



Chen's Double Eyelid Fold Ratio

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Background: Double eyelidplasty can construct palpebral folds and enhance beauty perception for Asians with single eyelids. A new palpebral parameter for the quantitative interpretation of surgical outcomes is proposed on the basis of a photometric study of the altered proportions of Asian eyes after double eyelid operation.

Methods: A total of 100 Asian adults with single upper eyelids who were satisfied with the enlarged eyes by operation were included in the study. A retrospective measurement of palpebral parameters in the frontal profile both preoperatively and 6 months postoperatively was performed. The proportions of various parameters in the eyebrow–eye aesthetic unit were calculated and analyzed.

Results: Double eyelidplasty can augment the vertical dimension of palpebral fissure by 27.9% increase on average. The vertical ratio of palpebral fissure to the eyebrow–eye unit is augmented by 34.4% increase. The vertical ratio of the subunit below double eyelid fold peak to the unit is augmented by 82.6% increase.

Conclusions: Double eyelidplasty can substantially enlarge the vertical dimensions of the eyes of Asians with single eyelids. The eyes are perceived to be larger because of the visually assimilated illusion of the superimposed eyelid fold and the relative proportions of the eyebrow–eye unit. The authors propose using a vertical ratio of the subunit below double eyelid fold peak in the eyebrow–eye unit to measure the visually perceived proportion of the eye in the unit. This ratio can be applied clinically for a quantitative evaluation of the surgical outcome after double eyelidplasty. (*Plast Reconstr Surg Glob Open* 2016;4:e681; doi: 10.1097/GOX.0000000000000655; Published online 20 April 2016.)

Double eyelid blepharoplasty is the most popular aesthetic surgery in East Asia. Millions of Asians with small eyes and single eyelids un-

dergo this surgery to construct supratarsal folds and enlarge their eyes. Double eyelid blepharoplasty is also a fashionable surgery for Asians to enhance the beauty and attractiveness of Oriental eyes. Although some anthropometric analyses of Asian eyes and faces have been reported in the literature, few have focused on the aesthetic effect produced by the double eyelid fold.^{1–6} Because of the lack of a unified quantitative tool to assess the aesthetics of double eyelids among aesthetic surgeons, a meta-analysis of the surgical outcomes of various techniques is impracticable. Hence, a photometric study of Asian eyes was developed to investigate the palpebral parameters or proportions that are significantly altered after double eyelid blepharoplasty. A new parameter for quantitatively evaluating the surgical outcome of double eyelid blepharoplasty is proposed in this study.

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MATERIALS AND METHODS

This retrospective study consists of a photometric analysis of the eyes of 100 Asian adults between July 2012 and July 2014. All patients underwent a

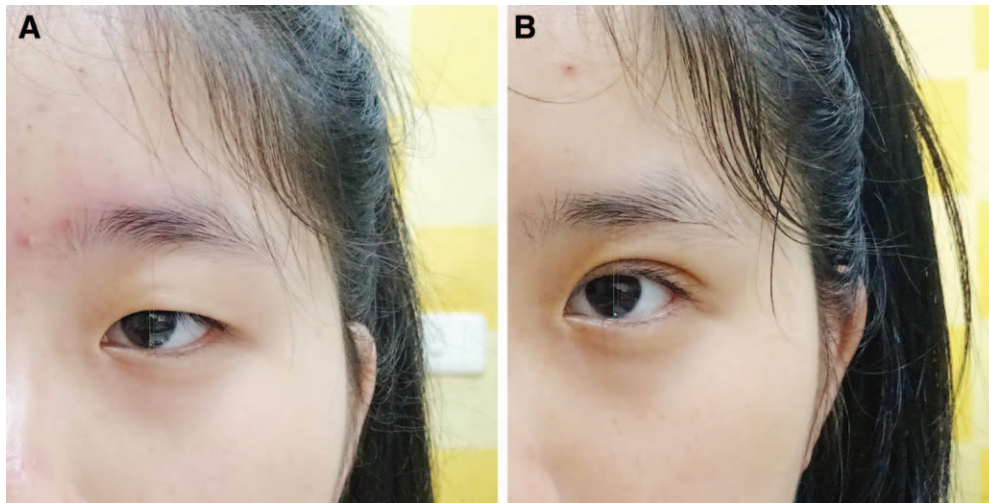


Fig. 1. A 21-year-old woman was assessed for palpebral parameters and ratios. A, Preoperative photograph of the left eye. The green line is the eye fissure height, and the red line is the height of eyebrow–eye unit. B, Photograph of the left eye 6 months postoperatively. The green line is the height of the subunit below the double eyelid fold peak, and the red line is the height of the eyebrow–eye unit.

small-incision double eyelid blepharoplasty by the same senior plastic surgeon and provided written informed consent. The inclusion criteria were patients who rated the aesthetic outcome of blepharoplasty as satisfactory and were pleased with their enhanced beauty and enlarged eyes as a result of double eyelid folds. The perioperative photographs of each patient with eyes open and eyebrows relaxed were recorded by digital photography under standardized conditions (Fig. 1). The palpebral parameters were measured by an electronic caliper using a computer monitor by the same investigator (Table 1). The relative proportions of various parameters were calculated to analyze alterations in the eye configuration after double eyelidplasty (Table 2).

Institutional Review Board Approval

This article includes a retrospective study of patients underwent double eyelid blepharoplasty, and the study follows the regulation and approval of institutional review board. This study also conforms to the Declaration of Helsinki.

RESULTS

The 100 patients ranged in age from 18 to 35 years (mean, 28 years). Most patients were female (n = 85). The follow-up period ranged from 6 months to 3 years (mean, 9 months). The perioperative pal-

Table 1. Palpebral Parameters

| | |
|---|----|
| Preoperative | |
| Height of eyebrow–eye unit | A1 |
| Eye fissure length | A2 |
| Distance of eyebrow to upper lid margin | A3 |
| Eye fissure height | A4 |
| Iris diameter | A5 |
| Height of exposed iris | A6 |
| Postoperatively | |
| Height of eyebrow–eye unit | B1 |
| Eye fissure length | B2 |
| Distance of eyebrow to upper lid margin | B3 |
| Eye fissure height | B4 |
| Iris diameter | B5 |
| Height of exposed iris | B6 |
| Distance of eyebrow to fold peak | B7 |
| Height of fold (pretarsal show) | B8 |
| Distance of fold peak to lower lid margin | B9 |

pebral parameters are listed in Table 1, and the perioperative palpebral ratios are listed in Table 2.

The vertical ratio of the exposed iris was 0.636 (SD, 0.099) before surgery and 0.794 (SD, 0.087) after surgery. The increase in the vertical ratio of the exposed iris after surgery [(B6/B5) – (A6/A5)] was 0.158 (SD, 0.106). The exposed iris was increased by 27.4% of the original height.

The ratio of the eye fissure height to the length was 0.316 (SD, 0.047) before surgery and 0.398 (SD, 0.039) after surgery. The increase in the ratio of the eye fissure height to the length after surgery [(B4/B2) – (A4/A2)] was 0.080 (SD, 0.053). The eye fissure was increased by 27.9% of the original height. The ratio of the eye fissure height plus the fold height to the eye fissure length [(B4 + B8)/B2] was 0.542 (SD, 0.037).

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Table 2. Palpebral Ratios

| | | |
|---|-----------------------|-------------|
| Preoperatively vertical ratio of exposed iris to iris diameter | A6/A5 | 0.636±0.099 |
| Postoperatively vertical ratio of exposed iris to iris diameter | B6/B5 | 0.794±0.087 |
| Preoperatively ratio of height to length of eye fissure | A4/A2 | 0.316±0.047 |
| Postoperatively ratio of height to length of eye fissure | B4/B2 | 0.398±0.039 |
| Preoperatively vertical ratio of eye fissure to eyebrow-eye unit | A4/A1 | 0.362±0.049 |
| Postoperatively vertical ratio of eye fissure to eyebrow-eye unit | B4/B1 | 0.480±0.061 |
| Vertical ratio of pretarsal show to eyebrow-eye unit | B8/B1 | 0.155±0.031 |
| Vertical ratio of pretarsal show to eye fissure | B8/B4 | 0.328±0.078 |
| Vertical ratio of subunit below fold peak to eyebrow-eye unit | (B4 + B8)/B1 or B9/B1 | 0.652±0.055 |
| Ratio of height of subunit below fold peak to eye fissure length | (B4 + B8)/B2 or B9/B2 | 0.542±0.037 |
| Increment of vertical ratio of exposed iris to iris diameter | (B6/B5) – (A6/A5) | 0.158±0.106 |
| Enlargement of exposed iris height | (B6/B5)/(A6/A5) | 1.274±0.230 |
| Increment of ratio of eye fissure height to length | (B4/B2) – (A4/A2) | 0.080±0.053 |
| Enlargement of eye fissure height | (B4/B2)/(A4/A2) | 1.279±0.232 |
| Increment of vertical ratio of eye fissure to eyebrow-eye unit | (B4/B1) – (A4/A1) | 0.118±0.064 |
| Enlargement of eye fissure in eyebrow-eye unit | (B4/B1)/(A4/A1) | 1.344±0.210 |
| Increment of visual ratio of eye in eyebrow-eye unit | (B9/B1) – (A4/A1) | 0.289±0.059 |
| Enlargement of visual ratio of eye in eyebrow-eye unit | (B9/B1)/(A4/A1) | 1.826±0.243 |
| Enlargement of visual ratio of eye fissure height to length | (B9/B2)/(A4/A2) | 1.734±0.260 |

The vertical ratio of the eye fissure to the eyebrow-eye unit was 0.362 (SD, 0.049) before surgery and 0.480 (SD, 0.061) after surgery. The increase in the vertical ratio of the eye fissure to the eyebrow-eye unit [(B4/B1) – (A4/A1)] after surgery was 0.118 (SD, 0.064). The vertical ratio of the eye fissure in the unit was enhanced by 34.4% increase of the original ratio.

The vertical ratio of the pretarsal show to the eyebrow-eye unit (B8/B1) was 0.155 (SD, 0.031). The vertical ratio of the pretarsal show to the eye fissure height (B8/B4) was 0.328 (SD, mean, 0.078).

The vertical ratio of the subunit below the double eyelid fold peak to the eyebrow-eye unit (B9/B1) or the vertical ratio of eye fissure plus the pretarsal show to the eyebrow-eye unit [(B4 + B8)/B1] was 0.652 (SD, 0.055).

DISCUSSION

Double eyelid blepharoplasty is the most frequently performed aesthetic surgery in East Asia and is used to enhance the eye size and eye aesthetics of Asians with slit and single eyelids.⁷ Various modified surgical techniques, including the small-incision method, have been reported to yield aesthetically pleasing eyes and permanent supratarsal folds.^{8–12} Aesthetic surgeons have emphasized that the double eyelid procedure should no longer be considered a surgery to Westernize Asian eyes but should instead be considered an ethnic beautification surgery.^{13–15} Although the perception of beauty varies among individuals, most Asians with single eyelids desire a pair of wide-open eyes with more visible iris and a pair of natural-looking, balanced double eyelid folds. A harmonious relationship or proportion of the eyes in Oriental facial features is also of major concern to Asians.

The concept of an eyebrow-eye continuum has been introduced recently, and this area is considered to be an anatomical and aesthetic unit in facial features.^{16,17} The eye's dimension has also been reported to be perceived by human vision and brains based on the real size of the eye aperture and its relative proportion in the facial structure.¹⁸ Although some reports have discussed eye beauty, attractiveness, and anthropometric proportion in facial features, few have studied these issues from the perspective of the oriental double eyelid.^{19–21}

Based on the perioperative palpebral parameters measured in this study, the aesthetic enhancement of eye dimension by double eyelid blepharoplasty can be analyzed quantitatively using 3 parameters. First, the actual dimension is enlarged by surgery: the eye fissure is vertically augmented by 27.9% increase, and the exposed iris is vertically augmented by 27.4% increase.

Second, the superimposed double eyelid fold hanging above the eye fissure can add an extra dimension to the eye by giving an illusion of assimilation, which is also known as the Delboeuf size illusion (the concentric circle illusion),^{22,23} which states that an inner circle appears larger in the presence of an outer circle. The perceived size of the target element shifts toward the actual size of the contextual element. Hence, the maximal value of perceived eye dimension approaches the sum of the eye fissure plus the surrounding double eyelid fold. The use of eyeliner or eye shadow can further enlarge the perceived eye dimension through the same assimilation illusion. In this study, the mean ratio of the double eyelid fold height or the pretarsal show at its peak to the eye fissure height is 0.328. The assimilation illusion effect created by the double eyelid fold may contribute an additional 32.8% of the actual vertical

dimension of eye fissure after surgery. In this study, the eye is maximally augmented by 73.4% increase of the preoperative vertical size by the assimilative illusion of overlying double eyelid fold curve $[(B9/B2 - A4/A2)/(A4/A2)]$. These data provide a quantitative determination of the surgical effectiveness of double eyelid operations for enhanced eye dimensions, and the augmentation effect also explains why this surgery is so popular among Asians with single fold and slit eyes.

Third, the eye size illusion is also induced by the distance between the eyebrow and eye and may involve a different type of assimilation illusion.²⁴ The shortened distance between the eyebrow and eye is reported to increase the illusion of a larger eye.²⁵ Hence, the visually perceived dimension and aesthetics of the eye are further influenced by the relative proportions of the eyebrow–eye anatomical unit.¹⁹ In this study, the vertical ratio of the actual eye fissure in the eyebrow–eye unit was significantly increased by 34.4%.

The eyebrow–eye unit is dynamically partitioned into 2 subunits by the double eyelid fold during eye opening. The most prominent part of the aesthetic unit of the eye is the central part of the eye, which includes maximal iris exposure, and the peak of the above double eyelid fold. Therefore, a vertical line is arbitrarily drawn through the fold peak. The vertical ratio of the subunit below the fold peak to the whole aesthetic unit serves as the partitioning ratio of the double eyelid fold in the unit. This partitioning ratio can be regarded as the maximal value of the visually perceived proportion of the eye in the unit. In this study, the visual ratio of the eye in the unit can be significantly enhanced from 0.362 preoperatively to 0.652 postoperatively. Thus, it is reasonable to state that the perceived eye proportion in the unit is augmented by a maximal increase of 82.6% along the arbitrary line.

Hence, a new palpebral parameter termed “Chen’s double eyelid fold ratio” is proposed by the authors to quantitatively measure the visually perceived effect of enhanced eye dimension resulting from double eyelid operation. This new parameter is designed for clinical applicability and consistency among aesthetic surgeons and will facilitate meta-analyses of surgical outcomes of different techniques for double eyelid operation at different institutions. The ratio of the double eyelid fold in the aesthetic unit may also be a useful parameter to quantitatively compare the perioperative symmetry of bilateral folds. Further studies are needed to justify the clinical applicability of this new parameter.

CONCLUSIONS

A quantitative analysis of the palpebral parameters and proportions in selected Asian adults after double eyelid blepharoplasty was performed. The double eyelid procedure can significantly enlarge the vertical dimensions of the palpebral fissure and the visible iris and augment the height-to-length ratio of the palpebral fissure. Eyes with double eyelid folds are visually perceived to be larger because of an assimilation illusion generated by the overlying the fold curve and the increased proportion of the eye in the eyebrow-eye aesthetic unit. A new parameter termed “Chen’s double eyelid fold ratio” is proposed to provide aesthetic surgeons with a quantitative dimension for assessing enhanced eye size after double eyelid blepharoplasty. This can be used in the comparative analysis of aesthetic outcomes among surgeons.

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PATIENT CONSENT

The patient provided written consent for the use of her image.

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