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# Acellular Dermis-Assisted Breast Reconstruction With the Use of Crescentric Tissue Expansion: A Functional Cosmetic Analysis of 40 Consecutive Patients

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## Abstract

**Background:** Crescentric tissue expanders have the potential to improve postoperative aesthetic results via selective lower pole expansion; however, limited data are available on their efficacy.

**Objectives:** The authors assess postoperative functional and cosmetic outcomes of acellular dermis-assisted breast reconstruction with crescentric tissue expansion.

**Methods:** This study is a single-institution, retrospective review of 40 consecutive patients who underwent acellular dermis-assisted breast reconstruction with crescentric tissue expansion. Demographic data, operative details, and procedural outcomes were recorded and assessed. Cosmetic outcomes were assessed using the Breast Evaluation Questionnaire.

**Results:** Fifty-eight breasts representing 36 bilateral and 22 unilateral reconstructions were analyzed. Of these, 45 (78%) underwent tissue expander (TE) to implant exchange. The mean interval between stage 1 and stage 2 was  $92 \pm 20$  days, with a total follow-up time of  $141 \pm 16$  days. The average intraoperative expander fill volume was 213.5 mL, with an average final fill of 285 mL (range, 180–740 mL). The average number of expansions was 1.6. Overall, there were five complications (8.6%). Eighty-three percent of patients participated in the breast evaluation questionnaire. Answers to each question were reported using a qualitative five-point scale that ranged from 1 (*very dissatisfied*) to 5 (*very satisfied*). For the bilateral reconstructions, the average score in all contexts was  $4.5 \pm 0.3$ ,  $4.33 \pm 0.5$ , and  $4.36 \pm 0.33$  for size, shape, and firmness, respectively. For unilateral reconstructions, the average scores were  $4.0 \pm 0.58$ ,  $3.93 \pm 0.38$ , and  $4.13 \pm 0.21$ , respectively.

**Conclusions:** Crescentric expander-based reconstruction with acellular dermis assistance is well tolerated, especially in smaller breasted women. Functional and cosmetic outcomes were acceptable and comparable to previous reports of traditional expander-based reconstructions.

## Keywords

acellular dermis, breast reconstruction, FlexHD, tissue expander

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According to the American Society of Plastic Surgeons (ASPS), in 2007 there were approximately 57,000 breast reconstructions performed. Of these reconstructions, nearly 60% involved the combination of tissue expanders and implants.<sup>1</sup> One of the greatest challenges in achieving an optimal outcome is attaining selective lower pole skin expansion to deliver natural ptosis and shape to the reconstructed breast. Traditional round expanders have been associated with several problematic qualities, such as upper pole fullness, poor ptosis, and inadequate expansion beneath the mastectomy scar. Anatomically shaped expanders were the next logical step, but had similar shortcomings and significant complications (such as malposition).<sup>2–6</sup>

Semilunar or crescent-shaped tissue expanders have the potential to improve postoperative results via selective lower pole expansion.<sup>5,7</sup> However, there is limited evidence on functional outcomes regarding their use. A recent evolution

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in tissue expander-based breast reconstruction is the use of acellular dermis for rapid intraoperative expansion (and concomitant early projection).<sup>2,3,8-10</sup> In this study, we assess postoperative outcomes and patient subjective cosmetic scores regarding acellular dermis-assisted breast reconstruction combined with crescentric tissue expansion.

## METHODS

This is a single-institution, retrospective review of the first 40 consecutive patients who underwent acellular dermis-assisted breast reconstruction with crescentric tissue expansion. All operations were performed by a single surgeon (JYK). Demographic data, as well as diagnostic information and procedural outcomes, were recorded and assessed. Cosmetic outcomes were assessed using the validated Breast Evaluation Questionnaire.<sup>11</sup> All data were expressed as mean  $\pm$  standard error of the mean. In the appropriate setting, median data were also reported. This research was approved by the Institutional Review Board.

The principal author's expander reconstruction technique relied on the disinsertion of the pectoralis major muscle at the inframammary fold (IMF), with creation of an acellular dermal sling using either FlexHD (Musculoskeletal Transplant Foundation, Edison, New Jersey) or Alloderm (Lifecell, Branchburg, New Jersey) to recreate the IMF (Figures 1 and 2). Next, a low-profile crescentric expander (Allergan, Santa Barbara, California) was placed within the new subpectoral pocket and intraoperative expansion was performed. Closure of the dermis and skin was performed with vicryl and prolene sutures, respectively.

## RESULTS

### Background/Operative Information

From 2007 to 2008, 40 consecutive patients underwent acellular dermis-assisted breast reconstruction with crescentric tissue expansion by a single surgeon (JYK). A total of 58 breasts were reconstructed, representing 18 bilateral and 22 unilateral reconstructions. The mean age of patients was 53.3 years (range, 26-81 years). Thirty-one patients (78%) were Caucasian, seven (18%) were of Hispanic origin, and the remaining two (4%) were African-American. Two women (4%) had a history of radiation exposure preoperatively for the treatment of thyroid disease and four (10%) women received postoperative radiotherapy. Six (15%) patients received adjuvant chemotherapy. All patients underwent unilateral or bilateral mastectomy with or without sentinel lymph node biopsy prior to their reconstruction. Twenty-one patients (53%) had lymph node-positive disease. The most common indication for mastectomy was invasive ductal carcinoma (73%), followed by relatively equal distributions of ductal carcinoma in situ and invasive lobular carcinoma. Three (7%) patients had evidence of local metastatic disease at the time of their operation.

Of the 58 breasts reconstructed, 45 (78%) have since completed the second-stage tissue expander to permanent implant exchange. For these patients, the average intraoperative tissue expander fill volume was 214 cc (range, 100-500 cc), with an average final fill volume of 285 cc (range, 180-740 cc, median 370 cc). The average number of expansions was 1.8 (range, 0-3). The mean interval between stage I and II was  $92 \pm 20$  days (range, 80-366 days; median 128 days). Mean follow-up was  $141 \pm 16$  days (range, 26-459 days; median 174 days).

### Operative/Procedural Complications

In this series, there was an overall complication rate of 9% ( $n = 5$ ). Two expanders became infected (3%); one was successfully managed conservatively with antibiotics and one required removal of the expander. One patient (2%) developed partial mastectomy flap necrosis requiring expander removal. One patient (2%) developed a hematoma, and another developed a seroma. Both were treated conservatively (2%). There were no cases of tissue expander migration or rupture. There were no complications in women with a history of pre/postoperative radiation or chemotherapy.

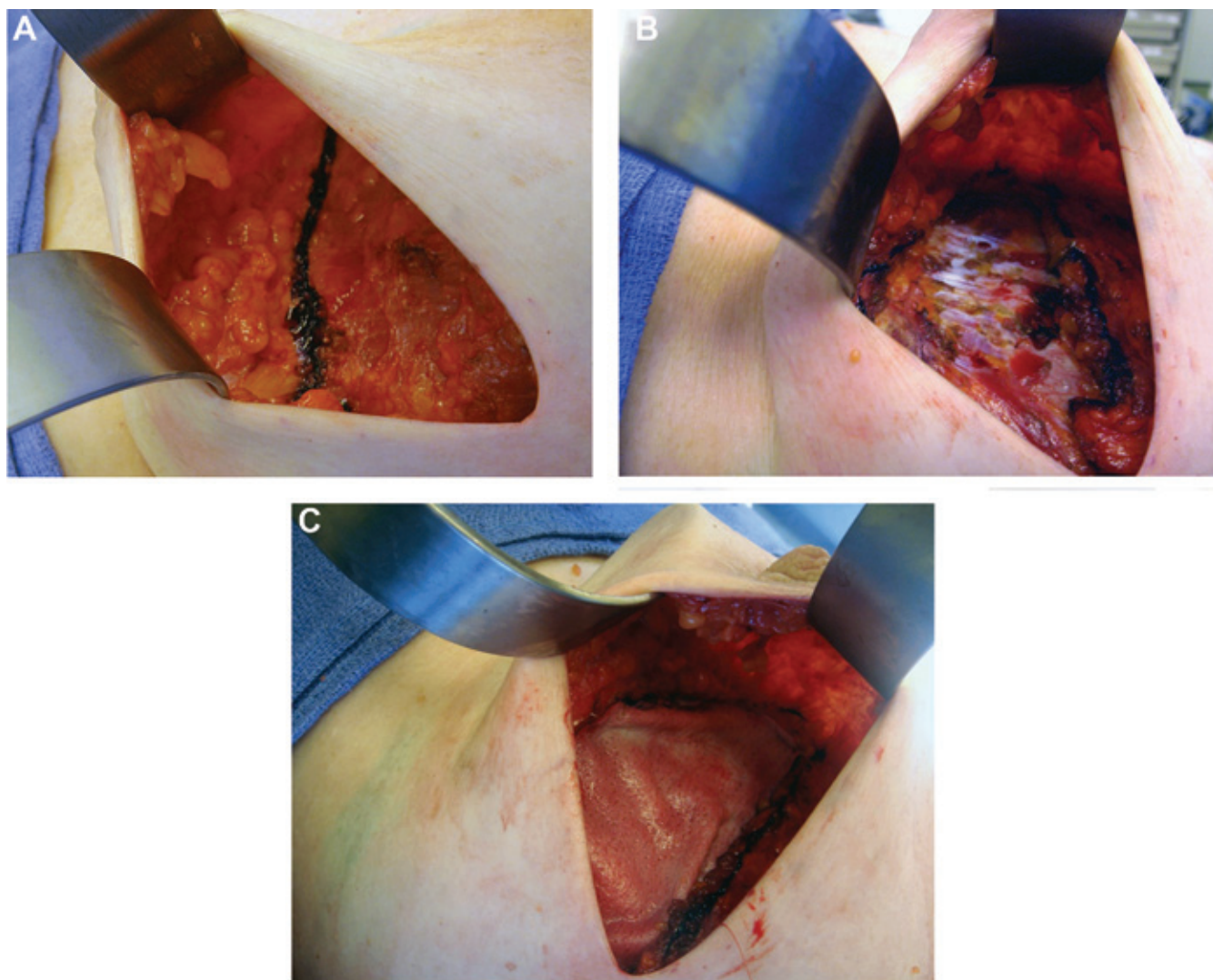
### Aesthetic Outcomes

Thirty-three patients (83%) completed the aesthetic outcomes survey, which utilized the Breast Evaluation Questionnaire.<sup>11</sup> Eighteen of these respondents (54%) had undergone bilateral reconstruction, whereas 15 (46%) had unilateral reconstructions. The survey scores were reported on a scale ranging from 1 (*very dissatisfied*) to 5 (*very satisfied*). Specific questions were related to breast size, shape, and firmness in three separate contexts: intimate or sexual activities, leisure or social activities, and professional or job-related activities. The questions directed toward implant firmness were related to how the implant feels to touch, with higher scores correlating to higher satisfaction with the natural "feel" of the implant. For the bilateral reconstructions, the average score was  $4.5 \pm 0.3$ ,  $4.33 \pm 0.5$ , and  $4.36 \pm 0.33$  for breast size, breast shape, and breast firmness, respectively. In the setting of unilateral reconstructions, average scores were  $4.0 \pm 0.58$ ,  $3.93 \pm 0.38$ , and  $4.13 \pm 0.21$  for breast size, breast shape, and breast firmness, respectively.

The results described above are listed in Table 1.

## DISCUSSION

The National Cancer Institute projected 178,480 cases of invasive breast cancer in 2007.<sup>4</sup> With the exception of those patients with advanced disease, secondary comorbidities, or advanced age, mastectomy with immediate tissue expander placement is considered a standard



**Figure 1.** (A) Intraoperative image showing ink marking the level of disinsertion of the pectoralis major from the inframammary fold (IMF). (B) The pectoralis muscle is disinserted from the IMF. (C) The expander is placed under the pectoralis muscle and the acellular dermis is then secured to the IMF and cut pectoralis edge, creating a new subpectoral pocket.

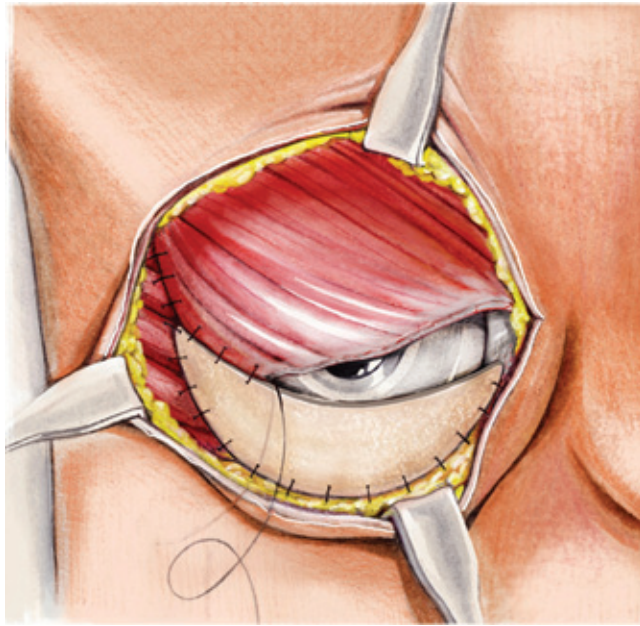
treatment option.<sup>5</sup> In fact, the use of tissue expanders and implant placement is still the most common method of breast reconstruction in the United States, despite the known benefits of autogenous tissue reconstruction.<sup>1,6-8</sup>

Traditional round expanders were the first available expanders used in breast reconstructive surgery. In this setting, round expanders have some important limitations, including upper pole fullness and poor ptosis.<sup>1,9,12</sup> Additionally, round expander reconstruction is not without risk. According to Yanko-Arzi et al,<sup>13</sup> the complication rate for tissue expander reconstruction with round expanders was reported as 17% for major complications and 39% for minor complications.

The next logical step in the evolution of expander/implant reconstruction involved anatomical expanders. The teardrop design of these expanders attempted to

improve on lower pole expansion and breast ptosis; however, they were plagued by functional problems because of their integrated valve design and issues of malposition. In a series by Nahabedian et al,<sup>14</sup> integrated-valve biodimensional expander use resulted in a 7.7% infection rate. Spear and Majidian<sup>15</sup> reported an overall 9.7% rate of expander loss, with rates of approximately 2% for expander puncture, 8% for skin flap necrosis, 3.5% for expander infection, and 1% for hematoma. According to Yanko-Arzi et al,<sup>13</sup> when compared to round expanders, anatomical expanders confer a greater risk of major and minor complications. In addition, despite attempts to create a more natural shape, aesthetic outcomes with anatomical expanders have been variable. One study in particular reported a 40% satisfaction rate at one year.<sup>16</sup>





**Figure 2.** Illustration depicting the senior author's (JYK) technique for acellular dermis-assisted breast reconstruction using expanders. The cut edge of the pectoralis muscle is sewn directly to the superior edge of the acellular dermal matrix, whereas the medial and inferior edge of the dermal matrix is sewn to the position of the inframammary fold. Laterally, the acellular dermis is secured directly down to the serratus muscle inferiorly. Superiorly, the pectoralis muscle is secured to the serratus to close off the superolateral free border of the expander.

Crescentic expanders are among the latest generation of tissue expanders available to breast reconstructive surgeons (Figure 3). The theoretical improvements in aesthetic outcomes may be a function of selective lower pole expansion and the presumed enhancement of ptosis. In comparison to historical reports regarding round and anatomical expander reconstruction, the total complication rate in this series was 8.6%. It is important to note that this rate may be artificially low given that very few breasts in this series received postoperative radiation therapy. The outcomes data from this series are comparable to other large series using crescentic expanders.<sup>17</sup> It is important to note that any discrepancies compared to previous studies using traditional expansion systems could be related to differences in study power and associated selection bias as a result of patient comorbidities, including radiation exposure.

Despite the relatively large amount of literature on tissue expander reconstruction in general, there are limited data available on the addition of acellular dermis. Evidence suggests that the addition of acellular dermis to expander and implant-based reconstruction results in a more aesthetically pleasing breast, allows for better control of the lower pole, and facilitates rapid completion of the procedure through the creation of a new breast pocket and

**Table 1.** Patient Series Data

Patient demographics	
Mean age, y	53.3
Caucasian, % (n)	78 (31)
Hispanic, % (n)	18 (7)
African-American, % (n)	4 (2)
Bilateral, % (n)	45 (18)
Unilateral, % (n)	55 (22)
Tumor characteristics, % (n)	
Invasive ductal carcinoma	73 (29)
Invasive lobular carcinoma	13 (5)
Ductal carcinoma in situ	8 (3)
Lobular carcinoma in situ	6 (2)
Lymph node positive disease	53 (21)
Adjuvant therapy, % (n)	
Neo-adjuvant radiation therapy	6 (2)
Adjuvant radiation therapy	10 (4)
Adjuvant chemotherapy	15 (6)
Reconstructive characteristics	
Mean intraoperative fill volume, cc	214
Mean final fill volume, cc (median)	285 (370)
Mean number of expansions (range)	1.8 (0-3)
Mean interval between stages, d (median)	92 ± 20 (128)
Mean follow-up, d (median)	141 ± 16 (174)
% completing both stages of reconstruction	83 (n = 18 bilateral; n = 15 unilateral)
Complications, % (n)	
Infection	9 (5)
Mastectomy flap necrosis	5 (2; 1 required explantation)
Hematoma	3 (1; required explantation)
Seroma	3 (1)
Breast Evaluation Cosmesis Scores	
Range: 1 ( <i>very dissatisfied</i> ) to 5 ( <i>very satisfied</i> )	
Bilateral cases, n = 18	
Mean score size	4.5 ± 0.3
Mean score shape	4.33 ± 0.5
Mean score firmness	4.36 ± 0.33
Unilateral cases, n = 15	
Mean score size	4.0 ± 0.58
Mean score shape	3.93 ± 0.38
Mean score firmness	4.13 ± 0.21

prompt intraoperative expansion. The addition of another soft tissue layer interposed between the implant and the visible skin may also help ameliorate implant visibility or wrinkling. In a recent publication by Spear et al,<sup>3</sup> the total complication rate for acellular dermis-assisted breast reconstruction with tissue expanders was 12.1%. Bindingnave et al<sup>18</sup> reported a total complication rate of 9.2% in a similar scenario. Complication rates in this series using Alloderm or FlexHD acellular dermis specifically with crescentic tissue expanders are similar to previous reports.<sup>19</sup> Importantly, we do not believe that any of the complications in this series were a direct result of the acellular dermis.

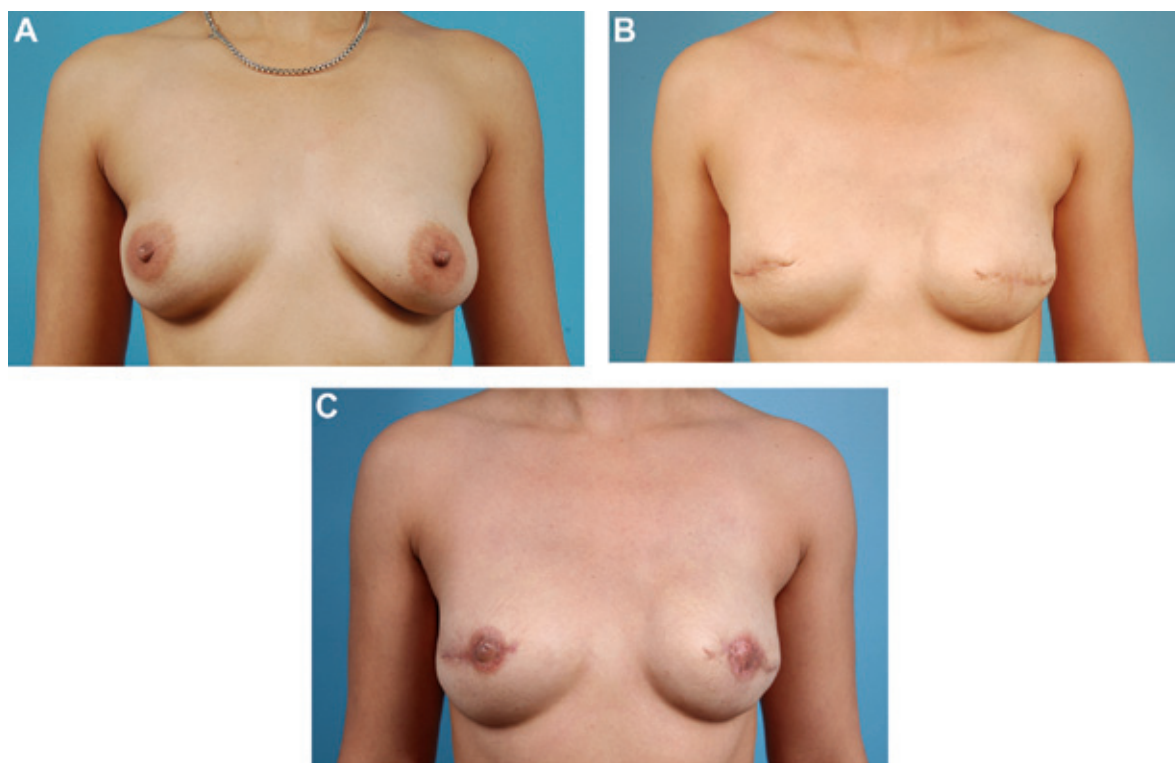


**Figure 3.** A fully expanded crescentic tissue expander is shown immediately following routine expander/permanent implant exchange.

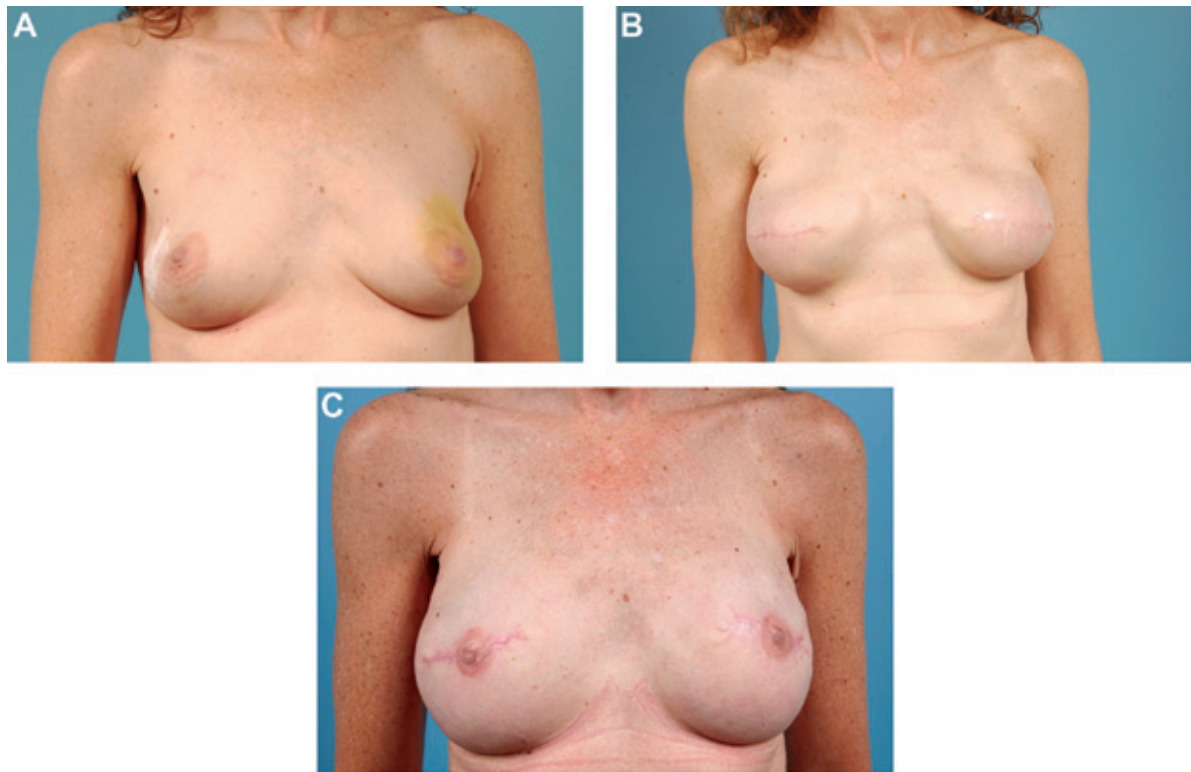
With respect to cosmetic outcomes, crescentic tissue expanders may provide some benefit through selective lower pole expansion, which may create a more natural appearing breast (Figures 3 and 4). In a series by Eriksen et al,<sup>20</sup> 85% of patients reported being “very satisfied” or

“satisfied” following reconstruction using crescentic tissue expanders as compared to 13% of patients who underwent reconstruction using a traditional saline contour expander or an anatomical model. In this series, the average cosmetic outcomes with respect to breast size, shape, and firmness in three separate contexts (intimate or sexual activities, leisure or social activities, and professional or job-related activities) in this series ranged from 3.93 to 4.50. Despite surgeon-observed problems with upper pole hollowing (especially in larger breasted women), patient satisfaction did not seem to be affected, as this effect was never mentioned by respondents. A drawback that is inherent in the asymmetric crescent-shaped expanders is the possibility of rotation during the expansion process, which can lead to significant asymmetry for bilateral reconstructions. Judicious correction of expander pockets during stage II expander-implant exchange readily corrects the issue. It is unclear whether the overall effect of crescentic expanders in larger breasted women would deliver similar functional and aesthetic results. With these patients, there may be a tendency with high-volume expansion to create a more noticeable step-off at the junction of the superior margin of the expander and the upper portion of the breast.

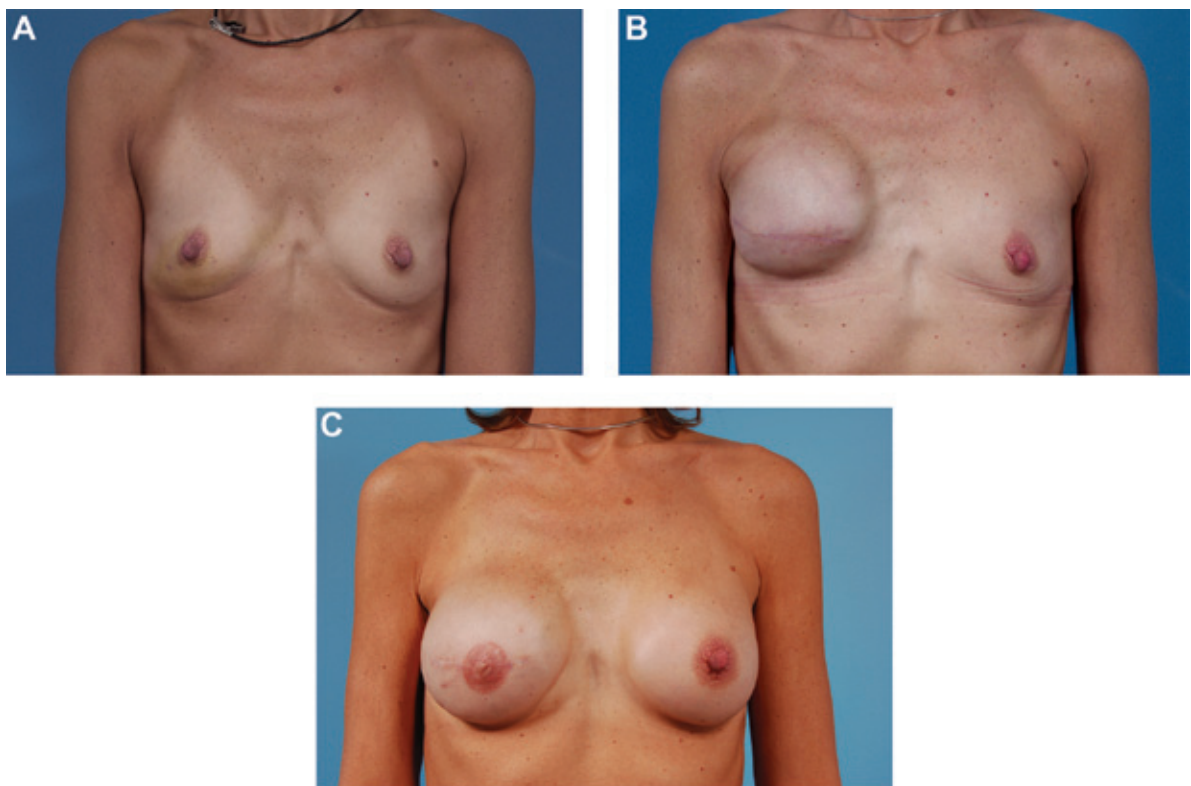
Within this series, there was a slight difference among survey results for unilateral and bilateral reconstructions. Although patients with unilateral reconstructions were



**Figure 4.** (A) A 36-year-old woman who underwent bilateral acellular dermis-assisted breast reconstruction using crescentic tissue expanders is shown preoperatively. (B) Four months after placement of bilateral crescentic tissue expanders and concomitant postoperative expansion. (C) Ten months after expander exchange to silicone implants and four months after nipple reconstruction.



**Figure 5.** (A) A 50-year-old woman who underwent bilateral acellular dermis-assisted breast reconstruction using crescentric tissue expanders is shown preoperatively. (B) Four months after volumetric overexpansion. (C) Nine months after expander-implant exchange and nipple-areolar complex reconstruction.



**Figure 6.** (A) A 47-year-old woman who underwent unilateral acellular dermis-assisted breast reconstruction using crescentric tissue expanders is shown preoperatively. (B) Three months after volumetric overexpansion. (C) Six months after expander-implant exchange and contralateral augmentation and three months after nipple-areolar complex reconstruction.



satisfied overall, their scores were consistently less than those reported for bilateral reconstructions. It is our opinion that the discrepancy between unilateral and bilateral patients is significantly related to symmetry issues. In bilateral reconstructions, we are able to achieve symmetry between both breast mounds (Figures 4 and 5). In comparison, unilateral reconstructions often result in significant asymmetries and may require manipulation of the unaffected breast to bridge this symmetry gap (Figure 6).

## CONCLUSIONS

The combination of crescentric tissue expansion with acellular dermis is well tolerated, with overall outcomes comparable to other series involving expander reconstructions. In addition, patient subjective aesthetic outcomes are favorable. The high satisfaction is likely a result of selective lower pole expansion related to the crescent shape, as well as the ability to perform significant immediate expansion thanks to larger subpectoral pockets. The authors believe this technique should be considered for small-breasted patients seeking expander-implant reconstructions.

## Disclosures

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