Fat Distribution: a Morphologic Study of the Aging Face

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A careful study of the aging face reveals it to be more than just surface textural wrinkling or loose skin. Changes in three-dimensional topography are responsible for the distinctive phenotypic presentation of the face throughout life. These geometric alterations are secondary to apportioning in the fat compartments and result in the fat dysmorphism characteristic of senescence. Redistributing this fat can rebalance the facial fat compartments and mimic the facial structure present in youth.

THE MORPHOLOGIC CHANGES in the face at each stage of life are a result of fat distribution. In infancy there is an abundance of fat in the cheeks, submental, and jowl areas. This is not dissimilar to that encountered in the aging face. We accept that a chubby-cheeked child appears cherubic due to fat deposition in the jowl area, why then are we so reluctant to attribute the senescent face to fat distribution as well? (Figure 1). There have been multiple exposés written on the causes of the nasolabial fold. It should be obvious by studying the face of a child that the nasolabial fold is caused by fat deposition lateral to the muscular insertion at the crease (Figure 2). Gravity is too often conveniently named as the culprit. It is of interest that no valid references ever appear in the scientific literature as to the effects of gravity on the skin. We have been conditioned for so long to accept "sagging secondary to gravity" as dictum that we have forgotten that it is only a supposition. Since we spend half of our lives recumbent, why doesn't our lateral face sag over our ears? If gravity is to blame then the direction of the gravitational force present when upright for half the day should be canceled out by the direction of the force present when lying down for the rest of the night. Gravity certainly does not effect our body the way we assume it effects our face. The diaphragm does not sag with age, our kidneys do not stretch their supporting connective tissue network and drop into our pelvis, and our ankles do not sag over our feet. The fact is, gravity merely allows us to witness what fat distribution has accomplished in the aged face. Similarly, actinic damage is repeatedly cited as the cause of skin sagging. Since elastic fibers show fragmentation with photoaging and undergo molecular changes in the elastic fiber network it is assumed that this is the reason for the excess of skin seen in aging.[1] We know that wrinkles and changes in elastin and collagen are related.[2] We also know that tretinoin restores normalcy to collagen and improves wrinkles.[3,4] Why then doesn't a 50-year-old look like a 30-year-old after 8 months of tretinoin use? Far too much importance is placed on wrinkles and their relationship with aging. The media is full of advertisements about wrinkle erasing creams. Faces that are excessively wrinkled appear older than their chronological age. Smooth out the wrinkles and the patients look their age, but they rarely look younger (Figure 3). We except that with age fat redistributes on the body. Slim hips become rounded, breasts droop, knees deposit fat medially, lower abdomens protrude. Liposuction and synthetic implants (breast, gluteal) have become excepted "antiaging" therapies for the body. Why then are we so reluctant to apply the same cause and common-sense treatment to the face? To recapture the youthful look our patients want, the fat compartments must be addressed.

The Young Versus the Old Face

The young face is full, with an even, ample distribution of superficial and deep fat. It appears homogenized and balanced without demarcation of the cosmetic units. Three-dimensionally the young face is a series of important arcs and convexities. From the front, there is a primary arc of the jawline from ear to ear, a convexity of the temples, and multiple smaller secondary arcs of the upper and lower lips (Figure 4A). In profile, the most defining features of youth are three primary arcs. The first and most significant makes up the lateral cheek projection and travels from the tarsus down through the lower face. The second primary arc occurs in the jawline on each side from the lateral mandible to the mentum. The third appears on the forehead and is contiguous with the convexity

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Figure 1. Fat characteristically distributes in the young face as well as the old face.

of the brow. In addition, there are multiple secondary arcs occurring periorally (Figure 4B). In contrast, the old face shows compartmentalization, with a "hill and valley" topography. There is vivid demarcation of the cosmetic units, which leaves the face unbalanced. There is disruption of the primary arcs and replacement with broken, wavy, or concave shapes. Frontally the senile face displays a scalloping of the jawline. There is a prominent convexity of the temples, the lateral cheeks, and the suborbital area. The lips are no longer arced, but are straight and/or angular (Figure 5A). In profile, the primary arc of the cheek is lost, the mandibular arc is replaced with a wavy line, and the forehead and brow lose their anterior projection to lie level against the calvarium (Figure 5B). Morphologically the disruption of the primary arcs is the most significant change in the aging face. This conversion of arcs to straight lines leaves behind a relative excess of skin (Figure 6).

The Atrophy/Hypertrophy Model for Aging

The aging process causes certain areas of the face to undergo fat atrophy, while others experience a persistence or hypertrophy of fat. Fat atrophy occurs in the periorbital, forehead, buccal, temporal, and perioral areas. Fat hypertrophy, however, is seen submentally, in the jowl, lateral nasolabial fold, lateral labiomental crease, and lateral malar areas (Figure 7). The suborbital area may display atrophic changes with concavities and evidence of the underlying orbital rim, or hypertrophy with infraorbital fat accumulation and festooning. In addition, there is a discrepancy in the

Figure 2. The nasolabial fold in the infant and the adult is secondary to fat deposition.

Figure 3. A 57-year-old woman A) before and B) after CO_2 laser resurfacing. The patient looks better, but not younger than her 57 years.

way the heavy face ages as compared with the lean face (Figure 8). Lean faces occur most often in thin patients, but may be seen as an individual variant in a heavy patient. Aging imparts a drawn look to the lean face with marked angularity and a pronounced "saggy" appearance to the upper half of the face. Thin faces appear skeletonized after facelifts and rejuvenate easily with volume replacement alone. Fatty faces most often occur in individuals with a high body fat percentile. Unlike the young face, which stores fat diffusely, the aged face pockets fat in the areas prone to hypertrophy, as mentioned above. This gives a heavy look to the lower half of the face, with prominent sagging and drooping in the jowl area. This face also shows atrophic changes in the perioral, periorbital, temple, and cheek areas. To achieve rejuvenation the hypertrophic areas need to be removed via suction lipectomy. In addition, the atrophic areas need to be augmented.

The Sagging Paradox

It seems that both too little and too much fat cause the appearance of sagging. Skin that has been emptied of its fat content secondary to atrophy will sag due to the relative excess of skin now left behind. Atrophic sagging occurs most often in the periorbital and cheek areas, affecting skin adjacent to atrophy-prone sites. When the redundant skin is reaugmented, the sagging resolves (Figure 9).

Another example of this can be seen in the breast. Ptotic breasts are most often due to glandular and fat atrophy displaying a flattening in the upper quadrant. Augmentation via breast implant serves to reestablish the arced contour to the breast, elevate the nipple, and make the breast appear lifted (Figure 10).

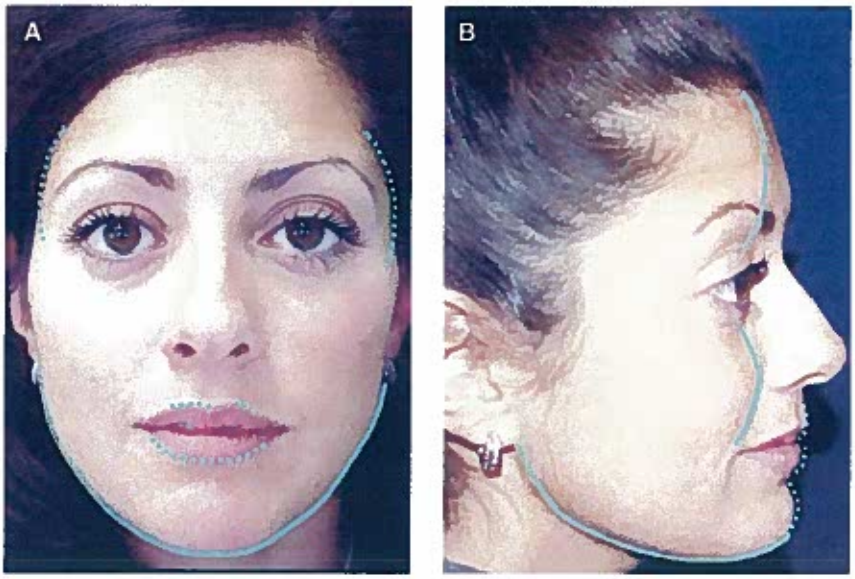

Figure 4. View of the primary arcs (solid) and secondary arcs (dotted) in the young face: A) front; B) profile.

In contrast, skin encumbered with extra fat will hang in the direction of gravity. Commonly seen in the jowl, submental, and nasolabial fold, these fatty deposits respond well to suctioning. Removal of the heavy deposits allows the skin to contract back to its resting position. Again, one can turn to the body-contouring literature to find support of this. A pendulous abdomen will hang down due to the weight of its fat content. Once the fat has been suctioned out, the skin contracts back into place, obliterating the need for skin removal (Figure 11).

The liposuction literature is full of reports of good skin contracture after tumescent liposuction of the abdomen, upper arms, and neck, areas previously thought to respond only to excisional surgery.[5,6] However, the skin of the face is different than the photoprotected skin of the body, and good skin contraction is rare in areas of severe actinic damage. This can be explained if you imagine that the skin is pliant like a balloon, and that the resting or baseline elasticity is greatest when the balloon is full but not distended with air. In a young face (balloon), fat gain (air) is seen to diffusely fill the balloon. With loss of fat, the skin contracts back to its baseline. Further loss of fat (as seen in anorexia or lipodystrophies) and young skin can accomplish what no balloon can. It can contract past its baseline elasticity and conform to the new underlying framework (Figure 12). Using the same analogy, an

Figure 5. View of loss of primary arcs (solid) and secondary arcs (dotted) in the old face: A) front; B) profile.

Figure 8. The two types of aging faces: A) 63-year-old with lean face; B) 63-year-old with heavy face.

Figure 6. One patient's change in fat distribution over the years. To name gravity as the culprit is to assume that the forces of gravity ignored her face for the first 30 years of her life.

old face (balloon) that gains fat with age (air) fills in pockets. With the loss of these fat pockets (as is accomplished with facial liposuction), the skin contracts back to its baseline elastic tension. However, any additional loss of fat (as seen with senile fat atrophy) and the old skin cannot contract past its baseline elasticity. Thus it hangs in folds and wrinkles like an empty balloon (Figure 13). It is photoaging that is responsible for this inelastic recoil of the skin envelope and its inability to respond to the insult of atrophy.

Conventional Cosmetic Procedures

Since atrophy and hypertrophy of fat are the issue, why do patients look better after standard cosmetic surgery? Facelifts are a solution that does not address the problem, but can mask the underlying dysmorphia of the fat compartments by "shifting" hypertrophic deposits to areas of neighboring atrophy. In addition, by excising skin in areas most prone to atrophic sagging, they in essence "tailor" the skin to fit the shrunken framework. Synthetic jaw and malar implants address the atrophy, but ignore the hypertrophy. Furthermore, they lack the dynamic ability to age with the patient and can often become delineated with advancing atrophy. Chronic ultraviolet (UV) light exposure causes alterations in collagen and elastin.[7] Skin resurfacing with ablative lasers such as carbon dioxide and erbium produces a modest skin tightening.[8,9] Presumably this is secondary to shrinkage of collagen fibrils.[10,11] What we may indeed be witnessing is the restoration of the young contractile properties of the skin and its renewed ability to contract past its baseline.

Perhaps the most interesting facial rejuvenation treatment of all is botulinum toxin.[12] Botulinum toxin injections are administered under the impression that

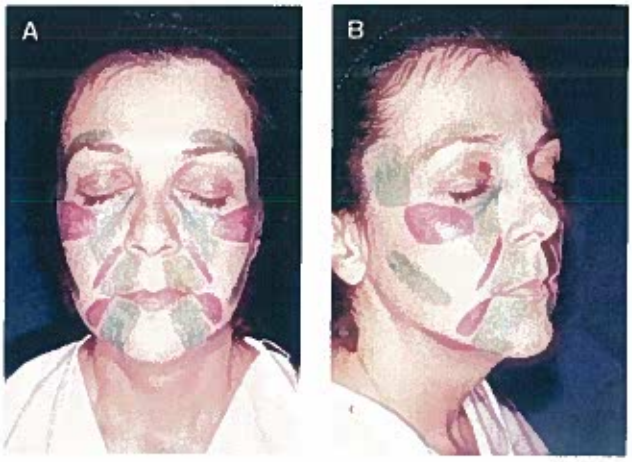

Figure 7. Areas prone to atrophy (green) and hypertrophy (purple) in the aging face.

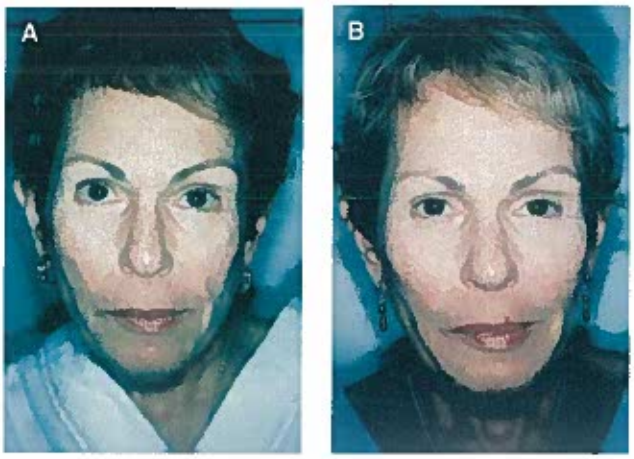

Figure 9. Lean-faced patient with atrophic sagging: A) before and B) after cheek and periorbital augmentation.

Figure 10. Augmentation of atrophic breast tissue with saline implants. Note how breast appears "lifted" by rearcing the upper quadrants (photos courtesy of Paul Fischer, MD): A) before; B) after.

the mimetic muscles somehow become hyperactive with age. Again, this would have to be a situation unique to the face since the body musculature does not hypertrophy with age. In fact, facial muscles lose tone and atrophy with age, so any hyperactivity we are witnessing must be a relative hyperactivity secondary to volume loss.[13] Picture that the skin is like a roman shade. When we are young the shade is made of thick foam: tugging on the cord produces few if any ripples in the shade. However, with increasing age the shade gets thinner until finally it is made out of tissue paper. The slightest pull on the cord and a multitude of ripples ensue. Intramuscular botulinum toxin decreases the "pull on the cord," making the force of the muscular contraction proportionate to the skin thickness, thus restoring the illusion of youth. A more desirable objective would be to increase the thickness of the shade, reapproximating youth.

Figure 11. A) Before and B) after liposuction of a large abdominal panniculus. Note skin contracture after weighty fat has been removed.

Figure 12. Young face shapes.

The Goal: Facial Rebalancing

Facial fat distribution is our visual clue to an individuals age. To restore the fat homogeneity seen in youth, the hypertrophic "hills" and the atrophic "valleys" must find common level ground (Figure 14). The compartmentalization of the aging face must be smoothed over and balance restored. It is of utmost importance to rebuild the primary youthful arcs. In particular, attention should be paid to the central cheek mass, forehead, and jawline. This can be accomplished by autologous fat augmentation to the flattened atrophic areas. Around the jawline, labiomental and nasolabial crease filling can be combined with facial microliposuction to empty the hypertrophic pockets. This allows the mandible to complete a smooth arc once again (Figure 15). Newer techniques in structural augmentation expand the predictability and longevity of fat transplantation, and smaller facial cannulas increase the accu-

Figure 13. Older face shapes.

Figure 14. Patient at A) age 20, B) age 45, and C) after "rebalancing" with a combination of structural pan-facial fat augmentation and microliposuction.

racy and decrease the risk of overcorrection from lipectomy.[14–16] Photographs of a patient at a young age are an invaluable tool for formulating a blueprint of areas needing suctioning or filling, and manual suspension of a cheek or forehead gives clues to areas requiring augmentation. Successful rebalancing takes time to accomplish and is best attained in multiple small procedures to monitor progression.

Conclusion

Facial aging is a complex synergy of surface textural and elastotic changes, relative muscular hyperactivity, and fat dysmorphism. Gravity, though always present, is most likely and innocent-bystander elucidative but not causative in nature. Conventional lifting procedures carry with them the morbidity common to all invasive surgery yet fail to make the patients look like they did when they were young. Wrinkle therapies certainly have merit but should not be the singular focus of antiaging protocols. The restoration of youthful fat distribution should be considered the primary goal in any rejuvenation procedure. Dedication to the study of why and how lipocytes age is an exciting challenge for the basic science researcher and continual improvement in fat transfer technique is welcomed by the clinician. However, it is not until we assign the fat compartments of the face the same important role as we have given wrinkles and gravitational sagging that any serious strides will be taken. Approaching the aging face from "the inside out" is a novel, commonsense concept worthy of embracing for its results.

Figure 15. A 63-year-old A) before and B) after "rebalancing" with a combination of structural pan-facial fat augmentation and microliposuction.

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