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Reconstructive

Cutaneous Breast Radiation-associated Angiosarcoma: Anterior Chest Wall Reconstruction Options Following Extra-radical Resection

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Background: Radiation-associated angiosarcoma (RAAS) of the breast is a rare complication following breast irradiation with high rates of recurrence and death. To improve survival, we have advocated for an extra-radical resection where the entire irradiated skin and subcutaneous tissue is excised. This results in very large chest defects for which we describe our reconstructive experience.
Methods: We performed a retrospective review of patients diagnosed with RAAS and treated with extra-radical resection followed by immediate reconstruction between 1999 and 2017. We analyzed reconstructive options, complications rates, length of stay, and operative times.
Results: Extra-radical resections were performed in 35 patients. We reconstructed these large defects with abdominal advancement flaps with split-thickness skin grafting in 25 patients and added a pedicled latissimus dorsi or omental flap in the 10 other patients. Skin grafts took well over the irradiated pectoralis major muscle with a median take rate of over 90%. Average operative times were 150 minutes for those treated with an abdominal advancement flap and skin grafting with a median length of stay of 5 days for all patients.
Conclusion: Large anterior chest soft-tissue defects caused by extra-radical resections leaves defects too large to be covered by traditional breast reconstruction flaps. Abdominal advancement, latissimus dorsi muscle, and omental flaps along with skin grafts can be safely performed while leaving other traditional options open for future breast reconstruction. *(Plast Reconstr Surg Glob Open 2018;6:e1938; doi: 10.1097/GOX.0000000000001938; Published online 5 September 2018.)*

INTRODUCTION

Breast conservation therapy consisting of a lumpectomy or partial mastectomy followed by adjuvant radiation therapy has been the mainstay for early breast cancer (ductal carcinoma in situ, stage I and II) treatment in women without multifocal disease and those with an adequate tumor to breast ratio, preserving native breast tissue while minimizing the operative burden of mastectomy.[1] In addition, more women with breast cancer are receiving postmastectomy radiation to reduce local recurrences.[2] Radiation-associated angiosarcoma (RAAS) is an aggressive secondary breast malignancy that develops within a previously irradiated field at least 3 years after treatment with microscopic histology that is distinct from the initial cancer pathology.[3] RAAS arises from the vascular endothelium in the dermis and subcutis of the breast and occurs in 0.05–0.14% of women who undergo radiation treatment for breast cancer with an incidence of 7 per 100,000 person-years.[4–7]

RAAS is rare with only case reports and small case series published in the literature since initially described in 1929.[6] Generally, women with RAAS are older (> 60 years)

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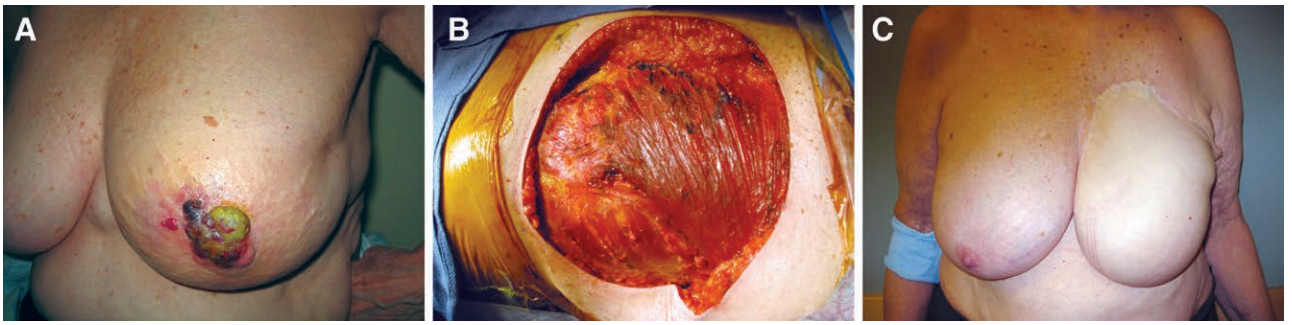


Fig. 1. A 75-year-old female who presented 8.5 years following partial mastectomy and radiation for treatment of breast cancer. A, Presentation of RAAS with an exophytic mass obliterating the nipple areolar complex with associated skin thickening and satellite violaceous lesions. B, Soft-tissue defect (approximately 400 sq cm) after a radical excision for RAAS of the breast. This was a typical defect before moving to our even larger extra-radical resection. C, Two years postoperative result following reconstruction with an ipsilateral pedicled transverse rectus abdominis myocutaneous flap. She had metastatic disease to the right lung approximately 6 months following RAAS surgery. She was treated with right upper lobe thoracoscopic wedge resection. She underwent chemotherapy and is now out 9 years (now age 84) with no evidence of disease.

and present with a median latency period of 76 months following initial treatment.[8] Treatment of RAAS of the breast has traditionally consisted of completion mastectomy resecting all macroscopic RAAS lesions and the remaining underlying breast parenchyma. This approach has proven to be inadequate with recurrence rates as high as 54–92% and 5-year survival rates ranging from 25% to 50%.[4,9–13]

We recently reported, in the largest series to date, 76 patients with RAAS, 38 of whom underwent a conservative completion mastectomy and 38 who underwent a more radical resection to include the entire skin and subcutaneous tissues of the irradiated field (Fig. 1). The more radical approach resulted in significantly improved 5-year disease-specific survival of 86% (from 46% in the conservative resection group).[14] Since publication of this article, we reviewed our reconstruction approach and noticed a trend among patients undergoing more radical surgery to an even more extensive resection including all of the irradiated skin from just below the clavicle superiorly to the top of the rectus sheath inferiorly and from the sternum medially to the lateral border of the latissimus dorsi muscle laterally, which we now classify as extra-radical resections (Fig. 2). These more extensive resections result in soft-tissue defects larger than traditional breast reconstruction flaps will cover.[12,13,15–17]

Anecdotal data from our institution suggest that this extra-radical approach is not in wide-spread use, as patients presenting to us from referring institutions have often undergone multiple prior surgeries without clear margins or with multiple recurrences. Although various options in the reconstructive armamentarium are available for the management of such chest wall defects, reports adequately detailing consistent and reliable techniques for reconstructing a wound this large following extra-radical resection are limited.[15,16,18] We retrospectively reviewed our experience with management of the sizeable defects created by extra-radical resections for RAAS.

PATIENTS AND METHODS

After institutional review board approval, a retrospective cohort analysis was performed on all 60 patients diagnosed with RAAS of the breast and managed with radical resection followed by immediate reconstruction between 1999 and 2017 at Brigham and Women's Hospital. Patients were selected based on their International Classification of Diseases (ICD)-9/ICD-10 codes and Current Procedural Terminology (CPT) codes billed for their procedures. A subset of patients from this sample with a defect size of at least 400 cm^2 requiring a flap reconstruction and skin graft were henceforth reclassified as an extra-radical resection based on defect characteristics and wound dimensions.

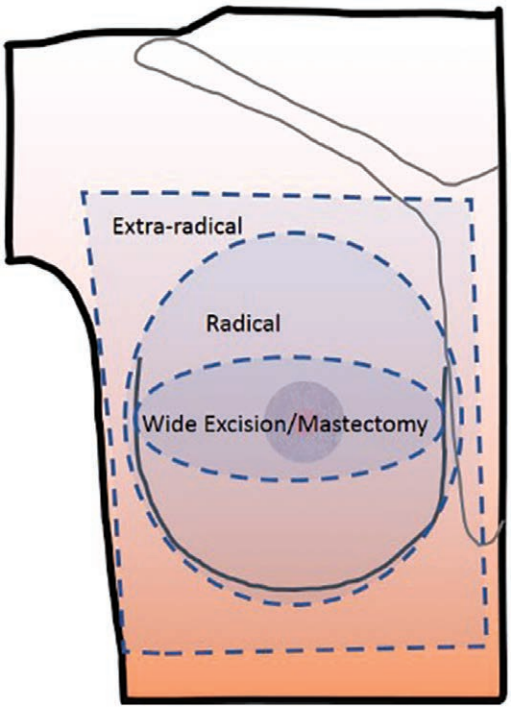


Fig. 2. Illustration of the various chest wall defects created following extirpation of RAAS of the breast. Traditional resection of the tumor has consisted of a wide excision. Expanding the resection borders to the extra-radical resection has led to improved disease-specific survival, however leaves the patient with a large soft tissue wound.

Thirty-five patients undergoing extra-radical resections were identified, 20 of whom were reported in our prior study (in which we called the resections "radical" rather than "extra-radical"), and 15 additional patients were identified since our prior study.[14,19]

Patients with primary angiosarcoma of the breast, patients with wound dimensions less than 400 cm^2, and those who had invasion of osseous structures were excluded. Medical charts, operative reports, and pathologic records were reviewed to collect the following clinical information: patient demographics, medical comorbidities, breast cancer staging and treatment, tumor characteristics, operative details, complications, and reconstructive technique. Descriptive statistics were used to determine mean, median, and ranges for both groups. Complications were assigned a Clavien-Dindo classification. Some patient information was unknown in cases referred from other centers resulting in a denominator less than the total number of patients per group. All patients were previously diagnosed with breast cancer and treated with partial versus complete mastectomy followed by radiation. Additional resection including axillary lymph nodes and chest wall musculature were performed at the discretion of the oncologic surgeon.

Following extra-radical resection, all wounds were evaluated to assess reconstructive needs. Reconstruction was performed immediately in all cases. Two principal reconstructive options were considered and used alone or in combination. The first of these options was an abdominal advancement flap with split-thickness skin grafting over the pectoralis major muscle. A second option was the use of a distant flap reconstruction when there was exposed osseous or cartilaginous structures not covered by the abdominal flap and nonirradiated tissue was needed to close the defect. These distant flap reconstructions included the use of either omental flap or a latissimus dorsi flap. Split-thickness skin grafting was performed in all cases. Choice of flap was based on defect characteristics and at the discretion of the reconstructive surgeon.

Table 1. Tumor Characteristics in Patients with RAAS of the Breast Who Underwent Extra-radical Resection

Characteristic	Abdominal Advancement Flap	Abdominal Advancement Flap + Distal Reconstruction Flap
Median age of AS diagnosis, y (range)	68 (44–82)	68 (51–82)
Median interval time between breast cancer surgery to AS diagnosis, mo (range)	87 (41–287)	76 (39–163)
Presenting symptom, n (%)		
Ecchymosis/violaceous lesion	18/25 (72)	6/10 (60)
Erythema	6/25 (24)	2/10 (20)
Palpable mass	3/25 (12)	3/10 (30)
Preceeding trauma	7/25 (28)	2/10 (20)
Skin thickening	5/25 (20)	2/10 (20)
Edema	1/25 (4)	3/10 (30)
Multifocality, n (%)	18/19 (95)	7/9 (78)
AS involvement (depth), n (%)		
Skin/dermis	25/25 (100)	10/10 (100)
Subcutis/breast parenchyma	9/23 (39)	9/9 (100)
Pectoralis major	1/23 (4)	2/9 (22)
Ribs/intercostals	0	1/9 (11)
Median tumor size, cm (range)	2.7 (0.4–14.5)	5.5 (1–22.8)
AS grade, n (%)		
I	4/19 (21)	0
II	0	2/10 (20)
III	15/19 (79)	8/10 (80)
5-year Survival, n (%)	23/24 (96)	6/10 (60)
Median follow-up after radical resection/reconstruction (mo)	40	50

AS, angiosarcoma.

RESULTS

Thirty-five women with RAAS in this study period between 1999 and 2017 were identified who underwent the extra-radical resection. Diagnosis was made at a median time of 85 months (range, 39–287 months) from the time of surgical excision for the primary breast cancer. The most frequent presenting sign of RAAS was violaceous and ecchymotic appearing lesions occurring in 69% of cases. Other presenting symptoms included breast erythema, palpable mass, skin thickening and edema, and/or a preceding trauma. All subsequently underwent extra-radical resection of the RAAS. RAAS involved the skin in all cases and invaded breast parenchyma in 56% of cases with further extension down to pectoralis major in 9% of cases. Most cases were diagnosed as high grade (Table 1).

Twenty-five patients were reconstructed with an abdominal advancement flap and skin graft to the pectoralis major muscle. Wound dimensions in this group had a median size of 700 cm^2 (Table 2). The abdominal advancement flap is performed in a similar fashion as a reverse abdominoplasty (without excision of the excess abdominal skin flap). Skin and subcutaneous tissues of the abdominal wall along the inferior border of the wound were elevated strategically raising an abdominal advancement flap while preserving perforators. The skin and subcutaneous tissue along the lateral and superior borders of the wound were also dissected discontinuously, preserving perforators to substantially decrease the diameter of the wound. In some cases, the reach of this flap was extended by creating a large rotation-advancement flap by incising along the mid axillary line and extended medially through the pannicular crease while preserving the rectus abdominal perforators. Split-thickness skin grafting was performed where abdominal flap edges could not be reapproximated without undue tension (Fig. 3). Skin grafts were harvested from the ipsilateral anterolateral thigh using the Zimmer dermatome set at 0.012 inches and meshed when needed at 1.5:1 or 2:1 using a noncrushing mesher. This was secured to the surrounding skin using dissolvable sutures. The skin graft was then dressed with Xeroform, and a polyurethane foam that was covered with a polyurethane drape and connected to a suction source of 75 mm Hg. In 1 case, a previously transposed breast reconstruction flap (latissimus) was utilized as part of the reconstruction combined with an abdominal advancement flap and skin graft (**see video, Supplemental Digital Content 1**, which displays a reconstruction after a chest wall angiosarcoma extra-radical resection. This video is available in the "Related Videos" section of the Full-Text article at PRSGlobalOpen.com or at ***http://links.lww.com/PRSGO/A855***).

Table 2. Intraoperative Characteristics in Patients undergoing Extra-radical Resection of RAAS of the Breast and Reconstruction

Characteristic	Abdominal Advancement Flap	Abdominal Advancement Flap + Distal Reconstruction Flap
Median age of resection, y (range)	71.5 (52–82)	69 (51–82)
Wound size		
Average length, cm (range)	28 (19–35)	28 (22–35)
Average width, cm (range)	24 (16–30)	26 (18–30)
Average surface area, cm^2 (range)	695 (400–1,050)	722 (500–900)
Exposed rib/cartilage, n (%)	7/22 (32)	8/9 (89)
Abdominal advancement flap		
Number	25	9
Average flap size, cm^2 (range)	612 (100–1,380)	318 (80–600)
Split-thickness skin graft		
Number	25	10
Average graft size, cm^2 (range)	281 (100–800)	592 (200–1,500)
Wound VAC use	25	7
VAC removed (median postoperative day)	5	5
Percent take	95%	95%
Other flaps		
Latissimus dorsi	1 (revision)	3
Omental	0	7
Median operative time, minutes (includes radical resection)	151 (97–259)	264 (146–323)
Median length of stay, d (range)	5 (3–8)	5 (2–7)

Seven women had a pedicled omental flap in addition to the abdominal advancement flap. A pedicled omentum flap was harvested if chest wall cartilage and ribs were exposed at the wound base and not easily closed by the abdominal flap. Exposure to the peritoneal cavity via the laparotomy was obtained through the existing chest wound. The omentum was harvested via a 7 cm infraxyphoid midline laparotomy through the abdominal fascia. Upon entry into the peritoneal cavity, the abdomen was explored.[20] Adhesions, if present, were lysed bluntly. The omentum and transverse colon were then delivered through the wound. Under direct visualization using 2.5× loupe magnification, meticulous dissection was performed separating the omentum from the colon in the thin areolar and avascular plane using a combination of needle tip cautery and blunt dissection ensuring preservation of the gastroepiploic branches and a bloodless dissection. If additional length was required, the greater curvature perforators were divided, preserving the great gastro-epiploic system based on the right side. Once harvest of the greater omentum was complete, the colon was replaced into the abdomen and care was taken to avoid kinking or twisting of the omental flap or stomach. The laparotomy incision was closed with 0-polypropylene sutures in an interrupted fashion, leaving a small but comfortable defect for the omentum to pass without strangulation. The omentum was draped over the exposed bony and cartilaginous struc-

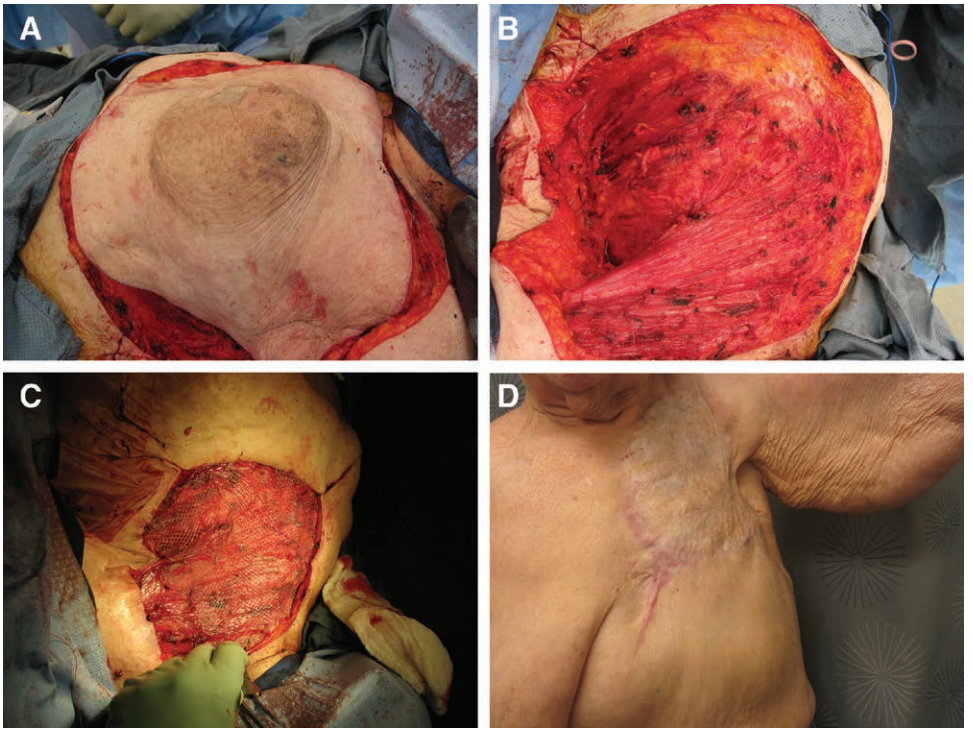
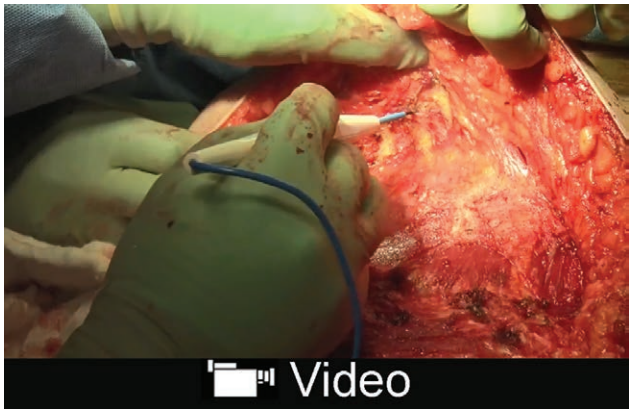


Fig. 3. An 81-year-old female who presented 9 years following partial mastectomy and radiation for breast cancer diagnosed with RAAS. A, Intraoperative photograph of the resected specimen in situ. B, Approximately 930 sq cm soft-tissue defect following extra-radical excision for RAAS of the breast. C, Intraoperative photograph following abdominal advancement flap and split-thickness skin graft. D, Three-month postoperative result following reconstruction.



Video Graphic 1. This video, Supplemental Digital Content 1, which displays a reconstruction after a chest wall angiosarcoma extra-radical resection. This video is available in the "Related Videos" section of the Full-Text article at PRSGlobalOpen.com or at ***http://links.lww.com/PRSGO/A855***.

tures and secured to the chest wall with dissolvable sutures (Fig. 4).

The remaining 3 cases had surgical wounds managed with a pedicled musculocutaneous flap in the form of a latissimus dorsi and abdominal advancement flap. Also harvested when exposed osseous or cartilaginous structures were not covered by the reverse abdominoplasty, the latissimus dorsi flap has a reliable pedicle, can include skin, and can cover a surface area of up to 20 × 35 cm. After incising the skin island, the anterior border of the latissimus having already been exposed as a result of the resection, is elevated and then dissected off of the serratus and eventually undermined. Its insertion points along the iliac crest and the thoracic and lumbar spinal processes are divided. The muscle is then elevated carefully to allow for meticulous dissection of the thoracodorsal pedicle allowing for rotation across the lateral chest to cover the anterior chest defect. The flap is secured to the chest wall with dissolvable sutures while the donor-site defect is reapproximated in layers.

All patients requiring a pedicled omentum or latissimus dorsi flap also underwent a split-thickness skin graft as described above. Those requiring a reverse abdominoplasty and a pedicled flap in the form of omentum or latissimus dorsi had larger wound dimensions with a median size of 730 cm^2. Less abdominal wall tissue was recruited in the reverse abdominoplasty when a pedicled flap was harvested.

Patients reconstructed with an abdominal advancement flap and skin grafting had an average body mass index (BMI) of 32 kg/m^2. Nearly 40% of the patients reconstructed with a reverse abdominoplasty (without pedicled flap) were morbidly obese; 6 patients suffered from class II obesity with a BMI 35–39.9 kg/m^2 and 3 patients fell into the class III obesity with a BMI > 40 kg/m^2. Of this same group, 30% had prior abdominal surgery compared with 40% of the group who underwent a pedicled flap. Patients requiring a pedicled flap in addition to the

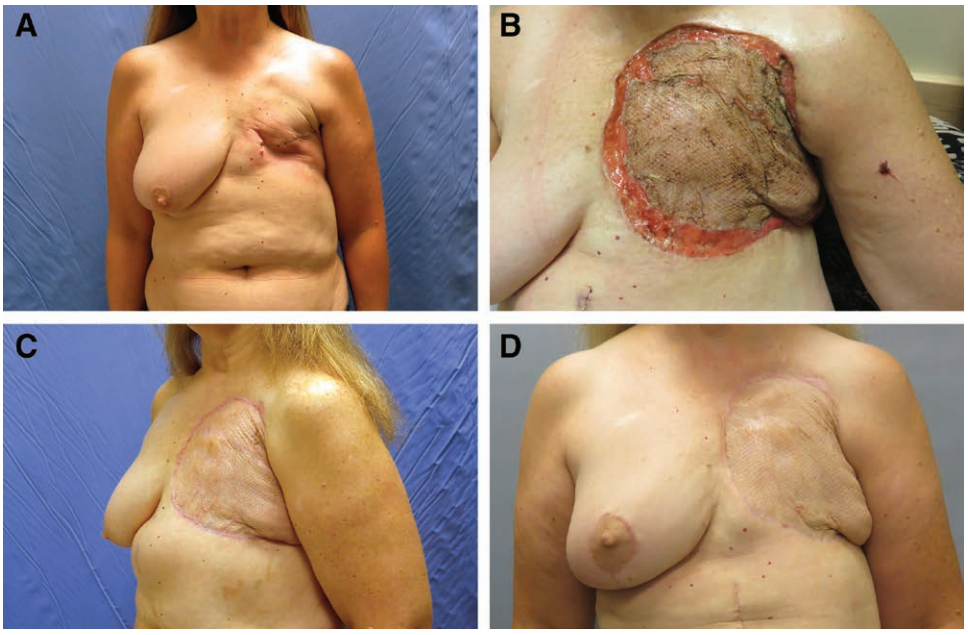


Fig. 4. A 61-year-old female who presented 6 years following left partial mastectomy and radiation, followed by left mastectomy showing RAAS with positive margins. A, Development of a left RAAS following a mastectomy before extra-radical resection. B, Eleven days following extra-radical resection of RAAS and reconstruction of approximately 600 sq cm soft-tissue defect with an abdominal advancement flap, pedicled omental flap, and split-thickness skin graft. C, Eight month postoperative result after initial reconstruction showing ventral hernia. D, Postoperative photograph 1 year after left chest wall reconstruction and 3 months following a contralateral mammaplasty reduction and repair of hernia as a secondary procedure.

abdominal advancement flap had a smaller BMI of 26 kg/m^2 (Table 3).

Median operative time, which consists of the resection and reconstruction, was 150 minutes for the group reconstructed with the abdominal advancement flap and 260 minutes when a distant flap was harvested. Skin graft rates were high in all groups with an overall median take of > 90% (range, 70–100%). Median length of stay was 5 days; ranging for those undergoing reverse abdominoplasty was 3–8 days and 2–7 days for those undergoing distant flap reconstruction.

Patients have been followed for a median duration of 35 months after reconstruction. Few complications have occurred in both groups (Table 4). Four patients managed with an abdominal advancement flap required reoperative intervention (Clavien-Dindo III): 2 patients developed wound infections with subsequent wound breakdown requiring return to the operating room, 1 patient developed an abscess that was managed with interventional radiology (IR) drainage, and a fourth patient developed wound breakdown overlying a rib that required a local tissue rearrangement. No patients managed with a pedicled flap developed an infection. Abdominal wall hernia without strangulation was found to be a late complication in 2 of the 7 patients who underwent reconstruction with an omental flap. There were few medical complications, all of which developed in the abdominal advancement group including venous thromboembolism in 2 patients, both of which were managed with therapeutic anticoagulation. One patient developed postoperative delirium, another developed an ileus resulting in a protracted admission.

Table 3. Characteristics of Patients with RAAS of the Breast Who Underwent Extra-radical Resection

Characteristic	Abdominal Advancement Flap	Abdominal Advancement Flap + Distal Reconstruction Flap
No. participants	25	10
Average height (cm)	154	162
Average weight (kg)	79	67
Average BMI (kg/m^2)	32	26
Median age of breast cancer diagnosis, y (range)	63 (41–75)	61 (37–76)
Diabetes mellitus, n (%)	2/23 (9)	1/10 (10)
Morbid obesity (BMI > 35), n (%)	9/23 (39)	1/8 (13)
Smoking history, n (%)	8/20 (40)	2/6 (33)
Prior abdominal surgery, n (%)	7/23 (30)	4/10 (40)
Breast cancer staging, n (%)		
I	13/21 (62)	6/9 (67)
II	9/21 (43)	2/9 (22)
III	0	1/9 (11%)
Breast cancer pathology, n (%)		
DCIS	0/19 (0)	0/9
Ductal carcinoma	17/19 (89)	7/9 (78)
Lobular carcinoma	2/19 (11)	2/9 (22)
Laterality, n (%)		
Right	14/25 (56)	4/10 (40)
Left	11/25 (44)	6/10 (60)
Mastectomy, n (%)		
Partial	24/25 (96)	9/10 (90)
Total	1/25 (4)	1/10 (10)
Lymph node surgery, n (%)		
SLNB	16/23 (70)	4/9 (44)
ALND	7/23 (30)	5/9 (56)

DCIS, ductal carcinoma in situ;
SLNB, sentinel lymph node biopsy;
ALND, axillary lymph node dissection.

Table 4. Complications Occurring in Patients Who Underwent Extra-radical Resection and Reconstruction of RAAS of the Chest Wound

Characteristic	Abdominal Advancement Flap	Abdominal Advancement Flap + Distant Reconstruction Flap
Seroma	0	0
Hematoma, n (%)	1/25 (4)	0
Cellulitis, n (%)	3/25 (12)	0
Abscess, n (%)	2/25 (8)	0
Wound breakdown/necrosis, n (%)	3/25 (12)	0
Reoperative rate, n (%)	4/25 (16)	2/10 (20)
Readmission related to wound, n (%)	3/25 (12)	1/10 (10)
Skin graft failure (partial < 80% take), n (%)	3/27 (11)	0
Other clinical complication, n (%)		
Pulmonary embolism	2/25 (8)	0
Ileus	1/25 (4)	0
Delirium	1/25 (4)	0
Incisional hernia, n (%)	0	2/7 (28)
Clavien-Dindo classification, n (%)		
I	3/25 (12)	0
II	3/25 (12)	1/10 (20)
III	3/25 (12)	1/10 (10)
IV, V	0	0

DISCUSSION

RAAS is a very aggressive secondary breast sarcoma that until recently has been managed with unfavorable outcomes. Although 1 study has demonstrated that chemotherapy may lead to reduced local recurrence, the benefits of various neoadjuvant chemotherapy regimens are unclear and should not delay surgical extirpation unless the patient is unfit for an operation.[9,14] The mainstay of RAAS management is surgery with radical resection of the entire irradiated field.[14,17,19] For patients with metastatic disease, we coordinate care with our medical oncologists you typically use a doxorubicin, paclitaxel, or experimental therapies. Though this approach has demonstrated reduced recurrence and improved disease-specific survival, it does result in large and complex chest wounds. Although the skeletal framework of the chest is generally unaffected, the likelihood of having exposed osseous or cartilaginous structures, previously irradiated, and a vast surface area of exposed soft tissue makes these challenging reconstructive cases.

Various algorithms recommend using the conventional rectus abdominis or latissimus dorsi musculocutaneous pedicled flaps for the reconstruction of anterior or anterolateral chest wall soft-tissue defects. Alternatively, microsurgical free tissue transfer is another option for managing a wound of this nature. In large defects, however, these flaps do not have a large enough skin area.

Anecdotally, our previous experience with breast reconstruction following extra-radical resection of RAAS suggests that using very large pedicled abdominal based rectus flaps can result in distal flap necrosis, increased infection risk, and higher reoperation rates and thus consider these options to be inadequate for the management

of this defect. Oftentimes, women wish to preserve options for delayed breast reconstruction. Also, these flaps may be needed in the case of recurrence especially given the aggressive nature of this cancer.

Despite the relatively small sample size and retrospective nature of this study, several lessons have been learned. The primary goal has shifted from breast reconstruction to efficient wound management. We propose managing the extra-radical resection of RAAS utilizing reconstructive principles using primarily an abdominal advancement flap with skin grafting. Distant flaps such as the omentum or latissimus dorsi may be added to our reconstructive algorithm in the setting of exposed ribs or cartilage.

The role of the reconstructive surgeon should begin with preoperative counseling, allowing the surgeon to evaluate the patient and extent of disease, and prepare an operative plan in conjunction with the surgical oncologist. The patient's mental state and expectations should be appreciated and goals of wound management should be discussed.[20] We clearly communicate to the patient the extent of deformity and that the primary objective of reconstruction is to provide coverage rather than breast restoration.

Our intraoperative approach has been aided by first assessing how much of the wound can be closed by an abdominal advancement flap. Strategic undermining of the abdominal wall, preserving perforators, is then performed to elevate a wide based abdominal advancement flap. Many of the patients in our study were either obese or had lost weight before the operation. Therefore, we were effectively able to recruit large amounts of abdominal skin allowing for a significant reduction in wound size without compromising critical blood supply. Initially reported in the 1970s as an aesthetic contouring operation, benefits to using this reverse abdominoplasty for coverage of large chest wall oncologic defects are manifold.[21–23] These flaps can be reelevated with relative ease in the case of recurrence and there is minimal donor-site morbidity with little to no functional disturbance, given that muscle is not incorporated into the flap.[16,24]

Although the abdominal advancement flap provides substantial wound area reduction, these defects are not completely covered with this flap alone. When possible, we design the abdominal advancement flap to cover areas inferior and lateral to the pectoralis major muscle so that the skin graft goes directly on the pectoralis major muscle. We have not had any problems healing skin grafts over this muscle, despite previous irradiation.

When abdominal advancement flaps are not able to cover all the cartilage and ribs, either an omental flap or a latissimus flap provided excellent coverage. The omentum, which has a robust blood supply and anti-inflammatory properties, provides a very large surface area that is pliable and usually covers the entire soft-tissue defect.[25,26] It is known to plastic surgeons for its ability to treat radiation defects and to support a skin graft.[20,27] Harvesting the omental flap can usually be performed through the chest wound. There is a learning curve associated with omental flap harvest and some plastic surgeons may not be comfortable performing it. It requires a meticulous dissection in the correct anatomical planes to preserve vascularity, prevent bleeding, and avoid injury to the remaining viscera. Omental flaps require an intraperitoneal dissection create an obligate abdominal wall hernia.[28] Two patients in our series reconstructed with an omental flap developed symptomatic abdominal wall hernias that were later repaired with polypropylene mesh.

The latissimus flap is familiar reconstructive surgeons, and it can cover reasonably large wounds if a skin graft is used. Disadvantages include the need for repositioning, unreliable blood supply to the distal end and, unless harvested endoscopically, it requires a separate incision and wound in a woman who already has a massive chest wall wound.[28]

CONCLUSIONS

Our results indicate that using plastic surgical techniques, these extra-radical soft-tissue defects of the chest can be managed efficiently with low complication rates, short operative times and limited lengths of stays. These women are generally older and have more comorbid factors than our traditional breast reconstruction patients. Given that breast conservation therapy has been a mainstay of early breast cancer this century, we anticipate that this oncologic complication will become more prevalent and the techniques to deal with these difficult reconstructive challenges more necessary. This study offers a reconstructive guide for surgeons presented with these problems to consider.

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