Aesth. Plast. Surg. 29:65–73, 2005
DOI: 10.1007/s00266-003-0066-1

Aesthetic Plastic Surgery

Eyelid Aging: The Historical Evolution of Its Management

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Abstract. The evolution of blepharoplasties is reviewed. By better understanding the mechanism of herniated lower eye lid fat pads, one can understand the interrelated enophthalmia, tear trough deformities, and sunken upper lid. The authors use a technique of relocating the herniated fat pad that reverses this process. All of this is described in detail.

Key words: Capsulopalpebral fascia—Enophthalmia—Eyelid herniated fat pad—Sunken upper lids—Tear trough deformity

We know that Castanares [9] in America popularized skin and fat resection for the aging lower lid. Bob Flowers [11] also was a great contributor, and he managed his tear trough deformity with an allograft. Raoul Loeb [12] grafted herniated fat and mobilized the orbital herniated fat pad as a flap to fill in the infraorbital sulcus. Sam Hamra popularized this approach, and currently, there is a trend to graft fat to fill in the sunken upper lid and the infraorbital sulcus.table 1

The management of the lower eyelid herniated fat pad using a transcutaneous approach was revolutionized by de La Plaza and Arroyo [10]. These authors sutured the capsulopalpebral fascia to the orbital septum and orbital rim, relocating the herniated fat pad and preventing further enophthalmia. With a large series of patients, Mendelson [13] demonstrated how efficient and persistent this approach could be. We are aware that orbital fat resorbs with aging, and some surgeons now graft fat in sunken upper lids.

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With a percutaneous approach, the numerous vertical motor nerves to the preseptal orbicularis occuli muscle can be damaged, and ensuing paresis or paralysis of the lower lid is possible. The vertical nerves run deep to the muscle. The preseptal orbicularis and the two canthi are responsible for the vertical high of the lower lid.

Another common cause of postblepharoplasty scleral show is the downward pull caused by contracting scarification resulting from an injury or hematoma at the junction of the orbital septum and orbicularis muscle.

Camirand et al. [1–8] used the transconjunctival approach, which does not denervate the preseptal orbicularis. This approach is not likely to cause a hematoma (it is a bloodless procedure), thus reducing the risk of scarification at the level of the orbicularis and orbital septum. The preseptal orbicularis and tarsus, being freed, can move upward freely to cover the lower limbus, reducing the risk of scleral show.

When we use this approach, we do not interfere with the physiology of the inferior tarsal muscle because we buttonhole this structure, leaving its medial and lateral attachment on the tarsus (a rigid structure) and transmitting its pull on the lower lid. This autonomous and involuntary inferior tarsal muscle lowers the lower lid to express fear, astonishment, or any other involuntary autonomous facial expression, but is not responsible for voluntary lowering of the lower lid. The lower lid comes down in response to relaxation of the pretarsal orbicularis, gravity, the downward push from the marked convexity of the cornea, and the downward motion of the lid. The voluntary muscle inferior rectus (inserting via the capsulopalpebral fascia onto the inferior tarsus) lowers the tarsus, but as soon as the lower lid comes down, its direction of pull, as that of the involuntary inferior tarsal muscle, is backward to maintain the contact of the lower lid with the globe.

Table 1. Lowering of the Lockwood suspensory ligament.[a]

↓	↓	
A ↓ Space between globe and floor of the orbit	B ↑ Space between globe and roof of the orbit	→ Sunken upper lid made worse by
		Periglobular fat rotation into the lower lid hernia
		Senile fat atrophy
↓		
Extraconical fat herniated anteriorly		
Herniated fat pad in lower lid		
Hernia above nonstretchable orbital malar ligament: tear trough deformity		
As fat comes out of the orbit, enophthalmia is made worse with		
Senile fat atrophy		
Surgery excision, mobilization, coagulation		

[a]The volume of the nonstretchable bony orbit is constant, and the volume of the noncompressible orbital fat is constant until aging which results in atrophy making things worse.

They do not pull the lid downward. This explains why we have no difficulty lowering the lower lid with our technique.

Technique

In 1993, while performing a transconjunctival lower blepharoplasty, we sutured the lower flap (conjunctiva, inferior tarsal muscle, and capsulopalpebral fascia) to the arcus marginalis, which is the fusion of the orbital septum with the periosteum of the orbital rim. We removed the double-prong hook and replaced the eyelid on the eyeball. Pressing on the globe, we noticed two hernias, one on each side of the stitch.

Encouraged with this observation, we placed two more stitches to suture the lower flap to the orbital rim. Then, pressing on the eyeball, we could not recreate the herniated fat pad nor the enophthalmia. On the opposite side, we used a continuous suture, and this has been our only management of the herniated fat pad since [1–8]. The level of satisfaction of our patients has been very high (Fig. 1). As you perform your next tranconjunctival blepharoplasty, try one, two, or three stitches, as I did the first time. Then if you do not like it, remove your stitches and remove the fat as usual. One can use the conventional transconjunctival incision, but I prefer incising opposite the orbital rim. You must keep away from the inferior tarsus because one can damage the orbital septum and adjacent orbicularis occuli. They converge with the capsulopalpebral fascia as they insert into the inferior tarsus (Fig. 2). You must avoid scarification at this level, and you must avoid the numerous vertical motor nerves innervating the pretarsal orbicularis muscle from behind (the nerves run deep to the orbicularis muscle).

We have observed that the arcus marginalis is always present medially (because of the bony attachment or the orbicularis), but usually absent laterally, making the lateral attachment of the lower flap more difficult. Because the amount of pressure required to relocate the herniated fat pad is minimal (check in the mirror and reduce your own fat pads), we suture the lateral portion of the lower flap to soft tissues in the vicinity of the lower orbital rim. At first, we cauterized the lateral fat pad and ressected some of it. However, with experience, we found that we do not need to excise, nor coagulate, fat. It remains an alternative.

Once the suturing is completed, we always make sure we have full movement of both the lower eyelid and the eyeball. Using Adson–Brown forceps, we pull the lower lid above the superior limbus and mobilize the eyeball with the forceps to eliminate any possibility of tethering. Because the lower flap is sutured anteriorly to the orbital rim, the flap becomes almost horizontal (in the upright position) or perpendicular to the globe, behaving as a hinge (Fig. 3) and not interfering with the motion of the globe. Besides, the capsulopalpebral fascia is a very stretchable membrane. Even so, the amount of tension required to stretch the capsulopalpebral fascia is much greater than the amount of tension required to maintain the relocated fat pad within the orbit.

With our technique, the resulting conjunctival defect is no greater than that resulting from transconjunctival blepharoplasty. The conjunctiva has a great propensity to regenerate, and this could be the reason why no one has ever needed to graft a posttraumatic conjunctival defect. We never suture our conjunctival defect.

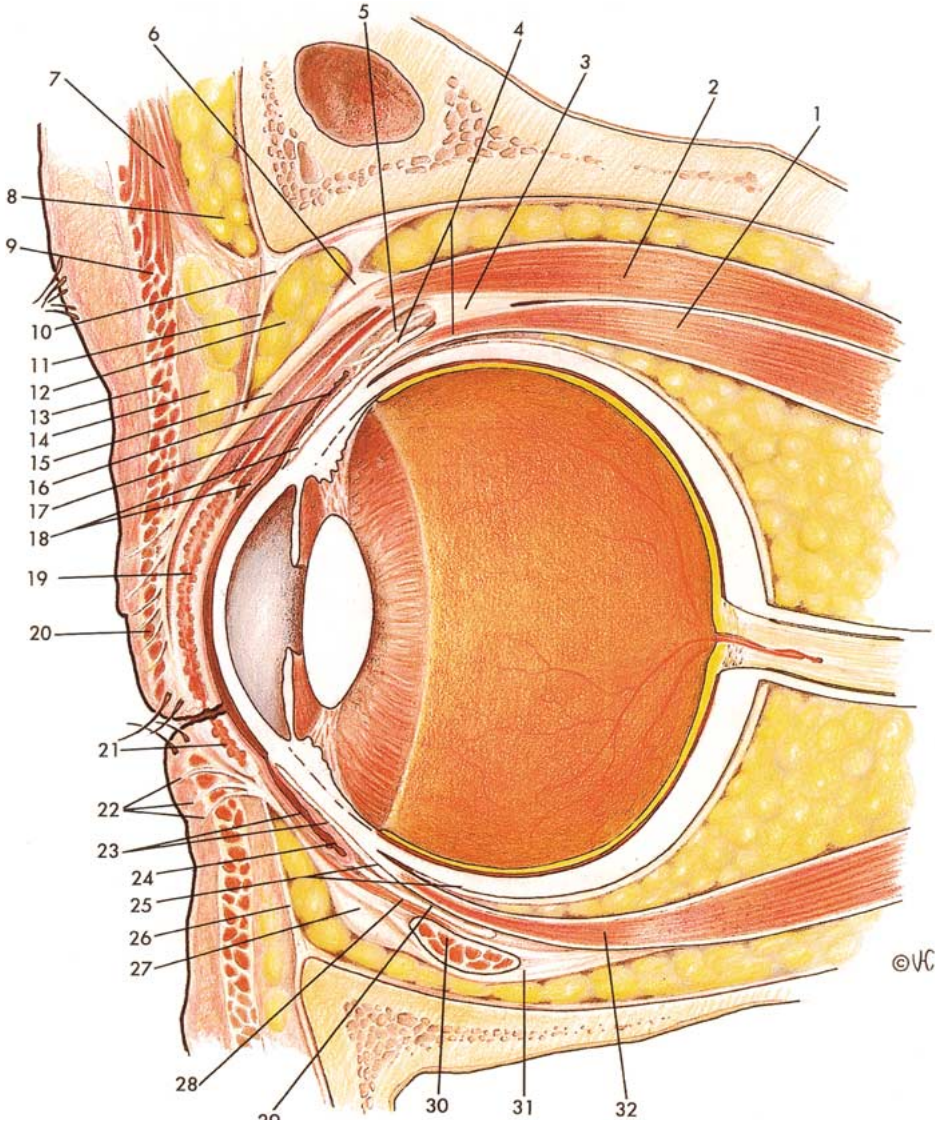

Fig. 1. Parasagittal section showing anterior orbital structures. 1, superior rectus muscle; 2, levator muscle; 3, conjoining of SRM with levator muscle sheath; 4, Tenon's capsule; 5, suspensory ligament of superior fornix; 6, Whitnall's ligament; 7, frontalis muscle; 8, brow fat pad; 9, orbital orbicularis; 10, arcus marginalis; 11, orbital septum; 12, preaponeurotic fat pad; 13, preseptal orbicularis; 14, postorbicularis fascia; 15, levator aponeurosis; 16, superior conjunctival fornix; 17, Müller's muscle; 18, conjunctiva; 19, superior tarsus; 20, pretarsal orbicularis; 21, inferior tarsus; 22, musculocutaneous retractor insertion; 23, conjunctiva; 24, inferior conjunctival fornix; 25, Tenon's capsule; 26, inferior orbital septum; 27, Lockwood's ligament; 28, inferior tarsal muscle; 29, suspensory ligament of inferior fornix; 30, inferior oblique; 31, capsulopalpebral fascia; 32, inferior rectus muscle.

Complications

At first, we did have some recurrences, but very rarely has this happened over the past 9 years. Rarely, we had to use the transcutaneous approach to remove a vestigious lateral fat pad. The transconjunctival approach would have been an alternative. On a few occasions we had conjunctival granulomas. These are easily removed with a few drops of ophthalmic local anaesthesia. We grab the granuloma with forceps and cut the stalk with a small pointed scissors. We never had a granuloma recur. The incidence was reduced considerably by the use of resorbable sutures, and now recurrence is very unusual.

On a few occasions, we had downward retraction and scleral show from scarification (not from pretarsal paresis or paralysis because we do not touch or damage the orbicularis and its enervation). Massage could improve this with time. Using local anesthesia to the lower lid or around the infraorbital nerve and waiting 25 to 30 minutes, we use a double-prong hook on the conjunctival side of the lower lid to pull and evert the lower lid. Holding the hook between the thumb and the index finger of the left hand, we apply our third finger (of the left hand) to the skin of the lower lid and feel bands of scar if weeks or months have passed since surgery.

If this procedure is performed early after surgery, we can palpate a tightness through the skin or with the tip of a scissors. Using small curved and pointed scissors and penetrating the conjunctiva above the original suture of the flap to the rim, we cut this scar until the third finger cannot feel transcutaneously any tethering throughout the whole lower lid. This maneuver must be performed thoroughly.

We also make sure that the lower lid moves freely and easily above the upper limbus. We do not suture the resulting conjunctival wound. We apply an oint-

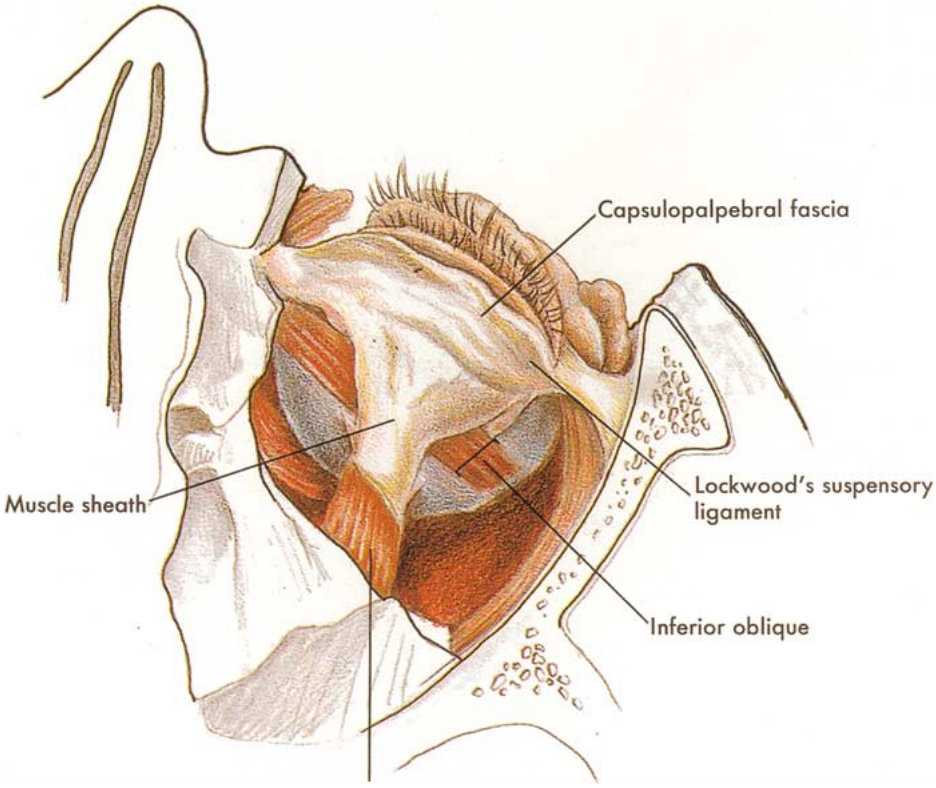

Fig. 2. Left orbit viewed from below showing suspensory Lockwood's ligament. It will support the globe in position within the orbit even after the floor has been surgically removed.

ment for a few days and make sure the patients use their fingers to raise to the lower lid as soon as possible (a day or two postoperatively). This maneuver has always been successful for us in the early postoperative period or after a few months when patients come from a distance, and we have not yet had a recurrence. Currently, as soon as we notice this rare anomaly, we immediately perform this painless, simple, safe, and efficient maneuver. It gives both the patients and us full satisfaction.

The following observations should be kept in mind:

- Chemosis is of a rare occurrence and will vanish with conservative management.
- Using a contact lens will eliminate any corneal irritation.
- Allergies to drops or ointments and conjunctivitis can occur.z

Discussion

If a herniated fat pad is found in the lower lid, what is its origin? Did it originate in the orbit? If you want to restore the original appearance (before the fat herniated), you must relocate the fat pad where it was originally. Because the volume of the orbit and that of the orbital fat remain the same with a herniated fat pad of the lower lid, the eyeball must move backward and downward, making enophthalmia is inevitable. With a hernia, the orbitomalar [14,15] ligament limits the herniated fat pad above or opposite the inferior orbital rim, resulting in an infraorbital sulcus or tear trough deformity (Fig. 3). This will be made worse with descent of a premalar fat pad. As the globe comes down, the distance between it and the roof of the orbit increases. Because of a Rouleau phenomenon and because of senile fat atrophy, the upper lid will be sunken, possibly obscured by a ptotic brow (Fig. 3).

If the distance between the brow and upper lashes is reduced, there will be an upper fullness from the excessive skin and orbicularis muscle. This amount of skin and orbicularis muscle is more voluminous than the space allotted by the 1 to 1.5 ml of extraconical fat herniated into the lower lid and the space allotted by the downward and backward motion of the globe.

Before an upper blepharoplasty is performed, the brow must be raised. This may not require removal of much tissue from the upper lid, so a conservative approach is advised. We prefer to do a brow lift first and then wait 3 months before a conservative skin resection from the upper lid. Rarely, we remove orbicularis muscle, but it must be remembered that the upper median whitish fat pad may have a different vocation. If manipulation is used, it must be applied conservatively. However, care must be taken not to excise too much tissue from the upper lid because this can cause a person to look older.

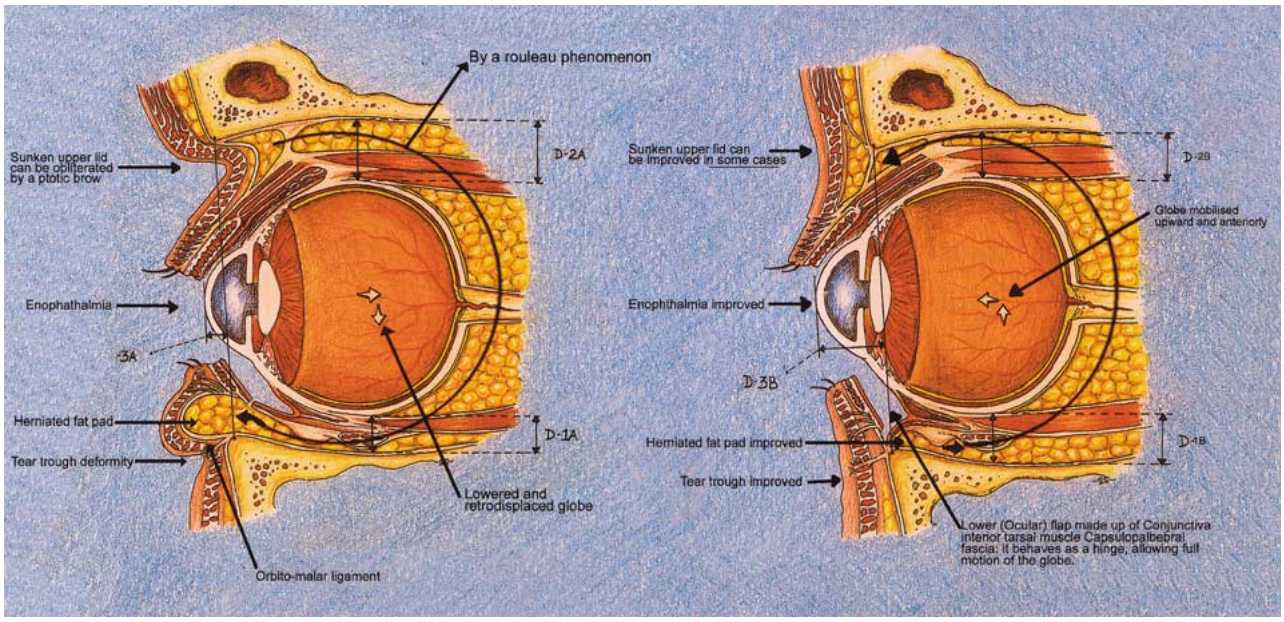

Fig. 3. As the globe comes down, the extraconical orbital fat must herniate anteriorly, which reduces the orbital content and makes enophthalmia inevitable. Because the fat herniates above the orbital malar ligament, tear trough deformity occurs, as well as a sunken upper lid that can be masked by a ptotic brow.

The orbital septum is always a weak structure (it stretches as the globe is pressed), and we always leave it open after a traumatic or surgical injury. We never cause a hernia or accentuate it. We believe it is a mistake to identify the orbital septum as the cause for a herniated fat pad of the lower eyelid. An excessive amount of orbital fat or a shallow orbit can rarely be blamed for this condition because before herniation of fat, these 20-, 30-, or 40-year-old patients would have had exophthalmia. This is the case because the orbital fat is not compressible, and the nonstretchable orbit maintains its constant volume after the fifth year of existence. Before surgery, use of the fingers to relocate the herniated fat pads raises the globe, but never causes exophthalmia. This proves that the volume of the fat and that of the orbit were normal.

Vistness [16] demonstrated that an intraorbital catheter inflated with 1 ml of liquid creates marked exophthalmia. As 1 to 1.5 ml of extra conical herniated fat pad is relocated into the bony orbit, the eyeball rises vertically. Later as the cone of the extrinsic muscles relaxes, the eyeball moves anteriorly to its youthful position, as it was before manifestion of the herniated fat pads. This is well tolerated by the loose "S"-shaped optic nerve and its vessels.

The medial canthus is a thick, strong, immobile structure. However, the lateral canthus is weak and mobile. This dynamic structure is mobilized by the vertical fibers of the orbicularis occuli muscle. As we smile, frown, cry, or initiate a sneeze, we raise the lateral canthus of the lower lid and get back the Mongoloid orbital fissure of youth. Smiling or frowning can raise the lower lid above the lower limbus and mask a scleral show. One must be aware of this when evaluating postblepharoplasty photos, Critical evaluation is necessary, especially when the patient is smiling or frowning for the postoperative photos. These facial expressions can mask a scleral show by raising the lateral canthus. Smiling always improves the result of a lower blepharoplasty, but accentuates dynamic crow's feet.

Causes for Herniated Fat Pads of the Lower Lid

As we age, the lateral canthus comes down, reducing the Mongoloid slant of youth and creating pseudodermachalasis of the lower lid (more so laterally). Consequently, because the Lockwood suspensory ligament is attached to the lateral canthus, the eyeball inevitably comes down. Not only because of age, but also for genetic reasons, the lateral canthus may stretch prematurely. Again, heredity can determine further stretching of the Lockwood suspensory ligament. Obviously, this lowering reduces the space between the globe and the floor of the orbit, expelling the lower extraconical fat anteriorly outside the orbit and thereby reducing the orbital content. The ensuing enophthalmia is inevitable (Fig. 3). This occurs anteriorly because it is the path of least resistance. The posterior and lateral bony walls of the cone-shaped orbit will not stretch and resist, leaving a possible anterior or superior avenue. Anteriorly, there is less resistance than in an upward direction because of gravity (orbital content above), so the fat herniates anteriorly.

The position of the eyeball in the bony orbit is maintained by the presence of orbital fat and because

Fig. 4. Before and after pictures of our technique, which improve the herniated fat pad, the tear trough deformity, and the enophathalmia. The sunken upper lid is not much improved because the patient had a previous upper blepharoplasty.

of the anteriorly located Lockwood suspensory ligament, which is a thickening of the capsulopalpebral fascia fixed to the medial and lateral (Figs. 2 and 4) canthi. Before herniating, the extraconical fat is located primarily beneath the vertical axis of the globe. As the globe comes down, this fat is projected anteriorly in relation to the vertical axis of the globe and anteriorly in relation to the already lowered Lockwood syspensory ligament, which then becomes less efficient. As a result of this, the eyeball must move backward and downward, and the result is the enophthalmia of aging. In Fig. 3, we can see 3A is less than 3B, 1A is less than 1B, and 2A is greater than 2B. All these measurements are reversed with our technique.

Cause of Tear Through Deformity and Sunken Upper Lid

As fat herniates anteriorly into the lower lid, enophthalmia is inevitable. This condition involves a sunken upper lid, which can be masked by a ptotic brow. Because of the orbitomalar ligaments [14,15] fixing or attaching the skin to the inferior orbital rim, an infraorbital sulcus or a tear trough deformity develops. (Fig. 3). It will be made worst by a ptotic premalar fat pad. We believe the best management of this defect is to relocate the herniated fat pad of the lower lid located above the malarcutaneous ligament, which will relax. It could be further improved with a mass lift of the ptotic premalar fat pad when a face-lift is performed. The sunken upper lid results from the increased space between the globe and the roof of the orbit as the eyeball comes down, the periglobular rotation of the extraconical fat (Rouleau phenomenon) as the fat herniates into the lower lid, and orbital fat resorbtion with aging.

We always relocate the herniated fat pad where it belongs (i.e., into the orbit). This gives the preherniation, or natural, appearance. Minor deformities will get a minor improvement, but management of a major hernia will result in a major improvement, giving back the previous anatomy and a natural appearance. Overcorrection is not possible with this technique because the patients have an orbital content and a bony orbit of normal volume.

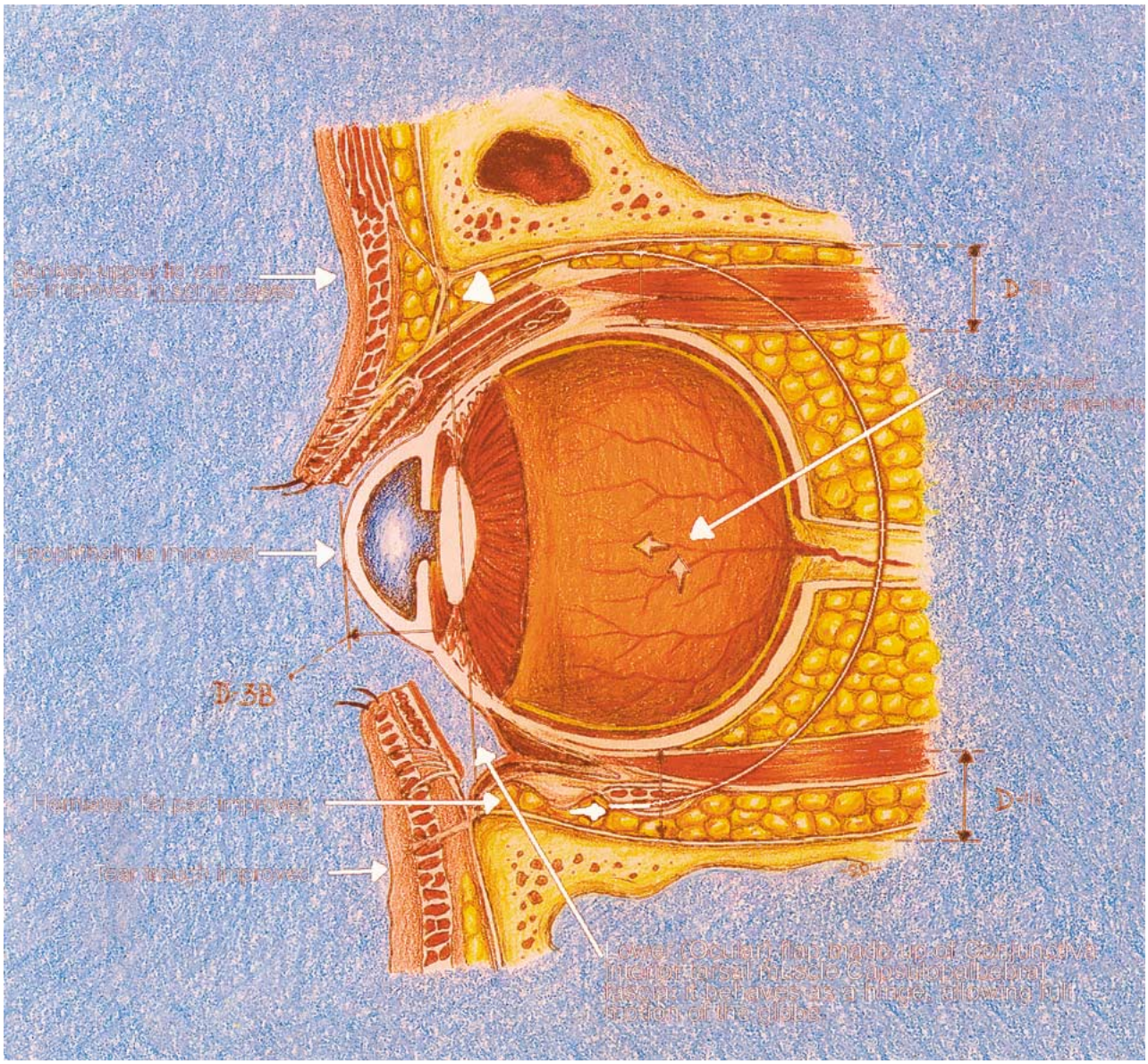

Fig. 5. Postoperative anatomy.

Canthoplasty

In cases of a marked anti-Mongoloid slant (because of marked downward movement of the weak lateral canthus) a well-performed canthoplasty alone can overcome most of these signs of aging provided the brow is not too low, in which case one would almost suture the lateral ocular comissure to the brow. In such a case, therefore, a concomitant brow lift would be imperative. However, if the Lockwood suspensory ligament stretches more than the lateral canthus, which is usual in younger patients, our technique is indicated. Our technique of relocating the herniated fat pad can be performed concomitantly with a canthoplasty if necessary, but a good canthoplasty should be sufficient when indicated, usually in older patients.

Conclusion

By relocating the herniated fat pad of the lower eyelid back into the orbit, we physiologically give back the preherniation appearance of youth. We can improve the herniated fat pad of the lower lid, the tear trough deformity, the enophthalmia, and occasionally, the sunken upper lid (Fig. 3). Using the transconjunctival approach, we avoid the common pericutaneous risks of scleral show resulting from scarification at the level of the septum orbicularis junction and damaging the vertical motor branches of the preseptal orbicularis oculi muscle of the lower lid. Besides, no studies have ever reported a retro-orbital hemathoma if the fat pads are not excised.

Eventually, we will publish a 10-year follow-up report of this technique. We suggest that surgeons

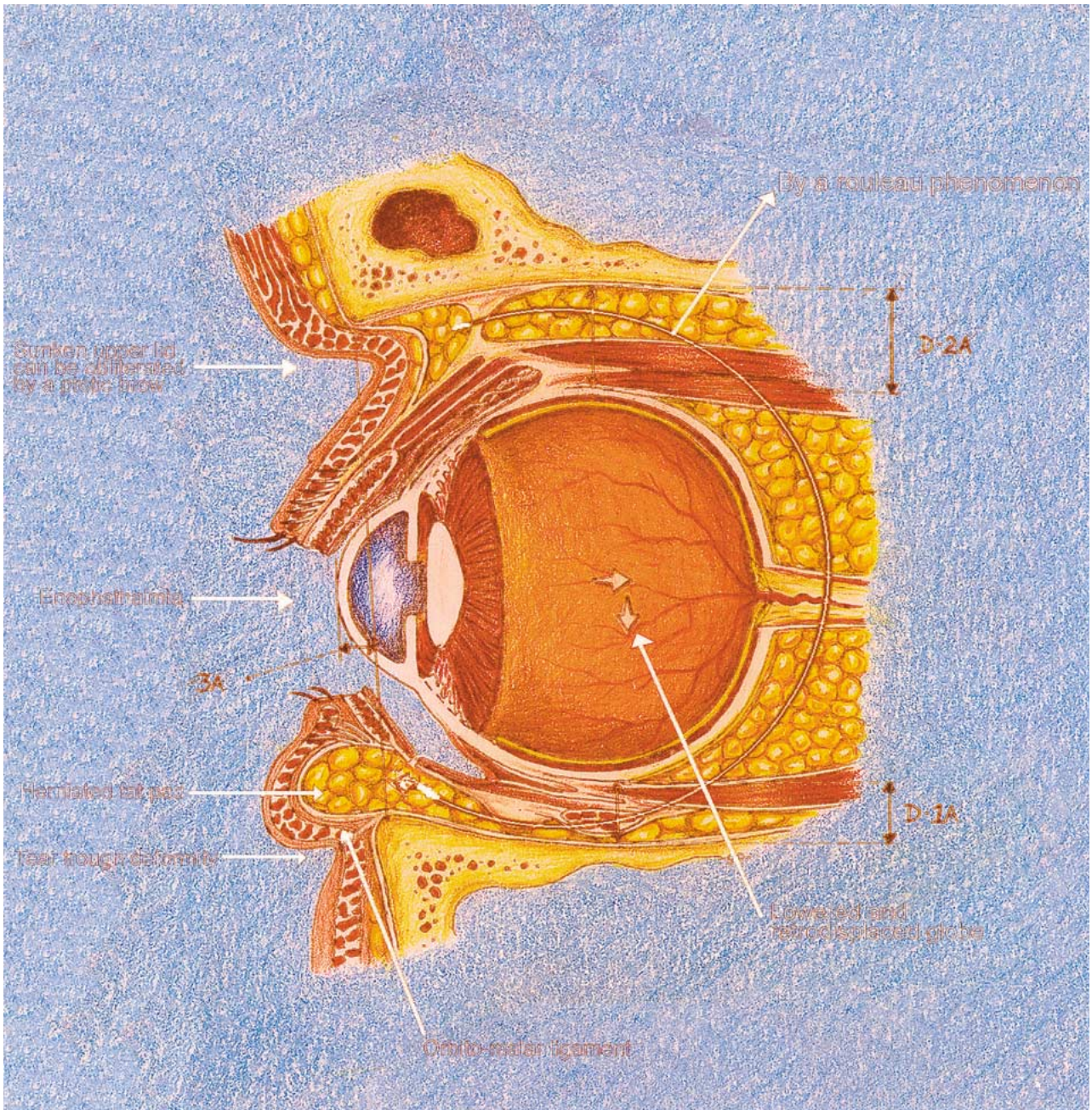

Fig. 6. Preoperative anatomy.

practice this procedure on fresh cadavers or view our video shown during postgraduate courses given at the American Plastic and the American Aesthetic Society Meeting before attempting this technique.

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