INTRODUCTION

The conventional treatments for hypomastia and ptosis use silicone implant placement and mastopexy, either simultaneous or staged. Dual plane technique allows for better control of implant cover and position and consequently improves outcome. However, in these cases, the interplay between soft-tissue characteristics and implant dynamics demands surgical adjustments. The surgical adjustments allow for optimal control and predictability while reducing surgical aggressiveness by minimizing mastopexy-related scars. This reduction of scarring satisfies an increasing number of ptotic breast patients for whom such scars are not acceptable.

The dual plane approach has proven successful at facilitating surgical resolution of nulliparous hypomastia patients, yet older parous involuted breasts often require additional staged mastopexy interventions. “In dual plane augmentation, the surgeon alters the position of portions of the pectoralis major muscle by ... freeing the attachments of parenchyma to muscle at the parenchyma-muscle interface by dissecting in the retro-mammary plane between the parenchyma and the pectoralis” to attain the fine equilibrium between the implant position and the overlying parenchyma. It is evident that such equilibrium is significantly challenged in ptotic

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Gland Suspension Improves Breast Augmentation Outcomes

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Background: While dual plane breast augmentation successfully addresses low ptosis grades, concomitant hypomastia and greater ptosis often requires combined immediate or staged mastopexy with extended incisions beyond those required for breast augmentation. In an attempt at offering a minimal scar in a single procedure, we evaluated the benefit of a gland suspension maneuver in addition to a dual plane dissection and implant placement to improve breast contour, avoid postoperative ptosis, and thus reduce staged reintervention procedures.

Methods: A consecutive group of 73 patients presenting ptotic hypomastia were jointly categorized and underwent implant placement, dual plane dissection level 3, and gland suspension maneuver. An age, implant volume, ptosis degree matched historical cohort was used as control (no gland suspension). All subjects were followed longer than 1 year postoperatively. Outcome analysis included re-intervention rates and objective geodesic changes using objective morphometric parameters as measured by 3D scan analysis.

Results: When experimental and control cohorts were segregated according to ptosis grade, gland suspension maneuver was associated to a lower frequency of subsequent ancillary mastopexy procedures (reintervention rate) for all ptosis grades except ptosis grade III. When gland suspension was compared with ptosis equivalent control groups, gland suspension was associated to a higher upper pole volume increment and higher pole convexity and lower pole morphometry.

Conclusion: The addition of gland suspension to implant dual plane breast augmentation appears to be a clinically beneficial maneuver with measurable contour impact and appears to avoid subsequent mastopexy procedures, except for high ptosis grade candidates. (Plast Reconstr Surg Glob Open 2018;6:e2032; doi: 10.1097/GOX.0000000000002032; Published online 19 November 2018.)

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breasts where both partial retropectoral and retromammary dissection are indeed needed, yet some component of parenchymal elevation is required. Furthermore, long-term muscle retraction and glandular tissue sliding results in muscle-fibrous-glandular interface with unpredictable breast contour, and also leads to reintervention rates. Gland suspension confers the control to elevate the soft-tissue envelope and reach harmonic implant-parenchyma relationship.

In an attempt to optimize breast contour, implant cover, and long-term results, while simultaneously offering a single minimal scarring procedure, we have tried to reduce reintervention rates by suture-suspending the breast to a dissected pectoralis muscle during a dual plane dissection and implant placement.

The specific aims of this study were to:

1) Quantify the overall reintervention rate following dual plane implant breast augmentation alone in a historical control cohort versus dual plane implant breast augmentation with gland suspension (experimental group).

2) Evaluate whether the gland suspension maneuver could potentially be related to a lower reintervention rate.

3) Identify statistically significant variables that impact the reintervention rate in both control and experimental cohorts.

4) Quantify ptosis-degree related reintervention rates and indications thereof in control and experimental groups.

5) Quantify complication rates in both control and experimental cohorts.

6) Quantify the upper and lower pole morphometric changes over time in the experimental group.

MATERIALS AND METHODS

The present retrospective (control) and prospective (experimental) data collection was submitted by the senior authors and approved by the Ethics Committee at Colic Hospital, Belgrade, Serbia on December 1, 2014.

A 5-year historical cohort (n = 67) (from 2008 until 2013) of dual plane implant breast augmentation patients were identified. A sequentially treated cohort (n = 73) of patients (from 2013 to the present, 4 years) were similarly categorized and underwent dual plane breast augmentation with gland suspension (Table 1).

Limited personal data were collected including age, preoperative photographic condition, implant type and size, complications, and reinterventions for both control and experimental groups. A team of plastic surgeons evaluated the preoperative photographic archive and categorized them according to Baker’s ptosis degree. In 4 patients, we also performed 3-D morphometric studies evaluating the shortest spherical N-IMF distance before, and 3 months after, the procedure. For this study, 3D morphometric quantification was performed using a device “ARTEC MHT 3D Scanner” and our previously reported and validated system and protocol.5

| Variables                  | P     | Experimental Cohort | Control Cohort |
|----------------------------|-------|---------------------|----------------|
| n                          |       | 73                  | 67             |
| Age mean ± SD             | NSa   | 33.5 ± 8.7          | 34.2 ± 9.8     |
| Age (youngest to oldest)  |       | 20–58               | 19–55          |
| Implant volume             | NSa   | 404.34              | 390.50         |
| Implant (minimum to maximum) | <0.05† | 260–550             | 220–400        |
| Reintervention rate (%)    |       | 15 (20.5)           | 32 (47.7)      |
| Pseudoptosis (%)           | NS†   | 6 (8.2)             | 7 (10.4)       |
| Ptosis degree I (%)        | NS†   | 28 (38.3)           | 19 (28.6)      |
| Ptosis degree II (%)       | NS†   | 18 (24.6)           | 18 (26.9)      |
| Ptosis degree III (%)      | NS†   | 21 (28.8)           | 23 (34.5)      |

aANOVA. †Chi-square goodness of fit (see Table 2).

NS, non-significant. | Fisher’s exact test.

Fig. 1. Placement of gland suspension suture. With the surgeon’s thumb introduced through the skin incision into the prepectoral plane, pressing on the breast’s deep surface (thumb blue dot), and the index finger over the suspension suture marking points (index blue dot), the breast gland thickness is now held in the surgeon’s palm and the field is easily exposed. The index finger is placed over the preoperative marking that now indicates the height (pectoralis muscle blue dot) where the deep glandular surface must be suspended to the anterior pectoralis surface.

Video Graphic 1. See video, Supplemental Digital Content 1, which displays the gland suspension operative technique. This video is available in the “Related Videos” section of PRSGlobalOpen.com or at http://links.lww.com/PRSGO/A924.
SURGICAL TECHNIQUE

Preoperative Markings

The patient is marked in a standing position and suspension points are determined according to the following surgical requirements:

If upper pole fullness is requested by the patient, the location of the suspension suture is determined on the breast meridian at the point at which the glandular tissue would best conform to a spherical lower pole. To determine this point, a pinch, applied at the superior areolar border, is used to pull the skin envelope superiorly, thereby unfolding the infra-mammary fold until the breast lower pole separates from the chest wall and the inframmary fold is fully open. The position of the nipple is then marked on the upper pole skin (Fig. 1).

If lateral fullness is requested by the patient, then an accessory suture can be marked at the same height yet displaced over the lateral edge of the pectoralis muscle.

Table 2. Rate of Reintervention between Experimental and Control Cohorts (Chi-square Goodness of Fit) and Distribution of Reintervention Rates among Ptosis Grades in Experimental Versus Control Cohorts (Fisher’s Exact Test)

| Reintervention Rate* | n  | Yes (%) | No (%) | Pseudoptosis | Ptosis Grade I | Ptosis Grade II | Ptosis Grade III |
|----------------------|----|---------|--------|--------------|----------------|----------------|-----------------|
| Experimental cohort (%) | 73 | 15† (20.5) | 58† (79.9) | 1/6 (16) | 5/28 (17.8) | 2/18 (11.1) | 7/21 (33.3) |
| Control cohort (%) | 67 | 32 (47.7) | 35 (52.3) | 3/7 (42.8) | 9/19 (47.3) | 12/18 (66.6) | 8/23 (34.8) |

*Twelve months follow-up period. NS, non-significant †Chi-square goodness 5.024 degrees of freedom 1; \( P < 0.05 \).

Table 3. Reintervention Indications and Frequency in Experimental Versus Control Cohorts

| Procedure* | Experimental Cohort (Gland Suspension); Total = 73 Patients | Control Cohort (Historical); Total = 67 Patients |
|-------------|-----------------------------------------------------------|--------------------------------------------------|
| Subjective dissatisfaction (%) | 3 (4.1) | 3 (4.5) |
| Recurrent ptosis (%) | 3 (4.1) | 8 (11.9) |
| Contour asymmetry (%) | 2 (2.7) | 3 (4.5) |
| Double-bubble deformity (%) | 2 (2.7) | 8 (11.9) |
| Implant exchange (any reason; %) | 5 (6.8) | 10 (14.9) |
| n (%) | 15 (20.5) | 32 (47.8) |

*At 12 months follow-up period.

Description of Intervention

Under general anesthesia, the patient is positioned in supine decubitus with their arms by their side. A 5-cm curved incision is made along the infra-mammary fold, and then the pectoralis muscle inferolateral origin is readily identifiable. Dissection proceeds superiorly over the prepectoral plane and extends over the entire breast footprint. The inferior aspect of the pectoralis major muscle lateral border is then elevated to access the areolar retro-pectoral plane. Medial and lateral muscle origins are attenuated using an electro-cautery with an extended-tip and an under lighted retractor, generating a slight superior muscle retraction. The suture is placed as illustrated in Figure 1. A single point of PDS II Suture 2-0, CT-2 needle (26 mm, taper point, 1/2 circle, 70 cm purple filament) is placed in the inner glandular surface right under the nipple and suspended on the muscle surface at the height of the operator’s index finger. Now the retracted muscle can be approximated via the suspension point. Similarly, a second accessory suture can be applied to join the glandular tissue to the retracted lateral pectoralis edge (see video, Supplemental Digital Content 1, which displays the gland suspension operative technique. This video is available in the “Related Videos” section of PRSGlobalOpen.com or at http://links.lww.com/PRSGO/A924).

Reinterventions and Complications

All surgical procedures postoperatively addressing the initial diagnosis (ptotic hypomastia) were considered “re-interventions” and included: recurrent ptosis, breast contour asymmetry, subjective patient dissatisfaction, objective “double-bubble” deformity (implant-tissue dissociation), and implant exchange. Scar revision, capsular contracture,
hematoma, seroma, and infection were all considered to be complications and were not reinterventions.

STATISTICAL ANALYSIS

Continuous variables such as age and implant size were analyzed for both groups using analysis of variance (ANOVA). The discrete variable, ptosis degree, and implant type were subjected to Fisher’s exact test (Table 1).

Overall differences in reintervention rates between the control and experimental (gland suspension) cohorts were studied by chi-square Goodness of Fit test (McNe-

Table 4. Complication Indications and Their Frequency in Experimental Versus Control Cohorts

| Complication*       | Experimental Cohort | Control Cohort |
|---------------------|---------------------|----------------|
| n                   | 73                  | 67             |
| Frequency (%)       | 16/73 (21.9)        | 14/67 (20.8)   |
| Scar revision       | 4                   | 3              |
| Capsular contracture| 2                   | 2              |
| Hematoma            | 4                   | 3              |
| Seroma (late-onset) | 4                   | 4              |
| Infection           | 2                   | 2              |

*At 12 months follow-up period.

Fig. 3. Morphometric changes of lower pole over time. A 3-dimensional scan (ARTEC MHT 3D Scanner, Santa Clara, Calif.) is utilized to scan spheric inframammary-nipple distances to quantify changes over time post implant augmentation. A preoperative inframammary fold - nipple areola complex (IMF-NAC) distance is recorded (68.39mm). The same distance in the early postoperative period is 80.05 mm. Note slight increase in the long-term follow-up as the breast bottoms out in gland suspension patients.
mar’s modification) to determine whether the observed proportions for a categorical variable differ from hypothesized control proportions. Reintervention subjects were segregated from their respective experimental and control cohorts, which were further divided among ptosis grade segregated groups, and then evaluated using Fisher’s exact test. Although chi-square test assumes that each cell has an expected frequency of 5 or more, the Fisher’s exact test has no such assumption and may be used regardless of the expected frequency. In our study, when ptosis degrees were segregated we observed frequencies of 2 and 1, which may indicate expected frequencies that could be below 5. Note that the Fisher’s exact test does not have a “test statistic” function, but rather computes the $P$-value directly (Table 2).

Continuous and discrete variables between control and experimental cohorts were evaluated for statistical significance. Specifically, continuous variables such as age and implant size were subjected to ANOVA, and discrete variables (implant type, ptosis degree) were evaluated using Fisher’s exact test. These variables were all found to be statistically unrelated to reintervention (reintervention subgroups were $n = 15$ in the experimental cohort and $n = 32$ for the control cohort; Table 3).

**RESULTS**

Ptotic hypomastia diagnoses at our institution display a steady increase since 2008 without significant changes between historical and experimental cohorts. Historical versus experimental samples are specimens that are statistically matched for age, implant size, and ptosis degree (Table 1).

The overall reintervention rate was 47.7% (32/67) for the ptotic and involuted breast sample before implementation of the gland suspension maneuver. The overall reintervention rate decreases upon gland suspension implementation to 20.5% (15/73). The difference observed here is statistically significant via chi-square goodness of fit test evaluation (Table 2).
The ptosis-degree–related reintervention rate decreases with respect to historical controls when gland suspension was implemented, except for ptosis grade III (Table 2 and Fig. 2).

No statistical differences were observed in the groups based on changes in age, implant size or implant type, specifically when glandular suspension and control groups are segregated as reintervened versus nonreintervened subjects. To determine if age, implant size, or implant type were statistically related to reintervention, between both control and experimental cohorts, the cohorts were pooled and a multiple ANOVA study was conducted to identify possible interactions. The continuous variables were not found to be statistically dependent on reintervention.

Reintervention indications have been tabulated in Table 3. The indications included recurrent ptosis, breast contour asymmetry, subjective patient dissatisfaction, objective “double-bubble” deformity (incongruent implant-tissue continuity), and implant exchange. “Double-bubble” deformity was significantly contained in the gland suspension cohort ($P < 0.05$).

Complication frequencies were statistically similar and not significant for both experimental and control cohorts, which included scar revision, capsular contracture, hematoma, seroma, and infection (Table 4).

When 3-D morphometric studies over postoperative follow-up time were tabulated, the shortest spherical N-IMF distance appears to increase during the first 3 months’ postoperative time and remains stable thereafter, which is illustrated in Figure 3. However, these measurements were done in only 4 patients. As the sample was too small for statistical analysis we consider our observations anecdotal and nonconclusive.

**DISCUSSION**

When it comes to complication rates of augmentation-mastopexies, there are patients in whom it would be wise to avoid a single-stage approach.\(^6\)\(^7\) Breast configuration is particularly risky for those that have moderate ptosis yet large areola diameter.\(^8\) The Wise-pattern is necessary to encompass large areola, which imposes a skin resection that is exposed to substantial tension when associated with...
simultaneous augmentation. Therefore, those patients benefit from glandular suspension.

The concept of suspending or quilting sutures has been advocated in different anatomical areas (face, abdomen, back, pubis, breast). We attempted to collapse the plane, prevent seroma formation, and confine fibrosis to ultimately determine the long-term relative position among different tissues.9–14 Stan and Biggs15 have recently mentioned placement of repositioning sutures in the cephalad portion of the breast gland, in cases of moderate ptosis.

When gland suspension sutures are applied to ptotic involuted breasts, a number of mastopexy patients can be contented by eliminating mastopexy-related scar patterns, thus gaining additional control on upper pole volume deficiency and lateral hollowness to achieve long-standing results (Fig. 4).

Level 3 dual plane technique involves 2 relevant steps, which are prepectoral dissection and pectoral insertion attenuation. Prepectoral dissection divides the muscle-fibrous-glandular attachments and thus allows spreading of the glandular tissue over the entire implant surface, thus minimizing “double-bubble” deformity. Pectoral insertion attenuation results in controlled lowering of the inframammary fold, thus requiring further expansion of the lower pole to nest the implant.

The addition of a suspension suture technique to the dual plane routine actually perches the glandular tissue in the position at which the lower pole skin envelope is stretched. In our hands, it appears to contribute to the generation of a feathering effect, establishing a congruent implant-soft tissue continuity, which may be responsible for the apparent control of postoperative “double bubble” deformity.

Our observations during the follow-up period support the concept that fixing breast tissue on the upper pole allows progressive bottoming-out of the implant. As edema subsides, the soft-tissue envelope releases peri-prosthetic pressure and the gravitational distribution of silicone contributes to efficiently fill the lower pole (Fig. 5).

The limitations of this technique are the use of film nipple shields because it can be difficult to place gland suspension sutures and cases of highly glandular breast elevation of parenchyma can be more challenging.

CONCLUSIONS

The gland suspension maneuver in addition to dual plane breast augmentation appears to avoid subsequent mastopexy procedures, except for high ptosis grade candidates. Furthermore, it can be easily incorporated and performed by recent adopters and impacts time and resources that are assigned to the standard surgical routine.

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