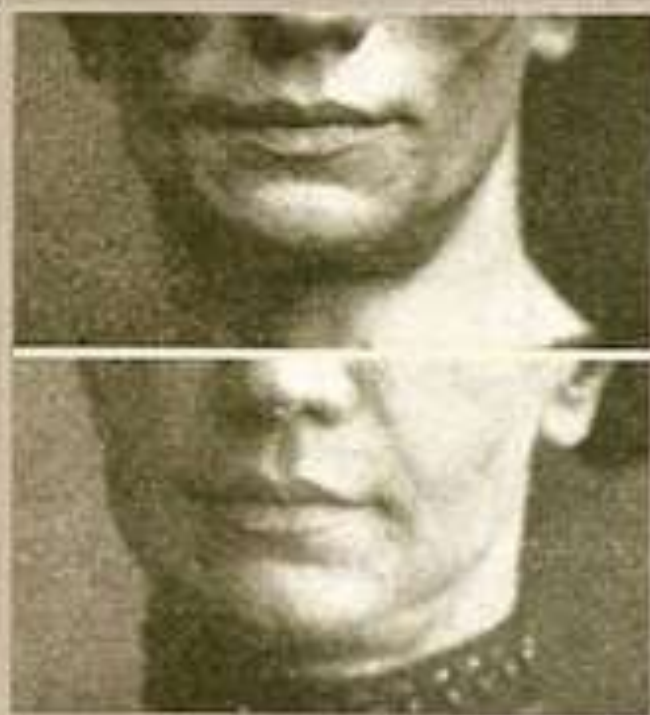


FAT INJECTION
FROM FILLING TO
Regeneration



EDITED BY

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Chapter 15

PERIORBITAL MICROFAT GRAFTING: THE FRAME CONCEPT

Fahd Benslimane



Dr. Benslimane marries surgical principles with artistic principles to develop « the Benslimane frame concept », a metered, artistic approach to upper eyelid rejuvenation. He begins by developing a clear vision of the aesthetic elements of a youthful eyelid. Using those concepts, he guides the reader through surgical manipulation of the upper eyelid structures and volumes to accomplish an innovative anatomic rejuvenation. He meticulously delineates the possible traps or complications so the reader can avoid problems with this conceptually complex procedure. His description is remarkably clear and detailed for this advanced approach.

For more than half a century, surgeons and the media have focused their attention on the

bulging of the lower lids and the excess, sometimes wrinkled skin on the upper lids to define the primary signs of aging in the periorbital region. Our minds have been programmed to focus on the “hills”—the pseudo-excess—ignoring the “valleys”—the adjacent depressions around the eye that lack volume. This shortsightedness has resulted in an erroneous perception of the stigmata of periorbital aging.

When considering periorbital aging, we must broaden our perspective. We need to treat the entire area around the eye and to think in terms of the full sphere of 360 degrees around the eye fissure. This approach to the periorbital area correctly places the eye as the center of attention. Precise definition of this anatomic area is important because surgeons referring to periorbital rejuvenation frequently address only the tear trough and lower lid—the lower half of the orbit. Yet in our effort to soften the hollowness of the lower eyelid, we must also devise a solution for removing the upper eyelid hollowness that results from the aging process.

It is essential to broaden patients’ perspective as well, so they do not focus on the bags of the lower lid or on the excess of skin of the upper lid but perceive the eye as part of an entire framework. Based on this principle, I have developed the *frame concept*, a useful tool for aesthetic planning and patient education. This concept is extremely helpful in promoting patient understanding. This can be done by showing patients photos of attractive models and comparing photos of the patient at younger and older ages. The frame concept provides an effective complement to Coleman’s visionary new model of aging.

Evolution of Ideas

A visit with Dr. John W. Little in 2001 was a wake-up call for me, leading me to reevaluate my approach to the treatment of periorbital aging.¹⁻³ Dr. Little objected to the trend in rejuvenation of the upper eyelid that involved aggressive resection of the upper lid skin and fat and was often associated with an overly elevated brow and hollowness between the eyebrow and the eye fissure. His answer to this problem was to employ micro-fat grafting, the transfer of medial fat laterally (similar to Coleman’s technique), only using much smaller instruments.^{4,5} He advocated placement at a deep level, versus supraorbital bone²; the compartment in which he was grafting the fat was the retroorbicularis oculi fat (ROOF).

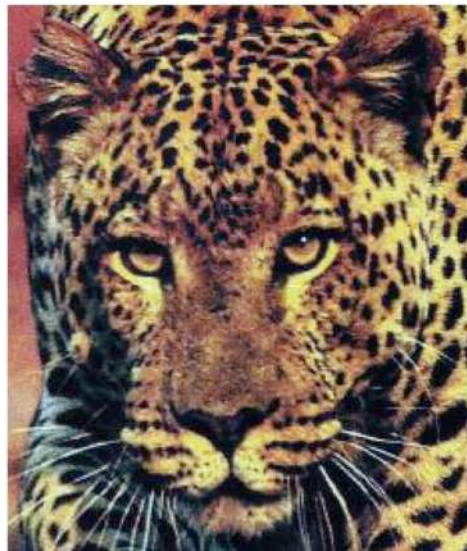
As I pondered this problem of upper lid hollowness, I noted that the eyelids of Asians represented the other end of the spectrum, with too much fullness. Their anatomy exhibits a lower fusion between the septum and the levator aponeurosis, with an excess of fatty tissue housed in the retroseptal compartment that descends down to the anterior

Surface of the tarsus. It became clear to me that the answer to the upper lid's hollowness was adding fat to the compartment that naturally houses the orbital fat—the retroseptal preaponeurotic space.

Finally, the challenge of fat grafting at a level in intimate proximity to delicate intraorbital structures led me to rethink the way it had to be done. Structural fat grafting is a closed blind technique. After a few cases of trying to determine the retroseptal space, which resulted in transient lid ptosis for up to 12 weeks, I understood that I had to find a way of performing fat grafting through an open approach to be able to identify the retroseptal compartment without undermining the retroseptal space. To promote fat take, this space should be left as undisturbed as possible. The solution became self-evident: opening the lowest part of this compartment at the upper edge of the tarsus and enhancing this space by infiltration of a solution of lidocaine and epinephrine. Once the space was created by means of a hydrodissection between the septum and the levator muscle, microfat grafting could proceed. Thus the *spring roll technique* was born.

Aesthetic Considerations

ANIMAL MODEL

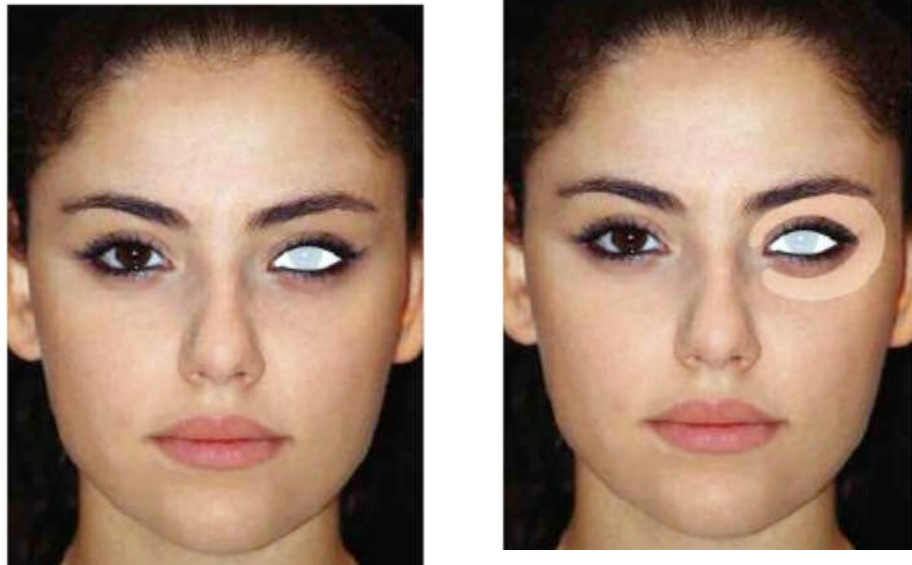


Mankind has always been fascinated by the gaze of big cats. This fascination has been attributed to the particular color of the iris and the mongoloid orientation of the eye fissure. However, a more precise analysis reveals a key third dimension: big cats have no hollowness around the eye fissure; their eyes seem to be directly planted into the forehead. This gives a concentration of light in the eye fissure, with a unique, hypnotizing effect.

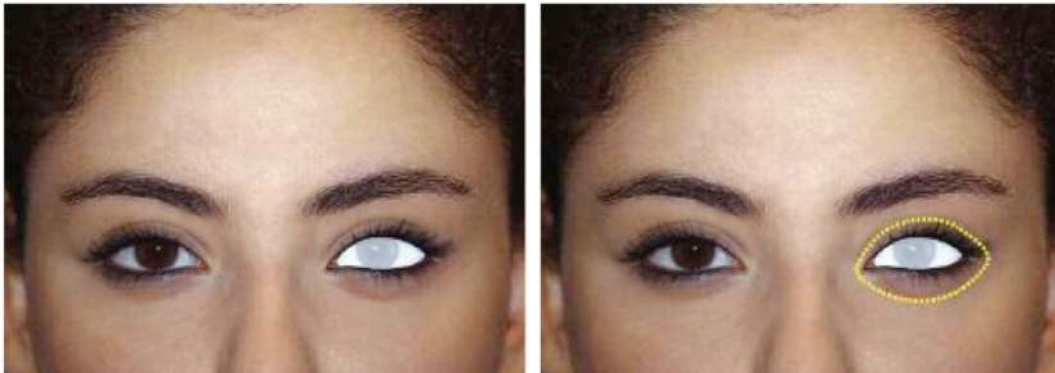


By contrast, we are disturbed by the gaze of the primates. We simply reject the similarity between them and ourselves as we age. In primates the eye is overwhelmed by the size of the cavity. This hollowness around the eye hampers the focus of the light in the eye fissure, which gives a diluted, dull expression to the eye. Such hollowness is represented in many depictions of primitive man. The progressive disappearance of the upper lid hollowness through evolution is an important component in human aesthetics.

ARTISTIC MODEL: THE BENSLIMANE FRAME CONCEPT



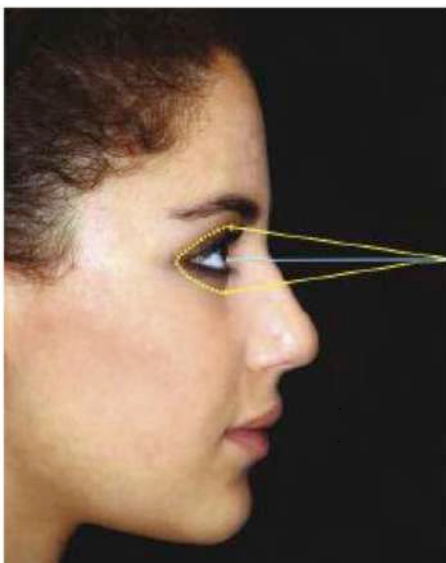
I have long wondered what makes the gaze of beautiful models and actors so attractive and hypnotic. Although one answer is “a subtle play of light and shadow,” I have tried to find a more specific answer. By studying thousands of photographs of fashion models and ordinary people, I came to realize that there was a common denominator among all these beautiful gazes. When we look at an attractive person, such as the model pictured above, the first dimension that reveals itself is the eye fissure. Our attention is focused on the glow of the eyes, because neither a depression nor a trough around the eye fissure casts a distracting shadow. The result is an intense gaze, and it is this intensity that gives an impression of youth, health, and beauty.



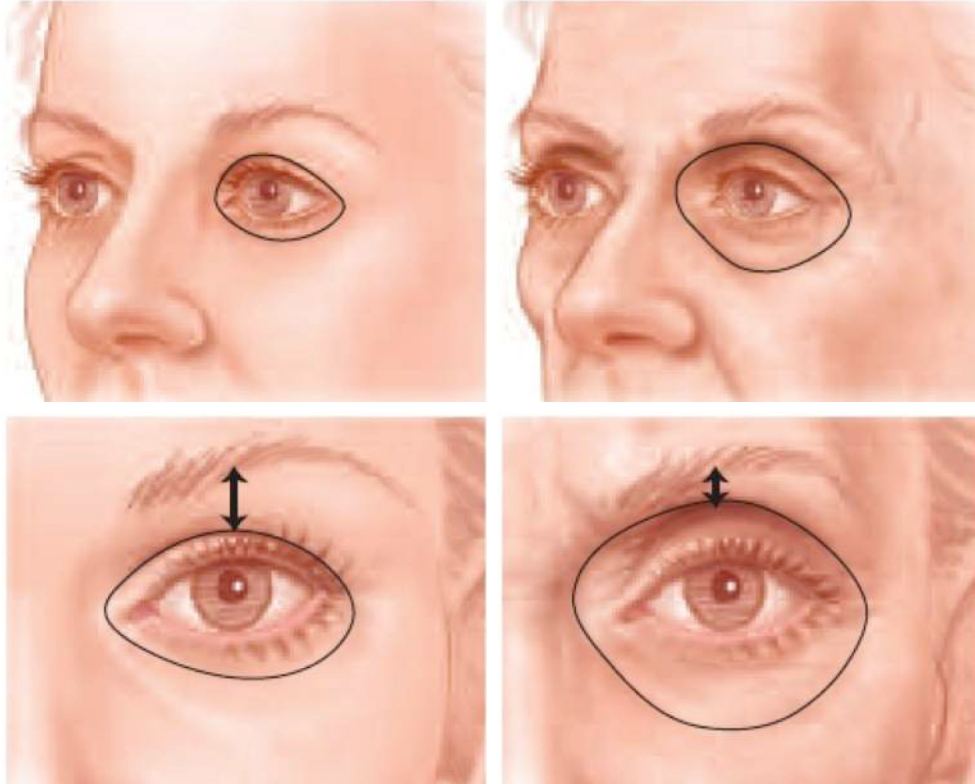
For greater clarity and for didactic purposes, I developed an artistic model based on the following theory. In this model, the eye fissure represents a painting, a work of art, and the most peripheral shadow around the eye fissure represents the “frame” of this painting. The narrower the frame, the more intense, awake, and sparkling is the resulting look.



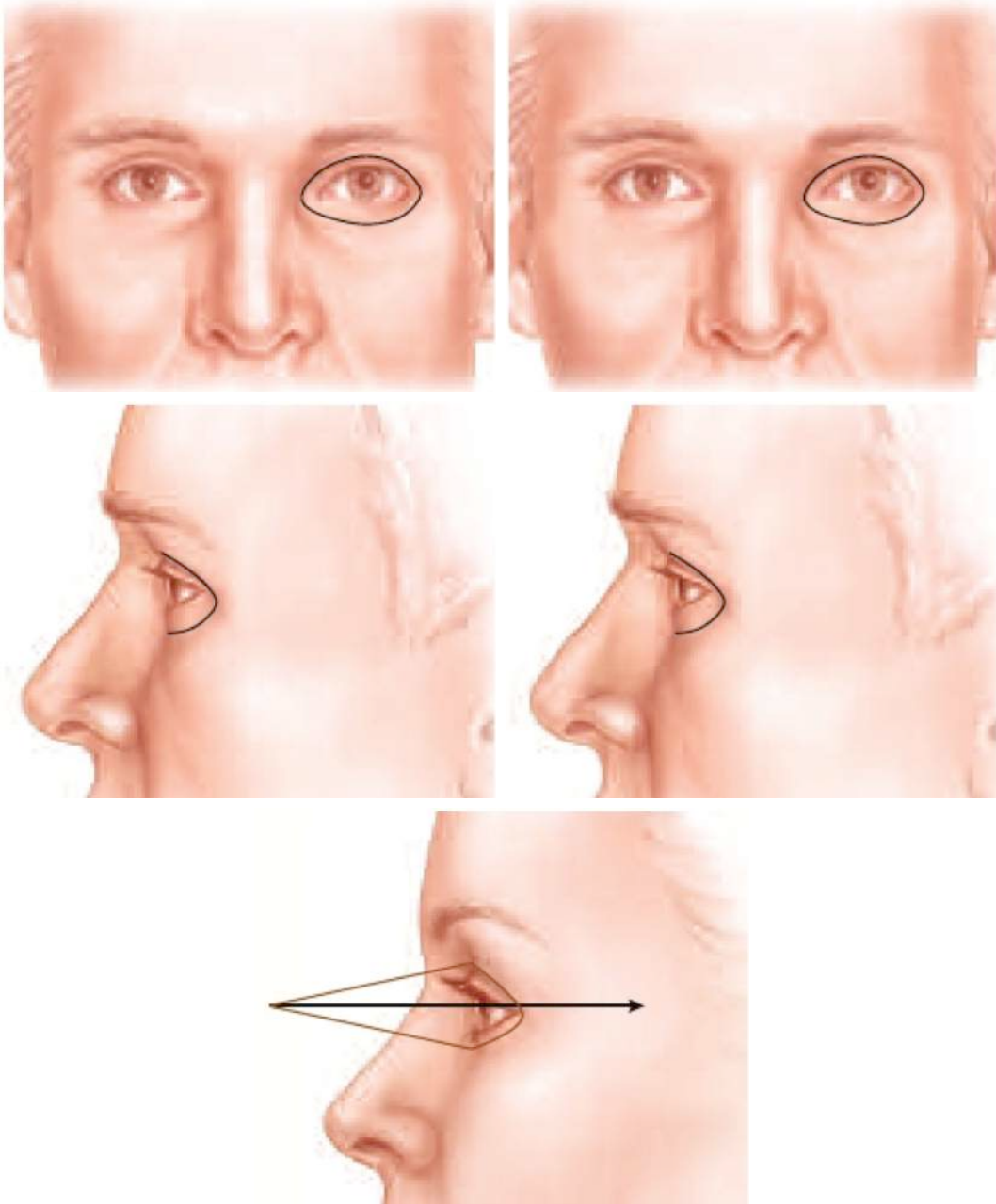
This applies only when there is a short lower lid and a full upper lid. In other words, the closer the shadows are to the eye fissure, the more attractive and sensual the gaze.



From a lateral perspective, the observer will have an acute closed angle of observation with a concentrated focus on the eye fissure.



A person with a hollow between the eyebrow and the upper lid will have a frame that is too wide for the painting. This will convey a lifeless and altogether dull look. This effect is intensified with a long lower lid. This frame concept applies beautifully to Coleman's new model of aging.



From the side, the viewer has a broader angle of observation, with less focus on the eye fissure.



This idea proved correct when I studied the pictures of 323 women and men in their youth and at an older age. One such individual is shown above.



The frame concept is effectively demonstrated by observing two photos of me—one when I was 14 and one of me as an adult. Note the narrow frame of the “big cat” in my youthful photograph compared with the wider “primate” frame in the recent picture.

Anatomic Considerations

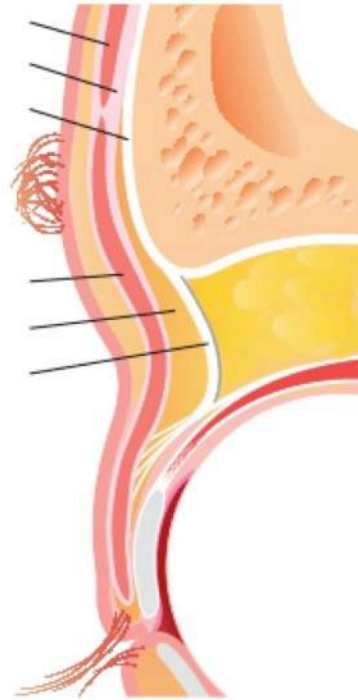
UPPER EYELID

A thorough knowledge of deep orbital anatomy is a prerequisite to mastering the technique described in this chapter. The motion of the 20-gauge cannula directly on top of the levator can cause tearing of the aponeurosis or a hematoma of the muscle, leading to lid ptosis. This is the reason I switched from the closed to the open technique: the challenge went from guessing the location of the retroseptal space to identifying it visually without undermining it. Two compartments are the target for periorbital microfat grafting: the retroseptal and the subbrow fat pad (ROOF).

Retroseptal Compartment

Frontalis muscle
Galea aponeurotica
Periosteum

Orbicularis oculi muscle
ROOF compartment
Orbital septum



Anatomically, the septum of the upper lid is the caudal continuity of the periosteum of the orbital rim (arcus marginalis). It descends like a curtain toward the upper-anterior aspect of the tarsus. The fusion between the septum and the levator aponeurosis creates a sling that houses the retroseptal fat. The level of this fusion determines the level of the lid fold in Caucasians. It is important to remember that this fusion is lower laterally rather than medially. This has a direct technical application: the access to the retroseptal space should be done laterally.⁶

Retroorbicularis Oculi Fat



The ROOF was initially described by Weiss⁷ in 1992 as the subbrow fat pad. At the level of the frontalis bone, the fat is bound by the galea aponeurotica anteriorly and the periosteum posteriorly. The inferior extension of this fat pad into the upper lid, when present, is bound by the preseptal orbicularis fascia anteriorly and the upper septum posteriorly. It is interesting to note that the height of the ROOF differs from one person to another. In a study of 16 fresh cadavers, Weiss showed that the fat of this compartment covers a height from 6 to 24 mm cephalad to the orbital rim (mean 16.75 mm). The same study has shown that the ROOF may descend lower than the orbital rim in the preseptal compartment (0 to 16 mm, mean 6.81). Micrografting fat into this space is relatively easy and has been advocated by others.^{2,10-16} However, it is important to remember that the supraorbital bundle exits into this compartment. This means that fat grafting of the medial hollowness should not be done in this compartment, but in the subseptal space, taking advantage of the septal shield.

Vessels: Supraorbital and Supratrochlear

It is virtually impossible to treat the hollowness of the medial upper eyelid without having the cannula in intimate proximity to the supraorbital bundle. However, avoiding the risk of blinding the patient depends on more than knowledge of the anatomy of vessels in this region. Coleman outlined the means for avoiding such a disaster:

1. Use only blunt cannulas and a 1 cc syringe.
2. Infiltrate this region with epinephrine to promote vasoconstriction of the arteries.
3. Limit the volume of each injection.

I would add one more precaution:

4. Treat the medial hollowness from underneath, not from above the septum.

In other words, all the grafted fat should be deposited in the retroseptal compartment, because the nerves and vessels exit through a foramen or a notch above the septum (see p. 15.12). Even when the neurovascular bundle exits through a notch, the arcus marginalis is under the bundle, closing the notch. I use smaller cannulas than those advocated by Coleman. The possibility of cannulating an artery is even greater with these small cannulas. Therefore, while grafting fat around the supraorbital-supratrochlear bundle, I am careful to place no more than $\frac{1}{80}$ to $\frac{1}{100}$ cc with each withdrawal. Another precaution is the extremely slow, gentle motion used for depositing the fat in the critical areas. The same safety measures are valid around the lacrimal gland, where the cannulation of the lacrimal artery of a ptotic gland is a possibility.

Lacrimal Gland

The lacrimal gland is housed in the retroseptal space under the upper lateral orbital rim. As with all body structures, it becomes ptotic during the aging process. Grafting fat in the lateral orbital rim should be done in the preseptal compartment to take advantage of the protection offered by the septal shield.

LOWER EYELID

Grafting fat in the lower eyelid is much easier. However, as stated by Lambros,⁴ this is a less forgiving area. Lumps are more likely to occur in the lower lid. For this reason, all fat injections in the lower lid are performed posterior to the muscle; that is, in the sub-orbicularis oculi fat compartment (SOOF).

Vessels

Infraorbital Bundle



The same precautions stated for the upper eyelid apply to the lower eyelid: we can only guess the exact anatomy of the vessels and nerves. Therefore depositing microaliquots of fat in slow motion is essential. The infraorbital foramen opens inferiorly and medially at the level of a vertical descent from the medial limbus. On this line, it exits no less than 5 mm and no more than 8 mm caudally to the orbital rim.

Angular Vein

The angular vein lies temporal to the angular artery over the insertion of the medial canthal tendon and 8 mm from the medial commissure. A confluence of angular, supra-trochlear, and supraorbital veins forms the superior ophthalmic vein. Outside the orbit, the angular vein is continuous with the facial vein at the medial aspect of lower lid. It can be easily perforated during the process of fat grafting of the medial canthus.

Indications

Patients with a wide frame of shadows around the eye fissure are the best candidates for periorbital microfat grafting. The hollowness can be genetic or secondary to the aging process. However, loss of subcutaneous fullness can also be seen after surgery (iatrogenic) or in drug-related lipodystrophies. A distinction should be made between the upper and lower lids.

UPPER EYELIDS

For sunken upper lids, the surgeon should strive to create a smooth radial expansion of the lids. This convex fullness should descend from the eyebrow, sloping gracefully into the lid fold. With a true excess of skin, the amount of skin resection is always less than what would normally have been planned, after structural fat grafting is performed.

LOWER EYELIDS

Sunken lower lids that present an abrupt transition with the malar region and tear troughs are excellent indications for microfat grafting. The goal is to ensure a smooth transition between the lower lid and the malar region. However, treatment of lower lid bags is challenging for the patient to understand. Most patients focus on removal of their “bulging bags”. Plastic surgeons should educate their patients not to focus only on the excess, but on what is lacking, with an awareness of the depressions adjacent to the bags. Whenever there is a hill (a bulge), we should search for a possible adjacent valley. The next question therefore should be: “Is the hill too high, or is the valley too low?” The final question is: “Should the problem be solved by lowering the hill, or by building up the valley ?”

Technical Guidelines

PREPARATION

Patient Evaluation

All patients are evaluated for lid ptosis. The margin reflex distance and the levator function must be assessed on the first visit. In fact, one of the reasons for a hollowed upper eyelid is lid ptosis. In this case, surgical treatment of the ptosis may improve the hollowness. The phenylephrine test is useful. If instillation of 10% phenylephrine in the conjunctival sac resolves the ptosis, Müller's muscle resection should be considered as a good alternative to aponeurosis shortening in patients who have good levator function. The patient's current use of ocular medication and contact lenses is also checked. Documentation of the visual acuity of each eye is extremely important. A patient may have an unrecognized unilateral loss of vision that can have dramatic legal consequences.

It is also important to evaluate the quality of the sunken skin of the upper lid. The presence of a hidden scar within the hollowed lid will be conspicuous, as with any skin defect, after tissue expansion.

Marking



The patient is marked preoperatively. On the upper lid, the blue markings indicate the Areas of maximum septal graftings. The red dots indicate the approximate upper border of the tarsus. Between the red dots and blue markings, areas for feathering the grafts are shown in the subseptal compartment. Cephalad to the blue markings is the area of preseptal grafting (green).

Eye Protection



Eye shields must be used. A drop of a local ophthalmic anesthetic increases the patient's comfort during the procedure.

ANESTHESIA

We use a local anesthetic and sedation for all patients. The infiltration is the same for every patient: 200 to 300 ml Ringer's lactate, 20 ml of 2% lidocaine, 1 mg epinephrine for the donor site; and 20 ml Ringer's lactate, 20 ml of 2% lidocaine, and 0.5 mg epinephrine for the recipient site (the periorbital area). The infiltration is critical in the eyelids for the constrictive effects and for the creation of the space to be grafted. Many patients who present with a hollowed upper lid have little or no retroseptal fat. In these patients, the septum sticks to the levator aponeurosis. In the lower lid, the infiltration separates the orbicularis oculi muscle from the orbital rim and the malar bone.

INCISIONS



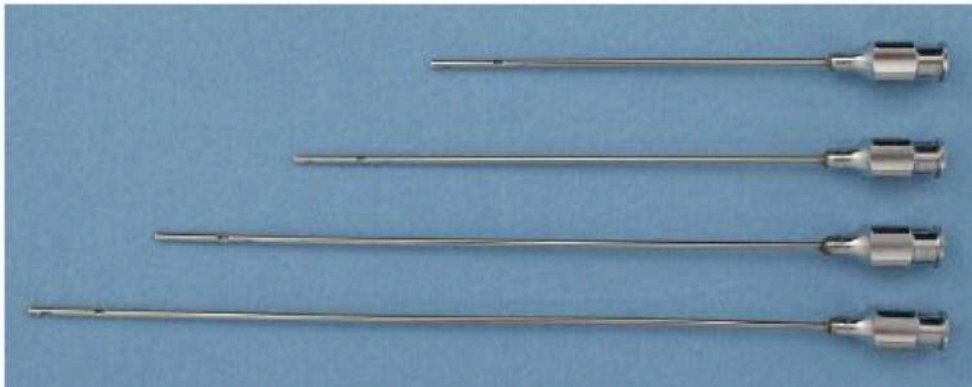
All incisions are made with a 21-gauge needle. I always use three incisions for each lid (upper and lower). Grafting fat in a multidirectional manner is one of the secrets of successful fat grafting.

CANNULAS

When I started using this technique, I harvested the fat with a 17-gauge Coleman cannula (normally used for injecting) and grafted the fat with a 20-gauge blunt microcannula. However, the tiny 20-gauge cannula was always clogging during grafting, so I switched to a smaller diameter 19-gauge blunt cannula with one side port for harvesting the fat. The result was less clogging, but the harvesting was more tedious and time consuming. Therefore I designed my own cannulas to speed up the procedure.



The original McIntyre 20-gauge cannula (top) has one port that is too small and rounded. The cannula I use (bottom) is also a 20-gauge, but it has two modifications: there are three ports instead of one, and the size of the port is bigger and oval, to correspond to the oval ports of the 19-gauge cannulas.



These are four 19-gauge cannulas with three holes; they are available in 6, 8, 10, and 12 cm lengths. The cannulas are 18- and 19-gauge with three side ports, one lower than the next. Each port is located on a different side of the cannula, thus producing a spiral pattern to the ports. The proximal end has a knurled Luer-Lok hub. These cannulas come in four different lengths: 6, 8, 12, and 14 cm.

VOLUME RANGES

The volume ranges of injected fat are 1 to 5.5 cc for the upper lid and 1 to 4 cc for the lower lid.

Key to Technique

The key to the spring roll technique is to have an artistic three-dimensional approach to the periorbital area, as well as an acute awareness of the effect produced by the light reflection around the eye fissure. The picture frame concept can therefore be very useful. This concept is based on our ability to perceive our patients and people around us in terms of wide or narrow frames. In observing someone's face, our attention should be drawn to the light, sparkle, and glow of the eye fissure. If there is any "pollution" or distraction that impedes our focus—that is, a wide frame of shadows—the surgeon, in an effort to correct this pollution, should not resort to traditional techniques of skin, muscle, or fat resection, but should rely on procedures that subtly shade the hollowness around the eye fissure, giving back the characteristic fullness of youth.

Understanding the importance of the shield offered by the septum is of paramount importance when grafting in the retroseptal compartment. The septum is a very resistant structure as it blends with the periosteum at the orbital rim. This resistance can be felt by gently lifting its undersurface. Despite this resistance, an injudicious movement can perforate the septum and enter the ROOF, where the vessels are at risk.

Technique

The choice of the first patient to perform direct microfat grafting in the upper lid is critical. Ideally, one should begin with a patient who has a mild hollowness in the subbrow area, with a true excess of skin.

ANESTHESIA

A solution of 200 to 300 ml Ringer's lactate and 20 ml 2% lidocaine with 1 mg epinephrine is infiltrated in every donor site. The volume of Ringer's lactate depends on the amount to be harvested if there are other areas to be grafted. Despite what has been said about the potential "toxicity" of lidocaine or epinephrine on fatty tissue, I have had no problems with fat take, despite the fact that I have infiltrated the same solution in every single patient.

HARVEST

The fat harvesting, centrifugation, and refinement processes are the same for the upper and lower eyelids. No particular site has shown its superiority in terms of fat survival.^{13,14} I used to select the most accessible site, which is the abdomen or the lateral thigh. However, I noticed that fat harvested from the abdomen was mixed with long

strips of fibrous tissue; this causes clogging during injection. For this reason, I prefer harvesting fat from the thigh or the inner aspect of the knees, since the fat there seems less fibrotic.

Instruments and Techniques

Although it takes more time to harvest with the 19-gauge cannula, it has the undeniable advantage that when harvesting the smallest possible parcels, they will easily go through the 20-gauge McIntyre blunt cannula. The three-port spiral on the Benslimane cannulas compensates the small diameter for harvesting.

Coleman's principles for harvesting fatty tissue are strictly respected (see Chapter 7). However, I use a 5 cc Luer-Lok syringe for harvesting rather than a 10 cc syringe.

Centrifugation, Refinement, and Separation of Components

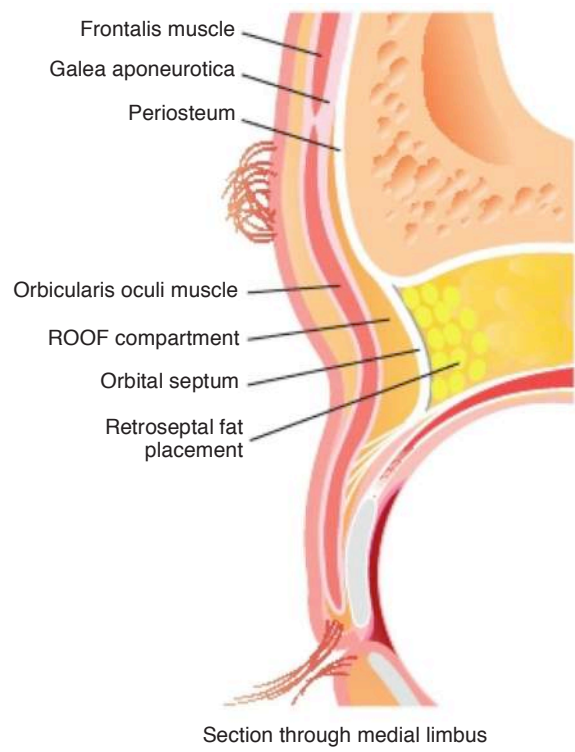
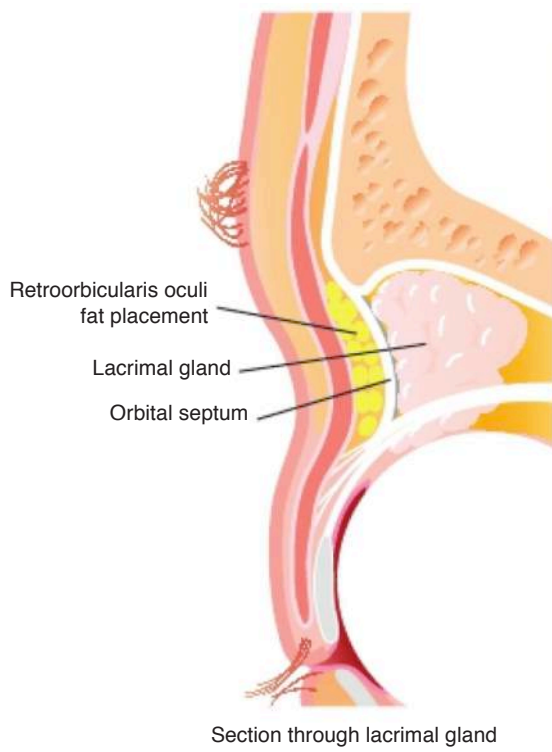
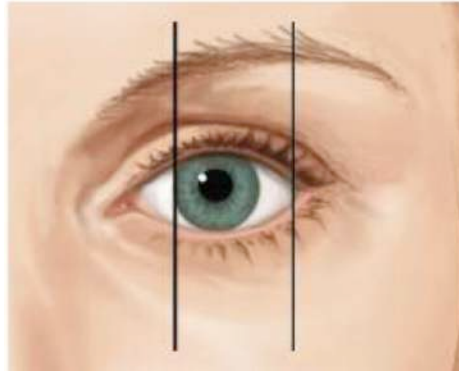


For many years, Coleman's timing of 3 minutes of centrifugation was the rule. With experience, and as I started micrografting tiny quantities of fat, I needed even more accuracy in the volumes. Thus I noticed that often the fat I was injecting was very oily. Even though I had centrifuged the harvested fat for 3 minutes, it didn't appear "pure."



Once the aspirate had been purified and transferred to the 1 cc syringe, it was still mixed with oil. This condition seemed to be the case empirically in more than a fourth of the cases. For this reason, I now centrifuge the fat in the 5 cc syringe for 45 seconds only. Once I have separated the different components and transferred the fat from the 5 cc to the 1 cc syringe, I add a new round of centrifugation in the 1 cc syringe for 15 seconds. In some cases, up to 50% of the recentrifuged aspirate in the 1 cc syringe is pure oil that can easily be eliminated. Therefore it seems that it is easier to separate the different components when the harvested material is in smaller quantities.

PLACEMENT TECHNIQUE: UPPER EYELIDS



Two compartments must be grafted: the retroseptal and the retroorbicularis oculi fat (ROOF).

Young Patient With No Ptosis: Direct Microfat Grafting in the Retroseptal Space

Skin Marking



Marking of the lower incision ignores the existing lid crease, especially if it is in a high position. In all instances, the new fold is marked at the upper border of the tarsus, 10 mm from the lash line in the midline, and 6 mm laterally with the skin under moderate stretch.



A simple way to judge accuracy is to flip the lid over and measure the height of the tarsus. The drawing for the upper border of skin excision is minimal, 2 to 4 mm at most. Using forceps to pinch the excess of skin is counterproductive.

Superficial Infiltration and Access



This first infiltration is strictly superficial (subcutaneous), with a 27-gauge needle; 0.5 cc of the solution is injected.



A superficial incision with a No. 15 blade is made through the skin only. The skin is resected respecting the underlying muscle. The fibers of the orbicularis oculi muscle are gently spread with Stevens scissors in the lateralmost aspect of the open incision; the opening of the muscle is no more than 5 mm long. Care must be taken not to use any cautery in this region, because it can lead to septal retraction and difficulty in identifying the septum.

Identification of the Septum and Entering the Preaponeurotic Space



Slight pressure on the eyeball helps to identify the septum as the fat bulges. A 1 mm opening is made in the septum with a 21-gauge sharp needle. The 20-gauge blunt cannula is then inserted in the retroseptal compartment. This is the same cannula that will be used for fat grafting. This maneuver may be difficult in patients who have a high lid crease, especially in older patients because of the absence of fat. In these difficult cases in which the eyes are sunken, it is easier to identify the retroseptal space superomedially. This is exactly the same approach used for medial fat resection. While the assistant exerts pressure on the eyeball laterally, the medial fat bulges under the muscle. The fibers of the muscle are gently spread, and the septum is readily identified and opened conservatively. The cannula can easily be inserted from medial to lateral.

Deep Infiltration of Anesthetic Solution

Deep infiltration of the anesthetic solution is imperative, not only because it causes constriction of the small blood vessels, but also because it expands this compartment by enhancing the space between the septum and the levator. Infiltration of 0.5 ml of the solution is done evenly from the edge of the tarsus to 10 mm inside the orbit, beyond the rim.

Direct Micrografting Under the Septum

Direct micrografting under the septum is done with the same 20-gauge blunt cannula used for infiltration and a 1 cc syringe. The fat is deposited in increments of 0.070 to 0.090 cc. In other words, 70 to 90 passes are necessary to deposit the contents of the 1 cc syringe. The fat is deposited starting from 1 cm behind the orbital rim to the upper edge of the tarsus. The index finger of the surgeon's nondominant hand ensures that the tip of the cannula travels under the supraorbital rim with each pass. It is important to make certain that the tip of the cannula does not bump against the bone so that the septum is not perforated. The fat is deposited in extremely slow motion during each withdrawal.

The surgeon deposits a total of 2 to 4 cc in this space. In the region of the supraorbital-supratrochlear bundle, one must exercise care to remain under the septum and to use an extremely slow motion to avoid traumatizing the vessels or nerves. The supraorbital and supratrochlear neurovascular bundles exit superior to the septum, in the ROOF compartment. As long as the cannula is behind the septum, and as long as brutal motion is avoided, the bundles of this region are safe. Surgeons familiar with septal manipulation at the bony level of the orbital rim are aware of how resistant it is. This resistance is easily felt during the procedure while gently hugging the septum.

Laterally, there is the lacrimal gland. There is no way to graft fat without harming the gland. In this region, most of the fat is grafted in the ROOF compartment, as the gland is protected by the septum.



For multidirectional structural grafting, the cannula is directed first toward the lateral-superiormost aspect of the orbital rim. At this exact spot the septum, orbicularis, and skin are perforated.



Another cannula is then inserted backward from the same port in the skin under the septum, following which the inner cannula is slowly withdrawn. A third port is then created in the same manner superiorly in the mid-subbrow region. Deep bipolar cautery along the lower edge of the wound is performed to promote adherence between the orbicularis muscle, septum, and aponeurosis.^{15,16} The skin is closed with a continuous 6-0 nylon suture.

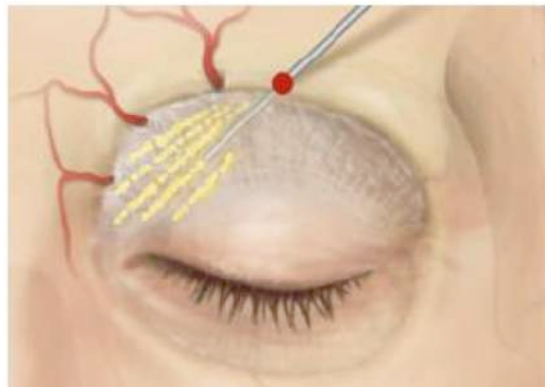
The surgeon must develop extreme tactile sensitivity while pushing the plunger to feel any minimal resistance. As soon as any clogging is suspected, the cannula must be immediately withdrawn and given to the nurse for replacement. If there is one rule to respect in the periorbital area, it should be not forcing the plunger during fat deposit. Forcing the plunger will lead, in the best of cases, to the injection of a large amount in the same spot, increasing the possibility of fat necrosis or the formation of a lump. In the worst cases, it could even lead to blindness. In other words, the enormous pressure per square millimeter that is developed at the instant the clogged fat is released can lead to disruption of a vessel, possibly developing fat emboli extending back to the ophthalmic artery.

Microfat Grafting in the ROOF Compartment Infiltration and Access

The goal is to place all the grafted fat in the subbrow fat compartment, which is between the orbicularis oculi fascia and the periosteum, feathering behind the eyebrow and 2 cm above it.



To make certain that I am in the right space, I make a superficial injection with a 27-gauge needle at the lateral border of the upper orbit. A drop of infiltrate is injected, allowing the epinephrine to act. Another injection is made deeper at the same spot. This second injection is made against the bone to lift the orbicularis muscle by hydrodissection.



Then a 21-gauge sharp needle is used at the exact same point, perforating from skin to bone. As soon as I feel the bone, I retrieve the sharp needle and then insert the 20-gauge blunt needle until I feel the bony sensation of the lateral orbital rim. I inject the aspirate as the blunt needle is advanced, along the superior orbital rim, from lateral to medial. A total of 0.5 to 0.8 cc is injected in the whole space. Infiltration is carried on in the infe-

rior forehead and in the temple with an additional 4 ml of the Ringer's/lidocaine/epinephrine solution. Two other small incisions are made in the same manner in the mid and medial brow.

At least 15 minutes is allowed for the epinephrine to take effect. After infiltration of the anesthetic, I always start harvesting the fat from the donor site before coming back to perform the grafting. This allows plenty of time to obtain a complete blanching from the epinephrine effect.



The 20-gauge blunt needle is introduced in the previously made ports. The fat is deposited in small aliquots of no more than 0.05 cc during each pass. A total of 3 to 4 cc is grafted around the upper orbital rim.

Enhancing periorbital and brow volume inevitably creates a depression above the eyebrows and in the temporal region. One should remember that the orbicularis fascia that lines the deep surface of the orbicularis muscle blends superiorly with the galea aponeurotica, while the septum is in continuity with the orbital periosteum. This is a unique continuous space, and all the fat grafted in the bony areas should be deposited evenly in this retrofascial space from the lateral and upper orbital rim to the retroeyebrow, low forehead, and temporal regions. No feathering should be done in the medial preseptal space, where the supraorbital bundle exits. As I explained earlier, this region is treated during the subseptal grafting step.

Older Patients and Patients With Lid Ptosis

Patients with ptosis and a positive response to the phenylephrine test are treated by resecting the conjunctival-Müller's muscle. This technique presents the undeniable advantage of leaving the subseptal fat undisturbed, enabling the surgeon to graft without having to dissect the preaponeurotic space. However, in patients who do not respond to the phenylephrine test, the surgeon has no alternative but to correct the ptosis with an open technique, shortening the levator. Even patients 50 to 55 years or older who present with no ptosis need some shortening of the levator aponeurosis to avoid postoperative ptosis. Patients in their late fifties have some permanent lid ptosis, even when the procedure is performed correctly; that is, without provoking hematoma in the preaponeurotic space. Patients with postoperative ptosis caused by hematoma recover completely within 3 to 12 weeks. Conversely, older patients develop a definite ptosis unless the levator aponeurosis is shortened. This phenomenon led me to realize that this ptosis is from the extra weight of the grafted fat, which hampers the normal functioning of the already weakened levator muscle in older patients. It is precisely for this reason that I perform a systematic shortening of the levator aponeurosis during the same stage.

Shortening of the Aponeurosis

Skin marking, superficial infiltration, and skin resection are performed in the manner described earlier. The surgeon's attention is directed toward the lateralmost aspect of the wound. The assistant exerts a slight pressure on the eyeball. The fibers of the orbicularis oculi muscle are gently spread; the septum is readily identified and opened. The subseptal compartment is thus entered and the septum is completely sectioned from lateral to medial. A perfect understanding of the septum's particular anatomy as it fuses with the aponeurosis is of paramount importance; this fusion is lower laterally rather than medially. Therefore the surgeon should angle the scissors cephalad while sectioning the septum to avoid damaging the aponeurosis.⁶

Next, the bulging fat is gently retracted cephalad with a Desmarres retractor, allowing the aponeurosis to appear under the retracted fat at the cephalic aspect of the tarsus. During the entire procedure, it is critical to keep the retroseptal compartment as undisturbed as possible, exposing no more than 5 to 10 mm of the caudal aponeurosis. The aponeurosis is shortened by plication and fixation to the anterior aspect of the tarsus at the junction of its upper third and lower two thirds. At no point is the aponeurosis sectioned. Three stitches of 6-0 silk are enough. Furthermore, it is important to keep the patient awake during this maneuver to maintain complete cooperation. Asking the patient to open and close his or her eyes is essential to avoid any overcorrection or contour distortion of the upper lid. Once this step is completed, deep retroseptal infiltration of the anesthetic solution is performed, and direct microlipostructure can proceed as de-

scribed previously. It should also be remembered that at every step of the way the substrate where fat is grafted must remain undisturbed to promote fat take. Aggressive dissection of the whole preaponeurotic compartment will result in leakage of the infiltrated fat.

Skin Closure

Skin closure is started by three 5-0 sutures incorporating the skin and orbicularis oculi muscle fixated to the aponeurosis. Deep bipolar cautery is performed between the cardinal stitches along the lower edge of the wound. A 6-0 monofilament nylon running suture completes the closure.

PLACEMENT TECHNIQUE: LOWER EYELIDS

Narrowing the frame in the lower lid is simpler to understand conceptually and easier to perform technically. In his new concept of aging, Coleman extensively explains the importance of enhancing the lower lid volume. He also emphasizes the importance of bringing it more in line with the malar region. Thus one should not be surprised to find Coleman's vision in the following discussion. However, there are two differences between Coleman's approach and mine: I use smaller cannulas than he does (the same cannulas described for the upper lid), and all the grafted fat is deposited against the bone and orbital rim; in other words, in the retroorbicularis compartment. I have had negative experiences with three different patients on whom I grafted the fat in the intramuscular and subcutaneous fashion. In these three patients, depositing fat subcutaneously produced a yellowish xanthelasma-type effect. The reason seemed to be the encrustation of the grafted fat in the dermis. Therefore I prefer to deposit the fat against the bone, which reassures me that the muscle acts as a thick shield.

Infiltration and Access

The technique used for the upper lid is also used for the lower lid. A superficial injection is made with a 27-gauge needle at the lateral border of the lower orbit. Another deeper injection is made at the same spot against the bone to lift the orbicularis muscle by hydrodissection. The port is created with a 21-gauge sharp needle which is introduced until it reaches the bone. Then the sharp needle is withdrawn and the 20-gauge blunt needle is inserted while keeping contact with the bone. Injection is done as the blunt needle is advanced, along the inferior orbital rim, from lateral to medial. A total of 0.5 to 0.8 cc is injected in the whole space. Infiltration is carried on in the anterior aspect of the malar bone. To give a vertical dimension, two other small ports are created, one next to the ala of the nose and the other in the midmalar region.



The 20-gauge blunt needle is introduced in the first incision at the lateral orbital rim. A maximum first layer of 0.5 to 1 cc of refined aspirate is deposited against the orbital rim, feathering 15 to 20 mm caudally on the malar eminence. All the grafted fat is deposited against the bone laterally with relation to a line drawn vertically from the medial limbus. This medial limbus vertical line is an important anatomic landmark for the infraorbital nerve and vessels. As I approach this vertical line, I remember that anatomically, the infraorbital bundle travels caudally, “sticking” to the periosteum. With this in mind, I angle the cannula anteriorly, lifting and gently hugging the undersurface of the orbicularis oculi muscle to avoid the neurovascular structures. My goal is to build up a fatty layer that will protect the nerves and vessels.

I have never had a hematoma or a problem of sensitivity in the infraorbital area. However, I continue to practice caution with each case, because I realize that each could potentially be the very first. After this first layer, the microfat grafting proceeds through the midmalar port (0.5 to 1 cc) in an oblique fashion and the paranasal port (1 to 2 cc) in a vertical fashion. Once again, whenever I am on the medial limbus vertical line, I gently angle the cannula anteriorly to remain distant from the nerves and vessels.

Another area of concern is the medialmost aspect of the lower lid, where the angular vein is at risk. Surgeons familiar with microsurgery know that tiny vessels tolerate a certain manipulation as long as the surgeon is gentle. When I am working in the medial region, I imagine that I am in close contact with the angular vein, almost playing with it. Only smooth, slow, gentle motion can be tolerated in this region.

The fat is deposited in small aliquots of no more than 0.050 cc during each pass. Throughout the procedure, the index finger of the less dominant hand should be in the inner side of the orbital rim to protect the eyeball. Because the cannula is tiny, there is a possibility of perforating the ocular globe. This is especially true when the grafting is done in an oblique or vertical manner. A total of 1 to 4 cc is grafted around the lower orbital rim.

The reason I graft most of the fat through the lower incisions (midmalar and paranasal) is that it has the undeniable advantage of avoiding visible lumps. By injecting the fat during withdrawal, we end up depositing more fat around the port of entry each time the cannula is withdrawn. When the incision is located on the thin skin of the lid, the accumulation of fat can create a lump that is easily visible. Conversely, when the incision is located in the thick malar skin, the accumulation of fat will have less chance of being conspicuous. Another trick to avoid this problem is to stop injecting in the last few millimeters next to the port.

No molding or manipulation of the fat is done whatsoever. One should remember that fragile cells and tissue are being grafted, and any pressure on the grafted tissue can lead to the death of the cells.

Postoperative Care

DRESSINGS



The grafted areas are gently cleaned with neutral soap and saline solution. No special dressing is applied. The patient is instructed not to manipulate the grafted eyelids and to apply cool gauze pads on both eyes for 48 hours. No antiinflammatory medication is given. Catabolic steroids are particularly avoided. I believe that any substance that may slow the healing process should be omitted. Massage of the area should be avoided.

TRANSIENT LID PTOSIS

Ptosis is the most likely complication in the upper lid. The cause is invariably the same hematoma. When bleeding occurs within the levator or Müller's muscles, it intrinsically hampers the levator function. When the hematoma is in the whole retroseptal compartment, ptosis is secondary to the weight of the accumulated blood. In both cases, lid ptosis resolves spontaneously when the hematoma subsides, within a maximum of 12 weeks.

HEMATOMA

One of the richest vascular networks in the human body is the palpebral one. This is another reason to avoid sharp needles. Hematomas not only obscure the surgical field, but also prolong the discomfort of the postoperative period. It is remarkable to note that the few hematomas I have had were on the right upper lid. Since I am left-handed, I suppose that I am less comfortable and probably less gentle with the needle motion on this side of the face.

IRREGULARITIES

I have never had an irregularity in the upper lid. I credit this to the fact that my vigilance has never dropped since my very first case. However, the lower lid is the most unforgiving area of the whole face. Consequently, I had a few irregularities in my early cases. Since I began applying the technical principles of the upper lid to the lower lid, such irregularities no longer occur. I draw an important conclusion from this: as long as the grafted quantities are minimal per square millimeter, and as long as the grafted fat is uniformly deposited, irregularities will simply not occur.

XANTHELASMA-LIKE DEPOSITS



Three of my patients have drawn my attention to a yellowish subcutaneous deposit of fat in the upper and lower lids. This intradermal fat encrustation occurred while I was grafting fat immediately subdermally. It is fortunate that the patients did not complain further, because I had no solution to the problem (I believe that an ablative laser treatment would leave more sequelae). However, my frustration was compensated by the fact that I had proof that I was grafting the smallest possible aliquots of “dustlike” fat. A smooth, flat, and even deposit of fat in the skin when the injection was made subdermally gave me the proof that my deeper injection was smooth, which means that I was depositing the smallest possible quantities of fat. I was sure that lumps or irregularities could not happen.

OVERCORRECTION



As stated by Lambros,⁴ virtually all the grafted fat in the inferior orbital rim and tear trough persists. I would go further: virtually all the grafted fat around the orbit (the upper and lower lids) persists. Overcorrection should be avoided.



Although some of the preseptal fat can be suctioned with a 17-gauge cannula, it is impossible to remedy overcorrection by removing the subseptal grafted fat by aspiration. The only way is to go back through a blepharoplasty incision, to open the orbicularis and the septum, and to shave the excess fat.

UNDERCORRECTION

At the beginning, before I understood that subseptally the supraorbital bundle was safe, I avoided the medial aspect of the upper lid. As a result, there was persistent hollowness in this critical area in two of the patients treated.

PERMANENT LID PTOSIS

Lid ptosis can be permanent if during the procedure the cannula disinserts or tears the levator aponeurosis or muscle. Thorough knowledge of the anatomy, enhancement of the retroseptal compartment, and extremely gentle motions are mandatory to avoid this complication. Lid ptosis may also be caused by the extra weight of the grafted fat on the already weak levator muscle. Prevention of the ptosis by resection of Müller's muscle or plication of the levator aponeurosis avoids this problem.

BLINDNESS

An injury to the eye that could lead to blindness is always on my mind as I am working around the ocular globe. The use of epinephrine and blunt cannulas, limitation of the injected bolus to $\frac{1}{80}$ to $\frac{1}{100}$ cc at each pass, and an extremely slow, gentle motion are all important to avoid such a disaster.

GLOBE PERFORATION

Perforation of the globe can occur, because the cannulas used are extremely thin. The surgeon should position the index finger between the globe and the extremity of the cannula during each pass to avoid harming the globe.

INFECTION

I have never had a single case of infection around the eyelids. I am aware that the eyelids represent an extremely rich vascular network, and I always observe strict sterile technique in the surgical environment.

PARESTHESIA

Loss of sensitivity in the area of innervation of the supraorbital-supratrochlear nerves can be avoided by grafting the inner aspect of the upper lid in the retroseptal compartment and not in the ROOF space. In the lower lid the surgeon should avoid injecting against the bone in the area of the infraorbital bundle.

SPECIAL CONSIDERATIONS

High Eyebrows



Contrary to common belief, high eyebrows are not a sign of youth and beauty. I always lower the eyebrows if they are too high and arched by performing a blepharoplasty 3 months after the fat grafting procedure. After preseptal undermining, the dissection is carried out on the orbital rim and lower frontalis bone in a preperiosteal plane. The eyebrows are pulled down and secured to the periosteum in a lower position with a 2-0 Prolene suture. During this procedure, some fat recontouring and resectioning of extra skin are performed to enhance the result.

Visible Scars or Darker Pigmentation



A patient with a scar in the upper lid may have ignored its presence preoperatively because it is hidden within the hollowed area of the upper lid. Therefore it is important to inspect the upper lid skin while the patient's eyes are closed. After radial expansion of the upper lid, the skin that once was concave and hidden becomes convex, exposing the defect. The same is true of pigmented upper lid skin, especially with some older patients, whose upper lid skin undergoes changes of texture and color, because the skin has remained within the cavity for many years. However, the regenerative effect of the stem cells in the grafted fat can lighten the skin and improve its texture.

Patients With Deep-Set Eyes

Patients with deep-set eyes and a positive vector between the cornea and the lower lid–malar eminence pose a significant challenge. Grafting fat in the eyelids produces the effect of deep-set eyes by creating more volume around the eye fissure. This is the most important limitation to this technique.

Results



<u>VOLUMES PLACED</u>	<u>Right (cc)</u>	<u>Left (cc)</u>
Temple	2	2
Upper eyelids		
Subseptal	3	2.8
Preseptal	2.5	2.1
Lower eyelids	2	2
Lateral malar area	6	6
Parotid area	6	6

This 39-year-old woman was concerned about the dark circles around her eyes. Reviewing a photograph of her at age 20 helped me to understand the obvious: in youth she had periorbital fullness and a narrow frame. The lid depletion of aging had created a wide frame of shadows. She understood that she needed to narrow the frame.

On the right upper eyelid, a total of 5.5 cc was grafted, of which 3 cc was placed in the subseptal compartment and 2.5 cc in the preseptal compartment. On the left upper eyelid, a total of 4.9 cc was grafted, of which 2.8 cc was placed in the subseptal compartment and 2.1 cc in the preseptal compartment.



Following fat grafting, the narrowing of the frame is obvious. Her eyebrows look as if they were lifted, yet neither lifting nor Botox injections had been done. It is the creation of a new volume under the eyebrows that gives this illusion. Six months after the procedure, she was very pleased by her new appearance.



The patient had asked for more fullness in her lateral malar eminence and temple. I added 6 cc in the lateral malar region and 2 cc in each temple. No additional grafting was necessary in her eyelids.



This is the most exciting patient I have followed—she came to the office every 4 to 6 months for follow-up visits for 5 years. Not only did she retain all the grafted fat, but also her skin texture kept improving. The regenerative effect of the grafted tissues can be seen: the skin color has lightened and the texture has improved. As she gained weight, the radial expansion was enhanced even more. This had two drawbacks, however: first, her upper lids appear bulgy compared with the temple. Actually, it is the adjacent valley (temple) that is too low, because the quantities grafted in that area were not proportional to the upper lid enhancement.

At one point small lumps appeared in both lower lids. By that time, I wasn't applying the technical principles of the upper lid to the lower lid; that is, I wasn't been as "compulsive" in the lower lids, and I used 17-gauge Coleman cannula instead of the 20-gauge I am using in the upper lids. For the last 5 years, I have not had a single lump in the lower lid.



<u>VOLUMES PLACED</u>	<u>Right (cc)</u>	<u>Left (cc)</u>
Upper eyelids		
Subseptal	1	1
Preseptal	1	1
Lower eyelids	1	1
Lateral malar area	1.3	1.7
Anterior malar area	3	3

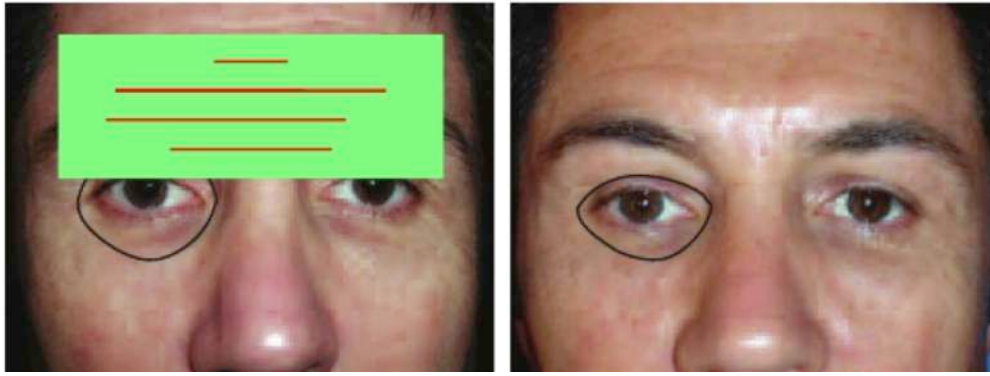
This is my younger sister. The younger picture was taken when she was 28 years old. She used to have full upper and lower lids with a narrow frame. At age 37, she displays a wider frame and pseudo-skin excess in her upper lids.



Preoperative

20 months postoperatively

She is shown 20 months postoperatively. No skin resection was performed. The eye fissure is gracefully enhanced by a narrower frame, and the lower lid is more in line with the anterior malar area.

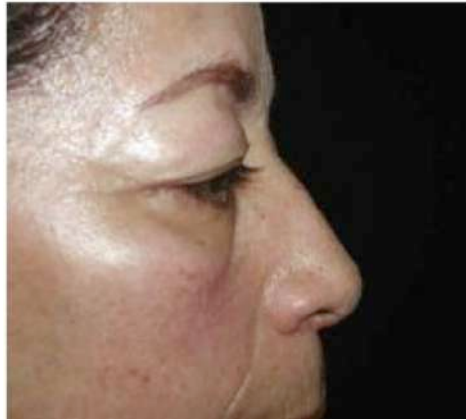


<u>VOLUMES PLACED</u>	<u>Right (cc)</u>	<u>Left (cc)</u>
Upper eyelids		
Subseptal	2.9	2.8
Preseptal	2.4	2.2

This man wanted to have the skin of his upper left lid resected to match his right lid. As is the case with many patients, he was noticing the excess of skin, not the “lack of”; that is, the deep hollowness in his upper eyelid. He underwent an upper lid spring roll procedure with a 2 mm skin resection of the left lid, no skin resection on the right lid. He is shown 6 months postoperatively.



The radial expansion of his right upper lid has brought the scar into view that was hidden inside the orbit. The narrower frame has brought more light to the eye fissure. The viewer’s attention is no longer distracted by the shadows around the eyes—one’s attention is focused on the epicenter of the periorbit: the eyes.



VOLUMES PLACED Right (cc) Left (cc)

Upper eyelids		
Subseptal	2	1.8
Preseptal	2.9	3
Lower eyelids	3	3.1
Lateral malar area	5.4	6
Anterior malar area	4	4.5

This woman had a previous frontal lift done elsewhere. She wanted to get rid of the excess of skin on her upper lids. She was the typical patient who focuses on the hill—the excess of skin—without noticing the valley—the depression above the excess. Her eyebrows were too high as a result of the frontal lift, as well as by permanent contraction of the frontalis muscle to compensate for the lid ptosis. The manual maneuver, which consisted of lifting her eyelids, did not improve the margin reflex distance. This means that the ptosis was not gravitational.

Besides microfat grafting, she underwent 6 mm of skin resection, 3 mm advancement of the levator aponeurosis. Five months later, she underwent a secondary 4 mm blepharoplasty and a lowering of her eyebrows through the same incision.



She is shown 14 months after the second procedure. Her ptosis has been corrected; there is an increase of the margin reflex distance. Her eyebrows are in a lower, relaxed position. They look less arched, because fat grafting has given some support in their lateral aspect. The viewer's attention is drawn to the eye fissure because the frame is narrower. The grafted fat in a continuous layer from temporal to subbrow and upper and lower lids produced a one-bloc unit rather than three subunits separated by abrupt transitions.



On the lateral view, a graceful convexity sloping from the eyebrow to the lid fold replaced the depression she used to have. The pseudo-bags in the lower lid have been "buried" by adding microlayers of grafted fat. No lower blepharoplasty was done. The abrupt transition between the lower lid and the malar eminence has been smoothed out, producing better balance with the malar area.



VOLUMES PLACED Right (cc) Left (cc)

Upper eyelids		
Subseptal	1.2	1.6
Preseptal	1.9	2.3
Lower eyelids	2.2	2

This 40-year-old woman had an upper blepharoplasty done elsewhere with a resulting medial hollowness and a sad eye expression. She underwent microfat grafting of the upper and lower lids. No blepharoplasty was done.



She is shown 9 months later, with a more alert and sparkling expression in her eyes. Her skin texture has been significantly improved in both upper and lower lids.



<u>VOLUMES PLACED</u>	<u>Right (cc)</u>	<u>Left (cc)</u>
Lower forehead	4	4
Glabella	3	
Temple	7	6
Upper eyelids		
Subseptal	2	2.8
Preseptal	2.9	3
Lower eyelids	3.7	3.8

This patient requested a complete face and neck rejuvenation. She was very concerned about her upper eyelids because, to her knowledge, no technique could improve their appearance. She underwent a cervicofacial lift with extensive microfat grafting to the whole face, including her temples, forehead, malar area, preauricular area, upper lip, lower lip, and anterior and posterior mandible.



Preoperative

2 months postoperatively

9 months postoperatively

The patient is shown at 2 months and 9 months postoperatively. Her face looks fresher, younger, and more attractive. Her eyes convey a more sparkling expression, and her temples are in continuity with the forehead, upper eyelids, and zygomatic area. No fillers were used besides the grafted fat.

Technical Pearls

- It is important to educate patients to broaden their perspective when they look at themselves. The frame concept is a very useful tool for the artist-surgeon in educating his or her patients.
- The most important technical consideration is the deposit of microdrops of fat, 1 mm or so in diameter. One should not embark on this delicate procedure before training “in vitro.” A good exercise is to practice the grafting on a gauze pad. The surgeon should train his or her hand to deposit 50 to 90 drops from a single cubic centimeter of fat to gain a better understanding of the size of each aliquot to be grafted.
- The surgeon’s attention should be constantly focused on three things: the site receiving the fat, the hand pushing the plunger, and the sensation felt in the hand handling the syringe. The slightest resistance of the plunger should be a warning, and the surgeon must stop any pressure on the plunger immediately.
- One should resist the urge to exert increased pressure when resistance is felt in the plunger.
- Levator aponeurosis shortening or Müller’s muscle resection is critical in avoiding palpebral ptosis caused by the weight of the grafted fat.

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