The Concept of a Glide Zone as It Relates to Upper Lid Crease, Lid Fold, and Application in Upper Blepharoplasty

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Classically, the normal eyelid anatomy can be conceptualized as consisting of two layers: the anterior skin/orbicularis oculi muscle layer and the posterior layers of the levator muscle and aponeurosis, Müller's muscle, and the tarsal plate. In general, Caucasians eyelids with a crease are thinner than their Asian counterparts. This is attributable to a combination of factors that include a higher point of fusion of the orbital septum onto the levator aponeurosis, the relatively higher position of preaponeurotic fat pads and resultant thinner lower segment of eyelid, less preseptal fat, and thinner orbicularis. Comparatively, Caucasians with an eyelid crease possess a greater number of distal fibers of the levator aponeurosis that terminate toward the skin along the superior tarsal border and the area above it to form the eyelid crease. When the levator contracts, the tarsal plate vectors upward and the eyelid crease invaginates easily. Caucasians may often have a deep-set supratarsal sulcus (Fig. 1).

The upper eyelid anatomy of Asians is further divided into two groups—those with an upper eyelid crease and those without any crease. In Asians with a crease, although the eyelid may still be thicker than in Caucasians with an upper lid crease, there are distal fibers of the levator aponeurosis terminating toward the skin along the superior tarsal border.[1] Despite the low point of fusion of the orbital septum, when the levator contracts, there is an invagination of skin along the superior tarsal margin to form a clinically apparent upper eyelid crease.[2] When the lids are open and the subject is looking ahead, there is a greater degree of fullness in the preseptal region compared with Caucasians with a crease but less than that typically seen in Asians without an upper lid crease (Fig. 2). Asians who are without an eyelid crease typically have thicker eyelids because of the presence of a hypertrophied orbicularis and the presence of fat in the pretarsal, preseptal, and preaponeurotic areas. The orbital septum fuses with the levator aponeurosis at a lower point compared with those Caucasians with an upper eyelid crease. There are relatively few fibers or no attachment from the levator aponeurosis toward the skin along the superior tarsal border. Their pretarsal and preseptal zones are thicker compared with Caucasians or Asians who have an eyelid crease (Fig. 3).

In aesthetic Asian blepharoplasty, where the goal has always been to create an ethnically appropriate crease, there are two categories of methods used to achieve this goal. The first consists of the suture ligation methods,[3–6] which are often described as being less invasive and simpler to perform, and use several buried sutures to tighten the soft tissues along the superior tarsal border, which includes orbicularis, levator aponeurosis, and Müller's muscle. The other category is the external incisional approach, whereby a skin incision is made along the designed crease and varying amounts of skin, muscle, and soft tissues may be removed; this is then coupled with various methods of crease construction by means of fixation or attachment of skin to the levator aponeurosis, skin to the tarsus, or orbicularis-to-aponeurosis fixation.

The surgical results often depend on a complex interaction between the degree of excessive tissues overlying the pretarsal and preseptal areas, the presence of fat, the thickness of skin over each of the two areas mentioned above, the position of the globe, the brow position, levator function, and whether there is a firm adhesion

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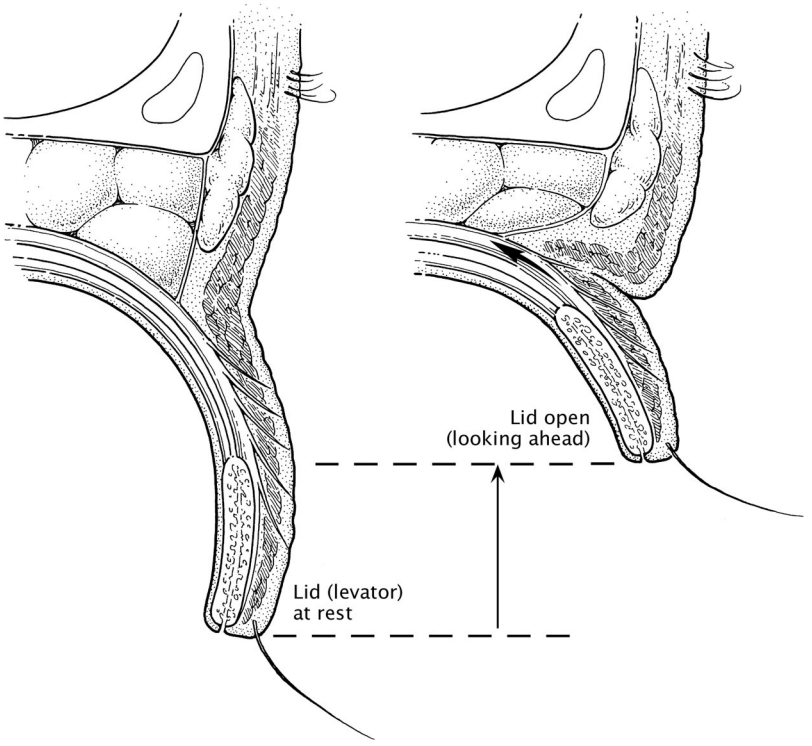

Fig. 1. Caucasian eyelid with a crease. In general, Caucasian eyelids with a crease are thinner than their Asian counterparts. This is attributable to a combination of factors including a higher point of fusion of the orbital septum onto the levator aponeurosis, the relatively higher position of preaponeurotic fat pads and resultant thinner lower segment of eyelid, the greater number of distal fibers of the levator aponeurosis that terminate toward the skin along the superior tarsal border and above to form the eyelid crease, less preseptal fat, and thinner orbicularis. When the levator contracts, the tarsal plate vectors upward and the eyelid crease invaginates easily.

of skin to orbicularis in the pretarsal area. In a normal upper eyelid, when the eyes are looking straight ahead and the lids are open, the anterior layer is in passive relaxation, allowing the posterior levator/Müller's muscle/tarsus to actively contract and pull the lid margin upward into an open position. The posterior layer only has to retract (glide) up and inward for 2 to 4 mm relative to the anterior layer for a reasonable crease to be observed. The vertical width (in millimeters) of the eyelid fold overhanging the crease can be measured simply by subtracting the "observed crease width" (from eyelash to inferior border of eyelid fold) from the anatomical crease width (measured with the eyelid fold moved away to expose the true crease line). This varies between 2 and 4 mm. The anterior layer therefore offers very little resistance and does not act as a "resisting platform" against the levator muscle/tarsus; exceptions to this will include heavy eyelids (those with abundant preaponeurotic or suborbicularis fat, and loose subcutaneous areolar tissues) with poor levator function, including true ptosis.

The role of the preaponeurotic space and fat is often mentioned as a hindrance to any attempt at surgical construction of a crease, and surgical dictum requires that at least a portion of the fat be excised. There is nothing inherently wrong with this concept; in fact, when the patient presents with excessive soft tissues along the preaponeurotic platform, this author has advocated using a beveled approach toward the preaponeurotic space along the upper line of the incision and performing a trapezoidal debulking of the skin, orbicularis, a small amount of septum, and inferiorly migrated fat.[7] Should one need to reenter this space later using a beveled approach, one can identify the preaponeurotic space and its fat quite readily. The problem arises when the ini-

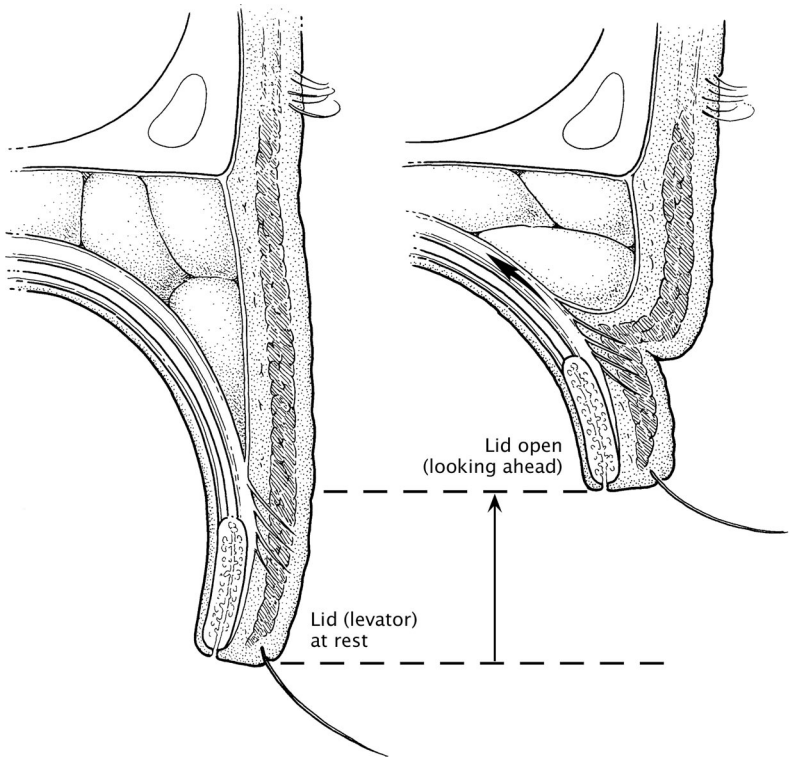

Fig. 2. Asian eyelid with a crease. Although the eyelid may still be thicker than in Caucasians with an upper lid crease, there are distal fibers of the levator aponeurosis terminating toward the skin along the superior tarsal border. Despite the low point of fusion of the orbital septum, when the levator contracts, there is an invagination of skin along the superior tarsal margin to form a clinically apparent upper eyelid crease. When the lids are open and the subject is looking ahead, there is a greater degree of fullness in the preseptal region compared with a Caucasian with a crease, but less than that typically seen in Asians without an upper lid crease.

tial procedure may have involved aggressive excision of the preaponeurotic fat or been accompanied by excessive hemorrhage within that space, which is surrounded by orbicularis oculi in front and vertical communicating arterial branches of the marginal arcade, the peripheral arcade, and the deep orbital arcade. The patient often develops a sunken supratarsal sulcus, with total loss of fullness to the preseptal zone, and may have poor crease invagination and a stiffened eyelid skin, with underlying cicatrix involving the pretarsal and preseptal areas (Fig. 4). During revision, one sees a collapse or obliteration of the preaponeurotic space and absence of preaponeurotic fat. The anterior and posterior layers appear fused into a single layered complex. One can visualize this as if the levator muscle now has to carry or lift the upper tarsal plate against the weight of a double load of eyelid layers, as opposed to the usual scenario where the tarsal plate glides up and under the anterior layers of skin and orbicularis. The skin/orbicularis is now acting as a "resisting layer" toward the posterior layer of the levator muscle. The absence or presence of this "glide zone" (with nonadhering preaponeurotic fat within its space) in the middle between the two layers can therefore hinder or facilitate formation of the crease. The author has observed the presence of tightly bound preaponeurotic fat in some "single-eyelid" (creaseless) individuals coming in for primary surgery, where this amorphous infiltrated fat in the "glide zone" may have contributed to the lack of a crease. Careful repositioning of this fibrosed fat to a higher level seems to facilitate the up-vectoring of the lid and crease formation.

The properly functioning eyelid crease was once described by Boo-Chai[8,9] in his 1963 article as being like the visor of a motorcycle helmet; in addition, Flowers[10] had mentioned in his article on anchor blepharoplasty the idea that the infe-

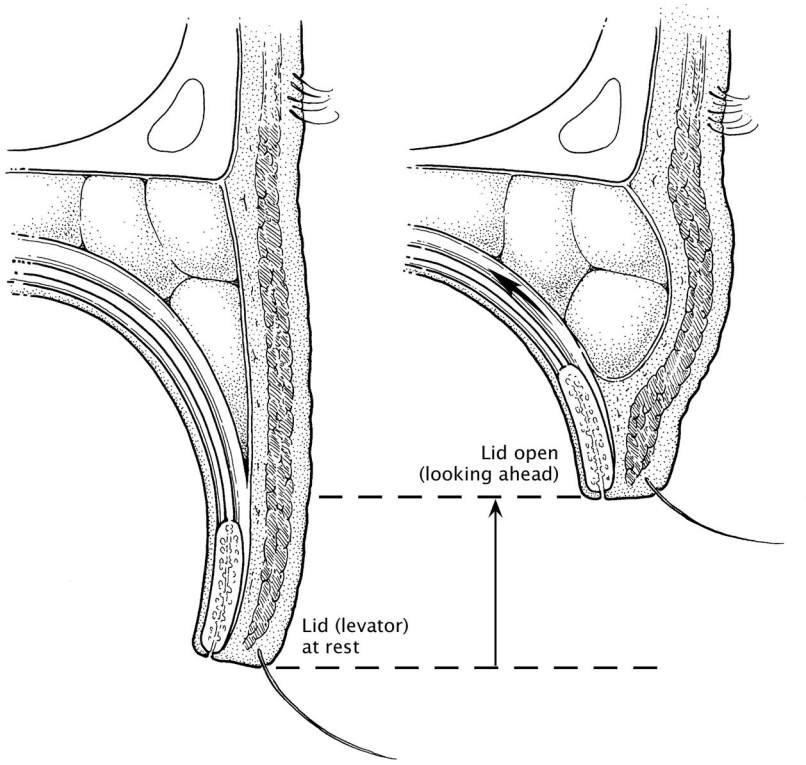

Fig. 3. Asian eyelid without a crease. The upper eyelid is often thicker because of the presence of a hypertrophied orbicularis and the presence of preseptal fat in the pretarsal and supratarsal areas. The orbital septum fuses with the levator aponeurosis at a lower point compared with Caucasians with an upper eyelid crease. There are relatively few fibers or no attachment from the levator aponeurosis toward the skin along the superior tarsal border. Both the pretarsal and preseptal zones are thick compared with Asians or Caucasians with an upper eyelid crease.

rior extent of the preaponeurotic fat acts like a ball bearing at the orbital septum-to-aponeurosis fusion point (the inferior extent of the preaponeurotic space).

This author's concept varies from the above authors in the following way: the preaponeurotic space, its presence and its preservation with some fat within it, is a necessary "third layer" and should be preserved pristinely as much as is feasible (Fig. 5). In this drawing, the middle zone (glide zone) where the preaponeurotic fat pads are located are colored beige and act like a friction-free layer that allows the posterior layer (red) to glide up. The up-vectoring of the tarsal plate is facilitated by this glide zone, which allows it to slide upward against the passively resisting eyelid fold to form an upper lid crease. The skin passively glides over the posterior layer (the upper part of the tarsal plate) for several millimeters in the process of forming the upper lid crease and becomes the eyelid fold. The absence of adhesion and the presence of natural fat within this glide zone allows the pretarsal platform (posterior layer) to shift and glide slightly posterosuperiorly under the preseptal eyelid (anterior layer) to form a physiologic upper lid crease.

The typical findings one sees following a suboptimal lid crease procedure for Asians and any upper blepharoplasty may include an unusual amount of swelling (tissue edema, hemorrhage from the orbicularis, or any of the vascular arcades[11–14]), excessive removal of fat within the preaponeurotic space, and inadequate construction of the crease based on physiologic principles. As the swelling recede, one or more of the following may appear: ptosis, a hollow sulcus, an inadequate formation or absence of crease, or multiple wrinkle lines (with or without a primary crease). These are all signs relating to excessive manipulation or inappropriate management of tissues within the glide zone, with adhesions involving orbicularis, septum, and levator aponeurosis. The patient may complain of a labored

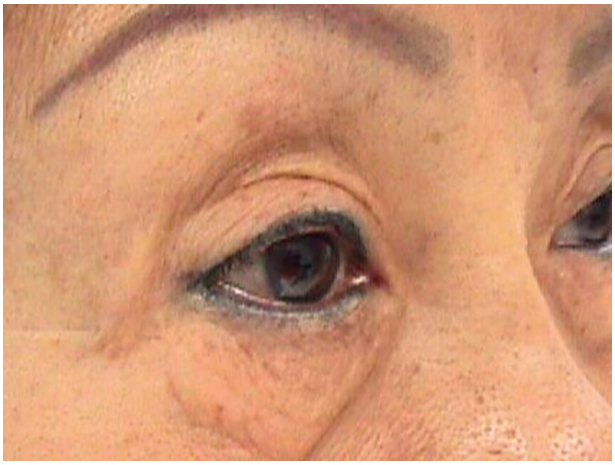

Fig. 4. Photograph of scarred upper lid/stiffened eyelid skin with underlying cicatrix in the pretarsal and preseptal areas.

effort in keeping the upper lids open, difficulty in upgaze, and having portion of the upper visual field obstructed.

The pretarsal and preseptal eyelid skin may appear as a single zone of flattened or convex plaque of thickened skin overlying the globe. This is indicated by one or more of the following three clinical signs:

1. With the patient looking downward, the examiner gently places his or her index finger superficially over the midportion of the preseptal skin superior to the upper tarsus to push or glide the anterior skin/muscle layer upward. If the anterior skin/muscle layer fails to be moved upward for 2 mm or more without the upper lid margin also moving upward, it is indicative of an abnormal "glide sign" (Fig. 6, *above*) (the patient should avoid closing his or her eyelids because this elicits active contraction of the orbicularis).
2. With patient looking downward, the examiner uses his or her thumb and index finger to try to pinch the preseptal zone's anterior skin layer from the lid tissue underneath it. If this is not possible, as indicated by the *posterior* layer and upper eyelid margin also coming off the surface of the globe, this is suggestive of an obliteration of the glide zone, constituting an abnormal pinch sign (Fig. 6, *center*).
3. The patient is asked to look down, and the ipsilateral eyebrow is splinted by the examiner's other hand to prevent brow action on upgaze. Then, with the examiner pinching the preseptal skin, the patient is asked to look upward. As the patient looks up, the superior rectus and levator muscle both contract. A normal finding should be the upper eyelid margin underneath moving up independently without the pinched skin going upward. If the pinching fingers should feel an upward tug, it indicates that the levator and preseptal skin are fused together and is an abnormal "upgaze skin traction sign" (Fig. 6, *below*).

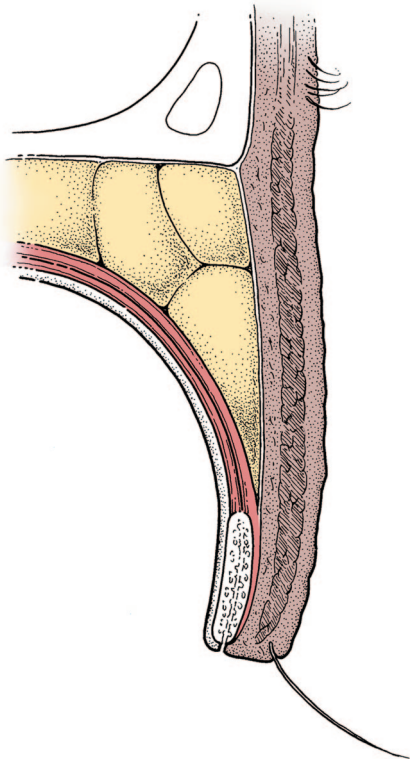

Fig. 5. Concept of the glide zone. The glide zone consists of the space occupied by the preaponeurotic fat pads and all potential space between the anterior orbicularis/orbital septum layers (*light purple*) and the posterior layers of levator/aponeurosis/Müller's muscle/tarsal plate (*red*). The middle zone (glide zone) has been colored *beige* and acts like a frictionless lubricating layer that allows the posterior layer to glide up. When the patient looks from downgaze to straight ahead, the levator contracts and the sphincter-like orbicularis relaxes. The anterior skin/muscle layer therefore acts passively as the levator contracts to open the eyelid fissure. The up-vectoring of the semirigid tarsal plate therefore depends on the glide layer to allow it to hinge upward under the anterior layer for several millimeters in the process of forming the upper lid crease; the overlapping portion of skin over the tarsus is the eyelid fold.

The above findings apply more to young or middle-aged adults and would not be accurate in those unlikely revisional cases where there is

Fig. 6. (*Above*) Image demonstrating the glide sign, here showing that the superficial dermis can glide superiorly or inferiorly over the deeper layers in normal eyelid. An abnormal finding indicates adherence of the anterior and posterior layers. (*Center*) Image demonstrating the pinch sign. When the glide zone is intact, the preseptal skin/muscle (anterior) layer can be lifted away from the posterior layer of the eyelid for several millimeters, as shown here, without the tarsus coming off of the globe. An abnormal finding indicates adherence of the anterior and posterior layers. (*Below*) Image demonstrating the upgaze skin traction sign. The patient is asked to look up while the skin is secured with the examiner's fingers, here showing a lack of adhesion. A direct pulling force from the levator indicates an abnormal traction sign and suggests that there is obliteration of the preaponeurotic space or glide zone.

redundant skin remaining in the preseptal area or in patients who have age-related dehiscence between the preseptal skin and orbicularis such that a false-normal finding may occur (in a situation where, although the glide zone has been obliterated, it is still possible to glide and pinch the skin relative to the orbicularis that became adherent to the levator and showed no skin traction on upgaze). It is possible that a patient with fused anterior and posterior layers may manifest a false-negative finding in any one or two of the above tests, but it is unlikely that all three would be normal on evaluation. This combination of glide sign, pinch sign, and upgaze skin traction sign have been helpful for this author and are additional tools one can use to help in the clinical assessment of those patients with revisional issues.

In the author's previous article on trapezoidal debulking of the preaponeurotic platform,[7] one observe that the excision of skin and some orbicularis in a beveled fashion removes no more than several millimeters of orbital septum along the upper wound edge. With wound closure, the septum's inferior edge is still allowed to lay back on the front surface of the distal aponeurosis at or slightly above the superior tarsal border, preserving and forming the anterior boundary of this glide zone.

During attempts at revision, it is crucial to be able to identify and reach this third space and restore a glide zone. At the same time, any scar tissue within this potential space can be approached and cleared, including removal of any buried sutures and correction of any cause that is impeding this glide (shift) of the posterior layer. The skin/orbicularis layers may have been improperly laid onto the levator during previous surgery because of the lack of proper loosening of the surgical drape on the forehead. The reestablishment of the glide zone, and downward and appropriate positioning of the skin and eyebrow/forehead complex, allows the now "released" tarsal plate to be properly pulled upward by the freed posterior levator muscle, the contraction of which then yields a crease at the superior tarsal border. This can be apparent as the patient lies on the surgical table even without any sutures closing wound edges together (Fig. 7).

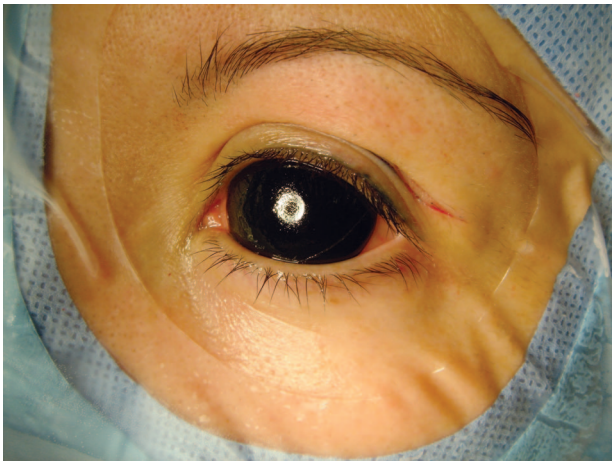

Fig. 7. Appearance of intraoperative crease form in a revisional patient before application of crease-fixation sutures and closure.

The various methods of crease construction, including the tightening of the tarsoaponeurotic junctional zone by suture ligation or external incision methods, all work in facilitating the upward vectoring of the tarsus against the anterior eyelid layer to form the crease, provided that the glide zone is preserved or has not been greatly disturbed.

Complications that are challenging to correct often follow obliteration of the glide zone. During the simpler techniques of transconjunctival and transcutaneous suture ligation, unexpected and sudden bleeding has been reported and may be caused by injury to the vertically oriented anastomotic vessels of the marginal and peripheral arcades of the upper lid[11] and the deep orbital arcade,[12,13] and can also involve the recently described lateral septoaponeurotic artery found in a certain percentage of the population.[14] The bleeding may occur in the postaponeurotic plane if the vessels retract after transection in front of the tarsus or aponeurosis, or within the preaponeurotic space (the glide zone) itself. Residual adhesion may follow resolution of blood clots and lead to irregularity in the crease thus created. Over the long term, partial, segmental, or complete disappearance of the crease may be seen.

The concepts discussed in this article arose from clinical observation and the surgical findings of the author, and have been applied in his practice to handle complex revisional issues. The use of the beveled approach in revisional Asian blepharoplasty is a direct application of the glide zone concepts discussed here.

CONCLUSIONS

The upper eyelid crease is an anatomical invagination of the eyelid skin along the superior tarsal border. Its originates from a complex interaction of vector forces consisting of the following: a healthy levator muscle (posterior layer), the presence of healthy skin/orbicularis over the preseptal region that rolls over passively as an eyelid fold (anterior layer), the presence of a third layer called the glide layer (with healthy preaponeurotic fat within it), and the absence of midlamellar scarring that may bond the anterior and posterior layers of the upper lid together. The theoretical basis for preservation of this third layer—the preaponeurotic glide zone—and the role it plays in upper blepharoplasty has been detailed in this discussion and should provide greater understanding in the management of blepharoplasty and complex revisional issues.

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DISCLOSURE

The author has no financial interest in any of the products, devices, or drugs mentioned in this article.

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