

Orbital fat Augmentation in volumetric upper eyelid fold rejuvenation

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Abstract. *Purpose:* to investigate the efficacy of adjunctive orbital fat flap and/or graft to eyelid crease forming sutures in upper eyelid fold rejuvenation. *Methods:* this prospective study included 24 patients (43 eyelids) who underwent orbital fat augmentation with crease-forming sutures. All patients underwent an eyelid crease evaluation and patient satisfaction evaluation at baseline, 2 weeks and 6 months after the surgery. *Results:* at the 6-month follow-up, the eyelid crease height significantly decreased from 12.4 ± 0.48 to 8.2 ± 0.4 mm, the mean baseline upper lid fold significantly increased from 19.1 ± 0.6 to 21.5 ± 1 mm, the mean baseline pretarsal space (PTS) significantly decreased from 7.8 ± 0.74 to 4.6 ± 0.45 mm. Volumetric eyelid fold augmentation was achieved through preaponeurotic fat flap, nasal fat flap, nasal fat graft and mixed augmentation in 11, 9, 10, and 13 eyelids, respectively. Baseline lid crease symmetry was graded as moderate asymmetry in 15 (62.5%) patients and obvious asymmetry in 9 (37.5%) patients. At the 6-month follow-up, symmetry improved, with 21 (87.5%) patients showing symmetry and only 3 (12.5%) patients exhibiting mild asymmetry. At the 6-month follow-up, GAIS scores of 1,2, and 3 were observed in 3 (12.5%), 19 (79.2%), and 2 (8.3 %) patients. The mean baseline BOE increased significantly from 42.5 ± 3.9 points to 85.5 ± 4.6 points over the same period. *Conclusions:* our cohort shows favorable cosmetic results and patient satisfaction in the treatment of high eyelid creases with minimal risks.

Key words: eyelid crease, high fold, orbital fat, dermatochalasis, blepharoplasty, upper eyelid

Introduction

A well-defined upper eyelid crease and pretarsal space (PTS) contribute to a youthful, aesthetically pleasing appearance. The eyelid crease forms due to the levator aponeurosis attaching to the dermis after passing through the orbicularis oculi muscle (OOM). The deep layer of the levator aponeurosis is attached to the anterior surface of the superior tarsus, while the superficial layer merges with the orbital septum and pierces OOM terminating in the skin of the upper eyelid¹⁻³.

An ideal crease follows a smooth contour parallel to the lash line, while the eyelid fold should not extend beyond the medial canthus or lateral orbital rim. The eyelid fold is formed by excess skin and muscle that

overhangs the eyelid crease. The pretarsal space is the visible area of the eyelid skin between the eyelid crease and the upper eyelid margin when the eyes are open⁴⁻⁶.

In Western (Occidental) populations, the eyelid crease height typically measures 8–10 mm in females and 6–8 mm in males, whereas the range in Asian (Oriental) populations generally varies between 4–6 mm. A normal pretarsal space ranges from 2–3 mm in Western populations and 0–2 mm in Asian populations. An absent eyelid crease is common in the Asian population and results from the lack of levator insertion into the skin^{7,8}.

High eyelid crease is a common aesthetic concern, which may be congenital, or result from aging, surgery, or ptosis. These creases are often associated with deep

folds, multiple creases, or excess skin, which can affect symmetry and overall aesthetic outcomes. The most common drawback of the lower eyelid crease is skin sagging. The height of the eyelid fold is affected by both patient and surgical factors such as skin thickness, skin laxity, brow ptosis, eyelid ptosis, dermatochalasis, the hollowness of eyelid, and the eyelid crease incision design, depth, and position. Upper eyelid crease asymmetry may be due to upper lid ptosis, retraction, dermatochalasis, or asymmetrical brow position^{7,9,10}.

Achieving a dynamic, natural-looking eyelid crease is a key goal in aesthetic upper eyelid surgery. A well-positioned crease should be prominent when looking straight ahead in a state of levator palpebrae superioris (LPS) contraction, but less noticeable in downgaze, corresponding to LPS relaxation. However, surgical complications such as excessive scarring, inadequate fat support, and asymmetrical placement can lead to static creases, which remain deep and visible in downgaze even with LPS relaxation^{11,12}.

According to Flowers' operative rule, 26–30 mm of upper eyelid skin between the eyebrow and eyelid margin is necessary to achieve a normal contour, proper eyelid fold invagination, and complete eyelid closure^{11,13}.

This study investigates whether orbital fat augmentation (flap and/or graft) combined with crease-forming sutures can improve the cosmetic appearance of high eyelid creases while maintaining a natural and dynamic movement.

Patients and Methods

Patient selection: This prospective study included 24 patients (43 eyelids) who underwent orbital fat augmentation with crease-forming sutures between May 2021 and July 2024. All surgeries were performed by a single surgeon (T.E.).

Inclusion criteria: Patients 18 or older who had unpleasant high and/or multiple upper eyelid creases.

Exclusion criteria: Patients with systemic diseases such as thyroid eye diseases, botulinum toxin injections within 6 months, and other orbital or eyelid diseases.

Patient assessment: A complete ophthalmic evaluation, a visual field test (VFT), and a periorbital

evaluation were done preoperatively, and in postoperative follow-up visits at 2 weeks and at 6 months after the procedure.

Eyelid crease evaluation^{4,14,15}:

- *Eyelid crease height:* the distance from eyelid margin to crease (measured at midpupillary line on down-gaze).
- *Upper eyelid fold:* the distance from the eyelid crease to the eyebrow (measured at midpupillary line).
- *Pretarsal space (PTS):* the distance from eyelid margin to crease (measured at midpupillary line when the eyes are open).
- *PTS grading:* No pretarsal show, partial, or complete.
- *Crease symmetry assessment:* Categorized as symmetrical, mild asymmetry (<0.5 mm difference), moderate (0.5–1 mm), or obvious (>1 mm).

Patient satisfaction evaluation^{4,16}:

- Global aesthetic improvement scale (GAIS): a 1–5 scale (1=very much improved, 2=much improved, 3=improved, 4=no change, and 5=worse).
- Blepharoplasty outcomes evaluation (BOE): a range from zero (lowest level of patient satisfaction) to 100 (highest level of patient satisfaction).

Photography: patients were photographed under standard conditions. Photographs were standardized to a corneal diameter of 11.5 using Adobe Photoshop (Adobe Systems, Inc., San Jose, Calif.). The images were scored by two independent observers^{16,17} (Figure 1).

Surgery

Preoperative markings are performed with the patient in the upright primary position. The marking of the upper eyelid crease is performed at the desired new crease position which corresponds to 1 mm above the

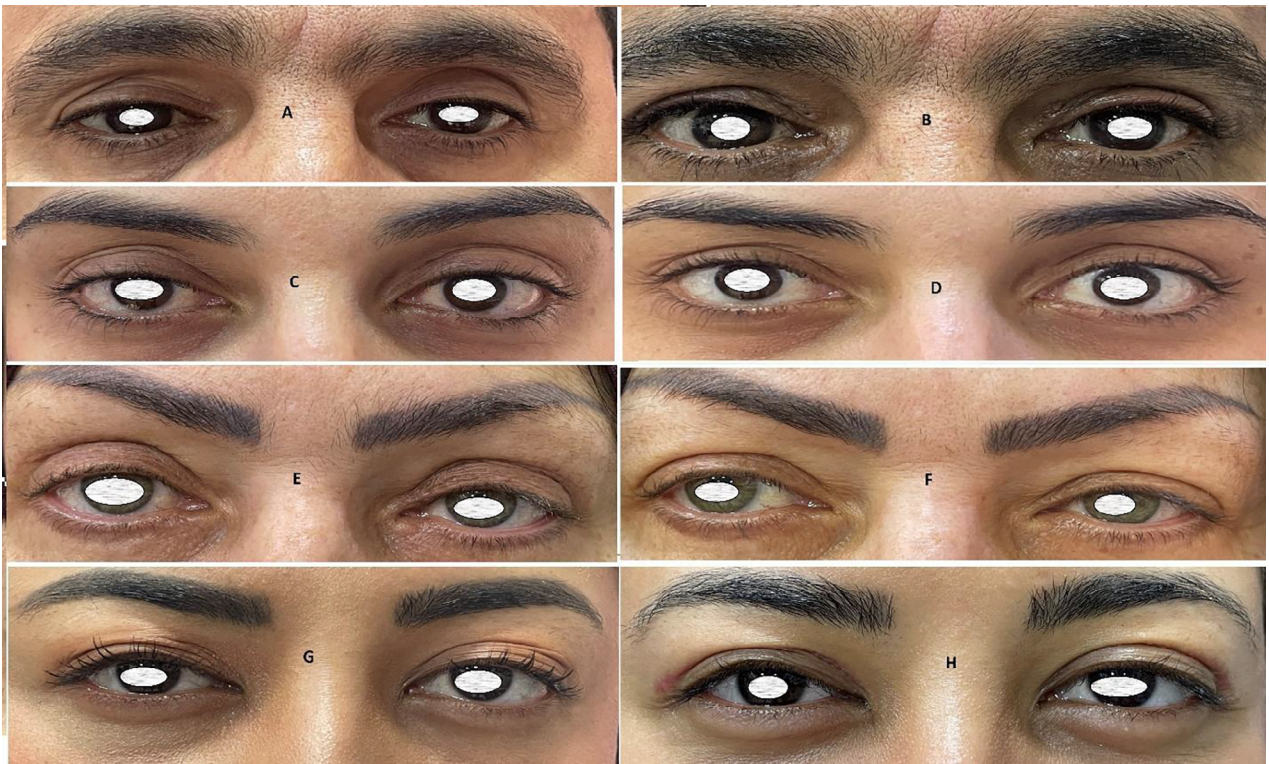


Figure 1. Case 1: A baseline photograph high eyelid creases, B 6 months postoperative photograph. Case 2: C baseline photograph high eyelid creases, D 6 months postoperative photograph. Case 3: E baseline photograph high eyelid creases, F 6 months postoperative photograph. Case 4: G baseline photograph multiple eyelid crease, H 6 months postoperative photograph.

upper tarsal border. A pinch test is performed to locate the upper marking which is placed at least 10 mm from the lower edge of the eyebrow. Surgical steps:

- All surgeries are done under local anesthesia and sedation. Surgical preparation and draping were done then the skin was infiltrated with 3–4 ml of lidocaine 1% with 1:100,000 epinephrine.
- Incision and excision of the marked upper eyelid skin were done. Blunt dissection of OOM and orbital septum, followed by excision of the herniated nasal fat pad and a strip of pretarsal OOM.
- Concurrent ptosis repair was performed using LPS plication. In brief, the LPS was marked at a measured distance and plicated to the anterior tarsal surface near the superior border with 1–3 interrupted 6–0 Prolene sutures.
- Orbital fat augmentation, using a combination of free preaponeurotic flap, nasal fat flap, or nasal fat graft, was performed and lowered to the desired eyelid crease position.
- Eyelid crease formation was achieved performing 3–4 interrupted 6–0 Prolene sutures anchoring the lower skin border and OOM-pretarsal levator aponeurosis along the superior tarsal border with the fat flap or graft secured to the OOM and upper skin border.
- The blepharoplasty skin incision is undermined and closed with a running 6–0 Vicryl suture (Figure 2).

Postoperative treatment: It includes the application of topical antibiotics and steroid ophthalmic ointments twice daily on the incisions and cold compresses at 30-minute intervals for 48 hours. The skin sutures were removed after 1 week.

Statistical analysis: Data was displayed as a mean with standard deviation or percentage. SPSS v16.0



Figure 2. Surgical technique: (A) Dissection of OOM and orbital septum (B) LPS plication (C) preaponeurotic flap (D) Nasal fat graft (E) Nasal fat flap (F) Crease forming suture.

(SPSS, Chicago, IL, USA) was applied to perform a statistical analysis, and a paired Student's t-test was used for statistical comparison. A P-value < 0.05 is considered significant.

Results

Study population: this is a prospective study of 43 eyelids of 24 patients who underwent surgical treatment of unpleasant high upper eyelid creases from May 2020 to July 2024. The mean follow-up was at 8.8 ± 1.7 months (range: 6–11 months). The mean age of the patients was 40.3 ± 9.8 years (range: 31–56) with 19 females (79.2%) and 5 males (20.8%). Primary and revisional surgery was performed in 15 (83.7%) and 7 (16.3%) eyelids, respectively, whereas unilateral surgery was performed on 5 patients.

Clinical results: the eyelid crease height decreased significantly from 12.4 ± 0.48 to 8.2 ± 0.4 mm at the 6-month follow-up (P value <0.0001). The mean baseline upper eyelid fold increased significantly from 19.1 ± 0.6 to 21.5 ± 1 mm at the 6-month follow-up (P value =0.0009). The mean baseline PTS decreased significantly from 7.8 ± 0.74 to 4.6 ± 0.45 mm (P value <0.0001) at the 6-month follow-up. Volumetric eyelid augmentation was achieved through a preaponeurotic fat flap, nasal fat flap, nasal fat graft, and mixed augmentation in 11, 9, 10, and 13 eyelids, respectively. At baseline, lid crease symmetry was graded as moderate asymmetry in 15 (62.5 %) patients and obvious asymmetry in 9 (37.5%) patients. At the 6-month follow-up, symmetry improved with 21 (87.5%) patients showing symmetrical creases and 3 (12.5%) patients showing mild asymmetry.

At the 6-month follow-up, GAIS scores of 1, 2, and 3 were observed in 3 (12.5%), 19 (79.2%), and 2 (8.3%) patients respectively. The mean baseline BOE increased significantly from 42.5 ± 3.9 points to 85.5 ± 4.6 points (P value <0.0001). At the 6-month follow-up, the BOE scale was 80–90%, and more than 90% in 22 (91.7%), and 2 (8.3%) patients respectively.

Concurrent ptosis surgery was done in 13 eyelids, and at the 6-month follow-up, marginal reflex distance (MRD1) increased from 2.16 ± 0.23 to 3.83 ± 0.23 mm (P value <0.0001) upper eyelid blepharoplasty was done in all cases (Table 1).

Table 1. Clinical outcomes.

Parameter	Baseline	6-Month Follow up	P-value
Eyelid Crease Height (mm)	12.4 ± 0.48	8.2 ± 0.4	<0.0001
Upper Eyelid Fold (mm)	19.1 ± 0.6	21.5 ± 1	0.0009
PTS (mm)	7.8 ± 0.74	4.6 ± 0.45	<0.0001
BOE Score	42.5 ± 3.9	85.5 ± 4.6	<0.0001

Millimeter (mm), Pretarsal space (PTS), Blepharoplasty outcomes evaluation (BOE)

Safety: There were no recorded major intraoperative or postoperative adverse effects throughout the study. Minimal postoperative eyelid edema and ecchymosis were observed in all cases. None of the patients reported scars caused by wound incisions.

Discussion

Treating the high upper eyelid fold for upper eyelid rejuvenation is challenging. Especially in the Western eyelid, neither high nor low eyelid creases, and concurrent long and short pretarsal spaces can be considered acceptable inputs in aesthetic upper eyelid surgery. The most common sources of dissatisfaction in upper eyelid surgery are postoperative unpleasant eyelid crease abnormalities, such as asymmetry, or deep, static, and high eyelid creases^{5,10,18}.

Successful surgical management of a high upper eyelid crease requires a customized treatment plan involving careful consideration of individual patient goals, addressing the underlying causes and managing concurrent eyelid diseases such as ptosis and dermatochalasis.

An unpleasant surgical high eyelid crease may be caused by the high position of the incision design or the crease fixation suture, overzealous skin excision, postoperative adhesion, the insufficient gliding zone of preaponeurotic fat, blepharoptosis, or a sunken eyelid¹⁸⁻²⁰.

The most frequent cause of high eyelid creases is the improper high position of the eyelid crease design. Therefore, the mainstay step in correcting the high eyelid crease is the precise design of the new desired lid crease position^{7,14}.

In our cohort, the position of the upper lid crease incision was designed based on the classic measurement of the eyelid crease height, which corresponds to one mm above the upper tarsal border. Eyelid crease symmetry was achieved by symmetrically marking both eyelid creases and correcting the underlying ptosis and dermatochalasis.

Orbital fat augmentation was performed to prevent postoperative adhesion, and create a natural dynamic fold. It provides an anatomical barrier and a volume enhancer between the anterior skin–OOM lamella and the levator aponeurosis. Furthermore, it offers a lubricating layer that aids in the upward glide motion of the posterior lamella. Orbital fat augmentation can be performed through flaps advancements such as preaponeurotic fat or nasal fat pad flaps and fat grafts such as nasal fat pad or Retro-orbicularis oculi fat (ROOF) grafts²¹⁻²⁴.

In our cohort, volumetric eyelid fold augmentation was achieved through the application of the preaponeurotic flap, nasal fat flap, and nasal fat graft. We ascertained that the fat flap was totally free and advanced to the desired eyelid crease position without tension.

The mainstay principle of the formation of eyelid crease-forming sutures is anchoring the anterior lamella structures (skin or OOM) to the posterior lamella structure (Tarsus or LPS)^{10,12,25,26}.

Previous reports proposed different fixation approaches including, the OOM–levator fixation, the OOM–tarsus fixation, the OOM–orbital septum fixation, the OOM–levator–tarsus fixation either in one bite or in separate bites to the tarsus and aponeurosis. Certain reports suggested that eyelid crease formation only requires an engagement of the OOM, other than the skin or the dermis, to the posterior lamella. Other reports find that dermis fixation can lead to dense scarring^{3,27-29}.

In the case series presented in this text, the crease forming suture attached both the skin and OOM at the edge of the lower eyelid to the levator aponeurosis. No depressed scars were encountered in our cohort.

We believe this study demonstrates that orbital fat augmentation significantly improves the cosmetic appearance of high eyelid creases by enhancing volume

to prevent deep static creases, reducing postoperative adhesion for a more natural crease movement, and improving symmetry, ensuring a balanced aesthetic outcome. The technique described is a modification of traditional blepharoplasty, refining crease formation while preserving natural eyelid dynamics.

The crucial steps include the design of the new crease at a precise position, enhancing the eyelid fold volume, fixing the skin and OOM-LPS-skin, correcting associated dermatochalasis, and addressing eyelid ptosis.

Drawbacks of our cohort include intermediate follow-up time and the lack of evaluation of other eyelid crease fixation techniques. The main strength in this study lies in its focus on Occidental eyelids.

Conclusion

Orbital fat augmentation combined with crease-forming sutures effectively enhances high eyelid creases, yielding natural results, improving symmetry, and ensuring high patient satisfaction with minimal risks.

Abbreviation: Pretarsal space (PTS); Orbicularis oculi muscle (OOM); levator palpebrae superioris (LPS); visual field test (VFT); Global aesthetic improvement scale (GAIS); Blepharoplasty Outcomes Evaluation (BOE); Retro-orbicularis oculi fat (ROOF).

Acknowledgment: No substantial contribution was provided for this submission.

Ethical Approval: The local ethics committee of Seha Emirates hospital; Abu Dhabi; UAE approves this study. The study followed the tenets of the Declaration of Helsinki. Patient informed consent was signed by all patients.

Declaration of Interest Statement: The author declares no conflict of interest. No financial support was received for this submission.

Data Sharing Statement: All data used to support the findings of this study are available from the corresponding author upon request.

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