BLEPHAROPLASTY

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INTRODUCTION
Eyelid rejuvenation is a complex subject within aesthetic facial surgery. With this in mind, we must maintain a global perspective of the aging face. Successful rejuvenation requires an individualized approach with a clear understanding of the underlying conceptual framework that delineates the anatomic problems identified by preoperative assessment. The main areas of potential focus include the following: 1) resuspension of descended periorbital structures; 2) restoration of volume loss; 3) support of the lateral canthus; 4) establishing a smooth lower eyelid-cheek junction; and 5) resurfacing or removing lower and upper eyelid skin excess.

HISTORY
An excellent discussion of the history of eyelid surgery can be found in articles by Dupuis and Rees1 and Stephenson2 and in a textbook by Wolford and Kanter.3 A description of eyelid surgery can be found in the 2000-year-old Indian document, the Susruta. During the 10th and 11th centuries, Arabian surgeons treated dermatochalasis with a crescent-shaped cautery to burn the eyelid and correct drooping.4 Johnson,5 in 1678, described the works of Ambroise Paré who excised excess upper eyelid skin and emphasized the importance of avoiding over-resection.

The first illustrations of excess eyelid folds in the medical literature were published in a textbook by the Viennese surgeon Georg Joseph Beer in 1792.6 von Graefe7 was the first to use the term blepharoplasty to describe eyelid surgery. Mackenzie,8 Alibert,9 Graf,10 and Dupuytren11 described resecting only the excess skin of the eyelid. Sichel,12 in his 1844 review, distinguished between paralytic ptosis, atonic ptosis, and fatty ptosis. He was the first to describe herniated intraorbital fat. Fuchs,13 in 1896, described a patient with recurrent swelling of the upper eyelid that led to wrinkles, a condition he termed blepharochalasis.

Cosmetic repair of baggy eyelids was popularized by Miller14 in 1908 in the first textbook devoted to cosmetic surgery. In it were photographs illustrating lower eyelid incisions for the removal of wrinkled skin. Bourguet,15 in 1928, was the first to note the separate fat compartments in the eyelids and described a transconjunctival approach to correction of lower lid fat bulging. Around the same time, Madame Noel’s16 technique involving a subciliary incision became the standard approach to the lower eyelid. Castañares,17 in 1951, described modern blepharoplasty and detailed the pathological anatomy of the orbital fat compartments. The technique used by the author separated the skin of the lower eyelid from the orbicularis muscle. In 1952, Fox18 first applied the term dermatochalasis to the eyelid with redundant skin.

The skin-muscle flap was popularized by Rees and Dupuis19 and others in the 1970s. The transconjunctival approach to correction of orbital fat was popularized by Zarem and Resnick20 in...
1992. In 1996, laser resurfacing and chemical peeling were proposed for the treatment of lower eyelid dermatochalasis.²¹ Researchers’ attention turned to the rejuvenation of the lower eyelid-cheek junction, specifically tear trough deformity. Loeb²²–²⁴ initially reported reposition of lower eyelid medial and central compartment fat for the correction of deep nasojugal grooves. The technique was modified by Hamra²⁵,²⁶ who then popularized it as the septal reset. The benefits of septal reset for tear trough deformity were further elucidated by Barton et al.²⁷

ANATOMY
For more in-depth descriptions of the anatomy associated with blepharoplasty, the reader is referred to descriptive articles, textbooks, and atlases by Zide and Jelks,²⁸–³⁰ McCord et al.,³¹ and Baker et al.³²

The palpebral fissure, which is the aperture between the upper and lower eyelid margins, measures 12 to 14 mm vertically and 28 to 30 mm horizontally. The upper eyelid normally rests up to 2 mm below the limbus, with the lower eyelid margin at the level of the lower limbus.³³ The arterial distribution of the eyelids is illustrated in a 2007 article from Turkey.³⁴ Nineteen cadaver heads were injected, and schematization showed the marginal and peripheral arterial arcades and their feeding vessels.

Skin
The skin of the eyelid is the thinnest in the body. Subcutaneous fat is sparse. Edema fluid can rapidly engorge the loose subcutaneous space and defines the juncture with the surrounding subcutaneous fibroadipose tissue, which is denser.³²

Age-related changes in the sun-exposed area of the periorbita include decreased type I collagen synthesis and increased dermal collagenase activity. With time, these metabolic alterations lead to thinning, folding, and wrinkling of the eyelid skin.³⁵

Hwang et al.³⁶ discussed the loss of skin sensation or numbness after lower blepharoplasty. They dissected 14 fresh cadaver heads and found that the infraorbital nerve and the zygomaticofrontal nerve coursed through the infraorbital foramen and the zygomaticofacial foramen, respectively. The nerves coursed superficial to the periosteum, beneath and then within the epimysium of the orbicularis muscle, and then distributed to the skin; 99.4% of infraorbital nerve branches were medial to the lateral canthus. The zygomaticofacialis nerve terminal branches were found lateral to the lateral canthus. The authors concluded that the skin-muscle flap infringes less than the skin flap on these terminal branches during lower blepharoplasty.

Orbicularis Oculi
The orbicularis oculi is the sphincter of the eyelid. This broad, thin, oval muscle is adherent to the overlying skin and consists of three parts: a peripheral orbital portion spreading over the forehead and cheek, a palpebral portion that constitutes the voluntary muscle of the eyelids, and a small lacrimal portion associated with the medial palpebral ligament. The orbital portion attaches to the medial canthal tendon, the nasal part of the frontal bone, and along the inferomedial orbital margin. Laterally, the orbital portion of the orbicularis oculi continues around the orbit without interruption at the lateral canthus.³²

The palpebral portion of orbicularis oculi spreads concentrically in the subcutaneous tissue of the upper and lower eyelids. The palpebral orbicularis oculi has pretarsal and preseptal segments. Mild eyelid closure is primarily through contraction of the pretarsal and preseptal portions of the orbicularis oculi. Tight closure is the result of contraction of the orbital portion of the muscle.³⁷,³⁸

Medially, the preseptal orbicularis oculi has two heads. The anterior head becomes the anterior crus of the medial canthal tendon and inserts into the frontal process of the maxilla. The posterior head inserts into the posterior lacrimal crest (Horner muscle).³² Laterally, fibers of the preseptal palpebral portion of orbicularis oculi interdigitate superficial to the lateral palpebral ligament to form the lateral palpebral raphe.³¹,³⁸

The orbicularis oculi is anchored by well-defined ligamentous attachments. Muzaffar
et al.\textsuperscript{39} provided a detailed description of the attachments. Medially, the orbicularis oculi has a direct attachment to the inferior orbital rim from the region of the anterior lacrimal crest to approximately the level of the medial limbus. Laterally, the attachment is indirect and is provided by the orbital retaining ligament (ORL) (Fig. 1).\textsuperscript{39} This structure is the same as the orbitomalar ligament described by Kikkawa et al.\textsuperscript{40}

The ORL extends from the periosteum just outside the orbital rim to the fascia on the undersurface of the orbicularis oculi. At its lateral extent (and in the region of the lateral canthus), the ORL merges with the lateral orbital thickening (LOT). The LOT represents a triangular condensation of the superficial and deep orbicularis oculi that extends across the frontal process of the zygoma onto the deep temporalis fascia. In the study presented by Muzaffar et al.,\textsuperscript{39} the dimensions of the LOT varied greatly with age (Fig. 2). The ORL is predictably continuous with the LOT below the lateral canthal tendon; specifically, the ORL, LOT, and lateral palpebral raphe form a single anatomic unit in that region (Fig. 3).\textsuperscript{39} Release of the ORL and LOT, therefore, allows untethered redraping of all the structures.

Age-associated changes in the orbicularis oculi are caused by muscle relaxation and increasing laxity and attenuation of the orbicularis oculi ligamentous attachments. The changes ultimately result in progressive eyelid ptosis. Combined with ptosis of the malar soft tissues, with which they are frequently associated, the changes result in a characteristic deformity at the point where the inferior muscle border becomes visible, forming a malar crescent or festoon over the malar eminence and creating a clinical appearance of periorbital soft-tissue widening.\textsuperscript{41}

**Septum**

The orbital septum consists of dense fibroelastic tissue and forms the anterior border of the orbital contents. The septum represents a continuation of the orbital periosteum. The junction is termed the *arcus marginalis*. Putterman and Urist\textsuperscript{42} noted that the orbital septum inserts 10 to 15 mm above the superior tarsal border of the upper eyelid to join the levator aponeurosis. On the lower eyelid, the orbital septum joins the capsulopalpebral fascia 5 mm below the tarsal border.\textsuperscript{42} The measurements, however, are subject to debate, as discussed by Zide.\textsuperscript{28}

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**Figure 1.** Cadaveric dissection within the prezygomatic space. The upper border is indicated by the blue line. Medially, the orbicularis oculi (OO) originates directly from the orbital rim above the origin of the levator labii superioris (LLS). More centrally, the orbicularis has an indirect attachment to the orbital rim by means of the orbicularis retaining ligament (ORL), which courses directly on the orbital side of the zygomatico-facial nerve (ZFN). At the lateral orbital rim, the ligament merges into the lateral orbital thickening. Sub-orbicularis oculi fat (SOOF) lines the undersurface of the prezygomatic orbicularis (pars orbitalis). Zmaj., zygomaticus major muscle; Zmin., zygomaticus minor muscle. (Reprinted with permission from Muzaffar et al.\textsuperscript{39})
Camirand and colleagues\textsuperscript{43,44} reported that the orbital septum does not offer much support and cannot maintain the fat within the orbit even at a very young age. After an orbital floor exploration or traumatic laceration, suturing of the orbital septum is seldom performed, yet herniated fat pads do not occur. Camirand\textsuperscript{44} proposed that the cause of herniated fat and enophthalmia of aging is likely to be a combination of the descended Lockwood suspensory ligament, the relaxed muscle tone of the orbicularis oculi and extrinsic muscles, and the weight of the globe pushing on the orbital fat as the patient lies on the operating table.

Fat

Postseptal (Intraorbital) Fat

The postseptal, or intraorbital, fat lies on the eyelid proper. Bourguet\textsuperscript{15} recognized two distinct adipose compartments in the upper eyelid, divided by the superior oblique. The medial fat pad is lighter in color and firmer in consistency than the central fat pad. The medial fat pad is associated with the intratrochlear nerve and the terminal branch of the ophthalmic artery. Bourguet,\textsuperscript{15} and later Castañares,\textsuperscript{17} also identified three distinct fat compartments in the lower eyelid, but the observation was subsequently challenged by Berry\textsuperscript{45} and Beard,\textsuperscript{46} who noted only two discrete compartments. Hugo and Stone\textsuperscript{47} injected dye into individual fat pockets in the lower eyelids of cadavers and found that the dye diffused throughout the entire eyelid, indicating a lack of true compartmentalization. On the other hand, in vivo dye injection studies conducted by Barker\textsuperscript{48} showed that the dye remained within the compartments.

Preseptal (Extraorbital) Fat

The preseptal, or extraorbital, fat accumulates outside the orbital rim on the inferior lateral brow and upper malar areas. Owsley\textsuperscript{49} described “a thick cushion of fatty tissue beneath the orbicularis muscle that overlies the lateral orbital rim extending outward toward the end of the brow. The lateral fat pad is superficial to the orbital septum, where it may overlie the lateral extension of the central fat pad.” May et al.\textsuperscript{50} reviewed the value of resecting the fat, which they termed the retro-orbicularis oculi fat, in decreasing heaviness of the lateral brow and upper eyelid.

Aiache and Ramirez\textsuperscript{51} described a counterpart in the lower eyelid and called it the suborbicularis oculi fat. In their words, “The suborbicularis oculi...
fat represents the position of the fat pad in relation to the orbicularis oculi muscle and is analogous to the retro-orbicularis oculi fat designated to the fat pad located in the brow area.” The authors suggested that “malar bags” are the result of ptosis of the suborbicularis oculi fat. Hwang et al.52 delineated the retro-orbicularis oculi fat and suborbicularis oculi fat pads histologically and by precise anatomic location relative to the midpupillary line.

Eyelid Retractors

Upper Eyelid
The levator palpebrae muscle originates from the lesser wing of the sphenoid and extends anteriorly along the superior orbit.33 Approximately 14 to 20 mm above the superior border of the tarsus, the levator forms a condensation of fascia known as Whitnall ligament.53 It functions as a fulcrum to translate a posterior vector into a superior vector. Anterior to that structure, the levator forms a bilamellar aponeurosis that joins with the septum to insert into the tarsus. A lateral horn divides the lacrimal gland into the palpebral and orbital lobes and contributes to the lateral retinaculum. A medial horn inserts into the lacrimal crest.54 The posterior lamella contains Mueller muscle.55

Lower Eyelid
The equivalent retractor in the lower eyelid is formed by the capsulopalpebral fascia. It originates as a fibroelastic tissue from the inferior oblique muscle as two sheets. Anteriorly, the sheets fuse to form Lockwood ligament. Anterior to Lockwood ligament is the capsulopalpebral fascia. Approximately 5 mm below the inferior tarsus, the septum and the capsulopalpebral fascia fuse to insert into the tarsus. Some smooth-muscle fibers are present in the condensation (the inferior tarsus muscle). Other capsulopalpebral fibers extend through the orbicularis oculi toward the skin and contribute to the lower eyelid crease (Fig. 1).32,39,56

Lateral Canthus
Jelks and Jelks30 stated that “the lateral canthus defines the geometric pattern of the lateral aspect of the eyelids” and is more appropriately termed a lateral retinaculum. The complex structure anchors the lateral soft tissues to the bony orbit. The retinaculum consists of the following: 1) lateral horn of the levator palpebrae superioris, 2) preseptal and pretarsal orbicularis oculi, 3) Lockwood ligament, and 4) check ligament of lateral rectus muscle.30,57 The dimensions were described by Gioia et al.58 Muzaffar et al.39 and Flowers et al.59 described the relationship between the lateral canthal tendon with the LOT and ORL, also known as orbitomalar ligament as labeled by Kikkawa et al.40

Medial Canthus
The medial canthal tendon inserts into the bony orbit in a tripartite manner: anterior and posterior horizontal elements and a vertical element. McCord et al.31 defined the medial canthal retinaculum as the deep head of the pretarsal orbicularis, the orbital septum, the medial end of Lockwood ligament, the medial horn of thelevator aponeurosis, the check ligaments of the medial rectus muscle, and Whitnall ligament.

PERIORBITAL AESTHETIC GOALS
Clearly defined goals of brow and orbital aesthetics are the basis of successful results in surgical rejuvenation of the upper portion of the face. The goals vary significantly with sex, age, fashion, race, culture, and personal preference. The globe by itself is entirely expressionless and depends on the surrounding soft-tissue complex to convey the myriad human emotions.

Farkas and Kolar,60 Flowers,61 and Wolfert et al.62 reviewed the aesthetic goals of blepharoplasty. Certain numerical guidelines are helpful in planning the surgery. At the midpupillary line, the anterior hairline to brow distance should measure 5 to 6 cm. The distances from brow to orbital rim, brow to supratarsal crease, and brow to midpupil should be 1, 1.6, and 2.5 cm, respectively.63 Canthal tilt averages 4.1 mm (+4 degrees) in women and 2.1 mm (+3 degrees) in men.64 Visible pretarsal skin should measure 3 to 6 mm,65 whereas lash line to eyelid fold ranges from 8 to 10 mm.66 The upper eyelid should cover 2 to 3 mm of the iris, and the lower eyelid forms a lazy-S and should just meet
its inferior aspect. The intercanthal distance is ideally one-fifth of the facial width at eye level and represents one eye-width.

The cornerstone of successful eyelid surgery is comprehensive but judicious resection of redundant skin, fat, and muscle while preserving or restoring symmetry and function. Goals for the upper eyelid include the restoration of sharp, crisp tarsal folds and pretarsal show with deepening of the orbitopalpebral sulcus. The lower eyelids must appear smooth and soft. Distortion of eyelid shape and position must be avoided. The lateral canthal angles should be maintained as sharp and distinct.

PREOPERATIVE EVALUATION

Astute preoperative evaluation requires thorough general medical and ophthalmic histories, physical examination, and photographic documentation of the appearance and function of the globe, eyelids, and adnexal structures. With proper evaluation, many of the unfavorable postoperative outcomes can be anticipated and avoided. For preoperative evaluation considerations, please review the maintenance of certification continuing medical education article on blepharoplasty by Trussler and Rohrich.

Jelks and Jelks detailed the steps of preoperative evaluation of a patient before blepharoplasty. In decreasing order of importance, they are as follows:

- detailed ocular history
- assessment of the ocular and periocular anatomy
- Schirmer test
- tear film breakup time
- assessment of Bell phenomenon

The history should include subjective assessment of vision, use of corrective lenses and/or contact lenses, symptoms of dry eye, facial nerve disorders, hypertension, bleeding disorders, endocrine disorders, cataracts, glaucoma, diabetes, corneal or previous eyelid surgery, psychiatric disorders, trauma, and medications. The physical examination should document any existing skin lesions and dermatological conditions. The status of the extraocular muscles should be documented. The bony topography and asymmetries should be noted. Malar hypoplasia should be recognized preoperatively. Jelks and Jelks described the relationship, as seen on lateral view, among the anteriormost projection of the globe, the lower eyelid margin, and the malar eminence. A “negative vector” is one that angles posteriorly and indicates an absence of support for the lower eyelid. Because patients with negative vectors frequently exhibit scleral show, appropriate modifications of lower eyelid surgery are indicated in such cases.

The upper eyelid examination should document asymmetries, ptosis, levator function, skin and fat excesses, and eyelid retraction. Examination of the upper eyelid is performed with the brow in its normal resting position and in an elevated position simulating browpexy.

The lower eyelid is assessed for scleral show, eyelid position, eyelid tone and support, entropion and ectropion, malar bags, nasojugal folds, and skin, muscle, and fat excess. The snap back test consists of pulling the eyelid down as far as it will go and watching its return to normal position when released. Hinderer summarized the standard tests for lower eyelid laxity.

Unfortunately, the eyelid snap back and distraction tests are unreliable predictors of postoperative eyelid malposition. Codner et al. suggested pulling the incised lower eyelid laterally to determine intraoperatively the degree of laxity. The distance the lower eyelid stretches from the lateral commissure to the orbital rim represents the amount of redundancy and dictates treatment: <3 mm overlap of the lateral orbital rim generally is managed with a suture canthopexy, but more severe redundancy usually requires canthoplasty. A prominent globe is also a high-risk indicator for postoperative eyelid malposition.

Other preoperative evaluations should include the visual acuity in each eye, with and without correction, and a basic funduscopic examination. A Schirmer test can aid in screening patients prone to dry eye conditions postoperatively. The presence of Bell phenomenon should be noted.

PITFALLS

Jelks and Jelks presented a review of the problems
that can occur in association with palpebral and periorbital surgery.

**Ptosis, Pseudoptosis, and Eyelid Retraction**

Depression of the eyelid margin to a position lower than normal (with relation to the limbus in central gaze) is a sign of possible ptosis. An elevated position of the supratarsal crease suggests levator dehiscence. Jones et al.\(^7\) presented a discussion of the anatomy and pathology of eyelid ptosis. Possible causes of ptosis include trauma, chronic progressive external ophthalmoplegia, Horner syndrome, myasthenia gravis, and upper eyelid tumors.\(^3\) Pseudoptosis occurs when excess skin is present and hooding depresses the upper eyelid. Pseudoptosis can be differentiated from true ptosis by elevating the excess skin. Eyelid retraction is indicated by elevation of the eyelid margin above the limbus. The most common cause of eyelid retraction is thyroid infiltrative ophthalmopathy.\(^7\)

Ptosis, pseudoptosis, and eyelid retraction must be accurately diagnosed preoperatively so that the appropriate levator surgery can be performed.

**Malar Hypoplasia and Prominent Globe**

Jelks and Jelks\(^3,6\) analyzed the influence of the anatomic relationships of the orbital region on the outcome of lower blepharoplasty and suggested adding a lateral canthoplasty in the patient with a negative vector. With age, the orbital rim moves posteriorly, relative to the anterior cornea, and the negative vector becomes more pronounced.\(^7\) To ensure stability of the surgical result, McCord et al.\(^7\) recommended redraping of the inferior arc of the orbicularis oculi and lateral canthoplasty as adjuncts to blepharoplasty in the aging face. Patients who have scores of $\geq 19$ mm on Hertel exophthalmometry are at increased risk of “clotheslining” when the lower eyelid is tightened, in which case both orbicularis oculi arc redraping and lateral canthoplasty require supra-placement of fixation.

**Dry Eyes**

Rees and Jelks\(^7\) and Jelks and McCord\(^7\) reviewed dry eye syndrome. Symptoms of itching, foreign body sensation, burning, mucoid secretions, frequent blinking, and conjunctival infection suggest dry eyes. The diagnosis is made clinically when mucous filaments are seen on a dull, gray-appearing cornea, by corneal staining with fluorescein testing, and by a positive result to a Schirmer test. The Schirmer I test measures both basic and reflex secretions, whereas the Schirmer II test measures basic secretion by using a topical anesthetic to block reflex tearing.

Per Rees and Jelks,\(^7\) a strip of #41 filter paper, $5 \times 35$ mm, is folded $5$ mm at one end. The folded end is placed on the lateral one-third of the lower eyelid conjunctiva, and the patient is requested to fix the gaze on an object above the direct line of vision for 5 minutes. Less than $10$ mm of wetting (of the paper) is considered hyposecretion. The normal range is between $10$ and $30$ mm.

McKinney and Zubowski\(^7\) found the Schirmer test to be an unreliable predictor of possible dry eye complications after blepharoplasty. The authors reported that the best predictor of dry eye was an abnormal preoperative ocular history or abnormal orbital and periorbital anatomy.

In a 10-year update of their 1989 study, McKinney and Byun\(^8\) confirmed their original impression and noted that they did even less preoperative tear film testing at the time of the second writing in 1999. They preferred to rely on the history and the anatomy as predictors of postoperative dryness, particularly the presence of scleral show, lagophthalmos, or a loose lower eyelid that is not adherent to the globe in its outer third.

Rees and LaTrenta\(^8\) noted that $65\%$ of patients with postoperative dry eye syndrome had normal preoperative Schirmer test findings, and proposed five clinical variables that indicate morphologically prone eyes, as follows:

- relative or real proptosis
- exophthalmos
- hypotonia of the lower eyelids
- maxillary hypoplasia
- inferior scleral show

These anatomic characteristics were found to be statistically significant predictors of dry eye syndrome, more meaningful than measured low tear film. Patients who exhibit one or more of these criteria should be treated with caution. The patients
can still undergo blepharoplasty as long as adequate ocular protection is provided and the procedure is altered to include a variety of reconstructive measures. Lee et al. discussed changes in the cornea after keratorefractive surgery and the effect of the changes in patients seeking blepharoplasty surgery. The authors recommended a 6-month wait after laser vision correction before performing blepharoplasty surgery. The patient might develop dysfunctional tear syndrome after laser vision correction.

**Lower Eyelid Laxity and Ectropion**
The most common complication of lower blepharoplasty is distortion of the eyelid. Preoperative eyelid laxity and ectropion must be identified, shown to the patient, and accounted for in the surgical treatment plan. Failure to do so can lead to a typical deformity with marked scleral show worsening laterally, rounding of the lateral canthus, and a narrowed intercanthal distance. Carraway and Mellow suggested other conditions that cause lower eyelid malposition:

- large globe
- hypoplastic malar eminences
- paralysis of the orbicularis oculi
- adhesion of the orbital septum
- hematoma
- lax eyelid margin
- proptosis
- excessive skin, fat, or muscle removal
- scar contracture

Postoperative malposition of the lower eyelid can be prevented by preoperatively checking for horizontal tension of the eyelid with a snap back or distraction test and identifying any scleral show. The tests were summarized by Hinderer.

**UPPER BLEPHAROPLASTY**
**Incisions**
By the 1930s, the basic blepharoplasty incisions had been described and standardized. The incision is placed 9 to 12 mm above the ciliary margin at the level of the upper edge of the tarsus. Baker et al., Ellenbogen and Swara, Gradinger, and Flowers emphasized the need for precise planning of the lower aspect of the incision. The superior aspect of the incision is determined by marking the level of overhanging skin after grasping the upper eyelid skin with Adson forceps.

An alternative way to estimate the upper skin excess was proposed by Silver, who marks only the eyelid crease and then redrapes the upper eyelid skin downward and removes the excess. Stambaugh compared both techniques and found no significant difference between them regarding the amount of skin that is excised. Flowers noted that the minimum distance from brow to fold is 12 mm, which is the minimum amount of skin that must be preserved. Modifications of the medial and lateral aspects of the incision for dealing with skin redundancy at either end include medial Z-plasty, lateral Z-plasty, lateral W-plasty, and lateral Y-V-plasty.

Most authors use a scalpel to create the initial skin incision. Tebbetts used a needlepoint Bovie on blended cutting current for skin and muscle resection. He reported that cautery helps to obtain hemostasis and minimize tissue morbidity.

Mittleman and Apfelberg compared the CO$_2$ laser with conventional techniques of blepharoplasty in 10 patients and found no difference in postoperative pain, swelling, ecchymosis, quality of scars, or long-term results. Intraoperative findings did suggest improved hemostasis, however. David and Sanders, in a similar study of 13 patients, found no difference in final cosmetic appearance but did observe less ecchymosis and edema with laser surgery. Trelles et al. questioned the methodology of the study by David and Sanders and cited his own favorable experience in 560 cases of blepharoplasty with the CO$_2$ laser. Januszkiewicz and Nahai removed the medial fat pad in the upper eyelid through a transconjunctival incision followed by CO$_2$ laser resurfacing to address the skin excess in selected patients. Guerra et al. reported use of the transconjunctival approach in 42 patients for the treatment of pseudoherniated upper medial fat with little or no excess skin. Halvorson et al. reported their 10-year experience in marking for...
upper blepharoplasty using a simple method to achieve expectations after surgery.

Muscle Excision
Opinions vary regarding the amount of muscle to resect during upper blepharoplasty, if any. Baker\textsuperscript{99} excised a strip of orbicularis oculi 5 to 8 mm long from immediately above the supratarsal fold in all cases. Tebbetts\textsuperscript{92} reported that a generous muscle resection, excising only 2 to 3 mm less than the skin resection, is necessary to avoid the excess orbicularis oculi from obscuring the supratarsal fold and to allow a natural fixation. Flowers\textsuperscript{65,88} removed a maximum of 2 to 3 mm of muscle and cautioned that tenting up the muscle during the excision can lead to inadvertent transection of the septum and levator aponeurosis.

Fat Excision
The septum should be opened cautiously, placing pressure on the globe to identify the fat and septum. The incision is made somewhat high to avoid the insertion of the septum and aponeurosis inferiorly. Flowers\textsuperscript{65} angled the incision upward, considering that the union between the septum and aponeurosis is higher in the central portion of the eyelid than laterally. Tebbetts\textsuperscript{92} indicated several landmarks to look for during fat resection and recommends resecting only the fat that bulges anterior to the plane of the orbital rim without retraction or globe pressure. The dissection should be anterior to the septal plane to avoid injuring the neurovascular structures or extraocular muscles. Over-resection of fat will lead to an undesirable “hollowed out” look.

Kranendonk and Obagi\textsuperscript{100} reported the details of their fat transfer techniques as an enhancement of volume restoration using autologous fat transplantation. An argument against surgery of the eyelids was suggested because of the cosmetically unacceptable results that the authors often observed after those operations. Hamra\textsuperscript{101} provided a strong argument opposing relying on fillers for facial rejuvenation, considering that surgery is the gold standard against which to compare results. He reported the long-term follow-up of patients who had undergone surgical anatomic correction and presented follow-up photographs that span many years.

Supratarsal Fold and Fixation
When the levator contracts and pulls the eyelid up, the dermal attachments of the levator aponeurosis produce a fold in the skin of the upper eyelid at the level of the superior tarsus (Fig. 2).\textsuperscript{39} Traditional methods for reconstituting the crease after blepharoplasty involve precise surgical planning of the lower incision and strip orbicularis oculi excision.

Fernandez,\textsuperscript{102} Sheen,\textsuperscript{103} and Flowers\textsuperscript{104} proposed fixation of the pretarsal orbicularis oculi or dermis—an anchoring technique—to create a more precise upper eyelid crease. Several blepharoplasty surgeons, including McCord et al.,\textsuperscript{31} Hinderer,\textsuperscript{71} and Siegel,\textsuperscript{105} also have reported incorporating some type of anchoring sutures into their blepharoplasties (Fig. 3).\textsuperscript{39} The aims are to excise less skin, recreate a more youthful upper eyelid, and achieve longer lasting results than if no fixation were used.

Flowers\textsuperscript{104} stated that a major problem with traditional blepharoplasty is that the supratarsal fold with its connections to the levator mechanism usually is excised, leaving a less-distinct fold than preoperatively. He cited photographs presented in an article by Baker\textsuperscript{99} to support the need for tarsal fixation. Baker, however, reviewed his blepharoplasty cases and did not find long-term improvement in the crease with the anchor technique. Spira\textsuperscript{106} analyzed his own cases and likewise could not confirm any benefit of supratarsal fixation.

Asian Eyelid
The Asian upper eyelid is characterized by an absent palpebral crease, a medial epicanthal fold hooding the caruncle, upward tilt of the lateral canthus, and a narrow palpebral aperture.\textsuperscript{107,108} The levator muscle inserts into the superior tarsal edge, but no fibrous extensions continue through the orbital septum to the pretarsal orbicularis oculi. The lack of attachment frequently allows the pre-levator fat to prolapse inferiorly, making the eyelid
appear puffy.\textsuperscript{102}

In 1954, Sayoc\textsuperscript{109} described an operative procedure designed to produce a more Western appearance to the Asian upper eyelid. Twenty years later, Sayoc\textsuperscript{108} reviewed his and other authors’ experience with the procedure.\textsuperscript{102,108−111}

Several surgeons\textsuperscript{102,108−115} have reported their individual modifications of the blepharoplasty operation for use in Asian eyelids. Most of the procedures involve at least some of the original elements proposed by Sayoc,\textsuperscript{109} including the following:

- supratarsal incision
- excision of a 2-mm strip of orbicularis oculi over the entire length of the eyelid
- removal of excessive pre-levator fat
- anchoring the lower muscle and/or skin flap to the insertion of the levator aponeurosis at the upper tarsal edge to construct the absent fibrous attachment

Combined with levator excursion, these maneuvers help create an upper palpebral fold.

Baek et al.\textsuperscript{116} proposed a single-stitch, non-incision technique to create an aesthetically pleasing supratarsal fold in Asian eyelids, with minimal morbidity. Their 762 patients were followed for up to 5 years, by which time the fold had disappeared in 2.9%. The authors concluded that the procedure is indicated in young patients whose upper eyelids have thin, non-redundant skin and no excessive fat.

Bang\textsuperscript{117} described the double-eyelid operation without supratarsal fixation for creating a supratarsal fold in Asian patients. Watanabe\textsuperscript{118} noted that the Asian upper eyelid grooves differ in position and shape from those of Europeans. He devised a method for determining the amount of excess skin to remove from the upper eyelid.

Yoon and Park\textsuperscript{119} reported their experience with 241 young Asian patients who underwent blepharoplasty to create supratarsal folds. The authors described their systematic approach and selective tissue removal based on increasing degrees of skin thickness and eyelid puffiness, from resection of peri-incisional tissue only to pretarsal tissue, orbital fat, and upper retromuscular fatty tissue in the more severe cases.

Zubiri\textsuperscript{120} illustrated differences between European and Asian eyelids and noted three variants of the supratarsal fold as it relates to the epicanthus. Correction of the epicanthal fold by some form of Z-plasty frequently is necessary\textsuperscript{108} to complete the conversion of Asian eyelids to a European look. Zubiri\textsuperscript{120} and Hin\textsuperscript{121} discussed potential complications of blepharoplasty in Asian patients and detailed methods for secondary revision.

The epicanthal fold does not need to be modified in most cases and probably should not be unless it constitutes a severe deformity. Del Campo\textsuperscript{107} used a Z-plasty technique, whereas Flowers\textsuperscript{65} preferred a V-W-plasty for correction (Fig. 4).\textsuperscript{103} Wu\textsuperscript{122} reported a simple and useful technique in epicanthoplasty with minimal scar as a modification of the technique presented by Fukuta.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{epicanthus.png}
\caption{Illustration shows basic anatomy of eyelid in cross-section. The levator expansion perforates the orbital septum and the orbicularis to insert into the skin at the level of the superior edge of the tarsus. The attachments determine the level of the palpebral fold. (Reprinted with permission from Sheen.\textsuperscript{103})}
\end{figure}
Kim et al.\textsuperscript{123} reported their variation of improving Asian upper lateral eyelid hooding by an infrabrow excision in a select group of patients. Li and Ma\textsuperscript{124} shared their V-Y epicanthoplasty technique in conjunction with double blepharoplasty.

The Asian lower eyelid is also different. The subcutaneous tissue has only sparse fibers of capsulopalpebral fascia, making the lower eyelid crease minimal and poorly defined. Compared with European lower eyelids, in Asian eyelids, the orbital septum fuses with the capsulopalpebral fascia at a higher level, and the lower eyelid retractor does not attach to skin.\textsuperscript{125}

The concept of a glide zone and its biomechanics on the blinking Asian upper eyelid was reviewed by Chen.\textsuperscript{126} The anatomy and the role of the upper eyelid crease and preaponeurotic space and fat in Asian and Caucasian eyelid anatomy were reviewed as applies to aesthetic blepharoplasty. Chen described the necessary third layer that should be entirely preserved to allow for friction-free sliding of the upper eyelid blink.

**Lateral Fullness**

Excessive fullness in the lateral aspect of the upper eyelid can occur secondary to brow ptosis, prominent supraorbital rims, prominent lacrimal gland, or subcutaneous fat.

Lassus\textsuperscript{127} described ostectomy of the superior orbital rim in cosmetic blepharoplasty to decrease lateral fullness secondary to prominent and downward-slanting bony rims. Ortiz Monasterio\textsuperscript{128} described remodeling of the orbital rim with a burr through a coronal approach.

An enlarged or herniated lacrimal gland can also produce fullness of the lateral portion of the eyelid. The lacrimal gland accounts for lateral eyelid fullness in 10\% to 15\% of patients.\textsuperscript{129,130} Horton et al.\textsuperscript{131} resuspended the gland to the lateral rim. Beer and Kompatscher\textsuperscript{132} used the lateral third of Whitnall ligament to resuspend the gland to the orbital rim with sutures. Excision of one lobe of the gland is discouraged because it can lead to keratoconjunctivitis sicca.

Subcutaneous fat deposits superficial to the orbital septum (retro-orbicularis oculi fat) can produce excessive bulk laterally that can extend beyond the canthal region. Owsley\textsuperscript{49} suggested removal through the upper blepharoplasty incision when indicated. May et al.\textsuperscript{50} reported their experience with 63 cases. All patients had transient lateral brow numbness but no paralysis of the orbicularis oculi. The superior orbital nerve courses near the medial border of the fat and must be protected. To obtain a natural, sculpted eyelid, the fibrofatty layer must be carefully resected with meticulous hemostasis and painstaking feathering of the edges.\textsuperscript{50}

Gulyás\textsuperscript{133} reported a technique using imbrication of the orbicularis oculi and grafting of 1 ml of fat in the crease to accent fullness and thus add to the convex appearance for a more youthful appearance.

**LOWER BLEPHAROPLASTY**

**Skin Flaps**

In 1951, Castañares\textsuperscript{17} reported that the skin flap method was most popular among American surgeons. The infraorbital space is approached through a subciliary incision, and the skin is elevated off the orbicularis oculi to the level of the infraorbital rim. Hinderer\textsuperscript{71} trimmed hypertrophic orbicularis oculi fibers and removed fat after separating the orbicularis oculi fibers and opening the septum.

Casson and Siebert\textsuperscript{134} described their technique for skin-flap blepharoplasty with muscle split for easier identification of the fat pads. In patients with malar mounds or cheek pads, a subcutaneous dissection can be continued onto the cheek. Doing so, however, severs the attachments of the cheek skin to the orbital rim, with the subsequent possibility of the heavier cheek skin placing traction on the eyelid skin, risking ectropion. Furnas\textsuperscript{135} addressed this concern by limiting the subcutaneous flap to the lateral aspect to the dissection and suspending the orbicularis oculi and dermis.

The skin-flap-only approach is recommended for the removal of wrinkling and redundant skin when good orbicularis oculi tone is present. Drawbacks of the approach are the potential for devascularization of the flap and possible...
impairment of the lymphatic drainage.

Skin-Muscle Flaps
The skin-muscle flap technique of lower blepharoplasty was reported by Beare\textsuperscript{136} in 1967 as the McIndoe-Beare technique. In its technical details, the procedure is similar to other blepharoplasties described by contemporary authors. A 2-mm incision is made below the ciliary margin, and the dissection proceeds through the orbicularis oculi, exposing the orbital septum down to the level of the orbital rim. The periorbital fat is removed through perforating incisions in the orbital septum. After the skin-muscle resection is redraped, a 2-mm-wide strip of orbicularis oculi along the free upper edge of the skin flap usually is resected so that the muscle will not overlap in the pretarsal area. Aston\textsuperscript{137} recommended a submuscular dissection from lateral to medial because it is quicker and easier to accomplish than is the classic dissection.

The skin-muscle flap is considered to be less effective in patients with marked skin redundancy. Rees and Tabbal,\textsuperscript{138} however, stated that the skin-muscle flap approach is indicated in more than 90\% of patients, even young adults with baggy eyelids. Spira\textsuperscript{139} compared patients who had skin flap only on one side and skin-muscle flap on the other and found little if any difference in postoperative appearance between the two groups.

Putterman\textsuperscript{140} reported that the cause of baggy eyes is the separation of the capsulopalpebral fascia from the orbital septum that allows fat to bulge into the lower eyelid. See also the discussion of Putterman’s article by Codner.\textsuperscript{141} Goldberg et al.\textsuperscript{142} presented a study of 114 patients who were interested in lower blepharoplasty for fat pads. The histories and photographs were evaluated for the cause of the condition. The authors found that cheek descent and hollow tear trough were the most prevalent anatomic bases for lower eyelid bags. Other anatomic bases were prolapse of the orbital fat, skin laxity, eyelid fluid, orbicularis oculi prominence, and triangular malar mound. The authors concluded that surgery is designed according to skin elasticity, extent of prolapse, and midface descent, but no single anatomic basis was identified. The discussion presented by Codner\textsuperscript{141} raised two points of clarification: first, the tear trough is a specific anatomic structure that manifests as a concavity overlying the narrow triangle formed by the origins of the orbicularis oculi, levator labii superioris, and levator labii alaeque nasi muscles. Second, the malar bag is made up of fat and fluid that accumulates between the orbitomalar and zygomatic cutaneous ligaments at the inferior border of the orbicularis oculi.

The skin-muscle flap approach maintains the normal skin vascularity and skin-ocularis oculi interface. It successfully corrects sagging from either cutaneous or muscular causes. Because the dissection proceeds along a relatively avascular plane, it results in less postoperative ecchymosis, subcutaneous scarring, and irregularity of the skin surface.\textsuperscript{143} Associated complications include the possibility of denervation of the orbicularis oculi and paralytic ectropion.

DiFrancesco et al.\textsuperscript{144} presented a report of 18 eyes in nine patients. Electromyography and video of blink and squint were evaluated before, 4 weeks after, and 12 weeks after subciliary blepharoplasty. The results of that study showed that lower eyelid malposition or dysfunction of the lower eyelid orbicularis oculi after blepharoplasty could not be explained by denervation of the zygomatic branch of the facial nerve. The most critical recommendation for this surgery presented by the authors is to properly perform a lower eyelid canthal anchoring maneuver. Despite the findings, some controversy exists. Lowe et al.\textsuperscript{145} reported their findings on dissection of 16 cadaver heads. The authors located multiple motor nerves to the lower eyelid without a single dominant branch identified. Byrd\textsuperscript{146} suggested that the terminal branches of the lateral innervation of the orbicularis oculi are probably divided with a subciliary transmuscular incision, which contributes to a loss of tone in the pretarsal strip and thus scleral show, necessitating canthoplasty. McCord et al.\textsuperscript{147} stated that the inner canthal muscle is innervated by the buccal branch of the facial nerve and that the extra-canthal orbicularis oculi is innervated by the zygomatic branch of the facial nerve. The statement suggested that a subciliary
incision is not the cause of clinical lower eyelid denervation. The authors noted a parasitization of sensory nerves, both infratrochlear and infraorbital, by the buccal branch to augment its innervation and field of effect.

Codner et al.\(^{148}\) reported a 10-year experience with use of a transcutaneous incision and routine canthal support anchor in 264 patients. The authors achieved a very acceptable complication rate requiring reoperation for eyelid position in 3.5%, hematoma in 0.4%, blepharitis in 3.8%, and minor surgical revisions in 11.7%.

Separate Skin and Muscle Flaps
Klatsky and Manson,\(^{149}\) Massiha,\(^{150}\) and Hinderer\(^ {71}\) advocated separate skin and muscle flaps for lower blepharoplasty. After the skin flap is elevated off the orbicularis oculi, the pretarsal orbicularis oculi is left intact. Massiha\(^ {150}\) noted that the advantages of this protocol are that it leaves the orbicularis oculi-tarsus relationship intact and the pretarsal orbicularis oculi innervated. Skin and muscle can also be removed independently.

Transconjunctival
In 1928, Bourguet\(^ {15}\) described the transconjunctival approach to lower blepharoplasty. Almost 50 years later, Tomlinson and Hovey\(^ {151}\) reviewed the procedure and Schwartz and Randall\(^ {152}\) compared the preseptal and retroseptal approaches.

Schwartz and Randall\(^ {152}\) stated that the preseptal approach affords better identification and control of the separated fat loculation. Baylis et al.\(^ {153}\) and Zarem and Resnick\(^ {20,154}\) on the other hand, supported a retroseptal approach. The retroseptal approach has the theoretic advantage of leaving the septum intact, which could decrease the incidence of eyelid retraction.

Although the transconjunctival blepharoplasty is limited in its ability to resect skin in the pure sense, Zarem and Resnick\(^ {154}\) proposed that the skin excess is often more apparent than real and that the skin is necessary to recontour the lower eyelid after the fat is excised. In approximately 50% of patients, the authors used additional subciliary incision and skin flap with skin resection in conjunction with a transconjunctival lower blepharoplasty.\(^ {155}\)

Zarem and Resnick\(^ {155}\) presented an update of his experience and concluded that transconjunctival lower blepharoplasty is superior to other techniques in that it is possible to completely resect the fat, avoid retracted lower eyelids and dry eye postoperatively, and achieve long-lasting correction.

Jelks\(^ {156}\) combined a transconjunctival blepharoplasty with a trichloroacetic acid peel for further skin tightening. The author introduced the concept of “no-tack” in lower blepharoplasty, which consists of transconjunctival fat removal, conservative pinch skin excision, and lateral canthopexy. The orbicularis oculi (or middle lamella) remains undisturbed. Good results have been achieved with the technique, as reviewed by Rohrich et al.\(^ {157}\) Stark et al.\(^ {158}\) reported realigning the intraorbital fat via a buccal mucosa incision in addition to an endoscopic midface-lift.

McKinney et al.\(^ {159}\) combined transconjunctival resection of fat with full-strength Baker phenol chemical peeling to tighten the skin. Dinner et al.\(^ {160}\) removed skin after a transconjunctival blepharoplasty while leaving the middle lamellar structures intact. The CO\(_2\) laser has also been used to tighten the skin in conjunction with transconjunctival blepharoplasty.\(^ {161}\)

The main disadvantages of transconjunctival blepharoplasty are limited exposure and potentially inadequate fat removal, particularly from the lateral compartment.\(^ {154}\) Baker et al.\(^ {32}\) reported removing slightly more fat during a transconjunctival blepharoplasty than they would during transcutaneous blepharoplasty to obtain the same result in fat contouring. Possible complications with that approach include damage to the inferior oblique muscle and persistent chemosis.

A review from the Manhattan Eye, Ear, and Throat Hospital\(^ {162}\) documented six patients who were referred with diplopia status posttransconjunctival lower blepharoplasty. The cause of diplopia was injury to the inferior rectus, inferior oblique, or lateral rectus muscle from intramuscular hemorrhage and edema, cicatricial changes within the muscle, or accidental incorporation of the extraocular muscle in the closure of the orbital septum. Two patients required muscle surgery for correction, and the other four
improved spontaneously after 6 to 8 months of observation. The authors recommended making the transconjunctival incision on the palpebral conjunctival surface, not deep in the interior fornix or on the bulbar conjunctiva.

An article by Sadove163 on transconjunctival septal suture repair for lower blepharoplasty argued in favor of muscle-preserving procedures. Comments indicated that tightening of the septum alone is not a panacea for rejuvenation of the lower eyelid; more is required for a comprehensive youthful result.

**Orbicularis Oculi Hypertrophy**
Sheen164 suggested that pretarsal orbicularis oculi hypertrophy is characteristic of a youthful eyelid, and suspended the upper 8 mm of the skin-muscle flap to the tarsal plate to produce a lower eyelid fold. Rees and Tabbal,138 however, warned of the dangers of extrusion of permanent sutures and ectropion with that type of technique. Fodor165 recreated the youthful bulge by leaving the pretarsal orbicularis oculi intact and overlapping the cut edge of the skin on the skin-muscle flap.

Castañares,166 Loeb,167 and Bernardi et al.168 advocated resection of variable portions of the hypertrophied orbicularis oculi to reduce muscle bulge, which they considered unsightly. Connell and Marten169 split the muscle vertically at the lateral canthus to lessen postoperative crow’s feet from a hyperactive orbicularis oculi. Care must be taken during the dissection to avoid injury to the frontotemporal branch of the facial nerve.

de Assis Montenegro Cido Carvalho et al.170 described their technique of resection of the lateral third of the orbicularis oculi in 105 patients during face-lift dissection. A superficial musculoaponeurotic system graft was placed to avoid depression. The authors reported achieving excellent results without increasing complications.

**Orbicularis Oculi Suspension**
Furnas171 offered an excellent review of the anatomy, physiology, and surgical alteration of the orbicularis oculi. Pretarsal hypertrophy, muscle laxity, festoons, and crow’s feet are problems related to the orbicularis oculi and dictate modification of the blepharoplasty technique. Festoons of hypotonic muscle are diagnosed by the “squinch test,” in which the patient tightly contracts the orbicularis oculi and the fold disappears. Muscle suspension is indicated for correction in such cases.

To improve the appearance of the lateral canthal area and reduce crow’s feet, Aston172 splayed the muscle and sutured it to the temporal fascia under tension. In cases of large skin folds and a thick muscle and in cases with perceived hyperactivity of the orbicularis oculi, the muscle ring can be divided and the ends suspended separately.

Complementing these techniques, as an alternative to laser resurfacing, Gruber et al. reported their dermabrasion technique as an effective, economic alternative for periocular rhytides confined to the lateral canthal region in 25 patients with no pigmentary changes.

Mladick174 preferred routine lateral suspension of the orbicularis oculi to the orbital periosseum. He suggested that the method reduces the risk of scleral show and rounding of the eyelid and produces better contact of the eyelid with the globe.

Surgeons often suspend the orbicularis oculi after dissection in the suborbicularis plane or in the periosteal plane in an attempt to lift the malar fat pad, decrease the periorbital aperture, or both. Hamra,41 Hester et al.,175 and Moelleken176 described their respective techniques for suspension of the orbicularis oculi to the lateral orbit or temporal area.

**Orbital Septum**
The orbital septum is the fascial barrier that keeps the intraorbital fat from protruding anteriorly. Castañares17 and Beare136 concluded that it is not necessary to suture and reconstruct the septum during blepharoplasty to prevent subsequent reherniation of fat. Tipton177 empirically confirmed that philosophy in a series of 33 consecutive blepharoplasties. The author sutured the septum on one side but not the other. At a follow-up visit 2½ years later, it was impossible to detect any significant differences between the two sides.
To lessen the risk of reherniation of the lower eyelid fat, Huang178 and Sensöz et al.179 complicated the orbital septum whereas de la Plaza and Arroyo,180 Mendelson,181 and Camirand182 sutured the capsulopalpebral fascia to the perioseum of the lower eyelid. Stark et al.183 suggested a pullout suture technique to facilitate fixation.

A comparative study of 26 patients who had undergone capsulopalpebral fascia hernia repair in one lower eyelid and standard blepharoplasty in the other showed no discernible differences in aesthetic outcomes at 6 weeks and 6 months postoperatively. However, the capsulopalpebral fascia technique is associated with less discomfort and pain during the operation, less postoperative bleeding and hematoma, and a reduced incidence of hollowing and sunken eye appearance.184 At 11.3 years of follow-up, the fat-preserving capsulopalpebral fascia repair presented by de la Plaza and Arroyo180 for palpebral bags was associated with a lower recurrence rate than was blepharoplasty by lipectomy in the same 26-patient cohort. The average time for recurrence was 6.5 years in the second group.185

van der Lei et al.186 reported 296 bipolar coagulation assisted-orbital septoblepharoplasties of the upper eyelid. The authors considered the procedure to be an effective method to coagulate the septum for shrinkage to reposition the prolapsed fat pads. They reported no short-term (9 weeks to 2 years) fat necrosis and no complications occurring in association with their controlled burn of the septum. A similar study187 compared the use of CO₂ laser and Colorado needle tip cautery of the septum for non-resective shrinkage; no difference between the two was identified.

Persing et al.188 presented a report of the “shade” procedure. It is a variant of previously described fascial barriers to fat herniation with which augmentation of the infraorbital rim is achieved by septum and capsular palpebral fascia release from the lower eyelid, securing the fascia and released septum to an intramuscular pocket at the inferior orbital rim. With this procedure, canthopexy is necessary. The procedure is indicated for patients with lower eyelid fat herniation, particularly in cases in which the infraorbital rim is significantly depressed. McCord et al.189 reported their use of Enduragen grafts for 129 eyelids. The complication rate associated with the material was very low. Reid et al.190 reported a septal extension, confirming that the septum orbitale does continue onto the tarsal plate.

**Nasojugal Groove and Orbital Aperture**

Loeb24 discussed the origin and management of palpebral depressions. He described using free fat grafts and sliding the fat from the retroseptal area over the arcus marginalis. Hamra25 further championed the fat-sliding technique to soften the lower eyelid depressions and make the palpebral aperture smaller. He later modified his technique to include anterior reset of the septum.41 Barton et al.27 confirmed the benefits of anterior fat repositioning and septal reset and reported a low incidence of complications with appropriate patient selection. Goldberg and colleagues191,192 attested to the usefulness of fat repositioning with lower blepharoplasty.

Patipa193 listed the following causes of lower eyelid retraction after blepharoplasty:

1. inadequate skin (anterior lamellar insufficiency)
2. middle lamellar inflammation and subsequent scarring between the orbital septum and capsulopalpebral fascia
3. lateral canthal tendon laxity or disinsertion
4. midfacial descent

Fat pad manipulation or resection causes inflammation that can act as a scaffold for fibrosis between the overlying orbital septum and capsulopalpebral fascia, resulting in lower eyelid retraction.193

As mentioned above, several authors use malar cheek lift and orbicularis oculi suspension to reduce the orbital aperture.41,175,176,194 By elevating the malar fat pad and interrupting the arcus marginalis, the surgeon narrows the palpebral angle and creates a more youthful appearance. Malar cheek lifts performed through the lower eyelid have been associated with a higher risk of lower eyelid ectropion and malposition.175,193–196
Goldberg\textsuperscript{197} wrote an editorial about three targeted periorbital hollow areas in which to inject filler and thus restore volume in lieu of any surgical options. He noted an alternative concept in aging (deflation) and concluded that gravitational changes might play less of a role in aging changes than traditionally thought. Hamra\textsuperscript{101} disagreed and reminded the reader of the value of “real plastic surgery” for a long-lasting, comprehensive, harmonious rejuvenating result. Odunze et al.\textsuperscript{198} reported that the lateral canthal complex descends relatively more quickly than in Caucasian women because of more dramatic attenuation.

**Laxity of the Lower Eyelid**

Preexisting laxity of the tarsal margin combined with slight over-resection of skin can lead to scleral show postoperatively and, if severe enough, to frank ectropion. Neuhaus\textsuperscript{199} studied the anatomic etiology of horizontal lower eyelid laxity leading to senile (involutional) ectropion in 20 patients and noted significant attenuation of the lateral canthal tendon. That view was shared by several other authors.\textsuperscript{83,200,201} Neuhaus\textsuperscript{199} recommended surgery to correct the horizontally lax canthal tendon rather than full-thickness or tarsal resection of normal eyelid structures in the palpebral fissure.

The following intraoperative measures help prevent post-blepharoplasty scleral show and ectropion:

- temporary external support of the eyelid margin
- wedge resection to shorten the eyelid\textsuperscript{202–206}
- suspension or tightening of the lower eyelid using skin or muscle components to create a suspensorial sling\textsuperscript{207,208}
- tarsal suspension to the perioriosteum or soft tissue of the lateral orbital rim\textsuperscript{209–214}
- lateral canthoplasty\textsuperscript{215,216}

Lisman et al.\textsuperscript{217} reviewed the evolution of tarsal suspension techniques for lower blepharoplasty and described a modification that approximates the edge of the tarsal plate to the lateral orbital rim periosteum.

Jordan and Anderson\textsuperscript{218} reported their experience with a tarsal suspension operation during which the lateral border of the tarsus is sutured to the periosteum just superior to the insertion of the lateral canthal tendon inside the orbital rim. Techniques that rely on cantholysis and resuspension of the tarsus have been said to be appropriate for patients with horizontal eyelid lengthening, but Flowers\textsuperscript{83} observed that many of the tarsal flap techniques and wedge resections shorten the aperture and give patients the appearance of having small, beady eyes.

Weber et al.\textsuperscript{219} illustrated several refinements of the tarsal strip operation. Fagien\textsuperscript{220} noted that tarsal strip procedures have been misapplied to a number of eyelid types and conditions regardless of horizontal eyelid length, canthal position, orbital rim, and malar complex relationship, globe size, or degree of exophthalmos. McCord et al.\textsuperscript{221} reviewed the principles involved in canthal support and illustrated the application of different techniques for canthal anchoring depending on the preoperative examination. Modifications are made based on presence of lower eyelid laxity and eye position (Figs. 5–9).

According to Fagien,\textsuperscript{220} many suture canthoplasty and retinacular suspension procedures have been described and have been very useful in patients for whom there is less need to actually shorten the eyelid, especially in aesthetic surgery. Fagien advocated lateral retinacular suspension according to the method presented by Jelks et al.,\textsuperscript{222} with which a double-armed suture is used to hitch the lateral canthal tendon to the perioriosteum of the upper lateral orbital rim (Fig. 10).\textsuperscript{220}

The trans-canthal canthopexy used by Hamra\textsuperscript{41} is technically straightforward and only slightly more lateral than that used by Jelks et al.\textsuperscript{222} Flowers\textsuperscript{83} recommended routine suspension of the lateral canthal tendon at the time of lower blepharoplasty and opted for a drill-hole canthopexy to achieve lower eyelid support. The author reported his finding of the “tarsal strap” as a new anatomic finding. The strap anchors the tarsus to the periosteum of the inferolateral orbit.\textsuperscript{59} Stampos\textsuperscript{223} reported the use of Lockwood ligament to suspend the orbicularis oculi laterally.
Comlications

Chemosis

Chemosis is the most common nonsurgical complication occurring in association with blepharoplasty. It is edema of the conjunctiva and very often occurs after eyelid or facial surgery. Clinically, it presents as visible swelling of the conjunctiva and has several levels of severity. Weinfeld et al.224 reported an incidence of chemosis of 11.5% among 312 primary blepharoplasties. The authors presented a classification system: type 1, acute mild chemosis with complete eyelid

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**Figure 5.** Upper illustrations, standard canthal anchoring with lysis (canthoplasty) and without lysis (canthopexy) in a patient with standard eye position as measured by the Hertel exophthalmometer. The canthal anchoring is placed at the inferior edge of the pupil. Lower illustrations, drawing illustrates proper placement of the canthal anchoring suture through the lower and upper lateral canthal tendon. The canthal anchoring is placed at the inferior edge of the pupil. (Reprinted with permission from McCord et al.221)

**Figure 6.** Illustrations show upward clotheslining in patients with deep-set eyes (Hertel measurement, <15 mm). The position of fixation of canthal anchoring needs to move inferiorly to prevent upward clotheslining and narrowing of the lateral scleral triangle. It should also be placed internally, inside the lateral orbital rim, to maintain lid position against the globe. (Reprinted with permission from McCord et al.221)

**Figure 7.** Illustration shows downward clotheslining of the lower lid in patients with prominent eyes (Hertel measurement, >18 mm). In such cases, fixation for canthal anchoring needs to be supraplaced above the inferior pupillary edge to prevent downward clotheslining of the eyelid. (Reprinted with permission from McCord et al.221)
closure; type 2, chemosis-induced lagophthalmos; type 3, subchronic lasting longer than 3 weeks; and type 4, associated with eyelid malposition. They also presented a comprehensive review of pharmacological, mechanical, and surgical therapies for the management of chemosis. The authors emphasized the importance of prevention by minimizing triggering factors intraoperatively and immediately postoperatively.

Hamawy et al.225 reviewed the prevention and management of dry eyes after surgery by addressing risk factors before surgery (Fig. 11).224 Cheng and Lu226 reported an effective treatment procedure for chemosis using a 27-gauge needle for perilimbal manipulation of chemosis using local anesthesia. The authors observed improvement in all cases at 2 months.

**Visual Loss**

Approximately 78 cases of visual loss after blepharoplasty have been reported in the English language medical literature.227–230 DeMere et al.231 estimated the incidence of blindness after blepharoplasty to be 0.04%. The common event in most reported cases is intraorbital hemorrhage, although the source remains controversial.

The widely accepted theory suggests that orbital bleeding increases intraorbital and intraocular pressure, compromising ocular circulation.232 Ischemic optic neuropathy and
central retinal artery occlusion are thought to be the most common final events in most cases of blindness after blepharoplasty.232−234 Suttcliff et al.235 examined the sources of hemorrhage in an anatomic study. The transconjunctival CO2 laser approach to lower blepharoplasty revealed left eye blindness in a case report from France.236

Acute orbital hemorrhage is a medical and surgical emergency that demands prompt recognition and management. Severe, permanent visual impairment is likely to occur if the circulation to the globe is compromised for >90 minutes.234 The clinical signs of retrobulbar hemorrhage include rapid onset of pain and proptosis, usually accompanied by eyelid ecchymosis.233 Visual acuity usually is reduced but can range from normal to no light perception. An emergency ophthalmological consultation should be obtained, and treatment must not be delayed. Retrobulbar hemorrhage without visual impairment is managed by opening of the incisions with decompression and exploration to identify the source of bleeding. Usually, a source is not found.237 Retrobulbar hemorrhage with visual impairment requires the following:

- surgical decompression of the orbit by opening the skin incisions and releasing the septum orbitale and the lateral canthus238
- reduction of intraocular pressure with an intravenous osmotic agent such as 20% mannitol, 1–2 mg/kg body weight, 12.5 g administered during 3 minutes and the remainder during 30 minutes
- further control of intraocular pressure with 500 mg of acetazolamide (Diamox; Lederle Laboratories, Pearl River, NY) by intravenous injection and then 250 mg by mouth every 6 hours239
- administration of 95% oxygen/5% CO2 mixture to dilate intraocular and intracerebral vessels

Figure 11. Chemosis classification system. Type 1, mild acute edema and inflammation with complete lid closure; Type 2, severe acute edema with inflammation that prohibits complete lid closure (chemosis-induced lagophthalmos); Type 3, subchronic edema and inflammation that persists longer than 3 weeks; and Type 4, chemosis associated with lower lid malposition. (Reprinted with permission from Weinfeld.224)
measures fail and has been successful in four cases reported by Sacks et al. Hepler et al., Castillo, and Goldberg et al. reviewed the management of acute intraorbital hemorrhage accompanied by visual loss.

**Corneal Injury**

Corneal injury can be prevented by careful attention to technique and the use of corneal shields. Hepler et al. suggested that if corneal injury is suspected, fluorescein staining should be performed under high magnification to obtain a diagnosis. Large or deep corneal wounds should be referred to an ophthalmologist. Superficial injuries are managed with topical antibiotics and patching of the eye. Patients should be examined every 24 hours or whenever they complain of pain.

**Bleeding**

Meticulous hemostasis and avoidance of pharmacological impediments to clotting are imperative in preventing bleeding after blepharoplasty. Lisman et al. outlined preventive measures. Likely causes of hemorrhage include traction on the posterior vessels during aggressive fat resection, poorly controlled fat pad vessels that retract into the orbit, and bleeding deep into the orbit from the cut edges of the orbicularis oculi.

Careful examination is required to differentiate a localized hematoma from a sight-threatening hemorrhage. Eyelid hematomas are anterior to the septum, without ocular symptoms. In the event of persistent bleeding or inability to rule out postseptal hemorrhage, the wound should be reexplored. Superficial hematomas might require observation only. Evacuation, if necessary, is performed in 7 to 9 days to allow time for liquefaction of the hematoma.

**Diplopia**

Temporary diplopia has been attributed to wound reaction, edema, and hematoma. Permanent strabismus results from structural damage to the extraocular muscles or nerves. Lowry and Bartley stated that the inferior oblique muscle is most frequently injured and the superior oblique muscle the second most frequently injured. The mechanism of injury has been postulated to be excessive use of cautery or direct trauma during injection of the local anesthetic. Secondary blepharoplasty seems to be a risk factor for the development of diplopia after surgery. Conservative management and close observation are recommended until no further improvement occurs. Refractory cases can be referred for appropriate strabismus surgery.

**Ptosis**

The most frequent cause of perioperative upper eyelid ptosis is the failure to recognize the condition preoperatively. Nevertheless, upper eyelid ptosis can result from direct injury to the levator aponeurosis during blepharoplasty. Baylis et al. suggested that such injury occurs at the inferior one-half of the skin-muscle excision, where the levator merges with the septum. Any injury that is recognized intraoperatively or immediately postoperatively should be repaired immediately.

**Lagophthalmos**

Lagophthalmos often occurs to some degree during the first week after blepharoplasty. Lagophthalmos is well tolerated by patients who have normal tear production and resolves with conservative treatment such as lubrication, massage, eyelid taping, and patching. Persistent lagophthalmos can occur secondary to excessive skin resection or incorporation of the orbital septum in the incisional scar. If conservative treatment fails to control ocular exposure, definitive surgical therapy is required, releasing the retraction by recreating the defect and applying a full-thickness skin graft.

**Ectropion**

Malposition of the lower eyelids is the most common and possibly the most visible complication of blepharoplasty. Carraway and Mellow stated that the ultimate position of the lower eyelid is determined by a balance of forces: the tarsus and canthal ligament pulling up against gravity; the pretarsal orbicularis oculi muscle fibers acting to support the eyelid; and cicatricial forces of skin, orbital septum, and capsulopalpebral fascia.
pulling inferiorly. According to the authors, the possible causes of ectropion are as follows:

- excessive skin, fat, or muscle removal
- scar contracture
- paralysis of the orbicularis oculi
- adhesion of the orbital septum
- hematoma
- lax eyelid margin
- proptosis
- unilateral high myopia

Techniques for the prevention of simple senile ectropion are described in the section, “Lower Eyelid Laxity and Ectropion.”

McCord and Ellis and Jelks and Jelks proposed that mild cases of lower eyelid retraction after blepharoplasty are the result of previously unrecognized eyelid laxity and can be corrected with lateral canthoplasty. Progressive degrees of eyelid retraction must be addressed by additional means, including vertical skin recruitment and spacer grafts in the most severe deformities.

McCord et al. described a special situation requiring cantholysis to perform a criss-cross anchoring technique of fixation of the upper and lower canthus separately. It is indicated in the case of primary blepharoplasty in which the patient has significantly prominent eyes and supra-placement of the lateral drill hole will not suffice, nor will release of the capsular palpebral fascia for sufficient superior displacement (>2 mm). Insertion of a posterior lamellar spacer might be required.

Over-resection/Under-resection of Fat

Excessive intraorbital fat resection can result in a hollowed out socket. Inadequate fat resection most likely occurs in the upper and lower medial and lower lateral fat compartments. Maniglia et al. reported a technique for surgical correction of a sunken upper eyelid.

Asymmetry

By far the most common complication associated with blepharoplasty is asymmetry of the results. Fortunately, this is generally addressed satisfactorily with subsequent operations.


126. Chen WP. The concept of a glide zone as it relates to upper lid crease, lid fold, and application in upper


159. McKinney P, Zukowski ML, Mossie R. The fourth option:


189. McCord C, Nahai FR, Codner MA, Nahai F, Hester TR.


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