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The Acellular Dermal Matrix Onlay Graft for Areolar Reconstruction

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Background: Acellular dermal matrix (ADM) has been well described for use in breast reconstruction. The purpose of this study was to describe a novel use for ADM in areolar reconstruction.

Methods: A total of 19 patients and 24 nipple-areolar complexes of breast cancer or BRCA-positive patients status postmastectomy were treated. After nipple flap reconstruction was completed, the areolar complex was marked at 40–45 mm and de-epithelialized. ADM was reconstituted and cut to size. This was sewn into place as an areolar onlay graft using 5-0 chromic running sutures and a vaseline gauze bolster.

Results: All 24 areola re-epithelialized in an average of 8.1 weeks. Graft take was 100% in 23 areolas, while 1 areola had only 75% graft take. Two patients underwent subsequent nipple projection procedures. Sixteen areolas were tattooed for color, with plans to tattoo the others. All patients had satisfactory transition from native skin to nipple-areolar complex. All surveyed patients stated they would undergo the procedure again. Average follow-up was 15.7 months.

Conclusion: The ADM onlay graft for areolar reconstruction is a feasible addition to the plastic surgeon's armamentarium. The primary benefits of this technique are grafting the donor bed of nipple reconstruction, avoidance of a skin graft donor site wound, and prevention of flattening of the breast dome, as seen with primary closure after nipple flap reconstruction. The cost of ADM must be taken into account (\$31 per square centimeter), which could be offset by banking excess ADM at the time of breast reconstruction.

Key Words: acellular dermal matrix, nipple-areolar reconstruction, areolar reconstruction

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In breast reconstruction, the final surgical step is creating the nipple-areolar complex. A number of the more popular methods for nipple reconstruction include the skate flap, star flap, C-V flap, and double-opposing tab flaps.^{1–4} These use available skin from the breast envelope. When an autogenous reconstruction is used for reconstruction, such as the latissimus flap or an abdominal flap (DIEP or TRAM flap), ample donor skin typically exists. However, in an implant reconstruction there may be a paucity of skin, particularly when the patient has elected to be larger than her preoperative cup size. There is more of a perceived skin deficit if the contralateral breast is not operated on or has had a skin-sparing mastectomy, which preserves more skin.

Most of the nipple-areolar reconstruction techniques borrow available skin leaving an open wound that is skin grafted or closed primarily.^{5–7} When a tight skin envelope respective to implant size exists, this closure can distort the reconstructed breast. The distortion,

a flattening of the breast behind the nipple-areolar complex, is detrimental to the breast aesthetics. A skin graft can be placed to avoid the distortion caused by primary closure of the nipple flap or to create the areola. This gives an aesthetically pleasing texture and color difference to the areola. A drawback to this technique is that a skin graft necessitates a secondary donor site deficit. This is simple if the patient has a c-section or hysterectomy scar, but is potentially a downside if there are no good donor sites. The geometry of closing a circular donor site can cause scar hypertrophy. The average areolar size of 4 cm requires a donor site with a 3:1 closure, leaving a 12-cm scar.^{8,9}

We present a series of 19 patients, totaling 24 nipple-areolar reconstructions using acellular dermal matrix as an onlay graft. Acellular dermal matrix (ADM) is cadaveric human skin processed to create an acellular matrix that can revascularize. Its use in breast reconstruction as an implantable is well documented for primary expander/implant reconstruction and for secondary contour deficits.^{10–19} The use of AlloDerm for projection in nipple reconstruction has been recently popularized as well.^{20,21} Free nipple transfer in breast reduction has been used for centuries.^{22,23} This innovation combines these techniques.

We suggest acellular dermal matrix can be used as an onlay graft to create the areolar complex. This method can be used around a flap nipple reconstruction or stand-alone.

METHODS

Breast cancer or BRCA-positive patients status postmastectomy with removal of the nipple-areolar complex were included. A total of 19 patients and 21 nipples were treated. At the time of the nipple-areolar reconstruction, an areolar complex of approximately 40–45 mm was marked on the dome of the reconstructed breast. The size of the areola was dictated by the contralateral areola if present, or was arbitrarily set at 42 mm, which provides adequate coverage for the defect secondary to the nipple flap. This was thinly de-epithelialized leaving as thick a dermal base as possible (Fig. 1). Petechial dermal bleeding was cauterized. Acellular dermal matrix (AlloDerm; LifeCell Corp., Branchburg, NJ) was reconstituted by standard practice and cut to size. No attempt to oversize the ADM graft is made. The ADM has no primary shrinkage to compensate for; therefore, a nipple form of 42 or 45 mm can be used to cut the graft and cover the defect. A cruciate opening was created in the center of the areolar graft to accommodate the nipple flap. A thicker sheet of ADM revascularizes more slowly, yet gives more depth relief. For single nipple-areolar reconstruction, a 4 × 7 cm sheet of ADM was used and 4 × 12 cm was used for bilateral reconstructions. It was sewn into place using 5-0 chromic running sutures, and a vaseline gauze bolster was placed. The bolster was left in place for an average of 5 days, similar to free nipple transfer technique. The revascularizing areola was kept moist with Aquaphor ointment until complete re-epithelialization was achieved.

RESULTS

All 24 areolas revascularized. The graft take was 100% in 23 of 24 areolas. One areola had 25% loss. The average dressing time and time to complete re-epithelialization was an average 8.1 weeks

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The principles outlined in the Declaration of Helsinki were strictly observed in this case series study. A formal institutional review board process was not available. Reprints: Samir S. Rao, MD, 1260 21st Street NW, Apt 311, Washington, DC 20036. E-mail: samirrao@gmail.com.

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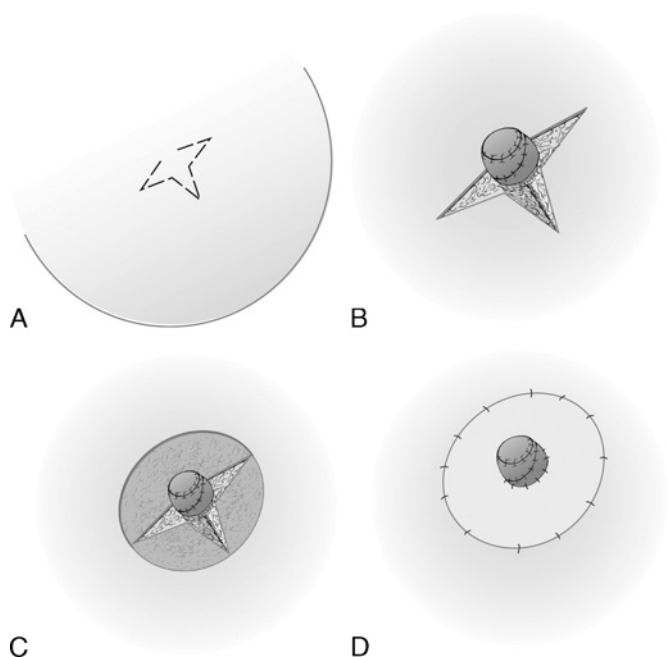


FIGURE 1. Illustration of nipple-areolar reconstruction utilizing the acellular dermal matrix onlay graft technique. A, Breast dome with planned skate flap drawn to proportionate size. B, Skate flap is complete with donor site left open to limit flattening of the breast dome. C, Areolar area thinly de-epithelialized leaving a thick dermal base. D, AlloDerm cut to size and sutured into place over the de-epithelialized area, completing reconstruction of the nipple-areolar complex. (This illustration was provided by LifeCell Corp.)

F2 (Fig. 2). Two patients underwent subsequent nipple projection procedures, 1 nipple with rolled acellular dermal matrix and 2 with auricular cartilage. Two patients had 3 nipple flaps created from ADM areolar grafts as staged operations. All patients had satisfactory transition from native skin flap to nipple-areolar complex (Fig. 3).

F3 Revision surgery was not required in any of the cases. Nineteen of the areolar complexes were subsequently tattooed for color, with plans to tattoo the remaining areolar complexes after adequate healing

F4 (Fig. 4). Seventeen of the 19 patients completed postoperative satisfaction surveys. All surveyed patients stated they would choose to undergo the procedure again. Average satisfaction score was 4.5 (range, 3–5) on a scale of 1–5 (1 = extremely dissatisfied, 2 = somewhat dissatisfied, 3 = neither satisfied nor dissatisfied, 4 = somewhat satisfied,

and 5 = extremely satisfied). Average follow-up was 15.7 months (range 8.4–26.5 months).

DISCUSSION

In surgery, the feasibility of a procedure must be considered as a risk-versus-benefit ratio. In this innovation for areolar reconstruction, the risk of a donor site for a full-thickness skin graft is weighted against the average cost of a 4×7 cm or 4×12 cm AlloDerm sheet (\$31 per square centimeter—\$480 to \$1500).²⁴ Patients often have scars with adequate surrounding skin to take a full-thickness skin graft for areolar reconstruction. Usable scars include DIEP, TRAM, and latissimus dorsi flap donor sites, as well as c-section and hysterectomy scars. In many cases, in which there are no ideal skin graft donor sites, this ADM onlay technique is beneficial. This is particularly true in very thin nulliparous women and women with no previous scars. This technique also avoids possible morbidity at the skin graft donor site, such as hematoma and infection.

The maximal benefit of this technique is matching nipple reconstruction with grafting of the donor bed. The use of ADM prevents the flattening of the breast dome caused by closing the nipple flap donor defect primarily. This is particularly true in patients who have undergone implant reconstruction, as they tend to have a very tight breast skin envelope, especially if they have chosen to increase their breast cup size from their preoperative size. Primary closure often flattens the entire nipple-areolar complex and breast dome taking away any nipple projection and giving a very unnatural appearance. This is more noticeable if the contralateral breast is native.

This technique is also of benefit in the setting of nipple-areolar complex removal for positive margins following nipple-sparing mastectomy. The use of an ADM onlay graft to close the defect from nipple-areolar complex removal eliminates the distortion that would occur from closing the secondary defect (Fig. 5). The ADM **F5** used to close the defect can later be used to form the flaps for nipple reconstruction.

Other techniques are available for areolar reconstruction after nipple flap reconstruction. Tattooing color without areolar reconstruction is one option. This is often suboptimal as no transition in texture or demarcation of the areola exists. Composite nipple grafting from the contralateral breast is another technique. This remains a good option for patients with excess contralateral nipple projection, but carries risks of donor site morbidity and decreased contralateral nipple sensation. Full-thickness skin grafting is a widely used technique with good cosmetic outcomes, but carries the risks of donor site morbidity and a second scar, as discussed above.

The ADM onlay graft technique has very natural appearing outcomes and avoids the morbidities of the other areolar reconstruction techniques described. Epithelialization does take some time making patient involvement in wound care important for the best outcome. Once epithelialization has been achieved, there is good demarcation

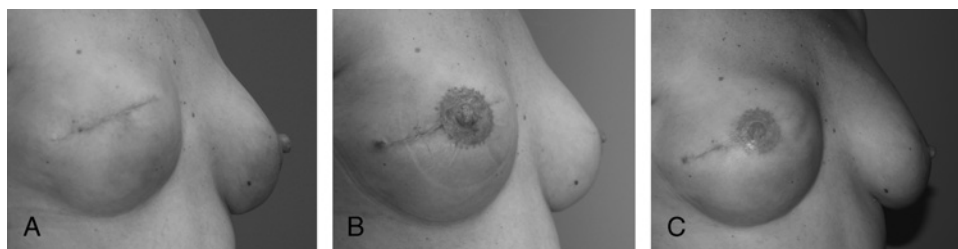


FIGURE 2. Phases of wound healing after ADM onlay grafting. A, Twelve days postoperatively, the graft is beginning to granulate. Note good vascularization as demonstrated by bleeding after pin-prick. B, Three weeks postoperatively, the ADM is granulating in and is beginning to epithelialize. C, Eight weeks after reconstruction, the graft is fully epithelialized.

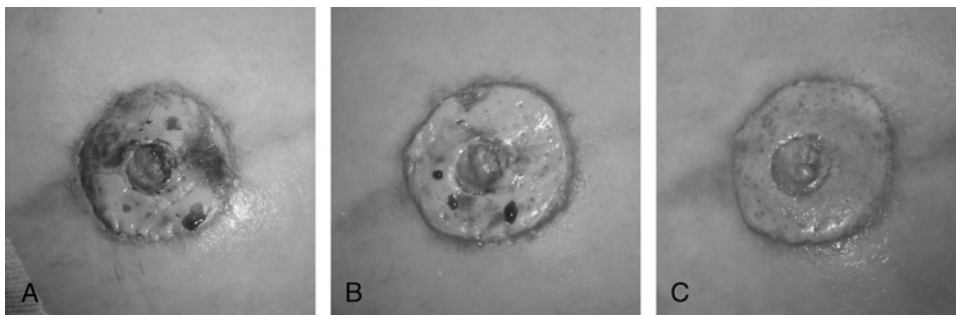


FIGURE 3. A 41-year-old female with invasive breast carcinoma of the right breast. A, Status post-right mastectomy and left nipple-sparing prophylactic mastectomy. B, Four weeks postoperation from nipple-areolar reconstruction with acellular dermal matrix. Epithelialization is taking place over the granulation tissue that has formed in the ADM. C, Seven weeks postoperatively, the reconstructed areola is fully epithelialized with good color and texture distinction of the nipple-areolar complex.

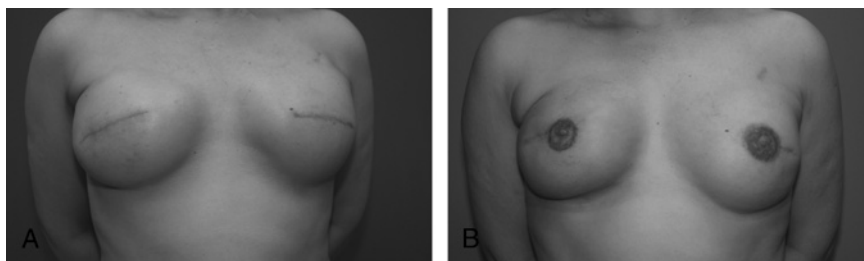


FIGURE 4. A 44-year-old female with right breast cancer. A, Status post-bilateral total mastectomy, right breast irradiation. B, Six months status post-ADM only graft to bilateral breasts with complete epithelialization and tattooing.



FIGURE 5. This patient underwent an immediate prosthetic reconstruction after nipple-sparing mastectomy. The final subnipple pathologic sampling was positive for cancer. The nipple-areolar complex was excised, but rather than close the defect, which would distort the breast, an ADM overlay graft was placed. This graft, once vascularized and epithelialized, can be used to create the flaps for nipple reconstruction.

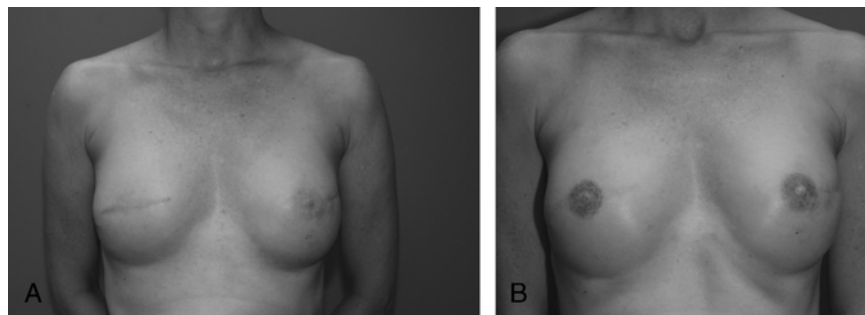


FIGURE 6. A 50-year-old female with right breast cancer. A, Status post–right total mastectomy and left nipple-sparing mastectomy. B, Sixteen months status post–ADM only graft to right breast with complete epithelialization and tattooing.

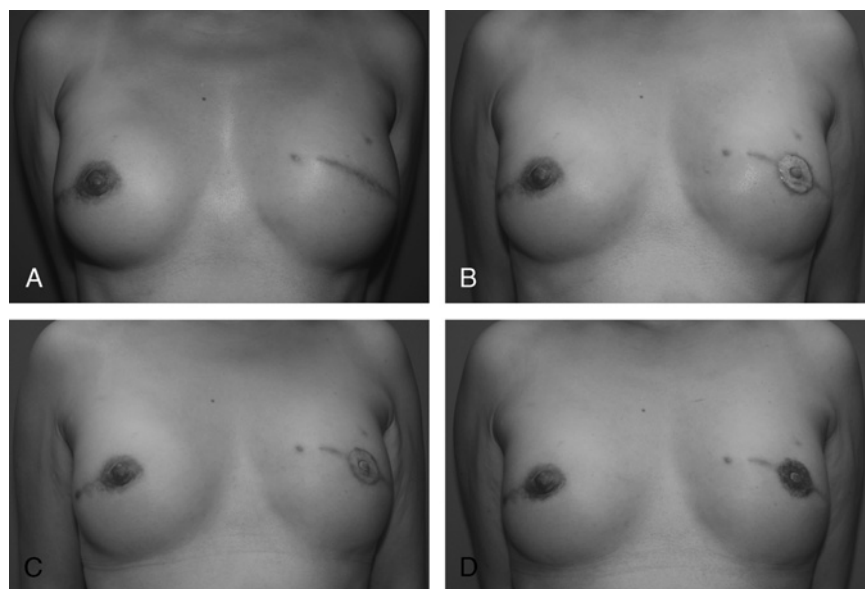


FIGURE 7. A 43-year-old female with invasive breast carcinoma of the left breast. A, Status post–left mastectomy and right nipple-sparing prophylactic mastectomy. B, Four weeks postoperation from nipple-areolar reconstruction using ADM almost fully re-epithelialized with a small amount of granulation tissue still present. C, Seven weeks postoperatively, the graft is fully epithelialized with good transition of texture. D, Status post–nipple-areolar tattoo for color.

of the nipple-areolar complex and noticeable transition of texture from breast skin to nipple-areolar complex (Fig. 6). Tattooing color can then enhance the appearance (Fig. 7). The overall outcomes of this technique are very similar to those seen in full-thickness skin graft areolar reconstruction. All of our patients have been satisfied with the appearance of their reconstructed nipples.

The main drawback of this technique is the cost of ADM. The price hurdle can possibly be overcome by banking excess acellular dermal matrix at the time of breast reconstruction for later use.²⁴ During implantation, the medial corner of the ADM is often removed. This portion can potentially be banked in the breast for use in later areolar grafting. The removal can be part of the expander exchange. In our opinion, the cost of a new sheet of ADM is justified in patients with no adequate skin graft donor site.

This technique has been successful, but requires patience for epithelialization and dressing changes. The patients have been totally satisfied and none have requested secondary revision or alternative reconstruction of the areola beyond nipple projection procedures. Acellular dermal-only grafting is a viable addition to the plastic

surgeon's armamentarium for nipple-areolar complex reconstruction and should be considered in appropriate cases.

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