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ORIGINAL ARTICLE

Breast

Breast Reconstruction Utilizing Buried Dermato-cutaneous Skin Flaps and Immediate Adipocyte Transfer: A Minimally Invasive Autologous Breast Reconstruction Technique

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Background: Autologous breast reconstruction historically required flaps that were invasive, required prolonged operative times and recoveries, and resulted in varying degrees of donor site morbidity. We present our early results with a minimally invasive completely autologous breast reconstruction technique utilizing buried dermato-cutaneous (DMC) flaps and immediate fat grafting. A 25-patient, 43-breast consecutive case series is presented.

Methods: Select patients desiring autologous breast reconstruction who had sufficient breast ptosis and fat donor tissue were offered breast reconstruction with buried folded over DMC flaps with adipocyte transfer (DCAT). A Wise pattern mastectomy was performed, and fat was transferred into an inferiorly based, buried and folded DMC flap. Fat was also immediately grafted into the pectoralis, subpectoral space, and below pectoralis and serratus fascia. Most patients underwent additional fat grafting at 3-month intervals to complete the reconstruction.

Results: Twenty-five consecutive patients (43 breasts) underwent the DCAT procedure with 18 (42%) free nipple grafts. Eight patients (8 breasts) had prior breast radiation, and 2 patients (2 breasts) required postmastectomy radiation. Average fat grafted at initial mastectomy was 70 mL per breast (range 50–103 mL). Nineteen patients (76%) underwent additional outpatient fat grafting. Two additional outpatient fat graft sessions (range 0–3) at 3-month intervals completed the reconstruction. Average fat grafted at the second stage was 217 mL (range 50–320 mL). Average follow-up was 20 months from DCAT and 12 months from last fat graft.

Conclusion: The DCAT procedure appears to provide a minimally invasive, autologous breast reconstruction alternative in select patients. *(Plast Reconstr Surg Glob Open 2019;7:e2392; doi: 10.1097/GOX.0000000000002392; Published online 31 December 2019.)*

INTRODUCTION

The Dermato-Cutaneous flap with Adipocyte Transfer (DCAT) procedure combines the 2 well-established techniques of fat grafting and buried dermato-cutaneous (DMC) flaps in the same setting to provide an immediate breast mound even in select patients with small- and medium-sized breasts and can be enlarged further with subsequent additional fat grafting. Fat grafting has been found to be a safe and effective adjunct to standard breast reconstructive techniques and has also been used effectively as a stand-alone approach for breast reconstruction utilizing external tissue expansion.[1–3] Numerous studies to date have documented the safety of fat grafting in patients with either invasive breast cancer or Ductal Carcinoma In Situ (DCIS).[4–9] However, there are relatively few publications describing complete breast reconstruction using only fat transfer.[2]

Dr. Wise originally described the Wise pattern mammoplasty in 1956.[10] Since then, de-epithelialized buried skin flaps have been used in breast reconstruction both as an adjunct to implant reconstruction and in partial mastectomy reconstruction.[11–17] In 2012, Richardson and Ma published their seminal article describing the "Goldilocks mastectomy" using only buried de-epithelialized Wise

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pattern skin flaps for breast reconstruction in mostly nonideal reconstruction patients—elderly or those needing to minimize operative time with large, obese or excessively ptotic breasts.[18] They did not use immediate or delayed fat grafting. In turn, in November 2017, Schwartz and Skowronski published a single case report extending the indications for the Goldilocks technique to include a smaller breasted woman, by using a 2-stage approach incorporating delayed fat grafting.[19] They also described a single case report of immediate free nipple graft in conjunction with the Goldilocks mastectomy.[20] Ter Louw et al published a single case report describing partial breast reconstruction with the Goldilocks technique after giant fibroadenoma excision.[21] Most recently, Shusterman et al and our group independently presented their novel approaches to fat graft only breast reconstruction. In December 2017, Shusterman et al presented 10 patients that underwent breast reconstruction utilizing bioabsorbable mesh placed in the prepectoral space and subsequent rounds of autologous fat grafting, at the Miami International Federation for Adipose Therapeutics and Science (IFATS) conference.[22] In December 2017, we presented our early series of 22 breast cancer patients (27 breasts) reconstructed immediately using only buried DMC flaps and immediate fat grafts, which included 13 immediate free nipple grafts, at the San Antonio Breast Cancer Symposium.[23]

METHODS

Institutional Review Board approval was granted by the Biomedical Research Alliance of New York, for a retrospective chart review, and the principles of the Declaration of Helsinki for medical research were followed. All reconstructions were performed by a single plastic surgeon. All patients were provided an opportunity to undergo traditional breast reconstruction techniques (Deep Inferior Epigastric Perforator [DIEP] flap, Transverse Rectus Abdominis Myocutaneous [TRAM] flap, latissimus flap, or implant-based reconstruction). All patients desiring autologous breast reconstruction, with Regnault grade 2 or greater breast ptosis and available fat donor tissue, but who did not desire an abdominal-based flap reconstruction (DIEP), latissimus flap, or implant-based reconstruction, were offered the DCAT procedure. Similar patients without adequate breast ptosis were offered fat graft only reconstruction and not included in this report. All previously radiated patients were offered DIEP flap or latissimus flap/implant reconstruction as a reconstructive option. Previously radiated patients were not eligible for free nipple grafting and were carefully counseled and their expectations cautiously managed regarding final aesthetic results following DCAT. Patients who were anticipated by the breast surgeon to receive postmastectomy radiation (PMRT) were recommended to undergo traditional autologous flap reconstruction or reconstruction with immediate placement of expander and definitive delayed reconstruction after completion of PMRT with flap or implant. Two patients in our series required unexpected PMRT due to tumor size or lymph node involvement. All patients had pathologically clear margins following surgery.

Surgical Technique

Patients were marked preoperatively in an upright position for a Wise pattern mastectomy, with conservative skin resection planned (Fig. 1). Areolar sparing, nipple sparing, and free nipple graft patterns were utilized. The apex of the Wise pattern was marked in the breast meridian at approximately the level of the inframammary fold, except in nipple sparing cases (patients with ptosis and pseudoptosis with an acceptable nipple position), where the apex was marked at the base of the planned areola. The width of the Wise pattern triangle was set at 2–7 cm, depending on the degree of skin laxity present. At the initial procedure, fat was harvested from the hip, in case an abdominal flap reconstruction was needed in the future (ie, radiated patients). A super-wet technique was utilized for fat grafting. Approximately 50% more lipoaspirate was harvested than the anticipated fat grafting amount. Fat was collected in a disposable fat collection canister via a MicroAire powered liposuction system, using 4-mm disposable TriPort cannulas. Suction was set between 18 and 22 inches Hg and power set at 65%. After 12 minutes, the aqueous layer was drained, and fat was transferred into 5-mL syringes. A 14-gauge curved flat tip cannula was used for microfat grafting with approximately 0.5–1 mL injected per pass. Fat was grafted into the de-epithelialized DMC flap, pectoralis muscle, subpectoral space, underneath the serratus and pectoralis fascia, and in select cases, into the mastectomy skin flap itself (Fig. 2). The amount of fat grafted into the de-epithelialized DMC flap was limited to approximately 20 cm^3, depending on the size of the flap and thickness of the subcutaneous layer. Mastectomy skin flaps averaged approximately 5 mm in thickness. If the DMC flap was greater than 3-mm thick, it was fat grafted, folded over, and anchored to the pectoralis fascia (Fig. 3). The DMC flap would not have been fat grafted if the flap thickness was less than 3 mm, but simply folded over and anchored to the pectoralis fascia to serve as an additional biologic surface area for future fat grafting. All patients in this series had immediate fat grafting to the DMC flap, pectoralis region and

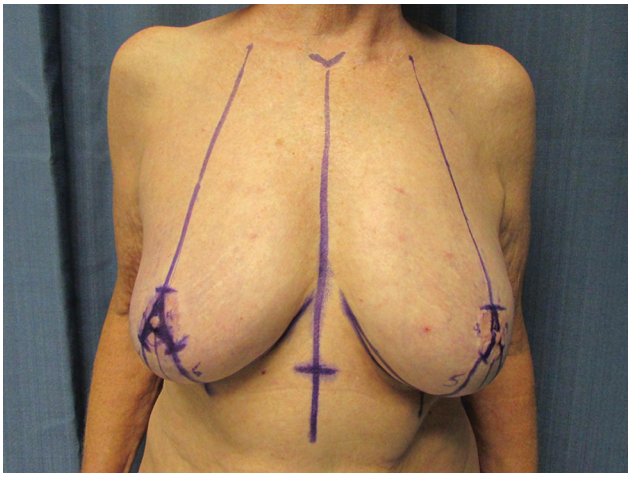

Fig. 1. Preoperative marking DCAT.

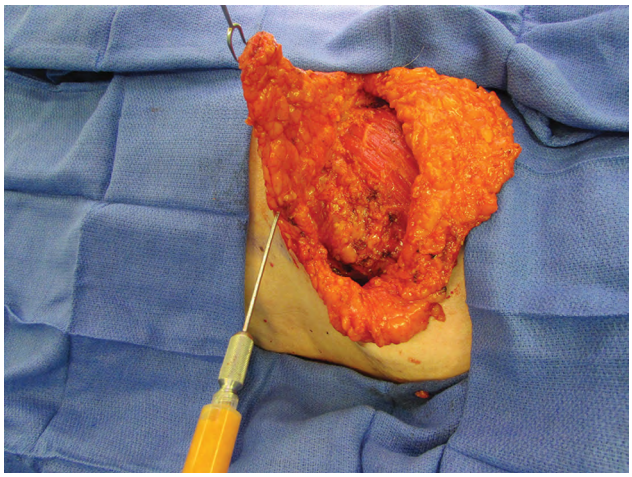

Fig. 2. Intraoperative DCAT.

just beneath the serratus fascia. The mastectomy skin flaps were then closed over a drain, light compression breast dressing applied, and lower body compression garment applied. Standard antibiotic prophylaxis was used in all cases. Patients were discharged home the following day and seen at 1 week, 6 weeks, 3 months, and at 3-month intervals thereafter for the first year. Additional fat graft sessions were performed on an outpatient basis at 3-month intervals, based on patients desired breast size, and donor fat availability.

RESULTS

The results are summarized in Table 1. Forty-three breasts from 25 consecutive patients (mean age 58 years, mean body mass index [BMI] 27) underwent the DCAT procedure using Wise pattern nipple sparing, areolar sparing, or skin sparing mastectomy skin flaps. Twenty-two (88%) patients had mastectomy due to breast cancer, and 3 (12%) patients had prophylactic mastectomy. Eight (18.6%) breasts from 8 (32%) patients had a history of prior breast radiation. Two (5%) breasts from 2 (8%) patients required PMRT. Average volume of fat grafted at the initial mastectomy session was 70 cm^3 per breast (range 50–103 cm^3). Nineteen (76%) patients underwent an average of 2 (range 1–3) additional fat graft sessions at 3-month intervals. Average fat grafted at subsequent sessions was 217 cm^3 (range 50–320 cm^3). There were no reconstruction failures. One (4%) patient had a postoperative mastectomy seroma, which resolved with serial aspirations. Three (12 %) patients had partial skin flap necrosis of 1 breast each that healed with local wound care. In all 3 of these cases, the area of necrosis involved the vertical limb near the "T" portion of the Wise pattern. None (0%) of these patients underwent free nipple grafting. One (33%) of the 3 cases occurred in a patient with a history of prior breast radiation. Four (16%) patients had palpable nodules in 5 (12%) breasts. Two of these patients required Magnetic Resonance Imaging (MRI) scans, and 1 required needle core biopsy. All areas were found to be benign fat necrosis. Figures 4–7 show completed immediate bilateral reconstructions with DCAT. Figure 8 shows a patient with a prior history of right nonskin sparing mastectomy and new diagnosis of left breast cancer that underwent left immediate DCAT reconstruction and right delayed fat graft only reconstruction. One can note that the left DCAT reconstructed breast, with its preserved skin envelope, has improved shape and contour as compared to the right fat graft only reconstruction.

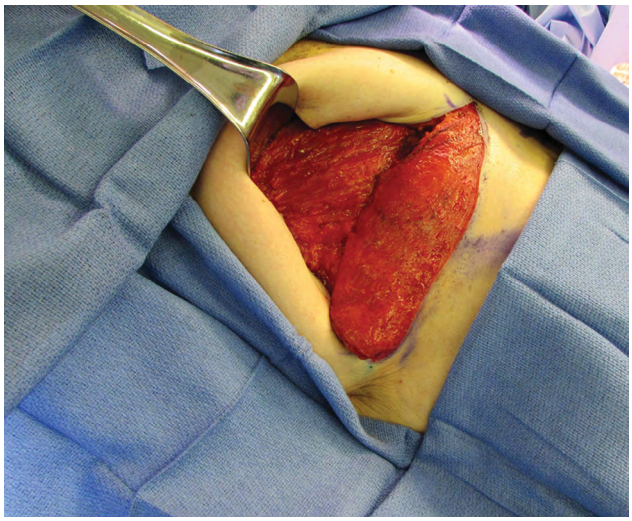

Fig. 3. Intraoperative DCAT.

Table 1. Data Summary

Patients	
Total patients with immediate reconstruction	**25**
Patients previously radiated	8
Patients without previous radiation	17
Patients requiring PMRT	1
Patients with breast cancer	22
Patients requiring prophylactic mastectomy (BRCA mutation or Hx)	3
Average age (y)	55.5
Average BMI	27.1
Average follow-up from initial fat graft session (mo)	20 (8–34)
Average follow-up from last fat graft session (mo)	12 (4-24)
Breasts reconstructed (immediate)	
Total radiated and nonradiated	**43**
Nonradiated	34
Radiation history	8
PMRT	2
Nipple reconstruction	
Free nipple areolar grafts	18
Areolar remnant nipple reconstructions	14
Fat grafting	
Mean number sessions (range)	2 (1–3)
Mean volume per outpatient session "cc" (range)	217 ml (50–320)
Mean volume of fat grafting at time of mastectomy "cc" (range)	79 cc (50–140)
Complications	
Seroma	1 (3%)
Hematoma	2 (4%)
Mastectomy (partial) skin flap necrosis (%)	3 (8%)
Oil cyst drained in office (%)	3 (8%)
Wound infection (%)	0 (0%)
Loss of reconstruction (%)	0 (0%)

Bold was used to highlight the total number of patients and total number of breasts reconstructed.

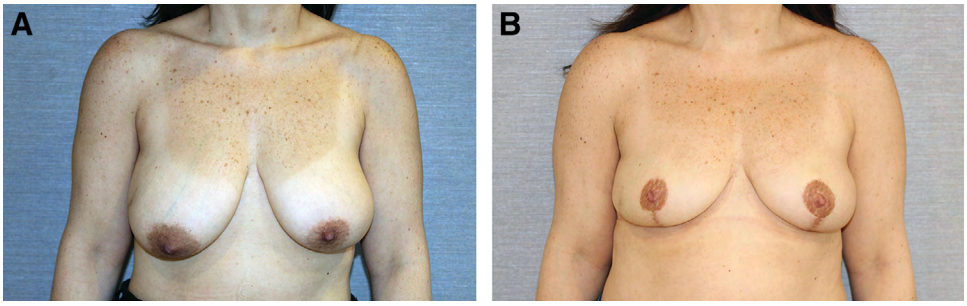

Fig. 4. DCAT results. A, Preoperative bilateral mastectomy. B, Postoperative 20 months bilateral DCAT and free nipple grafts, 12 months postoperative second outpatient fat graft.

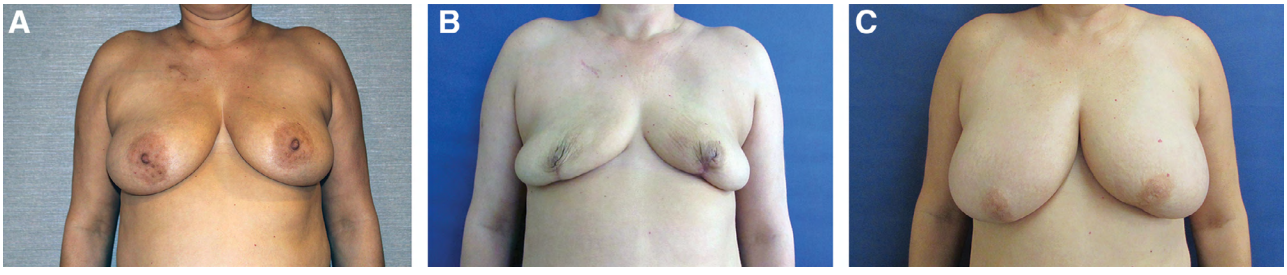

Fig. 5. DCAT results. A, Preoperative bilateral areolar sparing mastectomy. B, Postoperative 3 months bilateral areolar sparing mastectomy and DCAT. C, Postoperative 32 months bilateral DCAT, 20 months post third outpatient fat graft.

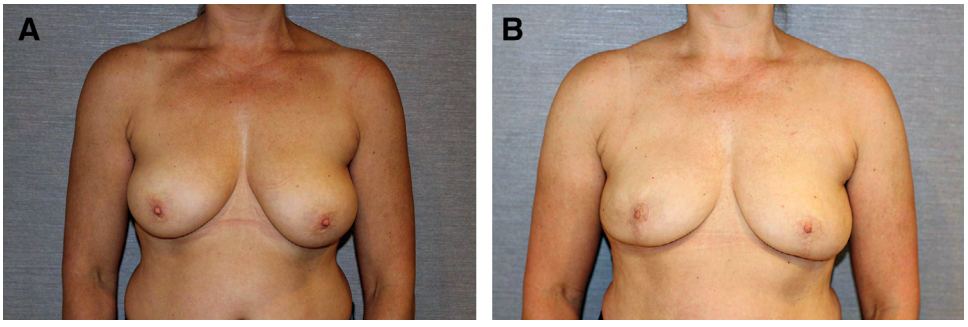

Fig. 6. DCAT results. A, Preoperative bilateral mastectomy. B, Postoperative 24 months bilateral DCAT and free nipple grafts, 18 months post first and only outpatient fat graft.

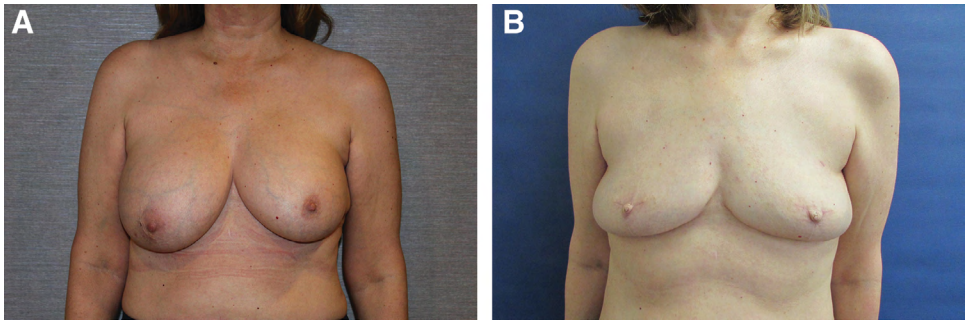

Fig. 7. DCAT results. A, Preoperative bilateral mastectomy. B, Postoperative 15 months bilateral mastectomy and DCAT, and 5 months post second outpatient fat graft.

DISCUSSION

The authors present an innovative minimally invasive, autologous breast reconstruction technique, the DCAT procedure. It allows for autologous breast reconstruction by combining 2 well-established techniques (buried DMC flaps and fat grafting) that do not require microsurgery, acellular dermal matrix/mesh, internal or external expanders, specialized equipment or longer operative times compared to standard autologous breast reconstruction techniques. Zhang and Dayicioglu reported a mean

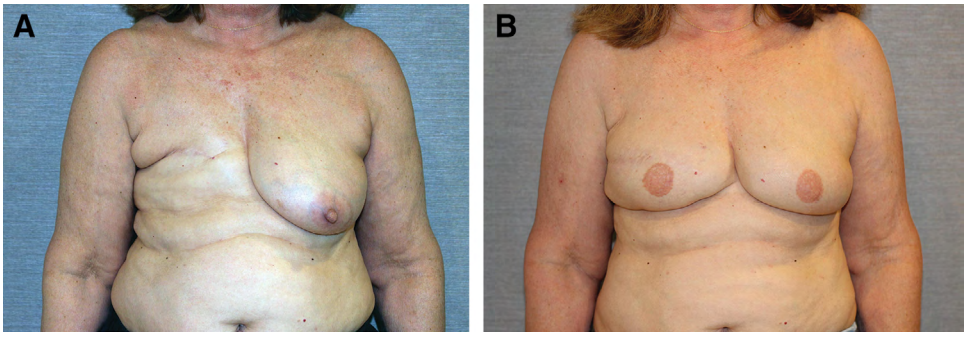

Fig. 8. DCAT results. A, Preoperative left mastectomy, left DCAT and right fat graft. B, Postoperative left DCAT 28 months and 13 months postoperative fourth outpatient fat graft on right and third fat graft on left.

operative length of 9.1 hours (range 3.7–15.8 hours) for unilateral DIEP procedures including mastectomy.[24] Our mean operative time, from incision to surgery end, including mastectomy, was 3.1 hours (range 2.8–3.5) for unilateral procedures, and 3.7 hours (range 2.7–5) for bilateral procedures. Subsequent outpatient fat graft sessions typically took approximately 1.5 hours for unilateral procedures and 2 hours for bilateral procedures. Eighteen (42%) free nipple grafts were performed at the time of mastectomy in 11 (44%) patients, including a 75-year-old who had a contralateral breast reduction. Patients who received free nipple grafts had mastectomy skin flap thickness of at least 5 mm. In addition, great care was taken to preserve the subdermal plexus when preparing the recipient site. No free nipple grafts were lost; however, most had a small central area of delayed healing at the thickest portion of the nipple graft, which all healed with local wound care only. None (0%) of our 3 patients who had partial skin flap necrosis had free nipple grafts. The authors suggest that surgeons first learning the technique consider deferring immediate free nipple grafting until they are confident in the vascularity and viability of their skin flaps post mastectomy.

There are numerous advantages of DCAT over existing autologous breast reconstruction techniques including it is minimally invasive, completely autologous, adds minimal time to the initial mastectomy procedure (significant benefit in bilateral mastectomies), adds little to the recovery process following mastectomy, and offers an autologous breast reconstruction option for those surgeons and patients that want to avoid implant-based reconstruction and abdominal flap-based reconstruction. Finally, the DCAT procedure is technically within the skill set of all plastic surgeons. However, the technique is not applicable to all patients and has some disadvantages. Disadvantages of the DCAT include potential need for multiple procedures following mastectomy (average 2, range 0–3), need for adequate fat donor tissue, and uncertain applicability to previously radiated patients.

Our early results with radiated patients are promising but further study is required. In our consecutive case series, there were 10 (40%) radiated patients. Eight (32%) had a history of prior breast radiation from breast conserving treatment of prior breast cancer, and 2 (8%) patients required PMRT following mastectomy and DCAT. In total, there were 10 (23%) radiated breasts. Figure 9A demonstrates a patient with a prior history of right breast radiation that was to undergo bilateral mastectomies and DCAT reconstruction. Figure 9B shows the patient intraoperatively after bilateral mastectomy and DCAT, and Fig. 9C shows 7 months post bilateral mastectomy with DCAT and 3 months post first and only outpatient fat graft session. Figure 10A shows a preoperative photograph of a patient who required right PMRT). Figure 10B shows the results of 20 months post bilateral areolar sparing mastectomy and DCAT reconstruction with right PMRT and 5 months post second outpatient fat graft. As compared to implant-based reconstruction, wound complications with the DCAT in radiated patients do not threaten the viability of the reconstructive effort. Our current recommendation for radiated patients is that the abdominal area not be utilized initially as a fat donor site to preserve it for possible

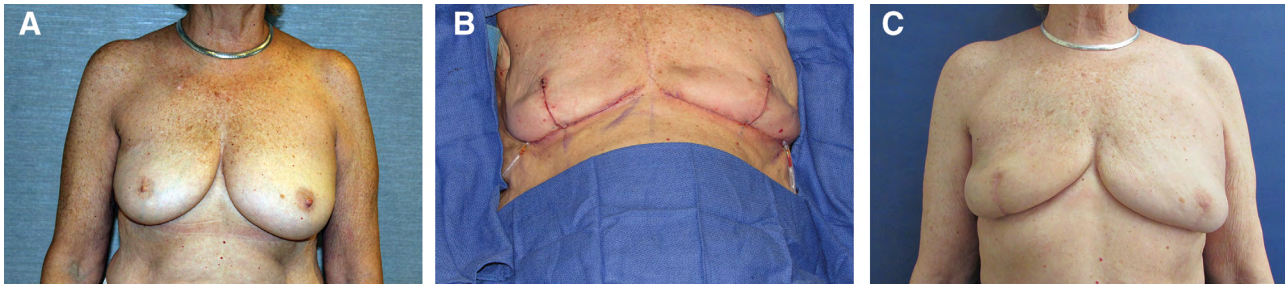

Fig. 9. DCAT results. A, Preoperative bilateral mastectomy, history of right breast radiation. B, Intraoperative bilateral DCAT. C, Postoperative DCAT 7 months and 3 months post first and only outpatient fat graft session.

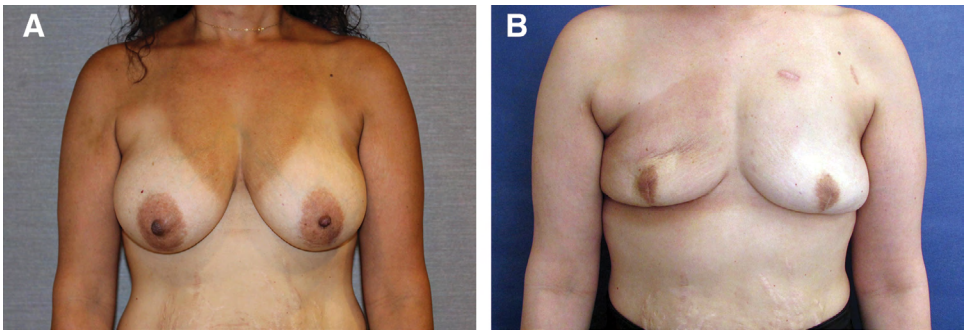

Fig. 10. DCAT results. A, Preoperative bilateral areolar sparing mastectomies, and right PMRT. B, Postoperative 24 months bilateral DCAT and right PMRT, 9 months post second outpatient fat graft.

flap-based reconstruction if needed. We suggest that surgeons first learning this technique initially limit it to those patients without a prior history of radiation and those not expected to receive PMRT.

Many of our patients (radiated and nonradiated) required additional outpatient fat graft sessions to complete their reconstructions. Implant-based reconstruction also requires reoperation. In their 10-year core study results, Allergan reported that patients reconstructed with Natrelle round silicone breast implants had a reoperation risk of 71.5%.[25] Furthermore, implant-based reconstructions have an increased risk of failure and complications in previously radiated patients.[26] Abdominal free flap-based reconstruction has a lower reported incidence of revision surgery at approximately 20%.[27,28] However, abdominal free flap-based procedures (ie, DIEP) require prolonged operative times at the initial procedure and are associated with donor site complications such as abdominal bulging, hernia, and seroma.[24,29]

Our patients required an overnight hospital stay following mastectomy, with an average of 2 additional outpatient sessions (range 0–3) at 3-month intervals to complete the reconstruction. To date, there have been no failures or loss of reconstruction. Based on clinical examination following DCAT, 5 patients in 5 breasts (5/43 = 12%) had palpable nodules. Two (8%) patients underwent a breast MRI, and 1 (4%) underwent needle core biopsy which confirmed fat necrosis. Issues of palpable fat necrosis versus recurrence are addressed by ultrasound, mammography, or breast MRI. In 2015, Khouri et al reported a fat necrosis rate of 12% in nonradiated patients and 37% in radiated patients reconstructed with fat transfer alone with their 7-year, 488-patient, multicenter experience of breast reconstruction with Brava-assisted fat grafting.[2] Our incidence of clinically palpable fat necrosis is consistent with Dr. Khouri's findings. It is known that fat necrosis occurs following all abdominal flap-based reconstructions. Khansa et al in their meta-analysis of 70 published articles reported a fat necrosis rate of 11% overall with abdominal tissue transfer breast reconstruction. DIEP flaps had the highest incidence of fat necrosis (14.4%), followed by pedicle TRAM flaps (12.3%), with free TRAM flaps having the lowest incidence (8.1%).[30] As with other forms of autologous breast reconstruction, we followed the current National Comprehensive Cancer Network guidelines for the monitoring and surveillance of recurrence (clinical examination and imaging as directed by examination).[31]

The authors caution that not all patients are candidates for the DCAT procedure. We continue to recommend autologous breast reconstruction for previously radiated patients with either abdominal-based reconstruction (ie, DIEP) or latissimus flap/implant/fat graft reconstruction. Patients who are not candidates or do not desire an abdominal flap-based reconstruction, or a latissimus flap, are offered the DCAT procedure. Candidates for a DCAT procedure must have enough breast ptosis (Regnault grade 2–3) and fat donor tissue to complete the reconstruction to their desired breast cup size. Patients with adequate fat donor tissue but inadequate breast ptosis do not undergo DCAT, but rather fat graft only reconstruction. Patients are counseled that a DCAT breast reconstruction will not provide the firmness or projection of an implant-based reconstruction but is comparable in shape and consistency to a mature nonaugmented breast. All patients must accept that additional[1–3] (average 2) sessions may be needed to complete the reconstruction, although 2 patients (4 breasts) were satisfied after their initial mastectomy and DCAT procedure and chose to forgo further fat grafting.

Our average fat graft volume per breast per subsequent fat graft session was 217 mL (range 50–320 mL). This compares favorably with the reported average of 225 mL per breast per session transferred during fat graft only reconstruction using an external expansion device.[2] However, a direct comparison is difficult to make because of differences in fat graft preparation (ie, centrifugation versus gravity separation) which may result in differences in fat graft concentration. We postulate that the buried DMC flap used in the DCAT may function as an additional vascular plane capable of accepting fat grafts. This requires further study. In the future, we hope to compare our fat grafted volume per session and fat retention with DCAT as compared to other fat graft only breast reconstruction techniques.

CONCLUSIONS

We conclude that based on our early experience, the DCAT procedure in select patients is a promising, minimally invasive autologous breast reconstruction technique. It has numerous advantages: easy to perform, shorter operative times than traditional flap reconstruction techniques, does not require microsurgery, limited to no

donor site morbidity, relatively short recovery time, and is within the skill set of all plastic surgeons. DCAT has a few disadvantages over some traditional breast reconstructive techniques including need for multiple procedures, less projection than implant-based reconstruction, and uncertain application to patients with prior breast radiation. We continue to view the DCAT procedure favorably and feel it may offer a reasonable alternative for autologous breast reconstruction in select patients.

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