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Breast

Destination Design msTRAM: For Greater Reconstructive Certainty

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Background: Performing delayed reconstruction to a unilateral breast while simultaneously performing a balancing procedure on the contralateral side can be the most difficult situation to achieve symmetry. We present here a novel approach to free TRAM-based breast reconstruction using reverse planning and subunit principles with simultaneous balancing reduction mastopexy and immediate nipple reconstruction.
Methods: A retrospective chart review and a BREAST-Q questionnaire of a single surgeon's practice was performed to compare revision rates and patient satisfaction following Destination Design msTRAM reconstruction compared with a historical cohort of patients who received traditional free TRAM reconstruction.
Results: The chart review identified 39 patients treated with the traditional unilateral technique from 1997 to 2004 and 88 patients treated with the novel unilateral technique from 2004 to 2017. Traditional technique patients had a breast revision rate of 64.1% and a nipple revision rate of 42.3% after secondary nipple reconstruction. Destination Design patients had a breast revision rate of 44.3% ($P = 0.0394$) and a nipple revision rate of 37.9% ($P = 0.689$) after primary nipple reconstruction. The BREAST-Q questionnaire was sent to nine traditional technique patients with 8 responses (89%), and 35 Destination Design patients with 25 responses (71%). Survey results showed that traditional technique and Destination Design patients had an overall breast satisfaction rate of 67.5% and 63.9%, respectively.
Conclusions: The Destination Design msTRAM breast reconstruction technique leads to a statistically significant reduction in breast flap revisions, and allows for equally accurate immediate nipple reconstruction compared with traditional methods with no additional complications. Overall patient satisfaction is comparable with both techniques. *(Plast Reconstr Surg Glob Open 2021;9:e3704; doi: 10.1097/GOX.0000000000003704; Published online 28 July 2021.)*

INTRODUCTION

Women have a one in eight lifetime risk of developing breast cancer. Approximately one in five women undergo breast reconstruction after mastectomy and the rate is rising secondary to improved awareness, resources, and access.[1–3] Breast reconstruction after mastectomy offers well-documented benefits regarding body image, quality of life, and patient satisfaction with many reconstructive options available.[4–10]

After mastectomy, implant-based reconstruction is the most common with either a one-stage direct-to-implant technique or a two-stage tissue expander followed by an implant method. Advantages of implant-based reconstruction include the ability to choose future breast size, faster operative times, and a quicker recovery.[11,12] However, autologous reconstruction is also an option for women seeking a more natural, softer reconstruction that ages with time and gravity with the added benefits of improved radiation resistance and no prosthetic-related complications or revisions.[12–14]

With regard to autologous reconstruction, there are several pedicled and free tissue transfer options available with their own advantages and disadvantages.[14–22] Free tissue transfer from the abdomen using either a TRAM or deep

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inferior epigastric perforator (DIEP) flap is considered the gold standard autologous reconstruction.[23] TRAM flaps can be harvested with varying amounts of muscle sparing, whereas DIEP flaps are completely muscle sparing.[15,16,24] Including more muscle improves the vascularity of the flap and maximum area of tissue perfused at the possible expense of more donor site morbidity.[13,25–34] Historically, TRAM flaps have been associated with impaired abdominal strength and increased hernia rates, but more recent evidence suggests that muscle sparing techniques are equivalent to DIEP flaps in terms of abdominal morbidity.[35–40]

When reconstructing breasts following mastectomy, performing immediate reconstruction to bilateral breasts provides the most accurate symmetric results.[41–46] On the other hand, performing delayed reconstruction to a unilateral breast initially treated with a simple or skin-sparing mastectomy while simultaneously performing a balancing reduction/mastopexy on the contralateral side can be the most difficult situation to achieve symmetry.[43,46–49] Traditional techniques involve harvesting a standard sized hemi abdominal flap, completing the anastomosis and then shaping the flap to try and match the contralateral side. Following this, revision rates for breast shape and position are common, therefore requiring additional procedures.[43,46,50] Additionally, nipple reconstruction is typically postponed to a later stage, thereby guaranteeing at least one more procedure.[51–53]

We present here a novel approach to TRAM-based unilateral delayed breast reconstruction using reverse planning and subunit principles with simultaneous balancing reduction mastopexy and immediate nipple reconstruction.[54–56] We hypothesized that this new technique offers consistent results in a single stage with significantly reduced revision rates and no increase in complication rate. Additionally, the technique can be applied to bilateral reconstructions just as easily.

METHODS

Surgical Technique

The contralateral balancing breast reduction or mastopexy is marked in a typical fashion with some additional measurements (Fig. 1). A and B are marked from the new nipple position to the most lateral and medial IMF extent. C and E are the medial and lateral IMF limbs that will remain after the reduction skin excision. X is the distance from the new nipple position to the upper breast border. U is the nipple to IMF distance. Y is the upper breast parenchyma to the clavicle. Z is the sum of X and Y, which is the distance from the nipple to the clavicle. On the contralateral side, W is the distance from the clavicle to the mastectomy scar. These measurements are done preoperatively, confirmed or adjusted after the reduction/mastopexy, and then transposed onto the abdomen relative to the umbilicus as the new nipple position (Fig. 1).

The TRAM flap is then elevated in a typical fashion preserving the medial and lateral muscle as a type 2 muscle sparing dissection. The native umbilicus is left on the abdominal wall. A muscle sparing TRAM is done instead of a DIEP because it has a more reliable blood supply across the midline especially because this flap is being coned and folded. The ipsilateral 11th intercostal nerve and contralateral SIEV are dissected and preserved. Zone 4 will be discarded and zone 2 will be de-epithelialized for placement in the axilla (Fig. 2).

The flap is then coned on itself while still on the abdomen to create the new breast shape. By using the previous measurements, this technique creates a breast with identical measurements to the contralateral side. The circular umbilical incision on the flap is then everted and closed on itself after being packed with cartilage graft that is taken from the internal mammary vessel rib dissection. This allows for immediate nipple reconstruction (Fig. 3).

The opposing tails are de-epithelialized to the extent necessary to match the height of the contralateral breast. The mastectomy scar and inferior skin flap are excised and vessels are prepared in the chest and axilla for anastomosis (Fig. 4).

The flap is then transferred to the chest. First the IMF and breast meridian are aligned. Then the height of the flap is set to match the contralateral parenchyma height and the remainder of the de-epithelialization is completed (Fig. 5). In an immediate reconstruction when there is sufficient native breast skin remaining, the same technique is used for shaping the flap, but in this case, most of the flap is de-epithelialized and placed under the native skin. The vascular anastomoses are then completed. The primary deep inferior epigastrics are connected to either the thoracodorsal or circumflex scapular artery and vein in the axilla. The venous outflow is augmented by connecting the contralateral SIEV to the IMV. The fourth intercostal nerve is neurotized to the 11th intercostal nerve. The abdomen is closed with an inlay mesh if needed. Additional intraoperative photographs are shown in Supplemental Digital Content 1. (**See figure 1, Supplemental Digital Content 1,** which displays intraoperative photographs of the Destination Design msTRAM technique. A, The flap is raised. B, the flap is coned on itself. C, Lateral view of coned flap. D, Flap is de-epithelialized and inset. **http://links.lww.com/PRSGO/B717**.)

Chart Review

After obtaining institutional review board approval from UBC CREB (approval no.: H18-02345), a retrospective chart review was conducted through the records of the principal investigator (J.S.W.) in the Division of Plastic and Reconstructive Surgery at Kelowna General Hospital. All patients who underwent unilateral traditional msTRAM technique reconstruction from 1997 to 2004, and all patients who underwent unilateral reconstruction with the novel Destination Design msTRAM technique from 2004 to 2017 were identified. Data collected included age, comorbidities, adjunctive chemotherapy or radiation treatment, reconstruction details, contralateral procedure details, donor and flap complications, and revision surgeries. SPSS software was used to perform two-tailed proportion z-tests to compare the outcomes and revision rates between the traditional historic reconstruction cohort and the novel Destination Design msTRAM technique patients.

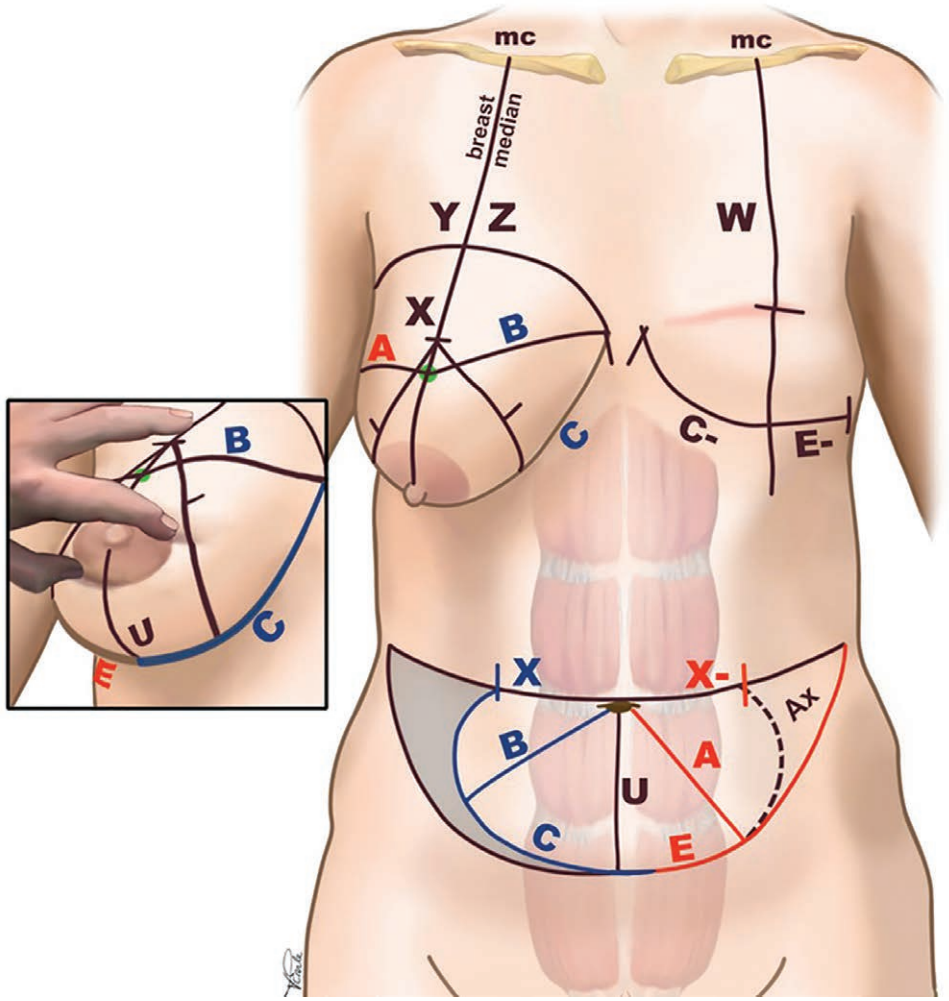

Fig. 1. Destination Design msTRAM markings. See Methods for details.

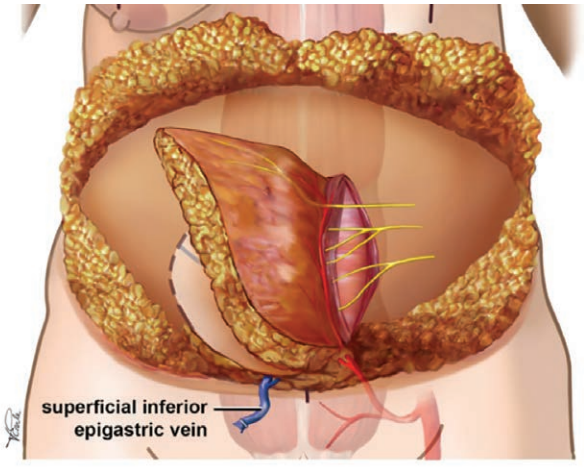

Fig. 2. The Destination Design msTRAM is elevated preserving the medial and lateral muscle as a type 2 muscle sparing dissection. The 11th intercostal nerve and SIEV are dissected and preserved.

Patient Satisfaction Survey

Patients in both cohorts were called on the phone to introduce them to the study and obtain permission to send them an electronically administered BREAST-Q questionnaire by email using the Qualtrics tool. The BREAST-Q is a peer validated reliable questionnaire that surveys patient reported outcome measures about the impact and effectiveness of breast surgery.[57,58] BREAST-Q modules surveyed included the "Satisfaction with Breasts," "Physical Well-Being (chest and abdomen)," "Psychosocial Well-Being," and "Sexual Well-Being" modules. SPSS software was used to perform two-tailed independent samples *t*-tests to compare patient satisfaction between both cohorts.

RESULTS

Case Examples

A 49-year-old woman was treated with a left delayed Destination Design msTRAM and right balancing

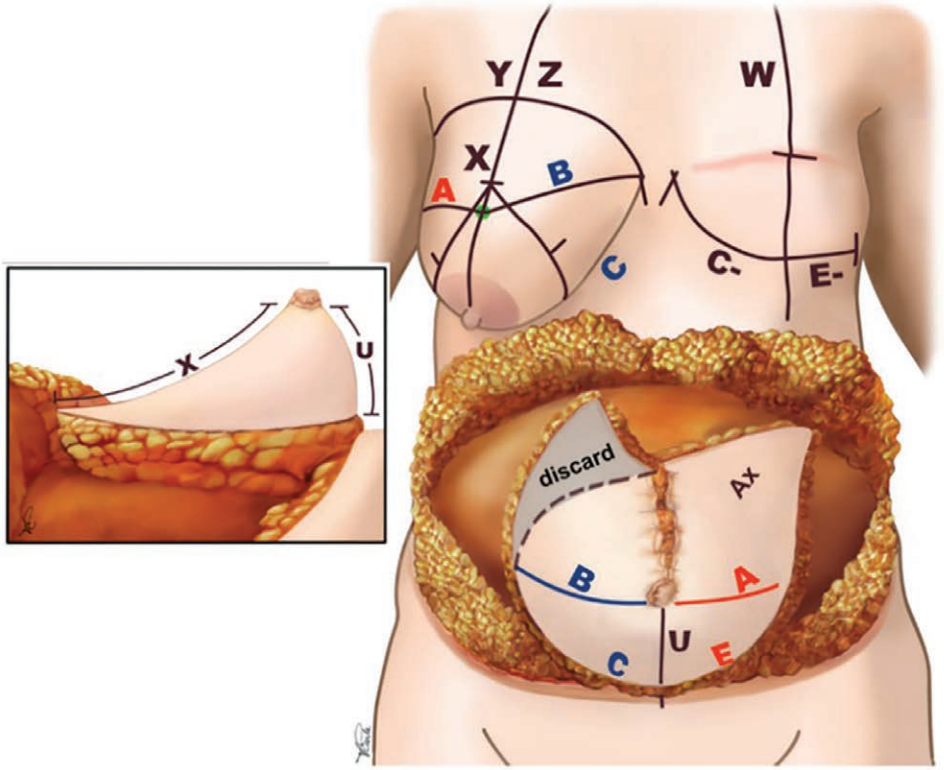

Fig. 3. The Destination Design msTRAM flap is coned on itself while still on the abdomen to create the new breast shape. The umbilical incision is everted and closed on itself after being packed with a cartilage graft that is taken from the IMA rib dissection.

reduction. (**See figure 2, Supplemental Digital Content 2**, which displays a 49-year-old woman treated with a left delayed Destination Design msTRAM and right balancing reduction. **http://links.lww.com/PRSGO/B718**.) A 56-year-old woman was treated with a left delayed Destination Design msTRAM and right balancing reduction. (**See figure 3, Supplemental Digital Content 3**, which displays a 56-year-old woman treated with a left delayed Destination Design msTRAM and right balancing reduction. **http://links.lww.com/PRSGO/B719**.) A 39-year-old woman treated with a left immediate Destination Design msTRAM and no balancing right-sided procedure. (**See figure 4, Supplemental Digital Content 4**, which displays a 39-year-old woman treated with a left immediate Destination Design msTRAM and no balancing right-sided procedure. **http://links.lww.com/PRSGO/B720**.) Patients were satisfied with excellent results in terms of breast symmetry, volume, nipple position, conical projection, and footprint.

Chart Review

The chart review identified 39 patients who were treated with a traditional msTRAM between 1997 and 2004, and 88 patients who received the novel Destination Design msTRAM between 2004 and 2017. The average age of each group was 52 and 56, respectively. There was no significant difference in comorbidities between groups but there were significantly more smokers in the traditional group compared with the Destination Design msTRAM group (43.5% versus 17.0% respectively, $P = 0.0015$). Both groups were equally representative of immediate and delayed reconstructions (Table 1).

There was no significant difference in the incidence of mastectomy skin, donor site, and TRAM flap necrosis in both groups. However, reduced major TRAM flap necrosis in the Destination Design msTRAM group approached significance ($P = 0.0561$) (Table 2). Minor necrosis was defined as necrosis that could be managed conservatively, and major necrosis was defined as necrosis that required operative debridement.

There was a significant reduction in the number of patients that required a flap revision in the novel Destination Design msTRAM group compared with the traditional msTRAM group (44.3% versus 64.1% respectively, $P = 0.0394$) (Table 3). The same results were seen when the delayed reconstruction subgroup was analyzed separately (Table 3). Minor revisions were defined as dog ear and scar revisions done in minor surgery. Major revisions were defined as corrections in volume or position of the breast mound. This included liposuction and excisional revisions. All patients were offered revisions until they were satisfied with the final result of their reconstruction.

In the traditional free msTRAM cohort, data on total number of revisions were available for only 14 of 39 patients. For the other 25 patients in this cohort,

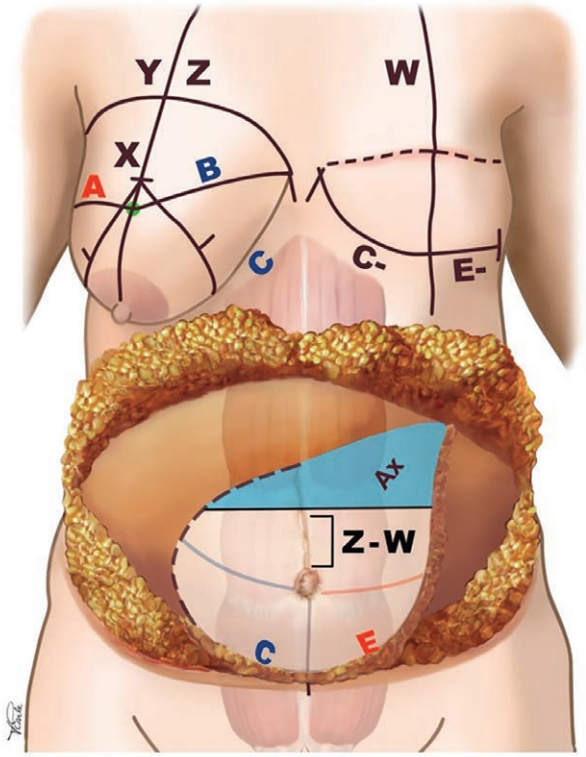

Fig. 4. The Destination Design msTRAM opposing tails are de-epithelialized to the extent necessary to match the height of the contralateral breast.

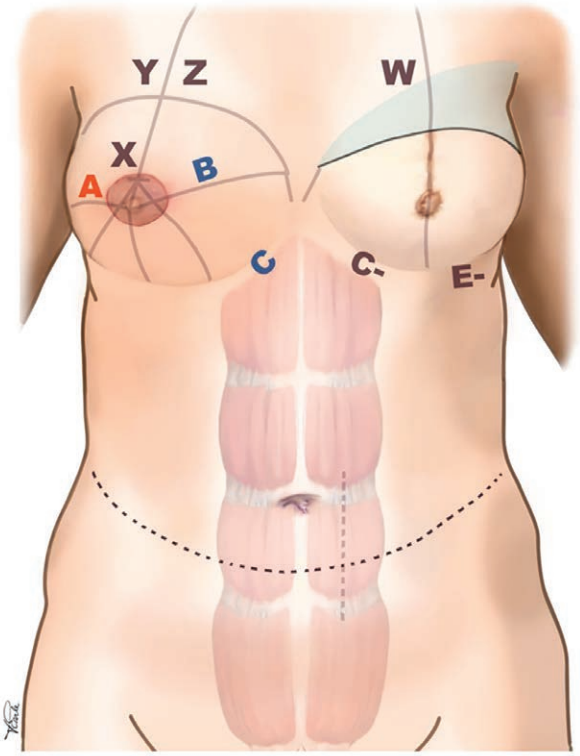

Fig. 5. The flap is then transferred to the chest. First the IMF and breast meridian are aligned. Then the height of the flap is set to match the contralateral parenchyma height and the remainder of the de-epithelialization is completed.

chart documentation could be used to identify whether patients needed a minor or major revision, as shown in Table 3, but not how many minor or major revisions were required. In this smaller subgroup of 14 patients, a total of 16 revisions were performed for an average of 1.14 revisions per patient. In the Destination Design msTRAM cohort of 88 patients, a total of 47 revisions were performed for an average of 0.53 revisions per patient (Table 3). There were significantly less revisions per patient in the Destination Design msTRAM group compared with the traditional free msTRAM group (0.53 versus 1.14, $P = 0.0001$).

Table 1. Demographics of 39 Patients Treated with a Traditional Free msTRAM Technique between 1997 and 2004, and of 88 Patients Treated with the Destination Design msTRAM Technique between 2004 and 2017

	Traditional msTRAM	Destination Design msTRAM	
Total patients	39	88	
Age	34–78 (51.97)	35–71 (56.19)	
Comorbidities	2 (5.1%)	12 (13.6%)	$P = 0.1584$
Smoking	17 (43.5%)	15 (17.0%)	$P = 0.0015$
Reconstruction timing			
Immediate	16 (41.0%)	44 (50.0%)	$P = 0.3524$
Delayed	23 (58.9%)	44 (50.0%)	$P = 0.3503$
Balancing procedure			
None	13 (33.3%)	9 (10.2%)	$P = 0.0015$
Primary	22 (56.4%)	77 (87.5%)	$P = 0.0001$
Secondary	4 (10.3%)	1 (0.12%)	$P = 0.0029$

Next, nipple revision rates were compared in both groups. Nearly all (95.5%) nipple reconstructions in the Destination Design msTRAM group were done primarily at the time of the flap as is described in the surgical technique section. In the traditional free msTRAM cohort, 26 patients (66.7%) received secondary nipple reconstruction and the other 13 patients (33.3%) opted for no nipple reconstruction. When revision rates post reconstruction were compared, there was no significant difference in nipple revision rate in the Destination Design msTRAM group compared with the traditional free msTRAM group, which shows that an immediate nipple reconstruction was equally accurate in terms of nipple size and position (37.9% versus 42.3% respectively, $P = 0.6891$) (Table 4).

BREAST-Q Questionnaire

When attempts were made to contact patients on the phone to introduce them to the research study, a significant number of patients could not be reached because of changes in address and phone number from those present in file. In some cases, patients were deceased. Initial screening phone calls identified 9/39 traditional technique patients and 35/88 novel technique patients that were available for survey completion. The BREAST-Q

Table 2. Number of Patients with Mastectomy Necrosis, Donor Site Necrosis, or TRAM Flap Necrosis in the Traditional Free msTRAM Group Compared with the Destination Design msTRAM Group

	Traditional msTRAM	Destination Design msTRAM	
Total patients	39	88	
Mastectomy necrosis			
None	35 (89.7%)	79 (89.7%)	$P = 1.000$
Minor	2 (5.1%)	8 (9.0%)	$P = 0.4473$
Major	2 (5.1%)	1 (1.1%)	$P = 0.1707$
Donor necrosis			
None	33 (84.6%)	71 (80.6%)	$P = 0.5961$
Minor	4 (10.2%)	12 (13.6%)	$P = 0.5961$
Major	2 (5.1%)	5 (5.6%)	$P = 0.8966$
TRAM flap necrosis			
None	28 (71.7%)	69 (78.4%)	$P = 0.4179$
Minor	4 (10.2%)	13 (14.7%)	$P = 0.902$
Major	7 (17.9%)	6 (6.8%)	$P = 0.0561$

questionnaire was sent to these nine traditional technique patients with eight responses (89%), and the 35 Destination Design msTRAM patients with 25 responses (75%).

Survey results showed that traditional technique and Destination Design patients had overall "Satisfaction with Breasts" scores of 67.5% and 63.9%, respectively. The scores were comparable to other published rates in the literature for both groups.[59] Then, when compared between both groups, there was no significant difference in BREAST-Q "Satisfaction with Breasts" scores, which shows that the novel technique does not compromise patient satisfaction (Table 5). Similarly, there was no significant difference between both groups in other BREAST-Q modules, including "Physical Well-Being (chest and abdomen)," "Psychosocial Well-Being," and "Sexual Well-Being."

Table 3. Number and Percentage of Patients Requiring TRAM Flap Revisions in the Traditional Free msTRAM Group Compared with the Destination Design msTRAM Group with Delayed Reconstruction Subgroup Analysis

	Traditional msTRAM	Destination Design msTRAM	
Total patients	39	88	
Patients needing revisions			
None	14 (35.8%)	49 (55.6%)	$P = 0.0394$
Minor	4 (10.2%)	3 (3.4%)	$P = 0.1188$
Major	21 (53.8%)	36 (40.9%)	$P = 0.1770$
Total	25 (64.1%)	39 (44.3%)	$P = 0.0394$
Delayed patients	23	44	
Patients needing revisions			
None	8 (34.7%)	28 (63.6%)	$P = 0.0244$
Minor	2 (8.70%)	1 (2.3%)	$P = 0.2263$
Major	13 (56.5%)	15 (34.1%)	$P = 0.0767$
Total	15 (65.2%)	16 (36.4%)	$P = 0.0244$
Patients with no. revisions available	14	88	
TRAM flap revisions			
None	3	49	$P = 0.0173$
Minor	1	3	$P = 0.5029$
Major	15	44	$P = 0.0001$
Total	16	47	$P = 0.0001$
Average per patient	1.14	0.53	

Table 4. Number of Patients who Underwent Nipple Reconstruction and Subsequently Required Revision of Nipple Size, Position, or Both in the Traditional Free msTRAM Group Compared with the Destination Design msTRAM Group

	Traditional msTRAM	Destination Design msTRAM	
Total patients	39	88	
Nipple reconstruction			
None	13 (33.3%)	1 (1.1%)	
Primary	0 (0%)	84 (95.5%)	
Secondary	26 (66.7%)	3 (3.4%)	
Nipple revision			
None	15 (57.7%)	54 (62.1%)	$P = 0.6891$
Size	10 (38.5%)	27 (31.0%)	$P = 0.4777$
Position	0 (0%)	4 (4.6%)	$P = 0.267$
Both	1 (3.8%)	2 (2.3%)	$P = 0.6672$
Any	11 (42.3%)	33 (37.9%)	$P = 0.6891$

DISCUSSION

Reconstructing a unilateral breast initially treated with a simple or skin-sparing mastectomy while simultaneously performing a balancing reduction/mastopexy on the contralateral side can be the most difficult situation to achieve symmetry.[43,46–49] Traditional techniques rely on subjective surgeon experience for flap size, shaping, and positioning. This often results in higher revision rates required to adjust these parameters as the reconstruction heals.[43,46,50] Some surgeons perform the reduction first and stage the reconstruction to improve the final symmetry but this also inevitably adds an extra procedure. Previous studies by Restifo, Coutinho et al, and Spear and Davison have described breast aesthetic subunits and patient scar placement preferences. Ideal flap placement incorporates horizontally positioned flaps, with incisions hidden in the inframammary fold and avoidance of the superomedial pole so that scars can be hidden by clothing.[54–56] The purpose of this novel technique is to develop a more objective method of breast reconstruction based on breast subunits and easily obtainable measurements.

Table 5. Results of BREAST-Q Questionnaire Sent to Patients Treated with the Traditional Free msTRAM Compared with the Destination Design msTRAM Groups Statistical Significance Calculated Using Two-tailed Independent Samples *t*-test

	Traditional msTRAM	Destination Design msTRAM	
Total patients	39	88	
Surveys sent	9	35	
Answers received	8 (88.9%)	25 (71.4%)	
BREAST-Q Scores			
Satisfaction with breasts	67.50	64.32	$P = 0.6558$
Psychosocial wellbeing	76.63	73.04	$P = 0.6919$
Physical wellbeing (Chest)	86.88	74.63	$P = 0.2357$
Physical wellbeing (Abdo)	79.00	71.96	$P = 0.4536$
Sexual wellbeing	48.88	56.82	$P = 0.4652$

Planning in reverse by transposing the anticipated breast measurements onto the abdomen creates a technique where the design is based on the destination, therefore giving rise to the name "Destination Design".

Our chart review results show that there was a significant reduction in the number of patients that required flap position and volume revisions in the Destination Design msTRAM cohort compared with the traditional free msTRAM cohort. When comparing minor and major revisions separately, the results failed to reach statistical significance but we believe this is due to insufficient power in the subgroup analysis. When looking at the total number of flap revisions required per patient, only a smaller subset of patients in the traditional free TRAM cohort could be analyzed due to inadequate chart information. However, despite this smaller subset of patients, results show that the traditional free msTRAM patients required an average of 1.14 flap revisions compared with 0.53 revisions in the Destination Design msTRAM group. This average does not include secondary nipple reconstruction, which is avoided with the Destination Design msTRAM primary nipple reconstruction technique. Although secondary nipple reconstructions can often be combined with a necessary flap revision, using the Destination Design msTRAM technique can save patients from ever needing any secondary procedure. A limitation in this part of the study is that we cannot account for the effect of late career surgical experience. Because all the Destination Design msTRAM cases were operated on in the later half of the study period, it is possible that the lead surgeon's overall technical skills, experience, and surgical equipment played a role. However, despite this confounding variable, the overall revision rate in both groups is lower than other published revision rates.[43] Another potential limitation is the fact that the traditional msTRAM patients have longer follow-up periods, which may inflate the number of revisions they underwent. However, inclusion criteria required a minimum of 3 years follow up for the Destination Design msTRAM patients, which is sufficiently long to complete all revisions in most patients. A final limitation is that the decision to undergo a revision can be influenced by patient and surgeon subjective preferences. However, all patients were offered revisions until they were satisfied with their results, and the adequately powered sample size controls for outlier patients who may have requested an atypical number of revisions.

As with any new surgical technique, it is important to ensure that the new method does not compromise patient outcomes with regard to complications. Our chart review results showed no significant difference in minor or major complications in the donor site, mastectomy skin, or flap between both groups. The nearly statistically significant reduction in major flap necrosis in the novel Destination Design msTRAM group ($P = 0.0561$) could be attributed to late career surgical experience, improved microsurgery equipment, or the robust perfusion of the technique itself.

The final patient outcome to consider is the resulting satisfaction with the reconstruction. Fortunately, the BREAST-Q questionnaire provides an evidence-based and validated breast satisfaction survey to assess this outcome.[57,58,60,61] Although the number of surveys sent was significantly lower than the total number of charts reviewed, the duration of time elapsed because the traditional reconstructions made it impossible to contact many of the earlier cohort patients. However, once available patients were identified, the survey response rate was acceptably much higher. Patient reported satisfaction with breasts, psychosocial, and physical and sexual well-being showed no significant difference in the Destination Design msTRAM group compared with the traditional msTRAM group. Although this does not suggest that the novel technique improves patient satisfaction, it does show that it achieves the same patient satisfaction with fewer revisions as previously shown with the chart review. This satisfaction score also supports the notion that the patients in both cohorts were treated until they were equally satisfied with the final result, which further supports the reduction in revisions required. The slightly higher Satisfaction with Breasts score in the traditional msTRAM group (67.5% versus 63.9%) could be attributed to a longer period of time since surgery and therefore more time for patients to mature their scars and to grow accustomed to their new reconstructed breasts.

Lastly, in the author's experience, the cone folding of the abdominal flap for breast shaping renders the contralateral vascular zones inadequately perfused with a DIEP flap alone and so msTRAMs were used. Indeed, even these flaps benefit from venous drainage augmentation by anastomosis of the contralateral SIEV to mitigate against medial breast mound induration and fat necrosis. This typically adds approximately 45 min to the procedure. That being said, an msTRAM approach is not absolutely requisite, and the same principles of flap technique and design can be equally applied with conjoined combinations of bilateral DIEP and / or SIEP flaps, as the author has done in cases of a midline hypogastric scar.

CONCLUSIONS

Surgical planning with the novel described Destination Design msTRAM unilateral breast reconstruction technique reliably leads to the desired outcome with a statistically significant reduction in breast flap revisions and allows for equally accurate immediate nipple reconstruction compared with traditional free msTRAM methods with no additional complications. Overall patient satisfaction with the final result is comparable with the traditional free msTRAM technique as well as other published rates in the literature. Certainly, preincisional planning with one's Destination in mind affords greater reconstructive certainty by Design.

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