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REVIEW

Use of human acellular dermal matrix in implant-based breast reconstruction: Evaluating the evidence

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Review

Summary The use of acellular dermal matrix (ADM) in implant based breast reconstruction has become increasingly popular to the point that a subset of surgeons use ADM for virtually every tissue expander/implant based reconstruction. While there may be a number of perceived and anecdotal advantages such as decreased post-operative pain, increased initial expander fill volume, and improved aesthetic outcome, it remains unclear as to whether there is sufficient evidence to support these as well as other claims or its routine use.

In this review, we identified all papers in the PubMed and Medline databases that addressed outcomes of the use of ADM in single and multiple staged implant based breast reconstruction. Papers were evaluated for any claim of benefit in using ADM in breast reconstruction. The following perceived advantages were supported solely by anecdotal reports and opinions: reduction in post-op pain, decreased operative time, precise control of the lateral and IMF, maximal use of mastectomy skin flaps, and improved lower pole expansion. There was inconsistent data for commonly perceived advantages, such as: eliminating the need for expanders, increased initial fill volumes, fewer expansions, faster time to reconstruction completion, decreased rate of revision, and improved aesthetic outcome. We found consistent support for a decreased incidence of capsular contracture; however the existing reports have limited long term follow-up.

Despite the many heralded benefits of ADM in breast reconstruction, the data supporting these claims is mostly anecdotal. Both long term outcomes and randomized controlled prospective studies are needed in order to definitively evaluate the perceived advantages of ADM in breast reconstruction.

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Introduction

Acellular dermal matrices (ADM) have been used in an increasing variety of surgical applications for over 10 years. These biologic materials not only provide initial structural strength and bulk but also allow relatively rapid vascular ingrowth and serve as a scaffold for "new" tissue formation.[1] These properties have led to its application in multiple surgical problems where tissue deficiency is an issue.

In recent years there has been a significant increase in ADM use for breast procedures.[2–5] ADM was initially reported after use in breast reconstruction to address secondary breast deformities such as rippling and contracture[6] but has since been applied to address the shortcomings of prosthetic based breast reconstructions.[7]

The most common use of ADM is to cover the inferior pole of the implant in immediate post-mastectomy prosthesis based breast reconstruction. The increasing use of ADM in prosthetic based breast reconstruction has been secondary to several perceived advantages over prosthetic based reconstruction using implants or expanders with local tissue alone.[8–10] Some of the perceived advantages, alluded to by authors referenced in this review include: 1) eliminated need for expanders, 2) reduction in post-operative pain, 3) decreased operative time, 4) increased initial fill volumes, 5) fewer expansions, 6) precise control of the lateral and inframammary fold, 7) maximal use of mastectomy skin flaps, 8) faster time to completion of reconstruction, 9) improved lower pole expansion, 10) decreased incidence of capsular contracture, 11) fewer capsular modifications at second stage surgery, 12) decreased rate of revision, and 13) improved aesthetic outcome (Table 1).

Despite minor variations in technique, the use of ADM is gaining rapid acceptance in breast reconstruction.[2–5,8] Market data from LifeCell Corporation (Branchburg, NJ) indicates that 87% of surgeons that perform at least 25 breast reconstructions of any kind each year have used a biological mesh in implant based reconstruction and that over 56% of all tissue expander and implant based reconstructions are now being done with the use of a biological mesh.[11] Multiple studies have been reported over the past 7 years, describing the experience and outcomes with its use.[2,4,8,9,12–14]

Surgical techniques utilizing ADM are numerous, and their multiplicity is well documented.[2,3,8,13] Although there are variations, in the setting of immediate or delayed breast reconstruction, the ADM sheet is used as an "extension" of the pectoralis major. After release of the inferior attachments of the pectoralis major, the ADM is sewn from the inferior edge of the muscle to the inframammary fold and to the serratus fascia laterally, thereby providing complete coverage of the device. (Figure 1) This essentially increases the volume of the breast pocket to accommodate adequate volume to fill the skin envelope. The increased size breast pocket then allows increased filling of the expander, or in certain cases, placement of an implant and completion of reconstruction. In most cases, closed suction drains are placed above and below the ADM sheet and left in place until drainage is minimal, most authors specify less than 30 cc of fluid over a 24 h period.[5]

Although excellent aesthetic results can be achieved in selected patients using ADM-assisted breast reconstruction (Figure 2), its use is controversial because the economic impact of ADM use may not be reliably correlated with clinical and experimental data. The use of ADM in breast reconstruction is controversial because the economic impact of its use may not be reliably correlated with clinical and experimental data. In order to establish the quality and quantity of evidence regarding ADM in prosthetic breast reconstruction, we sought to review the available data for evidence supporting or refuting these purported advantages.

Methods

A Pubmed and Medline search using keywords "acellular dermal matrix" or "AlloDerm" and "breast reconstruction" was performed. Thirty-seven articles were identified. Technique papers and those that did not clearly separate ADM from non-ADM groups not included. Articles that did not address any of the perceived advantages, as outlined in the introduction, were also excluded. Of these, 18 articles were evaluated in this review. We assessed the papers for any claim of the benefit of using ADM in breast reconstruction and assembled the list shown in Table 1. Each hypothesis was listed with the corresponding evidence the literature search produced. The evidence was stratified by supporting studies, refuting studies, and anecdotal support/opinions. Additionally, study type (e.g. prospective cohort, retrospective review, case series, etc.) was noted.

Critical review of acellular dermal matrix (ADM) proposed benefits

Decrease or eliminate the need for expanders

A potentially powerful advantage of ADM in immediate breast reconstruction is that the implant reconstruction process may be completed in one stage in patients who would have otherwise required a staged reconstruction. Specifically, an ADM sheet can be used to create a pocket large enough to accommodate a fully inflated implant, thus eliminating the need for a staged procedure with a tissue expander.[12] Four reports clearly address the safety and efficacy of using an ADM sheet with an immediate implant for reconstruction.[2,3,13,15]

All four of these studies are retrospective reviews that demonstrate an overall complication rate ranging from 6.9[15] to 25%.[4] In Breuing's study, there were comparable complication rates of a 6.7% (2/30) in the single stage reconstructions and 7.1% (1/14) for the two-stage reconstructions, all performed using AlloDerm.[15] The 25% (6/24) complication rate in Zienowicz's study were all minor skin flap necroses (6/24) which were managed conservatively.[4] Finally, in Gamboa—Bobadilla's study, the overall complication rate was 9%, however one patient had a significant complication including seroma and cellulitis followed by implant extrusion.[13] Salzberg reports a 6 percent complication rate in a study of 49 patients who underwent immediate breast reconstruction with ADM.[3] Thus, the reported evidence demonstrates that it is possible to skip an expansion stage for a single stage implant based reconstruction and achieve acceptable results. The quality of these reconstructions and the exact patient group to which they are applicable has not been described with certainty.