Extended Submuscular Implant-Based Breast Reconstruction with Pectoralis-Serratus Sling and Acellular Dermal Matrix

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Partial muscle coverage with the use of acellular dermal matrix (ADM) has become commonplace in implant-based breast reconstruction.\textsuperscript{1,4} Compared with total submuscular coverage,\textsuperscript{5,12} the advantages of partial muscle coverage and ADM have included greater primary implant fill volumes, quicker expansion, increased lower pole expansion, and improved breast aesthetics.\textsuperscript{5,8,13-15} Since Breuing and Warren’s 2005 description,\textsuperscript{1} ADM has been widely used as a “pectoralis extender” and “inferolateral sling.” Having amassed experience and largely favorable results with this classical technique,\textsuperscript{1} we have nevertheless found several limitations with this approach, primarily related to the incision of the lateral margin of the pectoralis major muscle and the requisite lateral inset of the allograft. First, the lateral ADM inset requires two suture lines, along both the incised pectoralis major muscle lateral margin and serratus fascia, which can be time intensive. Second, lateral allograft inset can be technically arduous, particularly through increasingly limited-length or inframammary mastectomy incisions. Finally, we had commonly noted lateralization of the breast pocket throughout the expansion process, with varying degrees of lateral breast prosthesis displacement, that have necessitated onerous and additional time-intensive lateral capsulorrhaphy maneuvers to re-define the lateral pocket at the second stage.

The authors’ current implant-based breast reconstruction technique was devised to establish more robust definition of the lateral breast pocket, limiting potential implant displacement and minimizing the need for capsular modification at a second procedure. The technique, described below and demonstrated in Figure 1, is a hybrid approach that combines the advantages of ADM inferiorly with extended submuscular coverage laterally by elevating the pectoralis major muscle in continuity with the serratus anterior muscle and fascia. This technique provides more vascularized autogenous implant coverage, improves support and maintenance of breast shape and implant position, facilitates control of the lateral pocket through more limited mastectomy incisions, and improves time efficiency, obviating the need for lateral allograft inset and fixation.

**OPERATIVE DETAILS**

The patient is marked standing upright, delineating key landmarks including proposed mastectomy incision lines, inframammary folds, and the midline. Immediately following mastectomy, the inferior margin of the pectoralis major muscle is marked, and the proposed lateral limit of the implant position is marked on the serratus anterior muscle. The pectoralis major muscle is incised horizontally across its inferior border with electrocautery. The medial limit of dissection is the lowermost pectoralis major muscle sternal origin. All inferior attachments of the muscle fibers are released, and a retropectoral pocket is developed. As the dissection progresses from medial to lateral, superficial to the pectoralis minor muscle, dissection is then carried deep to the serratus anterior muscle, maintaining a continual...
uous lateral musculofascial sling of pectoralis major and serratus anterior muscles (Figure 2). A useful landmark is the lateral border of the pectoralis minor muscle, at which point dissection is deepened beneath serratus muscle and fascia. The muscular pocket is developed for hand-in-glove fit of the prosthesis. After confirmation of hemostasis,

Figure 1. Illustration of the surgical technique for extended submuscular implant-based breast reconstruction with pectoralis-serratus sling and acellular dermal matrix, demonstrating (A) the horizontal division of the pectoralis major muscle inferiorly and development of a retropectoral muscular pocket in continuity with the serratus anterior, and (B) the inset of the ADM inferiorly and beneath the pectoralis-serratus sling laterally. Blue dots delineate tissue expander position.

Figure 2. (A) The pectoralis major muscle and serratus anterior muscle and fascia shown elevated in continuity, maintaining the integrity of the lateral pectoral border and creating an uninterrupted musculofascial sling. (B) With the tissue expander placed hand-in-glove within the pocket, inset of the dermal allograft and the extended lateral muscle coverage is demonstrated. Note that a modicum of sutures are used to affix the allograft laterally, as the musculofascial sling provides stout maintenance of implant position. *pm*, pectoralis major muscle; *sa*, serratus anterior muscle and fascia; *pss*, pectoralis-serratus sling; *adm*, acellular dermal matrix.
0.25% bupivacaine solution or 1.3% Exparel bupivacaine liposome suspension (Pacira, Inc., Parsippany, NJ) is administered for postoperative analgesia. The ADM is prepared by rinsing with triple-antibiotic solution consisting of cefazolin, gentamicin, and bacitracin. AlloDerm Tissue Matrix Ready to Use (LifeCell Corp., Branchburg, NJ), measuring 1.04 to 2.28 mm in thickness ("thick" variety) is used for all cases. In our early experience, 6 × 16 cm allograft sheets were most commonly used, and trimmed accordingly. Following the advent of Contour Perforated AlloDerm, a shaped allograft sheet is currently used for all reconstructions as it requires less tailoring. The size of the allograft sheet is selected based upon tissue expander size: medium (132 cm²) for base width of 11 to 13 cm, and large (164 cm²) for base width of 14 cm or greater. The ADM is then affixed with interrupted absorbable suture (3 – 0 Vicryl, Ethicon, Inc., Somerville, NJ) to the incised inferior margin of pectoralis major muscle. A tissue expander (Natrelle Style 133, Allergan Inc., Irvine, CA) is evacuated of all air, filled with saline to a volume of approximately 50% of the specified implant fill parameters, and placed within the pocket. Moderate volume in the tissue expander enables the establishment of a primordial breast shape, and facilitates tailoring and inset of the ADM. The inferior allograft margin is affixed to the superficial fascia of the inframammary region with interrupted braided absorbable suture, redundant allograft (if any) is trimmed, and the lateral margin of ADM is tucked beneath the musculofascial sling (Figure 2). Two closed suction drains (10-mm flat Jackson Pratt) are used in all cases and are brought through separate, distant percutaneous sites inferolateral to the reconstructed breast; one is placed beneath the pectoralis-serratus musculofascial sling and allograft, and one is placed laterally, superficial to the musculofascial sling and concomitantly draining the axillary regions. The mastectomy skin flaps are temporarily tacked closed and viability is assessed clinically or with indocyanine green dye perfusion imaging. Final implant fill volume is adjusted accordingly, and skin flap margins are sharply excised as necessary. Mastectomy flap closure with a combination of interrupted deep dermal and running intradermal monofilament absorbable suture (2 – 0 Monocryl, Ethicon, Inc., Somerville, NJ) completes the first stage of the reconstruction. A short video demonstrates the key surgical steps and is available as Supplementary Material at www.aestheticsurgeryjournal.com.

MY EXPERIENCE

Eighty-five patients who underwent mastectomy and immediate implant-based reconstruction from January 2012 through December 2014 were reviewed retrospectively. Of these, three patients were excluded because they had previously undergone elective bilateral submuscular augmentation mammoplasty, and consequently were not treated with the approach described above. Eighty-two patients (140 breasts) underwent first stage breast reconstruction with pectoralis-serratus sling and ADM. All breast reconstructions were immediate and two-stage, with tissue expander placement at the first stage, performed by the senior author (A.R.K.). There were no direct-to-implant reconstructions performed during this period. As a measure of satisfaction, patients were asked to complete four scales of the BREAST-Q Reconstruction Module (Postoperative) quality of life outcomes questionnaire,16 with scores converted into linearized measurements using the Q-score program.17 Mean age at time of first-stage surgery was 48 years (range, 24-74 years) and mean follow-up duration was 18 months (range, 11-30 months). Sixty-four (78%) had a personal history of breast cancer, and 18 (22%) had genetic predisposition. Bilateral mastectomy and reconstruction were performed in 58 women (71%), and 24 women (29%) underwent unilateral procedures. Total mastectomy was performed for 136 breasts (83%), and nipple sparing mastectomy (NSM) in 28 (17%). Nineteen breasts (14%) received postoperative radiation. Figures 3 and 4 demonstrate preoperative and postoperative images of sample patients after immediate two-stage breast reconstruction with pectoralis-serratus sling and ADM with ideal outcomes.

OUTCOMES

The results with regard to aesthetics, complications, and patient satisfaction were favorable. Complications requiring reoperation were four infections (5%), all treated and successfully salvaged with reoperation including washout and prosthetic exchange, one hematoma (1%), and one major skin flap necrosis (1%) occurring early in our experience in an ex-smoker, prior to more routine use of indocyanine green perfusion study. Minor complications included two seromas (2%) that were managed with outpatient aspiration. There were three capsular contractures (4%), Spear-Baker Grade III,18 all of which followed adjuvant external radiation therapy. The low rate of complications was similar to our personal experience with implant-based reconstruction prior to the development of this technique, and consistent with that of recent publications.9,14,19

Among the more substantive improvements with the pectoralis-serratus musculofascial sling technique in our experience were consistent aesthetic results, low rates of revision surgery, and more rapid, less technically demanding second stage exchange procedures. Five patients (6%) in this series underwent aesthetic revision following the second stage of reconstruction for size, shape or symmetry, a comparatively modest rate of revision,20,22 and none were related to lateral implant malposition. An additional advantage of the technique was realized at the second stage, as...
lateral capsulorrhaphy was required in only 11 breasts (8%) during planned tissue expander-to-implant exchange. The hand-in-glove fit of the prosthesis within the composite musculo-fascial and allograft pocket, along with the durability of the autologous lateral support of the pectoralis-serratus sling, minimizes the surgical maneuvers required during the implant exchange procedure. Furthermore, BREAST-Q postoperative mean scores were: satisfaction with outcome...
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78 ± 10 (range, 46-100), satisfaction with breasts 71 ± 9 (range, 43-100), psychosocial well-being 75 ± 12 (range, 46-100), and sexual well-being 60 ± 17 (range, 34-90), suggesting acceptable patient satisfaction.

While the technical ease of this approach, consistency of results, patient satisfaction, and nominal complication rates are encouraging, the study has several limitations. It is a single-surgeon review of 140 breasts in 82 patients; therefore,
direct inferences cannot necessarily be made from this study sample to a larger population. Additionally, after the senior author found excellent results in his early experience with this technique, it was adopted exclusively, thus a technique selection bias is inherent. Future study comparing outcomes and aesthetic results of the pectoralis serratus technique with classical inferolateral ADM reconstruction would be valuable. Further, whereas no increase in postoperative pain or any impairment of scapular stability were observed in this series, these parameters were not directly tested, and future analysis of postoperative opioid requirements, objective pain score, and upper extremity function would be beneficial. Finally, while no patients during this study were treated with direct-to-implant reconstruction in one stage, this technique is indeed applicable in such cases, and may have a favorable impact on reducing rates of revision.

**COST**

There are clear potential cost advantages of this technique. First, obviating the need for dual suture line inset of ADM to maintain the lateral border of the peri-prosthetic pocket confers greater time efficiency during the first stage. Additionally, as the prosthesis is placed hand-in-glove into the pocket at the index procedure with minimal subsequent displacement, the intraoperative maneuvers required at the second stage exchange procedure, and consequently the time spent in its performance, are minimized.

**CONCLUSIONS**

By providing increased autogenous coverage, rapid and durable lateral pocket control, and with an acceptable complication profile, low revision rate, good aesthetics and high patient satisfaction, the pectoralis serratus sling with ADM should be considered in implant-based breast reconstruction.

**Supplementary Material**

This article contains supplementary material located online at www.aestheticsurgeryjournal.com.

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