



A Modified Subbrow Blepharoplasty for Correction of Severe Upper Eyelid Skin Laxity

Yucheng Qiu¹ · Fei Liu¹ · Jun Yang¹ · Xianyu Zhou¹



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Abstract

Background Periorbital aging is characterized by dermatochalasis, lateral hooding and malformation of multiple eyelid creases. Rejuvenation of periorbital region is of great concern in aging Asians, especially for the females. However, the conventional subbrow blepharoplasty was indicated for mild or moderate skin laxity. For severe laxity, double-eyelid incision is necessarily to be involved. This study aims to improve the severe upper eyelid dermatochalasis through an extended subbrow single-incision approach with desirable outcomes.

Methods Patients underwent this surgical method from October 2020 to April 2022 were retrospectively reviewed. The redundant skin and orbicularis oculi muscle were excised through a spindle-like subbrow incision delicately designed in the sitting position. Surgical outcomes were evaluated by heights of designed line from the palpebral margin to the pupil center (HPPC), medial cornea (HPMC), and lateral canthus (HPLC) at different follow-ups. The overall satisfaction score of cosmetic outcomes was assessed by an independent surgeon and patients themselves based on the evaluation of: subbrow scar, eyelid

symmetry, lateral hooding lifting, visual block improvement and brow shape.

Results A total of 75 cases were reviewed, including 3 men and 72 women. The preoperative HPPC, HPMC, and HPLC were 4.27 ± 0.40 , 4.72 ± 0.45 and 3.41 ± 0.35 mm. The values were postoperatively improved to 7.01 ± 0.46 , 6.57 ± 0.34 and 5.69 ± 0.26 mm, respectively, presenting significantly different ($p < 0.05$). The mean surgeon satisfaction scores were 3.6 ± 0.6 (range, 2.0–4.0), and patient satisfaction scores were 3.5 ± 0.6 (range, 2.0–4.0). No hypertrophic scar, sunken upper eyelids or other complications was found.

Conclusions The modified subbrow blepharoplasty method is an effective and safe alternative for correcting severe upper eyelid skin laxity, which can achieve both good cosmetic outcomes and functional improvement.

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Keywords Eyebrow · Blepharoplasty · Preoperative design · Suture technique

Yucheng Qiu and Fei Liu contributed equally to the acquisition, analysis, and treatment of data and should be viewed as co-first authors.

✉ Jun Yang
yj55569@hotmail.com

✉ Xianyu Zhou
zhoulang@sjtu.edu.cn

¹ Department of Plastic and Reconstructive Surgery, Shanghai 9th People's Hospital Affiliated to Shanghai Jiaotong University School of Medicine, 639 Zhi Zao Ju Road, Shanghai 200011, China

Introduction

Periorbital aging frequently results in dermatochalasis, wrinkles, eye bag, pseudoptosis and malformation of multiple eyelid creases, which impairs individual appearances, vision and psychology. Blepharochalasis is one of the most common manifestations in aging often indicated by laxity of the upper eyelid skin, visual block and unappealing eye contours.

The laxity of upper eyelid skin could be determined by a pinch test, while the patients are in the sitting position [1]. A laxity of less than 2 mm is defined as mild dermatochalasis, laxity of 2 to 4 mm as moderate, and laxity of more than 4 mm as severe. A double-eyelid surgery (DS) is effective for correcting mild blepharochalasis, and a sub-brow blepharoplasty (SBB) is usually performed for moderate blepharochalasis [2–5]. In patients with severe upper eyelid skin laxity, however, the skin excision in DS cannot address the lateral hooding, while a simple SBB is not sufficient for correcting the laxity of the supratarsal upper eyelid skin [6–8]. To tackle with these concerns, a double-incision approach combining DS and SBB was reported to better ameliorate blepharochalasis [9]. It is a concern that skin close to the eyelash was much removed through a DS incision in severe eyelid skin laxity case. As the upper eyelid skin thickens gradually from the palpebral margin to the brow, removing thinner skin could result in unnatural and less aesthetic double eyelids, especially in the elder one with poor skin elasticity and quality. Besides, the interaction between the two incisions could affect the intended width of double-eyelid creases, thus arising complexity and instability. From the anatomical scope, this combined surgery could also lead to more intraoperative trauma, extensive swelling and prolonged recovery.

Preoperative design is usually conducted with patient in the supine position. An easily overlooked disadvantage of SBB is the inaccurate skin laxity evaluation in the supine position with changed gravitational impact on the upper eyelid skin. Moreover, even in a traditional sitting position with eyes in primary gaze, the sagittal line of patient's head is nearly parallel to the perpendicular line, the intended amount of skin excision cannot completely lead to satisfactory outcomes.

In the present study, we introduced a SBB technique with modification that can maximumly ameliorate skin laxity in patients with severe dermatochalasis, revive natural-looking eyelids without involving double eyelid surgery, and achieve satisfactory cosmetic outcomes.

Materials and Methods

Patients subjected to this surgery from October 2020 to April 2022 were comprehensively reviewed by medical records. A pinch test was performed preoperatively to measure the laxity of the upper eyelid skin. With patients' eyes closed, the excess upper eyelid skin below the eyebrow was clamped by a caliper and the eyelid was elevated to a position which the eyelashes curled slightly. The thickness of the skin clamped was measured, representing the laxity of eyelid skin, and a laxity of more than 4 mm was defined as severe laxity. The indications for the

procedure were as follows: (1) severe upper eyelid skin laxity and lateral skin hooding; and (2) not wanting an artificial double eyelid. Dermal fillers/fat grafting or botulinum toxin A of facial injection within 6 months before surgery were excluded. Written consent was obtained from all the patients, and the study was conducted with accordance to the Declaration of Helsinki.

Preoperative Design

Patient was horizontally distanced approximately 30 cm to the surgeon in the sitting position. With eyes in primary gaze, the patient's chin was slightly lowered and the angle between the sagittal line of patient's head and the perpendicular line was nearly 15°. At the meanwhile, vertical position of the surgeon's eye was about 10 cm higher than that of the patient when performing preoperative design (Fig. 1). A drooping line was drawn along with the lowest edge of the drooping upper eyelid skin. The heights from the designed line to the medial cornea (HPMC), pupil center (HPPC) and lateral canthus (HPLC) were measured

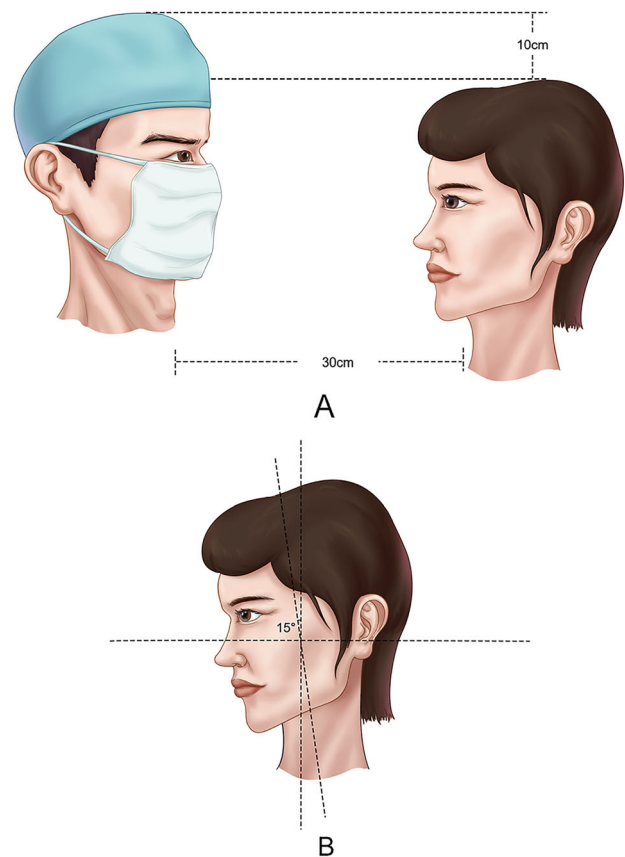
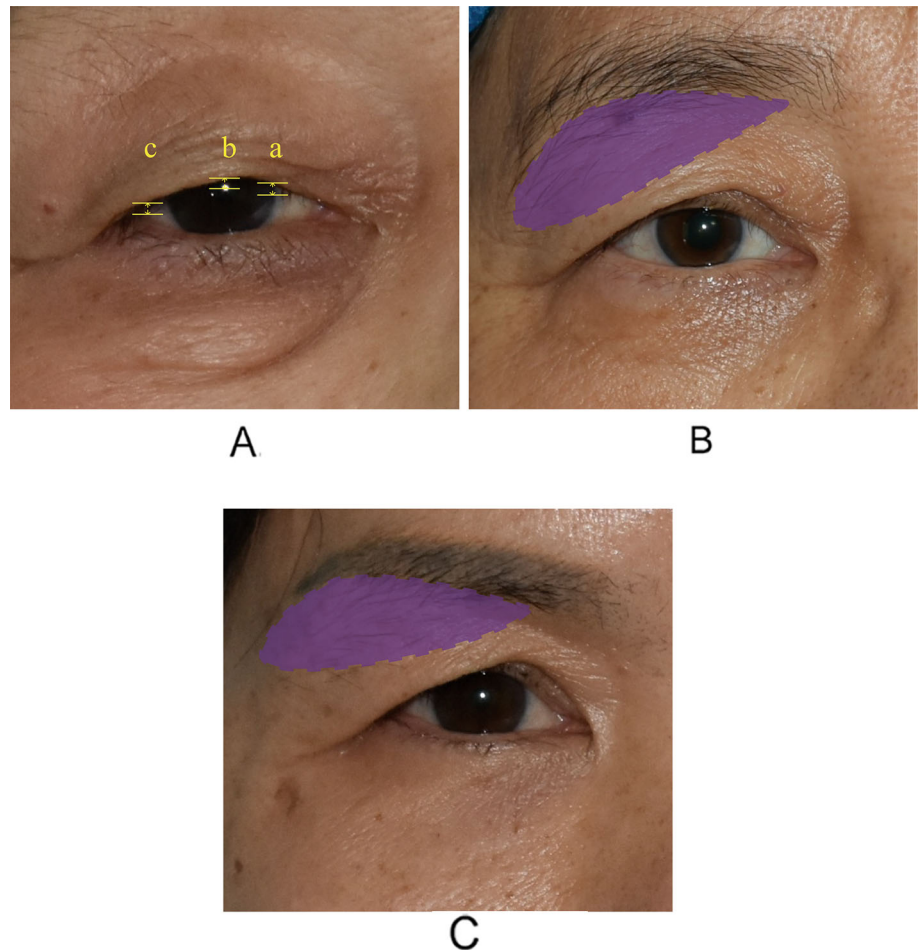


Fig. 1 Performing preoperative design. **A** In the sitting position, horizontal distance between the surgeon and the patient is approximately 30 cm, and vertical position of the surgeon's eye is about 10 cm higher than that of the patient. **B** Position of the patient's head with eyes in primary gaze.

Fig. 2 **A** The skin laxity is determined in terms of the height from the designed “droop line” to the medial cornea (a), the pupil center (b), and the lateral canthus. **B** The design of incision line in patients with wide and messy eyebrow. **C** The design of incision line in patients with existed eyebrow tattoo.



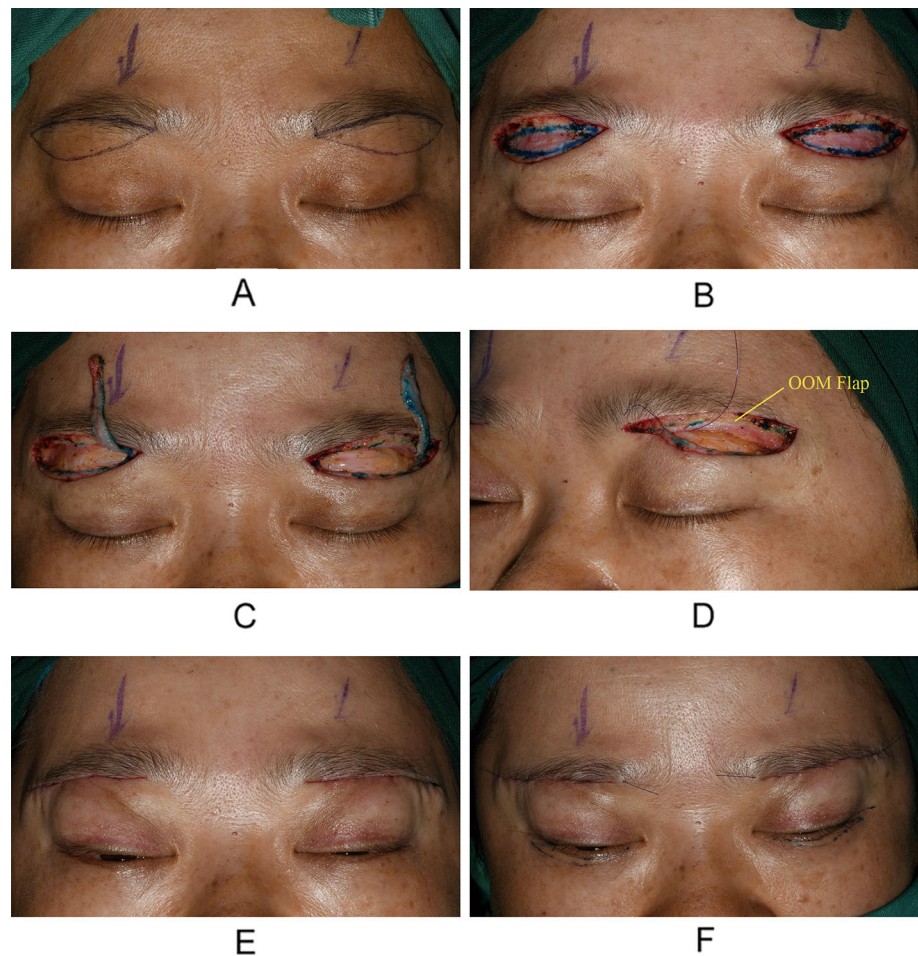
(Fig. 2A), which referred to the amount of skin laxity. The first subbrow point was marked at the vertical projection from the pupil center to the inferior margin of the eyebrow. With one hand holding the mark pen still over this point, the surgeon lifted the eyebrow upward with the other hand until the hooding was improved and the desired palpebral crease was achieved, then a new point was marked where the thumb holds the skin. The amount of excursion was the drooping skin supposed to be excised. Another two subbrow points were determined at the vertical projections from the medial cornea and lateral canthus to the brow, respectively. The upper eyelid skin after shift movement was marked in the same way as mentioned above, accordingly. The subbrow incision line was formed to draw a smooth curve at the 3 subbrow points starting at approximately 5 mm lateral to the brow head, and the lower upper eyelid skin incision line was completed in the same way. Two curved lines were integrated into a spindle-like area to be excised. In cases with wide and messy eyebrow, the subbrow incision was designed within the eyebrow, and the lateral incision descended along the tail of the eyebrow (Fig. 2B). In cases with narrow eyebrow or

existed eyebrow tattoo, this incision line was designed at the inferior edge of the eyebrow except crossing the eyebrow tail laterally, if necessary (Fig. 2C). This allowed for the excision of lateral hooding at the most extent and facilitated further eyebrow tattooing as well as avoiding lowering position of the tattooed eyebrow.

Surgical Procedures

Operations were performed under the local anesthesia using approximately 2 mL 2% lidocaine containing 1:100,000 epinephrine per side. The incision lines were drawn as mentioned above, and the spindle-like marked skin was incised and removed with a No. 15 blade, followed by removal of its underlying OOM (Fig. 3A–C). An approximate 2 mm OOM was preserved at the superior stump margin (Fig. 3D). The supraorbital nerve exits the orbit via the supraorbital notch or foramen, and the lacrimal nerve enters the orbit via the superolateral compartment of the superior orbital fissure, both locate deeper to the retro-orbicularis oculus fat (ROOF) [10]. Careful dissection was performed during surgery to prevent injury to

Fig. 3 Operative procedure of the modified technique. **A** Sign of the spindle-like incision lines. **B** Excision of loose skin and exposure of the OOM. **C** Removal of OOM flap. **D** The inferior OOM flap is sutured to the superior OOM flap. **E** The incision is closed with interrupted sutures. **F** A 6–0 Ti–Ni memory alloy tissue anastomatsuture is used to reinforce the suture. OOM, orbicularis oculi muscle.



these nerves and avoid impairing the function of OOM and corrugator. OOM inferior to the incision could be dissected 5–10 mm toward to the ciliary lash and separated from the upper eyelid skin. Then, inferior and superior OOM flaps were reapproximated with interrupted stitches using the 5-0 polydioxanone sutures (PDS). The skin was closed with interrupted stitches, and a 6–0 Ti–Ni memory alloy tissue anastomatsuture (Shanxi Fulltai Medical Technology Co., LTD.) was used to reinforce the suture (Fig. 3E, F). A diagram of the surgical procedure is presented in Fig. 4.

Cosmetic Outcome Assessments

Outcome assessments consisted of skin laxity improvement, overall satisfaction and postoperative complications. Upper eyelid skin laxity was quantitatively evaluated with HPPC, HPMC and HPLC in the same way as before, the difference between the pre- and postoperative values indicated the improvement of laxity. The overall cosmetic satisfaction score was graded as totally satisfactory, satisfactory, fair, and poor based on evaluation of the subbrow scar, symmetry of palpebral crease, lateral hooding lifting

visual block improvement and the brow shape by a surgeon unrelated to the study and patients themselves during the follow-up. Early-stage (such as hematoma and numbness in the eyebrow region) and long-term complications (such as scar hypertrophy and sunken upper eyelid) were documented postoperatively.

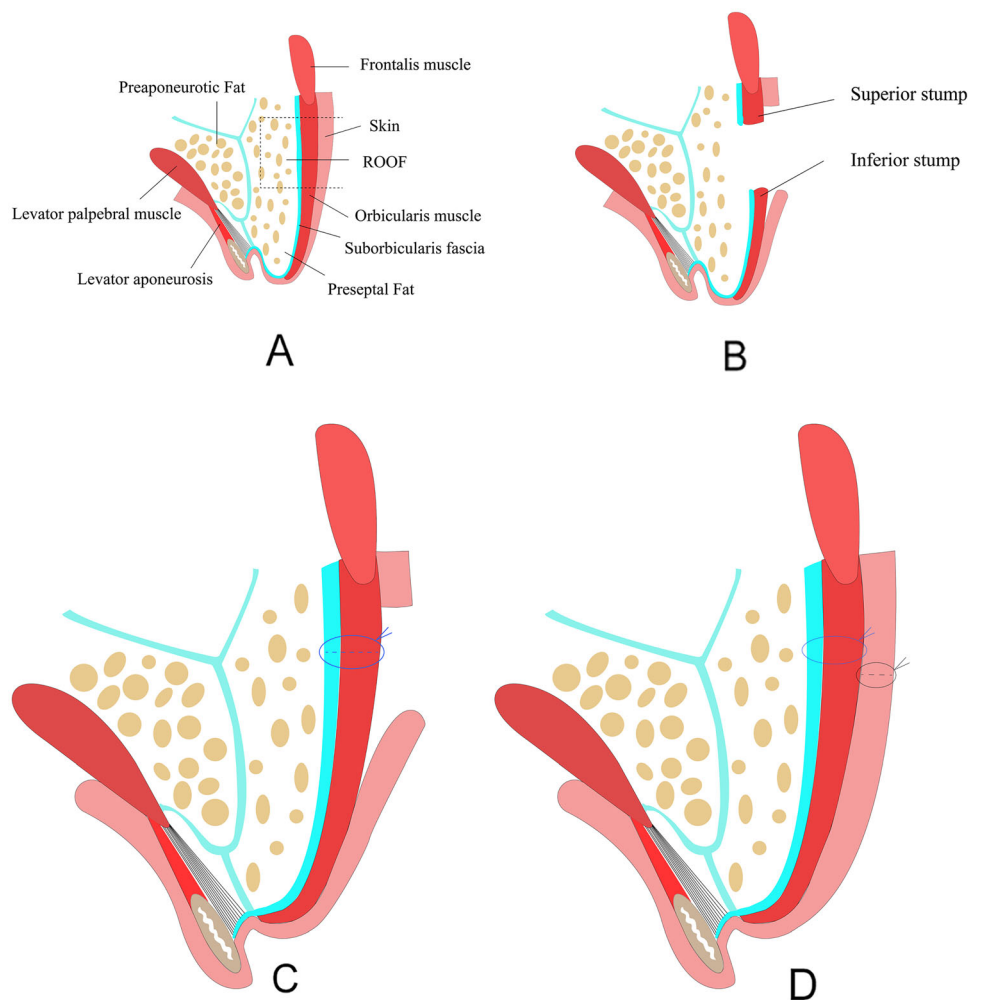
Statistical Analysis

Statistical analysis was conducted using IBM SPSS Version 23.0 (IBM Corp., Redmond, Wash.). Continuous variables are presented as the mean \pm SD. The Student's *t* test was used to analyze the differences of HPPC, HPMC and HPLC between pre- and post-surgery. A value of $p < 0.05$ was considered statistically significant.

Results

A total of 75 patients were enrolled, including 3 men and 72 women. Their ages ranged from 45 to 66 years (mean, 54.5). 63 patients (84%) were primary cases, while 12

Fig. 4 Diagram of operative procedure. **A** The anatomy of the upper eyelid. **B** The loose eyelid skin, part of the orbicularis muscle and ROOF are removed, while the superior and inferior orbicularis muscle stumps are formed. **C** The muscle stumps are sutured with interrupted stitches. **D** Closure of the skin incision. ROOF, retro-orbicularis oculi fat.



(16%) had undergone other oculoplastic surgery. The mean follow-up period was 14.6 months (range, 12–18 months).

In terms of the skin laxity, the mean preoperative HPPC, HPMC, HPLC were 4.27 ± 0.40 , 4.72 ± 0.45 and 3.41 ± 0.35 mm, respectively. The mean postoperative values were 7.01 ± 0.46 , 6.57 ± 0.34 and 5.69 ± 0.26 , respectively, which showed statistical significance with the *p* value <0.05 (Table 1).

The pre- and postoperative photographs were evaluated by an independent surgeon, and 47 patients (62.7%) were rated as totally satisfactory, 24 (32%) were rated as satisfactory, while 4 (5.3%) were graded as fair. As for patient satisfaction, 46 patients (61.3%) were self-assessed as

totally satisfactory, 23 (30.7%) as satisfactory, and 6 (8%) as fair (Table 2). Mean surgeon satisfaction scores and patient satisfaction scores were 3.6 ± 0.6 (range, 2.0–4.0) and 3.5 ± 0.6 (range, 2.0–4.0), respectively. No case of poor was reported. The reoperation rate was 6.7% (5 patients), due to eyelid crease asymmetry and slight under-correction.

2 cases (2.7%) of transient numbness were recorded 2 and 5 days postoperatively, and 5 cases (6.7%) had hematoma. However, all these complications spontaneously recovered within 14 days. 3 (4%) of slight asymmetry of bilateral eyebrow position were observed but did not require a revision. No hypertrophic scar, sunken upper

Table 1 Measurement of Upper Eyelid Laxity

Parameter (mm)	Preoperation	Postoperation	<i>p</i> -value
Above the medial side of cornea	4.72 ± 0.45	6.57 ± 0.34	<0.001
Above the pupil center	4.27 ± 0.40	7.01 ± 0.46	<0.001
Above the lateral canthus	3.41 ± 0.35	5.69 ± 0.26	<0.001

**p*-value <0.05 was considered significant, and *p*-value >0.05 was considered non-significant.

Table 2 Surgeon and patient's satisfaction measurement

Parameter	Poor	Fair	Satisfactory	Totally satisfactory	Score range	Mean \pm SD
Surgeon (cases)	0	4 (5.3%)	24 (32%)	47 (62.7%)	2.0–4.0	3.6 \pm 0.6
Patient (cases)	0	6 (8%)	23 (30.7%)	46 (61.3%)	2.0–4.0	3.5 \pm 0.6

*Satisfaction scores of 1, 2, 3, and 4 represented poor, fair, satisfactory, and totally satisfactory, respectively.

eyelids or other complications was found in this series (Table 3).

Case Report

A 51-year-old woman had severe dermatochalasis and pseudoblepharoptosis. She had not undergone previous plastic surgery. The average HPPC, HPMC and HPLC were 4, 5.1 and 3.6 mm. The bilateral pinch test was 4.4 mm. Twelve months postoperatively, the average HPPC, HPMC and HPLC were improved to 6.6, 6.0 and 5.3 mm with 2 mm for bilateral pinch test (Fig. 5A, B).

A 64-year-old woman had severe dermatochalasis and inherent double-eyelids with no oculoplastic surgery. Her HPPC, HPMC and HPLC were measured as 4.2, 5.2 and 3.3 mm before the surgery. The bilateral pinch test was 4.9 mm. Twelve months after surgery, the HPPC, HPMC and HPLC were improved to 6.9, 6.1 and 6 mm with 2.3 cm for bilateral pinch test (Fig. 6A–D).

Discussion

The most conspicuous characteristics of periorbital aging are dermatochalasis, eye bag, pseudoptosis, periorbital wrinkles and malformation of multiple eyelid creases [5]. Current correction of these bothersome conditions is usually carried out through DS or SBB [3, 5, 11–13]. Compared with DS, the incision of SBB is longer and extends toward the lateral extremity of the eyebrow, which facilitates the correction of lateral hooding, especially in cases of severe dermatochalasis [1]. In addition, the thicker part

Table 3 Complications

<i>Early-stage complications</i>	
Hematoma	5 patients (6.7%)
Numbness in the eyebrow region	2 patients (2.7%)
<i>Long-term complications</i>	
Bilateral asymmetry	3 patients (4%)
Scar hypertrophy	0 patient
Sunken upper eyelid	0 patient

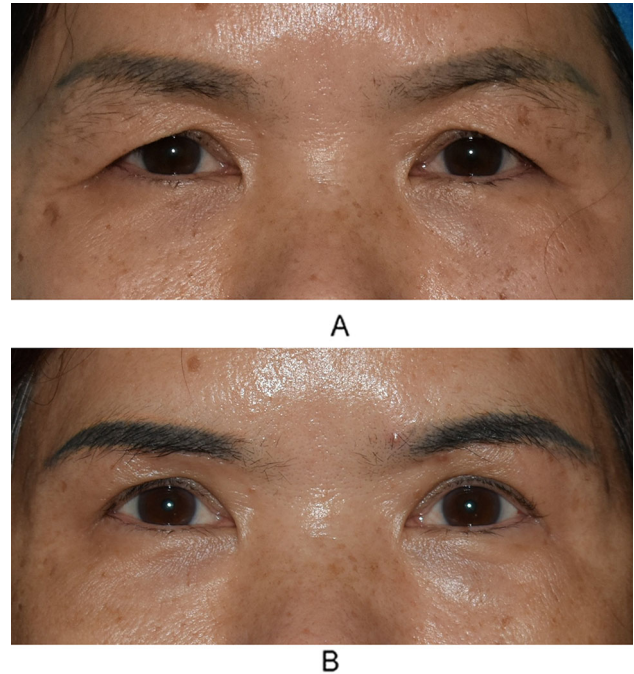


Fig. 5 A 51-year-old woman presented with severe blepharochalasis who underwent the described surgery and achieved good outcomes. **A** Preoperative straight-ahead gaze. **B** 12 months postoperative result with eyes open.

of the eyelid skin below the eyebrow is pruned in SBB, while the preferred thinner upper eyelid skin close to the ciliary lash region will be preserved, leaving double eyelids looking more natural and more aesthetic in patients with congenital eyelid folds. Another disadvantage of DS is that for older patients undergoing the surgery, each junction of the wrinkles and the incision could form a fold, which significantly affects aesthetic outcomes and impairs patients' appearance (Fig. 7). Therefore, subbrow incision is more suitable to resolve the upper eyelid skin laxity than double-eyelid incision.

Although various techniques of SBB have been reported for treating upper eyelid skin laxity, they are mainly indicated for mild and moderate dermatochalasis and cannot effectively remove the obvious redundant skin in patients with severe blepharochalasis [6–8]. In 2021, Guo et al. established an approach combining advanced SBB with DS to better ameliorate severe eyelid skin laxity [9]. However, this approach also had several drawbacks, such as the

Fig. 6 A 64-year-old woman with severe blepharochalasis and inherent double eyelids who underwent the described surgery and achieved ideal outcomes. **A** Preoperative straight-ahead gaze. **B** Preoperative closure of eyes. **C** 12 months postoperative result with eyes open. **D** Postoperative closure of eyes.

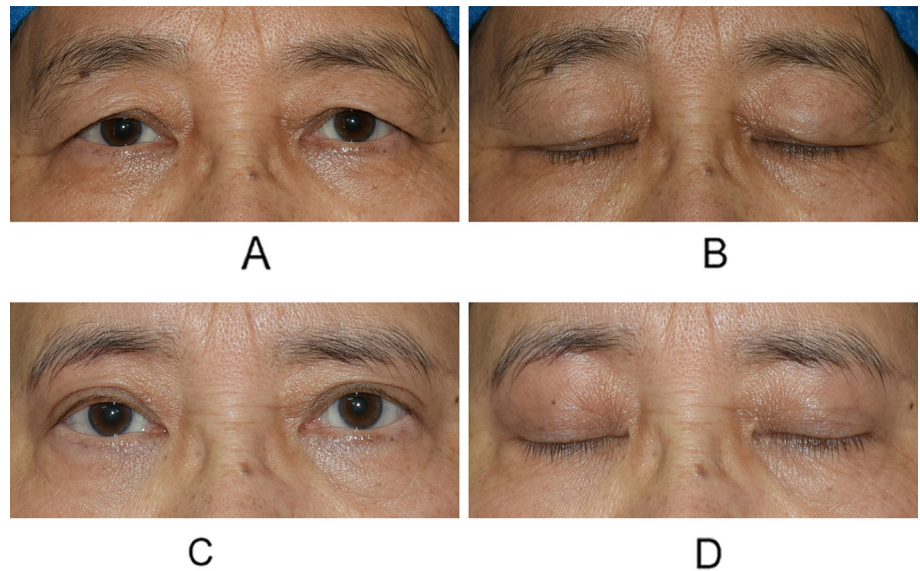


Fig. 7 The undesirable appearance of a 55-year-old woman who underwent a double-eyelid surgery for correcting skin laxity.

complicated procedures and large surgical trauma. Moreover, it was also difficult to strike the balance between the amount of removed eyelid skin and the desired width of double-eyelid crease. The described technique ameliorates the skin laxity without additional double-eyelid incision, and the surgical procedure is relatively simple for beginners. Less procedures reduced the intraoperative trauma, which further reduced postoperative swelling and convalescence.

In clinical experiences, we found that many surgeons conducted preoperative design with patients in the supine position. This position could not take into account gravitational impact, thereby leading to inaccurate skin laxity evaluation, while the sitting position in our technique facilitates a more precise preoperative design. In this approach, the patient's chin was slightly lowered with eyes in primary gaze, and the angle between the sagittal line of patient's head and the perpendicular line was nearly 15° , which provided ideal laxity evaluation and increased the amount of eyelid skin involved into the incision region. With this preoperative design, a single subbrow incision is sufficient to ameliorate severe dermatochalasis.

In this study, some patients sought to ameliorate the shape of the eyebrow through the surgery, thus personalized incision was a key point and shall be designed based

on the patient's initial eyebrows and their requirement. In cases with wide and messy eyebrow, part of the eyebrows was involved into the incision region in order to remodel its shape; while in cases with narrow eyebrows, the upper line was designed at the inferior edge of the eyebrow to avoid further narrowing. For patients with ptosis of the eyebrow tail, the lateral incision shall be raised laterally to form a triangular back cut, and part of the tail was involved into the incision region. When addressing the significant lateral hooding, the incision line could be extended laterally up to 5 mm to the temporal skin. No obvious scar was observed during the follow-up. For potential scar formation, eyebrow tattoo was recommended, especially for those who already had eyebrow tattoo before surgery.

Thick ROOF and excessive orbital fat are usually observed in many Asians, contributing to bulky upper eyelids. However, the majority present sunken upper eyelids and skin laxity in the elder because of tissue shrinkage and loss. For patients with hollow eyelids, any removal of ROOF or orbital fat shall be avoided, as that could potentially result in adhesion of the subcutaneous tissues with the levator aponeurosis [1]. Volume grafting at the ROOF layer was recommended for individuals with high expectation and pursuit of better eye appearance.

The management of OOM is critical to surgical outcomes. As previous reported, the contraction and relaxation of OOM leads to dynamic wrinkles, and loose OOM can aggravate the eyelid skin laxity [14, 15]. Various approaches of OMM manipulation have been established to resolve these problems [9, 16, 17]. During this procedure, a strip of OOM was removed instead of plication which usually conducted in cases of mild or moderate skin laxity, thereby considerably alleviating dermatochalasis. A 2-mm OOM stump was preserved at the upper edge of the

incision. The OMM at the lower edge of the incision was dissected 5–10 mm in the direction of the eyelid margin and separated from the upper eyelid skin, forming an inferior OOM stump. The inferior stump was pulled upward and sutured to the superior stump. In patients with significantly loose skin, a large amount of the eyelid skin and OOM were pruned, thus the separation of the OOM stumps from the eyelid skin at each edge of the incision should be properly extended toward the eyebrow and toward the eyelid margin by 1–3 mm, respectively, to further reduce skin tension. Moreover, the effects of muscle contraction on the overlying skin could lead to the aggravation of existed wrinkles and the formation of novel wrinkles, especially in older patients. Our technique could effectively relieve wrinkles by fixing the OOM stumps with interrupted sutures. We adjusted the direction of dermatoglyphics in the process of performing each stitch to diminish and prevent the aggravation of wrinkle lines. During follow-ups, satisfactory upper eyelid appearances with obvious relief of temporal wrinkles were achieved in all reviewed patients.

Conclusions

The described preoperative design addresses the blind spot of conventional subbrow blepharoplasty and makes it possible to resolve severe upper eyelid skin laxity through a single incision. Moreover, our modified technique is safe and effective for correction of severe blepharochalasis and could achieve satisfactory cosmetic outcomes.

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Declarations

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

Ethical approval The study was conducted with accordance to the Declaration of Helsinki and in accordance with the standards of good clinical care following local guidelines. No ethical approval was solicited due to the retrospective and observational character of this study.

Informed consent Written consent was obtained from all patients included in this study within this manuscript for accessing their data for the purposes of this study. All patients in the images provided written informed consent for sharing their pictures.

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