The Tissue-Based Triad in Augmentation Mastopexy: Single-Stage Technical Refinements

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Abstract

Background: The number of patients seeking augmentation mastopexy has increased over the last several decades. The conflicting goals of augmentation (tissue expansion) and mastopexy (tissue reduction) have led to higher revision rates, decreased patient satisfaction, and pending litigation. Some have even argued for staging of all augmentation mastopexy procedures.

Objectives: The goal of this study was to review the senior author's (W.P.A.) process-oriented approach to single-stage augmentation mastopexy and to detail the technical framework to produce reliable, reproducible, safe results in a 1-stage augmentation mastopexy.

Methods: A prospectively collected patient database from January 2007 until January 2018 was reviewed. All single-stage augmentation mastopexy patients were evaluated, including patient demographics, operative details, complications, and outcomes.

Results: A total of 251 patients were evaluated. Mean follow-up was 16.9 months, average patient age was 38.0 years, and average implant size was 285.8 cc. A total of 9 (3.6%) patients required reoperation and only 2 (0.8%) required explantation. Fourteen (5.6%) patients developed delayed wound healing that responded to local wound care alone.

Conclusions: Utilization of a safe and reliable processed approach to single-stage augmentation mastopexy is highly predictable with low reoperation rates. The technical refinements presented have led to increased consistency in delivering high-quality results to patients in a procedure fraught with challenges.

Level of Evidence: 4

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Since its first description by Gonzalez-Ulloa[1] and Regault,[2] augmentation mastopexy has continued to evolve, and the number of patients requesting augmentation mastopexy has increased. The dichotomy between a breast augmentation and mastopexy allows for only a small margin of error. The augmentation seeks to increase the overall volume of the breast and expansion of the skin envelope, and the mastopexy endpoint is a compression of the breast and reduction in the size of the skin envelope and parenchyma. These conflicting goals—increasing breast parenchyma/skin and decreasing and tightening the skin—have led to reported reoperation rates in the literature ranging from 8.7% to 23.2%.[3-7]

Additionally, even when patients do not require a reoperation, they may be less satisfied with their postoperative result and desire additional procedures on their breast.[8] This has led some to argue that staging of each procedure should be performed, and at the very least a large number of cautionary tales have been described.[9] Although the 2-stage

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operation is prone to less tissue distortion or wound breakdown in theory, it requires a second operation, which is usually not what the patient prefers. The procedure remains a highly litigated procedure in aesthetic surgery.

Given the complexities of the surgery and the high revision rates, numerous authors have described various techniques toward the goal of a reliable and predictable result with 1-stage augmentation mastopexy.[10-12] The reoperation rate remains high, and we previously published the tissue-based triad to aide surgeons in preoperative decision-making that affects outcomes. This process approach to augmentation mastopexy includes quantifying the patient's tissues/anatomy and basing planning decisions on the tissue-based triad. Similar to our process of breast augmentation,[13,14] the process approach to augmentation mastopexy has resulted in better outcomes and more predictable results. Our previous publication on the tissue-based triad detailed the preoperative assessment and algorithm for selecting a 1-stage vs 2-stage procedure, the 1-stage procedure (85%) being far more common.[12] The purpose of this study was to report an updated data set and to detail the technical nuances for surgeons to produce reliable, reproducible, safe results in this process approach to 1-stage augmentation mastopexy.

METHODS

A prospectively collected database was reviewed from January 2007 until January 2018. All patients who underwent single-stage augmentation mastopexy were included. The study was conducted in accordance to the Declaration of Helsinki. All patients were treated exclusively by the senior surgeon (W.P.A.) and had varying degrees of breast ptosis and volume loss. Patients who underwent isolated breast augmentation or mastopexy or patients who underwent planned 2-stage augmentation mastopexy bases on the tissue-based triad analysis were not included.

All patients were assessed using the tissue-based triad, and single-stage procedures were chosen for patients with a vertical excess (VE) less than 6 cm. The patient's demographics, operative details, complications, and outcomes were also evaluated. The complications were divided into major complications that required reoperation and minor complications that did not require reoperation. All patients received the same consistent validated process[14]: structured, extensive patient education about the procedure and the risks and expectations, tissue-based clinical assessment, refined surgical technique, and a thoroughly defined postoperative protocol.

Preoperative Assessment

Comprehensive patient education was performed before the preoperative assessment. This is key to success, and confirms the patient's goals for surgery and educates her on the philosophy and approach to augmentation mastopexy. During the surgeon consultation, primary measurements are taken (breast base width, nipple to fold, skin stretch [SS], and VE) to objectively discern which patients can be treated with an augmentation vs an augmentation mastopexy as well as a 1-stage vs 2-stage procedure. The patient's SS and nipple-to-inframammary fold distance on maximal stretch are utilized to determine when the patients can be treated only with a dual plane augmentation (SS < 4 and nipple-to-inframammary fold < 10 cm) and, conversely, what subgroup requires an augmentation mastopexy. Patients who have a nipple-to-fold distance greater than 10 cm or a SS greater than 4 cm have significant skin laxity that will require skin excision/tightening in addition to increased volume with an implant.

The VE measurement is the key variable to determine staging for the procedure. The VE is measured from the desired nipple-to-fold length to the preoperative inframammary fold. A VE greater than 6 cm is approached with a 2-stage augmentation mastopexy.

If the patient meets tissue-based criteria for a single-stage augmentation mastopexy, the next step is selecting the implant. The majority of these patients have adequate breast parenchyma. With adequate parenchyma, the patient needs fill, not projection, and preferably reliable upper pole fill that helps shift the distribution of fill to the upper pole. With this most common scenario, a form-stable, lower profile implant is used. Less commonly, patients will have virtually no parenchyma, essentially loose skin with no fill. In this case, a form-stable, moderate/moderate plus profile is carefully selected through tissue-based planning. The goal for this type of breast is to provide volume that is missing from absent breast tissue, therefore a more projecting, higher fill implant is needed. High-profile implants are never used because they are not an optimal height and volume for these patients.

The size of the implant is determined by the patient's preoperative breast width less 1-1.5 cm. In general, after the mastopexy, the breast base width that is measured on the patient by the surgeon also decreases approximately 1 cm. The implant that is similar in base diameter/width dimension to the new predicted postoperative BBW[15] is selected. In general, a slightly wider implant is preferable because the key dimension is the height of the implant to provide optimal distribution of fill to the upper pole; in lower profile implants, the height is maximized and equal to the base diameter of the selected implant.

The utilization of 3D imaging further assists the surgeon and the patient in selecting the implant that gives the patient the desired result they are looking for while keeping within safe tissue-based boundaries.

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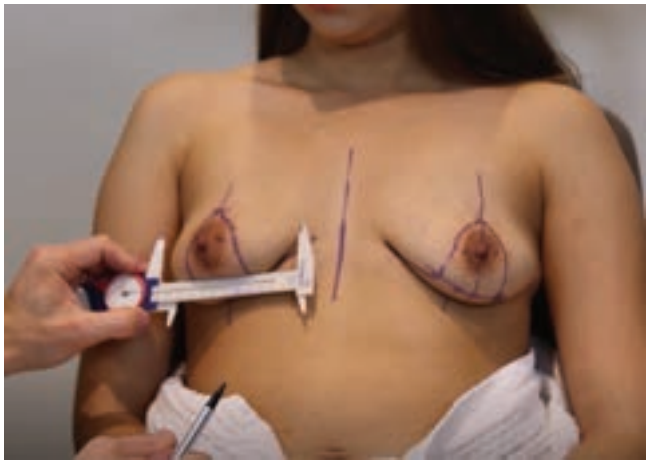

Video 1. Watch now at https://academic.oup.com/asj/article-lookup/doi/10.1093/asj/sjz006.

Markings

We utilize a modification of the mastopexy markings reported by Tebbetts.[16,17] In the preoperative suite, all patients are marked in an upright position (Video 1). The patient's midline, breast meridian, and inframammary fold are all marked. Pitanguy's point is utilized to obtain a rough estimate of the appropriate nipple position. Following this, an additional confirmation maneuver is performed where the nipple is manually raised superiorly to the most aesthetically pleasing position on the breast mound. A marker is placed directly anterior to this new nipple position and immediately placed on the breast skin after the superior displaced breast is released. The symmetry of both nipple positions is confirmed with the sternal notch to nipple measurement. The main differences with our modification are that the nipple position is doubly confirmed by Pitanguy's point and the nipple drop technique. More importantly, the top of the marking, not the superior border of the areola, is planned as the nipple. We prefer to cone the breast around the desired nipple location.

Next, utilizing the desired nipple to inframammary fold (N:IMF) planned for the procedure, an arc is created under max stretch that is equidistant from the nipple. We have used the following chart (Table 1) as a guideline for planning; however, this is not an exact science. In reviewing our cases utilizing a desired Nipple to Inframammary Fold (N:IMF) of 9 cm works well in the majority of cases. It is important to keep in mind that this bottom-up technique ultimately yields a final nipple position intraoperatively utilizing a measurement.

The additional distance between the desired nipple-to-fold length and the current inframammary fold is the VE. The VE determines the length of the IMF incision as well as the length of the vertical limbs and the angle of divergence of those vertical limbs. The IMF portion of the incision is 2 times the VE. Utilizing a ruler, from the end of the medial and lateral aspect of the IMF incision the point along the upper arc that is equal to the VE is marked, and these points define the angle of divergence of the vertical limbs (Figure 1).

The width and height of the implant pocket is also marked on the breast.

Table 1. Nipple-Fold Planning Index for Augmentation-Mastopexy and Mastopexy

Preoperative BW, cm	Augmentation Mastopexy NIMF Index (+/- 5mm)
10.5	8.2
11	8.6
11.5	9
12	9.4
12.5	9.8
13	10.2
13.5	10.6
14	11
Preoperative BW, cm	**Mastopexy NIMF Index (+/- 5mm)**
10.5	7.4
11	7.7
11.5	8.1
12	8.4
12.5	8.8
13	9.1
13.5	9.5
14	9.8

In augmentation mastopexy there is a shift/increase in the distribution of fill of the breast to the upper pole, thus, the nipple needs to be relatively higher to remain aesthetically pleasing. As depicted the nipple-fold index for a given BBW is approximately 1 cm more in augmentation mastopexy vs mastopexy alone. We use this index for planning and execution intra-operatively with the bottom-up technique; however, it is not a completely exact science and the surgeon should confirm the nipple position aesthetically as well during execution. BW, breast width; NIMF, nipple-to-inframammary fold.

Intraoperative Steps

Section 1: Augmentation

The procedure is split into 2 parts to completely separate exposure of the implant to breast parenchymal contaminates.

The augmentation is performed first through an inframammary incision. The incision is performed within the mastopexy marks and above the fold. The augmentation begins with a classic 4-part dual plane dissection (Video 2).[18,19]

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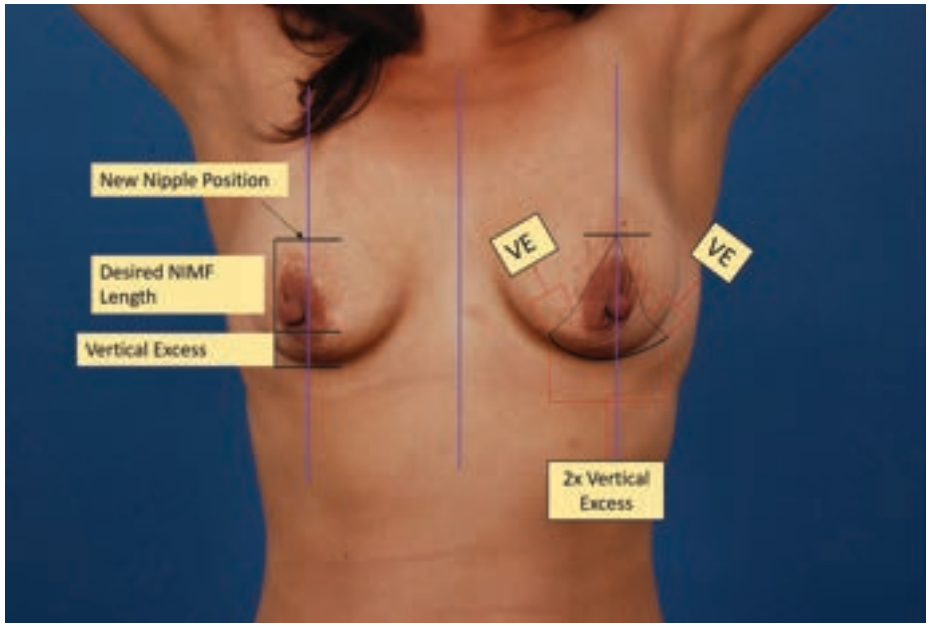

Figure 1. Use of vertical excess (VE) for skin excision pattern demonstrated on this 34-year-old woman (the same patient in Figure 2). The VE is determined by marking the new nipple position and then measuring under stretch the desired nipple-to-inframammary fold (NIMF) length based on the base width of the breast. The remaining skin from the desired NIMF to the current NIMF is the VE. This VE determines how wide the angle from the nipple to the desired NIMF will be. The VE is then used to determine the length of the IMF incision (2 times the VE). The VE measurement is then used to connect the medial and lateral aspects of the IMF incision to the point along the upper arc of the desired IMF position to determine the angle of divergence.

A modified inframammary incision is made wherein electrocautery preserves an inferiorly-based dermal flap (used later in closure; see Video 3), carried obliquely down to the pectoralis major muscle with electrocautery, similar to an IMF augmentation.. The inferior origins of the muscle are divided (part 1) with prospective hemostasis. The dissection is through the inferior pectoral origins into the subpectoral space. Next, the inferior pectoral origins are divided, and the division is stopped at the parasternal region before the pectoral origins progress vertically along the medial sternum. It is critical to avoid overdivision of the medial sternal attachments.

The dissection is then swept laterally to define the lateral border of the subpectoral pocket (part 2). Pectoralis minor is identified and protected. The dissection continues until reaching the lateral breast width mark from our preoperative markings. This is the extent of the lateral pocket dissection.

The dissection then continues superiorly to make the height of the dissection equal to the height of the selected implant (part 3), which is guided by the preoperative superior guide mark in the cranial caudal direction. Lastly, the medial pocket dissection is performed (part 4) to divide any identified tendinous or accessory origins of the pectoralis major. Care is taken to not divide any of the main body of the medial origins of the muscle. Once the pocket dissection is completed, a dual plane 2[19] adjustment is performed.

The pocket is then prepared with normal saline and meticulous hemostasis. After gloves are changed and betadine triple (50 cc Betadine, 1 g cefazolin, 80 mg gentamycin) solution is placed on the instruments and in the pocket in accordance with previously published guidelines and the 14-point plan to decrease bacterial load on the implant,[20] the implants are placed.

The superficial fascia is closed with a running 3-0 PDS suture. A dermal flap will be designed during the mastopexy that will further reinforce this closure and provide an additional layer between the implant and the skin.

Section 2: Mastopexy

Once the implant pocket has been closed, the mastopexy markings are again digitally confirmed. A simple skin pinch is employed to confirm that the skin resection has not been overplanned (surgeons with less experience can do simple tailor tacking if desired).

A 38-mm cookie cutter is utilized to incise around the nipple. The rest of the incisions are then incised. The area around the nipple is de-epithelialized as well as a central inferior dermal flap with a scalpel. This inferiorly based dermal flap will be inset later to protect the incision site at the T point should delayed wound healing occur. The dermal flap typically has a 2.5-cm height and a 4-cm base. It needs adequate height to be

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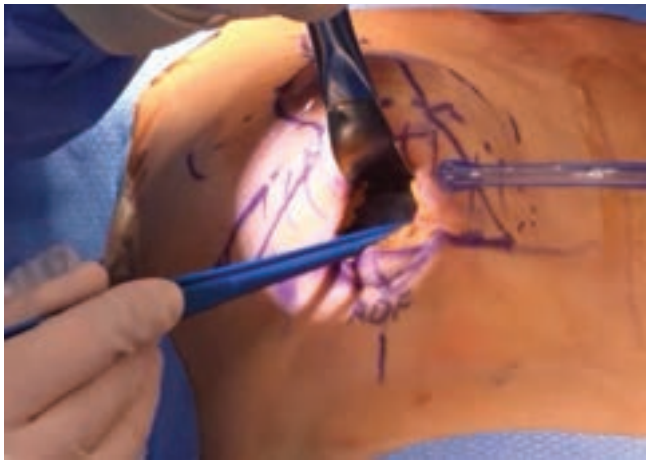

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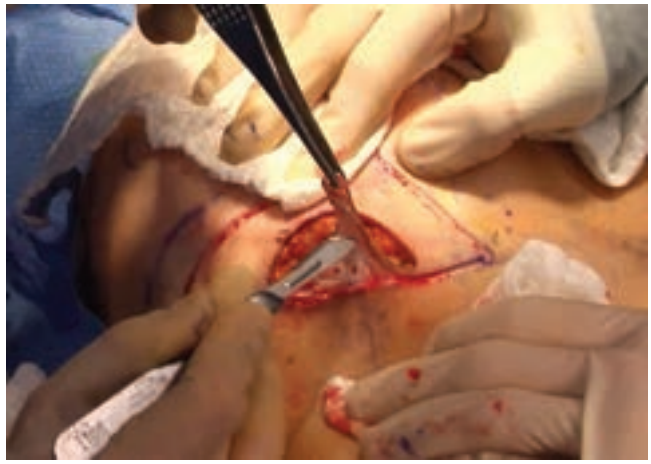

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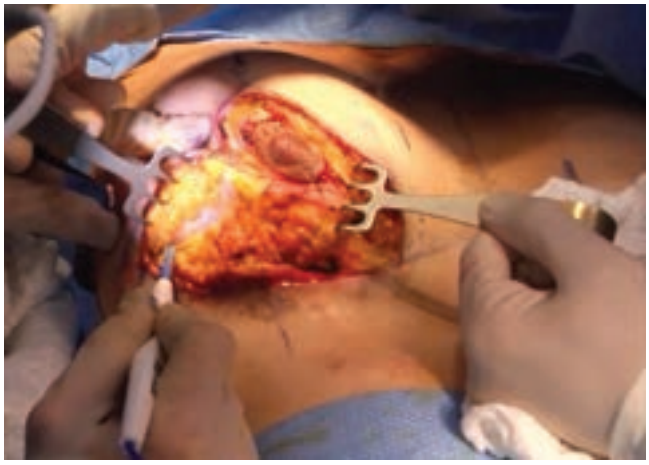

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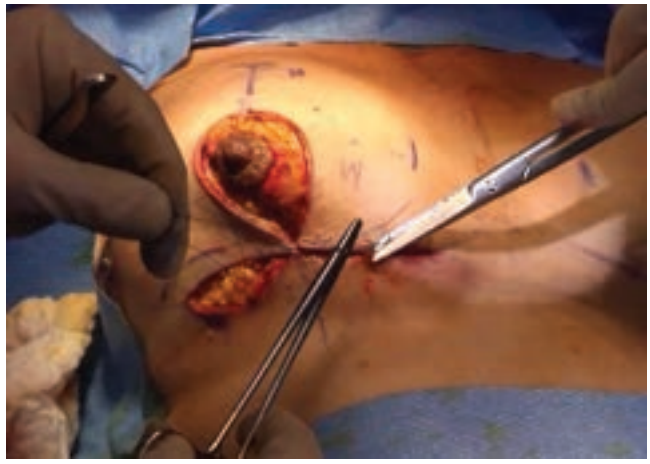

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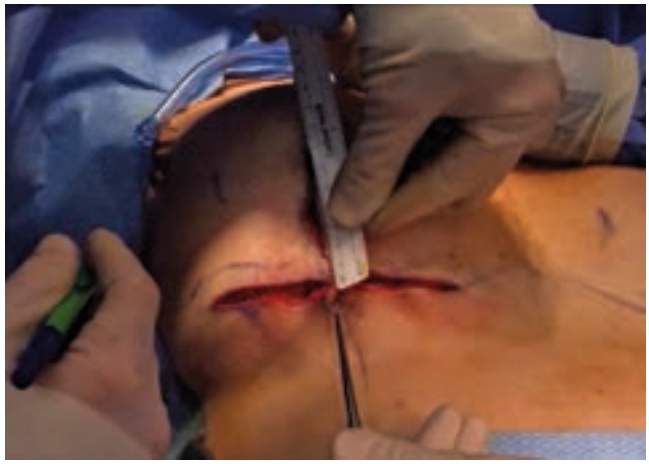

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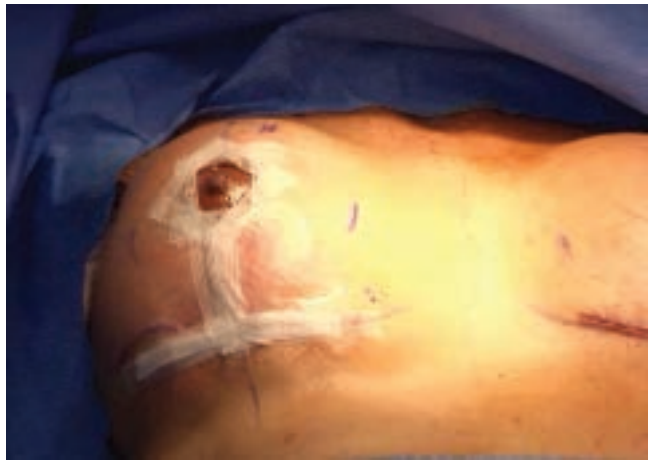

Video 7. Watch now at https://academic.oup.com/asj/article-lookup/doi/10.1093/asj/sjz006

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pulled cranially to unify the lateral and medial limbs of the breast. Slight undermining between the dermis and the parenchyma is performed to prevent tethering of the flap (Video 3).

The inferior skin is then excised directly with electrocautery. A second layer is closed over the previous implant closure to doubly secure isolation of the implant from the subcutaneous dissection. The amount of skin undermining is variable, but overall minimal, usually less than 2 cm. The level of undermining is slightly deep to the superficial fascia, which is important for the IMF fixation suture closure at the IMF, and if the undermining is continued it is taken more superficially just above the superficial fascia (Video 4). A diamond wedge of parenchyma is generally removed from the lower pole. This amount of resection can be customized to the clinical scenario to prevent tissue crowding at the T point. Four key sutures are placed as follows (Video 5):

1. 3-point dermal 3-0 Monocryl at T point
2. 2 IMF fixation 3-0 PDS: 1 medial and 1 lateral
3. 3-point fixation 3-0 PDS inferiorly-based dermal flap

The nipple position is confirmed utilizing a bottom-up technique (Video 6). The nipple-to-fold relationship in an augmentation mastopexy for most breasts is shown in the table (Table 1). This is not an exact science; however, the planning is based on known relationships between the breast width and nipple-to-fold length. In general, the nipple needs to be relatively higher on the breast to be in an aesthetic location. For most patients, this is 8.5 to 9.5 cm from the IMF. A higher nipple position is critical in an augmentation mastopexy compared with a mastopexy only where you are filling the upper pole more and shifting the distribution of fill superiorly.

Using skin hooks on the superior and inferior portion of the vertical limbs, the vertical dimension is placed on maximal stretch. The ideal nipple-to-fold distance is measured guided by the planned NIMF index from the preoperative marking, though this usually corresponds to between 8.5 to 9.5 cm. This technical step including placing the skin between the nipple and fold on max stretch and measuring from the fixed IMF to bottom of the areola are key to achieving predictability. The 38-mm cookie cutter is then placed on this mark, and it should correlate to the most projecting portion of the breast, and the 38 mm cookie cutter is typically on a horizontal plane roughly parallel to the ceiling when in this position. Marking the nipple at the end using a bottom-up technique allows for better control of the nipple position to optimize its placement on the breast mound. We have found this approach is far superior in predictability and accuracy compared with the "sit-up" technique that introduces multiple variables, which make it less predictable and accurate.

Table 2. Patient Demographics

Total no. of patients	251
Average age (range), years	38.0 (21.4-68.8)
Average implant size (range), cc	285.8 (170-400)
Average follow-up (range), months	16.9 (1.5-120)

The vertical and horizontal limbs have a deep dermal closure and then a running subcuticular closure. The nipple is closed in a running fashion.

Dressing

Steri-strips are placed square around the areola and then at 45 degrees square around the areola on top of the previous steri-strips to allow for equal compression around the areola incision (Video 7). Steri-strips are placed longways over the vertical and horizontal components of the incision. The bandages are removed 7 days after surgery and scar therapy is started with Mepiform (Molynlycke Health Care, Oakville, Ontario, Canada) and Biocorneum (Sientra, Santa Barbara, CA).

Adjunctive Procedures

Fat grafting, either primarily or secondarily, has further improved treatment in patients seeking larger breast sizes than the patient's base width would normally allow; however, we perform this primarily in less than 5% of the cases. Fat grafting allows the patient to have increased size and shape in multiple dimensions without taxing the breast tissue with the weight of a larger implant.

Depending on the patient's skin quality, the use of biologic adjunctive support is often needed.[21] The senior author (W.P.A.) now routinely offers a 3-dimensional (3D) P4HB scaffold (Galaform 3D, Galatea Surgical, Lexington, MA) to all patients seeking augmentation mastopexy in the setting of massive weight loss, thin tissue, multiple stretch marks, patients prone to soft tissue stretch, or those seeking larger implants that would increase the likelihood of stretch on the breast. The 3D scaffold is typically placed in the implant pocket during the augmentation. Suture fixation is not required, and implant/gravity dynamics ensures constant contact with the breast parenchyma to allow it to incorporate quickly and predictably. This is then closed over when the capsule is closed initially.

RESULTS

A total of 251 patients underwent single-stage augmentation mastopexy. Mean follow-up was 16.9 months (range, 1.5-120 months). The average patient age was 38.0 years

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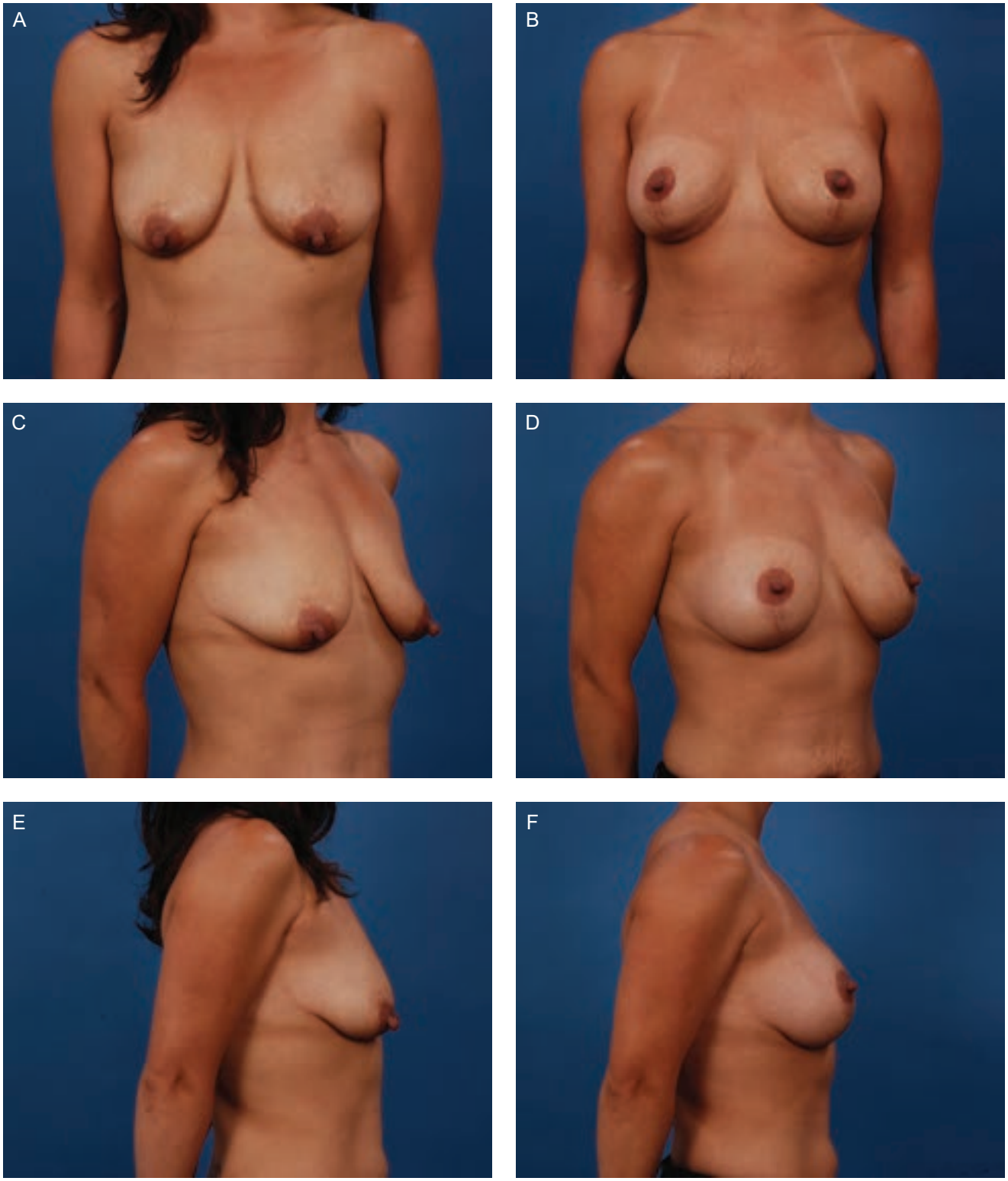

Figure 2. (A, C, E) Preoperative and (B, D, F) 1-year postoperative photographs of this 34-year-old woman who underwent single-stage augmentation mastopexy with placement of 270-cc Style 10 implants.

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Table 3. Implant Characteristics

Implant	No.
Round	218
Shaped	33
Saline	7
Silicone	244
Style 10	83
Style 15	51
Style 20	1
Moderate profile	4
SSM	3
SCM	1
SSL	13
SSLP	8
SRL	19
SRLP	16
SRM	12
410FM	5
410MF	2
410MM	5
410ML	1
CPG 321	6
CPG 322	9
CPG 332	4
27	1
2000 MPP	2
1600 Smooth round	3
68MP	2

(range, 21.4-68.8 years). The average implant size was 285.8 cc (range, 170-400 cc). Mastopexy operations were all performed with a central mound pedicle and inverted-T skin excision (Table 2).

Most patients (218, 87%) had round implants. Additionally, only 7 (3%) patients had saline implants placed. The implants were all various styles and from various manufacturers (Table 3).

A total of 251 augmentation mastopexy procedures were performed. A total of 9 (3.6%) patients required reoperation and only 2 (0.8%) required removal of the implant. Fourteen patients (5.6%) had delayed wound healing that responded to local wound care. One (0.4%) patient developed capsular contracture and one (0.4%) patient had an implant infection (Table 4).

Table 4. Complication Rates

Complication	No.	%
Delayed wound healing	14	5.6
Reoperations	9	3.6
Hypertrophic scar	8	3.2
Removal	2	0.8
Rippling	2	0.8
Capsular contracture	1	0.4
Infection	1	0.4

Only 3.6% required reoperation.

DISCUSSION

Augmentation mastopexy remains a frequently desired procedure by patients. Over the past decades, the technique for single-stage augmentation mastopexy has evolved; however, even with all this new knowledge, the procedure is still fraught with high revision rates[3-8] and decreased patient satisfaction. It remains one of the most litigated procedures in aesthetic surgery.[9,22]

The goal of this article was to demonstrate both our approach and results employing the tissue-based triad algorithm (Figures 2 and 3). Our previous publication[12] focused on the preoperative planning utilizing the tissue-based triad, whereas this article targets the detailed intraoperative steps for carrying out single-stage augmentation mastopexy employing the tissue-based triad process and concept. Our data show that our single-stage augmentation mastopexy has revision rates on the lower end compared with those in the published literature. It also shows no statistical difference in wound complication rates between our mastopexy and single-stage augmentation mastopexy group.

This technique serves as a guideline for the surgeon to utilize. Clinical judgement and the surgeon's aesthetic sense at the conclusion of the case are not removed from this technique. Ultimately, it is the operating surgeon's responsibility to utilize the tools at their disposal and to deliver the result their patients want, but having objective data to assist medical decision-making is quite useful.

The benefits of a systematic process for any critical operation have been well documented in both the medical and nonmedical literature.[14,23-25] A process driven method to approach each breast patient increases efficiency and the patient's safety and satisfaction. This systematic approach for augmentation mastopexy provides a framework for younger surgeons to hone their craft,

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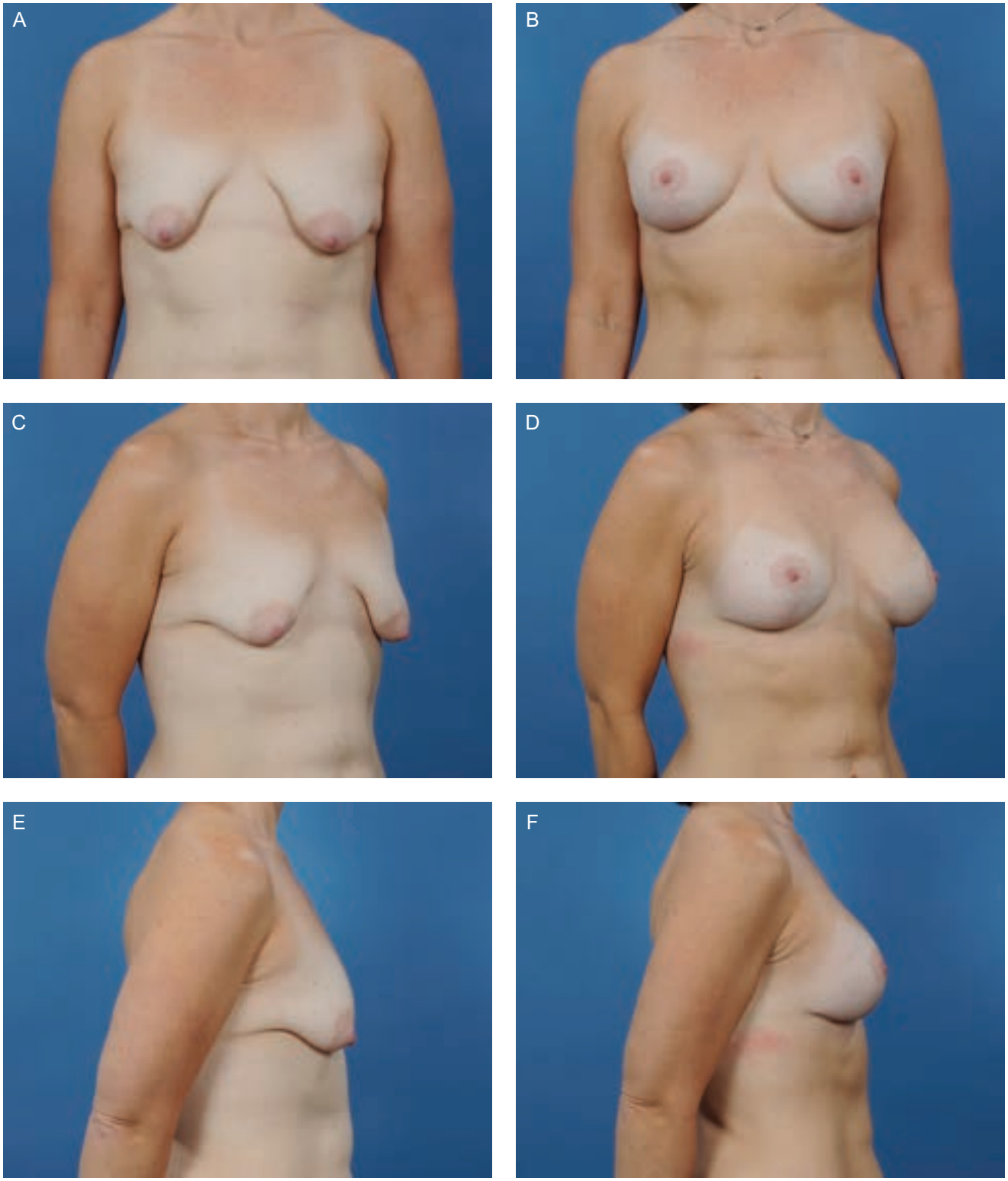

Figure 3. (A, C, E) Preoperative and (B, D, F) 1-year postoperative photographs of this 41-year-old woman who underwent single-stage augmentation mastopexy with placement of 310-cc SSM implants.

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with the hopes of minimizing complications. We would also argue that a process is perhaps even more important for experienced surgeons. As one's practice becomes busier, a streamlined process allows for greater efficiency and ensures the surgeon does not suffer an occasional lapse or inadvertent omission possible in a busy clinical practice.

Any system for augmentation mastopexy is of little use if it is too cumbersome for the user. The tissue-based triad is straightforward and simple, and the measurements can be performed in 15 seconds. The implants we utilize are typically low-profile or moderate implants if the patient does not have much breast parenchyma. The key to implant selection is related to the implant height. We routinely maximize the height/width in implant selection to best control the distribution of fill in the upper breast. The implant height is minimized in high-profile implants and is the primary reason we feel they do not work well for this procedure. The "reduced height" of a higher profile device results in insufficient shift of the distribution of fill in the breast. This is a common misnomer, because they may be more projected, but they do not possess the same upper pole fill volumes as lower profile implants for a given base width.

There are several limitations to this study. Patients who are unhappy with their results or who had complications may have chosen to receive their secondary care elsewhere, although we are not aware of such a patient. Nevertheless, the revision rate may have been underreported; however, our current data set with a much larger patient cohort than the original tissue-based triad paper still has the similarly low revision rate employing the tissue-based triad approach.

CONCLUSIONS

Utilizing the tissue-based triad for augmentation mastopexy carries high predictability and low reoperation rates and allows for safe and reliable 1-stage augmentation mastopexy. By employing the technical refinements developed during the senior author's career, complications rates are significantly decreased and outcomes enhanced. This has led to increased consistency in delivering high-quality results to patients in a procedure fraught with challenges.

Supplementary Material

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

Disclosures

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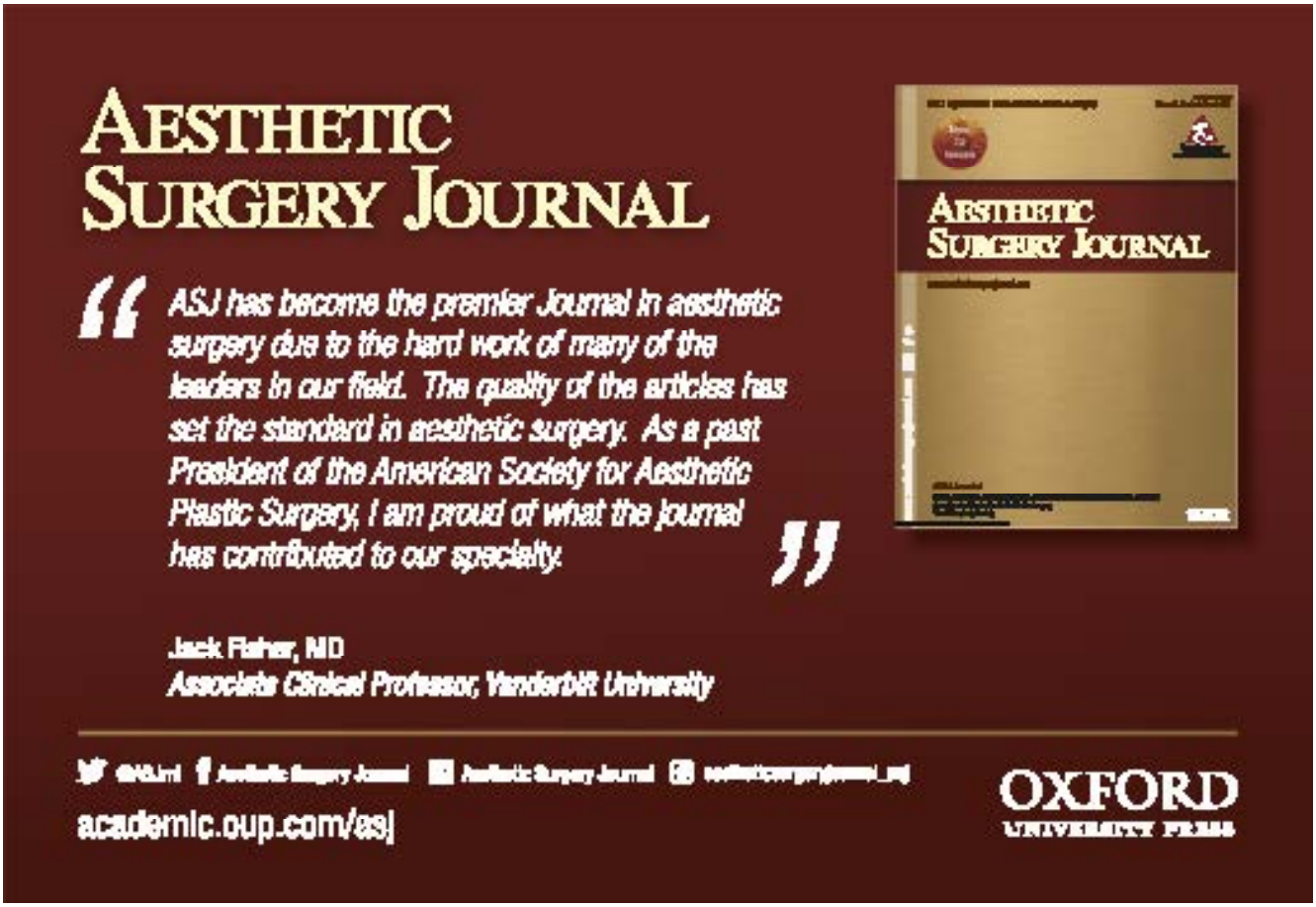

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