35 Alternatives to Acellular Dermal Matrix for Implant-Based Breast Reconstruction

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35.1 Introduction

Implant-based reconstruction remains the most commonly employed technique for post-mastectomy breast reconstruction in appropriate patients. In an effort to improve the aesthetic results of and minimize morbidity from total submuscular coverage, the use of acellular dermal matrices (ADMs) as an inferolateral sling has gained significant popularity in the last decade, arguably becoming the standard of care. Proponents of this technique report increased intraoperative fill volumes, more defined inframammary and lateral mammary folds, and stabilization of the pectoralis major without window-shading during expansion.

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As indications for nipple-sparing and skin-sparing mastectomies broaden, so has their commonality. For these patients, ADMs have played a fundamental role in the development of immediate single-stage direct-to-implant reconstruction, expanding our implant-based reconstructive options.

Although many consider the usage of ADMs as progress in the authors' technique, they are not without their flaws. Biologic materials are limited in availability and expensive to harvest and produce, resulting in significantly higher costs to an already burdened healthcare system. Within the literature, controversy exists as to whether the incidence of seroma and/or infection is increased with the use of ADMs. As a result, many have sought alternatives to ADMs in an effort to find a more cost-effective and safer material, without compromising aesthetic results. An expanding number of synthetic, absorbable meshes have been reportedly used with success. In a recently published experience, polyglactin 910 (Vicryl; Ethicon, Inc., Somerville, N.J.) has served as an ideal ADM substitute.

35.2 Technique

The inferolateral sling pectoralis extension technique for absorbable mesh is very similar to that for ADMs. Likewise, absorbable meshes are appropriate to use in either single or two-stage

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implant based reconstruction. Typically, the determination of direct-to-implant versus staged reconstruction will be based on mastectomy flap viability, degree of mastectomy skin sparing, and relative desired postoperative breast volume. Careful examination of the skin flaps and laser angiography, when available, guide the assessment. In either technique, a subpectoral pocket is dissected. The pectoralis major is released from its inferior costal insertions to their junction at the sternum where the direction of muscle fibers becomes more transversely oriented.

35.3 Direct-to-Implant Reconstruction

As described by Tessler et al. [1], for single-stage reconstructions, a saline sizer is selected based on the mastectomy specimen weight and breast base width. The sizer is inserted in the partial subpectoral pocket and inflated to the desired volume. The outline of the implant is marked to assist appropriate tacking of the absorbable mesh. The mesh is secured to the inferior and lateral mammary folds using absorbable sutures (Fig. 35.1). The sizer is reinserted and the skin flaps temporarily stapled closed. The patient is brought into the seated position to ensure symmetry, good contour, and proper fold placement. The patient is returned to the supine position, the sizer removed, and the final implant inserted with a minimal touch technique. The superior edge of the absorbable mesh is secured to the inferior edge of the pectoralis with absorbable sutures (Fig. 35.2). Two drains are tunnel subcutaneously and placed in the subcutaneous and subpectoral spaces. Hemostasis is ensured and the skin is closed. A loose surgical bra is applied.

35.4 Two-Staged Implant-Based Reconstruction

In two-staged, tissue expander to implant reconstruction, the technique is essentially identical to that of ADM. An inferolateral mesh sling is sutured to the inferior edge of the released pectoralis major muscle, serving as a pectoral extension. The mesh is then sutured inferior-laterally to define the neo-inframammary fold and lateral breast border. The tissue expander is placed in the subpectoral/mesh plane. Drains are only placed in the subcutaneous plane, as the mesh does not serve as a water-tight barrier dividing the space into separate pre and subpectoral planes. In-office expansion is initiated as early as 3 weeks.

35.5 Discussion

35.5.1 Benefits of ADM

ADMs offer significant improvements to implant-based reconstruction in both single and two-stage procedures. Reported advantages over traditional

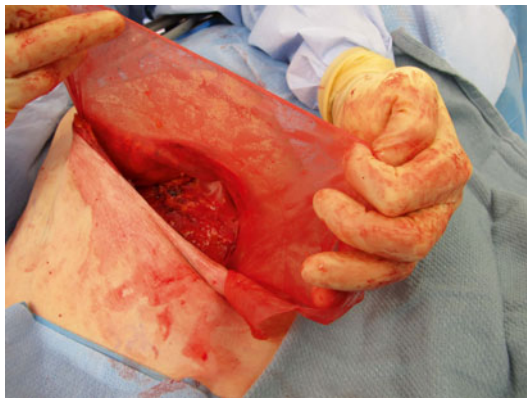

Fig. 35.1 The absorbable mesh secured to inferior and lateral breast borders on the chest wall

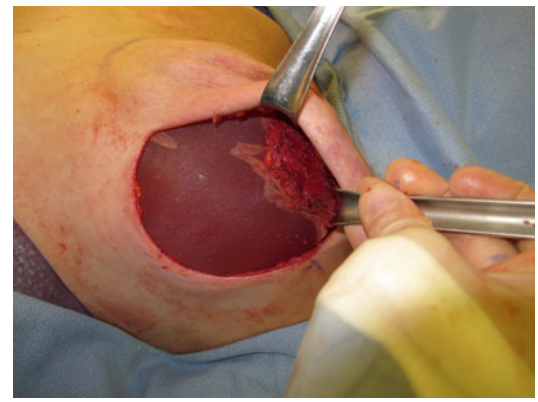

Fig. 35.2 The absorbable mesh in its final position secured to the inferior edge of the pectoralis major with implant underlying

total submuscular coverage include improved expansion of the lower pole allowing for increased intraoperative fill, better pocket control, enhanced definition of the inframammary and lateral mammary folds, and faster time to implant exchange [2, 3]. In addition, postoperative pain and hematoma rates may be reduced due to a lessened musculofascial dissection, particularly of the serratus which has a broad insertion and is transected by multiple perforating intercostals nerves. Several histologic and clinical studies have reported less significant capsule formation with the use of ADMs [4].

35.5.2 Potential Disadvantages of ADM

Several large-scale studies reveal a complication profile similar to non-ADM based reconstruction [5]. However, the data regarding their complication profile, particularly with respect to infection and seroma, remain conflicting. This is likely secondary to significant discrepancies in technique, materials, and definitions of complications. Antony et al. [6] reported a twofold increase in total complication rates with ADM in immediate two-stage breast reconstructions. The ADM group was found to have a statistically significant higher seroma rate (7.2 % vs. 1.6 %) and reconstructive failure (5.9 % vs. 1.9 %) when compared to non-ADM reconstructions. Although the reconstructive failures were most commonly due to infection, the difference in infection rate itself was not found to be statistically significant (3.3 % vs. 1.3 %) potentially highlighting an insufficient sample size. In a large, consecutive series of tissue-expander/implant-based immediate breast reconstructions, Chun et al. [7] used a multiple regression model to find an approximately fourfold increase in seroma and infection in the ADM group. Weichman et al. [8] reported consistent findings with another large, single-institution population undergoing two-stage tissue expander breast reconstruction. Major complications were increased in the ADM group (15.3 % vs. 5.4 %). These complications included infection requiring intravenous antibiotics (8.6 % vs. 2.7 %), flap necrosis requiring excision (6.7 % vs. 2.7 %), and explantation of the tissue expander (7.7 % vs. 2.7 %). Using an animal model for bacterial adherence, Liao et al. [9] found significantly higher rates of biofilm formation in two commonly used ADM products as compared to polypropylene and polyglactin 910, potentially explaining higher infection rates and need for explantation given antibiotic resistance [9].

Beyond concerns about complication rates, ADMs have been found to have significantly variable elastic properties among distinct donors [10]. The implications with regard to the effect on symmetry or long-term support have yet to be determined.

Table 35.1 Ideal material characteristics

Easy to use
Positions implant and allows for inframammary and lateral mammary fold contouring
Prevents window-shading of pectoralis major
Minimizes risks of seroma/infection/explantation
Minimizes capsular contracture
Minimizes tension of implant on skin
Inexpensive
Readily available
Uniform mechanical properties

35.5.3 Financial Implications of Use of ADM

Regardless of these potential disadvantages, ADMs, by their nature, are costly to produce and may not be readily available. In fact, the most commonly used material and size combination carries a hefty retail price of $4890 per piece, or approximately $26 per square centimeter. With rapidly rising hospital costs, profound efforts are being made to implement cost-effective methods. Consequently, financial concerns have been a major driving force in the quest to find more cost-effective materials with equal or better results and complication profiles. Ideal material characteristics are listed in Table 35.1.

35.6 Absorbable Vicryl Mesh

Although use of absorbable mesh represents a novel technique for implant-based breast reconstruction, preliminary results have been promis-

ing. As per Tessler et al.'s [1] experience, Vicryl mesh has yielded a cost-effective material (approximately $200 per bilateral case) that produces excellent aesthetic outcomes with a low complication profile. In 50 patients undergoing 76 breast reconstructions, a less than 7 % total complication rate was found, with average follow-up of 1.2 years. No implant bottoming-out or malposition was noted postoperatively, despite using an extensive range of implant sizes. During revisional or secondary surgery, capsule formation was found to be similar to that of a primary breast augmentation capsule.

35.7 Other Materials

Undoubtedly, other materials will emerge as feasible non-ADM alternatives. TIGR Matrix (Novus Scientific; Singapore), a long-term absorbable synthetic mesh with dual-stage resorption, has been successfully used in immediate breast reconstruction [11]. Fast-degrading fiber is a copolymer between glycolide and trimethylene carbonate, resulting in total resorption within 4 months. The slow-degrading fiber is essentially a copolymer of lactide and trimethylene carbonate that keeps mechanical strength for up to 9 months. With degradation, the mesh becomes softer and more pliable.

The Seri surgical scaffold (Allergan, Inc.; Irvine, C.A.) is a knitted material composed of silk-derived fibroin, sourced from the silkworm that being explored as yet another alternative. It functions as a long-term resorbable mesh, providing support for up to 24 months as tissue ingrowth occurs. Animal studies are promising with regard to maintaining mechanical strength, although published human data has yet to be concluded.

Conclusions

As the field of non-ADM alternatives expands, large, prospective studies need to be performed in order to further delineate their respective advantages and disadvantages. Preliminary data suggests that equivocal results can likely be achieved at a lower cost and with a potentially lower complication profile. The recent use of products like absorbable mesh and silkworm products are a demonstration of this effort.

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