



A Modified Procedure for Single-eyelid Asian Females with Lacrimal Gland Prolapse: Lacrimal Gland Reposition combined with Fat Transposition in Double-eyelid Operation



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Abstract

Background The awareness and treatment of lacrimal gland prolapse (LGP) have been primarily improved with a further understanding of lateral eyelid bulging over the decades. However, for Asian single-eyelid females with LGP, a tailor-made procedure applicable to their comparatively young puffy eyes is needed.

Methods This is a retrospective study. From Jan. 2009 to Jan. 2019, two hundred and three Asian single-eyelid females with LGP, who met the inclusion criteria, underwent double-eyelid surgeries and adjunctive lacrimal gland repositions with preaponeurotic fat transposition. Pertinent demographics, complications, pre- and post-operative photography were collected.

Results A total of 167 patients completed the 4–24 months' follow-up (average: 16.3 months). One hundred and thirty-two cases (79.0%) were diagnosed as LGP pre-operatively, and the rest (35/167, 21.0%) were diagnosed intraoperatively. All patients (average: 28.4 years old)

received modified blepharoplasty. Postoperative symptoms involving local mild pain (2.9%, 5/167), upper eyelid tightness (3.6%, 6/167), and moderate epiphora (9.0%, 15/167) were all recovered spontaneously within one month. Prolapse recurrence and severe complications such as dry eye syndrome were not observed.

Conclusions We proposed a modified procedure to enhance the diagnosis and treatment of LGP during Asian blepharoplasty. The lacrimal gland suspension and fat transposition assured the cosmetic outcome for selected young, puffy Asian eyes. The supratarsal creases were satisfactory, and the complication rate was low. Furthermore, the rearrangement of preaponeurotic fat smoothed the contour transition and preserved the orbital volume. Therefore, this is a safe and effective technique worth recommending.

Keywords Asian female · Lacrimal gland prolapse · Double-eyelid operation · Fat flap transposition

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Introduction

Double-eyelid operation is one of the most frequently performed periocular procedures in Asia. The most evident anatomic feature of the oriental is that more than half of the race have low or absent lid creases and upper eyelid puffiness [1, 2]. In previous reports, the etiology of upper eyelid puffiness is largely attributed to preaponeurotic fat [1, 3]. However, though the lacrimal gland prolapse (LGP) is one of the causes of lateral eyelid bulging [4], it is mostly neglected in Asians. According to studies about the Caucasians, it exists along with the involuntional changes in the periocular region, of which the prevalence is 10%–15% among the aesthetic blepharoplasty patients [5]. Massry et al. [6] even reported an incidence as high as 60% in the senile Caucasian population. However, when it comes to Asian women, patients with LGP are relatively young, without senile changes of the lateral third of the upper lid and brow (Fig. 1). Also, unlike aged Caucasian patients aiming for rejuvenation described in the literature [7], Asian females present at the clinic with the purposes of distinct eyelid creases and natural upper eyelid contours. Thus, we considered the previous spectrum of LGP treatment was not suitable for young, puffy, single-crease Asian females.

Traditionally, three methods, including light cautery, partial excision, and suture reposition, are used to treat LGP. As light cautery and partial excision may impair the ocular lubrication system [8], surgical refixation is widely adopted. Nowadays, there are two main principles for surgical correction of the prolapsed lacrimal gland: One is repositioning the prolapsed gland by suturing it to the

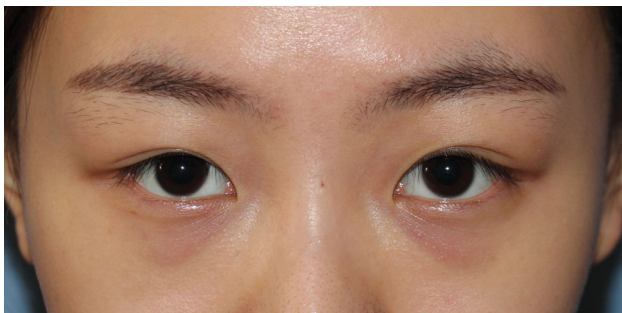


Fig. 1 A typical Asian LGP patient without senile changes of the lateral third of the upper lid and brow

periosteum of the lacrimal fossa, periosteum of superotemporal orbital rim [7, 9–13], or even the orbital rim with the help of two drilled holes [14]. The other one is strengthening supporting structures by suturing Whitnall's ligament to the periosteum of the orbital rim [8]. Commonly, as LGP accompanied with brow ptosis, dermatochalasis, or fat prolapse, conventional reposition of the lacrimal gland is adequate for contour correction. However, Asian females presenting for cosmetic blepharoplasty are commonly young, with most in their 20s. Simple lacrimal gland repositioning may leave unnatural and hollow upper eyelids.

Furthermore, the excessive preaponeurotic fat pad of the Asian female needs debulking during double-eyelid surgery [15], which provides a natural resource for lateral contour reshaping and strengthening the supporting structures for lacrimal glands. Thus, we innovatively combined lacrimal gland fixation with postseptal fat transposition. This study proposes to report our advancements in aesthetic blepharoplasty for Asian females with LGP and to provide insights for treating these patients.

Patients and Methods

Patients

From January 2009 to January 2019, a total of 203 patients (406 eyelids) underwent our modified aesthetic blepharoplasty in the outpatient clinic. One hundred and sixty-seven patients went back to the hospital for a follow-up visit from 4 to 24 months (average: 16.3 months). All of these patients were Asian females, ranging from 18 to 40 years (average: 28.4 years). Single-eyelid or inconspicuous double-fold eyelid females with LGP, which were detected either by the patients (symptoms or appearance) or the physician (physical examination or surgical explorations), were included. The exclusion criteria included severe congenital ptosis, craniofacial malformations (Apert, Crouzon, etc.), endocrinologic diseases (thyroid-related immune orbitopathy, diabetes), infectious diseases, post-traumatic deformities, secondary aesthetic blepharoplasty, severe chronic diseases (hypertension, coronary disease), and other obvious contraindications for blepharoplasty.

For each patient, we conducted a thorough history taking and physical examination (including visual inspection, palpation of LGP, and visual test), recorded preoperative photography (Fig. 2a), and then, after sufficient communication, designed and simulated the eyelid creases. Both verbal and written consents were obtained from each patient. Laboratory tests involved blood routine, coagulation, infectious diseases. The practiced surgeon (Dr. Jin)

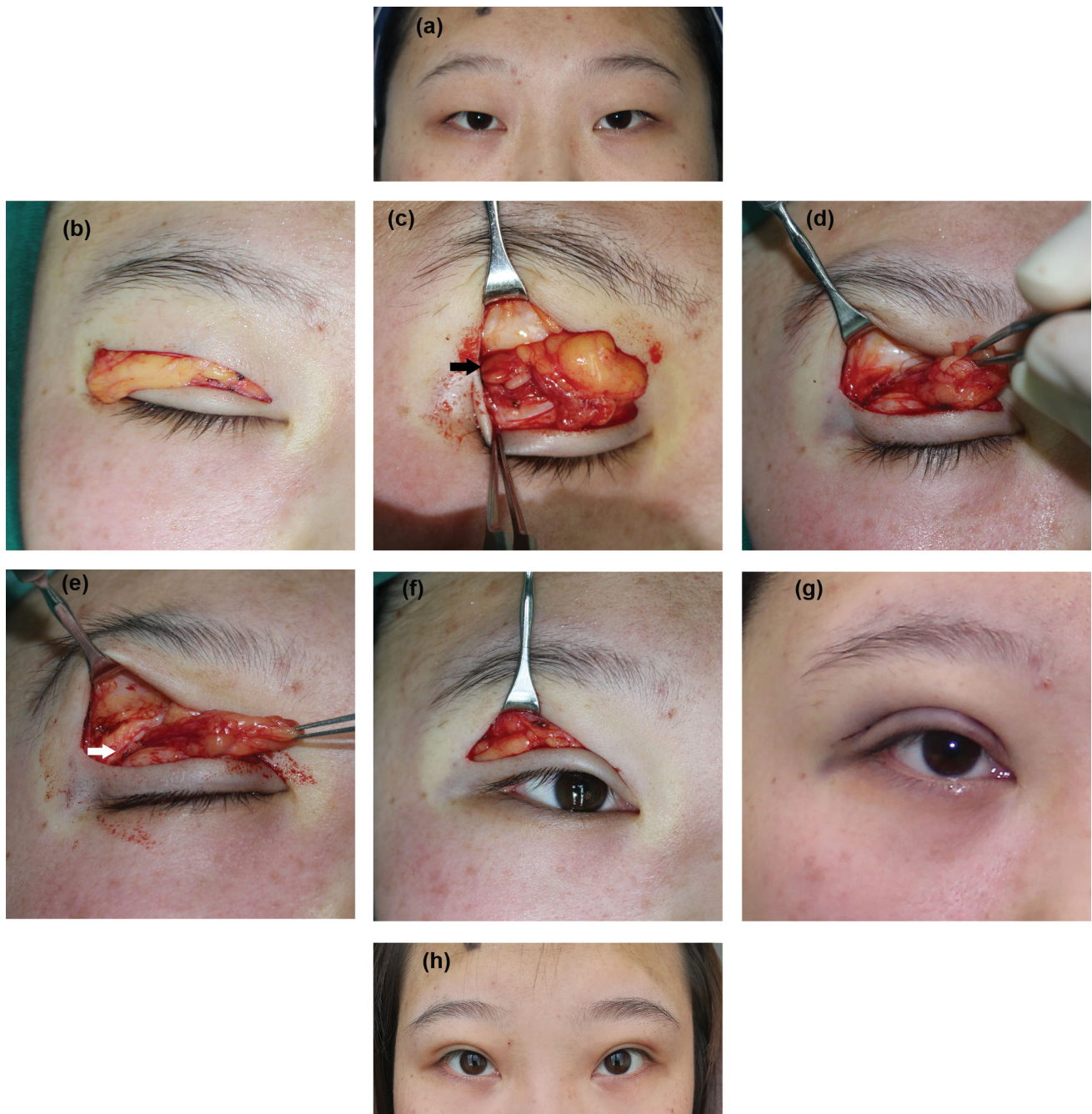


Fig. 2 Photographs of a 22-year-old patient. **a** Preoperative photography. **b** Central preaponeurotic fat pad and its extension. **c** Retracting central fat pad to display the prolapsed pinkish-yellow lacrimal gland (black arrow). **d** Orbital lobe was fixed to the periosteum of lacrimal fossa with horizontal mattress-stitches. **e** The pedicled fat flap was

used to flatten the hollowness that ensued the reposition (white arrow). **f** The pedicled flap was trimmed, debulked, and secured to the lateral margin of the orbital septum. **g** Instant postoperative photography. **h** Post-operative photography at 4 months after the surgery

performed all operations. Three attending surgeons (Dr. Zong, Dr. Song, and Dr. Du) followed the patients to document post-operative photography (Fig. 2h) and

evaluate the surgical prognosis at the outpatient clinic. Each patient was given a questionnaire to collect symptoms and satisfaction on day 14 and day 30.

Surgery Procedure

Exposure

Incisions were demarcated with methylene blue following the standard aesthetic blepharoplasty [16] (commonly, 6 mm–8 mm in the height of eyelid creases, 1 mm–4 mm in the width of redundant skin). The patients were locally anesthetized with 3mL–5 mL local anesthetic (1% lidocaine & 1:200,000 epinephrine). Along the designed incision line, the skin and muscle fibers were incised using a No.11 sharp knife. The marked skin, as well as a narrow strip of orbicularis oculi, was excised using an ophthalmic scissor. If a relatively thick pretarsal lip was encountered, the lower flap was released from the tarsal plate in a caudal direction, and excessive orbicularis oculi of the lower flap were conservatively excised to achieve a smooth transition from the designed palpebral crease to the pretarsal lip. Over-resection may cause a concave appearance, which could impair the aesthetic result.

Then, the layers of the upper eyelid were dissected. After fully exposing the orbital septum horizontally at the junction of the orbital septum and the pretarsal aponeurosis, the central preaponeurotic fat pad was totally released and preserved temporarily (Fig. 2b). We elevated the central postseptal fat pad with a retractor and explored the prolapsed lacrimal gland in its posterolateral direction.

Lacrimal Gland Refixation

The lacrimal gland is characterized by pinkish-yellow color, lobulated entity, and firm consistency (Fig. 2c). Sometimes, cautions should be taken as the boundary between the lacrimal gland and the preaponeurotic fat is vague. Generally, for young Asian females, we addressed the prolapsed gland if the orbital lobe's anterior tip surpassed the orbital rim. The inferior portion of the prolapsed orbital lobe (2mm to the inferior margin) was fixed to the periosteum of lacrimal fossa with two to three horizontal mattress-stitches using 6–0 Prolene sutures (the number of sutures depended on the gland size) (Fig. 2d). Sutures should be arranged parallel to the excretory ducts of the orbital lobe to avoid ligating the ducts. We left the palpebral lobe untreated if it was just mild hypertrophic.

Preaponeurotic Fat Transposition

After the lacrimal gland reposition, we noticed a relative hollowness (depended on the severity of prolapse). The released central preaponeurotic fat formed a medially based pedicled fat flap. We transposed the fully released fat flap to cover the hollowness (Fig. 2e). The optical result was to obtain a natural and smooth upper eyelid contour

and avoid sunken eyelids. The flap could be trimmed or debulked if it was too large or too thick.

During this procedure, we asked patients to open and close their eyes several times to adjust the position and contour of the fat flap. Commonly, the redundant temporal tail of the flap was trimmed and excised (Fig. 2f). The remaining flap was debulked to fit surrounding structures. Once symmetric and desired appearance was achieved, the temporal tail of the flap was secured to the lateral margin of the orbital septum with one or two 6–0 Prolene sutures. During the trimming and transposition process, we tried to preserve as much fat pad as possible and avoid disturbing visible vascular components. Also, we assured the fat flap under no strain to prevent necrosis. In patients with severe eyelid fullness, the retro-orbicularis oculi fat (ROOF) and medial preaponeurotic fat pad were also partly excised prudently if necessary. The orbital septum was left unsutured, and the incisions were closed as in a standard blepharoplasty fashion to form a distinct supratarsal crease (Fig. 2g).

Results

From January 2009 to January 2019, a total of 203 single-eyelid Asian females (406 eyelids) with bilateral LGP underwent our modified procedure. One hundred and sixty-seven patients (334 eyelids) completed our follow-up ranging from 4 to 24 months (average: 16.3 months). Among them, 132 cases (79.0%) were diagnosed preoperatively, and the rest (35 cases, 21.0%) were confirmed during surgical explorations. One hundred and forty-three patients were simple single-eyelid, and the remainders (24 patients) were inconspicuous double-fold eyelids. The aesthetic blepharoplasties performed for the patients included lacrimal gland reposition and fat flap transposition in all cases, partial retro-orbicularis oculi fat (ROOF) resection in 23 patients (13.8%), and medial preaponeurotic fat pad debulking in 27 patients (16.2%). No tumorous or inflammatory lacrimal apparatus diseases were observed.

After the follow-up, the surgery produced distinct supratarsal creases and natural upper eyelid contours, and the eyelid bulging was reduced (Figs. 3 and 4). According to the questionnaires, on day 14, transitory symptoms including local mild pain (2.9%, 5/167), moderate epiphora (9.0%, 15/167), tightness of the operative region (3.6%, 6/167), heavy upper eyelids (4.8%, 8/167), and a slight difficulty in closing eyes (4.2%, 7/167). These symptoms were clinically relieved within one month. On day 30, more than 80% of patients (81.4%, 136/167) were satisfied with overall outcomes, another 13.7% was partly satisfied, and eight patients (4.7%) were dissatisfied with unnoticeable

Fig. 3 A 23-year-old female patient underwent our modified procedure. Upper **a, b**: Preoperative view. Middle **c, d**: Postoperative view at 18 months after the surgery

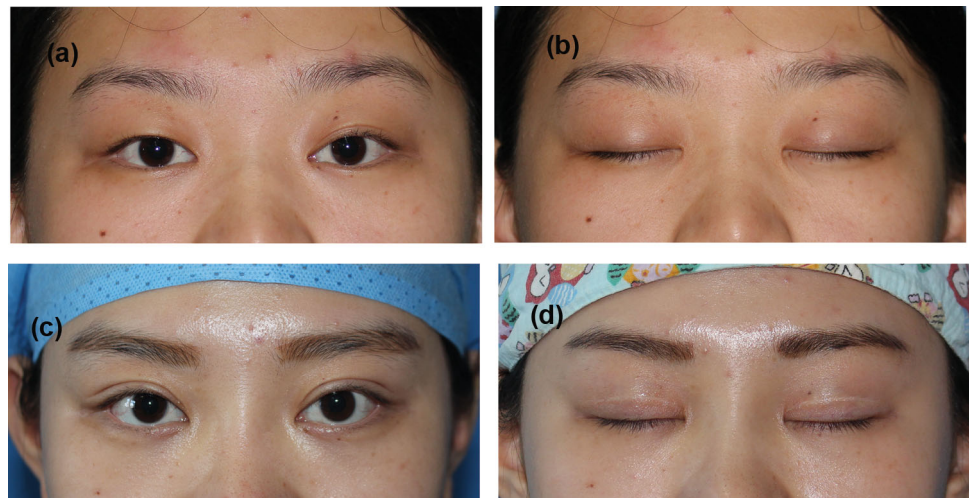
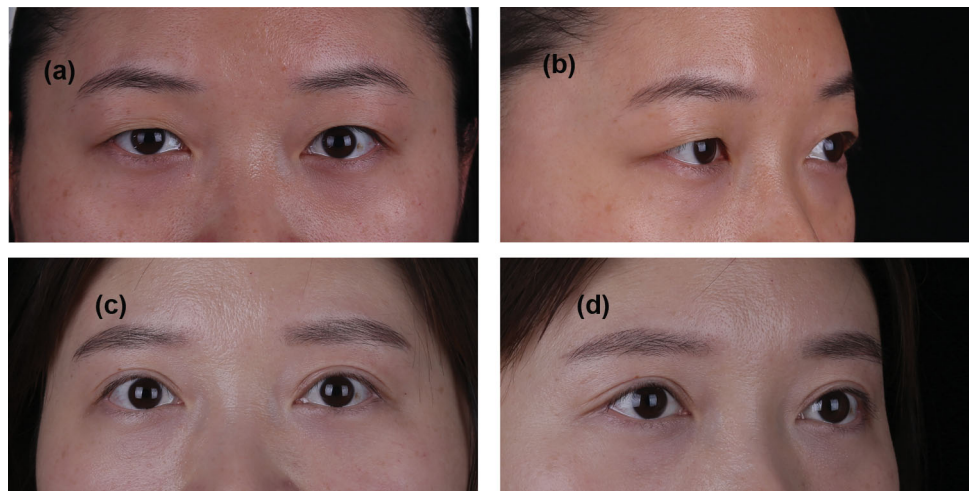


Fig. 4 A 31-year-old female patient underwent our modified procedure with evidently upper eyelid bulging improvement. Upper **a, b**: Preoperative view. Lower **c, d**: Postoperative view illustrating disappearance of lateral eyelid bulging, natural contour, and distinct eyelid creases at 24 months



eyelid creases (3 cases), asymmetric eyelid creases (3 cases) or conspicuous scars (2 cases). Moreover, the age appraisal of patients was an average of 2.3 years younger after the surgery. Severe complications, including irreversible alternations in ocular lubrication, dry eye syndrome, impaired vision, difficulty in opening eyes, severe fat flap necrosis, sunken eyelids, multiple eyelids, or recurrence of LGP were not observed by surgeons during the follow-up.

Discussion

Unlike senile Caucasian patients with aging-related peri-orbital changes, most Asian patients presented to the clinic for double-eyelid surgery are in their early 20s or even younger. Rather than rejuvenation, they mainly pursue natural supratarsal creases and smooth upper eyelid

contours. Also, we noticed a considerable number of Asian LGP patients are challengeable to diagnose before operations. The omission of LGP (false-negative error) compromised the result of the double-eyelid operation (Fig. 5). We reckoned that the current procedures were not tailored for young, puffy Asian eyes with LGP. Thus, we initiated to refine the lacrimal gland reposition with preaponeurotic fat flap transposition. On the one hand, the procedure assures the outcome of LGP treatment entirely according to hernial surgery principles, i.e., returning the herniated contents (lacrimal gland) and reinforcing the supporting structures (fat flap transposition). On the other hand, we reuse preaponeurotic fat to refill the concavity caused by lacrimal gland repositioning and smooth the upper eyelid contour. We also advocated surgical explorations for Asian females with lateral eyelid bulging to avoid the diagnostic omission of LGP.

Fig. 5 Two LGP patients after double-eyelid operation (including preaponeurotic fat debulking) without lacrimal gland fixation. The fullness of upper eyelid is distinct



Anatomy Highlights

Asian upper eyelids are commonly single-crease and puffy [1]. One of the most critical factors for these features is excessive preaponeurotic fat. Compared with Caucasians, researchers approved that the preaponeurotic fat pad volume is more substantial in Asians [17, 18]. Besides, the preaponeurotic fat in Asians descends and even covers part of the tarsal plate [19]. The average distance from the superior tarsal plate border to the postseptal fat pad was 1.90 mm in Asians while 3.17 mm in Caucasians [18]. Thus, debulking preaponeurotic fat is a conventionally used and anatomically based technique in Asian esthetic blepharoplasty [15]. Also, a particular portion of Asians with relatively excess ROOF and orbicularis oculi result in upper eyelid fullness or even ptosis. For these phenomena, physicians tend to pay more attention to debulking; however, on the contrary, when confronted with LGP, which also leads to fullness, physicians may inadvertently neglect this condition. LGP widely exists, and the prevalence is 10–15% among esthetic blepharoplasty patients [5]. Massry et al. [6] even reported an incidence as high as 60% in the senile population.

The lacrimal gland is the primary producer of tears. It is characterized by pinkish-yellow color, lobulated entity, and firm consistency. With the main entity in the lacrimal fossa, the gland is separated into an orbital lobe and palpebral lobe by the lateral horn of levator aponeurosis. The former is the main part and is twice the size of the latter. Two to six excretory ducts of the orbital lobe drain tears and traverse the palpebral lobe before secreting into the superior conjunctival fornix [20–22]. Either or both lobes of the lacrimal gland may prolapse [9] (Fig. 6). Generally, the prolapse of the orbital lobe causes a pink mass beneath the conjunctiva. In contrast, the displaced palpebral lobe, which is commonly hypertrophic, results in a bulge in the

lateral upper eyelid [13]. The prolapse of the orbital lobe usually impairs appearance.

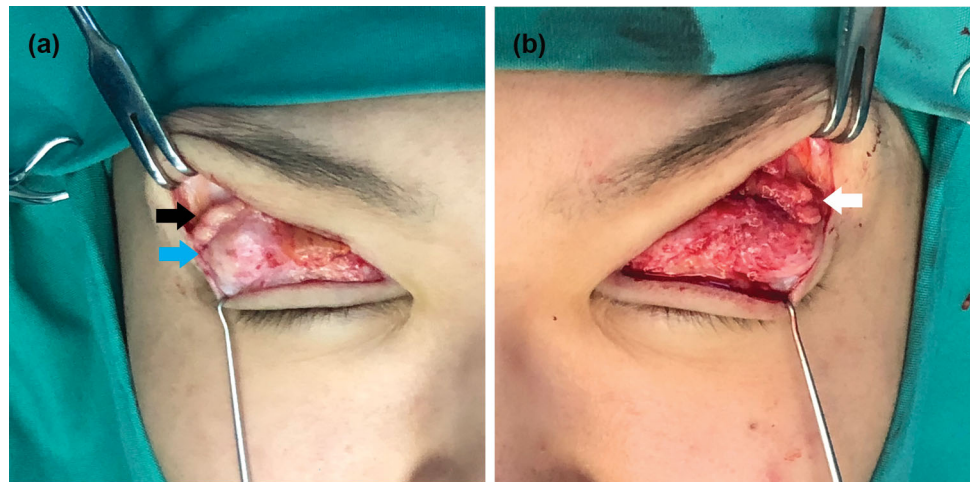
In the Caucasian population, LGP is one of the involuntional periocular changes [12]. One possible reason is the decrepit weakness of the orbital septum and supporting structures of the lacrimal gland [8, 11, 13], such as Whitnall's ligament. However, our patients are young Asian females, and thus aging is not the main issue. Unlike western patients aiming for rejuvenation, they yearn for natural eyelid creases and smooth contours. Under these circumstances, traditional blepharoplasty with adjunctive lacrimal gland reposition for LGP patients cannot produce optimal outcomes for young Asian patients with LGP.

Diagnosis and Treatment of LGP

Although the awareness and treatment of LGP are mainly improved, diagnostic omission or misidentification occur from time to time. Frequently, inadvertent ignorance leaves the problem unaddressed, and we conclude the reasons as firstly, false-negative preoperative physical examinations waves aside the possibility of intraoperative treatment; secondly, instead of adequately exposing the preaponeurotic fat pad, merely excising the herniated fat through a minimal windowed incision of the orbital septum decreases the possibility of detecting mild or even moderate LGP. Moreover, mismanagement of LGP results in severe complications, like dry eye syndrome. According to a recent survey sponsored by the American Society of Ophthalmic Plastic and Reconstructive Surgery, when LGP presented, up to 25% of surgeons left the situation undisturbed, and only 3% of surgeons partly resected the gland [23].

In clinical practice, several physical signs and tests have been recommended to increase preoperative examinations' accuracy. They can be concluded as inspection and palpation. The inspection includes upper eyelid bulging or

Fig. 6 Intraoperative photograph of a 26-year-old patient. **a** Both the orbital lobe (black arrow) and the palpebral lobe (blue arrow) were hypertrophic and prolapsed in the right orbit. **b** Only the orbital lobe (white arrow) was hypertrophic and prolapsed in the left orbit



visible mass at the eversion of the eyelid. Palpation comprises palpable mass near the superolateral orbital rim under slight pressure on the globe and a novel supine physical test [24]. However, the sensitivity is limited, and false preoperative diagnosis still existed. We also used ultrasound to aid us in diagnosis, but the accuracy depended on the doctors' proficiency and dexterity. Hertel meters and computed tomography can help to diagnose and exclude other ophthalmic diseases. Moreover, as Guyuron et al. reported the unreliability of the Schirmer's test, a reliable method to monitor tear production and predict "dry eyes" is also desiderated in clinical practice [7].

So far, no known presurgical examination is both highly sensitive and specific, and thus for those imperceptible but suspicious cases, intraoperative septal opening and detecting the lacrimal gland is the only definite way of diagnosis [24]. Considering anatomic features and imperfection of preoperative exams, we recommend surgical explorations for LGP in Asian patients with excessive preaponeurotic fat to avoid diagnostic omission.

Surgical Pearls

In our modified procedure, we routinely open the junction of orbital septum and aponeurosis horizontally to expose the central preaponeurotic fat pad and further detect the lacrimal gland. As preaponeurotic fat trimming is a conventionally used procedure in Asian double-eyelid operations, a lacrimal gland exploration through the adequately opened orbital septum is convenient. Hence the diagnosis and treatment rate for LGP is enhanced.

The technique of lacrimal gland suturing in this study resembled traditional surgical techniques mentioned before [7, 10–13], using non-absorbable sutures to firmly fix the lacrimal gland to the periosteum of the lacrimal fossa.

Generally, two or three mattress-sutures on each side were used.

The preaponeurotic fat pad was utilized as the supporting structures for the lacrimal gland and contour adjustment. The prolapsed gland extruded the surrounding soft tissue for a relatively long period and, after surgical reposition, the central preaponeurotic fat will not refill the previously occupied space automatically. Thus, an apparent hollowness is formed. Without an appropriate maneuver to refill the concavity, sunken eyelids and successive tissue adhesion ensued may compromise the esthetic outcome. Furthermore, in conventional double-eyelid surgery for Asians, a moderate amount of preaponeurotic fat pad is commonly removed. An undue removal of the fat may accelerate the aging process because of orbit volume loss. We took advantage of a superfluous preaponeurotic fat pad by shaping it to fit the successive hollowness in our technique. Through trimming and debulking the redundant portion of the flap, the eyelid contour was re-adjusted. Then we secured the tail to the lateral margin of the orbital septum to immobilization. If necessary, the ROOF was also partially resected conservatively. We left the orbital septum unsutured as reported in prior literature [7], for it is likely to tear during the process, and the risk of adhesion after the operation is not negligible.

It is noteworthy that we did not proceed to fat transposition until the lacrimal gland was securely fixed and the hollowness is apparent. The senior author (Dr. Jin) thought this surgical sequence avoided upper eyelid sulcus resulted from excessively debulking. We utilized the preaponeurotic fat to smooth the hollowness and avoid adhesion. The postoperative appearances were natural, and triple or multiple eyelids folds did not occur. Moreover, the secured fat flap turned into an additional supporting structure to restrain the recurrence of LGP. It needs to be emphasized

that debulking the preaponeurotic fat pad after transposition could not be performed in patients with sunken upper eyelids to avoid consequent tissue adhesion, triple and multiple upper eyelid folds, or other compromised outcomes.

Admittedly, there are limitations in our study. First, as the initial intention is to propose a modified procedure rather than the epidemiological study, only LGP patients who undertook our modified procedure were incorporated into the study. Thus, the perioperative diagnosis rate remains unclear. Further epidemiologic research combined with our procedure will elucidate the diagnosis rate of our technique and the prevalence of LGP in the locality. Second, this is a retrospective case series report, and thus a control group (classic repositioning of LGP) is needed to make our conclusion more persuasive in our future study. The inter-rater reliability of the surgeons was not assessed in this article. Moreover, we reckon that a longer follow-up will make the results of our procedure more unequivocal. As most of our patients are young, it will also reveal more information about long-term complications such as relapse and sunken eyelids.

Conclusions

This retrospective study proposed a modified procedure to enhance the diagnosis and treatment of LGP by lacrimal gland reposition and fat transposition. We recommend surgical explorations for LGP in young Asian patients with lateral eyelid bulging to avoid diagnostic omission. Transposition of preaponeurotic fat smoothed the contour transition and properly preserved the volume of orbit, which is vital to avoid postoperative upper eyelid sulcus and adhesion. The natural supratarsal creases were satisfactory, and the complication rate was low. Therefore, this is a safe and effective technique for selected young, puffy Asian eyes.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. For this kind of study, formal consent is not required.

Informed Consent Patients provided written informed consent for publication. For the use of their images, additional consent was provided.

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