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Breast

Two-Stage Prosthetic Breast Reconstruction after Mastectomy with or without Prior Postmastectomy Radiotherapy

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Background: Two-stage prosthetic breast reconstruction with initial insertion of a tissue expander followed by an implant after a period of inflation is a well-established breast reconstruction option. Most of the current literature concentrates on the immediate setting, and there are only a few reports into delayed cases, especially after postmastectomy radiotherapy (RT). We performed a retrospective review of our experience over a 12.5-year period.

Methods: Between June 1998 and December 2010, a total of 671 patients received prosthetic-only breast reconstruction. Of these, 170 (25.3%) underwent delayed 2-stage prosthetic breast reconstruction after mastectomy for cancer. Patients were divided into group A, no postmastectomy RT (n = 150), and group B, postmastectomy RT (n = 20). The primary factor examined was the failure of the reconstruction from loss of prosthesis with or without smoking. Other complications, as well as rates of revisional surgery were also recorded.

Results: Expander or implant loss occurred in 3 of 150 patients in group A (2.0%) and 3 of 20 patients in group B (15%; $P = 0.02$). For nonsmokers, implant loss was 1.6% and 5.6%, respectively (P = NS). Smoking was associated with 1 of the 3 losses in group A and 2 of the 3 in group B (smokers, n = 2; $P < 0.01$). There was no significant difference in other complications such as seromas or minor wound infections.

Conclusions: Delayed 2-stage prosthetic breast reconstruction has a low failure rate. It can also be successfully completed in selected patients after postmastectomy RT, but care must be taken with patients who smoke. *(Plast Reconstr Surg Glob Open 2017;5:e1489; doi: 10.1097/GOX.0000000000001489; Published online 21 September 2017.)*

Two-stage prosthetic breast reconstruction with initial insertion of a tissue expander followed by changeover to an implant after a period of inflation is a well-established option in breast reconstruction.[1] This can be performed immediately after a mastectomy or delayed by months or years after initial treatment. Most of the current literature concentrates on the former approach, as the use of immediate reconstruction is rapidly increasing, especially in the United States.[1–9]

Traditionally, tissue expansion is considered contraindicated after mastectomy and subsequent radiotherapy (RT).[10] With the recent expansion of the indication for postmastectomy RT,[11,12] the options for breast reconstruction appear to be limited to the more complex and expensive autologous breast reconstructions such as transverse rectus abdominis myocutaneous (TRAM) or deep inferior epigastric perforator flaps.[10] However, younger patients who have not had children or are slim and do not have excess lower abdominal soft-tissue excess for such a flap or patients who have had previous abdominal surgery are not suitable for a TRAM or deep inferior epigastric perforator flap. There are other free flap donor sites that have been reported[13,14] apart from the abdominal wall, but not all patients are willing to sacrifice another part of their body as a donor area and accept the resulting scars, despite the documented benefits of breast reconstruction.[15,16] Other

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options such as the pedicled latissimus dorsi flap are often used together with an expander or implant when the above-mentioned autologous options are excluded.[17]

Although the incidence of immediate 2-stage prosthetic breast reconstruction is increasing despite the risk of postmastectomy RT,[1,18] there are few reports of outcomes in the delayed setting.[19] This retrospective study examines the outcomes of patients who had delayed 2-stage prosthetic breast reconstruction after mastectomy, with or without RT.

PATIENTS AND METHODS

A retrospective review was undertaken of all breast reconstructions performed by a single surgeon (T.L.) between June 1998 and December 2010. A total of 671 patients who received prosthetic-only breast reconstruction were identified and their files audited. Of these, 170 of the 671 patients (25.3%) underwent delayed 2-stage prosthetic breast reconstruction after mastectomy for cancer. Patients who had immediate 2-stage or direct-to-implant or delayed reconstruction after conservation surgery and RT have been reported elsewhere.[20–23] Twenty-eight patients who underwent unilateral delayed 2-stage prosthetic breast reconstruction and also had immediate or previous breast reconstruction on the contralateral side were included as unilateral delayed cases. This included 6 patients who had previously had an immediate 2-stage prosthetic breast reconstruction that failed. Patients were divided into group A, no postmastectomy RT (n = 150) and group B, prior postmastectomy RT (n = 20).

In general, patients selected for postradiation reconstruction had mobile skin flaps without excessive tension, soft-tissue atrophy, telangiectasia formation or excessive hardening of the pectoralis muscles leading to shoulder restriction from radiation fibrosis. The possibility of not fully achieving the desired breast size and/or having a stiff immobile implant afterward due to reduced skin elasticity of irradiated tissues was discussed with the patient preoperatively. RT details were usually missing, but as a rule, the protocol in place at the time of our study was for a dose of 50 Gy in 23 or 25 fractions to the chest wall, usually with alternate day bolus of 0.5–1 cm. No patient received a boost to the scar.

Surgical Technique

All patients having a delayed 2-stage prosthetic breast reconstruction underwent a standard technique. Tissue expanders were not inserted in patients who underwent postmastectomy RT for at least 6 months to allow for acute tissue reaction to settle. Only the lateral 5 cm of the mastectomy scar is opened and a "dual-plane" subpectoralis pocket is dissected, with the distal muscle insertions onto the ribs divided, as the level of the contralateral inframammary crease is usually below these insertions. The parasternal insertions of the pectoralis major muscle are preserved. Lateral to the lateral margin of the pectoralis major muscle, the dissection plane is subcutaneous and superficial to the serratus anterior muscle. A tissue expander is then inserted and the wound closed with drainage in place. Next, a 23-guage needle is then inserted percutaneously into the port of the expander and saline infused into the expander to inflate it to moderate skin tension, usually between 100–300 cc.

Postoperatively the wound is permitted to heal for 4 weeks before further inflation by outpatient percutaneous infusion of saline solution via the magnet detected expander port. Typically, 60–120 cc of saline can be inserted without too much discomfort, as the overlying mastectomy skin is generally hypesthetic. The procedure is then repeated every 2 weeks until the desired volume is achieved, typically after 4–6 visits. For patients who had received postmastectomy RT, the expansion process is slower, as judged by skin tightness clinically. Stage 2 reconstruction is then planned for any time from 6 weeks onward according to the patient's wishes, and it consists of reopening the 5-cm wound laterally on the chest and removing the tissue expander. A capsulotomy is used if any adjustments to the pocket are required and then an anatomical, silicone cohesive gel implant is inserted. The wound is closed with drainage.

The primary factor examined in this study is the failure of the reconstruction from the loss of prosthesis, be it the tissue expander or the implant, and the effect of smoking. Other complications including rates of revisional surgery were also recorded.

Statistical Analysis

Statistical analysis was performed using Fisher's exact test. This study was approved by the Western Sydney Local Health Network Human Research Ethics Committee. Follow-up was counted from the date of stage 2 breast reconstruction. The average follow-up after reconstruction was 34.9 months (range, 1–168 months). There was only 1 patient who returned to a rural area after surgery and was followed up by local physician who did not report any postoperative issues, and for completeness, we have included all patients over this period. Excluding this patient, the minimum follow-up was 3 months.

RESULTS

Between June 1998 and December 2010, 170 patients underwent delayed 2-stage prosthetic breast reconstruction. These patients were divided into group A, no postmastectomy RT (n = 150), and group B, with postmastectomy RT (n = 20). Group B included 7 patients who had received bilateral reconstructions, but postmastectomy RT was only previously given unilaterally. There was no significant age difference between the 2 groups, although the patients in group B tended to be younger. The mean age for all patients was 50.4 years, and the average time from mastectomy to breast reconstruction was 43.3 months. The average final implant size for group A was 492.5 g (range, 180–775) and for group B, 452.5 g (range, 180–685). The average size for group B was 8.1% smaller than for group A (Table 1).

Complications Including Loss of Prosthesis

A total of 6 patients lost their expander or implant, 3 in group A (3/150, 2.0%) and 3 in group B (3/20, 15%; $P = 0.02$; Table 2). Of the patients in group A, 2 lost their tissue expanders and the third patient lost her implant

Table 1. Patient Demographic Data

	Group A—No RT			Group B—RT		
N = 170	Unilateral	Bilateral	Total	Unilateral	Bilateral	Total
No. patients	120*	30	150	13	7	20
No active smokers (%)			24 (16)			2(10)
RT given	No	No		Yes	Unilateral only	
No CT given (%)			76 (50.7)			19 (95.0)
No. breasts	120	60	187†	20		20
Mean age (y) (range)			50.9 (23.8–83.8)			47.8 (27.8–72.8)
Mean time to breast reconstruction after initial mastectomy (mo) (range)			46.1 (1–313)			41.5 (8–233)
Average follow-up (mo) (range)			34.4 (1–168)			38.6 (1–86)
Average size of final implant (g) (range)			492.5(180–775)			452.5 (180–685)

*Includes 6 unilateral from previous failed immediate breast reconstruction.
†Includes 7 contralateral breasts from group B.
CT, chemotherapy.

after stage 2 breast reconstruction, whereas for the patients in group B, all 3 prostheses were lost after stage 2 reconstruction.

All 3 patients in group A who lost their expander or implant developed seromas that required repeated ultrasound-guided aspirations. Two eventually developed wound infection that necessitated removal of the prostheses. The third patient did not attend ultrasound-guided aspirations and the wound dehisced, ejecting the expander. After the prosthesis was removed and the wound allowed time to settle over a period of 3 months, all 3 patients were successfully "re-reconstructed," with further tissue expansion and subsequent implant placement. Encouragingly, all 6 patients who had previously failed immediate 2-stage prosthetic breast reconstruction also underwent successful 2-stage delayed breast reconstruction.

Of the 3 patients in group B who lost their implants, 1 developed wound dehiscence 8 weeks later while travelling overseas and another developed a major wound infection 6 months after surgery. The third patient developed a wound on the medial end of her inframammary crease 7 months after reconstruction, which appeared to have been caused by pressure from an underwire in her bra. This patient eventually underwent further successful 2-stage prosthetic breast reconstruction after addition of a latissimus dorsi myocutaneous flap. The other 2 patients did not undergo further breast reconstruction.

Seroma was the most common complication in both groups, affecting 19 patients (12.6%) in group A and 4 in group B (20%; P = NS). Another 10 patients in group A and 1 in Group B (P = NS) developed minor wound infections (defined as requiring oral antibiotics only). Two patients developed a hematoma after stage 1, and these were evacuated in the operating theatres. The patients then completed reconstruction without further complications. Other infrequent complications included delayed wound healing, managed by simple dressing (n = 4), spontaneous deflation of tissue expanders (n = 2) and cellulitis in the arm (n = 1).

Apart from revisions for complications listed above, 11 other patients underwent revisional surgery for change of implant sizes between 3 and 412 months later (mean, 37.5 months). All of them were from group A and none from group B.

Effect of Smoking

There were 24 current smokers in group A, one of whom lost her prosthesis (4.2%). However, in group B, 2 patients were smokers and both lost their prosthesis (100%), a highly significant difference ($P < 0.01$). For nonsmokers, there was no significant difference in the rate of implant loss between the 2 groups. Two of 126 patients (1.6%) in group A and 1 of 18 (5.6%) from group B lost their prosthesis (P = NS). There is no difference when comparing loss of prosthesis between nonsmokers and smokers within group A, whereas there is a highly significant difference in group B, 5.6% of nonsmokers versus 100% of smokers, $P = 0.016$. However, it must be noted with caution that the number of events was small.

DISCUSSION

Two-stage prosthetic breast reconstruction with initial insertion of a tissue expander followed by an implant after

Table 2. Postoperative Complications for Groups A and B

	Group A—No RT (n = 150)				Group B—RT (n = 20)				
	Stage 1	Stage 2	Total	%	Stage 1	Stage 2	Total	%	*P*
Failure (loss of prosthesis)	2	1	3*	2	0	3	3	15	0.02
Hematoma	2	0	2	1.3	0	0	0	0	
Delayed wound healing	4	0	4	2.7	0	0	0	0	
Return to theatre for wound dehiscence	2	0	2	1.3	1	0	1	5	
Seroma	10	6	19*	12.6	2	2	4	20	0.26
Minor infection	10	6	16	10.7	1	0	1	5	0.70
Arm cellulitis	1	0	1	0.7	1	0	1	5	
Expander deflation	2	0	2	1.3	0	0	0	0	
Hypertrophic scar	0	1	1	0.7	0	0	0	0	

*Including 3 patients who developed seroma and subsequently lost their prostheses.

a period of inflation is a well-established option in breast reconstruction.[1] This can be performed immediately after mastectomy or in a delayed setting. In this study, expander or implant loss occurred in 3 of 150 patients without prior radiation (2.0%) and 3 of 20 patients who had prior radiation (15%; $P = 0.02$). For nonsmokers, implant loss was 1.6% and 5.6%, respectively (P = NS). For carefully selected patients, a delayed prosthetic breast reconstruction after a mastectomy and prior radiation is successful in over 90% of patients.

There are several advantages of delayed breast reconstruction. First, the patient and surgeon can focus on treating the cancer without any interference from the potential risk of additional complications[24,25] such as infection delaying adjuvant chemotherapy or the presence of the tissue expander affecting RT planning.[26] Second, in delayed prosthetic breast reconstruction, the tissue expander is only partially submuscular (pectoralis major), resulting in less tightness and pain and allowing the eventual level of the inframmamary fold to be better controlled. An acellular dermal matrix is not needed, thus reducing costs. Third, although seroma is still common, we have previously found that the incidence is significantly less in delayed breast reconstruction in our center, occurring 5.3% for the delayed procedure versus 15.9% for the immediate procedure, $P = 0.002$.[22]

In our current review, of patients who did not receive RT before their reconstruction, only 2 of 150 lost their expander (1.3%) and 1 lost her implant (1/150, 0.7%), giving a total of 2% (or 3/187 breasts, i.e., 1.7% per breast). This is lower than our own results from 24/363 (6.7%) immediate breast reconstruction patients during the same period (5.0% per breast).[22] However, some of our patients who had immediate breast reconstruction received adjuvant chemotherapy, which may account for some of the prosthesis loss. Excluding patients who had received chemotherapy during stage 1 in immediate breast reconstruction, there were 10 prostheses lost over 212 cases (4.7%), still higher than the 2% in this series ($P = 0.25$).[22]

It has been reported that women seeking immediate reconstruction at the time of mastectomy show a "relatively higher incidence of psychosocial impairment and functional disability" and that delayed breast reconstruction may also be psychologically better for patients.[27] Certainly, patients who find it difficult to deal with the diagnosis of having breast cancer plus having to decide whether to have immediate breast reconstruction or not should be reassured that they can still have breast reconstruction in a delayed setting, alleviating the pressure of having to make a rushed decision that they may regret later.[28] Others report that having lived without breasts, patients who then elect to undergo delayed breast reconstruction appreciate the reconstruction more.[29] The other indication for a delayed 2-stage breast reconstruction is a failed initial breast reconstruction. We have successfully performed that in 6 previously failed immediate breast reconstruction patients who did not receive RT as well as the 3 patients in group A who failed the first attempts of delayed breast reconstruction.

It has been generally accepted in the literature that prosthetic-only breast reconstruction is contraindicated after RT.[10,30] Most of the early literature has small numbers or mixed groups without specifically addressing the topic of 2-stage prosthetic breast reconstruction after postmastectomy RT in the delayed setting.[31–35] Lam et al.[18] published a systematic review of immediate 2-stage prosthetic breast reconstruction in 715 patients who underwent adjuvant RT after insertion of a tissue expander or an implant and found an average reconstruction failure rate of 18.6% (range, 0–45%). Despite that relatively high failure rate, most authors continued to perform immediate breast reconstruction after mastectomy and RT.

In a recently published meta-analysis on prosthetic breast reconstruction in previously irradiated breasts,[19] the authors included 18 studies, but only 12 reported on 2-stage prosthetic reconstruction using a tissue expander, of which "two[36,37] included delayed cases, and the other two[38,39] included both." The first of these 4 reports within the meta-analysis is a survey of the Danish Registry of Plastic Surgery of the Breast between 1999 and 2006 by Hvilsom et al,[36] who reported on 429 delayed 2-stage prosthetic breast reconstructions, of which 76 had prior RT. The failure rate was 6.8% (16 expanders, 8 implants) for those patients who did not receive prior RT and 13.1% for those who did (8 expanders, 2 implants). Seth et al.[37] also compared the results of immediate (1,127 breasts in 834 patients) or delayed (74 breasts in 59 patients) tissue expander reconstruction with or without postmastectomy RT. Their study found that in delayed breast reconstruction, the "explantation or conversion to flap" (ECF) rate without postmastectomy RT was 7.8% (4/51) and 8.7% (2/23) for those who had prior RT. The corresponding ECF rates for breasts undergoing immediate reconstruction were 6.0% (53/879) and 14.1% (35/248), respectively. It is interesting to note that their failure rate was also higher in the immediate group with adjuvant RT. However, an earlier report from the same unit[40] showed a higher ECF rate of 40% in 4/10 cases of delayed 2-stage prosthetic breast reconstruction after postmastectomy RT.

The third of the studies included in the meta-analysis was a comparison of prosthetic versus autologous breast reconstruction.[38] It is not clear what percentage of the cohort comprised delayed breast reconstruction, but only 27 (3.7%) were quoted as having had a history of RT before reconstruction. The implant extrusion rate in radiated patients was reported to be 16.5%. The fourth report by Chang et al.[39] evaluated 1,000 consecutive reconstructions, which included expander/implant alone in 776 breasts, latissimus dorsi flap/implant in 146, and 78 cases with a free TRAM flap/implant. Of the 776 breast reconstructions with expander/implant alone in 534 patients, 704 breasts did not receive any RT, whereas 33 had received preoperative RT. Once again, it is not clear if these were postmastectomy RT or RT after lumpectomy and then mastectomy and breast reconstruction after a recurrence, which may behave differently.[20] Of the 33 patients in the study by Chang et al.[39] who received prereconstruction RT, 30.3% (10/33) lost their implant compared with 9.4% (66/704) of patients who did not receive any RT.

Similarly to this most recent meta-analysis, a number of earlier meta-analyses or systematic reviews have all included a mixture of autologous and various types of prosthetic breast reconstructions, with immediate and delayed

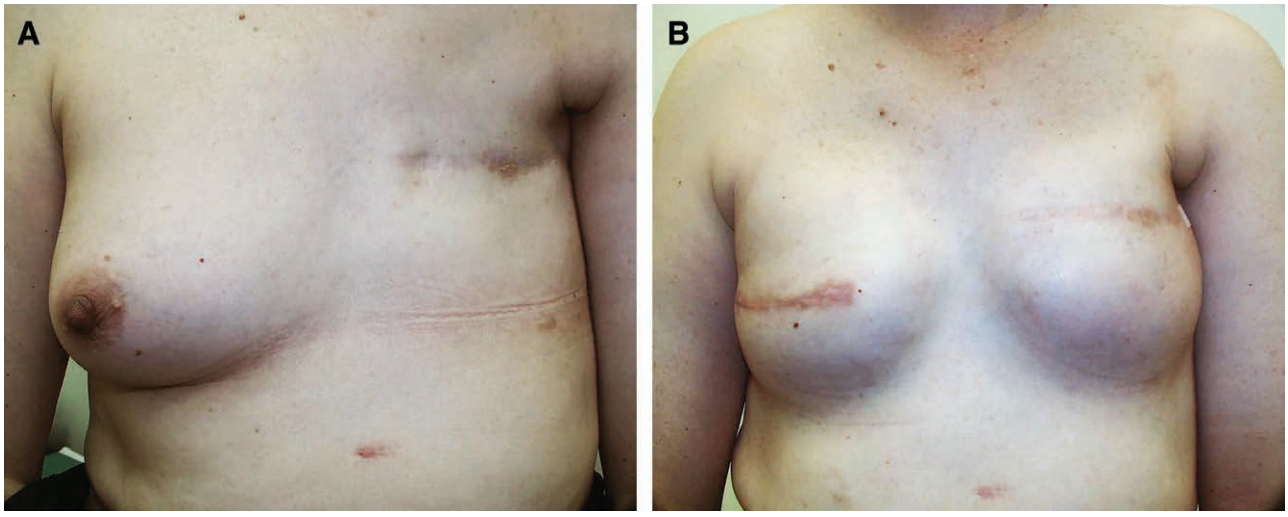

Fig. 1. A, Preoperative photograph of 47-year-old patient 19 years after left mastectomy for breast cancer and adjuvant RT with newly diagnosed right breast cancer. B, Three-month postoperative photo after 2-stage delayed prosthetic reconstruction of left breast and immediate prosthetic reconstruction of right breast.

cases grouped together.[41–44] As a result, the analyses are often difficult to interpret to obtain a meaningful comparison of the impact of prior, postmastectomy radiation on delayed prosthetic breast reconstruction. Even if the subtypes are delineated in the Methods section, the results are often reported as a group and impossible to extract.

We believe that with increasing experience, authors should undertake to report "pure" series of each subtype of prosthetic breast reconstruction and related timing, namely, (1) immediate 2-stage prosthetic breast reconstruction after mastectomy for primary breast cancer and adjuvant RT; (2) immediate 2-stage prosthetic breast reconstruction after mastectomy for recurrent cancer subsequent to previous lumpectomy and RT; (3) delayed 2-stage prosthetic breast reconstruction after mastectomy and RT; (4) delayed 1-stage prosthetic augmentation after lumpectomy and RT and; (5) RT after 1-stage direct-to-implant reconstruction after skin or nipple-sparing mastectomy.[20–23,33,35] In addition, there are 2 separate operations involved in a 2-stage breast reconstruction and each may have different risks as our series has demonstrated and reported, just as Hirsch et al. showed in their study on the risks at each stage in immediate breast reconstruction.[45] As such, reporting complications per breast reconstruction rather than per patient should reflect the true incidence of complication, especially with increasing contralateral and bilateral prophylactic mastectomies.

Although our series is relatively small, it is a "pure" series of 20 consecutive patients who underwent 2-stage prosthetic breast reconstruction after postmastectomy RT. Encouragingly, we were able to successfully complete the tissue expansion process in all patients. In addition, we were able to expand the skin to eventually accommodate breast implants of an average size of 452.5 g, only 8.1% smaller than the average of 492.5 g in patients who did not receive RT after mastectomy. Although there were 3 failures after stage 2, it is interesting that all 3 patients ultimately lost their implants relatively late, at 8 weeks, 6 months, and 7 months. As a result, close follow-up within the first year of surgery is recommended. Significantly, 2 of the 3 patients were current smokers, which has been shown to cause complications.[46] Finally, we have found that, on the whole, the aesthetic results were acceptable despite postmastectomy RT. With recent interests in fat transfer, we would anticipate that the final aesthetic result can be further improved (Fig. 1).[47]

In 3 of 3 patients who lost their prosthesis in group A, seroma was the initial complication, with the infection setting in after multiple aspirations. We currently provide oral antibiotic cover for 24 hours after the procedure.

CONCLUSIONS

Two-stage delayed prosthetic breast reconstruction has a low failure rate that is comparable with the immediate option. It can also be successfully completed in selected patients after mastectomy and RT but is not recommended with patients who smoke.

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