The Tissue-Based Triad: A Process Approach to Augmentation Mastopexy

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Background: Among the most exigent operations in plastic surgery is the combination of augmentation and mastopexy. The surgical challenge is related to oppositional forces that complicate the operative predictability. The purpose of this study was to investigate use of the tissue-based triad process approach in patients undergoing augmentation mastopexy. Measured components of the approach include skin stretch, nipple to inframammary fold distance on maximal stretch, and vertical excess.
Methods: Patients were selected for the study if they had been treated with one- or two-stage augmentation mastopexy, or mastopexy alone. Data gathered included preoperative measurements, operative details, complications, and outcomes including reoperation rate.
Results: A total of 176 consecutive patients were identified as meeting study inclusion criteria. Mean follow-up was 1.5 years. Seventy-one of 176 patients underwent mastopexy alone. Of the 176 patients included, 105 were treated with augmentation mastopexy. Ninety-one of 105 augmentation mastopexy operations were performed in one stage. The average amount of vertical excess was 5 cm. Nine patients exhibited delayed wound healing, while six (6.5 percent) required reoperations for scar revision ($n = 1$), delayed wound healing requiring revision ($n = 2$), hematoma ($n = 1$), seroma ($n = 1$), and soft-tissue stretch ($n = 1$). Fourteen of 105 patients were treated in two stages. Average vertical excess was 7.5 cm.
Conclusions: Use of the tissue-based triad process approach provided objectivity in determining which patients should undergo one- versus two-stage augmentation mastopexy. Use of this approach helps guide surgical decision making and is associated with lower reoperation rates. (*Plast. Reconstr. Surg.* 134: 215, 2014.)
CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, IV.

Augmentation combined with mastopexy remains one of the most litigated operations performed in plastic surgery. Such is the result of high complication and reoperation rates associated with the collective procedure. Several authors have detailed the basis for such untoward outcomes.[1–3] Augmentation serves to expand breast skin and parenchyma, thereby increasing overall breast mass. Conversely, mastopexy leads to reduction and tightening of the skin and parenchyma, resulting in a net decrease of breast mass. These opposing forces create a delicate balance that complicates result predictability.[1,2] Published results from some of the most experienced breast surgeons reveal reoperation rates ranging from 8 to 16 percent.[4,5]

Introduction of the combined procedure was originally described by Gonzalez-Ulloa,[6] with Renault[7–9] providing valuable contributions. Before these publications, augmentation for hypomastia in patients with ptotic breasts repeatedly produced a poor aesthetic result.[8,10] Although the amalgamation of augmentation with mastopexy is a sufficient method of treating both hypomastia and breast ptosis, it has been plagued by concern. Several authors have been compelled to publish warnings regarding the excessive complication and reoperation rates.[1,3] Such troublesome outcomes result from interplay of the aforementioned

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forces. In contrast, more recent publications claim acceptable complication and reoperation rates.[5,11] Debate surrounds the very definition of acceptable complication and reoperation rates in elective aesthetic surgery.[12,13] Some authors have proposed staging the two operations, allowing for a more predictable result with less risk of wound complications and tissue distortion.[1,2] Although a two-stage operation may provide a more reliable outcome, it mandates a second operation. Patients are often displeased with the planned notion of a second operation, and the general preference is for a final result from a single operation.

Across forums, there remains debate over the ideal way to perform and stage (or not stage) this procedure. Inconsistency in treatment, high levels of complications, patient dissatisfaction, and litigation underscore the lack of available data regarding augmentation mastopexy. This suggests the need for objective measures that guide patient-specific treatment planning. The search continues to determine what factors impact patient outcomes and thereby select which patients should undergo a one- versus two-stage operation. Ideal factors would be objective values that improve operative predictability resulting in lower reoperation rates. Implementation of greater objectivity and quantification provides guidance to the less experienced surgeon and simplifies consultation for the more experienced surgeon.

Use of a process approach has proven to lower reoperation rates in other plastic surgery operations.[12–15] Using a process approach as it relates to augmentation mastopexy centers on quantifying tissue quality of the existing breast envelope and underlying parenchyma. Tolerability of the opposing forces in augmentation mastopexy is inherently related to tissue integrity. The objective of this study was to evaluate the experience and clinical algorithm of the senior author (W.P.A), elucidating factors that influence the overall result and reoperation rate. Subsequently, we sought to produce an algorithm that guides patient-specific treatment planning.

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PATIENTS AND METHODS

Prospectively collected data were collated from January of 2007 to January of 2012. Patients included were treated with either one- or two-stage augmentation mastopexy or mastopexy alone. Mastopexy-only patients were included for the sake of comparison with regard to overall complication and reoperation rates. Patients included were treated by the senior author (W.P.A) for varying degrees of breast ptosis with or without hypomastia.

Data gathered included preoperative measurements, operative details, complications, and outcomes. Complications were divided into minor (not requiring reoperation) and major (requiring reoperation). Patient care consisted of the following four stages: structured patient education regarding procedure and potential risk, tissue-based clinical analysis, refined surgical technique, and defined postoperative regimen.

Patient Education and Informed Consent

All patients undergo extensive multimodality education before surgical consultation. Education is accomplished through both verbal and Web-based introduction to practice philosophy. Practice philosophy is heavily weighted in the importance of tissue-based planning. In cases of augmentation mastopexy, the limitations and pitfalls are emphasized.

The patient education consultation is performed with a dedicated staff patient educator and lasts 45 to 60 minutes. This important step allows the patient to discuss and receive answers to specific issues regarding breast augmentation and mastopexy. Informed consent documents are then made available to the patient. During the education consultation, all concepts, issues, and limitations are addressed directly and discussed with the patient.

Tissue-Based Clinical Analysis and Planning

The surgeon consultation is performed only after successful completion of the education consultation. This consultation is focused primarily on confirmation of patient motives and desires for surgery and obtaining the critical measurements for surgical planning.

The first assessment is to determine what procedure the patient needs using objective criteria. The key determinants that identify the patients needing more than a breast augmentation are the skin stretch (Fig. 1) and nipple-to–inframammary fold distance on maximal stretch (Fig. 2). A skin stretch greater than 4 cm or a nipple-to–inframammary fold distance greater than 10 cm

indicates a patient who will not do well with augmentation alone. If skin stretch and nipple-to–inframammary fold distance on maximal stretch are both less than 4 cm and less than 10 cm, respectively, that breast can be appropriately corrected with a breast augmentation alone and a dual-plane approach. Of note, if this patient type has down-pointing nipples, they can be treated with a dual-plane breast augmentation plus a periareolar nipple repositioning.

In patients with either a skin stretch greater than 4 cm or a nipple-to–inframammary fold distance on maximal stretch greater than 10 cm (indicating significant skin laxity and need of skin tightening in addition to implant volume expansion), a vertical excess measurement is obtained by marking the ideal nipple position, measuring under stretch the desired surgically defined nipple-to-fold distance (based on breast width). Defined, vertical excess is the vertical distance from this point to the preoperative fold (Fig. 3). (**See Video, Supplemental Digital Content 1**, which shows how patients were marked in the upright position on the day of surgery, ***http://links.lww.com/PRS/B46***.) Single-stage procedures are planned when vertical excess is less than 6 cm and two-stage procedures are planned when vertical excess is greater than 6 cm (Table 1).

The planning of a single-stage augmentation mastopexy is distinctly different from that of a primary breast augmentation. Tissue-based analysis cannot be based on determining the optimal fill volume for the preoperative breast,[12] as the chosen implant will be too large for the postoperative breast. Thus, the basis for the planning is to consider the optimal fill of the postoperative envelope. This is most easily accomplished using projected postoperative width of the breast (usually 0.5 to 1.0 cm) narrower than the preoperative width and selecting a low-profile implant that corresponds to this width based on accepted optimal fill volumes for breast base width.[12] A rule of thumb is 12 cm corresponds to 300 cc; for every 0.5 cm of width decrease/increase, the optimal volume will change by 50 cc. Low-profile implants are used most frequently, reserving moderate/moderate-plus profile implants for patients with minimal to no breast tissue. High-profile implants are never used with this technique. In the majority of cases, a low-profile implant, 200 to 300 cc, is used. Implant selection is not directly related to the measured vertical excess.

Surgical Technique

All patients were marked in the upright position on the day of surgery. Demarcation of the sternal notch, midline, and inframammary fold is standard in all procedures with anticipated mastopexy markings that include proposed new nipple position. (**See Video, Supplemental Digital Content 1**, which shows how patients were marked in the upright position on the day of surgery, ***http://links.lww.com/PRS/B46***.) The procedure always has a planned periareolar, vertical, and horizontal incision.

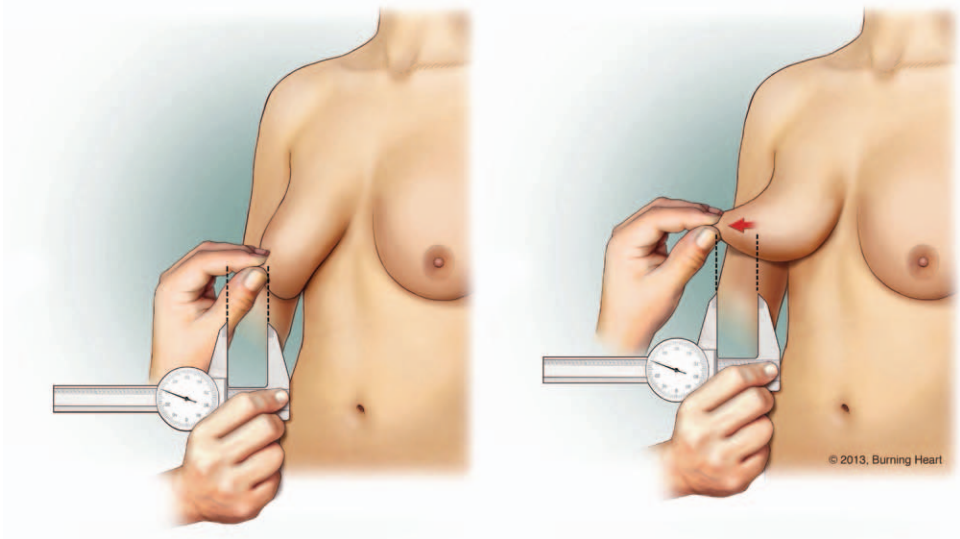

Fig. 1. Illustration depicting the measurement of skin stretch. This provides objective data regarding laxity of the breast envelope in the anteroposterior dimension. (Printed with permission from Alfredo Portales. Copyright © Burning Heart Studios.)

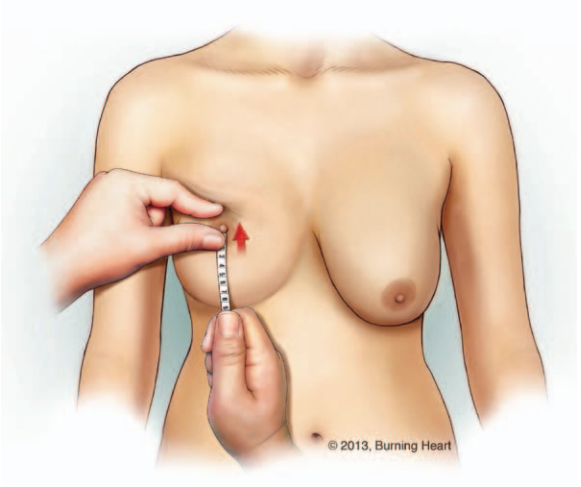

Fig. 2. Illustration showing the nipple-to–inframammary fold measurement on maximal stretch. This measurements quantifies breast envelope laxity in the vertical dimension. (Printed with permission from Alfredo Portales. Copyright © Burning Heart Studios.)

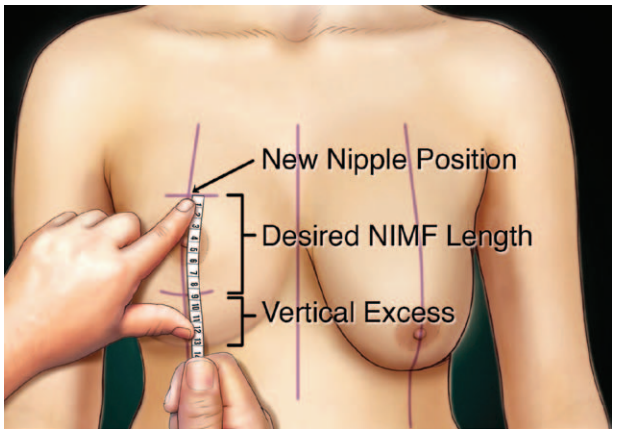

Fig. 3. Vertical excess is determined by marking the desired nipple position and then measuring under stretch the desired nipple-to–inframammary fold (*NIMF*) length based on breast width. The remaining skin to the existing inframammary fold is the vertical excess. (Printed with permission from Alfredo Portales. Copyright © Burning Heart Studios.)

Patients are then prepared and draped in the supine position under general anesthesia. Tegaderm (3M, St. Paul, Minn.) dressing is placed over the nipple-areola complex as a mechanical barrier to bacterial translocation. Through inframammary fold incision, dual-plane implant pockets are developed and meticulous hemostasis is achieved. Triple-antibiotic preparation is used. Sizers are not used, as the implant size has been determined preoperatively. Implants are always placed in a dual-plane fashion, with the augmentation access incision superficial fascial layer closed before the mastopexy. Following

Video. Supplement Digital Content 1 shows how patients were marked in the upright position on the day of surgery, ***http://links.lww.com/PRS/B46***.

Table 1. Tissue-Based Triad*

Measurement	Distance (cm)	Surgical Planning
Skin stretch	>4	Augmentation vs. augmentation mastopexy
Nipple-to–inframammary fold distance on maximal stretch	>10	Augmentation vs. augmentation mastopexy
Vertical excess	>6	One- or two-stage augmentation mastopexy

*Use of these three measurements guides surgical planning.

removal of Tegaderm dressings, the patient and all markings are confirmed or adjusted. The mastopexy is a broad-based central mound technique with limited undermining. A periareolar incision, in conjunction with vertical and horizontal incisions, is used to create the ideal postoperative breast shape. The nipple-to-fold relationship is measured intraoperatively, marked with a cookie-cutter technique, confirmed, and then executed to mature the new nipple-areola complex. Incisions are managed with Steri-Strip tape (3M) immediately.

Postoperative Care

Patients are provided with detailed instructions regarding postoperative care and allowed activity. Instructions are given following original informed consent and later reinforced on the day of surgery.

RESULTS

A total of 176 consecutive patients were identified as meeting study inclusion criteria. Mean follow-up was 1.5 years (range, 6 months to 5 years). Mean patient age was 39 years (range, 29 to 58

years). Mean implant size was 306 cc (range, 150 to 435 cc). Implants included both round ($n = 57$) and shaped ($n = 48$), and saline ($n = 31$) and silicone gel ($n = 74$). Mastopexy operations were all performed with a central mound pedicle and inverted-T skin excision (Table 2).

Mastopexy Alone

Seventy-one of 176 patients (40 percent) underwent mastopexy alone. Sixty-nine patients were Caucasian, one patient was African American, and one patient was Asian. Ten of the 71 patients (14 percent) developed the minor complication of delayed wound healing. One patient (1.4 percent) required reoperation for hematoma evacuation. Other complications are also listed in Table 3. These results were comparable to previous published complication and reoperation rates of mastopexy alone.

Augmentation Mastopexy

One hundred five of the 176 patients (60 percent) included were treated with augmentation mastopexy. One hundred four patients were Caucasian and one patient was African American. Dual-plane type 1 technique was used in 40 percent, type 2 was used in 52 percent, and type 3 was used in 8 percent of patients.

One-Stage Operation

Ninety-one of 105 augmentation mastopexy operations (86 percent) were performed in one stage. Average measurement of vertical excess was found to be 5 cm. Nine patients (10 percent) exhibited delayed wound healing treated conservatively and six patients (6.5 percent) required reoperations for scar revision ($n = 1$), delayed wound healing requiring revision ($n = 2$), hematoma ($n = 1$), seroma ($n = 1$), and soft-tissue stretch ($n = 1$). There were no cases of capsular contracture (Table 4 and Fig. 4).

Two-Stage Operation

Fourteen of 105 patients (13 percent) were treated in two stages (Fig. 5). Vertical excess average was noted to be 7.5 cm. One patient required reoperation for seroma (7 percent) and one patient (7 percent) developed delayed wound healing treated with conservative management. There were no cases of capsular contracture (Table 5 and Fig. 5).

Table 2. Implant Characteristics

	Value
No. of implants	
Saline	31
Silicone	74
Round	57
Shaped	48
Volume, cc	
Mean	306
Range	150–435

Table 3. Complications of the Mastopexy Group

Complication	Minor (%)	Major*(%)
Delayed wound healing	14	0
Hematoma	0	1.4

*Required reoperation.

DISCUSSION

Pioneers of augmentation mastopexy focused on simultaneously correcting the ptotic breast and restoring upper pole fullness. Although correction of both deformities resulted in higher patient satisfaction, the operation was not without significant risk. Spear[1] suggested that complications were related to the opposing forces at work and parenchymal repositioning adjacent to the implant. Surprisingly, this common problem has received much less attention in the literature than other comparable surgical procedures. The search continues to provide objective data to lower complication and reoperation rates in augmentation mastopexy.

Aging of the breast produces laxity of the skin envelope and parenchymal redistribution secondary to decreased tissue integrity and the influence of gravity. Volume loss in the upper pole in conjunction with nipple descent often leads to an unattractive ptotic breast. Complications with one-stage augmentation mastopexy are a result of opposing forces and influenced by the present state of the breast. Other authors[16,17] have previously stressed the importance of quantifying or classifying the existing breast envelope. Tebbetts recently provided a process of objective criteria for selecting nipple position and quantifying

Table 4. Complications of One-Stage Augmentation Mastopexy

Complication	Minor (%)	Major*(%)
Capsular contracture	0	0
Delayed wound healing	10	2.5
Scar revision	0	1
Hematoma	0	1
Seroma	0	1
Soft-tissue stretch	0	1

*Required reoperation.

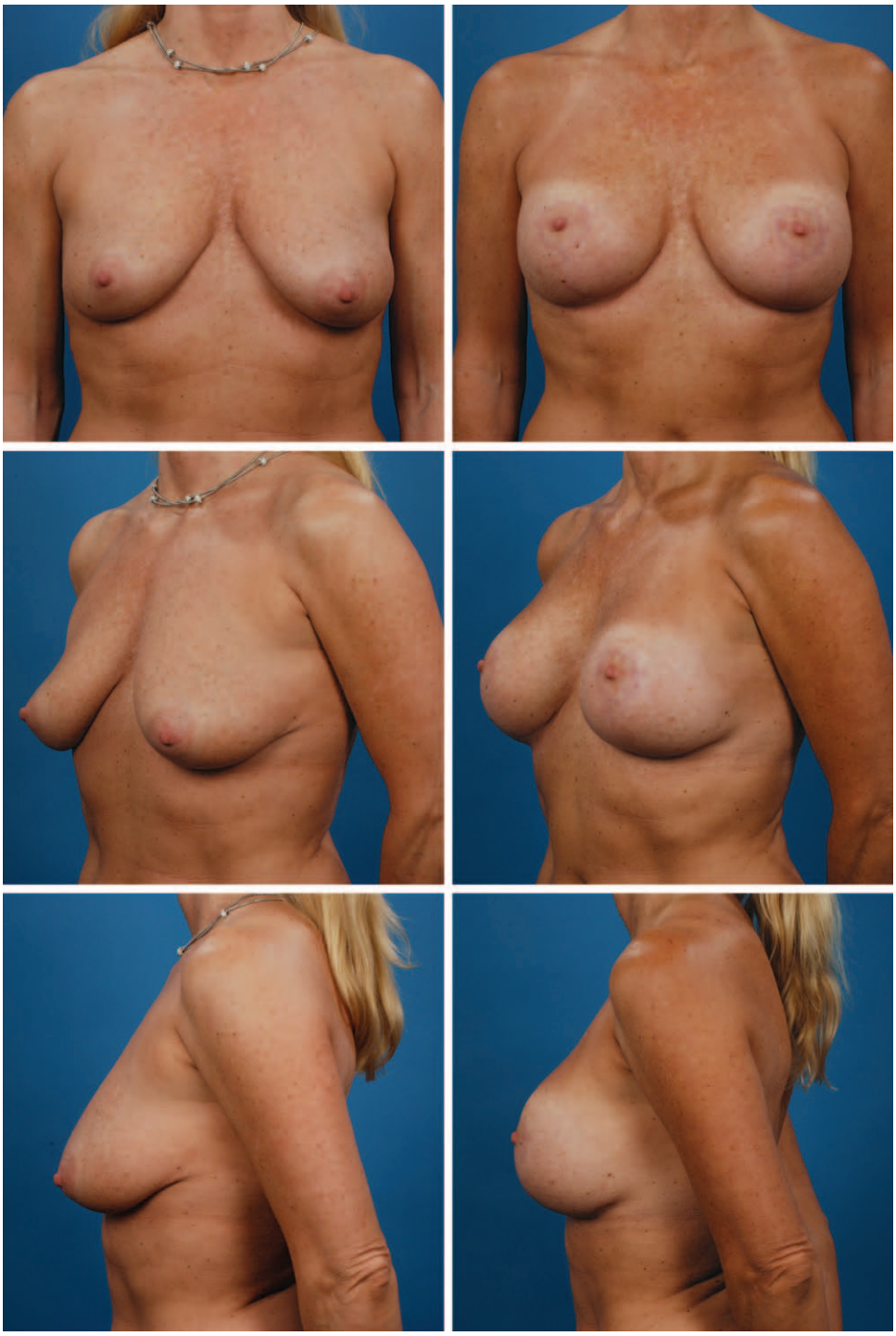

Fig. 4. Case example of one-stage augmentation mastopexy. The patient is a 46-year-old woman with hypomastia and breast ptosis (*left*). Preoperative measurements included skin stretch, 4.5 cm; nipple-to–inframammary fold distance on maximal stretch, 9 cm; and vertical excess, 4 cm. She underwent a one-stage augmentation mastopexy with 270-cc silicone gel implant placed with dual plane technique. One-year follow-up photographs (*right*) show that shape and good nipple position were maintained.

skin excess in mastopexy.[18] To the best of our knowledge, no specific surgeon guidelines have been provided for augmentation mastopexy, yet this procedure consistently ranks number one for medical malpractice claims. There remains the need for a practical algorithm to help guide

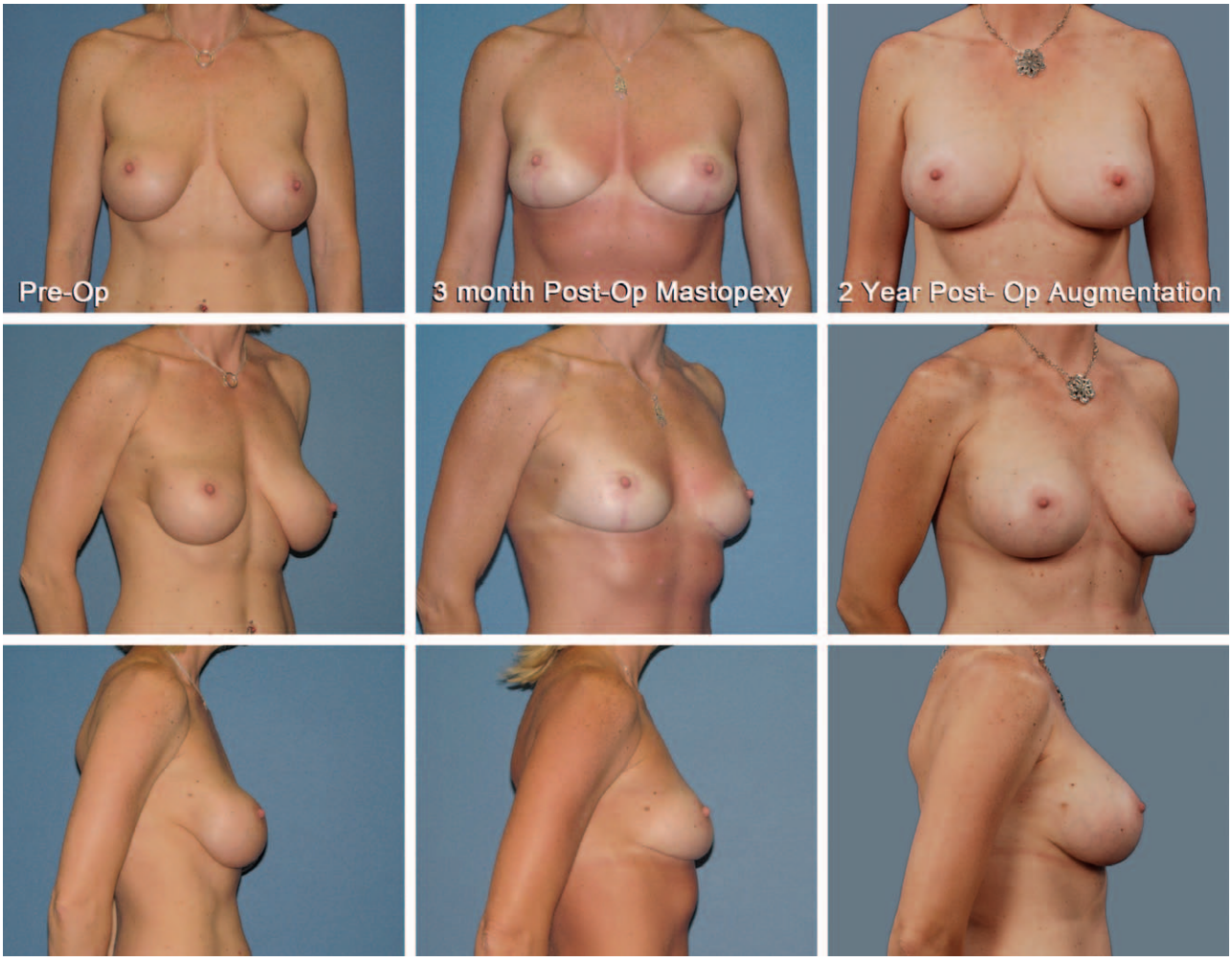

Fig. 5. Case example of two-stage augmentation mastopexy. The patient is a 37-year-old woman with hypomastia and breast ptosis (*left*). Preoperative measurements included skin stretch, 4 cm; nipple-to–inframammary fold distance on maximal stretch, 10.5 cm; and vertical excess, 7 cm. She underwent a two-stage operation. Three-month follow-up after mastopexy (*center*) shows good wound healing and nipple position. Augmentation was then accomplished with a 280-cc gel implant placed with dual plane technique. Two-year follow-up reveals a durable result with good nipple position (*right*).

surgeons in determining which patients should undergo a two-stage operation for augmentation mastopexy.

Patients with significant laxity appear to be at higher risk for major complications and reoperation. This is related to the ability of the soft tissue to maintain the relationship between nipple, implant, and inframammary fold. Greater laxity may be less likely to maintain the shape and form, thus decreasing the predictability of the operation. In fact, the true paradox of this clinical presentation is that the greater the initial tissue laxity, the more fundamentally sound the mastopexy needs to be to attain long-term success; however, the combined augmentation mastopexy does not allow for as aggressive a mastopexy as can be typically performed alone (because of safety/vascularity issues that the combined procedure carries).

Table 5. Complications of Two-Stage Augmentation Mastopexy

Complication	Minor (%)	Major*(%)
Capsular contracture	0	0
Delayed wound healing	7	0
Seroma	0	7

*Required reoperation.

Preceding authors have noted limitations of the Regnault classification and provided modifications.[16,17] Clearly, the relationship of the nipple to the inframammary fold is important but fails to fully quantify tissue integrity.[16–18] For this reason, the Regnault classification is truly nonspecific and not useful for surgical planning.

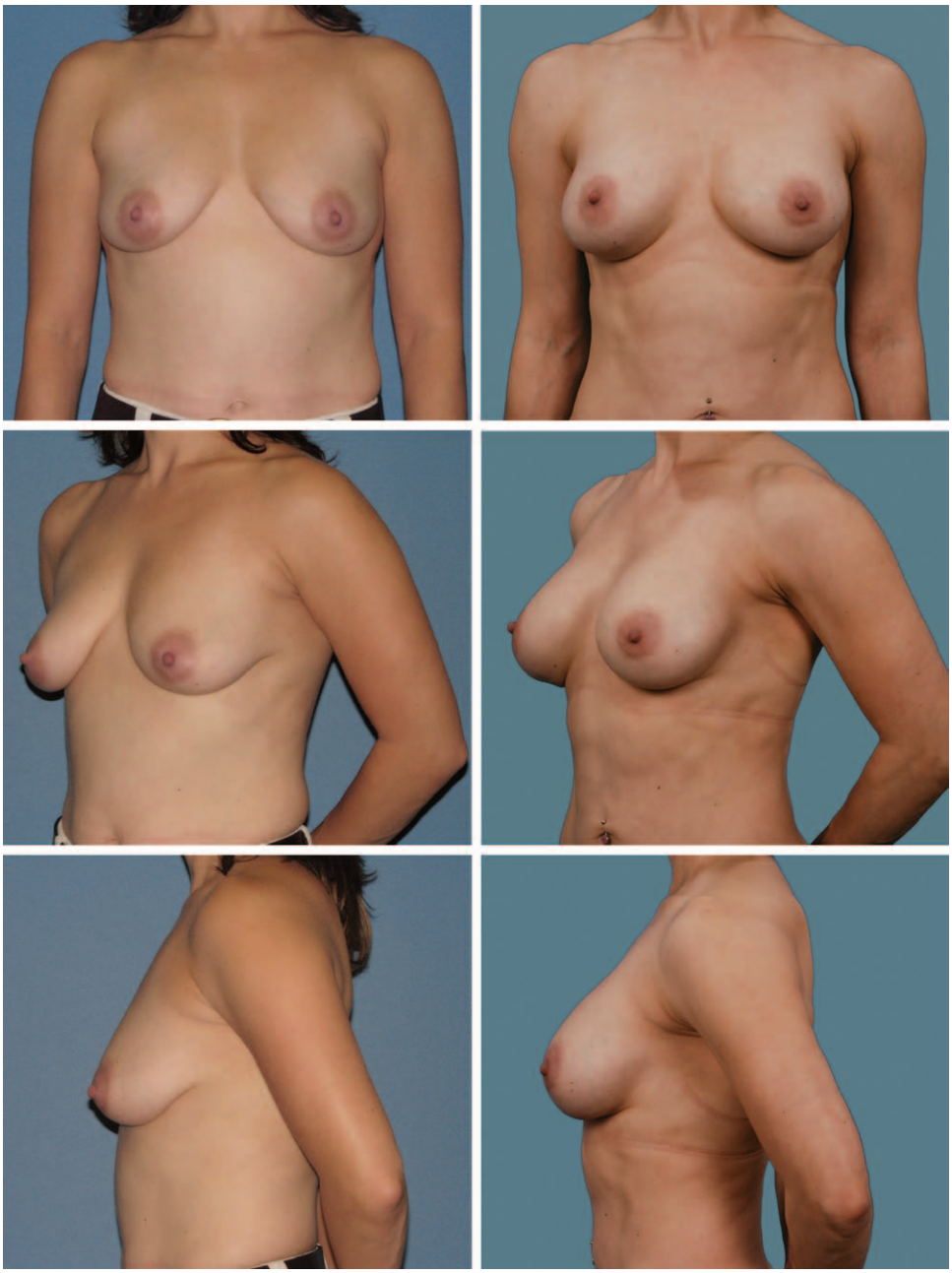

Fig. 6. Case example of patient presenting with Regnault grade 2 ptosis. Classically, this patient would be considered for a mastopexy. However, her skin stretch was 3.5 cm and her nipple-to–inframammary fold distance on maximal stretch was 9 cm, which are more precise, objective indicators of tissue laxity. Patients with skin stretch less than 4 cm and nipple-to–inframammary fold distance on maximal stretch less than 10 cm can be treated with dual-plane augmentation alone. The 2-year postoperative result is shown.

The patient in Figure 6 illustrates the limited usefulness of the Regnault system. Classically, the patient would be thought to require a mastopexy, given the degree of ptosis. However, objective assessment reveals a skin stretch of 3.5 cm and a nipple-to–inframammary fold distance on maximal stretch of 9 cm. These measurements verify that augmentation alone is sufficient for treatment. The patient has a satisfactory result 2 years after surgery.

Efforts focused on quantifying integrity of the existing breast tissue and skin in addition to nipple position provide a more complete approach for determining the end result. A more

comprehensive approach provides greater information and optimizes surgical planning. The present study found that three simple measurements in particular serve exactly this purpose. Many surgeons struggle with clinical decision-making in consultation. When seeing a patient with some degree of ptosis, surgeons across the world silently ask themselves the questions, "Will she be OK with an implant alone? Does she need a mastopexy?" The fall-back to determine this intraoperatively is not a good one; however, developing sound criteria on which to base clinical decisions will optimize planning and improve the patient consultation. By defining the laxity and integrity of the existing breast, the surgeon can better establish which breast should undergo a one- versus two-stage operation. Based on our data, although the potential for reoperation remains in those treated with one-stage surgery, it appears to be a much lower percentage. Compared with mastopexy, augmentation mastopexy has displayed reoperation rates three and four times higher.[19–22] The findings of this study provide an algorithmic approach associated with the much lower reoperation rate of 6.5 percent (Fig. 7).

Further discussion is warranted regarding implant size and surgical technique. There appears to be a notion that larger implants are necessary to fill the envelope and that more projecting implants are an advantage. We would disagree with both of these. Based on tissue-based planning principles of breast augmentation,[12,13] choosing an implant that fits the breast has led to the best outcome data in our specialty. Implant selection in augmentation mastopexy is no different. Logic would follow that the larger implants may cause more problems with wound healing. Surgeons have all been in the operating room wondering whether they can close the skin over a large implant. Also, it is important to remember that (1) the implant must be selected for the postoperative breast after the skin/parenchymal reduction of the mastopexy and (2) the postoperative breast will no longer have skin laxity. Based on the study data, low-profile implants correspond to the expected postoperative width of the breast and are recommended.

Surgical technique also appears to be of considerable importance. Combined augmentation mastopexy inherently delivers more soft-tissue rearrangement than simply augmentation alone. Concern over increased risk of infection and capsular contracture has been expressed.[1] Although the cause and pathophysiology of capsular contracture are beyond the scope of this article, it is interesting that there were no cases in this review. Minimizing exposure of the implant to any contaminating source is stressed with the described surgical technique. Mechanical barriers are placed over the nipples to prevent bacterial translocation. The implant is placed in a dual-plane pocket following meticulous hemostasis and irrigation. Before beginning any mastopexy incisions, the implant incision is completely closed off from the rest of the breast before the mastopexy is begun, essentially separating the two procedures from each other. When a two-stage operation is performed, the initial operation is

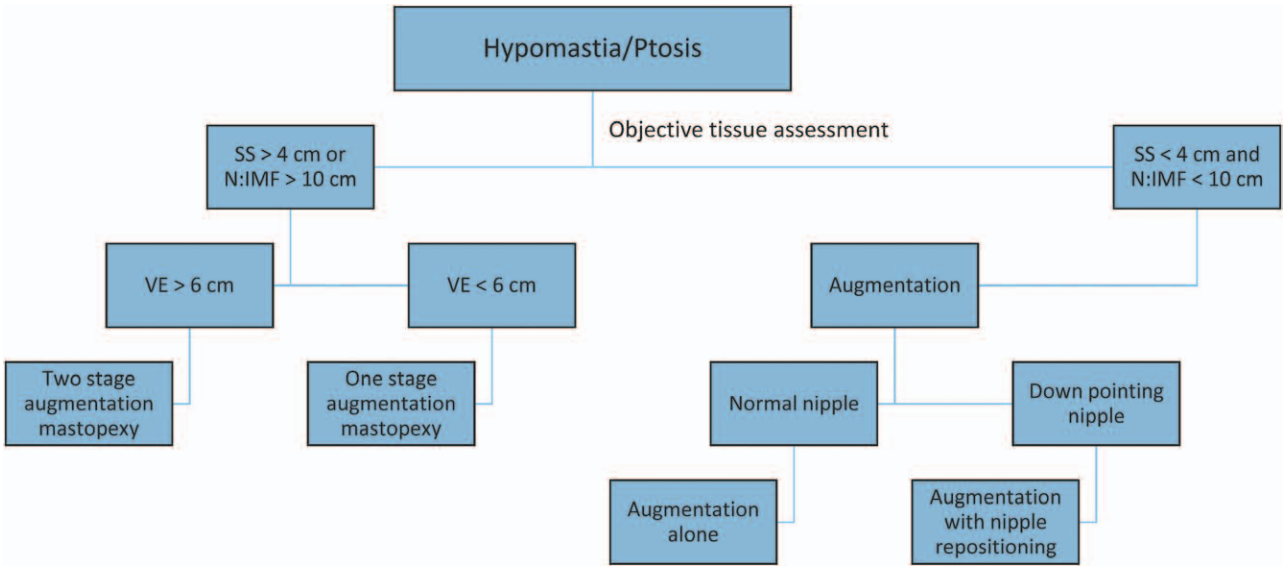

Fig. 7. Tissue-based triad algorithm for guiding surgical planning. *SS*, skin stretch; *N:IMF*, nipple-to–inframammary fold distance; *VE*, vertical excess.

typically mastopexy, as this may deliver an ultimately better result.

Experienced surgeons have often established practice algorithms learned by trial and error. However, even the most experienced surgeons report reoperation rates that would be deemed unacceptable in other aesthetic surgical procedures. Reoperation rates have ranged from 15 to 23 percent in the hands of the most experienced surgeons.[4,5,22] Greater concerns arise for those with less experience, who are left to learn from their own mistakes while patients suffer during the process. Use of the tissue-based triad creates a more objective approach to surgical planning. This would be particularly beneficial to the novice. However, using an algorithmic approach can simplify consultation and improve predictability, benefiting even the more experienced surgeon. Perhaps the greatest benefit to the clinician, regardless of his or her experience, is the reduction in the revision/reoperation rate. The low reoperation rates in this study compared with other comparable studies in the literature also validate the use of such an objective process approach for determining treatment. The reoperation rate in this study was found to be 6.5 percent, which is three to four times lower than those previously described in the literature. Revision and reoperation rates of those surgeons in general practice are likely higher than these reported rates.

Clinical judgment is always key. The tissue-based triad provides guidance for surgical planning, but other influences should be considered. In patients with breast characteristics that suggest tolerance of a one-stage operation, implant selection should be determined by optimal fill for the new postmastopexy breast. If patients desire implants significantly larger that the appropriate optimal fill as determined, a two-stage approach should be used.

Through the use of prospective patient analysis and review of tissue-based planning measurements, an algorithm to guide surgeons in augmentation mastopexy has been developed. Multiple goals are satisfied with the suggested algorithm, including objectivity and transferability. It is the opinion of these authors that surgeons of all levels will find these measurements and the resultant algorithm helpful.

CONCLUSIONS

Use of the tissue-based triad algorithm provides objectivity in determining surgical planning for augmentation mastopexy. Based on the presented data, use of this process approach is associated with lower reoperation rates than previously reported by experienced surgeons.

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