The Role of the Latissimus Dorsi Flap in Reconstruction of the Irradiated Breast

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Background: The role of the latissimus dorsi flap with a prosthesis in reconstruction of the previously irradiated breast is examined in this retrospective review of one surgeon's 10-year experience.
Methods: Twenty-eight patients with available charts were divided into five groups: (1) 11 patients with previous breast conservation therapy and recurrence; (2) eight patients with previous mastectomy and radiation; (3) four patients with an expander that had been irradiated; (4) three patients with prior irradiation and implant reconstruction presenting for revision; and (5) two patients with breast deformity from breast conservation therapy.
Results: Eighteen patients had a latissimus flap placed at the time of the expander and 10 had a latissimus flap at the time of implant placement or exchange. Average follow-up was 28.8 months (range, 1 week to 7 years). All patients had soft breasts at follow-up, with no evidence of capsular contracture. Donor-site complications included five donor-site seromas. The majority of patients (65 percent) underwent a planned two-stage reconstruction, and the majority of the revision operations were for exchanges to smaller implants. The response rate to a patient satisfaction survey was 67 percent. The average cosmetic satisfaction rating was 8.5 of 10 (with 10 being the highest). The average pain rating was 1.7 of 10 (with 10 being the worst). The overall satisfaction rating was 8.8 of 10. Fourteen of 16 patients indicated that they would undergo this procedure again.
Conclusions: Although purely autologous reconstructions may be the best choice for many irradiated breasts, it has been shown in this study that a cosmetically acceptable reconstruction with manageable risk can be performed using a prosthesis combined with a latissimus dorsi flap. (*Plast. Reconstr. Surg.* 119: 1, 2007.)

Radiation therapy has become increasingly common in the context of breast reconstruction. With the expanded use of breast conservation therapy for early and localized cancers as opposed to traditional mastectomies, more women are undergoing radiation therapy. In addition, more recent studies have shown possible benefits for some women who undergo radiation therapy even after mastectomy.[1–4] In addition, some women may seek reconstruction for deformities that have unfortunately developed as a result of their breast conservation therapy. Others may develop recurrent local disease after their mastectomies and reconstruction. The end result is more women who are having breast reconstruction who have had or will have radiation therapy.

Several articles have discussed the detrimental effects radiation has on tissues and, in particular, breast reconstruction.[5–8] Contracture, wound-healing problems, implant exposure, skin necrosis, and pigmentary changes are all commonly associated with radiation therapy.[9,10] Additional studies demonstrated that autologous reconstructions after radiation therapy have fewer complications and/or better cosmetic outcomes than reconstructions with an implant. For this reason, the free or pedicled transverse rectus abdominis musculocutaneous (TRAM) flap has become the workhorse for reconstruction of the previously irradiated breast.[11–14]

Despite the favorable outcomes of TRAM flap reconstructions, not all women are candi-

From the Department of Plastic Surgery, Georgetown University Hospital.
Received for publication May 20, 2005; accepted August 19, 2005.
Presented at the Annual Meeting of the Northeastern Society of Plastic Surgeons, in Naples, Florida, January 19 through 22, 2005.
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DOI: 10.1097/01.prs.0000244756.45925.7f

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Table 1. Data for the 28 Patients with Complete Records

Patient	Age (yr)	Type of Cancer	Radiation Year	Latissimus Year	Years Between	Chemo therapy	Implant Type	Follow-Up (mo)	Baker Score	Aesthetic Score	Pain Score	Revisions	Complication
Group 1: prior breast conservation therapy, now with recurrence, mastectomy, and immediate reconstruction with expander and latissimus flap													
1	55	DCIS	1990	1998	8	No	Saline, 450 cc	55.6	1b	NA	NA	1. IMF elevation 2. Smaller implant	None
2	41	Unknown	1998	1999	1	No	Saline, 310 cc	0.1	1b	NA	NA	None	None
3	32	Invasive ductal	1999	2000	1	Yes	Saline, 510 cc	6.3	1b	10	1	None	None
4	73	Unknown	Unknown	2001	Unknown	No	Silicone, 360 cc	24.7	1b	9	1	None	None
5	37	Unknown	2002	2002	0	Yes	Silicone, 450 cc	12.8	1b	8	2	None	None
6	53	Invasive ductal	1988	2000	12	No	Saline, 390 cc	56.9	1b	9	1	None	None
7	68	Invasive ductal	1985	2000	15	No	Saline, 390 cc	4.3	1b	NA	NA	Smaller implant	None
8	33	Unknown	1988	2002	14	Yes	Saline, 500 cc	32.1	1b	NA	NA	1. Smaller implant 2. IMF elevation	Hematoma after expander
9	52	DCIS	2001	2003	2	Yes	Silicone, 300 cc	12.8	1b	8	1	None	Partial nipple necrosis
10	77	Invasive ductal	1999	2001	2	Yes	Silicone, 340 cc	38.5	1b	9	1	None	None
11	45	Invasive ductal	1994	1999	5	Yes	Silicone, 540 cc	14.1	1b	NA	NA	None	None
Group 2: prior mastectomy and irradiation, now presenting for delayed reconstruction with expander and latissimus flap													
12	53	Invasive lobular	1998	1999	1	Yes	Saline, 375 cc	49.0	1b	NA	NA	Smaller implant	None
13	50	Invasive ductal	2001	2003	2	Yes	Saline, 425 cc	4.9	1b	9	1	None	None
14	44	Unknown	1993	1994	1	Yes	Saline, 510 cc	106.3	1b	10	1	Contralateral exchange	None
15	38	Inflammatory CA	1995	1996	1	Yes	Saline, 230 cc	77.6	1b	7.5	1	None	None
16	67	Invasive ductal	1994	1995	1	Yes	Saline, 510 cc	86.1	1b	NA	NA	None	Partial flap necrosis
17	54	Adenocarcinoma	1997	2001	4	Yes	Saline, 360 cc	6.4	1b	NA	NA	None	Seroma
18	54	LCIS	2000	2001	1	Yes	Saline, 390 cc	1.0	1b	NA	NA	None	None
19	50	Invasive ductal	1992	1998	6	Yes	Saline, 510 cc	31.5	1b	8	3	Smaller implant	None
Group 3: prior mastectomy with immediate expander, followed by irradiation and implant exchange and latissimus flap													
20	51	Invasive ductal	1998	1999	1	Yes	Saline, 390 cc	4.0	1b	7	4	1. Exchange for infection 2. Smaller implant	None
21	44	Invasive ductal	2000	2000	0	Yes	Silicone, 400 cc	36.6	1b	NA	NA	None	Seroma
22	59	Invasive lobular	1995	1995	0	Yes	Saline, 390 cc	49.1	1b	10	1	Contralateral reduction	Seroma
23	32	Invasive ductal	1995	1995	0	Yes	Saline, 390 cc	120.8	1b	7	1	1. Implant deflated 2. Smaller implant	None

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Table 1. Continued

Patient	Age (yr)	Type of Cancer	Radiation Year	Latissimus Year	Years Between	Chemo therapy	Implant Type	Follow-Up (mo)	Baker Score	Aesthetic Score	Pain Score	Revisions	Complication
Group 4: prior mastectomy, irradiation, and implants, presenting for revision reconstruction with new prosthesis and latissimus flap													
24	39	Invasive ductal	1995	2002	7	Yes	Saline, 450 cc	17.0	1b	NA	NA	None	None
25	49	Invasive ductal	2001	2003	2	Yes	Saline, 330 cc	5.0	1b	7	1	None	Seroma
26	50	Invasive ductal	1995	1995	0	Yes	Saline, 500 cc	13.0	1b	NA	NA	Smaller implant	None
Group 5: prior breast conservation therapy with deformity, treated with prosthesis and latissimus flap													
27	36	Invasive ductal	1998	2002	4	Yes	Saline, 215 cc	43.2	1b	10	1	None	None
28	58	DCIS	2001	2003	2	Yes	Saline, 500 cc	1.6	1b	8	6	None	Seroma
Averages								32.5		8.5	1.7		

DCIS, ductal carcinoma in situ; CA, carcinoma; LCIS, lobular carcinoma in situ; NA, not applicable.

dates for or wish to undergo such a large procedure. Extremely overweight or thin patients, smokers, and those with prior abdominal surgery may be poor candidates for TRAM flaps. In addition, many women are deterred by the commitment, recovery time, and risks involved with (pedicled or free) TRAM flap reconstruction. For such women who have had radiation therapy, the remaining reconstructive options are limited.

We have previously published our long-term results of staged breast reconstructions with saline-filled implants in patients who have undergone radiation therapy.[15] In that study, it was found that some women had successful implant-only reconstruction, but during the time of the study, half the patients with saline implants eventually required flap coverage. Those patients who did undergo a latissimus flap either electively or in a salvage procedure had cosmetic outcomes equivalent to those patients with implant-only reconstructions who had not received radiation therapy. Because of those encouraging results seen with patients who had received a latissimus flap after radiation therapy, we chose to further evaluate specifically the effectiveness of the latissimus dorsi musculocutaneous flap in patients who have had radiation therapy following mastectomy or lumpectomy and undergo prosthetic reconstruction.

PATIENTS AND METHODS

A retrospective chart review was performed of all patients operated on by the senior author (S.L.S.) between 1994 and 2003 who had undergone breast cancer surgery and radiation therapy followed by either immediate, delayed, or revision breast reconstruction using a latissimus flap and prosthesis. Parameters studied included patient age, type of cancer, type and timing of previous surgery, timing of radiation, type of reconstruction, interval between reconstruction and implant, implant type and size, length of follow-up, Baker classification evaluated by the senior surgeon (S.L.S.), complications, and patient-evaluated cosmetic result. Radiation dosing could not be identified for the majority of the patients.

RESULTS

Of 31 patients identified, 28 complete records were reviewed and separated into five

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groups (Table 1). Group 1 consisted of 11 patients with previous lumpectomy and local irradiation that were followed later by mastectomy and immediate breast reconstruction with an expander and simultaneous latissimus flap (Fig. 1). Group 2 included eight patients who were irradiated following mastectomy and underwent delayed reconstruction with an expander and latissimus flap (Fig. 2). Group 3 consisted of four patients who had a prior mastectomy with immediate expander reconstruction followed by local irradiation during the expansion phase and who later underwent exchange of the expander to an implant with latissimus flap coverage (Fig. 3). Group 4 included three patients who had irradiation following their mastectomy and reconstruction and presented for revision that included a latissimus flap and new implant (Fig. 4). Group 5 consisted of two breast conservation therapy patients who were irradiated following lumpectomy and later underwent reconstruction with a latissimus flap that included an implant for their breast deformity (Fig. 5). These patients did not undergo mastectomy.

A total of 28 reconstructions were performed using 22 saline and six silicone implants. In group 1, there were six saline and five silicone implants (average, 413 cc). In group 2, there were eight saline implants (average, 414 cc). In group 3, there were one silicone and three saline implants (average, 392 cc). In group 4, there were three saline implants (average, 427 cc). In group 5, there were two saline implants (average, 357 cc). All implants were placed in either a total sublatissimus or partial latissimus plane but superficial to the pectoralis major muscle.

The mean patient age was 51 years. Sixteen of the patients (57 percent) underwent immediate breast reconstruction following mastectomy, whereas nine of the patients (32 percent) had delayed breast reconstruction and three (11 percent) had revision of a previous reconstruction. For the delayed reconstruction group, the mean time from mastectomy to final implant was 46 months (range, 14 to 192 months). The mean time between placement of the expander and exchange for the implant was 6.7 months (range, 2.7 to 13.8 months). The mean length of follow-up for all patients from the time of implantation was 32.5 months; four patients subsequently died after latissimus flap surgery.

Generally, patients underwent a two-stage reconstructive process. Patients who had undergone prior breast conservation therapy or mastectomy had latissimus flaps and expander placement with later implant exchange and nipple reconstruction. Patients who had undergone immediate reconstruction with an expander and subsequent radiation therapy had latissimus flap with nipple reconstruction at the same operation or as a planned next stage. There was a total of 70 procedures for the 28 patients, giving an average of 2.5 procedures per patient. There were 14 revision procedures, giving an average

Fig. 1. Photographs of a 33-year-old woman after earlier right breast conservation therapy, now found to be BRCA-1 positive. (*Left*) Preoperative frontal view. (*Center*) Postoperative frontal view after bilateral subcutaneous mastectomies and expander placement. The patient had a hematoma that was drained in the operating room. (*Right*) Postoperative result 20 months after bilateral placement of 500-cc saline implants. The latissimus flap was added to the right breast in the inferior pole at the stage when the expanders were replaced with implants.

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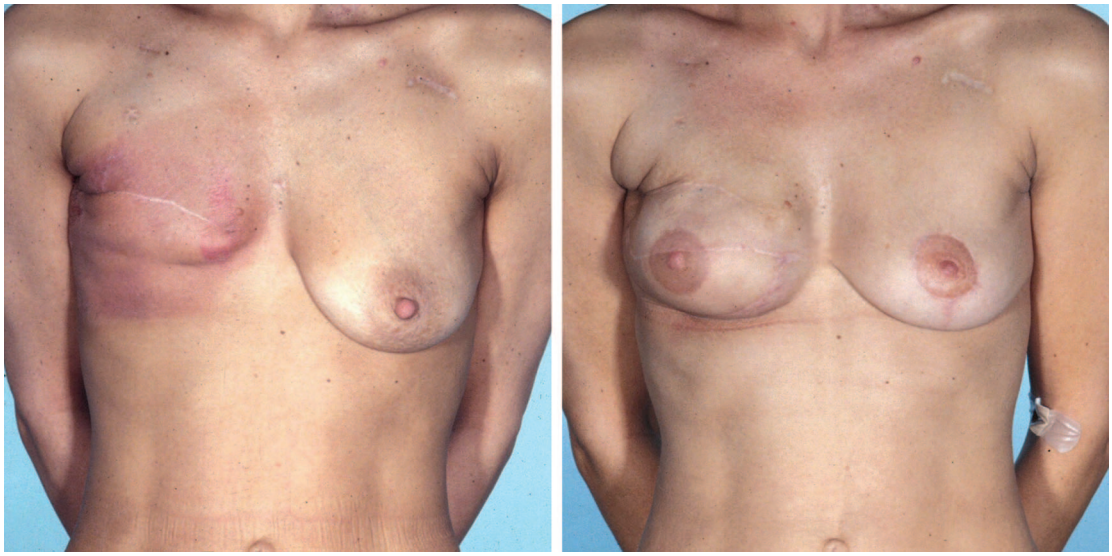

Fig. 2. Photographs of a 38-year-old woman who had undergone prior mastectomy and radiation therapy and who presented for delayed reconstruction. (*Left*) Preoperative frontal view. (*Right*) Postoperative results 6.5 years after reconstruction with a latissimus flap and 230-cc saline implant, with a left-sided mastopexy.

Fig. 3. Photographs of a 44-year-old woman with prior left mastectomy and immediate reconstruction with an expander followed by radiation therapy. (*Left*) Preoperative frontal view. (*Center*) Postoperative view after expander placement and radiation therapy. (*Right*) Postoperative result 18 months after adding a latissimus flap at the time of the silicone implant and nipple reconstruction. Tattooing was performed later.

of 0.5 revisions per patient. Eighteen of 28 patients (65 percent) underwent the planned two-stage reconstruction without any revision operations (Table 1). Four patients had a smaller implant replaced for symmetry. Two patients had contralateral breast procedures, one capsulectomy and one reduction mammaplasty. One patient had an infection of an implant that was exchanged and had another subsequent exchange for a smaller implant. One patient's implant deflated after 7 years, and this patient underwent implant exchange. One patient had their inframammary fold elevated and had another exchange later for a smaller implant. One patient had a smaller implant placed and had another procedure to adjust the inframammary fold.

A patient satisfaction survey was sent to the surviving 24 patients at the end of the follow-up time. Sixteen surveys were returned (67 percent return rate). On a scale of 1 to 10 (where 10 = high and 1 = low), patients rated their cosmetic

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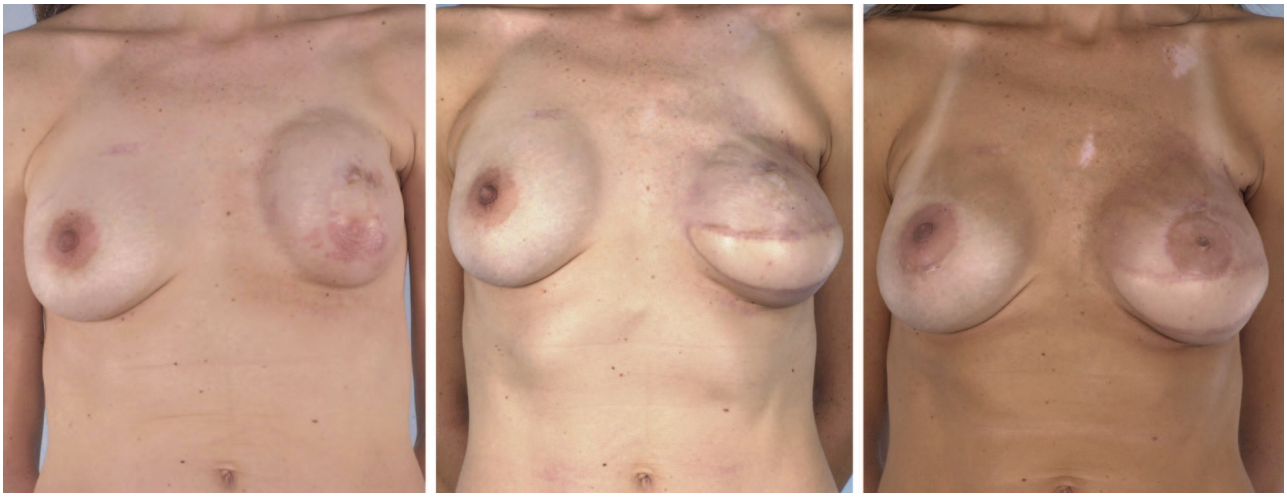

Fig. 4. Photographs of a 39-year-old woman who had undergone prior left mastectomy, expander/implant reconstruction, and radiation therapy during the expansion 8 years earlier, with significant capsular contracture and soft-tissue thinning, and who requested a revision operation. (*Left*) Preoperative frontal view. (*Center*) Postoperative view after expander placement and latissimus flap to the left side. (*Right*) Postoperative results 17 months after exchange to a 450-cc saline implant and right-sided augmentation mammaplasty.

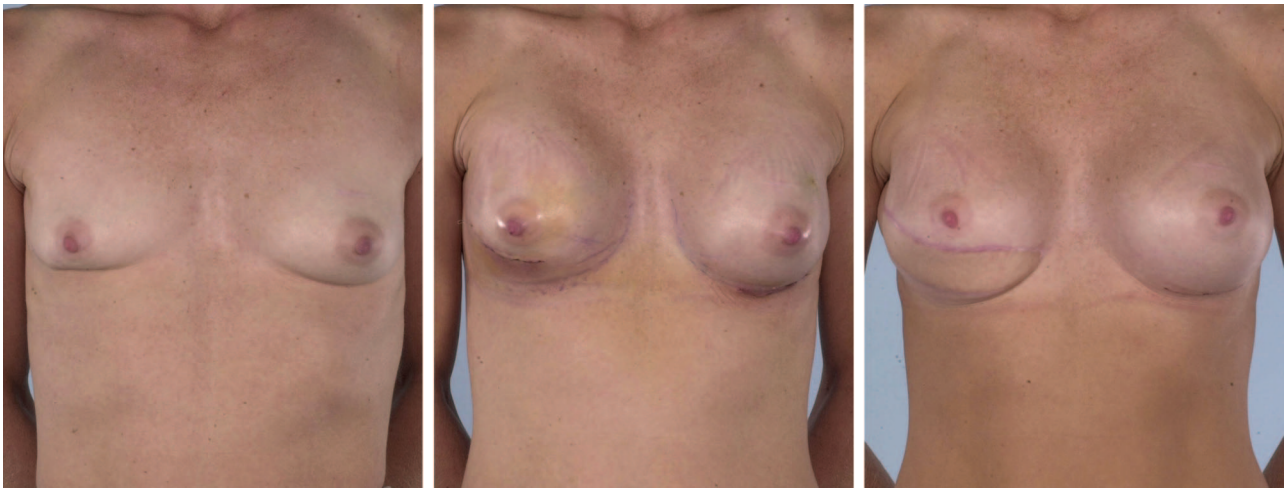

Fig. 5. Photographs of a 36-year-old woman who underwent right breast conservation therapy with a subsequent lower pole breast deformity. (*Left*) Preoperative frontal view. (*Center*) Postoperative view after expander placement and left-sided augmentation mammaplasty. (*Right*) Postoperative results 37 months after exchange for a 215-cc saline implant on the right with a latissimus flap.

satisfaction, pain, and overall satisfaction with the reconstruction. The mean cosmetic satisfaction score was 8.53 (range, 7 to 10). The mean pain score at last follow-up was 1.68 (range, 1 to 6). The mean overall satisfaction was 8.78 (range, 5 to 10). Fourteen of 16 respondents said they would go through with this type of reconstruction again. Fifteen of 16 respondents said they would recommend this type of reconstruction to others.

The complications that were studied included capsular contracture, device extrusion, hematoma, and back seroma. There was one patient (3.5 percent) with a capsular contracture 6 years after reconstruction that was successfully corrected with capsulectomy and implant exchange. Similarly, there was one expander extrusion that was successfully corrected during the reconstructive process. One reconstruction resulted in a hematoma that required operative drainage but did not affect the final reconstructive outcome. Five patients had seromas at the latissimus flap donor site that resolved with intermittent aspiration in the office.

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DISCUSSION

The optimal reconstruction following mastectomy depends on many factors, including the patient's anatomy, activity level, general health, type of mastectomy (e.g., skin sparing, nipple preserving, radical), radiation status, lymph node status, and history of prior procedures. Radiation therapy is associated with several issues that must be considered by the reconstructive surgeon. Radiation dosing is highly variable between institutions and geographic regions. Likewise, patients respond to radiation therapy differently. Despite the dose and patient response to radiation, all reconstructions, whether purely autologous or involving a prosthesis, can be adversely affected.

Although it is generally accepted that all reconstructions in the setting of radiation are inferior, several studies have previously advised against the use of the latissimus flap with a prosthesis. In 1994, Kroll et al.[12] published their results of 66 TRAM and 16 latissimus dorsi reconstructions in previously irradiated patients. In their series, a 63 percent complication rate was reported for latissimus reconstructions compared with a 33 percent complication rate in TRAM reconstructions. Even though the latissimus dorsi group had a higher mean radiation dose (5822 cGy versus 5637 cGy), they state that the TRAM flap was flap of choice in patients with "more severe radiation damage." Despite the preference for the TRAM flap, there was no statistically significant difference in aesthetic outcome between the TRAM and latissimus dorsi groups. When taking donor-site complications into consideration, however, "differences between the TRAM and the latissimus dorsi flaps are considerably reduced." Likewise, they state that "coverage of the implant with the muscle flap appeared to overcome any tendency toward increased capsular contracture that might have been caused by irradiation but did not eliminate it."

In 1995, Evans et al.[11] published their experience with implant reconstructions in patients who had undergone radiation at various stages in the reconstructive process. No expanders were used in this study. Despite small numbers to support their argument, they concluded that only autologous reconstructions should be performed in the setting of radiation and that flaps did not provide protection against radiation, either preoperatively or postoperatively. In 2003, Disa et al.[13] reported on a small series of patients who had immediate reconstruction following failed breast conservation therapy. Three patients had latissimus dorsi flap with implant reconstruction. Although they conclude that TRAM flaps are preferred in irradiated patients, they feel that a latissimus flap with an expander, followed by exchange to an implant, can be an alternative.

We have previously reported our experience with prosthetic reconstruction of the irradiated breast.[15] It was found that there was an increased capsular contracture rate (32 percent versus 0 percent) compared with nonirradiated patients, and almost half of all irradiated implant reconstructions required flap coverage. Likewise, a similar study out of Memorial Sloan-Kettering Cancer Center[16] found an increased rate of capsular contracture (68 percent versus 40 percent) and a decreased patient satisfaction rate (88 percent versus 67 percent) in patients who underwent postimplantation reconstruction radiation therapy compared with a nonirradiated cohort. Seventy-five percent of their patients felt that they would undergo the same implant reconstruction again. That study does not discuss the role of the latissimus flap for the correction of capsular contracture. Although we agree that a satisfactory result may occasionally be possible with only an implant, our review of the latissimus flap helps to illustrate the added benefit that this brings to reconstruction of the irradiated breast that may improve cosmetic results and help increase patient satisfaction levels.

In our institution, the preferred method of reconstruction for patients who need radiation therapy is to perform a delayed reconstruction with a pedicled or free TRAM flap. Although some authorities prefer immediate reconstruction followed by radiation therapy, we feel that the response of the TRAM flap to radiation is too unpredictable a risk. The alternative of bringing nonirradiated tissue for reconstruction of the breast after radiation therapy allows replacement of as much or as little radiation-damaged tissue as needed. A recent report from the M. D. Anderson Cancer Center[5] reinforces this concept of postradiation therapy reconstruction to maximize outcomes.

Despite our preference for the TRAM flap for reconstruction in the setting of radiation, there are certain real-world situations where patients are not candidates or do not wish to undergo TRAM reconstruction. In this study, we have found that adding a latissimus flap, generally to the inferior pole of the breast, has helped in creating a favor-

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able contour for the breast when combined with an implant. Critical to this concept is that the latissimus flap be added only after radiation therapy has occurred. Adding this nonirradiated tissue to the inferior pole is critical in releasing the noncompliant irradiated skin and soft tissue that prevents the implant from creating the normal breast contour. In addition, the latissimus muscle alone provides healthy, vascularized coverage over the remainder of the implant that lowers the risk of implant exposure.

In our experience, there are several distinctly different situations where patients may be candidates for latissimus/prosthetic reconstructions. These include correction of capsular contracture after irradiation of a tissue expander, immediate reconstruction after mastectomy following breast conservation therapy, delayed reconstruction after mastectomy and radiation therapy, revision of an unsatisfactory implant reconstruction in an irradiated breast, and reconstruction of a partial breast defect after breast conservation therapy. The latissimus flap with implant is particularly helpful when the deformity involves the lower half of the breast. We have found that patients from these groups can have an excellent reconstruction despite the effects of radiation.

This review is particularly important in the context of earlier reports on the latissimus flap and changes in other areas in plastic surgery. Before this, it was widely believed that the latissimus flap was not a satisfactory tool for helping to reconstruct the irradiated breast. Surgeons and patients alike were therefore prone to choose the TRAM or other purely autologous method in this setting despite their added complexity and morbidity.

Meanwhile, interest in the latissimus flap has reemerged in the past few years, partly for economic reasons and partly because of recognition of how to use it more effectively. At the same time, the quality and options in implants have both improved, and the hysteria over breast implants has abated.

This review demonstrates that the combination of a latissimus flap and implant not only is an excellent option in breast reconstruction in ideal cases such as a skin-sparing mastectomy but is also a highly effective tool in dealing with the many difficult situations seen in the irradiated breast. The fact that, overall, purely autologous reconstructions may, on average, be better, or that latissimus flaps without prior irradiation might similarly be preferable should not discount the substantial value of the latissimus flap and implant in dealing with these difficult cases.

CONCLUSIONS

Although the TRAM flap remains the standard in reconstructing the mastectomy defect in the irradiated patient, there are occasions where a favorable, cosmetically satisfactory reconstruction can be had when combining an implant with a latissimus flap after radiation therapy has concluded.

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DISCLOSURE

The authors have no financial interests associated with this research article.

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