Special Topic

Visual, Physiological, and Aesthetic Factors and Pitfalls in Asian Blepharoplasty

William Pai-Dei Chen, MD

Abstract

Double eyelid surgery to create an upper-lid crease in Asian patients is one of the more popular aesthetic surgeries among people of Asian descent. Much has been written about the myriad methods, but little has been written about the underlying factors that predispose a patient to complications and suboptimal results. This article touches on some of the possible errors in placement of crease height in upper blepharoplasty and the pitfalls that can be associated with permanent placement of nondissolvable sutures that encircle the complex layers of the upper eyelid, as well as the ideal eyelid crease wound closure and its biodynamics. One should consider these factors in any form of upper eyelid procedure, as they are not merely applicable to upper blepharoplasty.

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After 3 decades of performing Asian blepharoplasty (double eyelid crease procedure), it is apparent that the functional complexity of the upper lid anatomy is a major factor in determining outcome (success and failure) for this form of aesthetic surgery.

The upper eyelid is incredibly complex, composed of living tissue bundles that contain skin (epidermis and dermis), the orbicularis oculi (striated skeletal muscle fibers running circumferentially around the palpebral fissure), the orbital septum (a filmy, connective-tissue sheath), the preaponeurotic fat pads, the levator muscle with its tendinous levator aponeurosis, the Mueller’s muscle, the upper tarsus (a fibrous plate), and conjunctiva (squamous epithelium). At least 7 distinct tissue types exist. Embedded within, and not mentioned as separate layers, are the subcutaneous fat, preseptal or sub-orbicularis fat, meibomian glands within the tarsal plate, and eyelash follicles, as well as probably some as yet undefined anatomic structures.

I had thought of these layers as solid stacks of tissues, to be overcome as the desired surgical level dictates; and similar to other surgeons, I had thought little of the movement dynamics of the upper lid other than that one can measure levator function. Without levator muscle (LPS) contraction, the weight of the orbicularis oculi and the upper eyelid follows the downward rotation of the eyeball into an almost-closed position. If one is to set a ruler at 0 mm here at the lowered upper lid margin and ask the person to look up maximally, the range of movement (excursion in millimeters) of the central lid margin along a curved surface (cornea, sclera) as interpreted vertically has been traditionally recognized as levator function (LF) and taught to generations of ophthalmologists-in-training. However, one may have very attenuated levator muscle fibers (as is often the case in elderly patients) and still record a seemingly normal range of movement of 11 to 15 mm. Imagine 2 garage doors that each opens to their respective 9 feet opening, but 1 has a 0.5 horsepower (hp) motor drive and the other is 1.0 hp and they both open to the same height, but one is twice as strong: measuring their travel distance is not indicative of their power. Additional factors

Dr Chen is a Clinical Professor of Ophthalmology, Eye Plastic Surgery Service, Harbor-UCLA Medical Center, Torrance, CA; and a Clinical Associate Professor of Surgery, Department of Plastic Surgery, University of California, Irvine School of Medicine, Irvine, CA.

Corresponding Author:
Dr William Pai-Dei Chen, 1401 Avocado Avenue, Suite 505, Newport Beach, CA 92660, USA.
E-mail: wpdchen@gmail.com
(e.g., contractile force and speed) have not been measured and included as an intrinsic part of what is reported as levator function. These latter properties can be measured in a research laboratory setting, although it is likely impractical in a clinical setting.

The levator function is often used by ophthalmologists in the evaluation of ptosis. It is helpful to correlate this for patients being considered for Asian blepharoplasty because it does provide some predictive value for the likelihood of forming a good crease invagination. It helps to guide me on whether a supplementary technique is needed to enhance this likeliness. For example, for a patient with borderline ptosis in which their upper lid margin is resting at 2 mm below the superior corneal limbus, a lower value of levator function may guide me more toward suggesting concurrent ptosis correction.

An eyelid crease classically can be thought of as a crease line that is located on the upper lid at the junction where the tarsal-levator complex of posterior lamella vectors upward against a relaxed upper-lid fold (consisting of skin and the orbicularis oculi) that is gravitated downward. This occurs most often at the skin along the superior tarsal border. It is thought to be correlated with the subcutaneous presence of microfibrils of the distal terminating branches of levator aponeurosis. This has been confirmed by Collin et al’s histologic study and, subsequently, several other electron microscopy studies. Collin et al’s finding confirms the presence of these terminal microfibrils interdigitating with the intermuscular sheaths of the orbicularis oculi along the area where the crease is located, while subsequent electron microscopic studies were able to trace these microfibrils to areas directly underneath the dermis of the crease location.

It is this author’s opinion that the 3 most influential factors toward successful outcome in double eyelid surgery (Asian blepharoplasty) are: (1) visual interpretation (correct measurement of crease height and its placement); (2) physiological (functional aspect of the upper lid [immediate and long term]); and (3) aesthetic appearance of the crease (biodynamics of the crease indentation).

**VISUAL INTERPRETATION**

The first concept is that the upper tarsus is actually inclined at roughly 45 degrees in vivo when a subject is looking ahead with eyelids opened. I have investigated this through the following means: (1) slit-lamp measurement using a geometric scale; and (2) mathematical modeling.

**Slit-Lamp Measurement**

The first investigative modality involved direct measurement in front of a slit-lamp biomicroscope. One can have a patient positioned in front of a slit lamp with the eyes looking straight ahead and simply measure the geometric angle (I, or incline angle) of the upper tarsus (pretarsal skin surface) as viewed from the lateral side of the patient, and this measures the pretarsal tilt or tarsal tilt as being approximately 41° (Figure 1).

**Mathematical Modeling**

The second method is through mathematical modeling (Figure 2). One may assume the human cornea is 11.5 mm in diameter, and that an Asian upper tarsus (tarsal plate) typically measures 6.5 to 7.5 mm with a mean of 7 mm (compared with a typical Caucasian tarsus of around 10 mm). The mathematical assumptions include the anatomic knowledge that the human globe is 25 mm in anterior-posterior dimension and is roughly spherical. One can mathematically arrive at the incline angle of the upper tarsus (resting position relative to the horizontal axis) for Asians and Caucasians with lids opened and looking straight ahead, with the upper lid margin resting at the superior corneal limbus (boundary of cornea and sclera) covering 0.5 to 1.0 mm of the cornea. Additional information about the mathematical model is available online as Supplementary Material.
Conclusions From Mathematical Modeling

(1) In this mathematical modeling, one can see that the Asian tarsal plate has an incline angle of 51° (Caucasian eyelid incline angle of upper tarsus is calculated to be 44°) (Figure 3).

(2) When viewed frontally, an anatomic crease height of 7 mm in a typical Asian will appear to be 5.4 mm (incline crease height, Ich) (Figure 4). If there should be an overhanging skin fold of 2 mm, the observable crease height under this fold will then appear (and possibly be measured incorrectly) as 3.5 mm (apparent crease height). Although physicians should know that the eyelid crease is best measured when the lid is looking downward or closed, a physician may unknowingly measure this 5.4 mm as an ideal location for creating a lid crease, or be persuaded to do so. When a patient requests a “lower-than-average” crease height and the physician incorrectly understands the apparent crease as being 3.5 mm and makes an incision subsequently at that level or lower, suboptimal results may follow.

With clinical measurement by the slit-lamp biomicroscope, which is less accurate, and mathematical modeling, which is more rigorous, one can see that the tarsus when measured in its mid-section appears to have a tilt of 45° from the horizontal axis (averaging the 41° measured via slit-lamp photography and the 51° from the mathematical modeling for Asians). These potential errors in measurements and interpretation of what defines a crease as well as where the crease should be, insufficient communication as to the desired crease height, and possibly incorrect deductive reasoning by doctors could lead to suboptimal results in this form of aesthetic surgery.

We may see unsightly scars in the pretarsal skin, shallowing and fading of the crease due to excessively low placement, and crease obliteration with time. In the buried sutures methods, we may see excessively low placement from the skin side with upward reaching to the posterior lamella, patients complaining of a feeling of tightness or a foreign-body sensation, rare instances of tarsal ectropion or excessive show of the lid margin, and other
symptoms. In external incision methods, there is great discordance in opinions as to where the eyelid-crease incision should be placed (similarly with suture-placement position with buried-sutures techniques) if one is to read all of the literature on external incision techniques, partial incision technique, and mini-incision techniques, as well the articles on sutures techniques.

A good formula to remember is:

\[
\text{Anatomic crease height} \times \frac{5}{7} = \text{Inclined crease height, Ich (or Tch).}
\]

When shielded by a lid fold, we observe the Apparent Crease Height, which is less than the Ich.

\[
\text{Inclined crease height, Ich} - \text{Lid Fold(in mm)} = \text{Apparent crease height}
\]

I believe most Asian eyelid surgeons are aware that dissatisfaction with crease height and crease asymmetry are the most often encountered suboptimal postsurgical issues and may be attributable to physicians not being aware of some of these nuances.

**PHYSIOLOGICAL**

We will now review some of the intricate function and vulnerability of the LPS muscle.

**Function**

I have mentioned that the upper lid can be thought of as a 7-layered composite (it has more than this number if one were to count all of the fascial layers, but for clinical discussion purpose, this will suffice). The orbicularis oculi serves as a sphincter muscle of the palpebral fissure; it closes the eyelid fissure. One does not usually think of the first 3 layers of skin, the orbicularis oculi, and the orbital septum as possessing any functional relevance in the opening of the palpebral fissure (an exception will be in facial nerve palsy where the orbicularis oculi is partly or completely paralyzed leaving the LPS unopposed, and therefore, the eyelid fissure becomes wide open even more than one would normally expect). The fourth layer, the preaponeurotic fat pads, plays an important function as a physiologic glide medium (zone) between the anterior lamella (skin and orbicularis oculi) and the posterior lamella of levator/Mueller’s muscle/conjunctiva. The fifth layer, the LPS, plays a dominant role in the elevation of the upper lid, while the Mueller’s muscle (sixth layer) can be shown to play a lesser, although still significant, role. The conjunctiva (seventh layer) serves as the back layer and is a mucosa of squamous epithelium; it may contain tear glands, goblet cells and mucin cells. The boundaries are clear between the levator, Mueller’s muscle, and conjunctiva. There is significant glide movement between levator (LPS) and the preaponeurotic fat (fourth layer) in front.

In sutures techniques of Asian blepharoplasty, a surgeon typically places an encircling buried suture of double-armed 7-0 nylon from either the skin side or the conjunctival side; one is basically placing a cerclage around a 3 to 4 mm width (segment) of the second to sixth layers of the upper lid. It contains orbicularis oculi, levator LPS, and Mueller’s muscle, and in some cases, it may include traces of orbital septum and preaponeurotic fat (Figure 5). Typically, 3 sets of sutures are used for most variants of these buried sutures techniques (Figure 6). Through these permanently buried, nonabsorbable sutures, the anterior orbicularis oculi and the posterior lamella of levator and Mueller’s muscles (which have opposing physiological functions) are now locked together. Each of these muscle component will bear increase load (or increased impedance) when stitched through ligatures to the other. One may re-imagine Flower’s analogy of the eyelid crease being like a motor cycle helmet visor—envision the clear visor (anterior lamella) being stitched or stapled to the shell framing of the helmet (posterior lamella); the visor likely will not move as freely. Each became an impediment to the proper functioning of the opposing lamella. There is no longer any physiological freedom of movement. With buried sutures placed in this fashion, the LPS has been strained to carry some fraction of the orbicularis oculi when opening the eyelid fissure, and more effort is needed to look up or maintain the open-eye resting position for the upper-lid
margin near the superior corneal limbus. When the patient tries to close the eyelids, the responsible orbicularis may experience a strained sensation because it is now locked into the levator LPS/Mueller’s layer. These patients may actually complain of a vague foreign body sensation even if their suture knots are well buried within the layers of the upper lid. Similarly, we may see this in any patients, including non-Asians who have had abnormally high anchoring after anchor upper blepharoplasty. Some Asian patients who have had buried sutures crease procedures have complained of labored sensation opening the lid as well as relaxing the lid (closing the lids)—it may show as mild ptosis, lagophthalmos, and even slight retraction in downgaze.

These sutures that are passed from the skin side in a superiorly directed fashion toward the conjunctiva are skewed upward and often induce an unintended plication/shortening or advancement effect on the levator aponeurosis (it is not unlike what an oculoplastic surgeon would perform in levator aponeurotic repair of ptosis) such that they may have an initial ocular stare (appears wide-eyed) from lifting of the upper lid margin. Some physicians actually present this as a form of combined ptosis repair with creation of a lid crease, based on operative reports and itemized invoices I have seen from patients in consultation.

**Vulnerability of Levator Palpebrae Superiors**

The dampening effect on a primary muscle’s contractile function is used therapeutically in strabismus repair for large-angle congenital esotropia (cross-eye) where the medial recti muscles are the culprit. In posterior fixation of medial rectus with Faden (German for suture) placement, a suture is used to anchor the already-recessed medial rectus muscle to the globe through an intrascleral attachment further to the posterior half of that eye. This magnifies the recession effect, further lessening the pull of the medial rectus, and the severe crossing of the eyes becomes corrected. Recently, it has been shown by Clark et al (Supplemental Video 1) that this weakening effect is also manifested without having to fixate the extraocular muscle to sclera to reduce its axial function, but by simply hitching to surrounding or overlying orbital fat tissues. One can see a Faden-like effect without the need to place Faden’s scleral-fixating suture. In essence, any nonphysiological tethering of a primary muscle to surrounding tissues will weaken its proper function. The surgical video (Supplemental Video 2) shows that in upper lid surgery, the movement of the levator muscle may be impeded by higher placement of wound-closing sutures on the levator aponeurosis; in this video, we did not even have to use full thickness placement of sutures to see a partial limitation of upgaze and decrease in the range of excursion of the upper lid (levator function).

This is essentially what we see with application of permanent buried sutures that involves the levator muscle/Mueller’s muscles being tethered to (or encircled around) overlying orbicularis oculi. The act of linking the posterior and anterior lamella with 3 sets of double armed sutures each covering a 3.0 to 4.0 mm width of levator at the medial, lateral, and central locations (3 strategic locations) basically binds the orbicularis oculi/levator/Mueller’s muscles there. To counter the impairments seen, most surgeons skew the needle passage upward toward the conjunctiva, and this shortens (and lifts) the levator to open the palpebral fissure wider but actually further weakens the levator contractile function in the long term as the ligature is tied around the levator further proximally along the length of the muscle. The upper lid clinically shows the undesirable effect on the levator muscle as mentioned in the previous discussion on function. Here, the orbicularis oculi (which is tied by the encircling sutures to the primary levator muscle) plays a similar role as that of Clark et al’s demonstration that adjacent orbital tissue attachment to the medial rectus muscle can cause an impairment similar to deliberate Faden attachment of the rectus muscle to the globe, which is used for treatment of severe magnitude esotropia. One is not asserting that Asian blepharoplasty is Faden’s procedure. I am merely alluding to the fact that the use of buried permanent sutures used in certain Asian eyelid surgeries has adverse

![Figure 5. Cross-section drawing showing placement of buried sutures that encircle the orbicularis oculi, levator aponeurosis, and underlying Mueller’s muscle. Here it is shown as a blue 7-0 nylon or Prolene suture loop. Often a small fragment of pre-aponeurotic fat pad and orbital septum may be inadvertently included in the ligature.](image-url)
consequences as the orbicularis and levator muscles’ intrinsic functions may be compromised from being tied together.

It is precisely the failure to understand that the restrictive mechanism seen in Faden’s procedure can be similarly seen in binding together any opposing sets of muscles that I have seen all these under-reported issues. (One can imagine a tennis player having his biceps stitched with some buried nylon stitches to his triceps; his ability will be partly impaired).

Curiously, this tight unison of these muscles in the form of a noose may eventually wear through the tissue layers partly or completely in some instances, releasing its dampening effect; however, we may still observe mild ptosis together with fading or disappearance of the intended crease line.
The elevation of the upper lid is highly dependent on the levator LPS and Mueller’s muscles (fifth and sixth layers of the upper lid), together with the presence of the preaponeurotic fat as the glide zone (fourth layer) and physiological freedom of movement between all of the layers. The biodynamics of the eyelid crease is highly sensitive to the integrity of these tissues. Placement of buried encircling sutures may result in short-term improvement for creation of an apparent crease but is often accompanied by long-term regression of results or impairment on the health of these important muscles. This applies to both buried-sutures techniques in which permanent crease fixation sutures are used around the orbicularis oculi and levator muscles, as well as in the setting of external incision techniques in which the surgeon may have carried out high anchoring of the crease beyond the superior tarsal border.

**AESTHETIC APPEARANCE OF THE CREASE**

The third concept we will discuss has to do with the ideal positioning of the crease and its outcome. Over time, I understand that Asian blepharoplasty (double-eyelid procedure) is more than simple debulking of upper lid tissues. It requires selective removal of layers of tissues in a beveled approach (Figure 7),22,23 coupled with construction of a dynamic lid crease.

Briefly, the author’s placement of the crease height is primarily based on the central upper tarsal height, while the shape chosen is included in the design. After the crease incision (lower incision line) and upper incision have been made through the skin using a surgical blade, the next step is a superiorly-beveled traverse through the upper incision’s orbicularis oculi and orbital septum to reach the preaponeurotic space. The strip of myocutaneous tissues backed by the orbital septum (in most cases) is then rotated forward and trimmed along the superior tarsal border, as well as the lid crease incision, using light application of monopolar cautery on cutting mode with good control of vascular oozing and minimizing injury current that may affect the lower skin edge. Small strands of redundant fibroadipose tissues may be selectively thinned along the incision incision and superior tarsal border. The wound-injury involvement of the layers are staggered and distributed. With this beveled approach, access through the skin, orbicularis oculi, and orbital septum allows an en-bloc removal without having to deal with each layer, as well as a graded handling of the preaponeurotic fat as the clinical finding dictates. The tissue planes are then reset appropriately through release of any constraining surgical drapes. The upper edge of the incision wound will fall in place naturally without exaggerated wound tension; and the crease invagination is apparent intraoperatively even prior to closing the wound edges. Five to six crease-enhancing 6-0 sutures are applied from the skin to the fifth layer, to superficial strands of the levator aponeurosis, and then back to the skin as interrupted sutures; the wound is further approximated with a running 7-0 stitch. The orbicularis oculi muscle, orbital septum, and preaponeurotic fat pad are intentionally not embedded in the crease wound, further reducing the incidence of malformation of the crease and suboptimal results. In this technique, buried sutures are not utilized and all sutures are removed at 1 week.

The elegance of the author’s beveled approach is that instead of removing a square or rectangular cross-sectional block of preaponeurotic skin/orbicularis oculi/possible fat, a beveled approach through orbicularis removes less of these tissue layers (Figure 7). Fat excision is kept to a minimum to avoid a sunken sulcus. This preserves more of the orbicularis oculi than traditional excision and allows a greater surface of the aponeurosis to be cleared. In most cases, a small amount of skin is necessarily removed to reduce the lid fold.

Figures 8 and 9 show examples of patients who underwent Asian upper blepharoplasty based on the author’s technique.

This technique has the following advantages:

1. It spreads the wound injury among the eyelid layers in different depths and locations.
2. It allows a tension-free closure.
3. It preserves most of the preaponeurotic fat (as a glide-zone buffer).
4. It provides flexibility and access to all layers of the upper lid.
5. It aims to preserve and even enhance the biodynamics of tissue layers.

This last point may be most relevant: the biodynamics of the upper lid relies on a glide plane (preaponeurotic fat, fourth layer) to exist between the anterior and posterior lamella; this permits the formation of a dynamically pulled-in crease to occur between the interphase of activated levator-Mueller’s muscle with a relaxed skin-orbicularis oculi (lid fold). The anterior lamellar components of skin-orbicularis oculi-orbital septum acts as a functional unit, innervated by the facial nerve branches. The posterior lamella components are much more dynamic among its layers; there are movements at the boundary between the levator muscle (fifth layer) and the preaponeurotic fat pad (fourth layer) in front, as well as cocontraction of the Mueller’s muscle (sixth layer).

The technique described by this author22,23 for Asian blepharoplasty crease construction relies on the spatial optimization of the different tissue layers relative to each other. It creates a more favorable anatomic environment for a crease to form naturally, rather than relying on suture compression or ligation of upper-lid tissues with permanent sutures. We can achieve these benchmarks without having to use any embedded encircling sutures (temporary or permanent) on any muscles, by using strategic attachment...
of only fractional strands of the distal levator aponeurotic fibers, redirecting it toward the skin along the superior tarsal border while avoiding the use of dissolvable suture materials. All sutures are removed at 1 week. The concept and technique is equally applicable to revisions.24

DISCUSSION

A dynamic crease created in the fashion described here should appear soft yet significant enough in frontal pose, and it will naturally fade when observed at downgaze, appearing as a natural crease line. Techniques that use permanently buried sutures often will leave noticeable skin indentations and irregularity in the crease when the upper lid is observed in downgaze.

The external incision methods generally allow good control of the shape and height of the crease, as well as depth of crease construction for patients seeking double eyelid crease. Its main advantage is that, for a substantial group of single eyelid patients who present with redundant skin, orbicularis oculi and preaponeurotic fat, the technique can correct these factors without compromise. The ideal goals are to restore (for those patients who do not have the ideal) tissue proportion or spatial anatomy toward a more biodynamically-efficient environment for forming a crease.

The upper eyelid is a complex composite of tissue layers with varying innervations and functions, affected by dynamic forces within its layers. It is highly susceptible to external forces. This concept article is a deeper discussion of the factors that influence outcome of the eyelid-crease placement, as it relates to height, shape, the pursuit of symmetry, and failure analysis. I believe that if surgeons are cognizant of these current concepts, it will guide them toward the appropriate selection of surgical approaches in Asian eyelid surgery.

CONCLUSIONS

This article touched on some of the possible errors in placement of crease height in upper blepharoplasty, pitfalls that can be associated with permanent placement of nondissolvable sutures that encircle the complex layers of the upper eyelid, and the ideal eyelid-crease wound closure and its biodynamics. It differs from the usual reports of technique variants and instead concentrates on the biodynamic factors of the upper eyelid crease. These factors are not limited to upper blepharoplasty only, and they should be considered in
any form of upper eyelid surgery because the eyelid crease is the entry portal to its complex layers.

**Supplementary Material**

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**REFERENCES**


