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Breast

Prepectoral Implant-Based Breast Reconstruction and Postmastectomy Radiotherapy: Short-Term Outcomes

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Background: Prosthetic breast reconstruction in the setting of radiotherapy is associated with poor outcomes. Until recently, prosthetic breast reconstruction was predominantly performed by placing the prosthesis in a subpectoral space. Placement of the prosthesis in a prepectoral space is currently emerging as a simpler, alternative approach to subpectoral placement. The impact of postmastectomy radiotherapy (PMRT) on prepectoral reconstruction has not yet been specifically assessed. This study compared the outcomes of patients who underwent immediate, direct-to-implant, or 2-staged, prepectoral breast reconstruction followed by PMRT with those from patients who did not receive PMRT.

Methods: Patients with well-perfused skin flaps and without contraindications, including uncontrolled diabetes-mellitus, previous irradiation, and current tobacco use, were offered the prepectoral approach. Following implant or expander placement, patients underwent planned or unplanned radiotherapy. Complications after each stage of reconstruction were recorded.

Results: Thirty-three patients underwent 52 breast reconstructions via the prepectoral approach. Sixty-five percentage of the breasts were irradiated, including 21% after expander and 44% after implant placement. Patients were followed for a mean of 25.1 ± 6.4 months. Complication rate in irradiated breasts was 5.9% (1 incidence of seroma and 1 incidence of wound dehiscence followed by expander removal) and 0% in nonirradiated breasts. Capsular contracture rate was 0% in both irradiated and nonirradiated breasts.

Conclusions: Immediate implant-based prepectoral breast reconstruction followed by PMRT appears to be well tolerated, with no excess risk of adverse outcomes, at least in the short term. Longer follow-up is needed to better understand the risk of PMRT in prepectorally reconstructed breasts. *(Plast Reconstr Surg Glob Open 2017;6:e1631; doi: 10.1097/GOX.0000000000001631; Published online 28 December 2017.)*

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INTRODUCTION

Prosthetic breast reconstruction is the most common form of reconstruction for women who undergo mastectomy and immediate reconstruction. In 2016, more than 80% of breast reconstructions were prosthetic reconstructions.[1] Despite the success of prosthetic reconstruction, challenges remain with this mode of reconstruction, particularly with respect to reconstruction in the setting of radiotherapy. Radiation has a significant adverse impact on prosthetic reconstruction; notably, a reconstructive failure (implant or expander removal) rate of 20–50%,[2–8] a major corrective surgery rate of 40%,[9] and a capsular contracture rate of 17–60%.[3–5] Patient satisfaction and aesthetic outcomes are also diminished in the setting of radiotherapy.[10,11]

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Prosthetic breast reconstruction has until recently been exclusively performed by placing the prosthesis in a subpectoral space. The placement of the prosthesis in a prepectoral space is currently emerging as a simpler, alternative approach to prosthetic reconstruction. A number of studies have demonstrated the feasibility and safety of this approach.[12–22] The impact of radiotherapy on prepectoral prosthetic reconstruction is at present unknown, although premastectomy radiotherapy is generally contraindicated unless vascularized tissue is utilized in conjunction.[12] There is, thus, a need to characterize the impact of postmastectomy radiotherapy (PMRT) on the prepectoral approach to provide guidance to surgeons and patients alike.

The authors have previously reported on their early experience with the prepectoral approach in primary breast reconstruction.[12] In this study, outcomes of patients who underwent immediate, direct-to-implant, or 2-staged, prepectoral breast reconstruction followed by PMRT are reported and compared with those from patients who did not receive PMRT.

PATIENTS AND METHODS

Study Design and Patient Population

This is an institutional review board (PeaceHealth Southwest Medical Center, Vancouver, Washington)–approved retrospective analysis of patients who underwent immediate, prepectoral, direct-to-implant, or 2-staged expander/implant breast reconstruction following skin-sparing mastectomy or nipple-sparing mastectomy and had PMRT. Reconstructive surgery was performed from August 2014 to May 2016 at the practices of 2 reconstructive surgeons (S.S. and A.G.). Patients underwent planned or unplanned radiotherapy administered after expander or implant placement. Patients who had poorly vascularized mastectomy flaps, history of prior radiation, body mass index > 40 kg/m^2, poorly controlled diabetes (HbA1c > 7.5%), and who were active smokers and lacked fat donor sites were not offered immediate prepectoral reconstruction. In addition, patients who had late stage cancer, large tumors (> 5 cm), deep tumors, chest wall involvement, and grossly positive axillary involvement and were at high risk of recurrence were not offered immediate prepectoral reconstruction.[12]

Surgical Technique

Prepectoral reconstruction was performed as previously described.[12] Following mastectomy, skin flap perfusion was accessed using a Fluorescence Imaging System (SPY Elite, NOVADAQ Technologies Inc., Bonita Springs, Florida or Hamamatsu PDE, Mitaka USA Inc., Denver, Colo.). Only patients with well-perfused skin flap and without contraindications listed above were offered the prepectoral approach. An implant or expander was covered anteriorly and posteriorly with 1 or 2 sheets (16 cm × 20 cm) of thick, perforated, acellular dermal matrix (AlloDerm Tissue Matrix *Ready To Use*; LifeCell Corporation, Branchburg, N.J.) and placed in the prepectoral pocket. The dermal matrix was sutured to the pectoralis major muscle and subcutaneous tissue superiorly and to the inframammary fold inferiorly. Typically, 2 drains were placed, between the matrix and the mastectomy flap and were located laterally making sure that the drains do not cross the breast meridian. The drains were removed postoperatively when output was less than 30 mL over a 24-hour period. Implant exchange was performed at 6 weeks whenever possible before the start of radiation therapy. In patients who underwent radiotherapy after expander placement, tissue expansion was typically completed before delivery of radiotherapy. In patients who had air-filled expanders, the air was replaced with saline before radiotherapy. In patients who required additional soft-tissue coverage, autologous fat grafting was performed at the second stage. However, if patients had undergone capsulotomy during the second stage or were going to have radiotherapy after implant placement, fat grafting was delayed and performed at a later stage.

Data Collection and Analysis

Patient records were reviewed, and the following data were obtained: age at surgery; body mass index; history of tobacco use, hypertension, and diabetes mellitus; type of mastectomy (nipple-sparing mastectomy or skin-sparing mastectomy); laterality of mastectomy (unilateral or bilateral); timing of postoperative radiation (after expander or implant placement); and type and incidence of complications after each stage of reconstruction. Complications obtained included seroma, hematoma, infection, wound dehiscence, skin necrosis, expander/implant exposure or removal, and capsular contracture. Capsular contracture was graded based on the Spear-Baker classification.[23] Clinically significant contracture was defined as grade III/IV contracture.

RESULTS

Thirty-three patients met our inclusion criteria and formed the analytic cohort of this study (Table 1). Fifty-two breasts were reconstructed using the prepectoral approach. Patients' age at the time of surgery ranged from 23 to 75 years, with a mean of 50.6 years. Almost 40% of patients had comorbid conditions; in particular, 36% were obese with a body mass index ≥ 30 kg/m^2. Nineteen patients had bilateral and 14 unilateral mastectomies. Ninety-four percentage of the mastectomies were skin sparing; the remaining were nipple sparing. Nineteen breasts underwent direct-to-implant reconstruction and 33 expander/implant reconstruction. Sixty-five percentage of the breasts were irradiated, including 21% after expander and 44% after implant placement. Patients were followed for a mean of 25.1 ± 6.4 months (range, 15.5–37.3 months) after implant placement.

In patients who underwent 2-staged reconstruction, at the second stage, on visual inspection, the acellular dermal matrix was found to be fully integrated in all breasts, including those who had been irradiated after expander placement. Postoperative complications in irradiated breasts were limited to 2 breasts (Table 2). In 1 breast, there was 1 incidence of wound dehiscence after expand-

Table 1. Patient Characteristics

Characteristics	Value
No. patients	33
No. breasts	52
Age (y)	
Mean	50.6±12.1
Range	23–75
Body mass index (kg/m^2)	
Mean	27.7±5.9
Range	16–42
Comorbid conditions, n (%)	
Controlled diabetes (HbA1c ≤ 7.5%)	13 (39.4)*
Controlled hypertension	2 (6.1)
Obesity (≥ 30 kg/m^2)	6 (18.2)
Smoking	12 (36.4)
Prior	2 (3.1)
Laterality, n (%)	
Bilateral	19 (57.5)
Unilateral	14 (42.4)
Type of mastectomy, n (%)	
Nipple-sparing	3 (5.8)
Skin-sparing	49 (94.2)
Type of reconstruction, n (%)	
Direct-to-implant	19 (36.5)
Expander/implant	33 (63.5)
Radiation, n (%)	34 (65.4)
Expander	11 (21.2)
Implant	23 (44.2)
None	18 (34.6)

*Excluding prior smokers; patients with > 1 comorbid condition were computed once.

Table 2. Complications in Irradiated and Nonirradiated Breasts

Complications	Irradiated (N = 34), n (%)	Nonirradiated (N = 18), n (%)	*P*
Total complications*	2 (5.9)	0	0.5
Seroma	1 (2.9)	0	1.0
Wound dehiscence	1 (2.9)	0	1.0
Expander removal	1 (2.9)	0	1.0

*Breasts with > 1 complication were computed once. Between-group comparison was performed using Fisher's exact test.

er irradiation, which led to expander removal and salvage with transverse rectus abdominis muscle (TRAM) flap reconstruction. In the second breast, there was 1 incidence of seroma after implant irradiation, which was managed in the office. The seroma was drained and the patient treated with oral antibiotics. There were no complications in nonirradiated breasts. There was no incidence of clinically significant capsular contracture (grade III/IV) in irradiated or nonirradiated breasts. Representative patient cases are shown in Figures 1 and 2.

DISCUSSION

Radiation is the most significant risk factor for major complications in prosthetic reconstruction.[7] Radiation-induced injury is noticeable within days to weeks on breast skin and tissue as edema, inflammation, and desquamation. These acute effects may lead to complications such as incisional dehiscence, infection, delayed healing, seroma, and hematoma after breast reconstruction.[24] Over months to years, radiation causes progressive deposition of fibrosis tissue in the skin and underlying breast muscles resulting in dermal thickening and muscle fibrosis and atrophy. These delayed effects of radiation may lead to complications such as capsular contracture and implant malposition after reconstructive surgery.[10,11,25]

The impact of premastectomy and PMRT on subpectoral implant-based reconstruction has been extensively studied and documented.[10,11,25] Given that prepectoral breast reconstruction is a relatively new technique, there is a paucity of data in the setting of radiotherapy. Hence, this study was undertaken to document the outcomes of patients who received PMRT following prepectoral implant-based breast reconstruction. The results suggest that prepectoral reconstruction in the setting of PMRT appears to be well tolerated with a low complication rate that included a major surgery rate of 2.9%, a reconstructive failure rate of 2.9%, and a clinically significant capsular contracture rate of 0%. Reconstructions were successfully completed in 97% of irradiated breasts. Although there were no complications in nonirradiated breasts, the difference in the rate of complications between the irradiated and nonirradiated groups was statistically nonsignificant. Despite the fact that this is a small study of 34 irradiated reconstructions with a mean duration of follow-up of approximately 25 months, the low rate of complications following PMRT is noteworthy. In comparison, in a study by Spear et al.[4] of 56 acellular dermis–assisted, 2-stage subpectoral reconstructions with a median duration of follow-up of 15 months, PMRT was associated with a reconstructive failure rate of 21% and a capsular contracture (grade III/IV) rate of 61%.

An interesting observation from the present study is that the timing of PMRT (that is, expander irradiation versus implant irradiation) appears to have little influence on postoperative outcomes. There was 1 complication each in the expander-irradiated group and implant-irradiated group, respectively. In contrast, in subpectoral reconstructions, expander irradiation is generally associated with a higher risk of reconstructive failure and capsular contracture compared with implant irradiation.[4,5,25] However, a recent study (Mastectomy Reconstruction Outcomes Consortium Study) reported no significant difference in complication rates between expander or implant irradiation. This study concluded that the timing of PMRT is not a significant predictor of any complication, a major complication, or reconstructive failure,[26] which corroborates the findings from the current study in prepectorally reconstructed patients.

In speculating over reason(s) for the observed favorable outcomes after PMRT in the present study, particularly the absence of capsular contracture, one is reminded of a study by Cheng et al.[27] In this study, the authors described a novel technique to treat and prevent recurrent capsular contracture, which entailed using acellular dermal matrix to completely cover the implant anteriorly. Of the 16 breasts treated, none developed recurrent capsular contracture over an average follow-up of 9.2 months (range, 2.4–18.8 months). Clinically, it is now well recognized that acellular dermal matrix mitigates capsular contracture, even if it partially covers the implant.[28–30] Histopathological studies suggest that acellular dermal matrix diminishes the inflammatory and profibrotic signaling characteristics of breast capsule

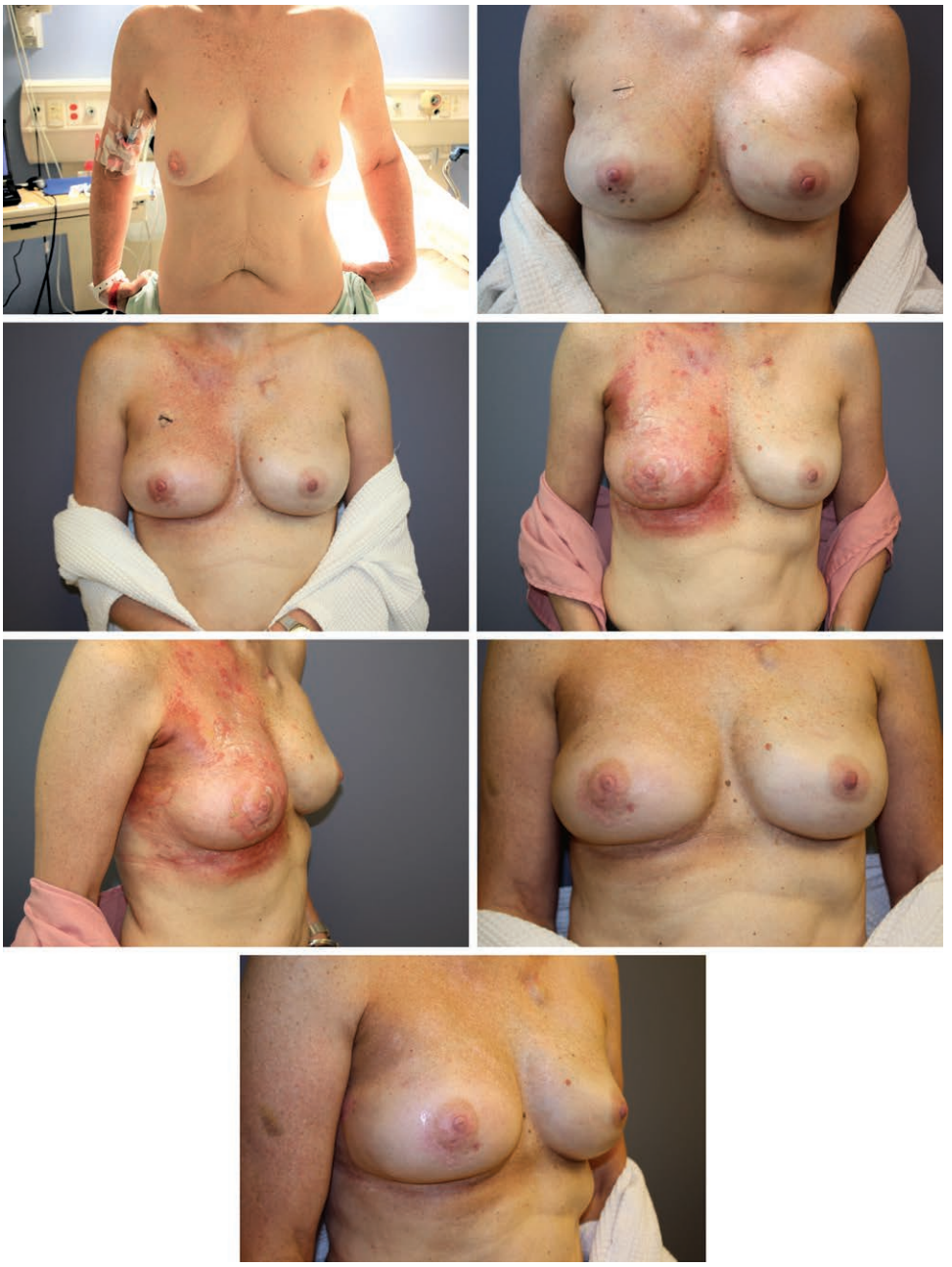

Fig. 1. A, A 49-year-old woman with a diagnosis of invasive right breast cancer. B, Patient at 4 weeks postoperatively following bilateral mastectomy and immediate direct-to-implant reconstruction with anatomical gel implants (Natrelle Style 410 445 cc) and AlloDerm RTU (extra thick, 640 cm^2). C, Patient 1 week into radiotherapy, D and E, 4 weeks into radiotherapy, and F and G, 8 months postirradiation and 9 months postoperative. Patient did not undergo fat grafting and her breasts remain soft without contracture at 8 months postreconstruction.

development leading to capsules that are thinner than native breast capsules.[31–33] But in the setting of PMRT, the benefit of acellular dermal matrix appears to be diminished as reported in the study by Spear et al.[4] This leads to the speculation that perhaps complete prosthesis coverage with acellular dermal matrix and sparing the pectorals major may provide greater protection against the adverse effects of radiotherapy than partial coverage. Sparing the pectoralis major minimizes and eliminates the cephalad pull of the muscle, permitting the implant to remain in its preradiation location. The skin reaction to radiation, however, is not eliminated in the prepectoral approach, which leads to dermal fibrosis and thickening of the skin envelope. This is where the addition of fat may play an important role in improving the overall skin envelope over time. Both hypotheses may be worth pursuing in future studies so as to improve prosthetic reconstruction outcomes PMRT.

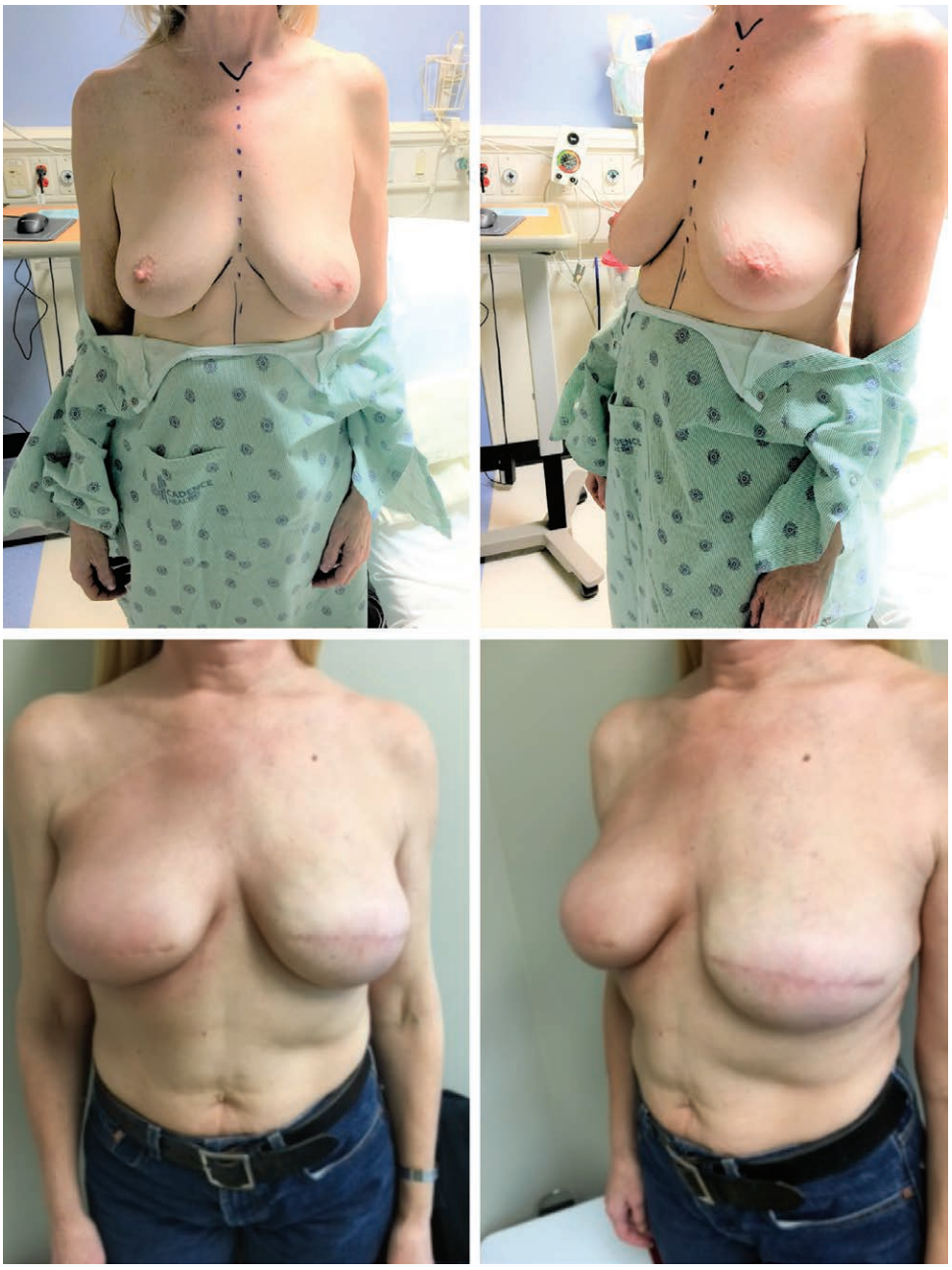

Fig. 2. A and B, A 53-year-old woman with a diagnosis of invasive right breast cancer. She underwent PMRT of her right breast following bilateral mastectomy and immediate direct-to-implant reconstruction with anatomical gel implants (Natrelle Style 410 MX 685 cc) and AlloDerm RTU (extra thick, 640 cm^2). C and D, Patient at 6 months following completion of radiotherapy and no fat grafting.

Technique principles are also important for successful outcomes in the setting of PMRT. The delivery of PMRT after complete tissue healing and recovery from the surgical intervention helps in minimizing the risk of wound dehiscence and skin necrosis. Incisional dehiscence may be minimized via an inframammary incision, which is the preferred incision in all 2-stage reconstructions. When expander irradiation is planned, tissue expansion is completed before irradiation. Fat grafting is usually necessary in irradiated breasts to improve overall aesthetics and is performed after tissue healing, typically 3–6 months after PMRT, although the authors are considering earlier fat grafting. As irradiation progressively compromises tissue perfusion, early fat grafting allows the capitalization of perfused tissue for graft retention and regeneration. The regenerative environment created by the incorporated fat cells may also benefit the host tissue during the early healing phase postirradiation. There is some evidence that earlier fat grafting may mitigate postoperative complications. In a study of 16 patients, Ribuffo et al.[34] reported fat grafting 6 weeks after expander irradiation prevented ulceration and implant exposure.

CONCLUSIONS

Immediate implant-based prepectoral breast reconstruction followed by PMRT appears to be well tolerated, with no excess risk of adverse outcomes, at least in the short-term. Longer follow-up is needed to better understand the risk of PMRT in prepectorally reconstructed breasts.

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