



15 Years of Upper Eyelid Micro-fat Graft: the Good, the Bad and the Ugly

Fahd Benslimane¹ · Henrique Pessoa Ladvocat Cintra²



Received: 20 July 2020 / Accepted: 24 August 2020

© Springer Science+Business Media, LLC, part of Springer Nature and International Society of Aesthetic Plastic Surgery 2020

Abstract This report is the product of investigation to review the result of Micro-fat graft (MFG) for upper eyelid rejuvenation compelled by Dr. Mark Codner and discusses the variety of suboptimal outcomes and rationale for their occurrence.

Methods This retrospective review included 1047 patients who underwent upper eyelid rejuvenation between 2001 and 2016.

Results The follow-up ranged from 3 to 190 months. Twenty-one patients were judged to have bad outcomes, and on four patients, the results were categorized as “ugly”. These undesirable outcomes are categorized and discussed.

Conclusion This report documents a variety of poor outcomes and the rationale for their development over a long-term follow-up and discusses the way in which these can be minimized.

Level of Evidence IV This journal requires that authors assign a level of evidence to each article. For a full

description of these Evidence-Based Medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266.

Keywords Cosmetic · Micro fat graft · Lipofilling · Fat injection · Oculoplastic surgery · Blepharoplasty

Introduction

In May 2016, I was invited by Dr. Mark Codner to attend the 10th Annual Atlanta Oculoplastic Surgery Symposium, which was to be held on 19 January 2017. The theme was “Oculoplastic Techniques and Surgery: The Good, The Bad and The Ugly” as it was mandatory to *include Good, Bad and Ugly results*. This paper is in memoriam to Mark Codner. He “forced” me to review my cases of upper eyelid (UEL) micro-fat graft (MFG) operated between May 2001 and November 2016 and to shed light on the bad and ugly results I obtained on 1047 consecutive cases. The present paper focuses mainly on complications that have not been described previously in the literature. Their aetiology and eventual treatment are discussed. This paper underlines the importance of a holistic approach to gaze beauty rather than thinking in terms of the sole upper eyelid’s filling. Finally, catastrophic complications reported in the literature are discussed. Their aetiology and sound strategies to avoid their occurrence are also described.

Method

The files of 1047 consecutive patients who benefited from UEL MFG between May 2001 and November 2016 were reviewed retrospectively to identify those who were judged to have poor outcomes and categorized.

In memoriam to Mark Codner Presented at the 10th Annual Atlanta Oculoplastic Surgery Symposium January 2017.

Electronic supplementary material The online version of this article (<https://doi.org/10.1007/s00266-020-01946-1>) contains supplementary material, which is available to authorized users.

✉ Fahd Benslimane
clinique.benslimane@gmail.com;
<http://www.cliniquebenslimane.com>
<http://www.crosslinkingartwithscience.com>

Henrique Pessoa Ladvocat Cintra
dr.henriquecintra@gmail.com

¹ Clinique Benslimane of Plastic Surgery, 7, rue Ahmed Annaciri, Palmiers, 20100 Casablanca, Morocco

² Craniofacial Unit, State University of Rio de Janeiro, Rio de Janeiro, Brazil

Patient Selection and Preparation

The patients were selected according to a study about the frame concept for female gaze beauty (Refs. [1, 2]). All patients were photographed in front, both lateral and oblique views. Markings of the peri-orbit were done pre-operatively. Hollowed areas to be enhanced were named “valleys” and marked in blue. The neighbouring elevated areas were named “hills” and marked in red (Ref. [2]) (Fig. 1). The donor site was also marked.

Surgical Technique

1. Anaesthesia and preparation.

All patients were prepared, draped sterile and operated on in the OR under sedation and local anaesthesia.

2. Fat harvesting.

Harvesting cannulas with a Luer lock were connected to 5- or 10-cc syringes. Cannula diameters ranged from 0.9 to 5 mm. The port sizes ranged from 0.3 to 0.9 mm, and the number of ports ranged from 1 to 160. The aspiration was gentle (Refs. [3, 4]). When a syringe was used, the plunger withdrawal was minimal to obtain 1–2 cc vacuum in a gradual manner. When an aspirator was used, the negative pressure was set at 300 mm Hg and the aspirated fat was transferred from the collector to 10-cc syringes for processing.

3. Fat purification and preparation.

Fat processing consisted of an accelerated decantation obtained with double-quick centrifugation (Ref. [2]). The first 15 s of centrifugation was done in the 5- or 10-cc syringe. Supernatant oil and subnatant fluid were eliminated. The purified substrate was transferred to a 1-cc syringe. The second round of 10–15 s of centrifugation was done in the 1-cc syringe. An 18-gauge needle was introduced into the proximal extremity of the 1-cc syringe



Fig. 1 Pre-operative markings of the peri-orbit. Hollowed areas to be enhanced are named “valleys” and marked in blue. The neighbouring elevated areas are named “hills” and marked in red

to aspirate the supernatant oil. The purified fat was injected immediately after fat harvesting/processing.

4. Technique of micro-fat grafting.

Infiltration with lidocaine and epinephrine of the area to be grafted was performed with a 21-gauge Mc Intyre cannula (Refs. [5, 6]). Three entry ports were used. The cannula was cautiously advanced in the pre-periosteal and pre-septal space. The substrate was always deposited in increments of 0.070–0.010 cc during the brisk withdrawal of the cannula to deposit minimal substrate in a dust-like fashion (Video 1).

a Lateral MFG.

In all cases, lateral UEL was grafted in the pre-periosteal/pre-septal compartment, lateral to a vertical tangent to the medial aspect of the iris, i.e. lateral to the supra-orbital bundle (Ref. [2]). Pre-septal lateral MFG was always performed after grafting the medial aspect of the UEL in the retro-septal plane.

b Medial MFG.

From 2001 to 2008, the fat was grafted in the sub-septal compartment in the area medial to the supra-orbital bundle (Ref. [2]). The first 49 cases (4.68% of total cases) were performed on patients who had obvious skin excess during an UEL blepharoplasty. The skin excision was limited to 2–3 mm even when more skin resection was needed. The orbicularis muscle was opened laterally on a length of 5 mm. The septum was identified in its lateral aspect, perforated with a 21-gauge needle and penetrated with a 21-gauge Mc Intyre blunt cannula. The sub-septal pre-aponeurotic space was infiltrated in its extra orbital and first centimetre of the intra-orbital space with 0.3–0.5 cc of lidocaine–epinephrine. The vasoconstriction effect was allowed to act for at least 10 min. The cannula in place was then connected to the syringe filled with the purified infiltrate and MFG was carried out in the medial pre-levator space. Subsequently, I developed a variation in the technique on the following 98 cases (9.36% of total cases). The upper eyelid skin was incised laterally on 5–8 mm. Lateral fibres of the orbicularis oculi muscle were opened by gentle spreading, the septum identified laterally and the subsequent steps were performed as described but with no skin resection was done. As I gained experience, I grafted the following 144 cases (13.75% of total cases) in the medial aspect of the retro-septal space with no skin incision. A trans-cutaneous/trans-septal perforation was carried out at the junction of the lateral third/medial two-thirds aspect of the upper eyelid. The skin was perforated with a 21-gauge sharp needle. A 21-gauge cannula was inserted in the port and maintained in close contact with the superior orbital rim during septal perforation. The cannula was connected to a syringe of lidocaine and epinephrine; infiltration behind the septum was carried out followed by



Fig. 2 a, b Pre-operative photograph of a patient presenting an exophthalmos of 23 mm measured with ophthalmometer. c, d Post-operative photograph of the same patient at 18 months exhibiting a correction of exophthalmos measured at 19 mm

MFG. As the understanding of the fat compartment anatomy of the region expanded, I switched to a pre-septal and pre-periosteal MFG medially and laterally in the last 649 (61.99% of total cases), extending fat deposit from lateral/middle UEL to its medial aspect.

Results

Among the 1047 patients who benefited from UEL MFG, 1037 were female and 10 were male. The range of patient ages was between 21 and 75 years old.

All patients were evaluated with standard photographs. The minimum length of patient follow-up was 3 months, maximum was 190 months. A total of 102 patients out of 1047 (9.74%) did not come for follow-up at 3 months or beyond. They all sent the requested photographs taken according to my recommendations.

The Good

The aesthetic reached with UEL volume enhancement has regularly been demonstrated in the last two decades (Refs. [1–13, 18]). Upper eyelid MFG successfully corrects mild to medium exophthalmos with up to four points correction measured with an ophthalmometer (from 23 to 19 mm) (Fig. 2). In some patients with UEL ptosis, I noticed an improvement in eye fissure aperture even when fat was grafted anterior to the septum. MFG seemed to correct partially UEL ptosis without undertaking any procedure for ptosis repair. Little confirmed this finding (Dr JW Little, personal communication) (Ref. [14]).

The Bad

See Table 1.

1. Hypocorrection of the A-Frame deformity.

Four of 1047 cases (0.38%) presented a hypocorrection limited to the medial aspect of the UEL. The reason was

Table 1 List of bad and ugly outcomes and possible severe complications

	Number	Percentage (%)
The bad conditions		
Medial hypocorrection	4	0.38
Transient UEL ptosis	3	0.29
Unightly pigmentation	3	0.29
Scar exhibition after UEL radial expansion	2	0.19
Xanthelesma-like fat skin incrustation	1	0.1
High eyebrow	1	0.1
Low eyebrow	2	0.19
Failure in addressing big picture	2	0.19
Fat resorption	2	0.19
Deep-set eye	1	0.1
Diplopia	1	0.1
Ugly conditions		
Over filling	1	0.1
Contour deformity	3	0.29
Catastrophic complications		
Permanent visual loss	0	0
Brain infarction	0	0
Eyeball perforation	0	0
Permanent eyelid ptosis	0	0
Permanent diplopia	0	0
Infection	0	0
Significant haematoma	0	0

probably to avoid bringing the cannula in close intimacy with the supra-orbital and supra-trochlear bundles. Correction was possible with a secondary stage of MFG, when the patient accepted it. The prevention of this condition is a uniform deposit of the substrate from lateral to medial.

2. Transient upper eyelid ptosis.

Three out of 1047 cases (0.29%) presented a transient ptosis of the UEL. The reason was probably the weight of haematoma on the levator system and/or a slight laceration of the levator muscle. No correction was needed as the three cases resolved spontaneously within 6 weeks. No permanent UEL ptosis was noted in the 1047 cases. The prevention of this condition is a slow motion while advancing the cannula in the pre-septal area along with a visualization of the spatial location of the eyeball and its levator system at all times. This visualization is of paramount importance when operating on patients who present a mild or medium exophthalmos as their levator system might be anteriorly positioned, hence more exposed.

3. Upper eyelid unsightly skin pigmentation of UEL.

Three out of 1047 cases (0.29%) presented an unsightly cutaneous pigmentation related to texture and colour changes of the UEL skin (Ref. [2]) (Fig. 3). I realized that when the skin invaginates inside the orbit, it undergoes

colour and trophic changes in some patients. Anterior radial expansion of the UEL exposes the unsightly-pigmented skin that was hidden pre-operatively inside the upper orbit. To my knowledge, there is no possible correction of this colouration. However, the regenerative effect of the grafted fat improved with time this condition on two patients out of three (Fig. 3e, f). The prevention relies on a pre-operative thorough inspection of the invaginated UEL skin and patient information.

4. Upper eyelid's hidden scars revealed after radial skin expansion.

Two out of 1047 cases (0.19%) presented an exposure of one or more scars of their UEL's skin (Ref. [2]) (Fig. 4). The scars were invaginated and hidden inside the orbit; the radial expansion of the UEL skin pushed the skin anteriorly bringing the scar into view. There is no possible correction of this condition, hence the importance of thorough inspection of the invaginated UEL skin and patient information.

5. Xanthelesma-like fat deposit.

A single patient presented visible xanthelesma-like fat incrustation in the skin (0.1%) (Ref. [2]) (Fig. 5). The reason was superficial fat deposit as I performed on that one patient fat graft according to Coleman's technique, i.e. placing the fat as superficial as the sub-cutaneous plane



Fig. 3 **a, b** Pre-operative photographs of a patient presenting upper eyelid hollowness; the invaginated skin within the orbit was not examined to note colour changes. **c, d** Post-operative photograph of the same patient at 4 months after radial expansion of her upper eyelids which brought to view an unsightly cutaneous pigmentation

(Ref. [4]). To my knowledge, there is no possible correction of such condition. Prevention is to avoid superficial placement, keeping the cannula under the muscles' deep harvesting fascia at all times.

6. Eyebrow malposition.

As a preamble to this complication, patients who present low eyebrows are traditionally treated with an eyebrow lift. However, MFG of the UEL and the sub-brow area repositions the eyebrows cephalad (Fig. 6). Hence, patients who present a hollowness of their UEL combined with over-elevated eyebrows either naturally, secondary to UEL ptosis or to a previous eyebrow lift should be approached with caution as MFG may further elevate the eyebrows to a non-desired position. This condition happened on a single patient (0.1%) who had a previous eyebrow lift performed elsewhere (Fig. 7). Eyebrow elevation seems to occur mostly in the medial eyebrow zone, an area of the eyebrow that usually should not be elevated in relation to the lateral eyebrow. UEL position evaluation with margin reflex distance (MRD) measurement should be a pre-requisite to

related to texture and colour changes of her UEL skin. **e, f** Post-operative photograph 49 months after a tertiary session of micro-fat graft associated with UEL blepharoplasty. The regenerative effect of fat graft seems to have significantly corrected the cutaneous pigmentation

plan sound correction. Treatment of such a condition may be achieved with UEL ptosis repair, which relaxes the eyebrows (Fig. 8). A reversed eyebrow lift may be necessary to pull down the eyebrows (Ref. [15]). Prevention should include a systematic MRD measurement to evaluate the need for ptosis repair. A combined reversed eyebrow lift with MFG of the upper eyelids may be indicated. The correction should be staged in two different sessions when the dissection plane of both procedures is the same, i.e. pre-periosteal pre-septal plane.

7. Low eyebrow.

Two patients (0.19%) did not present the expected eyebrow lifting effect after MFG of the UEL and sub-brow area (Fig. 9). Both patients had overly low eyebrows pre-operatively. I understood retrospectively that patients presenting low-positioned eyebrows might not benefit from the lifting effect of structural MFG in the eyebrow area. A test which consists in verifying if the posterior aspect of the eyebrow is at the level or higher than the upper orbital rim is helpful to apprehend if the eyebrows will be positioned



Fig. 4 a Pre-operative photograph of a patient who presented a masked scar hidden inside his right upper orbit where the skin was invaginated. **b** Post-operative photograph of the same patient at

10 months after radial expansion of his upper eyelids. The right upper eyelid scar was unveiled after skin radial expansion

superiorly after MFG. Patients presenting eyebrows with no posterior bony support, i.e. lower than the upper orbital rim should have their eyebrow lifted superiorly prior to UEL volume enhancement.

8. Failure in setting priorities.

General improvement of facial appearance didn't happen in two patients out of 1047 cases (0.19%) even with a meticulous MFG of their UEL. The reason was probably lack of setting a proper scale of priorities. Both patients presented upper and lower eyelids malposition. I failed to insist upon prioritizing eyelid repositioning over volume enhancement (Fig. 10a). The only way to prevent such a bad outcome is patient education and eventually turning down patients, refusing to perform volume enhancement unless they accept a holistic correction of their peri-orbital condition. One of the two patients accepted a secondary surgery which repositioned her upper and lower eyelids to a higher, more natural level (Fig. 10c). This resulted in frontalis muscle relaxation, which translated into eyebrow descent to a more natural position.

9. Fat resorption.

Two patients (0.19%) presented a complete fat resorption at 4 months. This is such a small percentage that the only explanation might be that it happened in a stage of my experience in which I was contemplating speeding up the different steps to shorten the time of the procedure. Prevention of fat non-take may be in meticulous execution of each step, regardless of the time spent on this task.

10. Deep-set eyes.

One patient (0.1%) presented an extinguished lifeless gaze after UEL MFG. She had a positive vector I did not recognize prior to her surgery, probably because she was the third patient I operated on with this technique, 19 years ago. Patients with deep-set eyes and a positive vector between the cornea and the lower lid–malar eminence pose a significant challenge. Heightening volume around the eyeball makes the eye look even deeper (Ref. [2]).

11. Diplopia.

A single patient (0.1%) reported an episode of mild diplopia during the first 24 h. The patient is an ophthalmologist who underwent an extensive MFG of the upper third of her face. Diplopia might have been the



Fig. 5 **a** Pre-operative photograph of a patient presenting upper eyelid hollowness. **b** Post-operative photograph of the same patient at 10 months. She exhibits visible xanthelasma-like fat incrustation in the skin as fat was deposited at the sub-cutaneous level instead of

consequence of extensive oedema that involved peri-ocular muscles. The incident resolved spontaneously after 24 h.

The Ugly

1. Over filling.

A single patient (0.1%) presented an extremely unsightly bulging of her UEL. The reason was over correction as I ignored, at the beginning of my experience, that virtually all grafted fat in the eyelids takes and is stable over time when meticulously performed (Ref. [2]). Only partial correction was obtained through blepharoplasty and excision of the over grafted fat (Fig. 11).

2. Uneven filling.

Three patients (0.29%) presented uneven UEL filling with contour deformity (Fig. 12). The reason was probably uneven fat distribution during the process of grafting. This

under the orbicularis oculi muscle's deep harvesting fascia. **c** Post-operative photograph of the same patient at 182 months. Xanthelasma-like fat incrustation in the skin has grown mostly on her left upper eyelid with passage of time

happened at a stage of my experience in which I wanted to speed up the different steps of the procedure. In one of the patients, I felt during surgery that the tip of the cannula was not in the right location, i.e. behind the deep harvesting fascia of the orbicularis oculi muscle. This was reported on the patient's chart and lately confronted with the result. Substantial correction was obtained on one patient with direct fat melting with bipolar cautery. Upper eyelid contour deformity was partially corrected with meticulous laser melting of the fat (Video 2).

Discussion Eye-Protecting Mechanism

The Good

UEL volume enhancement has gained popularity in the last two decades. However, information about complications is



Fig. 6 **a** Pre-operative photograph of a 24-year-old patient presenting upper eyelid hollowness and a low eyebrow position. **b** Post-operative photograph of the same patient at 9 months after a single session of upper eyelid MFG. Her eyebrows were repositioned to a higher position mostly in their lateral two-thirds. No eyebrow lift was performed

scarce, the literature reporting almost exclusively catastrophic complications such as blindness and brain infarction (Ref. [16]). Shue et al. conducted a recent systematic review of injection volumes by facial sub-units, no report of complication of fat injection in the peri-orbital area was mentioned (Ref. [17]). Marten and Elyassnia warned against the risk of eyeball perforation but did not report any complication related to UEL fat grafting. On the other hand, the authors suggested: “For all but the expert injector, it is safest to avoid sub-septal and subcutaneous injections” (Ref. [18]). I agree with this statement although I grafted 291 patients in the retro septal space (482 eyelids) with a limited number of minor complications, similar in numbers than those obtained by sub-orbicularis MFG, anatomical knowledge and training in cadavers being pivotal for any surgical technique. My experience of 1047 consecutive cases of UEL MFG confirmed to me the fact that injected volume must be deposited at the pre-septal level, into the eyelid itself, descending to the palpebral crease. This is in line with Marten and Elyassnia who advocate placing fat “along the inferior margin of the supra-orbital rim”. Their concept of «lowering the supra-orbital rim and filling the upper orbital area to lower skin that has retracted up into the orbit down onto the pre-septal eyelid» is equivalent to injecting at the pre-septal space, as, when the cannula is at the lower border of the supra-orbital rim, its spatial location has already deviated



Fig. 7 **a** Pre-operative photograph of a patient presenting an upper eyelid hollowness combined with over elevated eyebrows secondary to a previous eyebrow lift performed elsewhere. **b** Post-operative photograph of the same patient at 6 months after a single session of upper eyelid MFG. Her eyebrows were elevated to a non-desired position mostly in their medial third, which resulted in an unsightly appearance

inferiorly from the pre-periosteal to the pre-septal level, the periosteum stops at the arcus marginalis’ bony level; its inferior extension becomes septum. Fat injection at the lower border of the upper orbital rim signifies injection in the upper eyelid itself.

Beyond the rejuvenation effect of volumetric enhancement, UEL MFG corrects mild to moderate eyeball malposition when the latter advances beyond the beautiful normal: exophthalmos correction reached a scale of 4 mm measured by ophthalmometer, from 23 mm down to 19 mm in my best-operated case (Fig. 2).

It has also been noted that on some patients presenting UEL ptosis, their eyelid aperture improved, the best MRD improvement among my operated cases being 2 mm between the pre-op and post-op conditions without undertaking any ptosis repair procedure. This might be explained by the fact that autologous fat graft works at a cellular and sub-cellular levels (peptides, hormones and exosomes, e.g.). The gene expression of AGF ischaemic cells and the imminence of cell death, in addition to triggering the healing mechanisms, also unlocks the capacity for bioconstruction (Ref. [19]). Transforming growth factor beta (TGFbeta) is

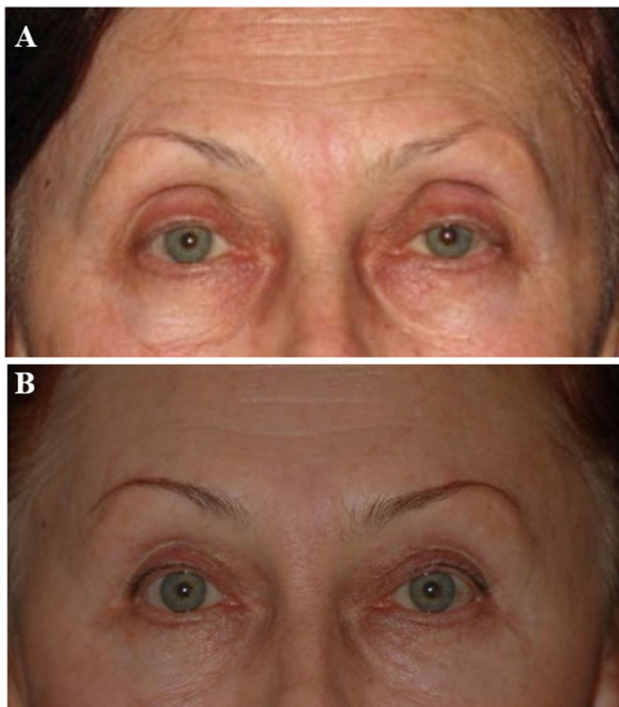


Fig. 8 **a** Pre-operative photograph of a patient presenting upper eyelid hollowness combined with over elevated eyebrows. Frontalis muscle over-contraction is present as a reaction to compensate eyelid ptosis. MRD is 1 mm on her left eye and 2 mm on her right eye. **b** Post-operative photograph of the same patient at 18 months after a single session of upper eyelid MFG combined with open sky ptosis repair. The latter resulted in frontalis muscle relaxation which translated into eyebrow descent to a more natural position

responsible for initiating and modulating a regenerative response in inflamed areas. The sympathetic nervous system is also activated as it stimulates the cells of the receptor area. There may be a regeneration of the motor plate of the muscles responsible for the elevation and dynamics of the eyelid. It must be kept in mind that this is because the incompetent musculature responsible for the motor deficit that generated the eyelid ptosis is an altered (inflamed) tissue, therefore susceptible to the entry of these regenerative molecules (Dr MA Pellon, July 2020 personal communication).

Catastrophic complications of volume enhancement such as permanent vision loss have been described. Such unfortunate cases with fat grafts were first described during nasolabial fold injection (Ref. [16]). Blindness and/or brain infarction following facial injections is not specific to fat or filler injections for aesthetic purposes. Von Bahr first described embolism in the fundus of an eye in 1963 after injection of hydrocortisone suspension in the scalp (Ref. [20]). Other publications reported visual loss after corticosteroid injection in the retro-bulbar area (Ref. [21]), into the nasal turbinates (Ref. [22]), intra-lesional injection of a chalazion (Ref. [23]) and injection for juvenile hemangioma (Ref. [24]).

This underlines the importance of three elements:

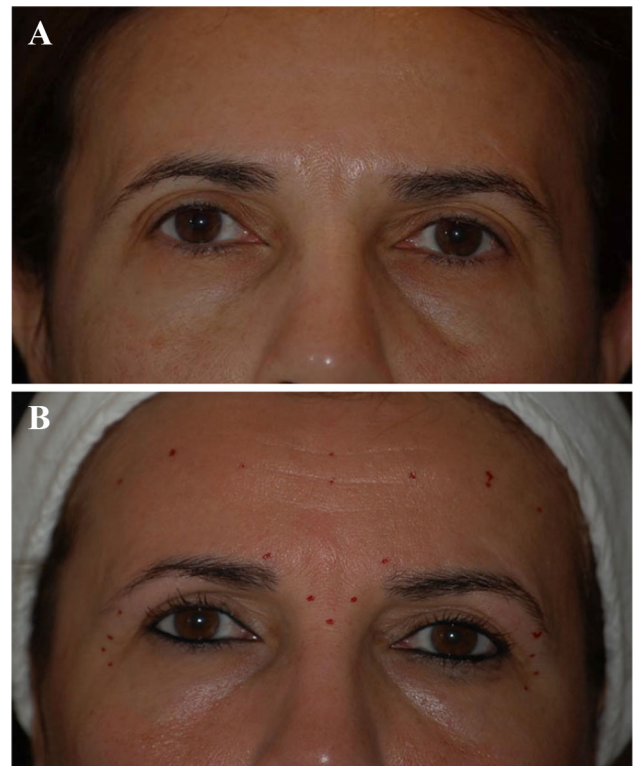


Fig. 9 **a** Pre-operative photograph of a patient presenting low eyebrows. **b** Post-operative photograph of the same patient. She did not present the expected eyebrow lifting effect after micro-fat graft of her upper eyelids and sub-brow area. The reason was probably the lack of bony support posterior to the eyebrows

1. Slow, non-forced injection is mandatory. It is well known that steroids were traditionally injected under high pressure to overcome pathologic tissue resistance.
2. Limited injection quantity of substrate at each pass while the cannula moves in a retro-grade manner is, in my view, the golden rule to avoid embolism. It allows minimal quantity deposit bolus (Ref. [3]). Central retinal artery occlusion secondary to intra-lesional injections may have been the consequence of high quantity of steroid delivered per square millimetre (Ref. [20–24]).
3. Anatomical knowledge is of paramount importance. Remote vascular connections to the ophthalmic artery should be kept in mind at all times during UEL injection.

The wide range of less than optimal results that may occur after UEL volume enhancement, their aetiology and how to avoid their occurrence have not been documented. This paper presents my experience of 1047 consecutive cases of upper eyelid MFG. It spans a period of 15 years from 2001 to 2016. It demonstrates that UEL MFG is a safe technique when meticulously performed. No major complications such as eyeball perforation, visual loss, permanent eyelid



Fig. 10 **a** Pre-operative photograph of a patient presenting upper eyelid hollowness along with upper and lower eyelids malposition. **b** Post-operative photograph of the same patient at 6 months after upper eyelid MFG. There is no general improvement in gaze appearance. The reason was probably lack of setting a proper scale of priorities. Ptosis repair and lower eyelid horizontal axis upward

reorientation should be prioritized over any other peri-orbital procedures. **c** Post-operative photograph of the same patient 3 months after a secondary surgery which consisted in upper and lower eyelids repositioning to a higher, more natural level. It resulted in frontalis muscle relaxation, which translates in eyebrow descent to a more natural position



Fig. 11 Post-operative photograph of a patient who exhibits upper eyelid bulging because of over correction. Virtually all grafted fat in the eyelids takes and is stable over the time when meticulously performed

ptosis, mild or important haematoma or infection occurred. This highlights the importance of epinephrine use along with blunt cannulas (Ref. [3, 4]), and limitation of the injected bolus to 1/50–1/100 cc at each pass (Ref. [2]). Finally, it is important to advance the cannula in the UEL in a slow, gentle motion, to avoid harming the eyeball, the levator system and/or oculo-motor muscles.

The brisk withdrawal technique is of paramount importance. It combines slow-cautious cannula



Fig. 12 Post-operative photograph of a patient who exhibits uneven filling of both upper eyelids that resulted in contour deformity

advancement into the UEL followed by brisk rapid withdrawal while the operator gently pushes the plunger. Slow cannula advancement ensures that neither brutal penetration nor laceration of important structures will occur, hence avoiding ptosis occurrence and eyeball perforation. Brisk withdrawal avoids substrate deposition within the lumen of a vessel in case the latter was perforated/cannulated. Moreover, the brisk withdrawal technique is combined with a gentle pressure on the plunger allowing 0.07–0.0010 mL of substrate to be deposited along the course of the cannula in its entire length. Although cannula withdrawal is brisk and may look brutal, no lesion can occur as a path was already laid, the cannula simply

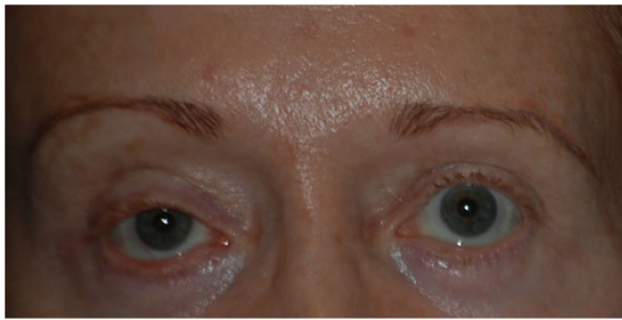


Fig. 13 Photograph of a patient 10 min after instillation of a drop of 2.5% neosynephrin in her left eye. She exhibits a good response to the test meaning that Muller's muscle shortening is a good option for ptosis repair. It also demonstrates to the patient the importance of having ptosis repair as her left eye presents an awake/aesthetically pleasing aspect in relation to the right eye. It is mandatory to perform a canthoplasty or canthopexy to avoid dry eye syndrome

retraces the same path created by careful cannula advancement. Thorough inspection of invaginated UEL skin should be undertaken before scheduling for UEL MFG as pigmented skin and scars may be hidden within the orbit and revealed after radial expansion of the skin. Fat may be better deposited posterior to the deep harvesting fascia of the orbicularis oculi muscle in order to avoid superficial unsightly yellow skin incrustation of the grafted fat (Ref. [2]). This condition occurred at the beginning of my experience when I grafted fat in the UEL following Coleman's technique as he advocated sub-cutaneous and intra-orbicularis muscle fat graft. It is mandatory to assess the position of the patients' eyebrows, upper and lower eyelids prior to UEL MFG. Eyeball position in relation to the orbital rim may be better assessed with an ophthalmometer as there is a strong association between senescence-related enophthalmos and eyelid ptosis (Ref. [25]). The upper eyelid crease becomes higher resulting in an elongated and hollowed UEL. Margin reflex distance (MRD) measurement is helpful to prioritize ptosis repair. In my practice, it became of paramount importance to educate patients towards diverting their attention from "the small detail" to "the big picture". I routinely use a drop of epinephrine 0.25% to demonstrate the importance of ptosis repair and how a normally open eye is important for an "awake-attractive" gaze (Fig. 13). Ptosis repair should be undertaken with a canthoplasty or canthopexy in order to prioritize eye-protecting mechanisms. UEL ptosis is often the consequence of lower eyelid malposition: UEL follows lower eyelid inferior shift to avoid dry eye. Patients who do not accept a holistic correction of their peri-orbital condition are systematically turned down. Deep-set eyes represent the most important limitation to UEL volume enhancement. The principle which consists of improved exophthalmos by building volume around the orbit, hence giving

the impression that the globe moved back explains why this same concept gives an impression of worsening of the deep-set eye configuration in patients who already present a positive vector. Intra-orbital MFG might be the sole solution for this group of patients; posterior volume deposit allows the eyeball to be moved forward. Over filling of the UEL should not be attempted and uneven fat graft should be avoided. These undesirable results are extremely difficult to correct. These were the most difficult conditions in which I struggled in a secondary or tertiary stage to obtain a harmonious result, sometimes unsuccessfully. It is wiser to graft less evenly and to add fat in a secondary session.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflicts of interest to disclose.

Human and Animal Rights This article does not contain any studies with human participants or animals performed by any of the authors.

References

1. Benslimane F, van Harpen L, Myers S, Ingallina FM, Ghanem A (2017) The Benslimane's artistic model for females' gaze beauty: an original assessment tool. *Aesth Plast Surg* 41:81–89
2. Benslimane F (2009) Peri orbital rejuvenation: the frame concept. In: Coleman SR, Mazzola RF (eds) *Fat grafting: from filling to regeneration*. QMP, St Louis
3. Coleman SR (1995) Long-term survival of fat transplants: controlled demonstrations. *Aesth Plast Surg* 19:421–425
4. Coleman SR (ed) (2004) *Structural fat grafting*. QMP, St Louis
5. Little JW (2001) Volumetric face lifting (discussion). *Plast Reconstr Surg* 108(5):1373–1376
6. Little JW (2015) Commentary on: superficial enhanced fluid fat injection (SEFFI) to correct volume defects and skin aging of the face and periocular region. *Aesthet Surg J* 35(5):516–523
7. Berman M (2000) Rejuvenation of the upper eyelid complex with autologous fat transplantation. *Dermatol Surg* 26:1113–1116
8. Trepsat F (2003) Periorbital rejuvenation combining fat grafting and blepharoplasties. *Aesthet Plast Surg* 27(4):243–253
9. Gulyá SG (2006) Improving the lateral fullness of the upper eyelid. *Aesthet Plast Surg* 30:641–648
10. Giuci M, Obagi S (2008) Rejuvenation of the periorbital complex with autologous fat transfer: current therapy. *J Oral Maxillofac Surg* 66:1686–1693
11. Liew S, Nguyen DQA (2011) Nonsurgical volumetric upper periorbital rejuvenation: a plastic surgeon's perspective. *Aesthet Plast Surg* 35:319–325
12. Buckingham ED, Glasgold RA, Kontis T et al (2015) Volume rejuvenation of the facial upper third. *Facial Plast Surg* 31:43–54
13. Rohrich RJ, Coberl DH, Fagien S, Stuzin JM (2004) Current concepts in aesthetic upper blepharoplasty. *Plast Reconstr Surg* 113:32–42
14. Little JW (2014) Personal communication. ASAPS Las Vegas aesthetic symposium
15. Yaremshuk MJ, O'Sullivan N, Benslimane F (2007) Reversing brow lifts. *Aesthet Surg J* 27(4):367–375
16. Yang LDH, Kim HN, Shyn JC, Hwan H (1996) Sudden unilateral visual loss and brain infarction after autologous fat injection into the nasolabial groove. *Br J Ophthalmol* 80:1026

17. Shue S, Kurlander DE, Guyuron B (2018) Fat injection: a systematic review of injection volumes by facial subunit. *Aesth Plast Surg* 42:1261–1270
18. Marten T, Elyassnia D (2018) Facial fat grafting: Why, where, how, and how much. *Aesth Plast Surg* 42:1278–1297
19. Pellon MA (2020) Características moleculares y microanatómicas de la grasa y su aplicación en el tratamiento de quemaduras agudas y secuelas. *Cir Plast Iberoamericana* 46(Supl 1):S53–S62
20. Von Bahr G (1963) Multiple embolisms in the fundus of the eye after an injection in the scalp. *Acta Ophthalmol (Copenh)* 41:85–91
21. Ellis PP (1978) Occlusion of the central retinal artery after retrobulbar corticosteroid injection. *Am J Ophthalmol* 85(3):352–356
22. Byers B (1979) Blindness secondary to steroid injections into the nasal turbinates. *Arch Ophthalmol* 97(1):79–80
23. Thomas EL, Laborde RP (1986) Retinal and choroidal vascular occlusion following intralesional corticosteroid injection of a chalazion. *Ophthalmology* 93(3):405–407
24. Shorr N, Seiff SR (1986) Central retinal artery occlusion associated with periocular corticosteroid injection for juvenile hemangioma. *Ophthalmic Surg* 17(4):229–231
25. Guyuron B, Harvey D (2014) Periorbital and orbital aging: senile enophthalmos as a cause of upper eyelid ptosis. *Plast Reconstr Surg* 138:31e–37e

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.