *Acta Oncol.* 2011;50:1053–1061.
3. 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.
4. Zhong T, McCarthy C, Min S, et al. Patient satisfaction and health-related quality of life after autologous tissue breast reconstruction: A prospective analysis of early postoperative outcomes. *Cancer* 2012;118:1701–1709.
5. Bodin F, Zink S, Lutz JC, Kadoch V, Wilk A, Bruant-Rodier C. Which breast reconstruction procedure provides the best long-term satisfaction? (in French). *Ann Chir Plast Esthet.* 2010;55:547–552.
6. Gurunluoglu R, Gurunluoglu A, Williams SA, Tebockhorst S. Current trends in breast reconstruction: Survey of American Society of Plastic Surgeons 2010. *Ann Plast Surg.* 2013;70:103–110.
7. Albornoz CR, Bach PB, Pusic AL, et al. The influence of sociodemographic factors and hospital characteristics on the method of breast reconstruction, including microsurgery: A U.S. population-based study. *Plast Reconstr Surg.* 2012;129:1071–1079.
8. Albornoz CR, Bach PB, Mehrara BJ, et al. A paradigm shift in U.S. breast reconstruction: Increasing implant rates. *Plast Reconstr Surg.* 2013;131:15–23.
9. Tanna N, Broer PN, Weichman KE, et al. Microsurgical breast reconstruction for nipple-sparing mastectomy. *Plast Reconstr Surg.* 2013;131:139e–147e.
10. Tanna N, Clayton JL, Roostaeian J, Perry AD, Crisera CA. The volume-outcome relationship for immediate breast reconstruction. *Plast Reconstr Surg.* 2012;129:19–24.
11. Koshima I, Soeda S. Inferior epigastric artery skin flaps without rectus abdominis muscle. *Br J Plast Surg.* 1989;42:645–648.

12. Allen RJ, Treece P. Deep inferior epigastric perforator flap for breast reconstruction. *Ann Plast Surg.* 1994;32:32–38.
13. 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.
14. Grotting JC. The free abdominoplasty flap for immediate breast reconstruction. *Ann Plast Surg.* 1991;27:351–354.
15. Rozen WM, Rajkomar AK, Anavekar NS, Ashton MW. Postmastectomy breast reconstruction: A history in evolution. *Clin Breast Cancer* 2009;9:145–154.
16. Allen RJ, Haddock NT, Ahn CY, Sadeghi A. Breast reconstruction with the profunda artery perforator flap. *Plast Reconstr Surg.* 2012;129:16e–23e.
17. Arnez ZM, Pogorelec D, Planinsek F, Ahcan U. Breast reconstruction by the free transverse gracilis (TUG) flap. *Br J Plast Surg.* 2004;57:20–26.
18. LoTempio MM, Allen RJ. Breast reconstruction with SGAP and IGAP flaps. *Plast Reconstr Surg.* 2010;126:393–401.
19. Kind GM, Foster RD. Breast reconstruction using the lateral femoral circumflex artery perforator flap. *J Reconstr Microsurg.* 2011;27:427–432.
20. Brenelli F, Rietjens M, De Lorenzi F, et al. Oncological safety of autologous fat grafting after breast conservative treatment: A prospective evaluation. *Breast J.* 2014;20:159–165.
21. Losken A, Pinell XA, Sikoro K, Yezhelyev MV, Anderson E, Carlson GW. Autologous fat grafting in secondary breast reconstruction. *Ann Plast Surg.* 2011;66:518–522.
22. Losken A, Pinell XA, Sikoro K, Yezhelyev MV, Anderson E, Carlson GW. Autologous fat grafting in secondary breast reconstruction. *Ann Plast Surg.* 2011;66:518–522.
23. Al-Sarraf N, Raza A, Rowley S, et al. Short-term and long-term outcome in low body mass index patients undergoing cardiac surgery. *Gen Thorac Cardiovasc Surg.* 2009;57:87–93.
24. Okamura Y, Maeda A, Matsunaga K, Kanemoto H, Uesaka K. Negative impact of low body mass index on surgical outcomes after hepatectomy for hepatocellular carcinoma. *J Hepatobiliary Pancreat Sci.* 2012;19:449–457.
25. Skipworth J, Foster J, Raptis D, Hughes F. The effect of preoperative weight loss and body mass index on postoperative outcome in patients with esophagogastric carcinoma. *Dis Esophagus* 2009;22:559–563.
26. Cano SJ, Klassen AF, Scott AM, Cordeiro PG, Pusic AL. The BREAST-Q: Further validation in independent clinical samples. *Plast Reconstr Surg.* 2012;129:293–302.
27. Pusic AL, Klassen AF, Scott AM, Klok JA, Cordeiro PG, Cano SJ. Development of a new patient-reported outcome measure for breast surgery: The BREAST-Q. *Plast Reconstr Surg.* 2009;124:345–353.
28. Pittet B, Montandon D, Pittet D. Infection in breast implants. *Lancet Infect Dis.* 2005;5:94–106.
29. 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.
30. Pinell-White XA, Kolegraff K, Carlson GW. Predictors of contralateral prophylactic mastectomy and the impact on breast reconstruction. *Ann Plast Surg.* 2014;72:S153–S157.
31. Soran A, Kamali Polat A, Johnson R, McGuire KP. Increasing trend of contralateral prophylactic mastectomy: What are the factors behind this phenomenon? *Surgeon* 2014;12:316–322.
32. Albornoz CR, Cordeiro PG, Hishon L, et al. A nationwide analysis of the relationship between hospital volume and outcome for autologous breast reconstruction. *Plast Reconstr Surg.* 2013;132:192e–200e.
33. Cano SJ, Klassen AF, Scott A, Alderman A, Pusic AL. Interpreting clinical differences in BREAST-Q scores: Minimal important difference. *Plast Reconstr Surg.* 2014;134:173e–175e.
34. Healy C, Allen RJ Sr. The evolution of perforator flap breast reconstruction: Twenty years after the first DIEP flap. *J Reconstr Microsurg.* 2014;30:121–125.
35. Baumeister S, Werdin F, Peek A. The sGAP flap: Rare exception or second choice in autologous breast reconstruction? *J Reconstr Microsurg.* 2010;26:251–258.
36. Granzow JW, Levine JL, Chiu ES, Allen RJ. Breast reconstruction with gluteal artery perforator flaps. *J Plast Reconstr Aesthet Surg.* 2006;59:614–621.
37. Locke MB, Zhong T, Mureau MA, Hofer SO. Tug 'O' war: Challenges of transverse upper gracilis (TUG) myocutaneous free flap breast reconstruction. *J Plast Reconstr Aesthet Surg.* 2012;65:1041–1050.
38. Weichman KE, Tanna N, Broer PN, et al. Microsurgical breast reconstruction in thin patients: The impact of low body mass indices. *J Reconstr Microsurg.* 2014;31:20–25.
39. Grover R, Padula WV, Van Vliet M, Ridgway EB. Comparing five alternative methods of breast reconstruction surgery: A cost-effectiveness analysis. *Plast Reconstr Surg.* 2013;132:709e–723e.
40. Albornoz CR, Matros E, McCarthy CM, et al. Implant breast reconstruction and radiation: A multicenter analysis of long-term health-related quality of life and satisfaction. *Ann Surg Oncol.* 2014;21:2159–2164.