Breast augmentation is one of the most common cosmetic surgical procedures in the United States, with 330,631 cases performed in 2012.¹ No matter how routine this surgery, however, it can be fraught with postoperative difficulties.² Complications such as capsular contracture (CC), implant malposition, rippling, and skin stretch are common. CC has been the “thorn in the side” of breast augmentation patients and plastic surgeons since the advent of the procedure, and Baker grade III or IV capsules have been reported in 14.8% and 20.5% of primary and revision cosmetic augmentation patients, respectively, over a 6-year period.³ Patients who present for revisionary procedures to address complications from breast augmentation already have endured the physical and emotional stress of the initial surgery, are anxious about undergoing another operation, and have extremely high expectations. With a thin, scarred tissue envelope, reoperation may translate to further technical difficulties. With all of these factors in

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Use of Porcine Acellular Dermal Matrix in Revisionary Cosmetic Breast Augmentation

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Abstract

Background: Aesthetic breast augmentation can be fraught with postoperative complications, particularly capsular contracture (CC), skin surface irregularities, and implant or inframammary fold malposition. Similar complications have been addressed successfully in reconstructive breast surgery with acellular dermal matrix (ADM) products.

Objective: The authors present their initial experience with porcine ADM (PADM) in aesthetic breast augmentation.

Methods: Retrospective chart review was performed for 93 consecutive patients (179 breasts) who underwent revisionary cosmetic breast augmentation with or without mastopexy between May 2009 and September 2012. Porcine ADM (Strattice; Lifecell Corp, Branchburg, New Jersey) was placed bilaterally in 74 patients and unilaterally in 19 patients. All patients were operated upon by 1 surgeon (J.N.P.). Product use description and complications were recorded, including infection, extrusion, CC, and implant malposition.

Results: Average follow-up was 12 months (range, 1-39 months). There were 2 major complications (1.6% of breasts): an infection in 1 breast that required implant explantation approximately 2 weeks postoperatively and an extrusion that required PADM removal. Two additional patients had high-riding implants resulting from folded PADM that required revision; both cases were corrected by excising the folded PADM segment. Seven other patients required office procedures to correct minor imperfections. Two CC recurrences were suspected (1 patient) in the 76 breasts that underwent capsulectomy and PADM placement.

Conclusions: Porcine ADM demonstrated great utility as an adjunct in revisionary cosmetic breast surgery. The product helped to provide good aesthetic outcomes with low complication rates. Prospective, randomized trials may prove helpful in defining the role of PADM further in these challenging cases.

Level of Evidence: 4

Keywords

breast augmentation, revision, acellular dermal matrix, capsular contracture, breast implant, ptosis, rippling, malposition

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mind, it is no wonder why some of the largest malpractice losses stem from breast augmentation revision surgery.4

Standard techniques to correct rippling and thin coverage include changing to silicone gel implants or converting to a submuscular plane, but often there is still not enough coverage. Fat injection has been advocated to correct skin surface irregularities, but this can result in induration, calcifications, cysts, infection, and lumpy irregularities.5 Capsulotomy or capsulectomy with insertion of a new implant is often performed to address CC, but these techniques are not the panacea. Placement of a fresh implant in a new plane—subpectoral, neopectoral,6 or dual-plane—has been touted as another solution to this difficult problem. Different variations of capsulorrhaphy and implant pocket changes have been employed to correct implant malposition as well. Despite there being a number of options, all these techniques fail at times and leave the plastic surgeon frustrated by an undesirable result.

An alternative method that has been described is the placement of acellular dermal matrix (ADM) to create a new implant pocket or mask surface irregularities. Animal studies have demonstrated that ADM prevents even postradiation CC.7,8 These products have been utilized extensively in the realm of breast reconstruction with some evidence that they reduce CC in humans, but this point remains controversial. Based on initial research support, ADM products have more recently been presented as an adjunct to the aforementioned techniques for difficult cosmetic breast revisions. Strattice (Lifecell Corp, Branchburg, New Jersey), a porcine ADM (PADM) product, may have particular promise for cosmetic breast surgery. It has less stretch, with the theoretical ability to provide more long-lasting support, and is more cost-effective than most other products. This latter point is often of particular concern for the cosmetic patient who is paying for her procedure without insurance coverage. In this study, we review our experience using PADM to enhance the outcomes of difficult revision breast augmentation surgery.

**METHODS**

A retrospective chart review was conducted on all patients who had undergone cosmetic breast surgery with PADM in our practice between May 2009 and September 2012. All cases were “fee for service,” with patients paying costs for surgery, anesthesia, operating room, implants, and PADM. Reconstructive procedures and cases that involved other ADM products were excluded. All 93 remaining consecutive patients (179 breasts) were operated on by 1 surgeon (J.N.P.). Data were analyzed for product use description and complications, including infection, extrusion, CC, and implant malposition.

The techniques employed were similar to those for breast reconstruction. For contour defects and rippling, the ADM was fenestrated to allow for egress of fluid and was secured deep to the affected cutaneous area to provide smooth soft tissue coverage. For breast support or implant malposition, the ADM was secured in place with 2-0 Vicryl sutures (Ethicon, Inc, Somerville, New Jersey) in a sling-like fashion (Figure 1). To recreate the inframammary fold with 2-0 Vicryl, it is then sutured to the inferior border of the pectoralis major muscle for complete implant coverage.

**Table 1. Preoperative Diagnoses**

<table>
<thead>
<tr>
<th>Preoperative Diagnosis</th>
<th>No. of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capsular contracture</td>
<td>36</td>
</tr>
<tr>
<td>Bottoming out/stretch</td>
<td>22</td>
</tr>
<tr>
<td>Malposition</td>
<td>16</td>
</tr>
<tr>
<td>Ptosis</td>
<td>8</td>
</tr>
<tr>
<td>Rippling/contour defect</td>
<td>7</td>
</tr>
<tr>
<td>Symmastia</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
</tr>
</tbody>
</table>

**RESULTS**

Average patient age was 42 years (range, 23-70 years). The mean follow-up period was 17 months (range, 1-39 months); 65% of patients in this series had a follow-up of more than 1 year. Preoperatively, there were 36 patients with CC (Figure 2), 22 with bottoming out or stretch...
Figure 2. (A, C, E) This 36-year-old woman presented with bilateral submuscular capsular contracture. (B, D, F) Fourteen months after complete capsulectomy with Strattice acellular dermal matrix (Lifecell Corp, Branchburg, New Jersey) sewn to the muscle edge and inframammary fold. Bilateral 300-cc implants were placed (Mentor moderate profile plus; Mentor, Santa Barbara, California).

There were 2 major postrevision complications (1.6% of breasts). One was an infection in 1 breast requiring explantation 2 weeks postoperatively. The PADM was partially incorporated and part was removed; the wound culture later grew methicillin-resistant *Staphylococcus aureus* (MRSA). The patient was treated with antibiotics, the infection resolved, and the patient underwent successful reaugmentation at a later date. A second patient who...
Figure 3. (A, C, E, G, I) This 42-year-old woman presented with inframammary fold malposition. (B, D, F, H, J) Thirteen months after capsulorrhaphy with revision augmentation. Strattice acellular dermal matrix (Contour 2 size; Lifecell Corp, Branchburg, New Jersey) was placed. A 375-cc implant was placed on the right; a 350-cc implant was placed on the left (Mentor high profile; Mentor, Santa Barbara, California).
underwent mastopexy augmentation developed PADM extrusion along the vertical limb of her mastopexy. The PADM was removed and the wound was closed. The same patient developed swelling along the contralateral vertical limb and the PADM was removed prophylactically. She healed without incident. Five patients (5.3%) required revision mastopexy to correct minor imperfections due to early skin stretch recurrence. Three patients required raising of the IMF and 1 patient required lowering. Two patients received small volumes of fat graft for minor contour correction. One patient went to another physician after augmentation with Strattice to exchange her implants for a larger size. One of her implants subsequently extruded, at which point she returned to our office for explantation and augmentation revision with PADM. She has experienced no other problems since then. One patient had early tightening; she developed a minor hematoma after capsulectomy and required drainage. She subsequently moved and was lost to follow-up but may have had recurrence of her CC. To date, there was no other CC recurrence in any of the patients who underwent capsulectomy with Strattice placement in this series.

**DISCUSSION**

Multiple ADM products have been used in breast reconstruction, but surgeons only recently have begun to explore their uses in cosmetic breast surgery. Maxwell and Gabriel\(^9\) published a case series of 78 revision breast augmentations with various ADM products, with the only complications being 1 hematoma and 1 malposition. Most important, there were no Baker III/IV contractures at 1 year. Hartzell et al\(^10\) later published their work on 38 cases with AlloDerm (Lifecell Corp). In that cohort, there was 1 infection and 2 persistent surface irregularities. Most recently, Spear et al\(^11\) reviewed their experience with multiple ADM products in 77 patients, 56% of whom underwent cosmetic procedures. Their complications were also infrequent, with 1.3% having bottoming-out,

![Figure 3. (continued)](https://academic.oup.com/asj/article-abstract/33/5/681/257912)
Figure 4. (A, C, E, G, I) This 44-year-old woman presented with submuscular implants and poor position. (B, D, F, H, J) Eighteen months after capsulorrhaphy and mastopexy with Strattice acellular dermal matrix (Contour 2 size; Lifecell Corp, Branchburg, New Jersey). Bilateral 424-cc implants were placed (Mentor high profile; Mentor, Santa Barbara, California).
1.3% having a major infection, and 1.3% having ripple recurrence.

Similar to previous reports, results from our series demonstrated a high success rate with few complications. The single infection is consistent with long-term data for primary breast augmentation, recently reported to have an infection rate of 1.8%. There were 4 minor revision mastopexies performed that were deemed necessary to correct small amounts of skin stretch or mild asymmetries. Many of the patients presented with extreme asymmetry and were told that minor touch-ups might be necessary.

Porcine ADM is easy to use as it comes in both sheets and precontoured shapes. Although we utilized small pieces of PADM in many of the early cases, we began to utilize large sheets with the “contour” shape for all of the more recent cases in late 2010, when they became commercially available. The latter were deemed most appropriate for inferior support and fold malpositions.

One concern that arises regarding these products is seroma formation. Although not all authors agree, only 1 of 4 comparative studies has demonstrated a statistically significant increase in infection and seroma rate in the ADM group. Chun et al reported a seroma rate of 9.7% in the ADM group versus only 3.0% in the control group after excluding all native skin flap necrosis cases. Considering the conflicting evidence, drains were used in all cases to prevent seroma formation.

Another objection that is often raised regarding the use of ADM for cosmetic surgery is that they are expensive when accounting for product cost, surgeon fee, and anesthesia expenses. If long-term data indicate that the revision rate of cosmetic breast surgery is dramatically decreased, however, the use of ADM for revisions and possibly even primary augmentation cases may save patients time and money. Unfortunately, only 61 patients from our series had a follow-up of 1 year or longer at the time this report was written, but we look forward to continuing to evaluate our results critically over time.

**CONCLUSIONS**

Porcine ADM demonstrated great utility as an adjunct in revisionary cosmetic breast surgery. The product helped to...
Figure 5. (A, C, E, G, I) This 24-year-old woman presented with subglandular implants, ptosis, and poor scarring. (B, D, F, H, J) Two years after a submuscular conversion procedure with the patient’s existing implants, mastopexy revision, and Strattice acellular dermal matrix (10 × 16 × 2 cm; Lifecell Corp, Branchburg, New Jersey) sewn to the muscle and inframammary fold bilaterally.
Figure 6. Number of corrective procedures performed with porcine acellular dermal matrix.

provide good aesthetic outcomes with low complication rates. Prospective, randomized trials may prove helpful in defining the role of PADM further in these challenging cases.

Disclosures

Dr Pozner and Dr Newman are both paid speakers for Lifecell Corp (Branchburg, New Jersey), manufacturer of the products discussed in this article. Dr White has nothing to disclose.

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