Lift-and-Fill Face Lift: Integrating the Fat Compartments

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Background: Recent discovery of the numerous fat compartments of the face has improved our ability to more precisely restore facial volume while rejuvenating it through differential superficial musculoaponeurotic system treatment. Incorporation of selective fat compartment volume restoration along with superficial musculoaponeurotic system manipulation allows for improved control in recontouring while addressing one of the key problems in facial aging, namely, volume deflation. This theory was evaluated by assessing the contour changes from simultaneous face "lifting" and "filling" through fat compartment–guided facial fat transfer.
Methods: A review of 100 face-lift patients was performed. All patients had an individualized component face lift with fat grafting to the nasolabial fold, deep malar, and high/lateral malar fat compartment locations. Photographic analysis using a computer program was conducted on oblique facial views preoperatively and postoperatively, to obtain the most projected malar contour point. Two independent observers visually evaluated the malar prominence and nasolabial fold improvements based on standardized photographs.
Results: Nasolabial fold improved by at least one grade in 81 percent and by over one grade in 11 percent. Malar prominence average projection increase was 13.47 percent and the average amount of lift was 12.24 percent. The malar prominence score improved by at least one grade in 62 percent of the patients postoperatively, and 9 percent had a greater than one grade improvement. Twenty-eight percent of the patients had a convex malar prominence postoperatively compared with 6 percent preoperatively. Malar prominence improved by at least one grade in 63 percent and by over one grade in 10 percent.
Conclusions: The lift-and-fill face lift merges two key concepts in facial rejuvenation: (1) effective tissue manipulation by means of lifting and tightening in differential vectors according to original facial asymmetry and shape; and (2) selective fat compartment filling of deep malar and high malar locations and nasolabial fold fat grafting to precisely control facial contouring. This was shown with objective numerical grading and through observer assessment. (*Plast. Reconstr. Surg.* 133: 756e, 2014.)
CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, IV.

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THERAPEUTIC

Current face-lift techniques have shifted to a more accepted paradigm of volume restoration and facial recontouring. Emphasis has been given less to the exact method of tissue mobilization and elevation and more to creation of smooth contour and highlights through deep and superficial volume augmentation. The concept of facial volume restoration is not new and has long been advocated by previous surgeons as an important concept in facial rejuvenation.[1–9] Fat grafting can serve as an isolated rejuvenation technique or as a powerful complement to "lifting" of the facial structures. Evidence for deflation as a primary

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component of facial aging has been clearly elucidated by Lambros.[6] Recent descriptions of the fat compartments of the face may improve our control and precision with respect to reestablishing the lost volume while the superficial musculoaponeurotic system (SMAS) and its attached structures are selectively repositioned.[10–13] In addition, numerous studies have revealed the significance of facial fat in facial aging and techniques to restore it.[14–18]

Various techniques with respect to SMAS manipulation exist but, to date, a single technique has not been shown to be superior over another. The missing link in efficacy of our face-lift results is now centered on the concept of precise volume augmentation as a mandatory component of optimal "lifting." Surgeons often use a variety of SMAS techniques, and techniques typically evolve over the course of their career. Historical and perpetual changes in "lift" methodology clearly indicate a shortcoming when focusing solely on extent of undermining, vectors, and tension. Bridging our knowledge of fat compartments with contour-directed SMAS modifications may bring surgeons closer to optimizing outcomes.

Indications for SMAS "stacking" (modified imbrication) and SMASectomy based on analysis of facial symmetry and shape have been described in a previous study.[9] The goal of the current study was to evaluate the synergistic effects of fat grafting of specific facial compartments and SMAS stacking or SMASectomy using objective data points and graded outcome analytics. Malar contour and nasolabial fold depth will serve as key objective outcome markers in our retrospective review. More importantly, perhaps the significance of restoring the native facial deflation of aging will be solidified.

PATIENTS AND METHODS

A review of the senior author's (R.J.R.) clinical experience with the lift-and-fill technique in surgical facial rejuvenation was conducted. One hundred consecutive face-lift patients (96 women and four men) who also underwent simultaneous fat compartment fat grafting were analyzed using a computer-based system that measured relevant data points.[19]

The face-lift and compartmental fat grafting technique includes the following: (1) individualized component face lift[9]; (2) open neck lift; (3) fat transfer to the deep malar fat compartment, high (superficial) malar fat compartment, and nasolabial folds; and (3) facial resurfacing (if indicated). Some subjects also underwent various forms of eyelid rejuvenation. The eyelid rejuvenation techniques used would not have any effect on the most projected malar contour point or the nasolabial fold depth. Typical fat compartment fill volumes using fat grafting were 1 to 3 cc injected into each compartment. The injected compartments include the deep malar, deep medial malar, and high/lateral deep malar fat compartments. The nasolabial fold was also injected. The average transferred volume was 2 cc per fat compartment; the total average per face was 12 cc, with a range of 8 to 14 cc for each patient. The nasolabial fold averaged 2 cc fat graft volume injected into each side.

Complication rates were also assessed. These were categorized into minor and major. Major complications included any that required the patient to undergo surgical revision or return to the operating room for treatment. Minor complications were those managed conservatively.

The postoperative outcomes were evaluated using contour ratios of specific morphologic facial points. Patient case examples are used to illustrate typical aesthetic outcomes of this technique. The clinical assessment includes the following:

1. The degree of preoperative and postoperative change of nasolabial fold depth was assessed according to a classification system previously described by Barton.[20]
2. The two-dimensional location change (x and y axes) of the most projected malar point of the obliquely oriented contour was measured. Point A represents the most projected malar apex, while point B demonstrates the submalar concavity. (Fig. 1).

Inclusion criteria were (1) at least a 6-month follow-up after the procedure, and (2) an oblique photographic view that was position-matched between the preoperative and postoperative views. All cases with oblique views that displayed horizontal tilt or lateral rotation were excluded from the series. The amount of horizontal tilt was confirmed by the pupil flash reflex aligned and in the center of both pupils on preoperative and postoperative photographs. Vertical rotation was checked by the position of the medial canthus to the ipsilateral dorsal aesthetic line of the nose (Fig. 1). All distances were divided by the interpupillary distance to acquire a percentage (ratio) and to cancel out any slight picture size variations.

Computer Program for Outcome Analysis

A computer software program was developed to quantify variations in specific topographic facial landmarks. This program methodology has been

Fig. 1. The *x* and *y* axes of the most projected malar projection point were measured on oblique standardized views of preoperative and postoperative photographs. Point A represents the most projected malar data point, while point B corresponds to the submalar point. Both points A and B represent the deep malar fat compartment, with point B solely representing the deep malar compartment.

previously published.[19] Data from preoperative and postoperative digital images were analyzed based on the following three variables: *x* axis, *y* axis, and interpupillary distance.

Specifically, primary reference points were marked on the pupil of the side of the face to be measured. A vertical line from the mid pupil was drawn. A horizontal intersecting line from the same point generated the *x* axis. A second set of points were marked at the middle of both pupils to measure the interpupillary distance. This distance will serve as a common denominator for all measurements to express all results as a percentage. Point B was used to denote the submalar region. Using a ratio for each subject also allows the analysis of measurements among all subject data sets. Next, a curvilinear line following the lateral contour of the face was drawn manually into the digital photograph from the lateral orbital rim to the jawline (Fig. 1). The computer program can then define the location of each point as an *x* and *y* axis value.

Quantitative Outcome Assessment

Quantitative assessments included evaluation of preoperative and postoperative position of the most projected point landmarks. All variations in terms of modification of landmark locations were calculated (i.e., postoperative – preoperative/preoperative) and presented as a percentage.

A negative variation (a decrease of the distance) on the *x* axis corresponds clinically to a decrease of the lateral contour projection point, whereas an increase on the *x* axis signifies improved malar projection and a corresponding increase of the facial volume *at that location*.

A negative variation of the *y* distance corresponds to a lowered vertical displacement of the malar projection after face lift. A positive change on the *y* axis corresponds clinically to a higher position of the most projected point. This means that the area of volume was moved cephalically because of a vertical or vertical/oblique vector lift.

TRAINED OBSERVER EVALUATIONS

A pair of plastic surgery observers examined the preoperative and postoperative photographs from each case and graded the nasolabial fold and malar prominence on a predetermined scale. As above, adjuvant facial procedures, such as brow lift, blepharoplasty, or cervicoplasty, were noted.

The nasolabial fold scale is as described by Barton[20]: 0, no visible fold; 1, minimal fold; 2, moderately deep fold; and 3, very deep fold. Malar prominence scores were scored on a scale ranging from one to three points as well: 1, concave malar projection below the zygoma; 2, neutral projection; and 3, convex malar projection below the zygoma.[20]

Table 1. Most Projected Malar Contour Point and the Submalar Depression

	x Axis (Projection) (%)	*y* Axis (Lift) (%)
Most projected malar contour point*		
Average	13.47	12.24
Minimum	–4.55	–5.88
Maximum	45.39	49.69
SD	15.24	15.74
Submalar depression†		
Average	15.64	
Minimum	0.09	
Maximum	49.85	
SD	13.31	

*The most projected malar contour point has a variation in the *x* axis (projection increased = filling) and a variation in the *y* axis (higher position = lifting).
†The submalar depression point has been assessed only on the *x* axis for its projection. We kept the *y* axis position unvariable in order to focus on the compartmental filling effect. This depression is augmented by injecting the deep and middle malar compartments. The B point was modified in 93 percent of cases (93 over 100) and unchanged in seven cases. These seven cases had a convex submalar zone that did not require any modification. For the 93 percent that changed, the observations are shown in the table.

In the postoperative period, photographs were taken and postoperative nasolabial fold depth was recorded for each patient and compared with the preoperative scores. An identical analysis was undertaken to measure the preoperative and postoperative malar prominence of each patient.

RESULTS

All patients had an individualized component face lift with fat grafting to the malar (deep medial and lateral-superficial) fat compartments and nasolabial folds.

Malar Projection

The most projected malar contour point increased in its projection, indicating volume or fill augmentation at that exact topographic location. Average lifting (positive ratio/cephalad movement) of the most projected malar point was 12.24 percent, whereas the malar projection increase was 13.47 percent on average. These correspond to average positive (increase) lift and fill efficacy, respectively (Table 1). The B point represents the submalar augmentation effects of deep malar fat compartment filling. When removing the 7 percent of cases in which the submalar regions were convex to begin with, a 15.64 percent increase in projection was seen, corresponding to deep malar fat compartment fill. Standard deviations reflect the high variation in preoperative volume in these topographical regions.

Observer Results

The average nasolabial fold score for the 0 grade improved from 1.5 percent preoperatively to 21.5 percent postoperatively. Average malar prominence convexity improved from 6 percent preoperatively to 28 percent postoperatively. Nasolabial fold improved by at least one grade in 81 percent and by over one grade in 11 percent. Malar prominence improved by at least 1 grade in 63 percent and by over 1 grade in 10 percent (Figs. 2 and 3).

DISCUSSION

The importance of volume restoration in facial aging and surgical technique is not new. Volume augmentation by way of fat has long been

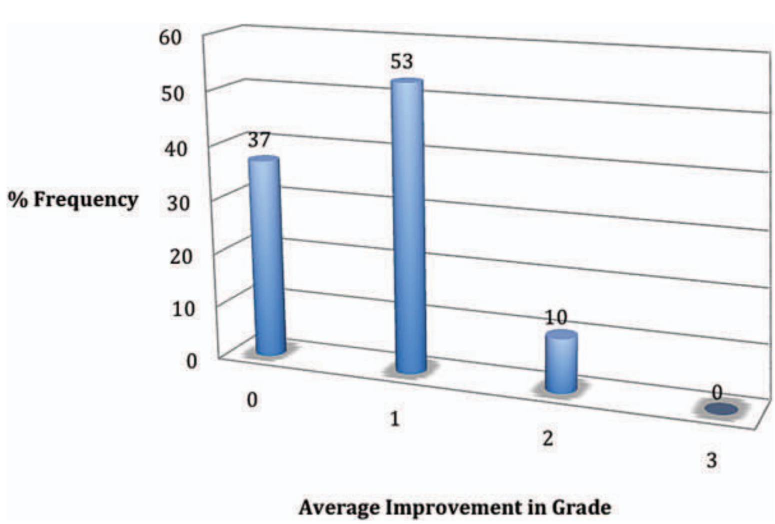

Fig. 2. Degree of malar prominence improvement. Percentage frequency of grade improvement shown as determined by trained observer visual evaluation.

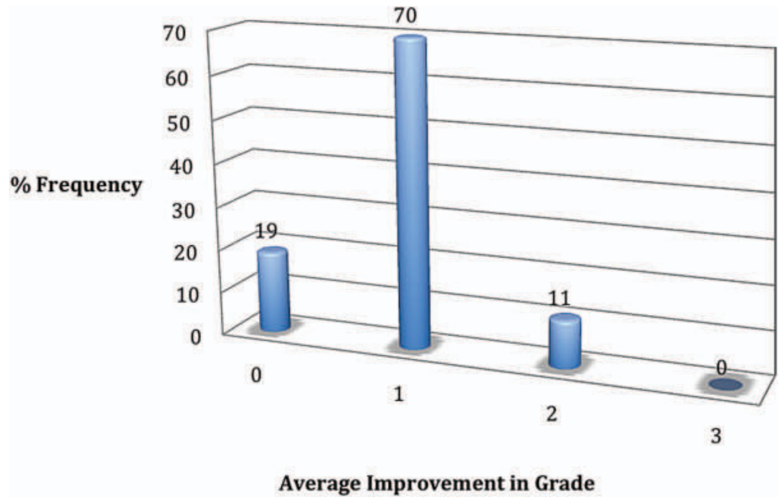

Fig. 3. Degree of nasolabial fold improvement. Frequency of grade improvement shown as determined by trained observer visual evaluation.

advocated.[1–7,9–14,16–19] However, the importance of varying specific SMAS vectors, depth/extent of dissection, amount of tissue mobilization, and other factors continually changes and is debatable. The superiority of one specific method of tissue (SMAS) manipulation over another has not been clearly determined.[21–23] The current focus has shifted to augmentation and redistribution of volume throughout the face (mostly using fat grafts). Little's application of the "ogee" architectural concept on facial volume in face lifting was important to our earlier understanding of volume and lift as a necessary combination.[7] Our more current understanding of the facial fat compartments now allows surgeons the ability to more selectively and precisely "fill" while "lifting" the tissues of the face with detailed knowledge of the architecture of the fat compartments.

It is important to know what topographic region(s) exactly we are filling when fat grafting various anatomical regions of the face. By using a "topographic map" of fat compartments that indicates the precise location, depth, and magnitude of each patient's facial deflation, surgeons can individualize their SMAS techniques and improve their effect on overall facial contour improvement. This "GPS-like" guidance may reduce problems with overcorrection or suboptimal facial augmentation. In the past, fat transfer volumes were underestimated. With recent knowledge of the difference in deflation magnitude between the deep and superficial fat compartments, volume compensation is now mandatory.[18] The deep malar compartment has smaller fat lobule size and deflates at an accelerated rate.[18] This is the critical and first compartment to be filled. The submalar point in our study (point B) as well as the malar apex represent this deep compartment. This sets the foundation to build on with further fat augmentation more lateral/superficial, with SMAS modification bridging the two. Large quantitative changes were not expected and if present may indicate overfilling, particularly in the high/lateral, more superficial fat compartments. Greater increase ratios are undesirable, unwarranted, and may indicate an awkward, "overdone" facial appearance. This sequential approach to the lift-and-fill face lift is shown in Table 2.

Indications for specific fat compartment augmentation is based on preoperative analysis of the topographic deflation. Preoperative planning of selective fat compartment fat grafting is a necessary first step of the lift-and-fill face-lift approach (Fig. 4). The deep volumetric foundation will thus influence the extent and type of SMAS and skin manipulation.[9] SMAS stacking is performed superficial to the augmented deeper malar fat compartments (Fig. 5). If a SMASectomy is indicated according to preoperative analysis of

Table 2. Technical Sequence in the Lift-and-Fill Face Lift

Fill of deep and superficial fat compartments
Selective skin undermining
SMAS and platysma manipulation*
Redraping of skin and closure†
Five-step blepharoplasty (when indicated)

*SMAS "stacking" is indicated when more fullness is required; SMASectomy when submalar and overall facial volume is excessive preoperatively.
†Degree of skin undermining altered is based on tethered skin points that interfere with underlying SMAS and deep fat compartment effects on surface topography. The wider facial side indicated more skin undermining.

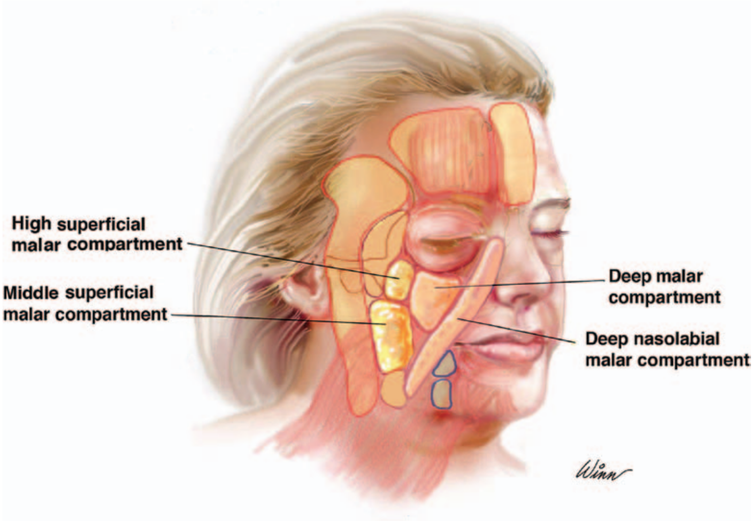

Fig. 4. Key fat compartments relevant to the lift-and-fill face lift.

the fuller and/or wider facial side, fat transfer volumes may be less indicated in the high lateral malar compartment to enhance the desired contour (Fig. 6).

The deep malar (medial) compartment and nasolabial fold are always fat grafted first and the high lateral (superficial) compartment and nasolabial fold are augmented last. The deep malar compartment is the foremost workhorse compartment in effective volume restoration. The contour and volume of the sub-SMAS fat grafting is based on preoperative shape of the malar bone and native

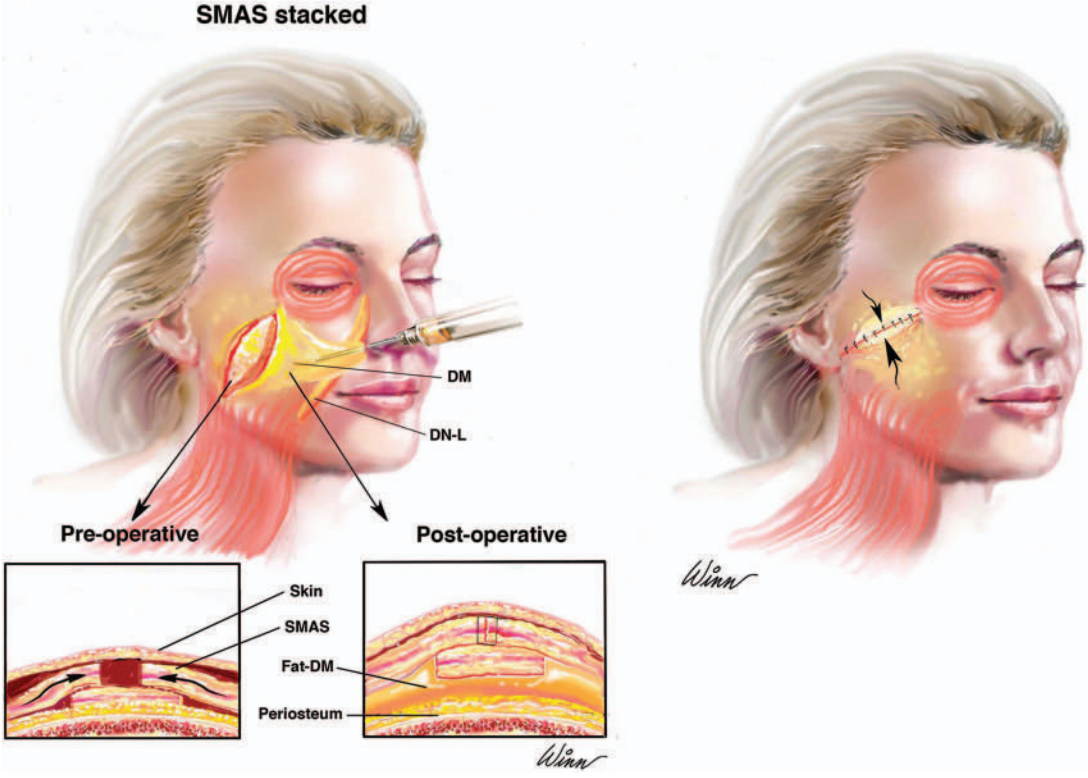

Fig. 5. SMAS stacking allows for enhanced augmentation in the precise topographic location that is indicated. Stacking bridges the contouring effect between the deep medial and lateral superficial malar compartments. Stacking is more powerful as an augmentative maneuver than plication because an island of SMAS is preserved centrally and a bilaminar construct is created. *DM*, deep malar fat; *DN-L*, deep nasolabial fold.

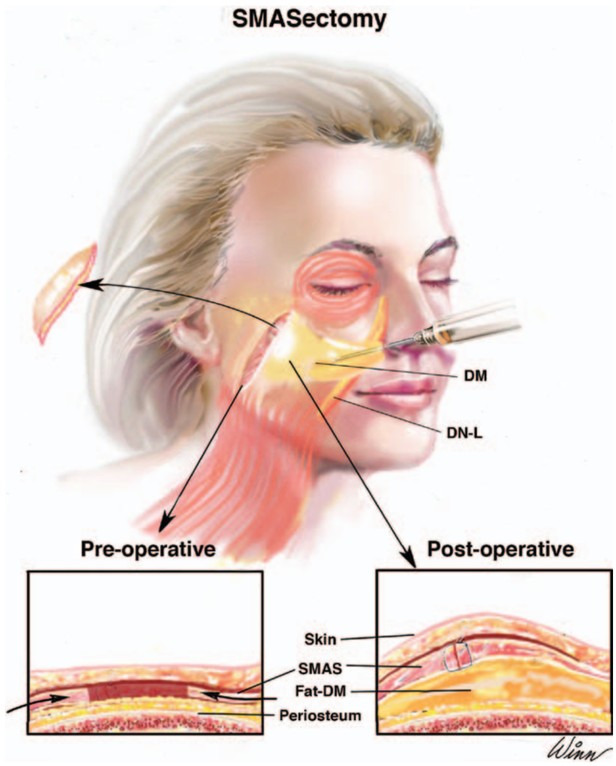

Fig. 6. SMASectomy is indicated when excess volume would inappropriately widen the face. Fat grafting is deep to SMAS manipulation. The combination of SMASectomy and lifting is more subtly enhanced with the contouring effect of deep medial and lateral superficial fat compartment augmentation.

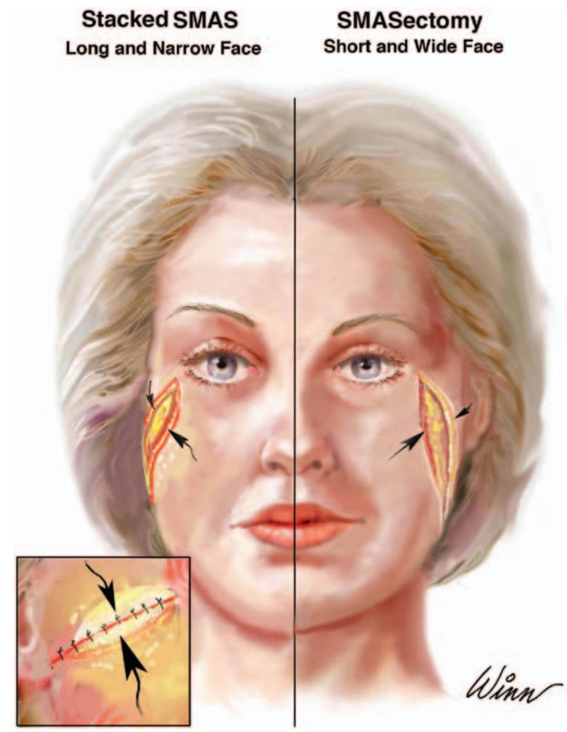

Fig. 7. SMASectomy is typically indicated for the wider/fuller facial side (*left*), whereas the narrower side (*right*) benefits from SMAS stacking to increase fullness for improved overall symmetry when final contour from lifting and filling is complete. Note the synergistic "hill" of SMAS and fat that is created (*inset*). *DM*, deep malar fat; *DN-L*, deep nasolabial fold.

distribution of facial fullness. Anticipated results of SMAS manipulation are taken into account. An individualized component face-lift approach allows for varying of vectors and performing a SMAS stacking for added malar fullness on one side while a SMASectomy to decrease facial fullness may be indicated on the fuller side.[9] Regardless of what facial side receives a SMASectomy versus SMAS stacking, fat grafting is always performed (Fig. 7).

A key principle is that the final blending of facial contour through fat transfer of the deep malar fat compartment and the high superficial (lateral) malar compartment is achieved by the overlying SMAS manipulation. Individualized SMAS treatment serves as the "contour bridge" between the deep malar and superficial lateral fat compartments. It served to coalesce the deep and superficial compartments in a seamless manner.

More superficial fat grafting may also be performed during or after SMAS manipulation and has become a preferred modality of some surgeons. Superficial fat grafting is recommended for the oral commissures, surrounding labial aesthetic units, and para-menton (lateral chin depressions). As our understanding and analytic precision improves, percentage deflation of specific fat compartments can be measured and compared with one another in youthful and aged faces. This will dictate compartment depth (i.e., superficial versus deep) and at what locations increased volume would benefit the patient most.

The malar projection in our study improved/increased by an average of 13.47 percent (x axis) and the malar tissue lift degree was 12.24 percent (x axis). In addition, qualitative evaluation by trained observers showed similar degrees of improvement in malar grade. Malar prominence improved by at least one grade in 63 percent and by over one grade in 10 percent. These average ratios provide a numerical and global assessment of contouring effects of SMAS and deep fat compartment augmentation. While visual assessment is clinically more relevant, it is useful to know the quantitative changes as well as the variations in fat compartment delta changes. The degree of standard deviations seen reflects the magnitude of variations in preoperative fat compartment deflation. Lambros has provided strong evidence

Fig. 8. Case 1. Preoperative and postoperative views.

that inferior movement of overlying facial tissues does not occur, which further supports fat compartment deflation as *the* primary cause in undesirable and aged facial contour.[6] However, surgical manipulation in face lifting by necessity may alter these stable surface landmarks. The lift-and-fill face-lift approach addresses the root cause of facial aging (volume deflation), and the requirements for tension and "lifting" are lessened. This allows for less manipulation of the stable surface landmarks, resulting in a more natural aesthetic facial appearance.

The type of SMAS treatment is based on the overall fullness of each facial side and has been described in a previous study.[9] SMAS stacking allows for selective augmentation exactly where the SMAS is stacked. When the stacked region is located directly over a grafted fat compartment, the augmentative effects are most powerful. SMAS stacking or SMASectomy each influences the

Fig. 9. Case 1. Preoperative and postoperative views.

facial rejuvenation process differently; the former by synergistic augmentation and the latter by subtractive effects. SMASectomy (when indicated) increases the augmentative effects of the grafted fat compartments because they appear fuller in comparison with the areas of excision and pull.

A limitation of our study is that we did not have a control side in which fat grafting was not performed. In addition, the variability of the fat graft survival and tissue pliability/elasticity further challenged our ability to precisely assess and compare the individual effects of combining the two key techniques (lift and fill). Unfortunately, the exact percentage of long-term fat graft survival is currently a challenge to ascertain. Therefore, it is difficult to assess exactly what volume of fat to graft while considering the magnitude of volume that is redistributed through SMAS manipulation alone. This may explain the high degree of variability (standard deviation) in malar data points observed in our study. However, fat transfer overcorrection should not be used as compensation for this variability. This may have detrimental aesthetic tradeoffs by creating an unnaturally overfilled facial contour. Furthermore, percentage graft survival is not entirely predictable, and long-term effects of future weight gain or weight loss add more variables. It is best to graft less primarily and discuss with patients the possibility of needing to perform fat grafting or use fillers in the future for maintenance.

As expected, nasolabial fold improvements were powerful. Nasolabial fold improved by at least one grade in 81 percent and by over one grade in 11 percent. We believe this to be result of both the direct effect of SMAS soft-tissue recruitment and fat grafting of the nasolabial fold itself. In our experience, patients complain of this region and the neck more often than the loss of malar projection. In fact, many patients need to be educated on the importance of malar volume as a component of their facial appearance.

A key aspect of any fat grafting technique is assessing the capacity of the recipient site to accommodate the graft volume. In facial fat grafting (unlike breast and buttock), it is less of a critical point because complementing the "customized facial tissue mobilization" rather than augmentation is the primary goal. Overcorrection is not necessary, as expansion of the overlying tissue is not reliant on the fat grafts alone. In general, overcorrection is a flawed concept. The intercompartmental membranes are elastic and pliable (perhaps because of deflation) and easily accommodate the low–fat graft volumes typically injected. The degree of skin undermining and pull is dictated in part by the final contour of deep fat compartment augmentation and SMAS movement. Superficial fat augmentation is not indicated and is more difficult in areas where skin has been undermined. When the skin is redraped properly, the shaping effects of deeper fat grafting and SMAS shaping translate effectively to the surface appearance. Therefore, unlike breast and buttock tissue, superficial ligamentous release of tethered skin points is not necessary and may be required only at the lid/cheek junction or when dimpling occurs during closure.[19]

Fig. 10. Case 2. Preoperative and postoperative views.

CASE STUDIES

Case 1

A 60-year-old woman underwent a lift-and-fill face lift with individualized component technique for correction of facial asymmetry (Figs. 8 and 9). Fat transfer volumes were as follows: 3 cc in the right deep malar fat compartment and 2 cc in the left, and 2 cc in the right superficial lateral (high) malar compartment and 1 cc in the left side. In addition, the prejowl area received 2 cc bilaterally. SMAS stacking bilateral was performed with an oblique vector on the right with more undermining to treat the shorter/wider facial side; on the left, SMAS was stacked in a horizontal vector with less skin undermining to recruit more vertical pull for the longer side. The open neck technique was also performed with a platysmaplasty. For future consideration, more fat should have been injected into the deep malar fat compartment, especially on the right side.

Case 2

A 62-year-old woman underwent a lift-an-fill face lift, open neck lift (Figs. 10 and 11). Individualized component face lift consisted of bilateral SMASectomy to decrease facial fullness. To directly treat fat compartment deflation, 3 cc of fat was injected into the nasolabial fold on the left and 2 cc was injected on the left. The deep malar fat compartment received 2 cc on each side. In retrospect, more fat should have been injected into the left side. The superficial high (lateral) malar compartment received 2 cc on each side. SMASectomy was oriented horizontally on the

Fig. 11. Case 2. Preoperative and postoperative views.

left and oblique on the right, with more skin undermining on the right because the right was the shorter/wider facial side.

CONCLUSIONS

Objective outcome analysis of SMAS manipulation and specific fat compartment filling with fat has been studied. Despite the limitations listed above, this serves as a starting point to improve our precision and efficacy in combining selective fat compartment fill with variations in SMAS modifications. Future studies that can three-dimensionally compare each patient in youth and with aging and measure individual compartment volume requirements are needed. Currently, fat restoration of deflated facial fat compartments is a necessary complement to surgical "lift" techniques. As with most aesthetic procedures, keen visual inspection of facial shape preoperatively, intraoperatively, and postoperatively is mandatory for successful outcomes.

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PATIENT CONSENT

Patients provided written consent for the use of their images.

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