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ORIGINAL ARTICLE OCULOPLASTIC

A Randomized, Controlled Study Comparing Subbrow Blepharoplasty and Subbrow Blepharoplasty Combined with Periorbital Muscle Manipulation for Periorbital Aging Rejuvenation in Asians

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Abstract

Background Improving periorbital aging is, currently, of great concern. The previous literature has reported some surgical methods for periorbital aging. The purpose of this study was to compare subbrow blepharoplasty (SBB) with subbrow blepharoplasty combined with periorbital muscle manipulation (SBB-pm) with regard to improving periorbital aging.

Methods A prospective, randomized, controlled study was designed to evaluate and compare the effects of two different surgical techniques on upper lid relaxation, brow shape and periorbital wrinkles. Patients were divided into two groups. Group 1 underwent resection of excess skin; group 2 underwent a modified technique that involved resection of an elliptical island of skin, separation of the corrugator supercilii muscle and dissection of the orbicularis oculi muscle, followed by suturing it to the orbital periosteum and cross-fixation with itself. The upper eyelid and eyebrow height, periorbital wrinkle score and patient satisfaction were measured preoperatively and postoperatively.

Results This study included 70 patients (140 eyes). At 1 month, 3 months, 6 months and 12 months after surgery, group 2 was superior to group 1 with regard to the improvement in upper eyelid relaxation at the medial limbus, middle pupil and lateral canthus. The eyebrow assumed a low and flat appearance in group 1. The eyebrow showed a low and flat appearance and then returned to the preoperative level in group 2. When comparing the two surgical techniques, the authors found statistically significant differences in regard to changes in crow's feet and glabellar frown lines. Two patients in group 2 experienced forehead numbness after surgery, which resolved by the 6-month follow-up. Patients in group 2 were significantly more satisfied with their surgery than patients in group 1.

Conclusion SBB-pm is more effective than SBB for improving upper eyelid relaxation and preventing secondary brow ptosis after surgery as well as for alleviating periorbital wrinkles, although it is accompanied by transient forehead numbness.

Level of Evidence II 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 Periorbital aging · Upper eyelid laxity · Periorbital wrinkle · Periorbital muscle treatment

Introduction

Eyebrows and eyes are important aspects of one's facial appearance. Facial expressions created by the eyebrows and eyes communicate different messages to individuals during social activities. However, the eyebrows and eyes are the areas on the face that are prone to aging the most, and they are key components of an aged appearance of the face [1, 2].

In Asians, subbrow blepharoplasty (SBB) is a commonly performed surgery of the eyelids that addresses eyelid skin redundancy or laxity as well as fat prolapse [3, 4]. SBB entails a simple excision of redundant skin and

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muscle and has several advantages, including a short recovery period, reviving the patient's natural eyelid crease and avoiding the creation of a new lid fold, which is one of the ethnic characteristics of Asians [5]. However, many plastic surgeons are unaware of the shortcomings of SBB that are emerging during the follow-up period. Secondary brow ptosis after SBB often results from skin tension from the surgical incision [6, 7]. It is commonly observed that as the width of the skin excision increases, the eyebrows drop more. In addition, recurrent upper eyelid laxity is common in a high percentage of patients.

Subbrow blepharoplasty combined with periorbital muscle manipulation (SBB-pm) is a modified subbrow blepharoplasty technique that is thought to be more effective than the traditional technique in improving periorbital aging [8]. However, these claims are based largely on expert experience and lack high-level evidence.

No previous reports have compared the variation in the upper eyelid position and eyebrow shape between SBB alone and SBB in combination with periorbital muscle manipulation. The objective of this prospective randomized trial was to compare SBB with SBB-pm using objective measurements and patient satisfaction scores.

Materials and Methods

This prospective, double-blind randomized controlled study was designed to compare the effects of two different operation methods on improving periorbital aging. The trial protocol was approved by Xijing Hospital Institutional Review Board. The study was performed in accordance with the Helsinki Declaration and Good Clinical Practice.

Patients and Randomization

This study included a consecutive sample of patients who underwent surgery between September 2017 and June 2018. Written consent was obtained from all patients. The inclusion criteria were as follows: (1) age-group in the 40 s through 60 s; (2) lateral lid hooding as the primary concern; (3) a desire to restore natural lid crease lines; and (4) obvious periorbital wrinkles (glabellar frown lines and crow's feet). The exclusion criteria were as follows: (1) congenital or acquired malformation of the facial cranium; (2) a previous injection of botulinum toxin within 6 months before enrollment; (3) myasthenia; (4) facial paralysis; and (5) eyebrow defects.

The included patients were randomized into two groups. The allocation for treatment was performed by computer-generated random numbers. Patients in group 1 underwent SBB, while patients in group 2 underwent SBB-pm.

Surgical Technique

All procedures were performed by one plastic surgeon (Professor Baoqiang Song). Preoperatively, markings were made with the patient sitting upright with a neutral gaze and the brow properly positioned. The amount of skin removal was determined on the recurrence of a natural eyelid crease that patients desired during preoperative design. A spindle-shaped region of skin was marked with an upper incision line along the lower margin of the natural or tattoo brow, and the lower incision line had a curved shape (Fig. 1). The largest width of the excised skin was approximately 6–12 mm. Patients who were not satisfied with the former eyebrow tattoo were allowed to undergo partial or complete eyebrow tattoo excision and receive a new eyebrow tattoo 6 months after the operation.

The operation was performed under local anesthesia (2% lidocaine combined with epinephrine 1:100,000). In group 1, an incision was made with a no. 15 blade to the subcutaneous level. The upper incision was beveled along the inferior margin of the eyebrow to prevent damage to hair follicles. The incision along the lower incision line was vertical. In the skin ellipse, skin and subcutaneous tissue were excised en bloc. Hemostasis was attained with bipolar cauterization. The subcutaneous sutures were placed with 5-0 absorbable sutures. The dermis and skin layers were closed with interrupted sutures. The operative incision area was pressurized with an elastic bandage that was continually in place. The bandage and skin sutures were removed on the third and fifth postoperative days, respectively.

In group 2, an incision was made with a no. 15 blade to the subcutaneous level. The upper incision was beveled along the inferior margin of the eyebrow to prevent damage to hair follicles. The incision along the lower incision line was vertical. An elliptical excision was made in the skin and subcutaneous tissue, and the orbicularis oculi muscle (OOM) was exposed. The OOM was divided by a

Fig. 1 Surgical design. The areas of skin marked for excision are spindle-shaped

transverse incision into the upper one-third flap and the inferior two-thirds flap (Fig. 2a). The incision of the OOM extended to both sides by 0.5–1 cm. At the supraorbital nerve (SON) area, the corrugator muscle was carefully dissected, cut off and separated by 4–6 mm (Fig. 2b, c). In the upper margin of the incision, the OOM lying on the lateral side of the SON was separated from the preseptal fat by approximately 1.5 cm. The OOM was separated from the connective tissue in the inferior margin of the incision, pulled upward and sutured to the supraorbital rim periosteum and subbrow fat temporal to the SON with 3–5 transverse 3-0 absorbable sutures (Fig. 2d). In addition, the OOM within 5 mm lateral to the orbital rim was separated from subcutaneous tissue, splayed out and sutured upward and inward to the periosteum in this expanded position. The bottom end of the upper one-third of the OOM was inserted downward between the inferior two-thirds of the OOM and subcutaneous tissue and sutured with the inferior muscle with 3–5 transverse 4-0 absorbable sutures so that the muscle flaps overlapped (Fig. 2e). The height of the lower muscle flap lift was determined by the amount of correction in upper eyelid hooding, the recurrence of a natural eyelid crease when patients opened their eyes and the inability to see the hypophasis when patients closed their eyes. In general, the muscle flap was anchored to the superior orbital rim by 7–10 mm. Hemostasis was attained with bipolar cauterization. Subcutaneous sutures were placed with 5-0 absorbable sutures. The dermis and skin layers were closed with interrupted sutures. The operative incision area was pressurized with an elastic bandage that was continually in place. The bandage and skin sutures were removed on the third and fifth postoperative days, respectively.

Excision Width of Upper Eyelid Skin

Digital photographs were taken with the preoperative design completed and methylene blue well marked. Objective measurements were performed by two blinded plastic surgeons using Adobe Photoshop (Adobe Systems, Inc., San Jose, Calif.). The excision width of the upper eyelid skin was measured at three points: the medial limbus, the midpupil and the lateral canthus.

Improvement in Upper Eyelid Relaxation Correction and Morphological Eyebrow Changes

Patient photographs were taken before the procedure and 1 month, 3 months, 6 months and 12 months after the procedure. Objective measurements were performed by two blinded plastic surgeons using Adobe Photoshop (Adobe Systems, Inc., San Jose, Calif.). The patients were photographed with their head in an upright position and neck in a neutral position. Digital photographs were taken with the forehead and eyebrows in a maximally relaxed position and the eyes open; the patients were asked to close their eyes and then gently open them before being photographed. A tag of known dimensions placed on the forehead was used as a measurement scale. The upper eyelid and eyebrow positions were measured bilaterally. The vertical distances from the midpupillary horizontal plane to the upper eyelid creases were measured at three points: the medial limbus, the midpupil and the lateral canthus. The vertical distances from the midpupillary horizontal plane to the eyebrow margins were measured at three points, namely the medial limbus, the midpupil and the lateral canthus (Fig. 3).

Patient Evaluation

Modifications in the patients' crow's feet and glabellar frown lines and patient satisfaction were evaluated. All photographs taken before surgery, 12 months after surgery and at the time of this evaluation were randomized and scored by three independent reviewers (two plastic surgeons and one layperson) blinded to the study groups by the wrinkle assessment scale developed by Lemperle et al. [9]. At 12 months after surgery, the patients underwent a

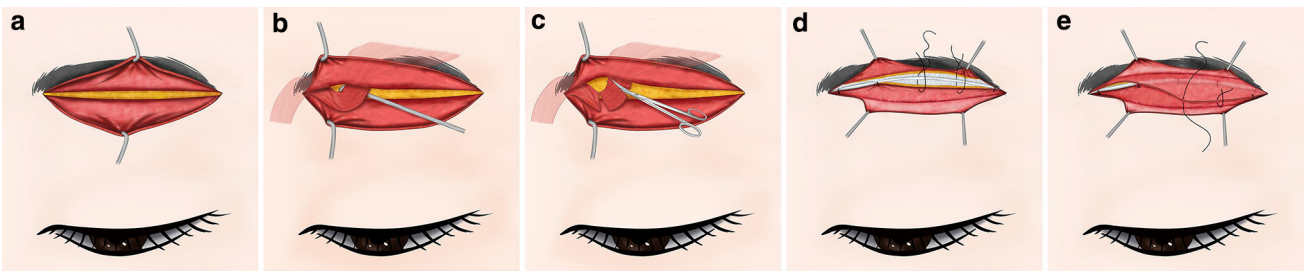

Fig. 2 Surgical technique. **a** The OOM was divided by a transverse incision into the upper one-third flap and the inferior two-thirds flap. **b** The corrugator muscle is fully revealed below the brow. **c** The corrugator muscle is cut off and separated by 4–6 mm. **d** Suture plication/suspension of the lower muscle flap to the supraorbital rim periosteum and subbrow fat located temporally to the SON. **e** A crossed muscle flap created with the upper muscle flap and the lower muscle flap

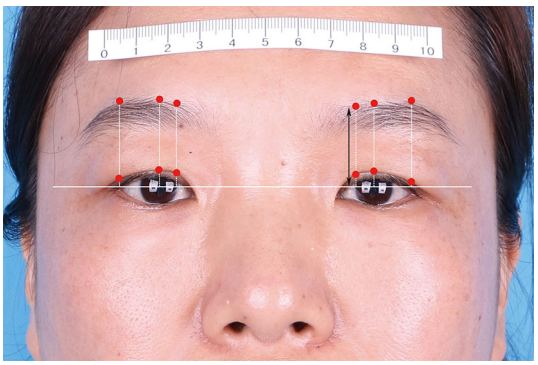

Fig. 3 Measurements of the upper eyelid and eyebrow positions. A horizontal plane is drawn through the midpupil. Vertical lines are drawn from the horizontal to the upper eyelid creases, and the upper brow margins at these points, the medial limbus, the midpupil and lateral canthus were measured. A tag of known dimensions placed on the forehead was used as a measurement scale, and these distances were measured in millimeters

self-assessment of the apparent improvement in the lateral hooding of the upper eyelid skin (question 1) and the brow position (question 2). The responses to question 1 and question 2 were selected from a 5-item scale (0 = none, 1 = minimal, 2 = modest, 3 = very good and 4 = complete).

Statistical Analysis

Continuous variables are reported as the mean ± SD. The between-group differences in continuous, normally distributed data were assessed using the independent *t* test, and for nonparametric data, the Mann–Whitney *U* test was used. For intragroup comparisons, the paired t test was used. All analyses were performed with IBM SPSS Advanced Statistical Software version 22.0 (IBM Corp., Armonk, N.Y.). A value of $p < 0.05$ was considered to indicate statistical significance.

RESULTS

Study Population

Seventy patients (140 eyes) were enrolled and randomized into group 1 and group 2 (n = 35 and 35, respectively). The demographic data and baseline characteristics are shown in Table 1. Overall, the demographic characteristics were similar between the treatment groups. All patients in both groups were followed up for more than 12 months. The mean duration of follow-up was 13 months in group 1 and 14 months in group 2.

Table 1 Baseline demographics and patient characteristics

	Group 1	Group 2	*p*
No. of patients	35	35	
Age at surgery (years)			
Mean ± SD	47.8 ± 7.5	48.5 ± 6.1	0.652
Range (min, max)	41–67	45–62	
Gender, *n* (%)			
Female	35	35	
Race			
Asian	35	35	
Excision width of upper eyelid skin at the medial limbus (mm)			
Mean ± SD	4.4 ± 0.4	4.5 ± 0.5	0.184
Range (min, max)	3.5–5.0	3.8–5.3	
Excision width of upper eyelid skin at the midpupil (mm)			
Mean ± SD	6.4 ± 0.4	6.5 ± 0.5	0.09
Range (min, max)	5.6–6.9	5.4–7.8	
Excision width of upper eyelid skin at the lateral canthus (mm)			
Mean ± SD	9.7 ± 0.9	9.8 ± 1.0	0.603
Range (min, max)	8.9–12.5	8.4–12.0	

Data are expressed as mean ± SD (range). The independent *t* test was used to compare group means, with a value of $p < 0.05$ considered significant

Efficacy

The amount of correction in upper eyelid relaxation was determined by comparisons among the preoperative and 1 month, 3 month, 6 month and 12 month postoperative photographs (Table 2). The analysis of data from the per-protocol population showed a significantly larger change from baseline to 1 month in upper eyelid height at the medial limbus, midpupil and lateral canthus points in group 2 than in group 1. At 3 months, 6 months and 12 months after the operation, there were significant differences in the upper eyelid changes at all points between the two groups. The upper eyelid height in group 1 gradually decreased relative to the 1 month value, and the largest decrease was at the lateral limbus eyelid. The upper eyelid height in group 2 slightly decreased, and the decrease was smaller in group 2 than in group 1 (Figs. 4, 5, 6, 7).

To evaluate the eyebrow morphological changes, the upper eyebrow heights at the medial limbus, midpupil and lateral canthus points measured preoperatively and 1 month, 3 months, 6 months and 12 months postoperatively were compared (Table 3). In group 1, the brow descended by 1.34–2.05 mm at all positions 1 month after surgery and remained at the same height until 12 months after the operation, leading to a low and flat appearance (Figs. 4, 5). In group 2, the eyebrow descended by 0.91–1.42 mm at all positions at 1 month after the

Table 2 Changes in upper eyelid height measurements between two groups (mm)

	Group 1	Group 2	*p*
1 month after operation			
MLEH	0.54 ± 0.52	0.88 ± 0.62	< 0.001
MPEH	0.83 ± 0.76	1.43 ± 0.74	< 0.001
LCEH	1.37 ± 0.93	1.95 ± 0.83	< 0.001
3 months after operation			
MLEH	0.5 ± 0.56	0.84 ± 0.61	< 0.001
MPEH	0.76 ± 0.68	1.41 ± 0.71	< 0.001
LCEH	1.28 ± 0.87	1.89 ± 0.92	< 0.001
6 months after operation			
MLEH	0.47 ± 0.54	0.8 ± 0.58	< 0.001
MPEH	0.69 ± 0.78	1.34 ± 0.76	< 0.001
LCEH	1.09 ± 0.7	1.8 ± 0.76	< 0.001
12 months after operation			
MLEH	0.44 ± 0.52	0.78 ± 0.63	< 0.001
MPEH	0.58 ± 0.78	1.27 ± 0.73	< 0.001
LCEH	0.83 ± 0.65	1.71 ± 0.68	< 0.001

Data are shown as mean of distance (mm) measured from digital images

MLEH medial limbus eyelid height, *MPEH* mid pupil eyelid height, *LCEH* lateral canthus eyelid height

The independent *t* test was used to compare group means, with a value of $p < 0.05$ considered significant

operation, with a statistically significant difference, leading to a flat appearance; it then returned to the preoperative value during the remaining follow-up time, and the preoperative eyebrow morphology returned (Figs. 6, 7). There were significant differences in the upper eyebrow height measurements at the medial limbus points between the two groups at 3 months, 6 months and 12 months after the operation (Fig. 8). There were significant differences in the upper eyebrow height measurements at the midpupil and lateral canthus points between the two groups at 1 month, 3 months, 6 months and 12 months after the operation (Figs. 9, 10).

In group 1, the mean changes in the rhytide scores for crow's feet and glabellar frown lines were 0.47 ± 0.12 and 0, respectively (Figs. 4, 5). In group 2, the mean changes in the rhytide scores for crow's feet and glabellar frown lines were 1.02 ± 0.18 and 2.13 ± 0.93, respectively (Figs. 6, 7). The amount of wrinkle alleviation was significantly greater in group 2 than in group 1 ($p < 0.05$).

With regard to question 1, the mean patient satisfaction scores at 12 months were 3.03 ± 0.71 and 3.43 ± 0.65 for groups 1 and 2, respectively ($p < 0.05$). With regard to question 2, the mean patient satisfaction scores at 12 months were 2.86 ± 0.69 and 3.74 ± 0.44 for groups 1 and 2, respectively ($p < 0.05$). Postoperative complications, such as forehead numbness and obvious incisional

Fig. 4 The effect of SBB. **a** Preoperation: a 40-year-old woman with a moderate degree of aging in her eyelids was not satisfied with the former eyebrow tattoo. She underwent SBB to correct the lateral hooding of the upper eyelids. **b** The 6-month postoperative view shows improvement in the lateral lid hooding and the flattened appearance of the eyebrow. **c** At 12 months after the operation, she received a new eyebrow tattoo. The photograph shows descent of the upper eyelid and the flattened appearance of the eyebrow. **d** The postoperative view shows obvious crows' feet wrinkles. **e** The postoperative view shows the presence of corrugator function

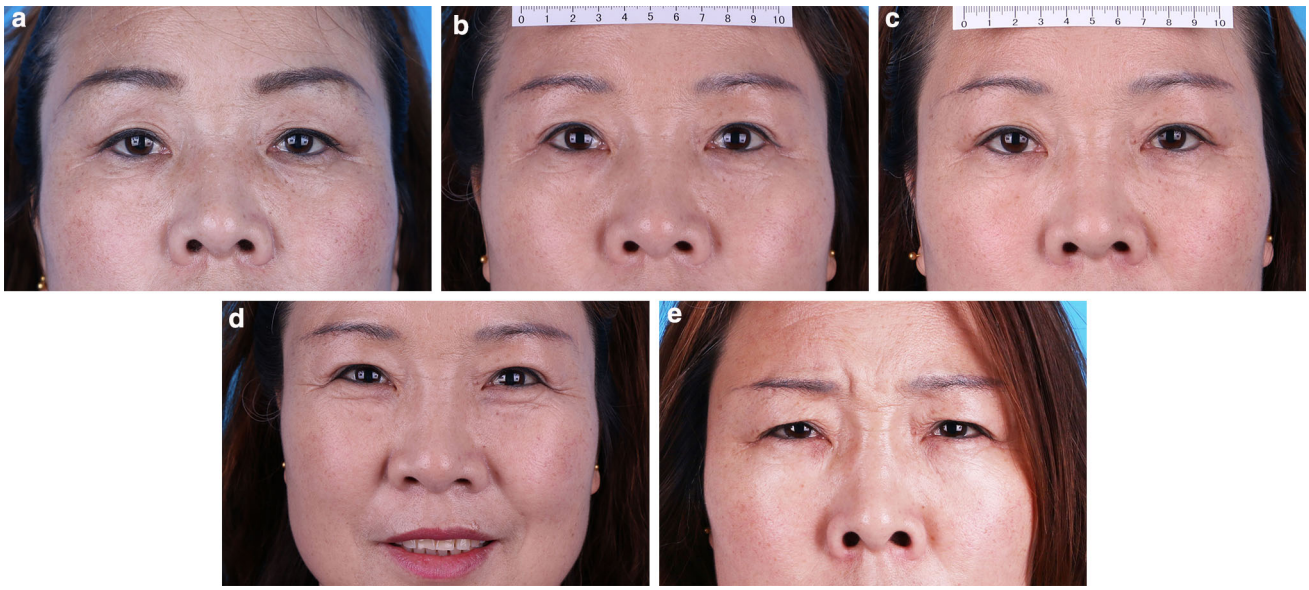

Fig. 5 The effect of SBB. **a** Preoperation: a 46-year-old woman with a moderate degree of aging in her eyelids was not satisfied with the former eyebrow tattoo. She underwent SBB to correct the lateral hooding of the upper eyelids. **b** The 6-month postoperative view shows improvement in the lateral lid hooding and the flattened appearance of the eyebrow. **c** The 12-month postoperative photograph shows descent of the upper eyelid and the flattened appearance of the eyebrow. **d** The postoperative view shows obvious crows' feet wrinkles. **e** The postoperative view shows the presence of corrugator function

Fig. 6 The effect of SBB-pm **a** Preoperation: a 43-year-old woman with a moderate degree of aging in her eyelids was not satisfied with the former eyebrow tattoo. She underwent SBB-pm to correct the lateral hooding of the upper eyelids. **b** The 6-month postoperative view shows improvement in lateral lid hooding. **c** The 12-month postoperative view shows a stable upper eyelid height. **d** The postoperative view shows mild crows' feet wrinkles. **e** The postoperative view shows the complete loss of corrugator function

scarring, were also evaluated during the follow-up period. Thirteen patients in group 2 reported forehead numbness that gradually subsided within 6 months. There was no conspicuous incisional scarring in all patients 12 months after surgery.

Discussion

The periorbital area represents a potential defining factor for facial attractiveness. Because of this conspicuous location, age-related changes, such as lateral hooding of the upper eyelid skin, eyebrow ptosis, and periorbital wrinkles,

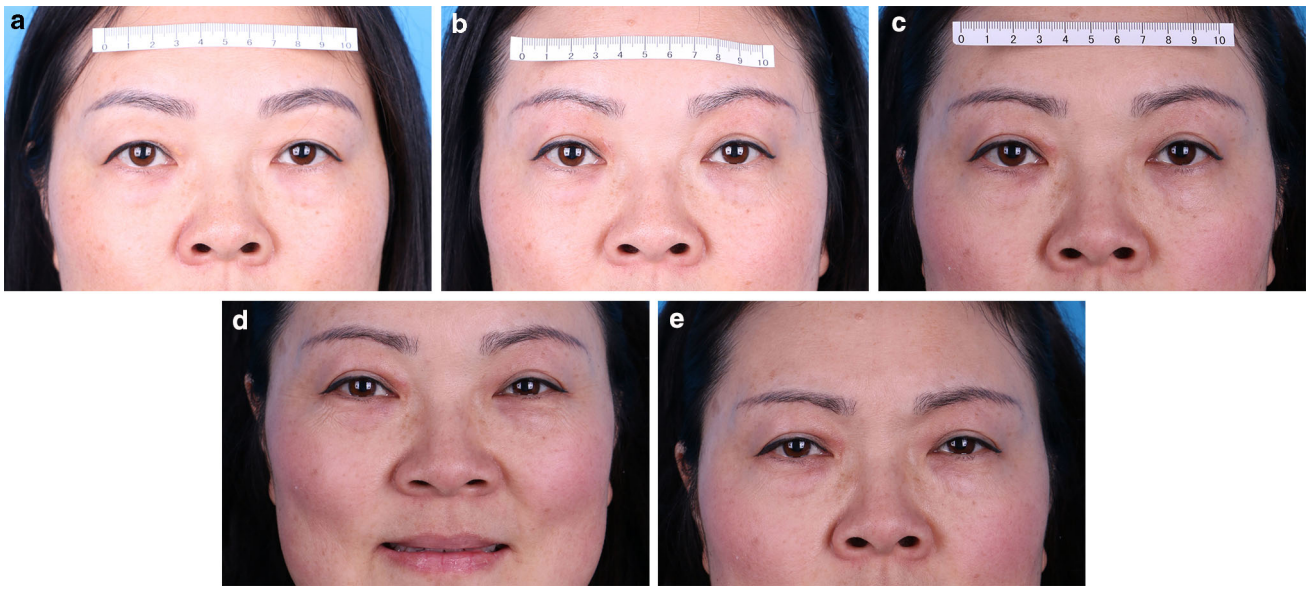

Fig. 7 The effect of SBB-pm a Preoperation: **a** 41-year-old woman with a mild degree of aging in her eyelids was not satisfied with the former eyebrow tattoo. She underwent SBB-pm to correct the lateral hooding of the upper eyelids. **b** The 6-month postoperative view shows improvement in lateral lid hooding. **c** The 12-month postoperative view shows a stable upper eyelid height. **d** The postoperative view shows mild crows' feet wrinkles. **e** The postoperative view shows the complete loss of corrugator function

Table 3 Eyebrow position measurements in two groups (mm)

	Preoperatively	1 month after operation	3 months after operation	6 months after operation	12 months after operation
Group 1					
MLBH	22.37 ± 1.98	21.03 ± 2.42*	20.99 ± 2.39	20.98 ± 2.39	20.93 ± 2.37
MPBH	22.94 ± 2.09	21.18 ± 2.53*	21.53 ± 2.49	21.49 ± 2.48	21.38 ± 2.45
LCBH	23.88 ± 1.81	21.83 ± 2.51*	21.78 ± 2.48	21.73 ± 2.47	21.61 ± 2.43
Group 2					
MLBH	22.16 ± 2.63	21.25 ± 2.77*	22.35 ± 2.55*	22.42 ± 2.52	22.49 ± 2.49
MPBH	22.82 ± 2.44	22.06 ± 2.69*	22.96 ± 2.42*	23.09 ± 2.39	23.14 ± 2.36
LCBH	24.33 ± 2.32	22.91 ± 2.51*	24.26 ± 2.26*	24.36 ± 2.21	24.39 ± 2.19

Data are shown as mean of distance (mm) measured from digital images

MLBH medial limbus brow height, *MPBH* mid pupil brow height, *LCBH* lateral canthus brow height

The paired *t* test was performed in each surgical group to detect eyebrow position changes (i.e., between presurgical procedure and 1 month of follow-up, between 1 and 3 months of follow-up, between 3 and 6 months of follow-up, and between 6 and 12 months of follow-up)

*Significant differences (paired *t* test, $p < 0.05$)

are leading complaints of patients seeking cosmetic surgery. The SBB technique was first described by Parkes et al. [10] in 1976 and has become popular among Asian women in recent years. SBB-pm is a modified technique that involves resection of an elliptical island of skin, separation of the corrugator supercilii muscle and dissection of the orbital orbicularis oculi muscle, followed by suturing of the muscle to the orbital periosteum and cross-fixation with itself to revive the natural eyelid shape, prevent secondary brow ptosis and alleviate periorbital wrinkles in Asian women [8].

Compared with patients who underwent resection of excess skin only during the operation, patients treated with the modified subbrow blepharoplasty technique experienced a more effective upper eyelid elevation and less eyebrow descent at 1 month after surgery. Analysis of the data from the two groups also showed that upper eyelid height was stable in group 2, while it continued to decrease in group 1 at 3 months, 6 months and 12 months after the operation. Preventing the recurrence of upper eyelid laxity after surgery is challenging. Recent studies have suggested that resection of excess skin combined with OOM fixation

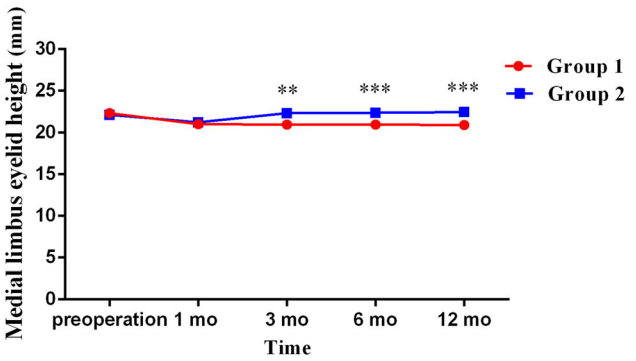

Fig. 8 The medial limbus brow height (MLBH) was measured preoperatively and at 1, 3, 6 and 12 months after the operation. The MLBH in group 1 was significantly lower than that in group 2 at 3, 6 and 12 months after the operation (*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; ****$p < 0.0001$)

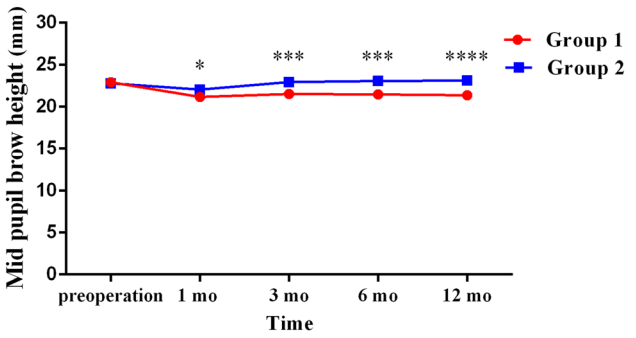

Fig. 9 The midpupil brow height (MPBH) was measured preoperatively and at 1, 3, 6 and 12 months after the operation. The MPBH in group 1 was significantly lower than that in group 2 at 1, 3, 6 and 12 months after the operation (*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; ****$p < 0.0001$)

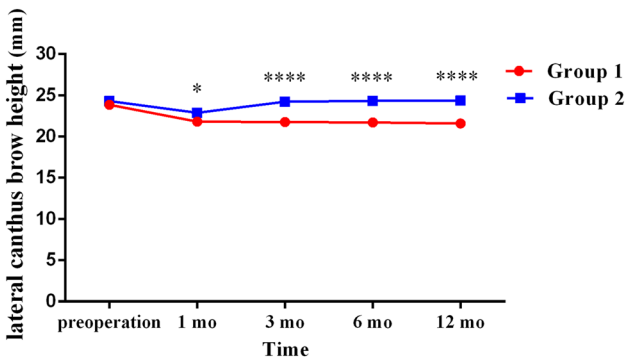

Fig. 10 The lateral canthus brow height (LCBH) was measured preoperatively and at 1, 3, 6 and 12 months after the operation. The LCBH in group 1 was significantly lower than that in group 2 at 1, 3, 6 and 12 months after the operation (*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; ****$p < 0.0001$)

might help maintain upper eyelid height [11], although a longer follow-up is required to determine whether this technique results in permanent lifting of the upper eyelid. With aging, skin elasticity and the amount of subcutaneous tissue reduce, and relaxation of the orbital orbicularis oculi muscle may occur [12–14]. Thus, removing the skin only cannot effectively improve tissue relaxation, especially in patients with severe upper eyelid laxity. When surgical tension is concentrated in skin with low elasticity, the raised upper eyelid naturally returns to the original position over time. We usually determine the height of OOM suturing to the periosteum on the basis of the amount of correction in upper eyelid hooding and the inability to see the hypophasis. The loose OOM is raised and bears the weight of the upper eyelid, which contributes to improved stability of the upper eyelid.

The natural position for the eyebrows is at or immediately above the supraorbital margin [15]. In group 1, overall, the patients' eyebrows descended, especially at the lateral canthus points, and presented a low and flat appearance. The patients' eyebrows descended to a lesser extent in group 2 than in group 1 at 1 month after the operation, and the original appearance was restored at the later stage of recovery. The SBB approach requires the resection of a substantial amount of skin to achieve an elevated upper eyelid, which creates high skin tension. Muscle suspension and fixation can reduce tension at the skin suture line and traction in the elevated upper eyelid. In addition, a neutral position of the eyebrow is maintained by the upward-pulling force generated from the frontalis muscle and the downward-pulling forces derived from the orbicularis oculi and corrugator muscles and severing the corrugator muscles and partial OOM can alleviate downward muscle strength [16, 17]. This process may be the reason for the rise in the eyebrows during the recovery period.

Both techniques can improve crow's feet by reducing upper eyelid relaxation. Muscle contraction is commonly considered to be the mechanism of periorbital wrinkles [18, 19]. We cut the corrugator muscles, separated the OOM from the subcutaneous tissue and suspended it in a stretched and expanded state. The results demonstrate that our procedure can improve glabellar frown lines and crow's feet wrinkles more effectively than SBB. In our experience, if the corrugator muscle is cut off rather than separated by 4–6 mm, it is usually reconnected by scar tissue, leading to only a minimal or temporary effect on frowning. More muscle destruction or interposition of fat may prevent the muscles from healing. In addition, we plan to perform SBB-pm combined with botulinum toxin A for periorbital wrinkle alleviation in a separate and extensive study.

Scarring is a common complication associated with facial surgery. In our study, no patient had scarring in either group. The infrabrow region is thought to be an area less prone to conspicuous scarring [3]. The application of interrupted sutures and pressure bandaging may be another

reason there was no scarring. A few patients who underwent SBB-pm presented with transient numbness over the forehead region. The numbness in these patients gradually resolved within 6 months during the long-term follow-up period. Injury to the supraorbital nerve branches and the supratrochlear nerve branches may be one of the reasons for this phenomenon, and careful dissection can reduce the incidence of this side effect. When patients choose SBB-pm, this complication should be explained to them before surgery.

In this trial, the subjects were women, so meaningful conclusions for male subjects should be drawn with caution. The sample size was small, with only 70 participating patients; studies with a larger sample size are necessary to confirm the results. Effectiveness data were collected over 12 months, and additional data collected over longer follow-up periods may provide information on the difference between the two surgical methods in the treatment of periorbital aging.

Conclusion

In this prospective double-blind randomized controlled study, we compared the effectiveness of SBB-pm and SBB in improving periorbital aging. SBB-pm is more effective than SBB in improving upper eyelid relaxation and preventing secondary brow ptosis after surgery, as well as alleviating periorbital wrinkles. SBB-pm causes transient forehead numbness, but SBB does not.

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Compliance with Ethical Standards

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

Ethical Approval The trial protocol was approved by Xijing Hospital Institutional Review Board. The study was performed in accordance with the Helsinki Declaration and Good Clinical Practice.

Informed Consent Written consent was obtained from all patients.

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