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# A Review of the Use of Acellular Dermal Matrices in Postmastectomy Immediate Breast Reconstruction

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Acellular dermal matrices (ADMs) are now commonly used in postmastectomy implant-based immediate breast reconstruction. In 2-stage reconstructions involving placement of a tissue expander followed by an implant, they can improve the aesthetic outcome and expedite the expansion process. The use of ADMs has also allowed for 1-stage immediate placement of an implant following mastectomy (direct-to-implant reconstruction). However, the use of ADMs is associated with an increased risk of certain types of complications. An understanding of the use of these materials is essential to the postoperative care of patients who undergo ADM-assisted breast reconstruction. In this article, the use of ADMs in postmastectomy immediate breast reconstruction is reviewed.

Breast reconstruction is an integral part of the care of breast cancer patients, with demonstrated improvements in quality of life (Al-Ghazal, Fallowfield,& Blamey, 2000; Eltahir et al., 2013; Wilkins et al., 2000). Implant-based (alloplastic) and tissue-based (autologous) techniques are the primary reconstructive options following mastectomy. The choice of technique depends on a host of patient and surgical factors. In some cases, patients favor implant-based approaches because of the shorter surgery and recovery time involved. Recent studies indicate that over the last decade, there has been a significant increase in the rate of alloplastic reconstructions compared to autologous tissue reconstructions in the United States (Albornoz et al., 2013; Cemal et al., 2013).

One of the most impactful innovations in implant-based immediate breast reconstruction has been the introduction of the use of acellular dermal matrices (ADMs). In two-stage reconstructions (where a tissue expander is placed at the time of mastectomy and then exchanged for an implant at a subsequent procedure), these materials can expedite the expansion process thereby allowing for breast reconstruction to be completed sooner and can also improve aesthetic outcomes. Acellular dermal matrices have been largely responsible for the ability to now perform one-stage reconstructions (where the permanent implant is placed at the time of mastectomy, also known as *direct-to-implant* reconstruction). A recent survey indicated that approximately 84.2% of plastic surgeons utilize ADMs for breast reconstruction (Ibrahim, Koolen, Ashraf, et al., 2015). However, ADMs are associated with certain risks, and an understanding of how they are used, predictors of complications, and the postoperative care of these patients is essential. In this article, the use of ADMs in implant-based postmastectomy immediate breast reconstruction is reviewed.

## ANATOMY

To understand the role of ADMs in implant-based reconstruction, it is helpful to briefly review pertinent anatomy and the changes that occur with a mastectomy. In a simple mastectomy, the nipple-areolar complex and adjacent skin are removed, in addition to the underlying breast tissue. Skin-sparing mastectomies and nipple-sparing mastectomies are variations that involve preservation of more skin and the nipple-areolar complex, respectively. While in breast augmentation, an implant may be placed either beneath breast tissue or under muscle (pectoralis major), because the breast tissue is removed in all mastectomies, implants placed during breast reconstruction are always placed beneath the pectoralis major. However, this introduces an issue, because the pectoralis major is not anatomically located where the footprint of the breast is located (i.e., the pectoralis major is positioned higher).

To address this problem, plastic surgeons have developed ways to create a lower breast pocket that has a more natural position using a patient's native tissues. One of the most common approaches to achieving this is to dissect inferiorly beyond the lower edge of the pectoralis major, and continue that submuscular plane under the

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rectus abdominis muscle (specifically, the anterior rectus sheath of the rectus abdominis muscle) to the inframammary fold, in order to create one continuous submuscular implant pocket (*submuscular* placement). Typically, the serratus anterior muscle is also elevated laterally. In doing so, a layer of soft tissue coverage (other than skin) is maintained over the entire implant (the pectoralis major superiorly, the anterior rectus sheath inferiorly, and the serratus anterior laterally). However, this submuscular implant pocket is generally not large enough to accommodate the size of the final implant, and therefore historically implant-based reconstructions were almost universally performed in two stages. Another issue is that a submuscular implant pocket often expands uniformly in all directions to create a round breast, whereas generally it is desirable to preferentially expand the lower pole to create ptosis that is more natural appearing. The use of ADMs in breast reconstruction has served as an alternative solution to these issues in implant-based breast reconstruction.

## ADM FUNDAMENTALS

Acellular dermal matrices are biologic materials, typically of human, bovine, or porcine origin. This tissue is processed to remove cells as well as any antigenic components to prevent an immune reaction, resulting in a dermal matrix that is composed of proteins such as collagen, elastin, hyaluronic acid, fibronectin, and proteoglycans. This matrix then serves as a scaffold for tissue ingrowth and revascularization by the host following implantation, during a process that can take several weeks (Garcia& Scott, 2013). Acellular dermal matrices retain the elastic properties of skin, which is favorable in the context of the stretch that occurs during expansion and implant placement.

Numerous ADMs have been described for use in implant-based breast reconstruction, the most commonly used of which are listed in Table 1. Although there are minor differences among these materials, in general, these differences do not significantly impact how the materials are used in the setting of postmastectomy breast reconstruction. Some materials have polarity, meaning that there is a distinct dermal side (through which revascularization occurs) and basement membrane side, in which case the dermal side is placed facing the mastectomy flap rather than the implant.

## SURGICAL TECHNIQUE

In breast reconstruction, ADM is typically cut to a rectangular shape on the basis of the patient's anatomy. It is then placed as a bridge between the lower edge of the pectoralis major and the inframammary fold. To achieve this, the inferior insertion of the pectoralis major is released so that it can be sewn to the superior edge of the ADM. After the implant is placed, the lower edge of the ADM is sewn inferiorly to the inframammary fold and also laterally to the chest wall. Ultimately, the pectoralis major covers the superior aspect of the implant and the ADM covers the inferior and lateral aspects of the implant. It thus replaces the use of the anterior rectus sheath and the serratus anterior traditionally used by plastic surgeons. At the same time, the ability of ADMs to stretch allows for more preferential lower pole expansion of a tissue expander in two-stage reconstructions. In one-stage reconstructions, ADMs allow for the creation of a sufficiently large pocket to accommodate the permanent implant.

## OUTCOMES

While many ADMs have been described for use in breast reconstruction, the vast majority of research on surgical outcomes has involved AlloDerm (LifeCell, Branchburg, NJ), particularly in the setting of two-stage implant-based breast reconstruction (Antony et al., 2010; McCarthy et al., 2012; Sbitany, Sandeen, Amalfi, Davenport,& Langstein, 2009). Most studies report outcomes with the use of a specific type of ADM, with relatively few head-to-head comparisons between ADM and traditional submuscular implant placement, or between multiple different types of ADMs (Glasberg& Light, 2012; Liu, Mathes, Neligan, Said,& Louie, 2014; Mendenhall et al., 2015).

**TABLE 1 Acellular Dermal Matrices Commonly Used in Breast Reconstruction**

| Name | Source | Refrigeration required | Rehydration method | Polarity | Size range (cm) | Thickness range (mm) |
|---|---|---|---|---|---|---|
| AlloDerm | Human | Yes | Soak in saline | Yes | 1 × 1 to 16 × 20 | 0.23–3.30 |
| AlloMax | Human | No | Soak in saline | No | 2 × 4 to 16 × 20 | 0.8–1.8 |
| DermaMatrix | Human | No | Soak in saline | Yes | 1 × 1 to 20 × 25 | 0.4–1.7 |
| FlexHD | Human | No | Rinse | Yes | 1 × 2 to 20 × 25 | 0.2–2.5 |
| Strattice | Porcine | No | Soak in saline | No | 1 × 1 to 16 × 20 | Not specified |
| Surgimend | Bovine | No | Soak in saline | No | 3 × 3 to 25 × 40 | 1.0–4.0 |

### Two-Stage Reconstruction

There is strong evidence indicating that patients who undergo breast reconstruction with ADMs have an increased risk of seroma, infection, and reconstructive failure (need for implant removal) (Antony et al., 2010; Kim et al., 2012). This bears relevance to the management of these patients, as discussed later (see the Postoperative Care section). The rates of other types of complications (hematoma, mastectomy flap necrosis), however, appear to be generally similar. The risk of postoperative complications is greater with increasing age, increasing body mass index, and in patients undergoing axillary dissection (Antony et al., 2010).

Although ADMs might be expected to allow for greater initial expander fill volumes and a fewer number of fills to complete the expansion process, existing studies do not unequivocally demonstrate this (Kim et al., 2012; McCarthy et al., 2012; Sbitany& Serletti, 2011). The aesthetic outcomes with the use of ADMs have been reported to be superior to those with traditional submuscular placement based on blinded comparisons of postoperative photographs (Forsberg et al., 2014; Ibrahim, Koolen, Ganor, et al., 2015). Most studies suggest that the use of ADMs in two-stage breast reconstruction is associated with a greater financial cost than without its use, when using models that factor in variables such as the expense and likelihood of complications, and the number of patient encounters for expander fills (Bank, Phillips, Park,& Song, 2013; Krishnan et al., 2014).

### One-Stage Reconstruction

Patients who undergo direct-to-implant breast reconstruction with ADMs have been found to experience similar rates of postoperative complications compared with patients who undergo two-stage reconstruction without ADMs, and therefore this procedure is generally considered to be a safe and reliable approach to breast reconstruction (Colwell et al., 2011, Salzberg, Ashikari, Koch,& Chabner-Thompson, 2011). However, most studies indicate that not all patients are good candidates for one-stage breast reconstruction, and therefore patient selection is critical. Patients at risk for increased complications include those with a history of prior irradiation and those with larger bra cup sizes (Gdalevitch et al., 2014). One-stage breast reconstruction with ADM appears to be more cost-effective than two-stage breast reconstruction with ADM (Jansen& Macadam, 2011). There are limited data analyzing the aesthetic outcomes associated with direct-to-implant breast reconstruction.

## POSTOPERATIVE CARE

The postoperative management of patients who undergo breast reconstruction with ADMs is an important part of reducing complications. As previously mentioned, these patients, particularly those undergoing two-stage reconstructions, are at increased risk of developing seromas and infections. Seromas likely develop if fluid accumulates between the ADM and the mastectomy flap before revascularization and adherence between those two tissue surfaces occurs, which is a process that may take several weeks. Because ADMs are avascular until revascularization occurs, they are also susceptible to infection during this time period (similar to other types of grafts). This can, in turn, lead to a foreign body infection of the implant that can be difficult to eradicate.

Although there is no standard protocol for the postoperative management of patients who undergo breast reconstruction with ADM, there are certain practices that are common among plastic surgeons that aim to decrease the risk of seroma and infection. Placement of closed suction drains is universal in these patients, and it is essential to diligently perform standard drain maintenance to ensure proper functioning (e.g., stripping), and to maintain an accurate record of their output to ensure removal at the appropriate time. A compressive garment such as a surgical bra can also be helpful. To reduce the risk of infection, hygiene at the drain site, which can serve as a portal for contamination, is important. For a similar reason, at many centers, patients are advised to only sponge bath while the drains are in place. Postoperative antibiotics are typically prescribed and continued for variable periods of time, sometimes even as long as until all drains are removed. It is helpful to review all of these elements of postoperative care with patients before surgery.

## CONCLUSIONS

Acellular dermal matrices are commonly used in implant-based breast reconstruction. In two-stage reconstructions, they can improve the aesthetic outcome and may expedite the expansion process, but can increase the risk of seroma and infection, and are costlier than traditional approaches. Acellular dermal matrices have also allowed for the possibility of performing one-stage direct-to-implant breast reconstructions, which reduce the number of procedures necessary to complete the reconstructive process, but are appropriate only in select patients. An understanding of the use of these materials is essential to the postoperative care of patients who undergo ADM-assisted breast reconstruction.

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