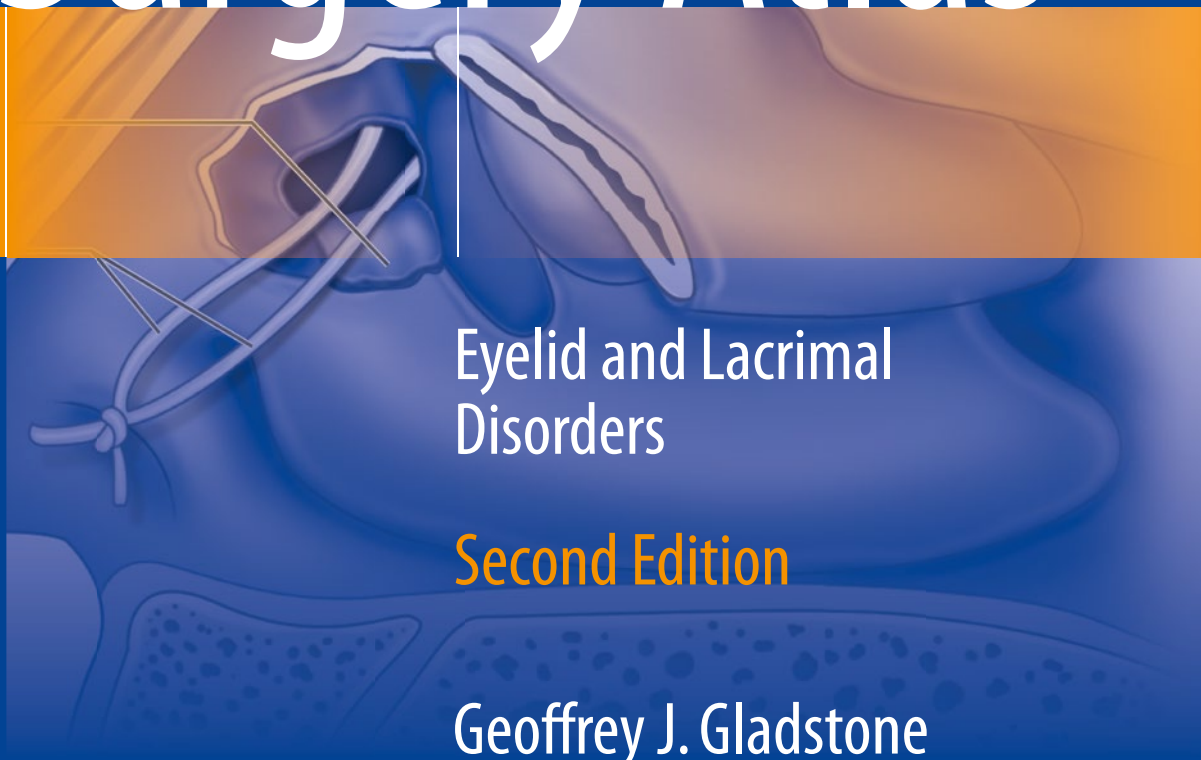
Oculoplastic Surgery Atlas



Eyelid and Lacrimal Disorders

Second Edition

Geoffrey J. Gladstone
Frank A. Nesi
Evan H. Black *Editors*

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Springer

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There is no greater joy in medicine than to pass on knowledge. The benefits are innumerable. Patients receive better care, the physician practices a higher quality of medicine, and the field of medicine achieves a more advanced state by the synthesis of knowledge from many sources.

The teacher's benefits are less obvious but just as meaningful and rewarding. Seeing a resident or practicing physician broaden their knowledge or perfect a new surgical technique provides a wonderful sense of accomplishment. It is also a way to repay those who have selflessly given their knowledge in the past.

This book is dedicated to those who seek knowledge. It is hoped that in some small way these books and high-quality videos will improve your practice of medicine and simplify the application of appropriate oculo-facial surgical procedures.

Geoffrey J. Gladstone, MD, FAACS

Foreword

The desire to teach and the fulfillment attained from teaching have again prompted us to produce a work that we hope will be both useful and enlightening to our readers.

The field of oculo-facial plastic surgery has grown and evolved to include all aspects of eyelid and facial plastic surgery. Our literature now reflects the advancements and direction of our field. Knowledge of anatomy, the basis of all surgery and the root of surgical principles and techniques, is the basis of our ability to deliver the highest quality care to our patients.

We have therefore combined text and diagrams and supplemented them with high definition streaming video technology to provide those who wish to perform this surgery with the best possible instruction and preparation. We hope that our attempts to accomplish this will be rewarded by the use of our material by our colleagues and the acknowledgment of our unique and logical progression in the field of oculo-facial plastic surgery.

Frank A. Nesi, MD, FAACS

Preface to First Edition

This will be the first text to closely coordinate high quality digital video footage of surgical procedures with a surgical atlas and text. The test will thoroughly cover patient evaluation and decision making for each procedure. This should allow the reader to choose the proper operation. The text will have a detailed description of the surgical procedure keyed to limited number diagrams. The description of the procedure follows the digital video footage on a separate CD-ROM.

The book is intended for ophthalmologists, ophthalmic plastic surgeons, ENT, general plastic surgeons and others wanting a better knowledge of eyelid surgery. It is geared at the beginner/intermediate level and includes only practical, immediately useful techniques. It is limited in scope to keep it practical and quickly producible.

Although many texts and surgical atlases exist, this will be the first with easily accessible digital footage of every procedure. This will be tightly edited footage exactly and completely showing each procedure. It will provide a unique learning experience for the reader as well as allowing Springer-Verlag to be the first to market this type of multimedia presentation.

More and more general ophthalmologist, ENT, and plastic surgeons are interested in eyelid surgery. This text will offer them a learning experience not obtainable elsewhere.

One or two more volumes are possible once the appeal of this format is demonstrated:

Volume II-Orbit, Trauma and Lacrimal Disorders

Volume III-Cosmetic Eyelid and Facial Surgery

Southfield, MI, USA — Geoffrey J. Gladstone, MD, FAACS

Preface to Second Edition

These books update our previous volumes published almost 15 years ago. One of the major advances since that time is the availability of high-quality streaming video. Coupled with our updated text and really beautiful illustrations, these new volumes are concise and immediately useful to those who read them. The chapters thoroughly cover patient evaluation and decision making for each procedure. A detailed description of each procedure is provided that correlates with the videos.

The books are intended for ophthalmologists, ophthalmic plastic surgeons, otolaryngologists, general plastic surgeons, and others wanting a better knowledge of eyelid and facial surgery. They are geared for the beginner/intermediate level and include only practical, immediately useful techniques. They are limited in scope to keep them practical and quickly useful. These books are accompanied by tightly edited, high definition video exactly and completely showing each procedure. They will provide a unique learning experience for the reader.

More and more comprehensive ophthalmologists, otolaryngologists, and plastic surgeons are interested in eyelid and facial surgery. This text offers them an unparalleled learning experience.

Southfield, MI, USA — Geoffrey J. Gladstone, MD, FAACS

Acknowledgments

Bringing a book project to fruition is always a complicated process involving many people. It is through their dedication, professionalism, and team effort that it all comes together.

Our medical illustrators deserve special recognition for the quality and beauty of their work; their illustrations clarify the text in a way that only visual images can. The ease with which they communicated during the illustration process is appreciated.

Rebekah Amos Collins, our executive editor, did a wonderful job initiating the creation of the two volumes. Lee Klein, our editor at Springer, worked tirelessly with me to complete the process. His gentle prodding to complete the task was necessary and appreciated.

Drs. Servat and Baylin updated the anatomy chapters for this edition. We want to once again thank Drs. Rose, Lucarelli, Cook, and Lemke for their work on the first-edition anatomy chapters.

Most importantly, Dr. Nesi and I would like to pay tribute to our mentors. Without Drs. Byron Smith and Allen Putterman, none of this would have been possible. They guided and molded us during our fellowships and have had a decades-long influence on us. It is because of them that we are able to give back to our profession in this way. Thank you Allen and Byron.

Geoffrey J. Gladstone, MD, FAACS
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Surgical Anatomy of the Eyelid

1

J. Javier Servat and Eric B. Baylin

Proper diagnosis and management of eyelid disorders, both functional and cosmetic, hinge upon a thorough understanding of the location of critical eyelid structures and the anatomic relationships between them.

This chapter attempts to explore the complexity of the anatomy of the eyelid and to expand and refine our anatomical knowledge within the context of surgical planning, surgical procedures, and surgical patient care.

Eyebrow

As an important source of support for the eyelids and a major determinant in facial expression, the eyebrows should be included in any evaluation of eyelid dysfunction. Eyebrow position strongly influences eyelid position and architecture, and many cases of upper eyelid ptosis and apparent dermatochalasis are, in fact, a consequence of eyebrow ptosis. Similarly, frontalis muscle recruitment can mask significant blepharoptosis. In these situations, addressing only the lids may lead to an inadequate or undesirable surgical result.

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The ideal contour of the eyebrows is highly debated and varies according to age and gender [1]. The medial and lateral ends of the brow are typically at the same vertical level, although the lateral brow may be slightly higher. The apex should lie above the region between the lateral limbus and the lateral canthus [2]. The male eyebrow generally rides lower and flatter than that of the female [3].

Eyebrow contour and position are influenced by five principal muscles: frontalis, orbicularis, corrugator, procerus, and depressor supercilii. Contraction of the frontalis elevates the eyebrows, while contraction of the orbicularis depresses them. The corrugator depresses the medial eyebrows toward the midline and forms the vertical furrows in the glabella. The procerus depresses the glabella and forms horizontal wrinkles across the dorsum of the nose. The depressor supercilii also depresses the eyebrows medially, contributing to the formation of vertical glabellar wrinkles.

Beneath the eyebrow lies the eyebrow fat pad, which supports the eyebrow over the supraorbital ridge. Dense, fibrous attachments anchor the eyebrow to the supraorbital ridge. Because the ridge underlies only the medial one-third to one-half of the eyebrow, the lateral eyebrow lacks the same degree of underlying support. This has been proposed as an explanation for the fact that the lateral eyebrow often droops more than the medial eyebrow with age [4].

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Eyelid Topography

Eyelid topography is influenced by age, race, ethnicity, and surrounding facial anatomy. In most individuals, the lateral canthus sits 2 mm higher than the medial canthus, with slightly greater elevation in individuals of Asian descent. The adult interpalpebral distance measures 28–30 mm horizontally and 9–12 mm at its greatest vertical extent centrally. The upper eyelid margin rests approximately 1–2 mm below the superior limbus. The lower eyelid margin rests at the inferior limbus. Laxity of the canthal ligaments not only causes poor apposition of the eyelids to the globe, but also changes the contour of the interpalpebral fissure. The upper eyelid is gently curved, with the highest point nasal to the center of the pupil [5, 6].

The upper eyelid crease is an important surgical landmark, as it is often an incision site. The crease is formed by the superficial insertions of the levator aponeurosis [7] and should generally be re-formed if these attachments are disturbed [8]. It rides parallel to the lid margin and lies 8–11 mm above the eyelid margin in women and 7–8 mm above in men [6]. In people of European ancestry, the septum-levator insertion occurs 2–5 mm superior to the upper edge of the tarsus [9]. In Asians, the orbital septum inserts low on the levator aponeurosis [9], below the superior tarsal border [10], yielding a low or poorly defined lid crease [11]. This is an important point to keep in mind when operating on Asian eyelids.

The lower eyelid crease is less prominent. It begins medially 4–5 mm below the lower eyelid margin. It slopes inferiorly as it proceeds laterally. It is formed by fibers that extend anteriorly from the capsulopalpebral fascia into the subcutaneous tissues [12].

Eyelid Skin and Margin

The eyelid skin is the thinnest in the body, mainly owing to its attenuated dermis. Eyelid incisions therefore heal rapidly. The thinness of the skin also helps to keep scarring to a minimum. As it crosses superiorly over the orbital rim, the eyelid skin abruptly thickens.

The surface of the eyelid margin contains numerous important anatomical landmarks (Figs. 1.1 and 1.2) for eyelid surgery. The upper eyelid margin has approximately 100 eyelashes, while the lower has about 50. Several sebaceous Zeiss glands empty into each lash follicle, while Moll sweat glands are located between follicles. Posterior to the lash line on the eyelid margin is the easily noticeable line of meibomian glands, which emanate from the edge of the tarsus. Between the lash line and the meibomian line lies a faint gray line, which is more pronounced in younger individuals. This represents the edge of the muscle of Riolan. The gray line serves as an important surgical landmark, separating the eyelid vertically into the anterior lamella—skin and orbicularis—and posterior lamella: tarsus, retractors, and conjunctiva [13].

Eyelid Connective Tissue

Orbital Septum

The orbital septum (Fig. 1.1) is the boundary between the eyelids and orbit. It is commonly encountered during eyelid surgery and is easily identified by tugging inferiorly on it to confirm its strong attachment to the orbital rim. The orbital septum is a multilamellar layer of dense connective tissue that lines the orbit and terminates by fusing at the periosteum of the orbital rim. This termination forms the arcus marginalis [9]. Laterally, the septum inserts anteriorly onto the lateral canthal ligament and posteriorly on Whitnall's tubercle on the lateral orbital rim. Medially, the septum splits and inserts to both the posterior and anterior lacrimal crest. Multiple fibrous attachments emanate from the orbital septum, anchoring it anteriorly to the orbicularis muscle [14]. The preaponeurotic fat lies immediately posterior to the orbital septum. In the lower eyelid, the orbital septum fuses with the capsulopalpebral fascia 5 mm inferior to the lower border of the tarsus [12].

The strength of the orbital septum varies among individuals, as well as with age. Age often results in attenuation of the septum, resulting in anterior prolapse of orbital fat [6].

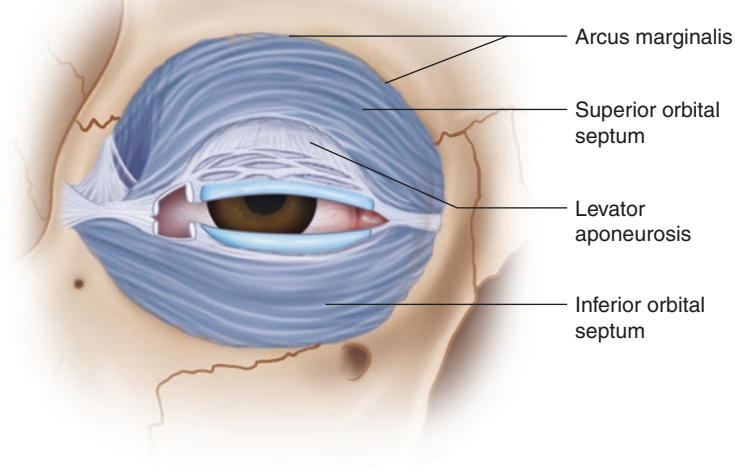

Fig. 1.1 Orbital septum and its relationship with adjacent structures

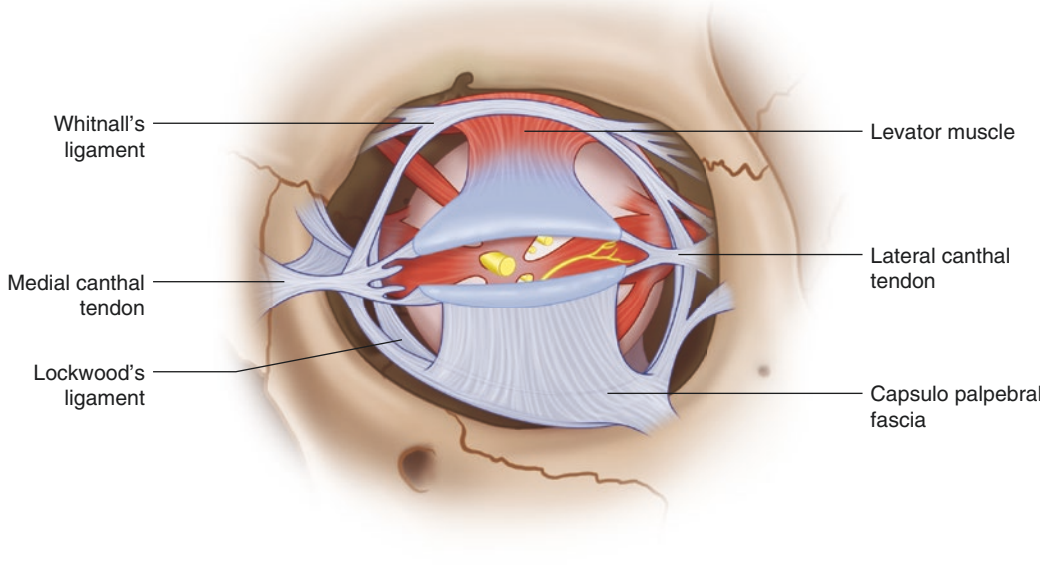

Fig. 1.2 Canthal tendons insertion and Whitnall's ligament

The orbital septum serves as a barrier to infection. Eyelid infection that remains anterior to the septum and is therefore prevented from entering the orbit is termed preseptal cellulitis. When infection crosses an intact or violated septum, orbital cellulitis results, which is a vision-threatening, and, in some cases, life-threatening condition.

Tarsal Plates

The tarsal plates provide rigidity to the eyelids. They are composed of dense, fibrous connective tissue. The upper tarsus measures 10–12 mm vertically, while the lower measures 3–5 mm [15]. The tarsal borders adjacent to the lid margin are straight, while the opposite edges have a convex curvature. The posterior edge of the tarsus is firmly attached to the palpebral conjunctiva, which extends to the eyelid margin.

Within the tarsus lie branched, acinar, sebaceous glands with long central ducts. Known as the meibomian glands, they open at the eyelid margin, just posterior to the gray line, and secrete the oily layer of the tear film. There are about 25 in the upper eyelid and about 20 in the lower [9]. Inflammation of these glands, known as meibomitis, may, over a long term, result in distichiasis [16]. A common treatment for distichiasis, electrohyfrecation, may cause focal necrosis of the tarsus, resulting in notching at the eyelid margin [6]. Similarly, excessive cryotherapy for distichiasis can cause a wider-than-planned area of lash loss and scarring.

Canthal Ligaments

Emanating from the medial and lateral borders of the tarsi and anchoring them to the orbital rim are the canthal ligaments. These are formed by a fusion of the upper and lower crura, the thickened extensions of the margins of the upper and lower tarsi, respectively. These support not only the tarsi, but also the orbicularis. The medial canthal ligament splits into three arms: anterior, posterior, and superior. The anterior arm attaches to the maxillary bone, anterior to the lacrimal crest. The posterior arm attaches to the posterior lacrimal crest [17, 18]. The superior arm inserts onto the orbital process of the frontal bone [19]. The lateral canthal ligament inserts 1.5 mm inside the lateral orbital rim at Whitnall's tubercle, on the zygomatic bone (Figs. 1.1 and 1.2) [20]. In lower eyelid tightening procedures, which usually involve surgical manipulation of the lateral aspect of the lower tarsus and the lateral canthal ligament, the posterior direction and insertion of the lateral canthal ligament must be preserved. Laxity of the canthal ligaments can cause ectropion, as well as a cosmetically apparent shortening of the horizontal palpebral fissure [21].

Whitnall's Ligament and Levator Aponeurosis

An important support for the upper eyelid is Whitnall's ligament (Fig. 1.2). Its role has been debated [14]; it may serve as a fulcrum-like check ligament for the levator or as a swinging suspender providing vertical support for the upper eyelid [20, 22]. Despite this debate, it is understood that Whitnall's ligament suspends the lacrimal gland, superior oblique ligament, levator muscle (with the primary support for the levator coming from the globe), and Tenon's capsule. Whitnall's ligament is a transverse fibrous condensation that inserts medially inside the superomedial orbital rim on the frontal bone at the trochlea and laterally inside the superolateral orbital rim, near the frontozygomatic suture, where it fuses with fibers of the lacrimal gland capsule. It encircles the levator complex [23] at the level of the junction of the levator muscle and the fibrous levator aponeurosis. The levator aponeurosis extends another 14–20 mm inferior to Whitnall's ligament (Fig. 1.3) to insert on the lower third of the anterior face of the upper tarsus. Dehiscence of the levator aponeurosis is responsible for most cases of involutional ptosis, and when encountered during ptosis repair, it can be identified as a band of pearly, white tissue that retracts on attempted upgaze (Fig. 1.3).

Eyelid Musculature

Orbicularis Oculi, Muscle of Riolan, and Horner's Muscle

The orbicularis oculi muscle surrounds the anterior orbit and can be divided into three compo-

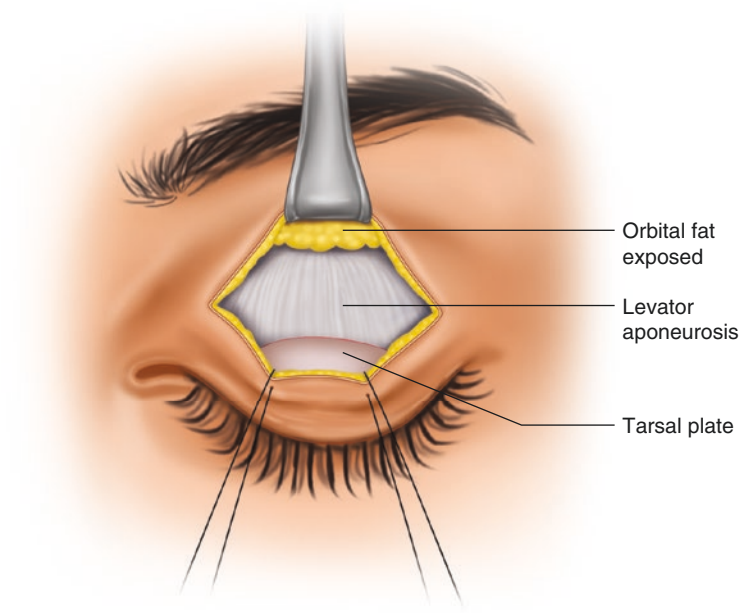

Fig. 1.3 Levator aponeurosis and its relationship to the orbital fat

nents: pretarsal, preseptal, and orbital [24]. The pretarsal orbicularis originates from the anterior and posterior arms of the medial canthal ligament. It is firmly adherent to the anterior face of the tarsus and to the levator aponeurosis. Medially, the pretarsal orbicularis divides into a superficial head, which surrounds the canaliculi, and a deep head, which inserts on the posterior lacrimal crest and lacrimal fascia. These insertions allow the pretarsal orbicularis to play an important role in the lacrimal pump mechanism. The preseptal orbicularis originates from the upper and lower margins of the medial canthal ligament and inserts lateral to the orbital rim on the zygoma. It overlies the orbital septum and orbital rim, and it is separated from the septum by a fibrofatty layer, the postorbicularis fascia [6]. This layer is an important dissection plane in anterior eyelid tightening procedures. The orbital orbicularis originates from the maxillary and frontal bones, as well as from the medial canthal ligament; it overrides the orbital rims and inserts at the same location as the preseptal orbicularis. These latter two portions of the orbicularis are responsible for forced eyelid closure (Fig. 1.4).

Two important components of the orbicularis are the muscle of Riolan and Horner's muscle. The muscle of Riolan is a small segment of the orbicularis that is separated from the pretarsal orbicularis by the eyelash follicles. It corresponds to the gray line seen at the eyelid margin [13]. The deep pretarsal head of the orbicularis is known as Horner's muscle. Contraction of this muscle pulls the eyelids medially and posteriorly. In so doing, Horner's muscle compresses the canaliculi and lacrimal ampullae, pushing tears toward the lacrimal sac [25]. This mechanism, known as the lacrimal pump [26], can therefore be compromised by weakening or laxity of the eyelids, resulting in epiphora [27].

Levator Palpebrae Superioris

The main retractor of the upper eyelid is the levator palpebrae superioris (Fig. 1.5). It originates at the annulus of Zinn in the orbital apex and courses anteriorly through the superior orbit, along the superior aspect of the superior rectus muscle. As it approaches the upper eyelid, the

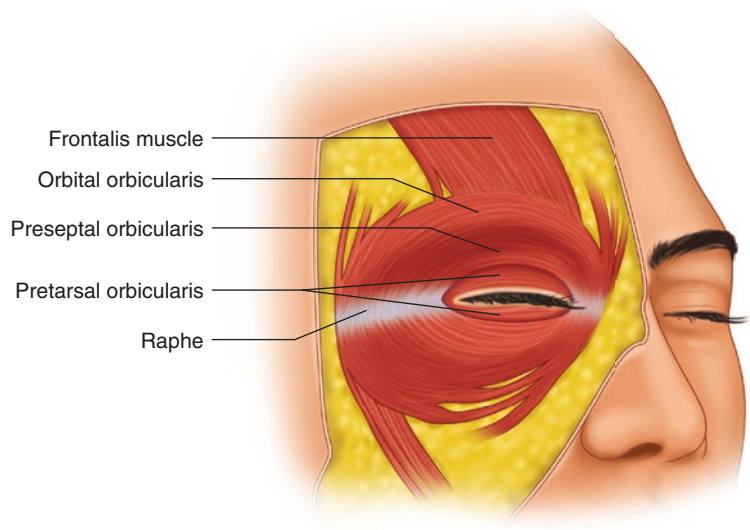

Fig. 1.4 Pretarsal, preseptal, and orbital orbicularis oculi muscle

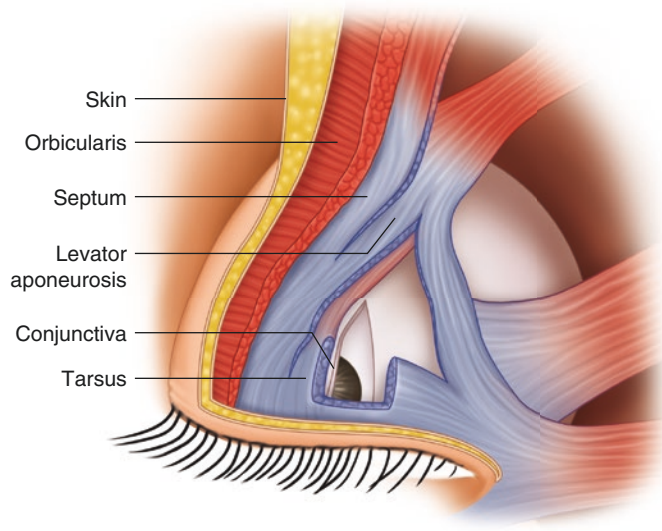

Fig. 1.5 Levator muscle and its relationship to surrounding structures

levator is encircled by Whitnall's ligament [23]. At this point, the levator muscle transitions into the fibrous levator aponeurosis, which courses inferiorly for another 14–20 mm, to attach to the inferior third of the anterior surface of the tarsus. Also at the level of Whitnall's ligament, the levator sends off lateral and medial horns. The lateral horn attaches to the zygomatic bone. The medial horn fuses with the posterior arm of the medial canthalligament and inserts on the posterior lacrimal crest. The lateral and medial horns help ensure that the upper eyelid maintains a curvature

that keeps it apposed to the globe during opening [5]. The levator aponeurosis sends fibers anteriorly through the septum and orbicularis to the skin; these insertions form the upper eyelid crease (Fig. 1.5) [7].

Aging affects both the levator muscle and the aponeurosis. Age-related thinning and dehiscence of the aponeurosis from the tarsus is a common cause of involutional ptosis [28, 29]. In addition, the muscle belly can become infiltrated with fat and connective tissue [6].

Müller's Muscle

Underlying the levator aponeurosis, and attached to it via loose connective tissue, is Müller's muscle, which is sympathetically innervated and composed of smooth muscle fibers. It originates from the undersurface of the levator and courses inferiorly for approximately 15 mm to insert on the superior edge of the tarsus in the upper eyelid. (Fig. 1.6). A lateral extension of Müller's muscle divides the lacrimal gland into its two lobes [30]. It is generally accepted that Müller's muscle is a secondary transmitter of lift to the upper eyelid, as evidenced by the 2–3 mm ptosis seen either in sympathetic denervation syndromes, such as Horner's syndrome, or in the normal fatigue-related decrease in sympathetic tone. Some have suggested that Müller's muscle may serve as a primary transmitter of levator muscle tone to the tarsal plate [31].

Lower Eyelid Retractors

Less defined than their counterparts that elevate the upper eyelid, the lower eyelid retractors—the capsulopalpebral fascia and inferior tarsal muscle—are palpebral extensions of the inferior rectus muscle (Fig. 1.7). The inferior rectus muscle is responsible, through these lower eyelid retractors, for the full extent of depression of the lower eyelid during downgaze [6]. A fibrous extension of the inferior rectus muscle, the capsulopalpebral head of the inferior rectus wraps around the inferior oblique muscle, at which point the capsulopalpebral head splits into superior and inferior divisions. The inferior division, which is the capsulopalpebral fascia, then rejoins the superior division, the inferior tarsal muscle

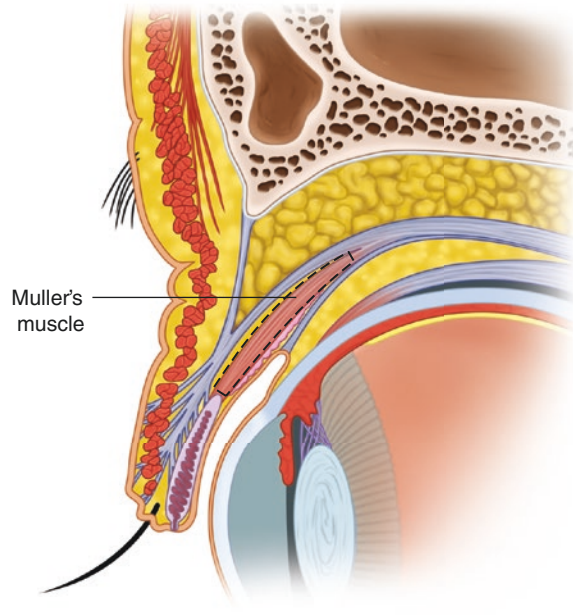

Fig. 1.6 Sagittal view of the Müller's muscle

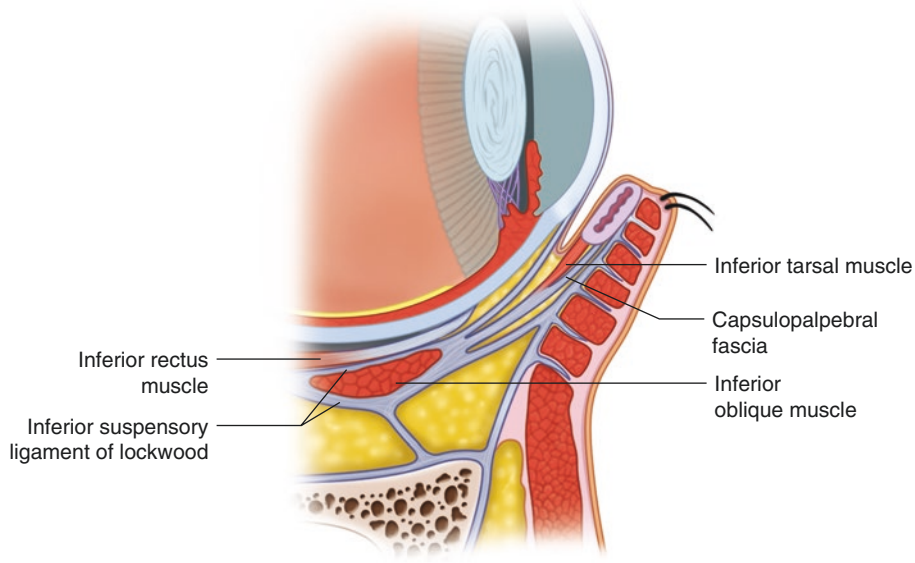

Fig. 1.7 Sagittal view of the capsulopalpebral fascia and its relationship with the lower eyelid retractors

[12], which, like Müller's muscle, is composed of smooth muscle fibers. These two layers are not generally distinct during surgical dissection.

The lower eyelid retractors have three insertions. Posteriorly, the retractors insert on Tenon's fascia. Centrally, the inferior tarsal muscle fibers terminate a few millimeters inferior to the tarsus [12], and a fibrous continuation attaches to the inferior border of the tarsus. Anteriorly, the capsulopalpebral fascia fuses with the orbital septum 4 mm inferior to the tarsus. Fibers continue through the septum and attach to the subcutaneous tissue, forming the lower eyelid crease [5].

Eyelid Fat Pads

The eyelid fat pads (Fig. 1.8) play an important role in the appearance and contour of the eyelids. In the youthful face, eyelid fat imparts a fullness and smoothness to the upper and lower eyelids. With age, atrophy of eyelid fat can cause the eyelids to sink posteriorly, resulting in involutional enophthalmos and a lid crease displaced away from the lid margin [21]. In addition, weakening of the orbital septum can allow anterior prolapse of the eyelid fat, resulting in a puffy appearance known as steatoblepharon [3, 5].

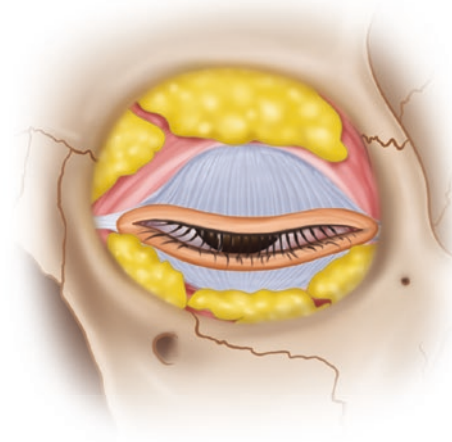

Fig. 1.8 Diagram showing the two fat pads on the upper eyelid, which are located posterior to the orbital septum and immediately anterior to the levator muscle and aponeurosis. The lower eyelid contains three fat pads

The upper eyelid contains two fat pads, which are located posterior to the orbital septum and immediately anterior to the levator muscle and aponeurosis. This anatomical relationship is convenient for the eyelid surgeon who wishes to combine levator aponeurosis repair with blepharoplasty and/or fat pad excision. This region of the upper eyelid is divided into three fibrous compartments. The medial and central compartments contain the two fat pads, while the lateral compartment contains the lacrimal gland [32]. Care must be taken not to confuse the lacrimal gland with eyelid fat in the upper eyelid. The lacrimal gland sits lateral to the two upper eyelid fat pads, and in contrast to the glistening, yellow, loose-appearing fat, it appears grey and firm.

The lower eyelid contains three fat pads, which are enclosed in three fibrous compartments: medial, central, and lateral. The inferior oblique muscle courses between the medial and central compartments in the lower eyelid, and care must be taken not to damage it in lower eyelid fat excision. The lower eyelid fat pads are contiguous with posterior orbital fat, as is the medial fat pad in the upper eyelid; care must therefore be taken not to cause excessive traction on the lower fat pads intraoperatively, as orbital hemorrhage may result in the intra- or postoperative period.

Eyelid Vasculature

Arteries

The eyelids are highly vascularized, and knowledge of vascular anatomy is critical to avoiding complications during eyelid surgery. Eyelid blood supply (Fig. 1.9) arises from both the external and internal carotid arteries. The external carotid artery gives rise to the facial artery, the superficial temporal artery, and the infraorbital artery. As it courses across the face diagonally toward the nasolabial folds, the facial artery becomes the angular artery, which lies directly beneath the orbicularis and feeds the vascular arcades of the eyelids at the medial canthus. The internal carotid artery gives rise to the

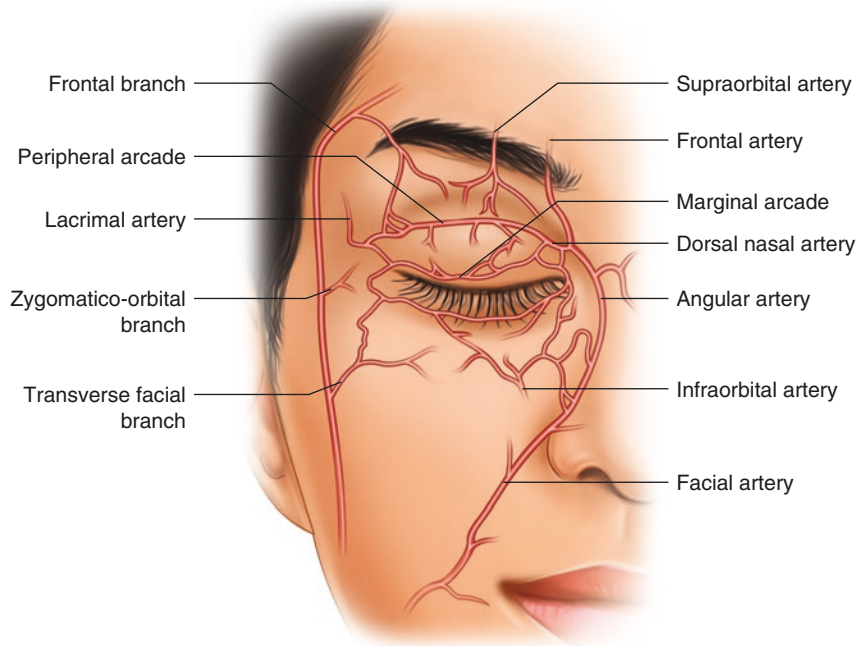

Fig. 1.9 Arterial blood supply to the eyelids

ophthalmic artery, which in turn terminates as the lacrimal, frontal, supraorbital and supratrochlear, and nasal arteries. A poorly developed inferior peripheral arcade may be present in some individuals [5, 6].

In the upper and lower eyelids, the marginal arcades lie just anterior to the tarsi, 2–4 mm from the eyelid margin. Also in the upper eyelid, the superior peripheral arcade lies just anterior to Müller's muscle, superior to the tarsus. This arcade not only serves the upper part of the upper eyelid, but also supplies the superior conjunctival fornix and communicates with the anterior ciliary vessels near the limbus. Dissection in the plane of Müller's muscle can cause hemorrhage from this arcade [6].

Veins

The facial vein is the principal venous drainage source for the eyelids. It courses superficial and lateral to the facial artery. It begins near the medial canthus as the angular vein and anastomoses with the superior ophthalmic vein via the supraorbital vein.

Lymphatics

Lymphatic drainage of the medial portions of the eyelids and conjunctiva follows the course of the facial vein to the submandibular nodes. Lateral portions of the eyelid and conjunctiva drain into the preauricular lymph nodes.

Eyelid Innervation

Sensory Innervation

Sensory innervation to the upper eyelid is provided by the ophthalmic division of the trigeminal nerve (cranial nerve V_1), which has three branches—lacrimal, frontal, and nasociliary—all of which enter the orbit via the superior orbital fissure (Fig. 1.10). The lacrimal nerve supplies the lacrimal gland conjunctiva and lateral upper eyelid, and it sends off a branch that anastomoses with the zygomaticotemporal nerve. The frontal nerve courses anteriorly between the periorbita and levator, dividing into the supraorbital and supratrochlear nerves. The supratrochlear nerve innervates the medial upper eyelid and forehead, while the

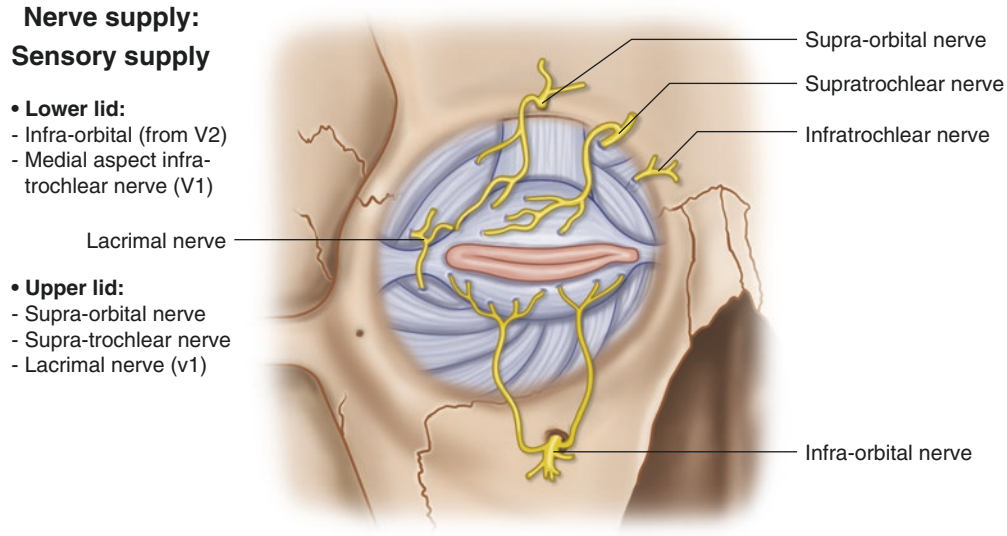

Fig. 1.10 Ophthalmic division of the trigeminal nerve (cranial nerve V1) and the maxillary branch of the trigeminal nerve (cranial nerve V2)

two divisions of the supraorbital nerve innervates most of the remainder of the forehead. A superficial division passes anterior to the frontalis muscle to innervate the forehead skin, and a deep division that passes laterally anterior to the pericranium and supplies the frontoparietal scalp [33]. The nasociliary branch gives rise to the posterior and anterior ethmoidal nerves, two or three long ciliary nerves to the globe, a sensory root to the ciliary ganglion, and a sensory root to the infratrochlear nerve [6].

Sensory innervation to the lower eyelid is provided by the maxillary branch of the trigeminal nerve (cranial nerve V_2). The zygomatic branch from V_3 divides into the zygomaticofacial and zygomaticotemporal nerves. The zygomaticofacial nerve courses along the inferolateral orbit, passes through the zygomaticofacial foramen, and supplies the skin of the cheek. The zygomaticotemporal nerve exits the orbit into the temporal fossa, innervating the lateral forehead. The infraorbital nerve, a continuation of V_2, exits via the infraorbital foramen, yielding several terminal branches—the inferior palpebral, lateral nasal, and superior labial nerves—which supply the skin and conjunctiva of the lower eyelid, the skin and septum of the nose, and the skin and mucosa of the upper lip, respectively [6].

Motor Innervation

Eyelid motor innervation is achieved by cranial nerve III (the oculomotor nerve), cranial nerve VII (the facial nerve) and sympathetic nerve fibers.

Cranial nerve III courses within the muscle cone of the orbit, entering the superior rectus from its inferior aspect, 15 mm from the orbital apex. At this point, it also sends off terminal fibers, which pass around or through the medial aspect of the superior rectus to innervate the levator.

The facial nerve (CNVII) innervates the orbicularis oculi, frontalis, procerus, and corrugator supercilii muscles, and supports eyelid protraction. After originating at its nucleus in the pons, the facial nerve leaves the facial canal via the stylomastoid foramen. It then passes through the parotid gland and gives rise to several divisions: temporal, zygomatic, buccal, mandibular, and cervical nerves. The temporal branch innervates the frontalis muscle and is one of the most commonly injured nerves during forehead and temporal surgical dissection. The temporal, zygomatic, and buccal divisions all innervate the orbicularis oculi, with significant overlap of regions innervated by each nerve.

Sympathetic fibers contribute to upper eyelid innervation of the superior tarsal muscle (Müller's muscle). Sympathetic fibers also innervate the inferior tarsal muscle.

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Entropion

2

Geoffrey J. Gladstone

Entropion, or inward rotation of the eyelid margin, is an eyelid malposition commonly seen by general ophthalmologists and oculoplastic surgeons. The severe corneal irritation secondary to contact with the lashes and keratinized epithelium of the eyelid skin brings patients in for evaluation promptly. There are four major types of entropion: congenital, acute spastic, involutional, and cicatricial. It is important to define the pathologic process in entropion to plan and achieve successful surgical repair.

Examination

A patient with any type of entropion will have complaints related to corneal irritation. Foreign body sensation, redness, and tearing are common. Entropion as well as its symptoms may be intermittent. A careful examination of the lids, lashes, conjunctiva, and cornea should exclude external disease that may exacerbate or cause spastic entropion.

The eyelid examination is first performed like an ectropion exam, in which the canthal tendons, lower lid laxity measurements, and snapback are assessed. In addition, the movement of the lower lid with downgaze may show evidence of weakness of the lower lid retractors. Normal excursion of the lower lid on downgaze is about 4 mm. The depth of the inferior cul-de-sac is assessed and inspected for scarring or symblepharon formation. If there is a cicatricial component to the entropion, this posterior lamellar shortening should be evident with examination. It is important to document the presence or absence of symblepharon, and to diagnose and treat ocular cicatricial pemphigoid prior to surgical intervention. A deep inferior cul-de-sac, or a visible white line (lower lid retractors) several millimeters inferior to the lower tarsal border is consistent with an involutional process.

Congenital Entropion-Epiblepharon

Etiology

True congenital entropion is a rare condition in which the entire lid margin is turned in. This is thought to be due to an overacting orbicularis muscle with congenital disinsertion of the lower eyelid retractors. Epiblepharon is much more commonly seen. This condition results from a fold of lower eyelid skin pushing the lashes in against the globe. Epiblepharon is most common in Asian children, and it often resolves as the facial bones develop.

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Surgical Management

Congenital entropion can be repaired by reattachment of the capsulopalpebral fascia. This procedure is described in the involutional entropion section, and is performed without concomitant horizontal lid tightening in children.

Epiblepharon repair is necessary if there is evidence of keratopathy or if it is symptomatic. This can be accomplished with or without any skin removal. A horizontal incision is made 1.5 mm below the lash line, across the lower eyelid. The incision should extend a minimum of 2 mm medial and lateral to the inturned area. A small amount of skin is removed. A small amount of pretarsal orbicularis muscle is also removed, to expose the inferior tarsal border. The wound is then closed by approximating the upper skin edge to the inferior tarsal border, and then to the lower skin edge using interrupted 6-0 plain gut suture (Fig. 2.1, Video 2.1). This forces the incision made 1.5 mm below the lashes downward and inward toward the inferior tarsal border 4 mm below the lashes. This rotates the lashes outward.

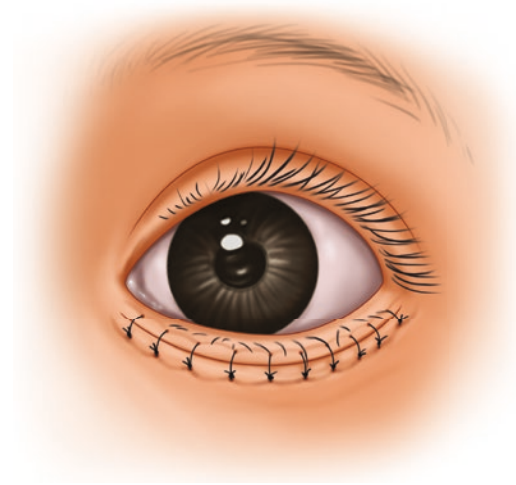

Fig. 2.1 Proper suture placement in epiblepharon repair

Acute Spastic Entropion

Etiology

Spastic entropion, an acute condition that often occurs following eye surgery, injury, or inflammation, is believed to be the direct result of edema and blepharospasm. The process may improve or resolve with resolution of the underlying irritative process, but it may also cause a vicious cycle in which the spastic entropion creates more irritation and more orbicularis spasm. Injection of botulinum toxin is often effective in paralyzing the orbicularis and breaking the cycle. The effect of the botulinum toxin lasts only about 3 months, but the entropion may not recur when the effect wears off. More often than not, the authors have found, there is an underlying involutional component to the spastic entropion and these patients will develop involutional entropion later.

Involutional Entropion

Etiology

The most common type of entropion is the involutional type. The pathophysiology of this disorder involves several different mechanisms. Laxity of the medial and lateral canthal tendons, and thinning of the tarsus with aging, result in loss of horizontal support of the lower eyelid. Though a similar process occurs with involutional ectropion, associated dehiscence or attenuation of the lower eyelid retractors creates an imbalance of forces on the tarsus that results in an entropion. Additional contributing factors are thought to include the propensity of the preseptal orbicularis to override the pretarsal orbicularis. Involutional enophthalmos secondary to fat atrophy may contribute as well.

Surgical Management

Capsulopalpebral Fascia Reattachment

The method of repair of entropion is based on the type and severity of the problem, as well as the patient's ability to tolerate a procedure. Involutional entropion is reliably treated with a procedure that addresses the causative factors of the process. After local anesthesia, a subciliary incision is

made 2 mm below the lash line from below the punctum to the lateral canthal angle. A small skin flap is dissected inferiorly over the tarsus, and a strip of pretarsal orbicularis muscle is dissected off the tarsus. The orbital septum is tented and incised, exposing the thin white edge of capsulopalpebral fascia. This lies below the inferior orbital fat pads, as it is the lower eyelid analogue to the levator (Fig. 2.2). It is useful to mark the fascia with a 4-0 silk suture. A lateral tarsal strip operation is then performed to address the lower eyelid laxity (see Ectropion chapter) and the strip is sutured to the lateral orbital rim, with the appropriate amount of tension on the eyelid (Fig. 2.3). Three 6-0 silk sutures are used to reattach the capsulopalpebral fascia (CPF) to the inferior tarsal border (Fig. 2.4, Video 2.2). The eyelid should not be overcorrected, and the amount of CPF advancement can be confirmed by having the patient look down. The lid should have a normal 3–4 mm excursion. The skin is closed with interrupted 6-0 plain gut suture, and a small amount of CPF edge should be incorporated into the three central sutures to form a barrier to prevent overriding of the orbicularis muscle. The lateral canthal angle is reformed with 6-0 plain gut suture.

Cicatricial Entropion

Etiology

Cicatricial entropion results from a differential horizontal shortening of the posterior lamella of the eyelid in relation to the anterior lamella. Chronic inflammation such as meibomianitis or blepharo-conjunctivitis can lead to lid margin keratinization, trichiasis, or distichiasis with severe symptoms in the absence of frank entropion. Trauma, particularly chemical burns, can lead to severe scarring and entropion. Chronic use of medication such as pilocarpine can cause conjunctival contracture leading to entropion. Trachoma is a common cause of entropion internationally, though it is seldom seen in North America. Other causes include ocular cicatricial pemphigoid, severe viral conjunctivitis, and erythema multiforme major (StevensJohnson syndrome).

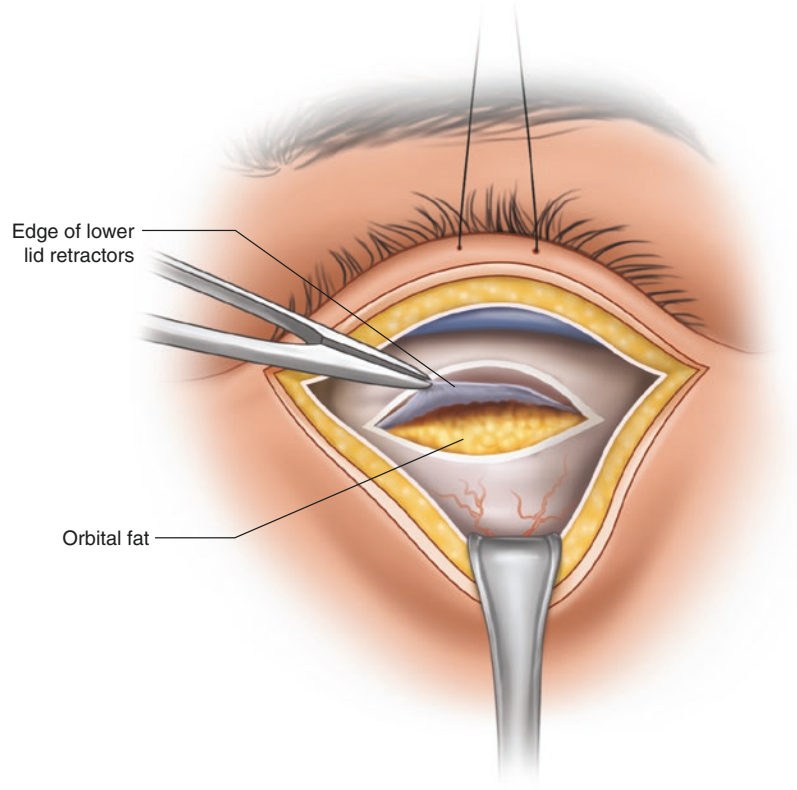

Fig. 2.2 A subciliary incision has been made, exposing the tarsus and lower eyelid retractors

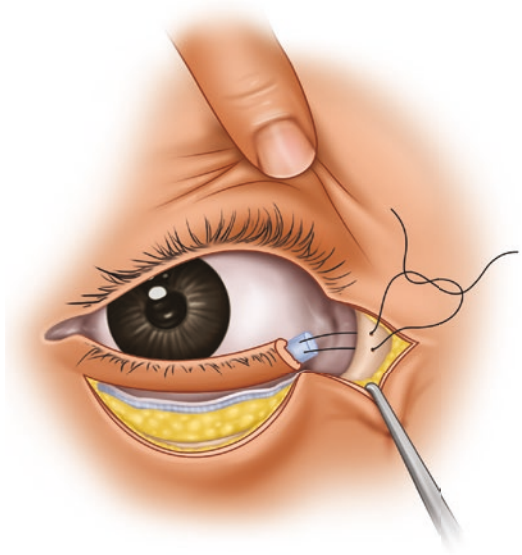

Fig. 2.3 A lateral tarsal strip is used to tighten the eyelid

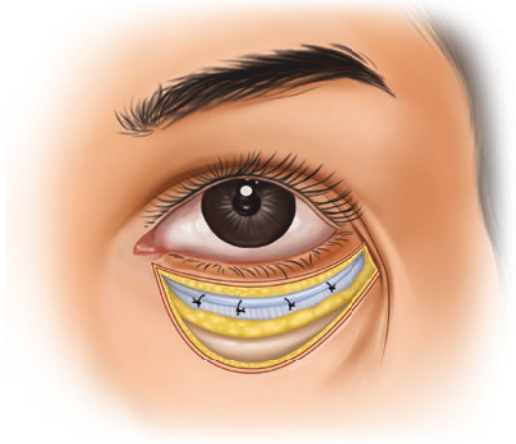

Fig. 2.4 The capsulopalpebral fascia is reattached to the inferior tarsal border

Surgical Management: Wies Procedure

If the entropion is cicatricial in origin, a transverse blepharotomy and marginal rotation (Wies procedure) is effective for repair of the upper or lower eyelid. Local anesthesia is administered to the eyelid, and a horizontal incision is made 4 mm from the lid through skin and orbicularis. Care is taken to spare the marginal arcade, which lies 2–4 mm from the eyelid margin (Fig. 2.5). The lid is then everted, and a second corresponding incision is made through conjunctiva and tarsus. Westcott or tenotomy scissors are used to extend the full-thickness blepharotomy medially and laterally across the tarsus. Three double-armed 6-0 silk sutures are passed in mattress fashion through the tarsus internally, and over the surface of the tarsus to exit the skin near the lash line (Figs. 2.6 and 2.7). The closer these sutures are passed to the lashes, the more rotation is achieved. The sutures are tied over cotton or rubber bolsters to prevent "cheese wiring" (Fig. 2.8). A small overcorrection is the goal. The skin incision is closed with interrupted or running 6-0 plain gut suture. The silk sutures and bolsters should be removed in 10–14 days.

If the cicatricial entropion is severe, or if the foregoing procedure fails, posterior lamellar augmentation is necessary. A graft may be

Fig. 2.5 A skin incision is made 4 mm below the eyelid margin

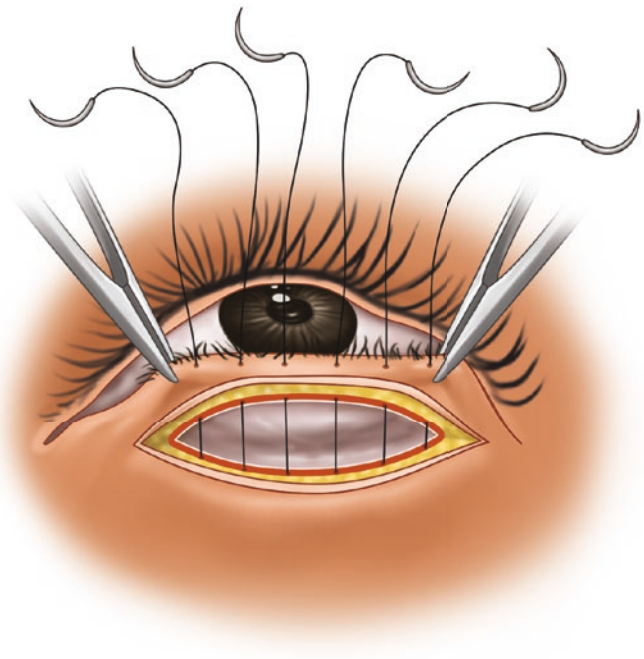

Fig. 2.6 A full-thickness blepharotomy is made and sutures are placed

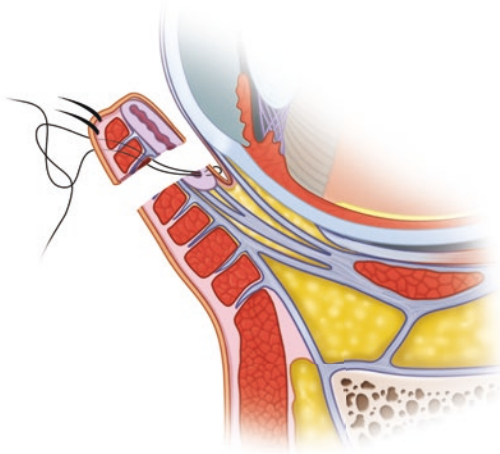

Fig. 2.7 Sutures for a full-thickness blepharotomy

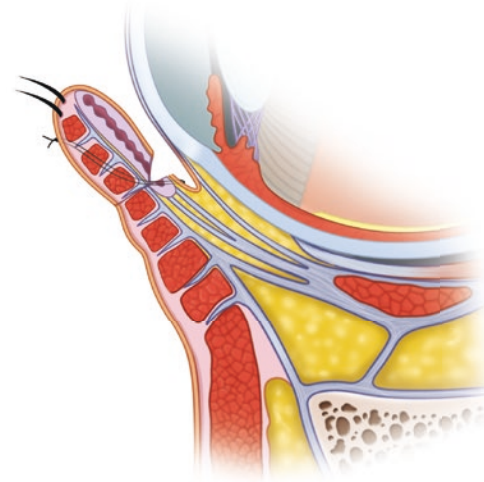

Fig. 2.8 When the sutures are tied, an external rotation of the eyelid is seen

placed between the conjunctiva/lower lid retractor complex and the inferior tarsal border of the lower lid. The various graft materials available include ear cartilage, hard palate, nasal septum, mucous membrane grafts, and tarsal substitutes. Upon release of the scarring, and production of a posterior lamellar defect, the graft material is sutured into place with absorbable suture and the lid is allowed to heal with a traction suture placing it on stretch. The disadvantage of posterior lamellar grafting is that the lid may not retract well with downgaze (Video 2.3).

Ectropion

3

Geoffrey J. Gladstone, Frank A. Nesi,
Francesca Nesi-Eloff, and Francisco Castillo

Ectropion, or turning out of the eyelid margin, is a common eyelid malposition. Ectropion of the lower eyelid may result from several entirely different pathologic processes. The major types of ectropion are involutional, cicatricial, paralytic, and mechanical. These are all managed differently and are discussed as separate entities.

Involutional Ectropion

Etiology

As the patient ages, the lower eyelid becomes lax owing to the combination of muscle and tendon atrophy, and gravity. The medial and lateral canthal tendons stretch, and the orbicularis muscle weakens. This creates an imbalance of forces on the tarsal plate, and the eyelid loses its ability to approximate the contour of the globe. The exposed conjunctiva and cornea can become irritated and inflamed. The loss of muscle tone and the eyelid malposition may also result in tearing. The entire process is progressive, and it may be exacerbated by eye rubbing. If the ectropion is long-standing or the patient has a history of excessive sun exposure, there may be a cicatricial component that has developed as a result of shortening of the anterior lamella of the eyelid.

Evaluation

The relationship of the individual anatomic changes must be evaluated to devise a successful treatment plan for ectropion. Most of the data can be obtained by performing the three P's: pinching, pulling, and pushing. The lower eyelid skin is gently pinched, and the eyelid is distracted straight out away from the globe. The distance between the lid and the globe is measured in millimeters and documented as "lower eyelid laxity." Six millimeters or less is considered normal. The lower eyelid snap-back is also measured. The lid is pulled outward and the patient asked not to blink. The eyelid normally snaps back to be appositional to the globe in several seconds. If it fails to snap back within 10 s it is considered to have failed. The lid is then pulled medially and laterally to evaluate the laxity of the canthal tendons. As the lateral canthal tendon is stretched,

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the horizontal palpebral width will decrease if the tendon is lax. With tension on the medial canthal tendon, punctal displacement across the nasal limbus will occur when significant laxity is present. This degree of laxity often requires a plication of the medial canthal tendon. Finally, the lid is pushed superiorly. The eyelid margin should be easily pushed upward to make contact with the upper eyelid with the eyes in primary gaze. Inferior scleral show and distance of corneal light reflex to lower eyelid margin (MRD_2) should be measured as well.

Surgical Management

Lateral Canthal Tendon Plication

The surgical treatment for involutional ectropion depends on the severity of the dysfunction as well as the presence or absence of medial canthal tendon laxity. For mild involutional ectropion without significant medial canthal tendon laxity, a plication of the lateral canthal tendon is effective. This is a minimally invasive procedure that avoids disrupting the canthal angle. After administration of local anesthetic, an incision is made starting just lateral to the lateral canthal angle and extending outward for 15 mm (Fig. 3.1, Video 3.1). The periosteum of the lateral orbital rim is exposed by deeper dissection with scissors or cautery starting 2 mm lateral to the lateral canthal angle. The common crus of the lateral canthal tendon is identified and a double-armed 5-0 Prolene suture is placed through it in a mattress fashion. Each arm of the suture is then passed through the periosteum of the inner aspect of the rim. The suture is tied to a moderate amount of tension, and the surgeon should test the tightness of the lid with a gentle pull. A distraction of 2–4 mm is ideal, as this will loosen with time. To help ensure coverage of the permanent suture, the muscle may be closed with inverted interrupted 6-0 Vicryl suture. The skin is closed with 6-0 plain gut suture.

Lateral Tarsal Strip

For repair of moderate-to-severe generalized ectropion without medial canthal tendon laxity, a lateral tarsal strip procedure is ideal (Video 3.2). Local anesthesia is given. A lateral canthotomy is performed by crushing the canthus with a hemostat and making a 10 mm incision straight out from the canthal angle with Westcott scissors (Fig. 3.2). The inferior crus of the lateral canthal tendon is identified with palpation by the tips of the scissors. The tendon is cut, freeing the lateral portion of the lower lid. The length of the strip can then be determined by pulling the edge of the lid laterally and marking with a #11 blade the point on the lid margin where it crosses the edge of the lateral orbital rim. The lid margin and lashes are removed over this region with the #11 blade (Fig. 3.3). A skin muscle flap is dissected off the anterior tarsal surface of the segment with scissors (Fig. 3.4). Along the inferior tarsal bor-

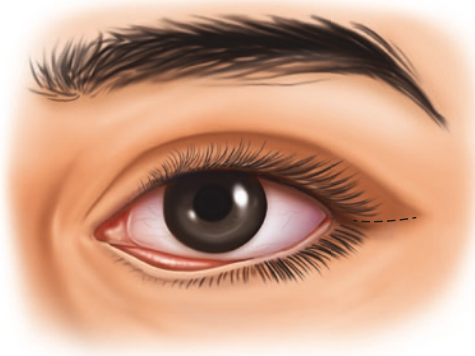

Fig. 3.1 A lateral canthal skin incision is marked for a lateral canthal tendon plication

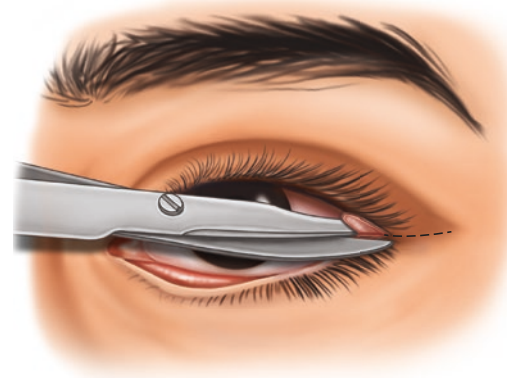

Fig. 3.2 A lateral canthotomy is made with scissors

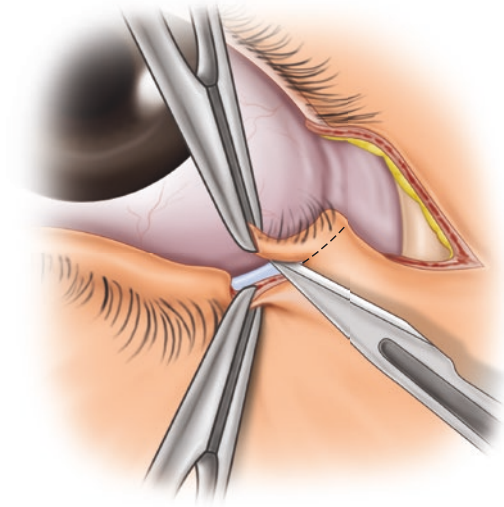

Fig. 3.3 The eyelid margin is removed, including the lashes

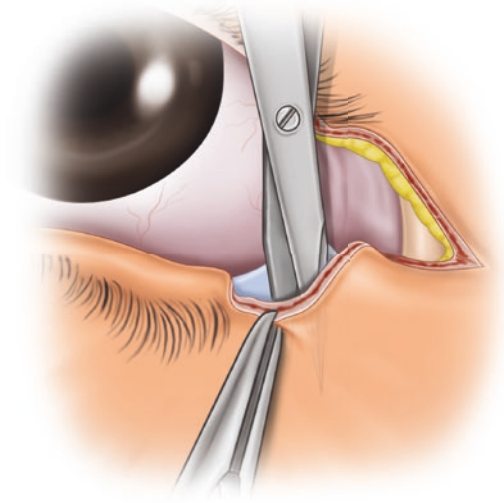

Fig. 3.4 Skin and orbicularis are dissected from the anterior tarsal surface

der, scissors are used to make an incision through conjunctiva and lower lid retractors. The blade should be used to de-epithelialize the conjunctiva on the posterior surface of the segment. A vertical incision with scissors completes the creation of the strip by trimming the tarsal strip to a length of 2–3 mm. Dissection to the periosteum of the lateral orbital rim is then carried out with scissors and blunt dissection to obtain good visualization (Fig. 3.5). Both arms of a double-armed 5-0 Prolene mattress suture are passed through the tarsal strip, from posterior to anterior, and then through the periosteum (Fig. 3.6). The suture is then tied to an appropriate tension, so the lid can still be distracted 2–4 mm off the globe. The lateral canthal angle is reformed with a single 6-0 plain gut suture, using a circular suture technique to bury the knot in the wound. The muscle and skin are closed with 6-0 Vicryl and 6-0 plain gut, respectively.

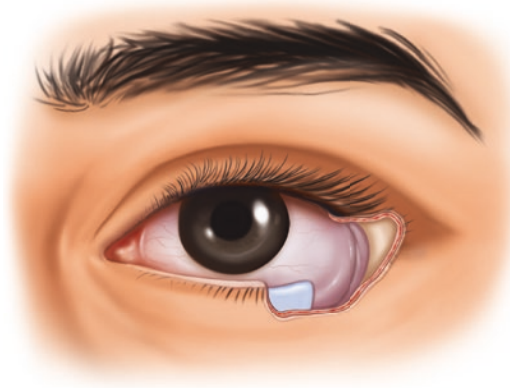

Fig. 3.5 The lateral orbital rim periosteum is exposed

Medial Canthal Tendon Plication

If there is significant medial canthal tendon laxity, this condition should be addressed because either of the aforementioned procedures will pull the punctum far laterally. We recommend a minimally invasive, posterior approach to medial canthal tendon plication. This procedure also works well for isolated punctal ectropion with medial canthal tendon laxity. This is accomplished by incising a diamond shape or ellipse of conjunctiva and lower lid retractor tissue 4 mm inferior to the punctum (Fig. 3.7, Video 3.3). The ellipse should be about 6 mm in length and 3–4 mm in height. Through this ellipse, Westcott scissors are used to bluntly dissect a tunnel toward the posterior lacrimal crest. Care is taken to avoid the lacrimal canaliculi and sac. Once the crest has been identified by palpation and dissection, both

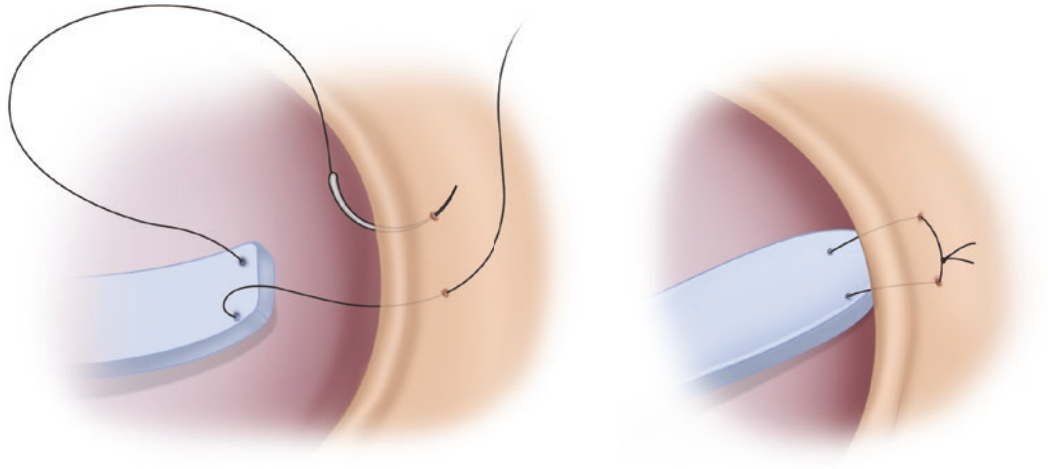

Fig. 3.6 A mattress suture fastens the tarsal strip to the periosteum

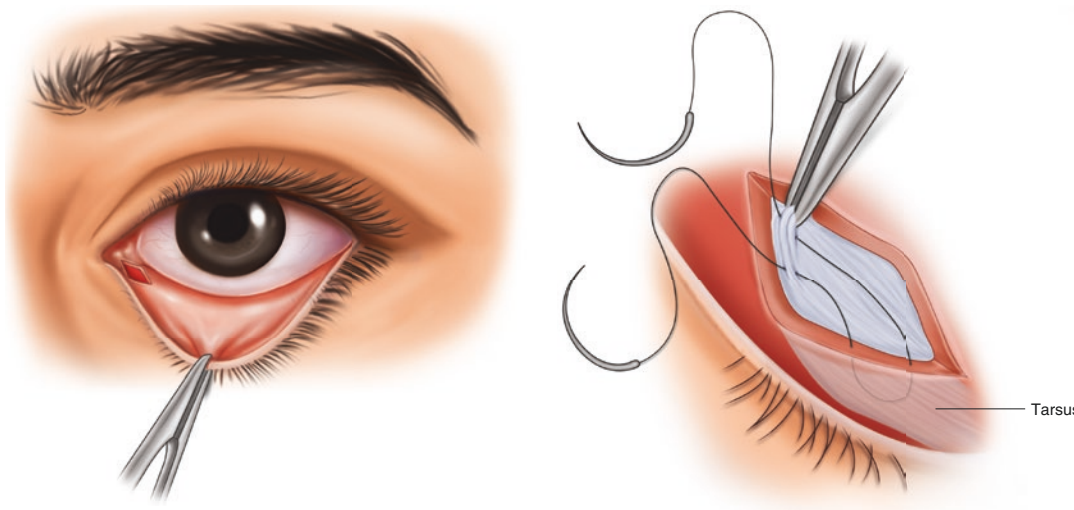

Fig. 3.7 A diamond-shaped excision of conjunctiva and retractors is performed

Fig. 3.8 The medial canthal tendon is plicated with a permanent suture

needles of a double-armed 5-0 Prolene suture are passed through the inferomedial edge of the tarsus that has been exposed through the elliptical incision, from posterior to anterior. A forceps is then passed into the tunnel and the medial canthal tendon attachment to the posterior lacrimal crest is grasped and exposed (Fig. 3.8). Each arm of the mattress suture is passed through this tissue, and the suture is tied to the appropriate tension. Closure of the elliptical incision with interrupted, buried 6-0 plain gut suture will further facilitate inward rotation of the punctum to complete the medial ectropion repair.

Medial Ectropion Repair

Punctal ectropion with normal medial canthal tendon function can be repaired via a posterior lamellar shortening procedure. An ellipse of conjunctival and lid retractor tissue is excised and

subsequently closed by a double-armed 6-0 chromic gut or Vicryl suture. The suture is passed in mattress fashion through the lower portion of the wound entering inside the inferior wound edge and exiting on the conjunctival surface. Each needle is then passed through the upper wound edge, entering through the conjunctiva and exiting below the superior wound edge. Finally, the needles are passed through the center of the ellipse and out the skin of the lower lid. Exiting slightly lower on the skin than the suture entered facilitates the inward rotation. They are then tied (Fig. 3.9, Video 3.4). This rotates the punctum inward, completing the procedure.

Cases of extreme or refractory ectropion may require more extensive surgery, such as combination tarsal strip and pentagonal wedge resection, or temporalis muscle transfer procedures. These operations, which are rarely necessary, are not discussed in this volume.

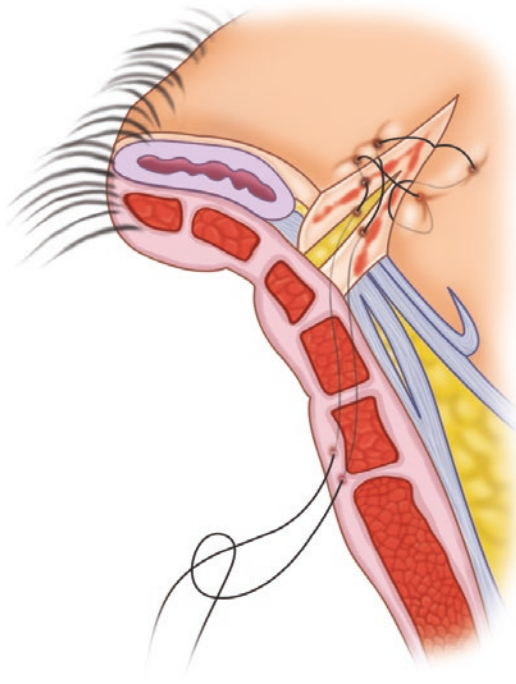

Fig. 3.9 The ellipse is closed, producing an inward rotation of the punctum

Paralytic Ectropion

Ectropion of the lower lid may result from paralysis of the orbicularis muscle. This may occur with Bell's palsy, trauma, surgery (including facial or parotid gland procedures), or cerebrovascular accident. If the paralysis is permanent, ectropion becomes very likely. The eyes often become irritated and corneal exposure may be a concern. Tearing is common because of lid malposition and loss of pump function. Conservative measures for treatment include vigorous lubrication and moisture chambers, but these usually are not effective for long-term management. A lateral tarsal strip procedure is an effective repair for paralytic ectropion. In cases of severe corneal exposure, a tarsorrhaphy is sometimes necessary.

Cicatricial Ectropion

Etiology

Ectropion due to scarring often involves a shortening of the anterior lamella of the eyelid. Scarring from actinic changes or dermatologic conditions may be uniform and can cause a diffuse bilateral ectropion. Trauma can cause random, irregular scarring with segmental or complete ectropion. In any of these cases, the anterior lamellar insufficiency must be addressed for repair to be successful. Full-thickness skin grafting is the main procedure for correcting these abnormalities. Z-plasty has a role in smaller scars and segmental ectropion, but often this procedure does not give the aesthetic result of scar removal with graft placement.

Surgical Management

The repair of cicatricial ectropion is detailed but technically straightforward. Any scar tissue present is excised, and a dissection carried inferiorly in a subcutaneous plane. This is accomplished with a high-temperature cautery or a Westcott scissors. Remaining scar bands in the anterior

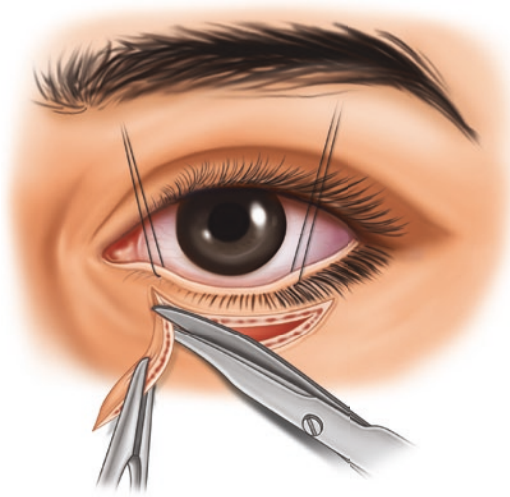

Fig. 3.10 Superficial scar tissue is excised

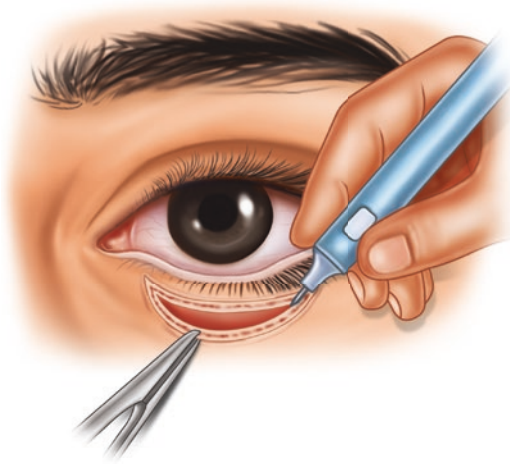

Fig. 3.11 Scar tissue bands are dissected and removed

lamella are lysed (Fig. 3.10). This is usually facilitated by placing a 4-0 silk or Neurilon traction suture through the lid margin to permit palpation of the vertical scar bands with the lid on stretch. It is important to free all scarring so that the lid settles in a normal position without tension (Fig. 3.11). Once the region containing the scarring is free and mobilized, a defect will remain in the anterior lamella. A piece of Telfa gauze is then blotted over the defect and cut with scissors to the same size. This is the template for

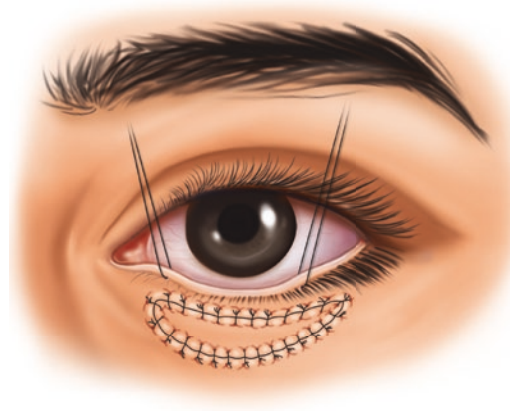

Fig. 3.12 A skin graft is sutured in place

the skin graft. A variety of sites can be used to obtain the full-thickness skin graft. For lower eyelid or medial canthal defects, upper eyelid skin is a good match. Skin from the upper arm or retro auricular area can also be utilized. Upper eyelid skin, if available, works best for upper eyelid grafts. When upper lid skin is the chosen donor tissue, be sure to verify that adequate skin will remain, and allow eye closure by using a pinch technique or leaving 20 mm of vertical skin. Once the site has been chosen, the donor graft is marked using the Telfa template. A #15 Bard-Parker blade is used to incise the skin, and a thin full-thickness skin graft is removed with Westcott scissors. The graft must be thinned with Westcott scissors to remove excess subcutaneous tissue, and the borders trimmed. Full-thickness eyelid skin grafts shrink only a small amount, if at all, so only slight oversizing is recommended.

The graft is placed in the defect and sutured into place using interrupted and running 6-0 plain gut suture (Fig. 3.12). 6-0 silk sutures are placed around the graft to secure a bolster. The Telfa template (or a new one) is placed over the graft and a small, damp piece of cotton is compressed and placed on the Telfa. The sutures are then snugly tied over this bolster to place gentle pressure on the graft and the underlying bed, from which it will receive its blood supply. Fenestration is usually not necessary with this technique. The 4-0 silk or Neurilon traction

suture is taped with Mastisol adhesive and Steri-Strip bandages to the forehead (for lower lid traction) or cheek (for upper lid traction) to place the lid on mild stretch. The bolster and traction suture can be removed in one week (Video 3.5).

Mechanical Ectropion

Mechanical ectropion is really a secondary ectropion resulting from an eyelid mass. Any large eyelid tumor or inflammatory mass can cause an ectropion. The treatment is removal of the mass. If the process is long-standing, there may be a residual involutional type of ectropion following mass removal. A pentagonal wedge resection of the mass will often treat both problems effectively. In some cases, additional lid tightening is required.

Eyelid Retraction and Lagophthalmos

4

Dianne Schlachter, Evan H. Black, and Geoffrey J. Gladstone

Eyelid retraction and lagophthalmos are common conditions encountered in ophthalmology. Diagnosis and appropriate management involve a systematic approach, beginning with a complete history. The surgeon must also be aware of conditions that could potentially worsen these problems. A thorough history and physical examination will help the physician avoid misdiagnosis and inappropriate surgical intervention.

Etiology

Although these problems are most commonly seen in thyroid-associated ophthalmopathy, there are many reasons a patient may develop retraction of the eyelids and lagophthalmos. Cicatricial causes include prior trauma and previous surgery. Noncicatricial causes include paralysis of the orbicularis oculi muscle, aberrant regeneration of the third nerve, unilateral ptosis with contralateral overaction of the levator palpebrae muscle, Collier's sign of dorsal midbrain syndrome (Parinaud's) and hyperkalemic periodic paralysis. Any problem within the orbit causing the eye to move forward can also cause retraction of both upper and lower eyelids with resultant lagophthalmos. Hypoglobus secondary to trauma can also cause upper eyelid retraction (Fig. 4.1). A careful history and preoperative evaluation can be helpful in determining the cause of the retraction.

In patients with Graves' disease, it is believed circulating T cells are directed against cross-reactive antigens in the orbit. Activated T cells and macrophages release cytokines resulting in the disease. Up to 90% of Graves' patients will get eyelid retraction. Of those diagnosed with thyroid associated ophthalmopathy, 90% have hyperthyroidism, 1% have hypothyroidism, 3% have Hashimoto thyroiditis, and 6% are euthyroid. The many factors that have been associated with upper lid retraction in patients with thyroid ophthalmopathy include overaction of the levator muscle, increased sympathetic tone causing Müller muscle contraction, proptosis of the globe, fibrosis with contracture of the levator aponeurosis and Müller muscle, and adhesions of the levator to the orbital septum. It has also been postulated that because of the restrictive, myopathic nature of the inferior rectus muscle, the superior rectus-levator complex overcompensates and causes the upper lid to retract (Fig. 4.2).

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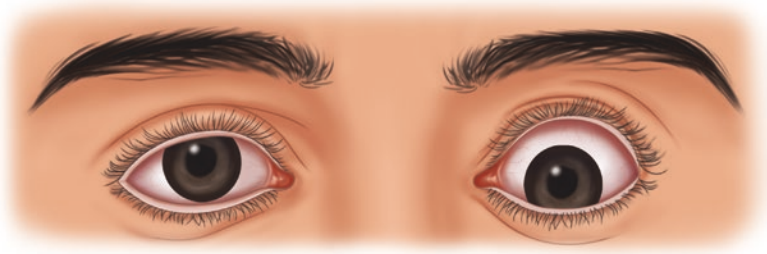

Fig. 4.1 The left globe is hypotropic, thereby stimulating left upper eyelid retraction, creating a pseudoretraction

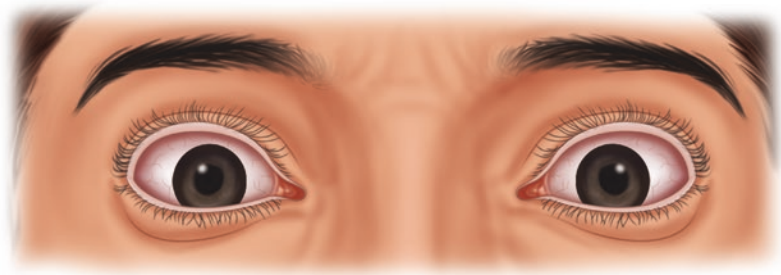

Fig. 4.2 Bilateral upper eyelid retraction with temporal flare

Frequently, the lateral half of the upper eyelid is more severely retracted in these patients, leading to an abnormal, temporal contour of the upper eyelid. Immobility of the upper lid on downgaze (Von Graefe's sign) and lower eyelid retraction are also common. Causes of lower lid retraction in thyroid patients can include inferior rectus contracture, over-contraction of the inferior tarsal muscle with increased sympathetic tone, proptosis, and prior surgical recession of the inferior rectus muscle (Fig. 4.3). Prompt referral to an endocrinologist for evaluation and care is important if a thyroid disorder is suspected.

Paralysis of the orbicularis oculi muscle can result in unopposed action of the levator palpebrae muscle with resultant upper eyelid retraction and lagophthalmos. Paralysis of the orbicularis oculi muscle can also cause lower eyelid retraction from failure of the muscle to hold the lower lid in proper position against the globe. This paralysis can be secondary to conditions such as Bell's palsy, trauma, surgery, or overuse of botulinum toxin.

Many other causes of eyelid retraction and lagophthalmos exist. Anatomically shallow orbits can cause lower eyelid retraction secondary to prominent globes. Aberrant regeneration of the third nerve, or misdirection syndrome, can cause upper eyelid retraction. This problem occurs secondary to injured nerve fibers. As the nerves heal, there may be extensive and haphazard growth resulting in upper lid retraction on attempted downgaze (pseudo Von Graefe's sign). Patients who have unilateral ptosis can present with contralateral upper lid retraction from overaction of the levator palpebrae muscle due to an excessive attempt to elevate the ptotic eyelid. Correction of the ptosis will usually improve the retraction. Dorsal midbrain syndrome, or Parinaud's syndrome, produces a constellation of neuro-ophthalmic signs as a result of lesions in the rostral midbrain. Most common causes of this condition are pineal area tumors and midbrain infarction, resulting in pathological upper lid retraction (Collier's sign). Prior surgery and previous trauma are also important reasons for upper and lower eyelid retraction, and these causes must be elucidated before any attempt at surgical correction.

Careful preoperative evaluation is vital in managing these patients. The choices for surgical correction and timing of surgery depend on an accurate assessment of preoperative eyelid position and function.

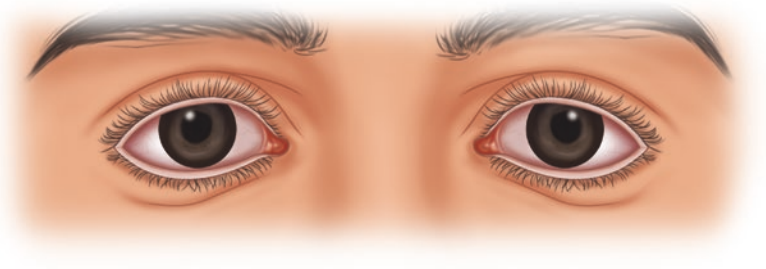

Fig. 4.3 Bilateral lower eyelid retraction

Preoperative Evaluation

The upper eyelid should ideally be positioned 1–1.5 mm inferior to the 12 o'clock limbus. The distance between the corneal light reflex and the upper lid margin, MRD_1 (margin reflex distance), is the most useful measurement for documentation and monitoring of upper eyelid retraction. Any measurement over 5 mm is considered retraction. It is sometimes useful to measure MRD_1 with the room lights dim, as lowering the light can prevent artificially low readings due to photophobia, which is often present in these patients. The lower eyelid is normally positioned at the level of the inferior limbus. The distance between the corneal light reflex and the lower lid margin, MRD_2, is the most useful measurement for documentation and monitoring of lower eyelid retraction. Any measurement over 5 mm is considered retraction. The amount of lagophthalmos, documented during gentle lid closure, should also be determined. The cornea should be examined closely for signs of exposure keratopathy, and an assessment of the tear film should be performed. Preoperative photographs are essential for documentation and for postoperative comparison. If thyroid-associated ophthalmopathy is suspected, a non-enhanced CT scan with axial images and coronal reconstruction may be useful to allow the surgeon to visualize possible extraocular muscle enlargement and rule out other orbital pathology such as vascular or neoplastic entities. Iodinated contrast can worsen the eye disease in thyroid-associated ophthalmopathy, so it is important to avoid contrast in these patients.

Management: Medical

The most important medical management is the liberal use of artificial tear lubricants to prevent exposure keratopathy, corneal erosion, and secondary corneal ulcer. Botulinum A has also been used to paralyze the levator palpebrae muscle, but relief is only temporary and vision-limiting ptosis is a significant potential side effect. Ointment instillation and taping of the eyelids at night can also be useful as a temporary measure to prevent permanent damage to the eye if full or partial recovery is expected, as seen with some forms of paralytic retraction. This treatment may also be necessary as a protective measure until surgery can be performed.

Management: Surgical

Upper Eyelid Retraction and Lagophthalmos

When surgical repair of upper eyelid retraction is necessary, the goals are to limit scleral show, minimize lagophthalmos, reduce corneal exposure, and restore a more normal appearance. The surgical approach chosen is based on the cause and severity of the retraction.

Retraction Repair with Gold Weight

For paralytic lagophthalmos, the surgical approach depends on the amount of orbicularis function and the desired result of surgery (Video 4.1). Many patients benefit from a weight placed within the eyelid to minimize lagophthalmos and

corneal exposure. This weight can be made of gold or platinum, and thin profile weights are available if cosmesis is a concern.

The patient's MRD_1, lagophthalmos and orbicularis function are carefully measured preoperatively. The appropriate weight of the implant is also determined prior to surgery by adhering different weights from a weight-sizing set to the outside of the upper eyelid approximately 2–3 mm above the lash line. An optimum weight will eliminate lagophthalmos on gentle closure while still allowing the lid to clear the visual axis in primary gaze.

The surgery is generally done as an outpatient procedure with intravenous sedation and local anesthesia; it can also be done, when needed, under general anesthesia or local anesthesia. A surgical marker is used to mark the upper eyelid crease. Lidocaine 2% with 1:100,000 epinephrine and 0.5% bupivacaine with 1:100,000 epinephrine is given in a 50:50 mixture in a 5 mL syringe with a 30-gauge needle. A skin incision is made over the previously placed marking with a #15 bard parker blade. Dissection is then done through the orbicularis muscle with Westcott scissors, forceps, and high-temperature cautery to expose the surface of the tarsal plate. A deep dissection is important to prevent exposure of the gold weight. Once the tarsal plate is adequately exposed, the weight is placed over the tarsus and oriented so the two pre-drilled holes in the weight are toward the lashes. The pre-drilled holes are used to suture the plate into place using 6-0 Prolene suture. Care is taken to use confirmed, partial thickness bites to prevent abrasion of the cornea with the sutures. The orbicularis muscle is then re-approximated over the weight using buried, interrupted 6-0 Vicryl sutures. The skin edges are then reapproximated using a running 6-0 plain gut cutaneous suture (Fig. 4.4). Ophthalmic ointment is placed on the incision and continued postoperatively for one week.

Permanent Lateral Tarsorrhaphy

When there is no residual orbicularis function, and/or the cornea is severely damaged from lagophthalmos, a long-lasting adhesion can be created between the upper and lower eyelids by a permanent lateral tarsorrhaphy. The amount of eyelid closure needed depends on the amount of lagophthalmos and the final surgical goal (Fig. 4.5, Video 4.2).

The surgery is generally done as an outpatient procedure with intravenous sedation and local anesthesia; it can also be done, when needed, under general anesthesia or local anesthesia. A surgical marker is used to mark the desired amount of closure on the upper and lower lids. A 50:50 mixture of 2% Lidocaine with 1:100,000 epinephrine and 0.5% bupivacaine with 1:100,000 epinephrine is injected into the area using a 5 mL syringe with a 30-gauge needle. The eyelid margin in first removed from the upper and lower lids with a #11 bard parker blade, sparing the lashes. Both eyelids are then split into an anterior and posterior lamella across the length of the incisions using a #11 blade. The dissection plane is kept directly anterior to the tarsus and extended for 3–4 mm. Both needles of a double armed, 6-0 Prolene suture are then passed through a rubberband bolster and each arm is passed through the skin exiting deep within the lower lid incision. Both needles are then passed through the depths of the upper lid incision exiting through the skin. Both needles are passed through a second rubber band bolter and tied. A second double-armed 6-0 Prolene suture can be placed in the area if needed prior to suture tightening. When the sutures are tightened the eyelid splays open, creating a large area for adhesion between the upper and lower eyelid. No skin suturing is necessary. Ophthalmic ointment is placed on the incisions and within the eye. The ointment is continued post-operatively, and the bolsters are removed in 7–10 days.

Mullerectomy

When thyroid ophthalmopathy leads to retraction of the upper eyelid and exposure, vertically elongating the posterior lamella of the eyelid with a mullerectomy can achieve a desirable result. This surgery is done through a posterior incision, avoiding an external incision and eliminating a scar (Video 4.3).

The patient's MRD_1, lagophthalmos, and palpebral fissure height are carefully measured preoperatively. Surgery via mullerectomy is an outpatient procedure with intravenous sedation

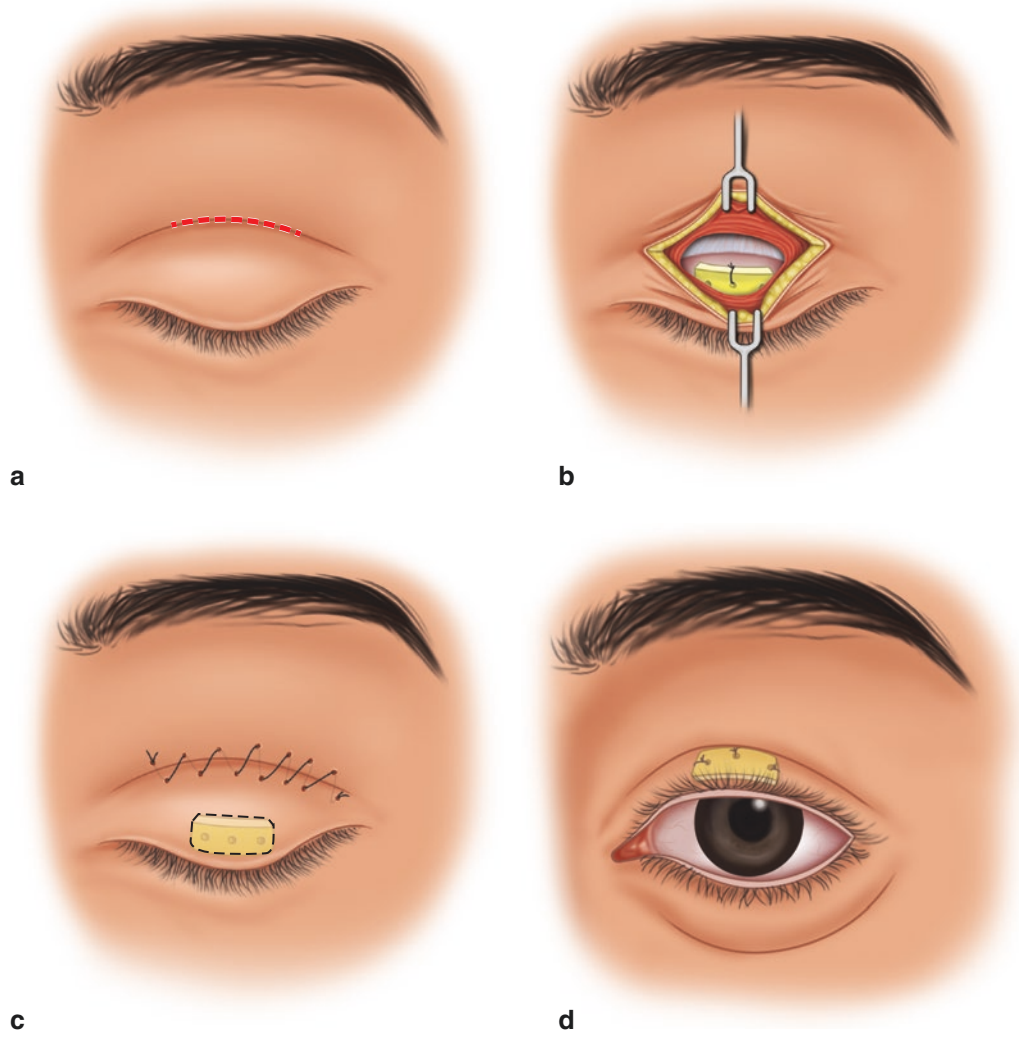

Fig. 4.4 Gold weight placement for lagophthalmos

and local anesthesia. This surgery should not be done under general anesthesia unless absolutely necessary. A 50:50 mixture of 2% Lidocaine with 1:100,000 epinephrine and 0.5% bupivacaine with 1:100,000 epinephrine is given in a 5 mL syringe with a 30-gauge needle. The upper eyelid is everted and local anesthetic is injected just beneath the conjunctiva at the superior tarsal boarder. Care is taken to avoid injection into the levator muscle. This injection ideally creates hydrodissection of the conjunctiva from Müller's muscle. A 4-0 silk traction suture is placed through the skin of the upper lid centrally just superior to the lash line. The eyelid is then everted over a Desmarres retractor. A buttonhole incision is made temporally through the conjunctiva at the superior border of the tarsus. Westcott scissors are then used to dissect the conjunctiva away from the superior border of the tarsus across the temporal two-thirds of the eyelid (Fig. 4.6). Thyroid patients typically have more retraction temporally and the incision usually does not need to extend beyond the medial one-third of the eyelid. Hemostasis is achieved with pressure. It is better to avoid too much cauterization to prevent damage to the lacrimal ductules. The conjunctiva

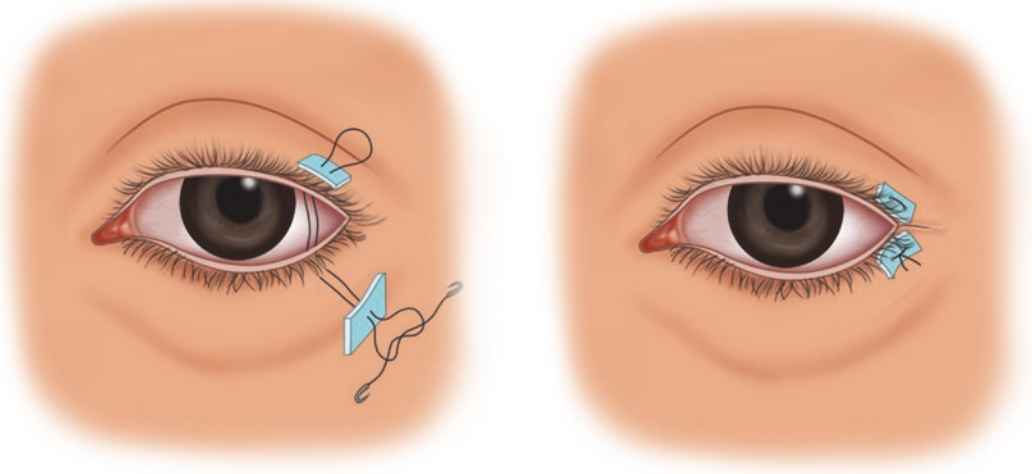

Fig. 4.5 Permanent lateral tarsorrhaphy

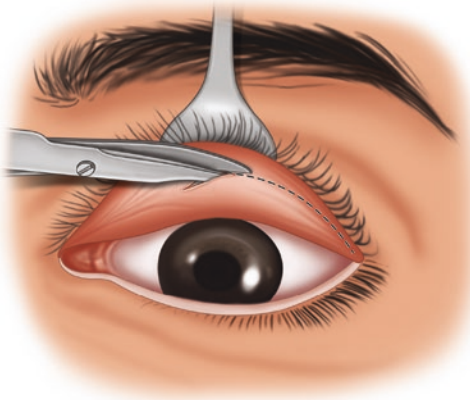

Fig. 4.6 The conjunctiva is incised at the superior tarsal border over the temporal two-thirds of the eyelid

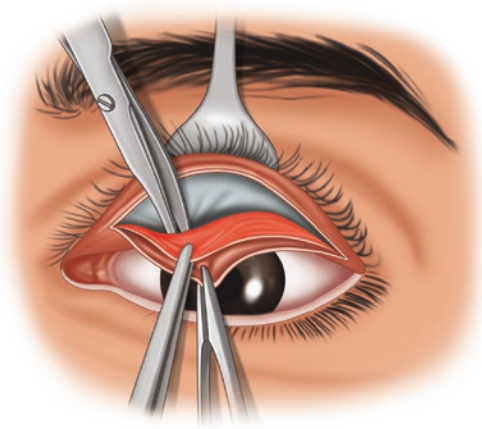

Fig. 4.7 Müller's muscle is dissected off the levator aponeurosis

is then freed from its attachments to Müller's muscle with Westcott scissors.

Another buttonhole incision is made temporally at the superior border of the tarsus through Müller's muscle. Anatomical awareness of this muscle is fundamental for this surgery. Müller's muscle originates from the undersurface of the levator aponeurosis at Whitnall's ligament, 14–16 mm above the superior border of the tarsus. This sympathetically innervated muscle inserts on the superior border of the tarsus and has some attachments to the conjunctival fornix. Once the buttonhole incision has been made, Müller's muscle is disinserted from the superior tarsal border along the temporal two-thirds of the eyelid. Müller's muscle is then detached from the levator aponeurosis carefully using blunt and sharp dissection (Fig. 4.7). The eyelid is then flipped back into position and the patient is placed in an upright position. The patient is asked to open his or her eyes to allow the surgeon to determine the height and contour of the upper eyelid. If the height and contour are appropriate, Müller's muscle is infiltrated with the local anes-

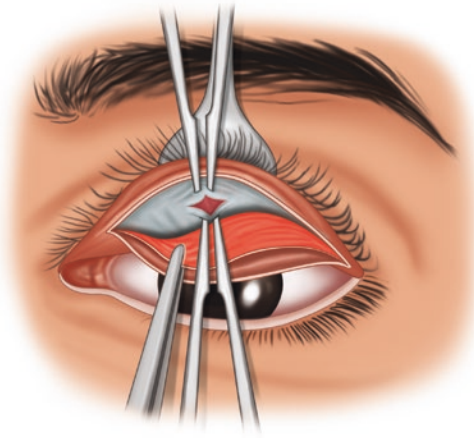

Fig. 4.8 Two toothed forceps are used to elongate the levator aponeurosis, adjusting both the eyelid height and contour

thetic mixture and a hemostat is clamped across the base of the muscle. The muscle is then excised with a high-temperature cautery. If retraction is still present, the levator aponeurosis is grasped above the superior tarsal border with two forceps and gently stretched vertically. Care is taken to avoid damage to the skin (Fig. 4.8). This lengthening maneuver is titrated by incrementally stretching the levator and checking lid position until the lid margin is 1 mm below the superior limbus and contour is ideal. A buried, 6-0 fast gut suture is used in an interrupted fashion to reattach the conjunctiva to the superior tarsal border centrally, medially, and laterally. The 4-0 silk suture is then removed, and ophthalmic ointment is placed within the eye. The ointment is continued postoperatively for one week. Ptosis may be present postoperatively for approximately one week. The lid should achieve a stable position within 3–4 weeks. There may be a role for downward eyelid massage for persistent retraction in the early postoperative period.

Lower Eyelid Retraction

Lower eyelid retraction can be repaired with either an anterior or posterior approach. When a large amount of retraction is present, we prefer the posterior, transconjunctival approach using a spacer graft. The use of a spacer graft can give approximately 3–5 mm of elevation to the lower eyelid. A variety of grafts can be used with this technique. The type of material used depends on availability and the comfort level of the surgeon.

The videos accompanying this chapter illustrate the use of both ear cartilage and Enduragen as lid spacer grafts. Auricular cartilage and other spacer materials use a ratio of 1 mm for each millimeter of elevation. Enduragen is acellular, porcine dermal collagen. The product is pre-hydrated with a uniform thickness and can be cut as desired. Independent of the type of spacer used, the surgical approach is the same. The material is placed between the inferior border of the tarsus and conjunctiva of the inferior fornix.

Another technique for repair of lower eyelid retraction is recession of the capsulopalpebral fascia without the use of a spacer graft. This technique involves a lateral tarsal strip procedure combined with recession of the lower lid retractors. Careful attention to the cause and extent of the retraction preoperatively can determine the best surgical approach.

The patient's MRD_2, lagophthalmos, and palpebral fissure height are carefully measured preoperatively. The surgeries are generally done as an outpatient procedure with intravenous sedation and local anesthesia; they can be done, when needed, under general anesthesia or local anesthesia.

Harvesting of Ear Cartilage Graft

To harvest the ear cartilage graft, the retroauricular area and preauricular area are infiltrated with a 50:50 mixture of 2% Lidocaine with 1:100,000 epinephrine and 0.5% bupivacaine with 1:100,000 epinephrine using a 5 mL syringe with a 30-gauge needle. A 4-0 silk traction suture is placed in a mattress fashion through the skin of the helix and the preauricular skin to hold the ear forward. A surgical marker is used to mark an incision line approximately 22–25 mm in length on the flattened portion of the posterior ear just anterior to the helix (Fig. 4.9). An incision is made along the markings with a #15 bard parker blade. A dissection is carried down to expose the top of the auricular cartilage with Westcott scissors. The scissors can be pressed firmly against the carti-

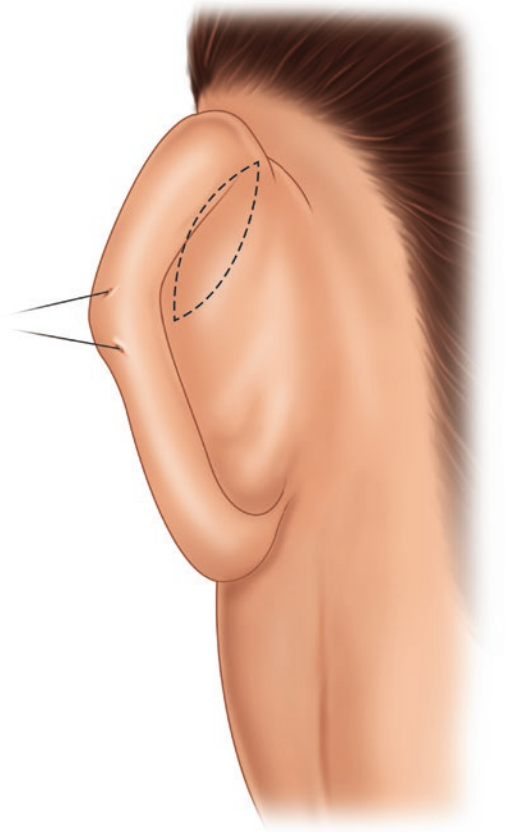

Fig. 4.9 The flattened portion of the posterior ear just anterior to the helix is used as a donor site for ear cartilage. Dashed lines show a typical ear cartilage graft

lage to help obtain the proper plane. The length of the cartilage graft is usually 22–25 mm. This length is marked along the cartilage using a metal ruler and high-temperature cautery. The amount of retraction, determined preoperatively as MRD_2, is used to arrive at the width of the ear cartilage. A 1:1 ratio is used to determine the width of the cartilage graft and is marked above and below the straight line in either direction. For example, if the desired width is 4 mm, 2 mm is marked anterior and 2 mm posterior from the center of the line drawn on the cartilage. A graft of approximately 30 mm in length and 8 mm in width can be easily obtained from this area. High-temperature cautery is then used to delineate an ellipse of ear cartilage to be excised. A partial-thickness incision is made with a #15 bard parker blade through the cartilage. Care is necessary to avoid incising the underlying skin. A full-thickness incision through the cartilage can be made in one area, and Westcott scissors can then be used to completely excise the graft. Once the graft is free, Westcott scissors are used to clear off any tissue attached to the graft prior to placement in the lower eyelid. The defect in the ear cartilage should not be sutured. A single 6-0 plain gut suture is tied centrally in the auricular skin to realign the incision edges. The skin of the ear is then closed with a running 6-0 plain gut suture, and the silk traction suture is removed. Ointment should be applied postoperatively to the incision (Video 4.4).

Retraction Repair of Lower Lid with Graft

A 50:50 mixture of 2% Lidocaine with 1:100,000 epinephrine and 0.5% bupivacaine with 1:100,000 epinephrine is injected into the lower lid margin and inferior fornix using a 5 mL syringe with a 30-gauge needle. A double-armed 4-0 TiCron suture with attached bolster is placed within the eyelid margin and used as a traction suture for the lower lid. A double-armed 4-0 silk suture can be used instead of the TiCron suture with a rubber band bolster if needed; however, silk tends to cause more inflammation of the eyelid margin during healing. The eyelid is then everted over a cotton-tipped applicator. The conjunctiva and lower lid retractors are released from the inferior tarsal border along the length of the lower lid using high-temperature cautery (Fig. 4.10). The lid will elevate when the lower lid retractors, the capsulopalpebral fascia and inferior tarsal muscle, have been removed from the inferior border of the tarsus. When using Enduragen, the graft is now trimmed to the appropriate size with similar dimensions to the ear cartilage graft (see above). The graft is then placed within the defect on the lower eyelid. Multiple partial thickness, buried interrupted 6-0 Vicryl sutures are placed between the graft and the inferior border of the tarsus. Burying the knots at the inferior tarsal border helps prevent postoperative corneal irritation. Multiple interrupted 6-0 Vicryl sutures are placed at the inferior edge of the graft to the conjunctiva

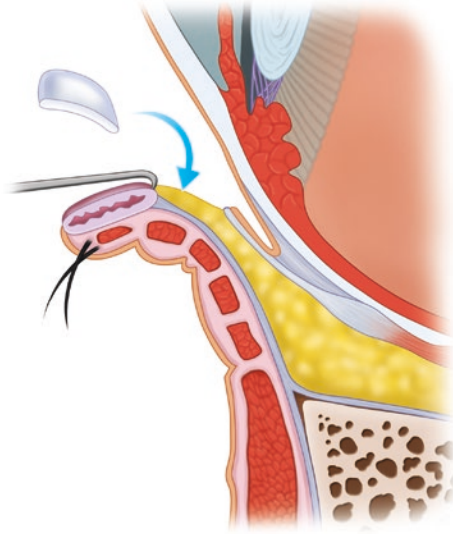

Fig. 4.10 The retractors of the lower eyelid have been recessed from the inferior tarsal border

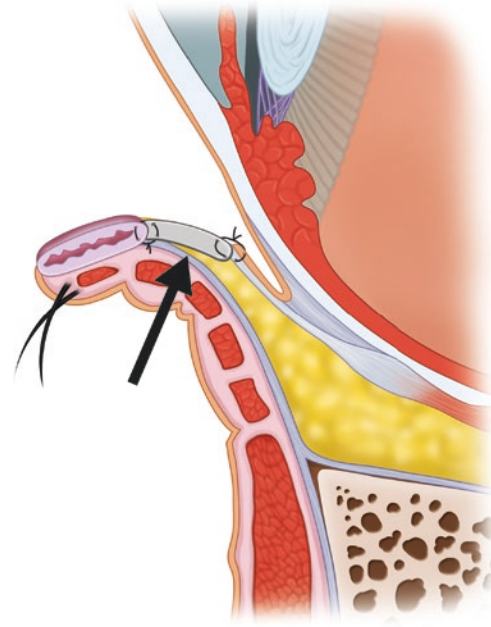

Fig. 4.11 A spacer graft is inserted between the inferior border of the tarsus and the recessed edge of the retractors

(Fig. 4.11). The lower lid is then pulled superiorly with the 4-0 traction suture and taped above the brow with Mastisol and Steri-Strips, placing the lower lid on gentle stretch during healing. Ophthalmic ointment is placed within the eye, and two eye pads are taped above the surgical site with paper tape. The dressing and traction suture are typically removed in one week (Video 4.5).

Retraction Repair of Lower Lid with Capsulopalpebral Fascia Recession

A 50:50 mixture of 2% Lidocaine with 1:100,000 epinephrine and 0.5% bupivacaine with 1:100,000 epinephrine is injected into the lateral upper and lower lid, the inferior fornix, and the periosteum of the lateral orbital rim using a 5 mL syringe with a 30-gauge needle. A lateral canthotomy is performed by crushing the lateral canthus with a hemostat and making a 10 mm incision straight out from the canthal angle with Westcott scissors (Fig. 4.12). The inferior crus of the lateral canthal tendon is identified with palpation by the tips of the scissors. The tendon is cut, freeing the lateral portion of the lower lid. An incision is then made along the length of the inferior tarsal border to the level of the punctum with Westcott scissors to

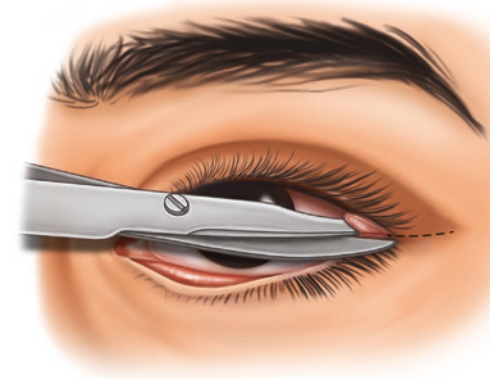

Fig. 4.12 A lateral canthotomy is made with scissors

release the conjunctiva and capsulopalpebral fascia. The inferior tarsal border is then grasped and pulled inferiorly while the capsulopalpebral fascia is grasped and pulled superiorly. High-temperature cautery is then used to dissect the capsulopalpebral fascia from the surrounding tissue. Cautery allows the surgery to proceed quickly while obtaining hemostasis at the same

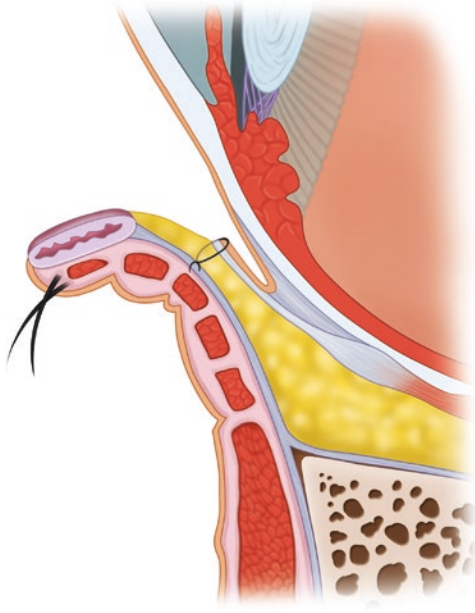

Fig. 4.13 Conjunctiva and capsulopalpebral fascia are recessed and reattached with multiple sutures

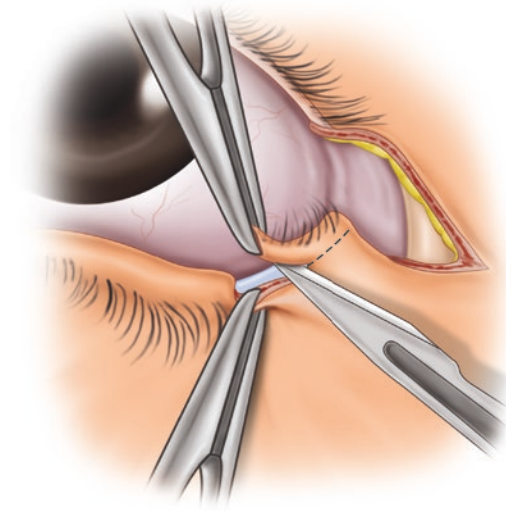

Fig. 4.14 The eyelid margin is removed, including the lashes

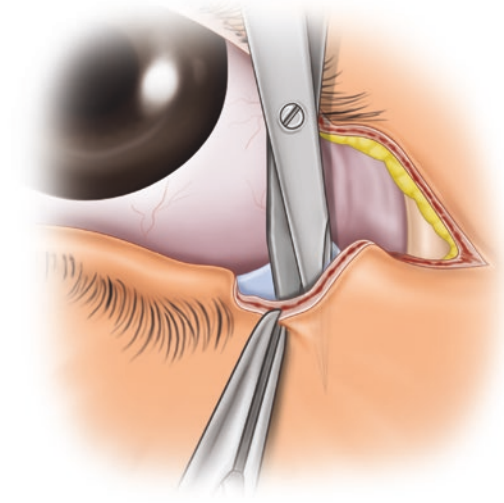

Fig. 4.15 Skin and orbicularis are dissected from the anterior tarsal surface

time. Three or four interrupted, buried 6-0 Vicryl sutures are then used to attach the recessed capsulopalpebral fascia and conjunctival to the deeper tissues approximately 8 mm inferior to the inferior tarsal border (Fig. 4.13).

Attention is then turned to creation of the lateral tarsal strip. The length of the strip is marked in advance by pulling the edge of the lid laterally and marking with a Westcott scissor the point on the lid margin where it crosses the interior edge of lateral orbital rim. The lid margin and lashes are then removed over this region with Westcott scissors or a #11 bard parker blade (Fig. 4.14). A skin muscle flap is then dissected off the anterior tarsal surface in this area with scissors (Fig. 4.15). Along the inferior tarsal border of this segment, scissors are used to make an incision through conjunctiva and lower lid retractors. Westcott scissors or a blade are then used to de-epithelialize the conjunctiva on the posterior surface of the segment. A vertical incision with scissors completes the creation of the strip by trimming the tarsus in this location to a length of 2–3 mm. Dissection to the periosteum of the lateral orbital rim is then carried out with scissors and high-temperature cautery to obtain good visualization (Fig. 4.16). Both arms of a double-armed 5-0 Prolene mattress suture are passed through this tarsal strip, from posterior to anterior, and each arm is then threaded through the periosteum of the lateral orbital rim internally. The suture is then tied to the appropriated tension, allowing the lid to still be able to be distracted 2–3 mm off the globe. The lateral canthal angle is reformed using

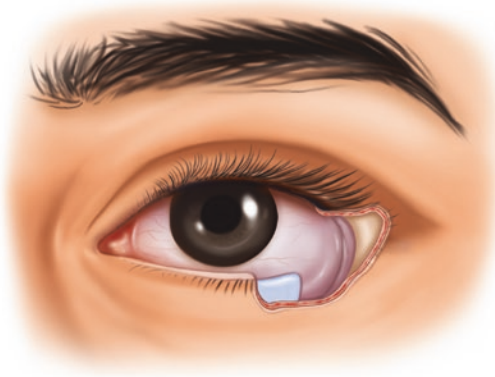

Fig. 4.16 The lateral orbital rim periosteum is exposed

a buried, circular 6-0 plain gut suture. The skin of the lateral canthus is closed using running 6-0 plain gut. Ophthalmic ointment is placed on the wound and given to the patient post-operatively (Video 4.6).

Conclusion

Surgical repair of eyelid retraction and lagophthalmos requires careful patient evaluation. Both the timing of surgery and type of procedure selected are very important and should be discussed with the patient in detail preoperatively. It is important to discuss the variability of the eyelid in thyroid disease, and the limits this condition places on the predictability of the surgery. Careful discussion with the patient and use of the correct procedure will minimize postoperative complications and maximize patient satisfaction.

Blepharoptosis

5

Geoffrey J. Gladstone

Anytime the eyelid droops, blepharoptosis results. The condition is cosmetically noticeable even in the earliest stages. When significant visual field defect occurs, it becomes a functional problem. Blepharoptosis repair is one of the most common oculoplastic procedures performed. Accurate evaluation of the patient with blepharoptosis will lead the surgeon to choose an appropriate surgical procedure and minimize the incidence of complications. An understanding of the etiology of the various subtypes of eyelid ptosis is also important in surgical decision-making.

Etiology

The etiology of blepharoptosis can be divided into five main categories: aponeurotic, muscular, neurological, traumatic, and mechanical. The terms "acquired" and "congenital" can be misleading and should be avoided. Although most cases of acquired ptosis are aponeurotic, not all are. Likewise, although most cases of congenital ptosis are muscular, some may be neurological or aponeurotic. Using the proper terminology leads to less confusion. Determining the subtype of ptosis leads to choosing the proper surgical procedure.

The most common etiology of blepharoptosis is aponeurotic. This condition is typically seen as adult-acquired ptosis but may occur congenitally or through trauma. The levator aponeurosis is either stretched or detached from its insertion on the tarsus.

Muscular ptosis occurs when there is a replacement of striated muscle fibers with noncontractile fibrous tissue. Typically the worse the ptosis, the less normal muscle is found microscopically. This condition is unilateral in 75% of patients and is the most common type of congenital ptosis seen.

Various etiologies of neurological ptosis are encountered. Some of the more common are trauma, myasthenia gravis, myotonic dystrophy, and chronic progressive external ophthalmoplegia (CPEO). In myasthenia gravis, a defect in neuromuscular communication occurs at the junction between the neuron and the muscle fiber. This is caused by antibodies to acetylcholine receptors of the muscle end plate. Myotonic dystrophy is an autosomal dominant form of muscular dystrophy. In CPEO a gradual deterioration in extraocular muscle function is seen secondary to mitochondrial dysfunction.

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Traumatic ptosis may not deserve its own category. In reality most cases of traumatic ptosis are either aponeurotic or neurologic in origin. Mechanical blepharoptosis is seen whenever a mass or swelling of the eyelid causes it to droop. Tumor, trauma, edema, poor lymphatic outflow, and other etiologies could be responsible for such drooping.

Preoperative Evaluation

The evaluation of the patient with blepharoptosis has several goals. It should help identify the type of ptosis the patient has and indicate which particular operation is appropriate. Additionally, it should identify any preexisting conditions that might call for modifications of surgical goals or even the abandonment of the surgical plan. In other words, a detailed evaluation should keep the surgeon and patient out of trouble.

The actual amount of ptosis is determined by measuring the MRD_1. The patient is asked to look directly at a small light source. The ipsilateral frontalis muscle is suppressed and the contralateral eyelid is elevated if it is ptotic. This suppresses the contribution of the frontalis muscle and Herring's law to eyelid height. The distance, in millimeters, between the light reflex on the central cornea and the central eyelid margin is the MRD_1. Negative measurements are possible. Normal values are between 3.5 and 5 mm.

The Burke levator function (BLF) measures the eyelid excursion from maximum downgaze to maximum upgaze. The ipsilateral frontalis muscle is suppressed by placing several fingers on the eyebrow. This is arguably the most important measurement in ptosis evaluation. Normal values are between 15 and 18 mm.

The vertical fissure width in downgaze is measured in maximal downgaze. Normally the levator aponeurosis acts as a check ligament in downgaze, keeping the eyelid from closing with reading. Normal measurements are between 2 and 4 mm.

Ductions and versions of the eyes are evaluated. Deficiencies in these can point to unusual conditions such as third nerve palsies, CPEO, and double-elevator palsies.

The presence of strabismus is important to note. If present, it prompts a decision whether to correct the strabismus and, if so, whether correction should precede ptosis surgery. Correction of vertical misalignments can have a profound effect on eyelid position, and if they are going to be corrected, they should be corrected first.

Various danger signs are evaluated. Lagophthalmos, the inability to completely close the eyelid with *gentle* closure, is measured. This mimics what occurs when the patient is sleeping. Corneal staining, Bell's phenomenon, and dry eye are also looked for. A basic secretor test, tear osmolality, or other indicators of a dry eye condition are very important. The presence of any of these danger signs is notable and may cause a modification of the surgical goals for the patient (e.g., placing the eyelid lower than would otherwise be optimal). The presence of several of these could be a reason to not perform the desired surgery.

In patients with good levator function a Neosynephrine test can be employed. Several drops of 10% phenylephrine hydrochloride (Neosynephrine, Sanofi Pharmaceuticals, New York) are placed under the eyelid. The maximum height of the eyelid is measured as an MRD_1. The maximum height typically takes several minutes to occur. If a significant response to Neosynephrine is seen, this is an indication that a conjunctival-Müller's muscle resection procedure may be useful.

In patients with poor levator function, an MLD measurement is used. This will help determine how much levator resection should be performed. The patient is asked to gaze maximally upward. The distance from the inferior limbus to the upper eyelid margin is measured in millimeters. A normal measurement is 9 mm. Negative measurements are possible.

The position of the eyelid crease is recorded. Normally this is between 7 and 10 mm above the eyelid border. In aponeurotic ptosis this is often increased. In muscular ptosis it is unchanged or absent (owing to poor muscle development).

An approximation of orbicularis strength can be made. This is important when the ptosis has neurological causes. Poor orbicularis strength is

often seen with myotonic dystrophy and can lead to lagophthalmos and corneal problems postoperatively.

If myasthenia gravis is suspected, a fatigue test and/or orbicularis squeeze test should be performed. Alternatively the patient can be referred to a neuro-ophthalmologist for evaluation.

History is very important. Systemic disease can cause eyelid ptosis. The age at onset of the ptosis as well as other symptoms occurring should be sought. It is important to remember that not all ptosis occurring at birth is muscular in origin. Likewise, a 60-year-old patient with no history of surgery may have decided only recently to investigate the possibility of surgical correction of a muscular ptosis present since birth.

Surgical Decision-Making

The most important factors in differentiating aponeurotic from muscular ptosis are history, Burke levator function, eyelid crease position, and fissure width in downgaze (Table 5.1). In aponeurotic ptosis the patient will typically have good levator function (between 12 and 18 mm). The history is that of gradual onset beginning in middle-to-later life. The eyelid crease is characteristically elevated. Since the levator muscle is stretched or detached, it does not perform the function of a check ligament in downgaze, and the fissure width in downgaze is narrowed and sometimes actually closed (Table 5.1).

Muscular ptosis will have moderate-to-poor levator function of between 0 and 10 mm. The history is that of a ptosis essentially stable since birth. The eyelid crease is either in a normal position or is absent in severe cases. Owing to the fibrotic, inelastic nature of the levator muscle, the fissure width in downgaze is often increased.

When dealing with an aponeurotic ptosis, either a conjunctival-Müller's muscle resection or a levator advancement procedure is employed. If the patient responded to the Neosynephrine test and does not need skin resection, a conjunctival-MülIer's muscle procedure is a reasonable choice. The Neosynephrine test dictates the amount of resection to be performed. The range of resection is between 6.5 and 9.5 mm. When the ptotic lid rises to a height equal to the normal lid, an 8 mm resection is performed. If the lid rises above the normal lid, a decreased amount of resection is performed, with 6.5 mm being the minimum. If the lid rises, but not to the desired height, the amount of resection is increased up to a maximum of 9.5 mm. If no response is seen with the Neosynephrine test, the conjunctival-Müller's muscle resection should not be employed.

A levator advancement procedure can be employed in all cases of aponeurotic ptosis. It is especially useful when skin excision is desired. The amount of advancement is determined intraoperatively by sitting the patient up and judging the eyelid height and contour.

A muscular ptosis is corrected by either levator advancement or a frontalis sling procedure. The main determinant is the levator function. If the levator function is 4 mm or greater, a levator resection should be used. If the levator function is 3 mm or less, a frontalis sling is employed. In most cases a sling of fascia lata is recommended, as the long-term results are the best.

The MLD formula is utilized to determine the amount of levator resection performed. If the ptosis is bilateral, the number of millimeters of resection is found by subtracting $MLD_{ptotic\ lid}$ from 9 and multiplying by 3. If only one eyelid is involved and the plan is to match the ptotic eyelid's height to that of the normal eyelid, the

Table 5.1. Factors distinguishing aponeurotic from muscular ptosis

	History	Levator function (mm)	Crease position	Fissure width in downgaze
Aponeurotic ptosis	Gradual onset, middle age or older	≥12	Often elevated	Decreased
Muscular ptosis	Stable, present at birth	≤10	Normal or absent	Increased

amount of resection is found as follows: ($MLD_{normal\ lid} - MLD_{ptotic\ lid}$) × 3. For example, if the MLD of the normal eyelid is 8 mm and that of the ptotic eyelid is 2 mm, the formula dictates a resection of 18 mm.

If a frontalis sling is performed, the lid height is set intraoperatively. The lid is placed at or just above the desired final position.

A neurologic ptosis is corrected by utilizing levator advancement, levator resection, or a frontalis sling. The decision is made primarily on the basis of the levator function. In myasthenia gravis it is often advisable to perform a sling procedure even when the levator function would suggest performing levator advancement. This is due to the variable nature of the levator function in myasthenia gravis, and the patient can use the frontalis muscle to varying degrees to compensate. In certain conditions with poor orbicularis strength, such as myotonic dystrophy, it is advisable to utilize a silicone rod sling instead of fascia lata. This type of sling stretches, allowing better closure of the eyelids, protecting the cornea better, and minimizing problems related to exposure.

Surgical Techniques

Müller's Muscle-Conjunctival Resection

After the patient is sedated, a small amount of local anesthetic is injected in the central upper eyelid. An equal mixture of 0.5% bupivacaine hydrochloride (Marcaine, Astra Pharmaceutical, L.P., Wayne, PA) and 2% lidocaine hydrochloride (Xylocaine, Astra Pharmaceutical) is used. A 4-0 silk traction suture is place centrally just above the lashes, and a Desmarres retractor is used to evert the lid. The predetermined amount of Müller's muscle resection is marked with a high temperature cautery (Fig. 5.1). A forceps grasps both conjunctiva and the Müller's muscle and loosens the muscle from the overlying levator aponeurosis. A Putterman Müller's muscle resection clamp is placed between the cautery mark and the superior tarsal border. The clamp is closed and contains only conjunctiva and Müller's muscle (Fig. 5.2). A 6-0 double-armed plain gut suture is placed 1.5 mm below the clamp as a running horizontal mattress suture (Fig. 5.3). A #15 blade is used to remove the tissue in the clamp. Maintaining a "metal-on-metal" feel between clamp and blade will help prevent cutting the suture (Fig. 5.4). The needles are passed full thickness through the lid, exiting on the skin. A small piece of surgical tape holds the suture in place. In one week the surgical tape is removed and suture ends trimmed if necessary (Video 5.1).

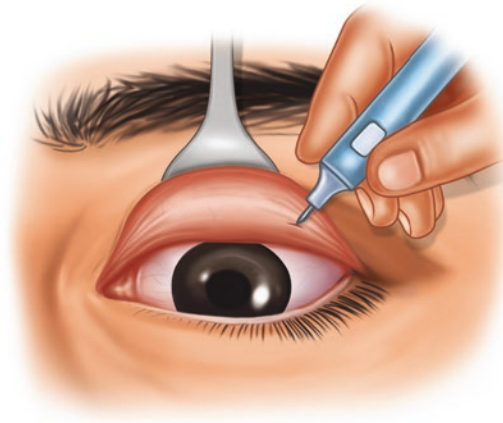

Fig. 5.1 A cautery mark is placed at a predetermined distance from the superior tarsal border

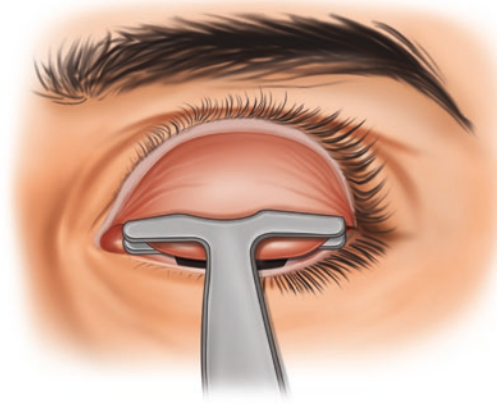

Fig. 5.2 A clamp is placed, which now contains conjunctiva and Müller's muscle

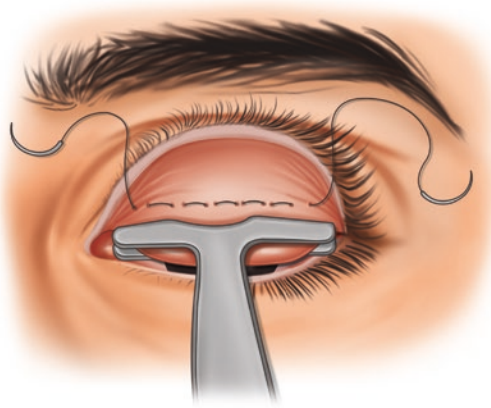

Fig. 5.3 A 6-0 plain gut suture is placed superior to the clamp in a running mattress fashion

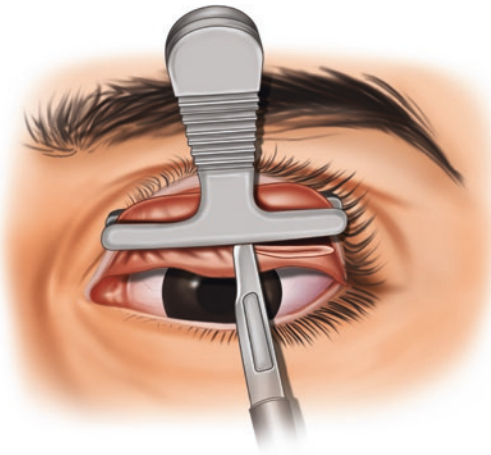

Fig. 5.4 The tissue within the clamp is removed with the blade, maintaining a metal-on-metal feel to minimize the chances of cutting the suture

Levator Aponeurosis Advancement

An eyelid crease incision is marked. When skin resection is desired, this is marked utilizing the pinch technique or leaving at least 20 mm of vertical skin to minimize the risk of lagophthalmos. An equal mixture of 0.5% Marcaine and 2% Xylocaine, both with epinephrine, is injected in the marked area. A small amount of anesthetic is used to prevent distortion of the eyelid and to avoid complicating the intraoperative assessment of eyelid height. The incision is made with a #15 blade, and a skin muscle flap is removed with Westcott scissors. In the area overlying the cornea, an inferior skin muscle flap is dissected for 5 mm, exposing the tarsus.

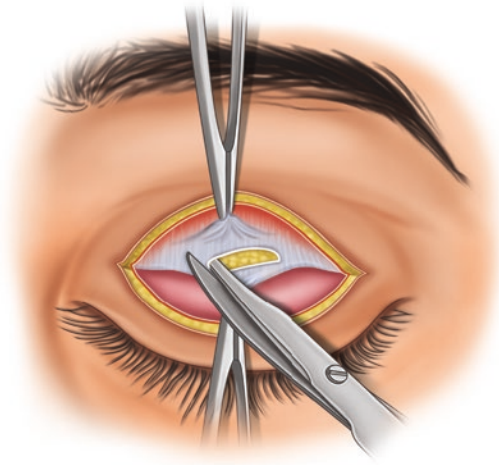

Fig. 5.5 Westcott scissors are used to incise the orbital septum

When the lid is pulled downward, the edge of levator aponeurosis is often visible just deep to the orbital fat. The edge of the aponeurosis or the tissue just deep to the orbital fat is grasped and pulled inferiorly. The tissue just anterior to this is pulled perpendicularly outward. Westcott scissors cut the tissue between the forceps, staying parallel to the plane of the aponeurosis (Fig. 5.5). This avoids damage to the aponeurosis. The levator aponeurosis is exposed and separated from the orbital septum (Fig. 5.6). This is crucial because incorporating the septum in the advancement would lead to lagophthalmos. Just below the superior tarsal border, a 6-0 silk or 5-0 polybutester (Novafil) suture is passed partial thickness through the tarsus for a distance of about 5 mm. (Fig. 5.7) The lid is everted to be certain the suture has not penetrated through full-thickness tarsus. The suture is placed in a mattress fashion through the levator aponeurosis and tied temporarily (Fig. 5.8). A piece of 4-0 silk suture approximately 6 in. long can be placed under the throw of 6-0 silk. This knot-releasing suture can be pulled upward to loosen the mattress suture when adjustments are made; it is removed prior to final tying of the mattress

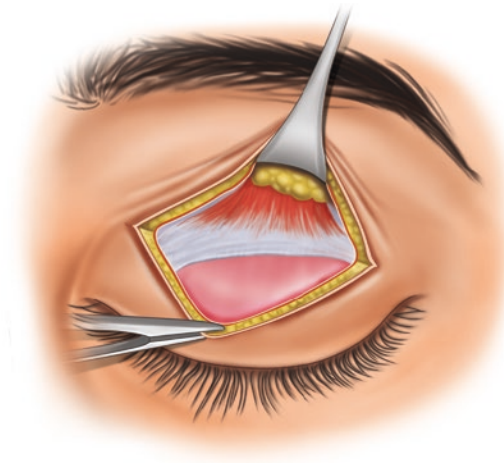

Fig. 5.6 The levator aponeurosis is seen to be slightly dehisced from the tarsus

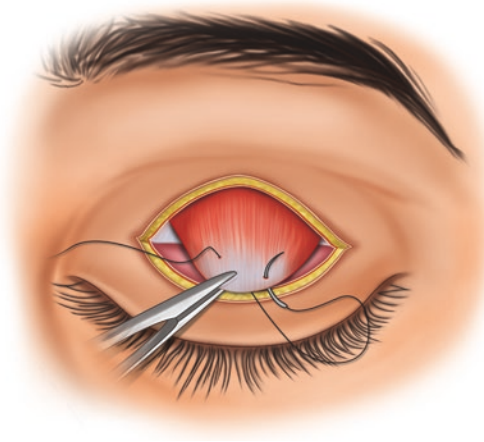

Fig. 5.8 Both arms of the suture are passed through the edge of the levator aponeurosis

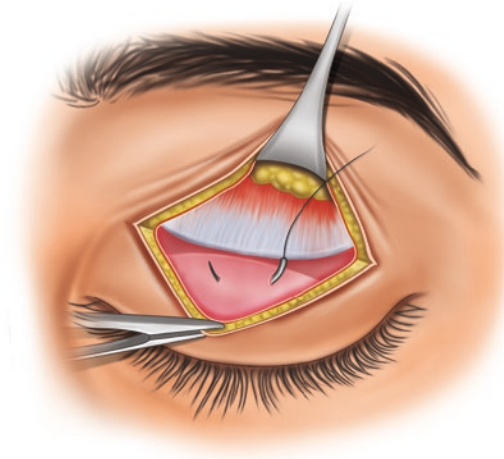

Fig. 5.7 A suture is placed through partial thickness tarsus

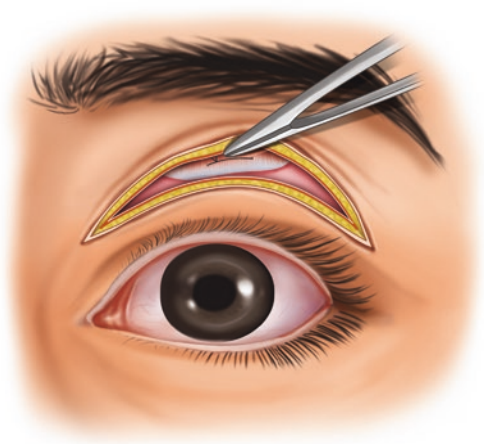

Fig. 5.9 With the patient sitting up and fully awake, the eyelid height is judged

suture. The patient is brought to a sitting position and asked to open the eyes; a slight overcorrection of about 1 mm is desirable on the table (Fig. 5.9). The suture can be loosened or tightened or a larger bite of aponeurosis taken until the appropriate lid height is achieved. Medial and lateral sutures can be placed if the eyelid contour needs to be adjusted. The patient is returned to a supine position and the suture tied. Skin closure is with a 6-0 polypropylene (Prolene) running subcutaneous suture. For the next 48 h, ice is applied for 15 min every hour the patient is awake. Surgical tape is placed over the wound. Sutures are removed in one week (Video 5.2).

Levator Resection

Depending on the age of the patient, either general or local anesthesia can be used. The eyelid crease is marked and an infiltration of an equal mixture of 0.5% Marcaine and 2% Xylocaine, both with epinephrine, is given. An incision is made with a #15 blade through the skin and orbicularis muscle.

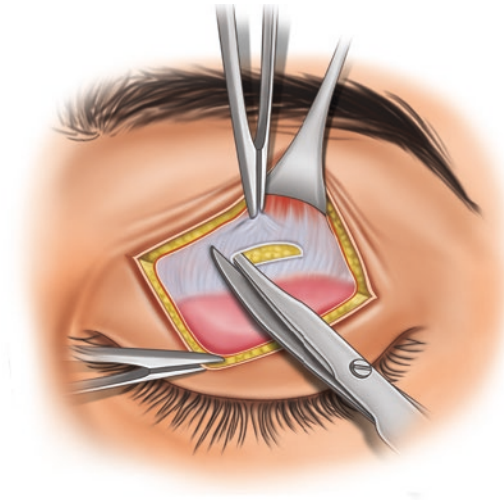

Fig. 5.10 The orbital septum is opened and the levator aponeurosis is exposed

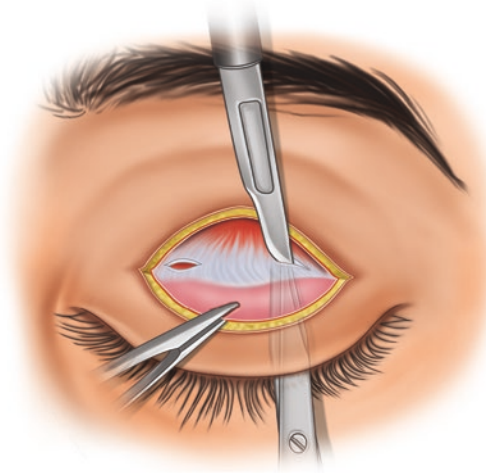

Fig. 5.11 A Westcott scissors pushes upward at the superior tarsal border, and a blade is used to make a buttonhole through conjunctiva, Müller's muscle, and the levator aponeurosis

Westcott scissors are used to dissect through the orbital septum (Fig. 5.10), exposing the underlying levator muscle. Westcott scissors tent the conjunctiva, Müller's muscle, and levator muscle upward at the superior tarsal border at the far medial border of the tarsus. A #15 blade cuts through these tissues. The same incision is made at the far temporal end of the tarsus (Fig. 5.11). A Putterman levator resection ptosis clamp is placed just above the tarsus. This clamp holds the levator muscle, Müller's muscle, and conjunctiva. A #15 blade is used to separate these tissues from the superior tarsal border. Vertical incisions through these tissues are made at the medial and temporal ends of the clamp. Superior dissection through Müller's muscle and levator muscle is carried out medially and temporally (Fig. 5.12). These lines of dissection should not converge, since this would produce unpredictable results. How far the dissection proceeds superiorly depends on the amount of levator resection planned. It is important not to cut the horns of the levator. Avoid reaching far superiorly with the scissors. Small superior cuts, on alternating sides of the levator, will deliver the muscle to the surgeon and not sever the levator horns. The conjunctiva is dissected free from the underside of Müller's muscle (Fig. 5.13) and reattached to the superior tarsal border with a running 6-0 plain gut suture. A strip of orbicular muscle is removed from the superior tarsal border. A double-armed 6-0 polyglactin 910 (Vicryl) suture is passed partial thickness through the central tarsus, several millimeters below the superior border. It is then passed in mattress fashion through the levator muscle at the predetermined position. This suture is temporarily tied and the

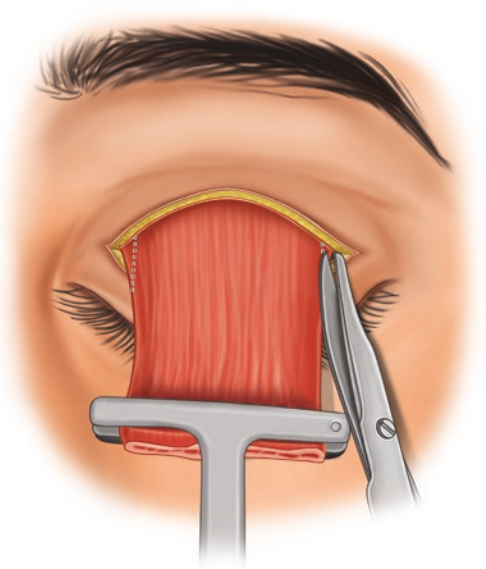

Fig. 5.12 A superior dissection through Müller's muscle and the levator aponeurosis is performed medially and laterally

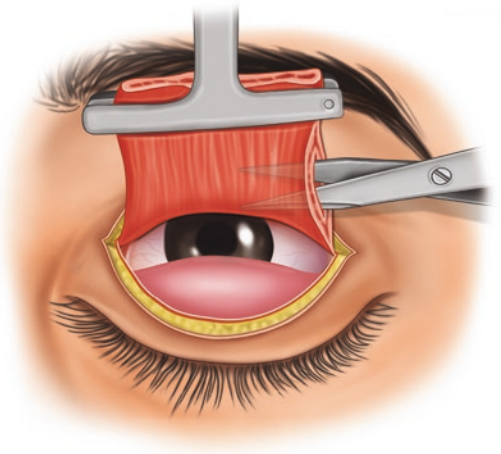

Fig. 5.13 The conjunctiva is dissected from the levator aponeurosis

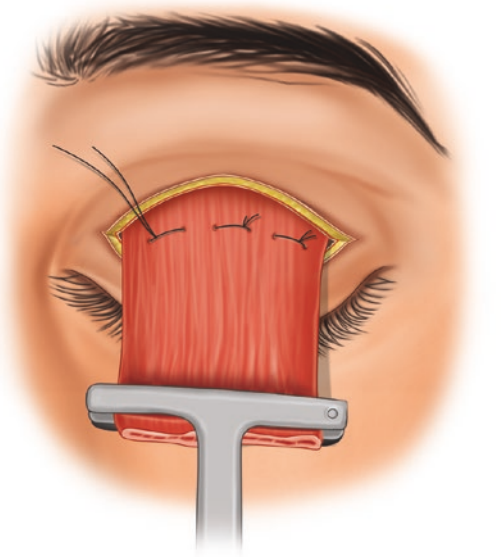

Fig. 5.14 To control the height and contour of the eyelid, three sutures are placed through the predetermined amount of levator aponeurosis

eyelid height checked. If acceptable, the suture is temporarily loosened to allow easier placement of the remaining sutures. Medial and lateral sutures of the same type are placed, utilizing the same amount of resection as with the central suture. The central suture is tied first. The medial and lateral sutures are temporarily tied (Fig. 5.14). These sutures affect the contour of the lid, and the amount of resection can be varied to achieve an acceptable eyelid contour. Once appropriate medial and lateral contours have been achieved, the sutures are tied permanently. The advanced levator and Müller's muscle are clamped with a hemostat and excised. Running or interrupted 6-0 Prolene or 6-0 plain sutures are placed closing the skin. The running 6-0 Prolene suture can be placed in a subcutaneous fashion. Three deep bites incorporating the skin edges and the advanced edge of the levator muscle are taken to re-form the eyelid crease. These are placed prior to final skin closure. Ointment is placed in the eye and a mild pressure patch placed for 24 h. Sutures are removed in one week when appropriate (Video 5.3).

Silicon Rod Frontalis Sling

General or local anesthesia is used, depending on the age of the patient. A single rhomboid pattern is marked. Just above the lash border, two incisions are marked, each about 3 mm long. The incisions are centered approximately 6 mm medial and temporal to the point directly above the central cornea. The desired positions can be checked and adjusted by placing cotton-tipped applicators under each mark and elevating the eyelid. Three eyebrow incisions are used. The central incision is directly above the central cornea. This incision is placed approximately 1 cm above the brow. The medial and lateral brow incisions are marked just medial and lateral to their respective lid incisions and just above the brow. An injection of an equal mixture of 0.5% Marcaine and 2% Xylocaine, both with epinephrine, is given. Small incisions are made in the brow and eyelid area through skin and muscle. A small inferior dissection deep to frontalis muscle is made through the central brow incision. This will allow the silicon rod knot to be buried easily. The supraorbital nerve can be damaged if the medial brow incision is too deep. A Wright fascia needle is used to pass a 1-mm-in-diameter silicon rod. The needle is passed from the temporal eyelid incision to the medial eyelid

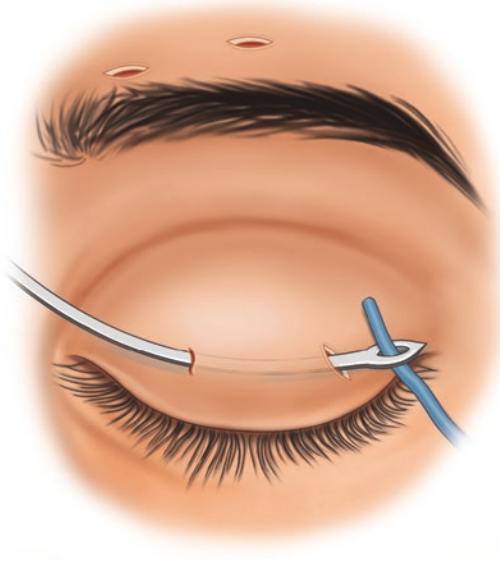

Fig. 5.15 The silicon rod is passed with a Wright fascia needle from the temporal eyelid incision to the medial eyelid incision

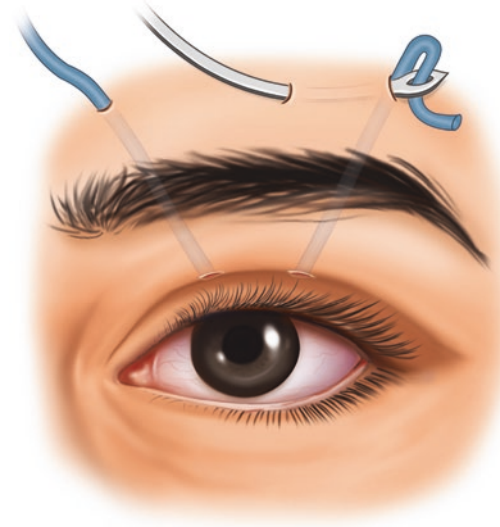

Fig. 5.16 The silicon rod is passed from the medial and temporal eyelid incisions to the medial and temporal eyebrow incisions and then to the central eyebrow incision

incision. The needle passes under the orbicularis, staying just above the tarsus. It is important to always know where the globe is with respect to the needle. The silicon rod is passed through the eye of the needle and withdrawn (Fig. 5.15). The same technique is used to pass the silicon rod from the temporal eyelid incision to the temporal eyebrow incision. The plane of passage is just deep to the orbicularis muscle. The silicon rod is then passed from the medial eyelid incision to the medial eyebrow incision. The silicon rod from the medial and temporal eyebrow incisions is passed to the central eyebrow incision (Fig. 5.16). The fascia is tied with the first throw of a simple square knot. A patient who is awake should be brought to a sitting position to judge the eyelid height. A slight overcorrection is desirable. If the patient is asleep, the height is adjusted until the lid is at or just above the desired position. Prior to judging the eyelid height, it is important to tuck the temporarily tied fascia lata knot into the previously created subfrontalis pocket. Once an adequate height and contour are achieved, the final throw of the fascia lata square knot is tied (Fig. 5.17), and the

Fig. 5.17 A simple square knot is tied in the silicon rod

knot is buried in the central incision. Several 6-0 plain sutures are used to close the incisions. Ointment is placed in the eye and a mild pressure patch is used to close the eye for 24 h. Ocular lubrication, especially at night, is important to avoid corneal complications in the early postoperative period (Video 5.4).

Eyelid Reconstruction

6

Geoffrey J. Gladstone and Frank A. Nesi

Etiology

Description of Disorder

Eyelid defects require precise closure to maintain proper function and appearance of the eye. Repair of the defects depends on their location and extent. Superficial tissue involving the skin and orbicularis may require simple closure or development of flaps or grafts. Full-thickness eyelid injury requires precise assessment of available surrounding tissue and closure of the lid at several levels. Deeper injury to the orbit may involve exploration and repair of the lacrimal drainage system, orbital bones, or the globe itself. Evaluation and repair of these delicate structures requires a fundamental knowledge of the regional anatomy as well as a thorough understanding of reconstructive techniques.

Among the most common eyelid deficits encountered by ophthalmic plastic surgeons are those that are full thickness. Simple vertical full-thickness lacerations without canalicular involvement can be closed with the classic "three-suture" or other methods. Lacerations that involve loss of tissue present greater challenges. Numerous reconstructive techniques, which depend not only on the extent of the defect but also on the quality and availability of surrounding tissue, exist to repair the tissue deficits.

Prevalence and Significance of Disorder

Eyelid defects are usually caused by trauma or by surgery to remove tumors. The resulting defect may be the loss of a small amount of superficial tissue, or absence of an entire eyelid. Removal of small eyelid margin masses usually allows the surgeon to prepare a pentagonal wedge defect with even borders. However, large lesions as well as malignant neoplasms that are excised using Mohs micrographic surgery often present with large defects and irregular borders.

Repair may be more difficult in certain individuals with preexisting medical conditions. Those with prior radiation exposure or other skin disorders may have significant tissue shrinkage or destruction at different levels of the skin. For example, full-thickness tissue scarring may be present following radiation exposure or herpes zoster dermatitis. Anterior lamellar defects, primarily of the skin, are present in numerous

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dermatologic conditions, including numerous types of dermatitis and many connective tissue disorders. Another important consideration is that certain reconstructive procedures have limited success in particular patients. For example, individuals who have received radiation treatment may not accept free grafts (skin or other autogenous material).

Skin quality and laxity differ among patients. Those with excess skin and "loose" eyelids with significant canthal tendon laxity tend to be older patients, who will have more available tissue than typical younger patients. With more available tissue, repair of the eyelid defect usually involves a less complicated repair. Patients with prior eyelid surgery, burns, or radiation tend to have less lax and mobile eyelids. Also, individuals with dermatologic conditions that limit skin elasticity or mobility may require more complex reconstruction.

Subtypes

Congenital colobomas involve full-thickness loss of part of an eyelid, usually the upper. These rare defects often result in no functional impairment, and significant keratopathy seldom develops. Congenital colobomas may present with a rounded superior border that contains a small amount of normal tarsus. This residual tarsus should be removed during the reconstructive process to allow proper tissue apposition, and to avoid a raised tissue deformity at the superior wound margin. Repair of most colobomas can be initiated if signs or symptoms of corneal exposure develop. Most surgeons prefer to delay treatment until the infant is at least 6 months of age.

Full-thickness traumatic defects are much more common than congenital defects. Frequently, lacerations that appear to involve a small region of the eyelid skin are associated with a large vertical tear of the tarsal plate. Lacerations may be perpendicular to the lid margin, or they may be irregular and highly angulated. Traumatic defects often involve situations where all tissue is present but may be difficult to locate or identify. When a significant amount of tissue is absent or severely damaged, flaps must be created and mobilized.

Repair of the canalicular system may be required in conjunction with eyelid repair when trauma results in lacerations in the area of the medial lower eyelid during extirpation of tumors. Lacerations of the canalicular system are a common subtype of eyelid trauma. The lacrimal drainage system must be inspected in all situations when trauma to this area is suspected. Canalicular trauma may be caused by direct as well as indirect trauma. The drainage system should be inspected visually, and canalicular probing and irrigation performed before repair is initiated. An experienced surgeon should perform the repair within several days of the injury. While some patients with a single functioning canaliculus are asymptomatic, many will notice epiphora in certain situations.

When surgery is planned in the area of the canaliculi, the surgeon should consider placing a Bowman probe in the canaliculi prior to initiating the procedure. The probe will allow the surgeon to judge the location of the lacrimal system and thus avoid unnecessary injury to the canaliculi (Video 6.1).

Pathophysiology

Proper eyelid reconstruction requires thorough preoperative evaluation of the involved structures. The surgeon should consider the integrity and relationships of the five basic eyelid components: anterior lamella (skin and orbicularis), posterior lamella (tarsus and conjunctiva), canthal tendons, canaliculi, and levator muscle.

Eyelid skin, primarily because of its attenuated dermis, is the thinnest skin of the body. While this characteristic allows for rapid healing of incisions, it also creates difficulty for the surgeon attempting to find a suitable donor area for a skin graft with appropriate color, texture, and thickness. Common donor areas in eyelid reconstruction are other eyelid skin, pre- and postauricular skin, supraclavicular skin, and forearm skin. Full-thickness skin grafts are commonly utilized in eyelid surgery, either alone or in conjunction with flaps, to repair defects ranging from approximately 1 to 5 cm. A full-thickness skin

graft includes the two layers of skin, epidermis and dermis, along with a small amount of subdermal fat.

Eyelid skin, particularly from the contralateral lid, tends to be the best match for eyelid defects. Upper eyelid skin always provides the best match for the contralateral upper eyelid. The second choice of donor tissue is usually any eyelid skin. For some patients, particularly young individuals or those in whom large areas require repair, adequate eyelid skin may not be available. The preferred donor site for eyelids is generally the postauricular sulcus, the skin of which heals well in the periorbital region. Post-auricular skin may provide an excellent match, based on its greater thickness, for grafts to the lower eyelid. Thicker donor tissue from the pre-auricular, supraclavicular, or forearm regions provides appropriate donor tissue to repair defects outside the periorbital region. Multiple grafts may be required to repair a large defect.

The medial and lateral canthal ligaments provide structural support to the orbicularis muscle by connecting the tarsus to the periosteum of the orbital bone. Fibers from the medial canthal ligament insert on both the anterior and posterior lacrimal crest. The deep fibers that insert on the posterior lacrimal crest serve as the anterior border of the deep pretarsal orbicularis muscles and also as a posterior anchor. Successful reconstructive surgery in the medial canthal area requires reestablishment of this important relationship.

The lateral canthal ligament is composed primarily of fibrous strands continuous with the upper and lower tarsus. The lateral canthal ligament inserts just inside the lateral orbital rim at Whitnall's lateral orbital tubercle. In lower eyelid reconstruction, the surgeon must recognize the posterior direction of this ligament. The lateral canthal angle, formed by the union of the upper and lower eyelids, rests approximately 2 mm higher than the medial canthal angle.

The surgeon should consider the integrity of the lacrimal drainage system following eyelid trauma. The puncta in the upper and lower eyelids are 8 and 10 mm lateral to the tear sac, respectively. If trauma occurs medial to this point, there is a higher probability of damage to the lacrimal system. The canaliculi are buried within the orbicularis muscle. The canaliculi are vertical for the initial 2 mm, before each becomes horizontal at a right angle dilation termed the ampulla.

The levator muscle is the primary elevator of the upper eyelid. Following trauma, the levator may become disinserted from the tarsus. This dehiscence, which may be detected by recognizing the white aponeurosis that retracts on attempted upgaze, should be repaired.

Reconstruction of eyelid defects requires adherence to basic surgical principles. If adequate tissue is not available for direct closure, repair will involve mobilizing local tissue or providing graft material. For full-thickness eyelid repair, the two main layers, the anterior and posterior lamellae, must be preserved. Free grafts can be used to supplement either the anterior or posterior lamella, but separate free grafts should not be used to reconstruct a single full-thickness eyelid.

Clinical Evaluation

History

While the immediate cause of an eyelid defect is usually not difficult to elicit, several circumstances can determine how the preoperative evaluation proceeds. Following trauma, the mechanism of injury can determine the depth of the wound and whether a foreign body is present. Decreased visual acuity can suggest an injury to the globe or optic nerve. Orbital fractures may be associated with diplopia, hypesthesia, abnormal globe position, epistaxis, or pain during eye or jaw movement. If the injury is caused by an animal bite, the rabies immunization status of the animal should be determined. If the wound follows removal of a tumor, the surgeon should confirm that all margins are free of tumor.

A history of injury or surgery to the eyelids should be elicited. Patients with prior surgery or trauma may have atypical anatomic landmarks. The patient should be asked about any irregular wound healing that has taken place in the past.

A history of any prior ocular injury should be determined, along with known allergies and a list of medications.

Examination

A thorough ophthalmologic examination should be performed on all patients with ocular or orbital trauma. Often a wound appears to be superficial, but examination reveals a deeper track into the orbit or eye. When a laceration occurs to the eyelids, it is often easily recognized. However, concurrent blunt trauma may cause additional fractures, tendon and other soft tissue injuries, and numerous intraocular defects. The surgeon should perform a full evaluation of the eye, followed by inspection of the surrounding soft tissue adnexa, orbit, and face.

The examination should begin with evaluation of the eye. Visual acuity, pupillary response, and intraocular pressure should be checked. Slitlamp and dilated fundus examinations should be completed. Eyelid edema and patient discomfort may limit the surgeon's ability to assess the globe, and evaluation may need to be repeated as the tissue heals.

Evaluation of the soft tissue adnexa should confirm the depth and extent of lacerations. If the lid margin is involved, the posterior lamella should also be inspected and the length of the laceration documented. Eyelid position and function should be examined, although edema and discomfort may limit the surgeon's ability to assess levator function. If fat appears within the depths of a wound, the surgeon can assume that the septum has been violated, and there is a higher possibility that the orbit is involved.

The canalicular system should be closely examined for laceration in the vicinity. If a laceration is present, often the severed canaliculus can be visualized. If there is any doubt about whether the canaliculus has been severed, the system should be probed and irrigated. Even if there is a suggestion of blunt trauma to the area, probing and irrigation are appropriate to assess the continuity of the lacrimal system.

Displacement or "rounding" of the canthal angles suggests injury to the canthal tendons. If the medial canthus is displaced, there is a greater incidence of canalicular injury. Lateral displacement of the punctum is another sign of canalicular damage.

Orbital examination involves assessing extraocular muscle function in all fields of gaze. Hypesthesia of the cheek should be tested. The orbital rim should be palpated to detect a bony deformity. Proptosis and significant tightness of the eyelids may indicate orbital hemorrhage. Abnormal globe position (particularly hypophthalmos) may indicate a fracture. Pain upon chewing or opening the mouth, or depression of the malar eminence of the cheek, may be associated with a zygomatic fracture. If fracture or foreign body is suspected, a CT scan with direct axial and coronal views with 3 mm cuts should be obtained prior to eyelid reconstruction.

Diagnostic Testing

Following appropriate examination, the surgeon determines the extent of the eyelid defect. If only the anterior lamella is injured, appropriate repair may include simple closure, harvesting and placement of a skin graft, or mobilization of a skin flap. For a full-thickness laceration with minimal or no tissue loss, direct closure with the classic three-suture technique should be attempted. For larger defects with significant loss of both lamellae, advanced reconstructive techniques are necessary.

The surgeon's first choice of closure of large defects is usually to mobilize local tissue. In younger individuals with good skin tone and minimal skin and tendon laxity, little local tissue is available for mobilization. In older individuals, large defects may be closed with direct closure or development of small flaps.

The surgeon should assess the patient's skin tone and quality. Patients may have minimal skin available for flap formation if they have had prior surgery, trauma, or radiation treatment, or have certain dermatologic conditions.

Clinical Decision Making

Most simple skin lacerations can be repaired by direct closure. When possible, the direction of the incision or repair should be along the relaxed skin tension lines, to allow a less obvious scar. Care must be taken not to evert the eyelid margins when large horizontal wounds are closed.

Full-thickness eyelid lacerations can be repaired by direct closure. If the wound edges are irregular, they should be excised with scissors, and the wound prepared in a pentagonal wedge configuration. The edges can then be closed with the classic three-suture or other techniques.

For lacerations to the canalicular system, the canaliculi should be inspected and intubated with Silastic tubing. When the tubing is placed under light tension, the wound edges move into close apposition. Although there is no tarsus present medial to the punctum, similar closure of the margin defect is performed with multiple superficial sutures, as well as absorbable sutures placed through the canthal tendon (Fig. 6.1).

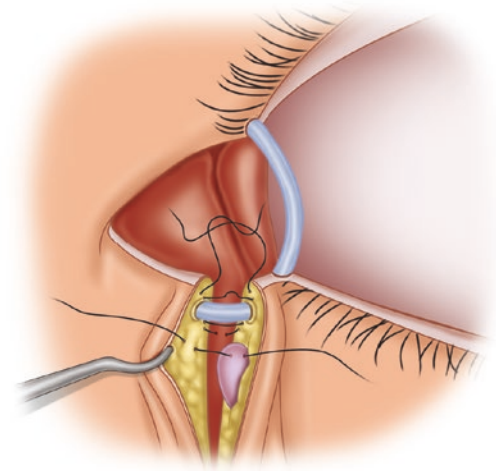

Fig. 6.1 After the canalicular system has been intubated and before skin sutures are placed, the tendon and canaliculus are sutured

For a small defect (25%) of an eyelid, direct closure is usually appropriate to bring wound edges together without placing excessive tension on the sutures. In young patients, however, repair of even a small defect may require the assistance of other methods. The surgeon can always assess the availability of tissue for direct closure by grasping the wound edges with forceps and gently drawing them together. If the edges can be apposed easily, then adequate tissue is present.

For most moderate (≤40%) eyelid defects in older adults, and for small defects in younger patients, the lateral wound edge may be mobilized by releasing the attachment of the lateral canthal tendon from the orbital rim. Lateral canthotomy involves incising the common crus of the canthal tendon, which provides a small amount of mobility to the lower eyelid. Inferior cantholysis releases the corresponding canthal tendon from its attachment to the orbital rim. Cantholysis is a "titratable" procedure. As more canthal fibers are incised, the eyelid gains significant mobility.

Defects that are too large to be closed by canthotomy and cantholysis may be closed with a lateral semicircular flap. This method is based on the concept of the canthotomy and cantholysis, but it additionally mobilizes skin lateral to the lateral canthus. The semicircular flap may be used to reconstruct defects up to 50% of the eyelid in adults.

In larger defects that cannot be closed by advancement of lateral tissue, typically following over 50% horizontal eyelid loss, tarsoconjunctival flaps may be created. For full-thickness upper eyelid deficits, a lower eyelid flap may be created from the lower lid. This procedure, known as a Cutler-Beard bridge flap, advances skin, muscle, and conjunctiva to the upper defect. To maintain stability of the upper lid, an autogenous cartilage graft may be placed anterior to the conjunctival layer.

For full-thickness lower eyelid reconstruction, a flap of tarsus, and conjunctiva from the upper lid may provide adequate posterior lamella (Hughes procedure). Because the upper tarsus has approximately 10 mm vertical height, transfer of a small segment should not significantly alter the integrity of the eyelid. Skin may be advanced superiorly from the remaining lower eyelid or grafted from the upper lid or postauricular region.

Reconstruction of the medial canthal area is often complex because of the presence of the lacrimal drainage system. Medial canthal repair of large defects may require formation of a tarsoconjunctival flap from the upper eyelid, with a full-thickness graft to replace the skin deficit. Repair with a flap is often difficult because of the contour of the region and a lack of adequate skin that can be mobilized from surrounding areas. Contralateral upper eyelid skin or postauricular skin is usually the best match. When small medial canthal defects are present, the surgeon may choose to allow the region to heal by secondary intention. When proper wound care is followed, this area heals remarkably well. If an unacceptable scar results, the scar can be excised and reconstruction initiated.

Management

Medical Treatment Options

Prior to reconstruction, the wound should be kept moist with antibiotic ointment, and the cornea protected from exposure. Frequent application of lubricating drops or ointment to the ocular surface is recommended.

Some areas of the face heal well by secondary intention. These areas include the concave areas of the nose and ears, the temporal and glabellar regions, and the medial canthus. If a large defect is present, partial wound closure with "purse string" sutures may decrease healing time. The wound should be kept moist with antibiotic ointment until complete epithelialization has occurred, which may require several weeks or months. The wound should be cleaned twice a day to remove debris and crusting. If the healing by secondary intention is unfavorable, the process may be interrupted at any stage and reconstruction initiated.

Surgical Treatment Options

Most surgical procedures are performed in the operating room under intravenous sedation. Local anesthetic, 2% lidocaine with epinephrine, is provided subcutaneously. Appropriate sterile prep and drape is performed for all patients.

Pentagonal Resection of an Eyelid Tumor, with Direct Closure

Direct closure of small full-thickness eyelid wounds following mass excision can commonly be performed in patients who have moderate or marked eyelid laxity. The same classic three-suture technique should also be performed for full-thickness eyelid lacerations involving the margin when there is no significant tissue loss. This method provides secure wound closure and eversion of the eyelid margin, allowing the edge to reform its smooth contour. During the initial repair, the wound edges should be converted into a pentagonal configuration by excising the irregular edges.

Prior to excision of a margin mass, the borders of the lesion are marked. If a malignancy is suspected, appropriate borders of normal-appearing skin are included in the resection (Fig. 6.2, Video 6.2). A #11 blade is used to create the vertical incisions through the margin. The incisions are initiated along the inferior aspect of the vertical markings and advanced through the entire eyelid, with attention to the globe, to avoid damaging it. The blade is advanced superiorly through the margin, to create a smooth wound edge. If the entire vertical arm of the incision is not completed, the blade may be reversed and the cut extended inferiorly to the appropriate level. Westcott scissors are used to complete the pentagonal incision.

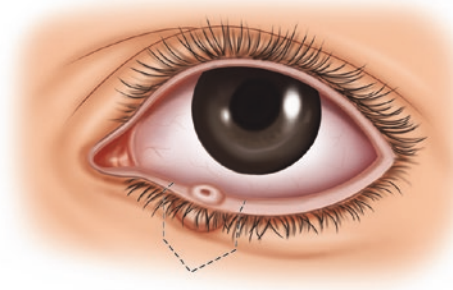

Fig. 6.2 The mass is outlined with appropriate margins in the form of a pentagon

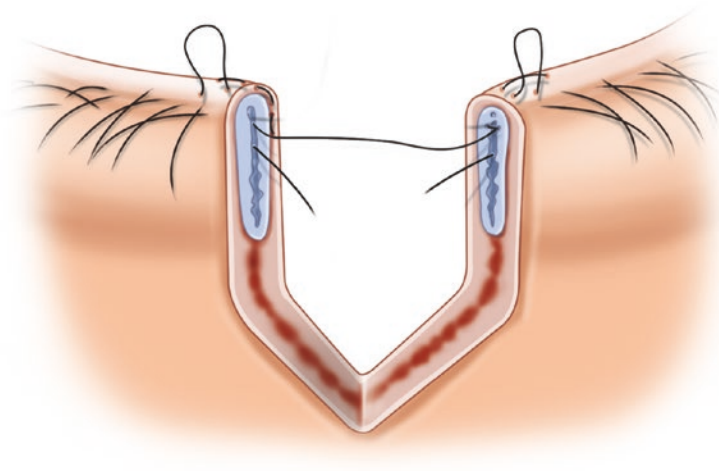

Fig. 6.3 A 6-0 Vicryl suture is placed at the eyelid margin and at the anterior row of lashes

Margin repair involves placing a 6-0 Vicryl buried horizontal mattress suture in the eyelid margin just posterior to the midline. The initial bite of the suture is approximately 1.5 mm from the wound edge placed from deep to superficial. The needle is reversed and passed from superficial to deep 2.5 mm from the wound edge. The second arm of the suture is passed in the same fashion on the opposite side of the defect (Fig. 6.3).

It is important to place the sutures on opposite sides of the defect at the exact same depth. This will align the eyelid margin perfectly. The sutures are not tied immediately. The surgeon or an assistant can cross both ends of the suture to bring the margin together, verifying that the edges move into good position and that the wound will not be under excessive tension. If the margin is not properly aligned, the suture should be removed and passed again. If excessive tension persists, other reconstructive techniques should be implemented.

The surgeon can tie the margin suture to verify that the wounds are under minimal tension and have appropriate alignment. The tarsus is closed with one or two simple interrupted 6-0 Vicryl sutures, placed in the partial-thickness manner to avoid irritation to the cornea. For upper eyelid wounds, an additional suture may be used to stabilize the larger tarsus. These tarsal sutures generally provide adequate deep tissue support for the entire wound, and additional deep sutures are not necessary. An additional 6-0 Vicryl suture is now place in a simple fashion at the anterior row of lashes. The eyelid margin should be slightly everted at this point. During the healing phase, as the scar contracts, the margin will become even. Several optional subcutaneous Vicryl sutures may be placed to provide additional support for skin closure. The skin is closed with running or interrupted 6-0 plain gut sutures. (Fig. 6.4). With this technique excellent eyelid margin eversion is achieved and suture removal is not necessary.

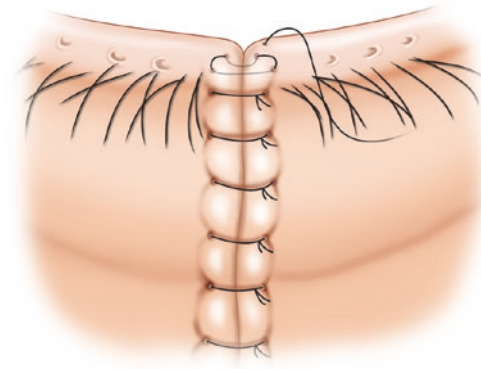

Fig. 6.4. Additional margin suture is place at the anterior lash line. Skin sutures are placed

Canthotomy and Cantholysis

When a significant part of the eyelid (approximately one-third) is absent and direct closure is not possible, additional horizontal lengthening is commonly necessary. This situation frequently occurs following removal of medium-sized tumors of the lower eyelid. One commonly performed option of mobilizing the tissue necessary for wound closure involves canthotomy and cantholysis. In these steps, the lateral canthus is incised (canthotomy) and the upper or lower crus partially or completely released (cantholysis) from the periosteum of the orbital rim.

Curved Stevens tenotomy scissors are used to incise the lateral canthus to the orbital rim, completing the lateral canthotomy (Fig. 6.5). Many surgeons prefer to initially "crush" the lateral canthus with a hemostat, which is placed horizontally at the lateral canthal angle with one of the instrument blades on the conjunctival surface and one on skin. The hemostat is advanced posteriorly until the lateral orbital rim is palpated and then is tightened for several seconds to compress the canthus. This maneuver may assist in hemostasis and allow an even incision along the tissue. However, this step is not mandatory.

While the canthotomy may provide several millimeters of horizontallaxity, it usually needs to be followed by cantholysis to provide adequate horizontal tissue mobility and to allow closure of lower eyelid defects. The lateral margin edge of the defect is then grasped with forceps or a small skin hook and pulled toward the opposite wound edge. If the edges are not in apposition, cantholysis should be performed.

The lateral portion of the eyelid can be grasped with forceps several millimeters from the canthotomy incision, and the lid gently stretched outward and medially, to place tension on the inferior limb of the lateral canthal tendon. With Westcott scissors placed through the canthotomy incision, the surgeon can palpate the canthal tendon between skin and conjunctiva. As small incisions are made through the tendon, the eyelid becomes more mobile, and the eyelid defect can be closed. After each incision of the tendon, the edges of the wound should be grasped with toothed forceps and the amount of overlap and tension of the defect tested. This portion of the operation is titratable, and often it is not necessary to incise the entire tendon (Fig. 6.6).

As with direct closure, approximately 2 mm of overlap with minimal or no tension is recommended. The margin defect is closed as a pentagonal wedge. No suture removal is necessary on the eyelid margin.

The new lateral canthal angle is re-formed with a simple interrupted 6-0 plain gut suture (Fig. 6.7). This suture is placed through the lateral edge of the upper eyelid margin, at the site of the previous lateral canthal angle. The suture is next placed through the conjunctiva and then through the skin of the lateral edge of the lower eyelid. When the suture is tied, the new lateral canthal angle is formed. Additional interrupted or running 6-0 plain gut sutures are placed to close the remaining lateral skin incision.

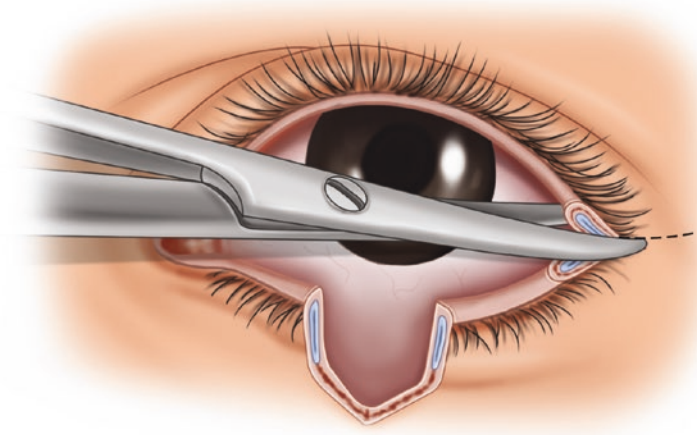

Fig. 6.5 A lateral canthotomy is completed with scissors

The reconstructed portion of the lower eyelid margin is reformed. One or more buried 6-0 plain gut sutures are placed through the skin edge and then through the conjunctival edge, and tied. These sutures allow the conjunctiva to cover the rough skin at the new lid margin and reduce the risk of abrasion to the eye. No suture removal is needed.

"Tenzel" Semicircular Advancement Flap

The semicircular temporal advancement flap allows the surgeon to mobilize a larger amount of tissue lateral to the defect than is possible with the canthotomy and cantholysis procedure. The semicircular advancement flap procedure is particularly useful when both sides of the wound contain tarsus. The incision begins at the lateral canthus and extends temporally in a semicircular manner. As the flap is rotated and closed, the wound flattens to correspond to the facial lines.

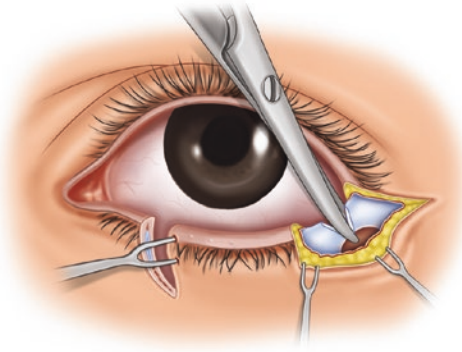

Fig. 6.6 A cantholysis is performed by stretching the eyelid medially and incising the corresponding canthal tendon

A semicircular temporal advancement flap is frequently developed following excision of lower eyelid neoplasms. Standard mass excision includes marking the borders with appropriate margins. The vertical incisions are created with a #11 blade, passed full thickness through the edges of the wound. The blade is advanced superiorly, through the margin, to create smooth, even wound edges. Westcott scissors are used to complete the removal of the lesion. The specimen is marked with suture to clarify the proper orientation, and the specimen is sent to the pathology department for review.

When the surgeon is ready to reconstruct the eyelid, the edges of the tissue are gently advanced together with forceps, to estimate the sizes of the defect and to determine whether additional tissue needs to be mobilized for closure. The wound should be trimmed to form a pentagon before a Tenzel flap is mobilized.

A curved line is marked on the skin beginning at the lateral canthus. For lower eyelid flaps, the incision should arch superiorly; and for upper eyelid flaps, the incision should arch inferiorly (Fig. 6.8). A typical flap extends two-thirds of the distance from the canthus to the hairline, but

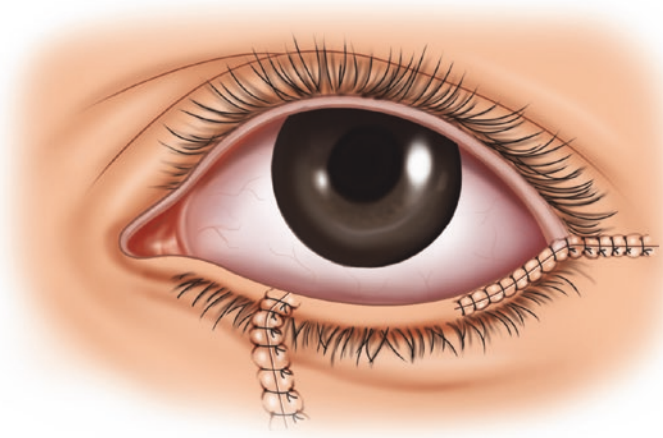

Fig. 6.7 The eyelid defect is closed in the same manner as with a pentagonal defect. The lateral canthal angle is reformed, and the skin edges are closed. Suturing conjunctiva to the skin edge reforms the lateral eyelid margin

larger flaps may be created. A #15 blade is used to develop the incision through skin and muscle. The plane beneath orbicularis is dissected with scissors to mobilize the entire flap.

A lateral canthotomy is performed through the initial incision. The lower lid can be mobilized with cantholysis (Fig. 6.9). These maneuvers should provide significant mobility to the eyelid. If the wound edges still cannot be brought into apposition, further undermining of the flap may be performed to allow maximal rotation of the flap. When the wound edges can be apposed without tension, the eyelid margin is closed with a three 6-0 silk suture technique or other technique that has already been discussed.

The silk margin suture technique utilizes three 6-0 silk margin sutures. These sutures are placed at the posterior eyelid margin, the meibomian gland orifices, and at the posterior edge of the lash line. An assistant crosses one of the margin sutures to bring the eyelid into proper position, allowing the surgeon to tie the other margin sutures without significant wound tension. If the margin appears to have good contour, the final silk suture is tied. The ends of the sutures should not be cut at this time; rather, they should be used to place gentle superior retraction during the remaining closure of the margin.

One or two simple interrupted 6-0 Vicryl sutures are placed in a partial-thickness manner through tarsus, and tied. Several simple interrupted subcutaneous inverted 6-0 Vicryl sutures are placed to reduce tension on the skin edges. Running or simple interrupted 6-0 plain gut sutures are used for skin closure. A simple interrupted 6-0 silk suture is tied loosely over the skin, approximately 5–7 mm from the margin. The ends of the silk margin sutures are rotated inferiorly and tied to the recently placed silk skin suture, to prevent the margin sutures from irritating the globe.

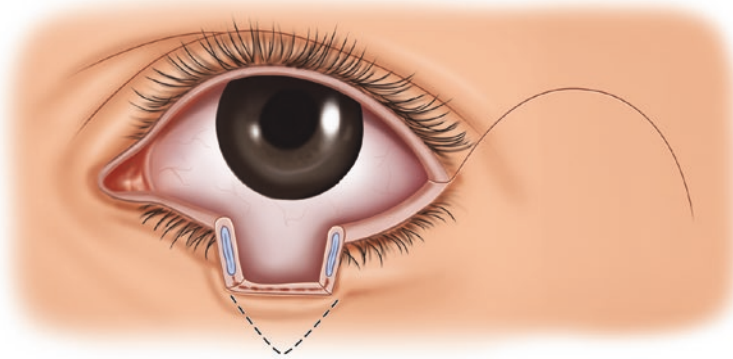

Fig. 6.8 A large eyelid defect is trimmed to form a pentagon. The lateral canthal incision is marked

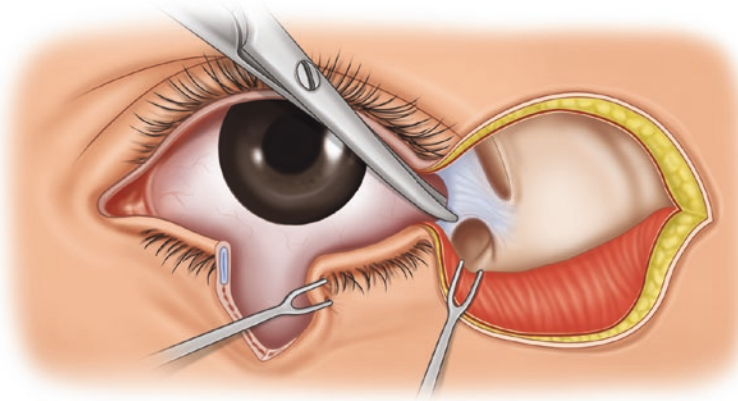

Fig. 6.9 A skin-orbicularis flap is elevated. A lateral canthotomy and cantholysis are completed, and the eyelid is mobilized

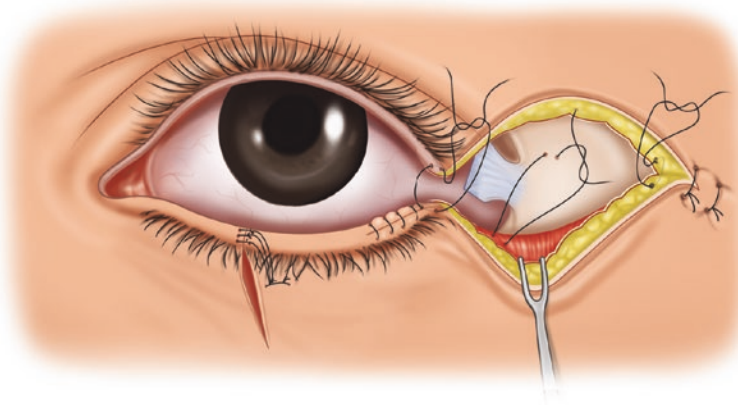

Fig. 6.10 The defect is closed with the classic three-suture technique. The lateral canthal angle is recreated, and joining the edges of conjunctiva and skin re-forms the lateral eyelid margin. The orbicularis is secured to the periosteum

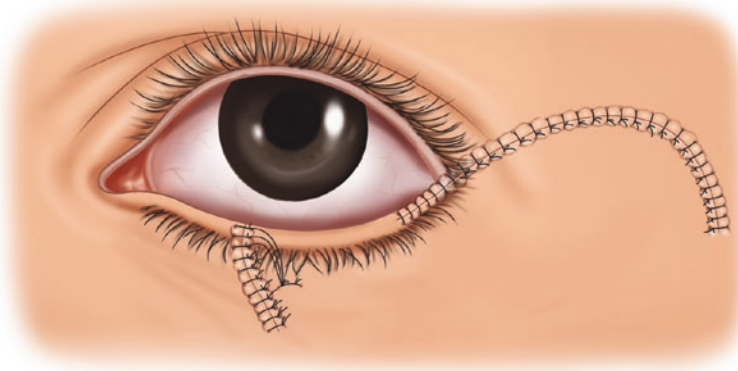

Fig. 6.11 Skin sutures are placed, closing both wounds

The new lateral canthal angle is formed by passing a 6-0 plain suture from the skin edge, through a lateral remnant of palpebral conjunctiva, and through the lateral edge of the normal upper eyelid (Fig. 6.10). The posterior aspect of the newly rotated advancement flap is composed of muscular tissue. The underlying conjunctiva should be undermined and advanced to the edge of the flap to form a new margin. The new eyelid margin is formed by passing several buried simple interrupted 6-0 plain gut sutures from the skin edge through the remaining palpebral conjunctiva. Mucous membrane grafting using a free conjunctival or buccal mucosal graft is an alternative means of preparing the posterior surface of the flap.

To prevent retraction of the newly reconstructed eyelid, a 5-0 Vicryl suture is passed from subcutaneous tissue of the flap to the periosteum of the lateral orbital rim. When this suture is tied, mild over-correction of the eyelid should exist. Several inverted simple interrupted 6-0 Vicryl sutures are placed in the subcutaneous plane of the skin, and the skin edges are closed with running or multiple interrupted 6-0 plain gut sutures (Fig. 6.11, Video 6.3).

Upper Eyelid Tarsoconjunctival Reconstruction (Cutler-Beard)

The "Cutler-Beard" bridge flap is useful for reconstructing large upper eyelid defects, particularly those that are located centrally. The upper wound edges are trimmed and made perpendicular to the margin, and the lower eyelid flap is developed (Video 6.4).

The lower eyelid skin is carefully marked, beginning 4 mm inferior to the margin, to avoid

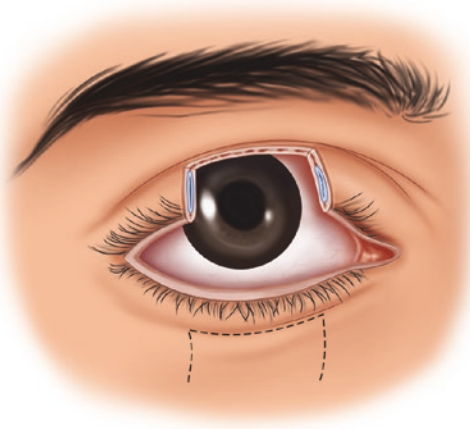

Fig. 6.12 A large central upper eyelid defect is trimmed and a lower eyelid bridge flap is outlined to the same width

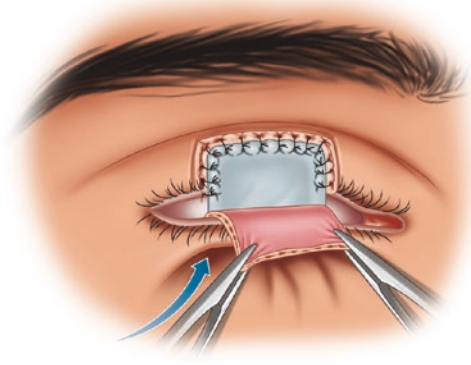

Fig. 6.13 The conjunctival layer may be closed with interrupted 6-0 plain gut sutures. The levator may be sutured to the orbicularis layer, or a cartilage graft may be placed over conjunctiva and secured to the tarsus and levator

incising the marginal arterial arcade (Fig. 6.12). A corresponding mark is made on the conjunctival side of the eyelid. The horizontal length of the flap should equal the width of the upper defect. At the ends of the skin marking, vertical lines are extended inferiorly.

The incision through skin and orbicularis is made with a blade. The eyelid is everted, and the same blade is used to make a corresponding incision through the conjunctiva and tarsus. The two incisions are joined with sharp Westcott scissors. This process of making two incisions helps the surgeon to avoid damaging the marginal arcade. With the same scissors, the full-thickness incision can be extended horizontally in both directions to the predetermined edges of the flap. The surgeon must remember to remain 4 mm from the margin at all times during the incision.

The lower eyelid bridge that is developed is important in retaining the normal appearance and function of the reconstructed lower eyelid. At the ends of the horizontal incisions, vertical full-thickness incisions are made inferiorly, forming a lower eyelid advancement flap. This flap is gently placed under the lower eyelid bridge and then placed into the upper eyelid defect. The flap must fill the defect and have no significant inferior traction. Additional lower eyelid tissue may be advanced by extending the vertical incisions.

The conjunctiva of the upper edge of the wound is gently pulled inferiorly with forceps. The skin edge may be retracted superiorly by the assistant. Upon separating the tissue plains, the white edge of the levator can be identified above the conjunctiva.

Three layers of closure are recommended for this procedure. The upper eyelid conjunctiva is connected by multiple interrupted 6-0 plain gut sutures to the conjunctiva of the bridge flap (Fig. 6.13). Some surgeons may elect to place a cartilage graft to provide additional stability to the eyelid. If a graft will be placed, the lower eyelid conjunctiva should be gently separated from the overlying tissue for several millimeters, to serve as a recipient site for the cartilage graft. Ear cartilage graft (or other suitable material) is harvested, trimmed, and secured to the levator (superiorly) and tarsus (sides) with 6-0 Vicryl interrupted sutures. The skin-orbicularis layer is closed with interrupted 6-0 plain gut suture.

If a graft is not performed, two additional layers of closure are planned. The middle layer of closure involves joining the remnant of the levator aponeurosis to the orbicularis muscle or the bridge flap. The superficial closure involves closing the skin.

The middle layer is closed with multiple interrupted 6-0 Vicryl sutures, connecting the

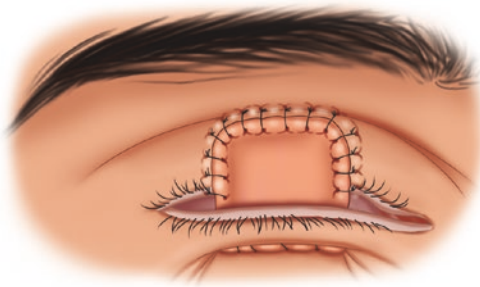

Fig. 6.14 Skin closure is completed with interrupted sutures

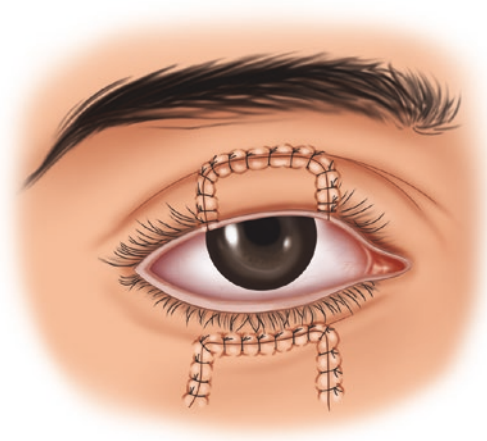

Fig. 6.15 After the bridge flap has been severed, it is reattached to the lower eyelid margin

orbicularis of the bridge flap to the levator aponeurosis at the upper aspect of the defect. This closure is important to ensure good movement of the reconstructed upper eyelid.

The skin is closed with multiple interrupted 6-0 plain gut sutures (Fig. 6.14). The surgeon should also pay attention to closure of the skin edges along the upper eyelid margin. The skin closure along the inferior portion of the advancement flap to the lower eyelid is completed at the medial and lateral edges. Direct closure of additional wounds that extend into the canthal regions should be performed with 6-0 plain gut suture.

The entire completed bridge flap can be seen under the bridge of normal lower eyelid tissue. A pressure dressing or bolster should be avoided, to ensure that the flap circulation is not compromised. The flap can be severed along the palpebral fissure and the eyelids reconstructed after approximately 3 weeks. The inferior margin of the bridge should be denuded with a blade or scissors and sutured to the upper margin of the skin flap with absorbable sutures (Fig. 6.15). The upper eyelid may be sculpted with thermal cautery; the margin will re-epithelialize within several days (Video 6.5).

Lower Eyelid Tarsoconjunctival Reconstruction (Hughes)

The Hughes tarsoconjunctival flap can be used to replace the posterior lamella in large lower eyelid reconstructions. The flap may be secured at its lateral and medial borders to existing lower eyelid tarsus or to a periosteal flap at the canthus. The tarsal flap is then covered by an advancement skin flap or graft (Video 6.6).

The lower eyelid tumor is identified, and several millimeters of normal-appearing tissue are marked. The skin is incised with a blade, and the tumor is removed with scissors. The lower lid wound edges are made perpendicular to the margin. If permanent or frozen section analysis of the margins is desired, the specimen is sent to pathology.

Temporary eyelid closure can be performed to protect the cornea and stretch the remaining eyelid skin, to prevent contraction. A 4-0 silk mattress suture is passed through the temporal portion of the remaining eyelid, then through the inferior and medial portions of the lid. The suture is tied over cotton bolsters. Once complete tumor removal has been confirmed, the mattress suture is removed.

The edges of the wound are debrided with a blade. The size of the defect is measured. The width of the upper eyelid flap should be wide enough to prevent horizontal tension on the closure. The flap is marked on the tarsal surface. The surgeon must leave at least 3.5 mm of tarsus on the upper eyelid, to allow proper stability.

A blade is used to make an incision through conjunctiva and tarsus (Fig. 6.16). Westcott scissors are used to dissect the tarsus from the overlying orbicularis. Once the tarsus is free, the surgical plane continues superiorly, just above

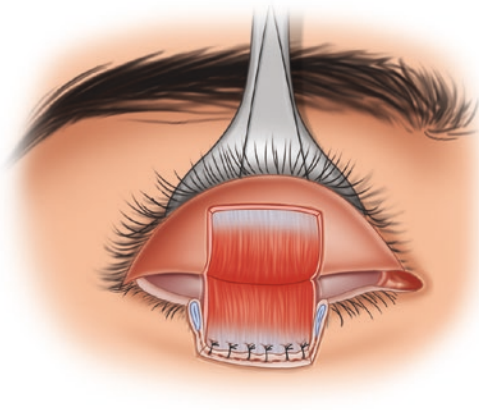

Fig. 6.16 A tarsoconjunctival flap is incised and dissected from upper eyelid to correspond in width to the width of the defect. It is sutured to the lower eyelid conjunctiva. A lower eyelid advancement flap is marked or a skin graft planned

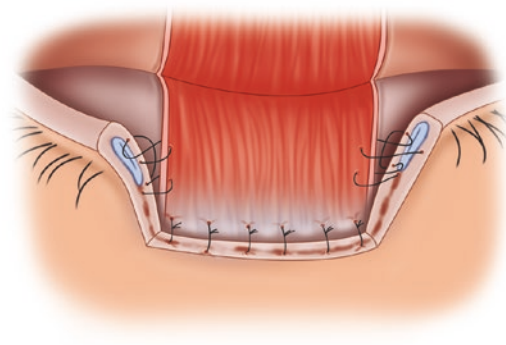

Fig. 6.17 The tarsoconjunctival flap is attached medially, laterally and inferiorly

the conjunctiva. To improve exposure, the surgeon gently pulls the tarsus inferiorly, and an assistant lifts the skin-muscle plane superiorly. The surgeon should be able to visualize the tips of the scissors through the conjunctiva at all times.

Vertical incisions along the lateral and medial edges of the conjunctival flap are made, to form a flap that will correspond to the lower eyelid defect. The flap should be positioned in the lower eyelid deficit. If upward traction persists, additional conjunctival dissection and extended lateral incisions should be performed. The inferior tarsal border of the flap is secured to the remaining conjunctiva of the lower eyelid defect with interrupted 6-0 Vicryl sutures.

The superior most portion of the tarsus in the advancement flap is secured to the medial and lateral remnant of the lower eyelid. Several 6-0 Vicryl sutures are place on each side. The tarsoconjunctival flap is secured in this manner on its lateral, medial, and inferior ends. The tarsus from the upper eyelid can be seen to align with the remaining tarsus of the lower eyelid (Fig. 6.17).

The tarsal flap can be covered with a sliding advancement skin flap developed from the eyelid and cheek inferior to the wound. Vertical incisions can be made inferiorly, from the vertical edges of the wound defect. The skin flap should not place inferior tension on the wound. Also, to reduce the chance of postoperative retraction, the flap should not incorporate muscle.

The superior aspect of the skin flap is tied to the upper aspect of the donor tarsus with multiple interrupted 6-0 plain gut sutures. The lateral edge of the skin flap must be correctly attached to the skin of the remaining eyelid margin with an interrupted 6-0 silk suture. A similar suture is placed medially to connect the skin flap to the medial eyelid margin remnant. The remaining skin edges can be closed with interrupted 6-0 plain gut sutures.

Alternatively a full-thickness skin graft can be prepared and secured. (Fig. 6.18). This is covered with a cotton Telfa bolster. The bolster is removed after one week.

The conjunctival bridge may be severed in 3–6 weeks (Fig. 6.19). The new lid margin may be sculpted with thermal cautery if any surface irregularities persist (Videos 6.7 and 6.8).

Medial Canthal Tumor Excision with Full Thickness Skin Graft

Closure of small medial canthal defects can usually be performed directly, or the areas can be allowed to granulate. The concavity of the region, and proximity to the eyelids and brow, are factors that limit the development of flaps for closure of larger defects. Skin grafts tend to provide adequate coverage and heal well for reconstruction of most medial canthal defects.

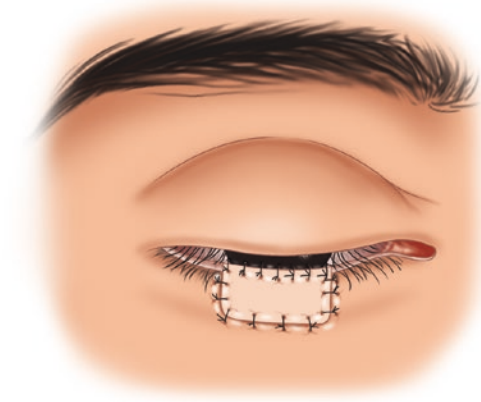

Fig. 6.18 A full thickness skin graft is sutured to the skin edges. This covers the upper eyelid flap

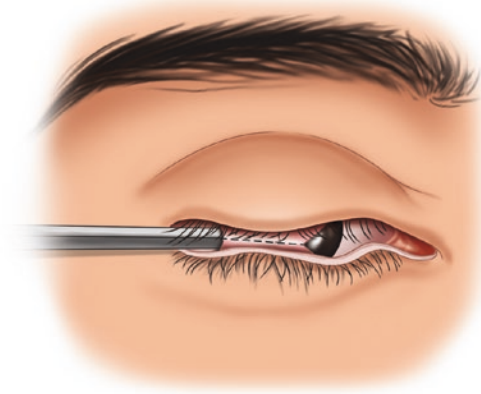

Fig. 6.19 In several weeks, the bridge is severed with scissors. A smooth, blunt instrument is placed behind the scissors to protect the eye

At the beginning of the procedure, the donor site is injected with 2% lidocaine with epinephrine and Marcaine 0.5% in the subcutaneous plane. The injection should hydraulically elevate the skin, to provide easy dissection later.

To excise a medial canthal mass, the surgeon first delineates the suspected location with a marking pen, allowing several millimeters of normal skin surrounding a suspected malignancy (Fig. 6.20). The specimen can be marked with sutures to provide correct orientation, and is sent for frozen section analysis. The depth of the dissection should be at least through the orbicularis muscle. Thorough hemostasis is mandatory.

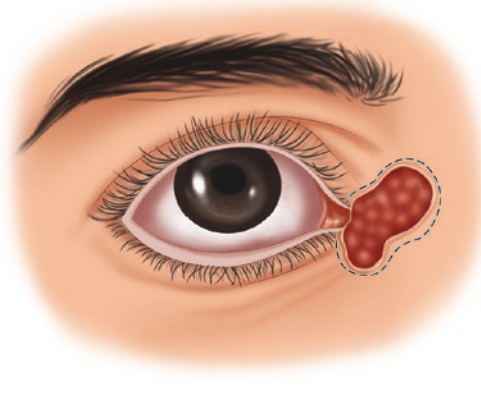

Fig. 6.20 A medial canthal tumor is marked with appropriate borders and excised

When a retroauricular skin graft is planned, a traction suture should be placed to hold the ear in position. A 4-0 silk mattress suture, placed through the skin over the outer aspect of the helix and the preauricular skin, is tied securely. This suture places the retroauricular skin in tension and provides excellent visualization. Skin for this area can also be harvested from the forearm or supraclavicular area.

A piece of Telfa is cut with scissors to match the size and shape of the medial canthal defect. This material will serve as a template for the graft. The template is placed over the donor site and outlined with a marking pen. To facilitate closure, "wings" may be added to the outline along the crease of the sulcus, forming an ellipse (Fig. 6.21). The ellipse is excised with a #15 blade and Westcott scissors. The surgeon should be careful to remove a thin graft, with little subcutaneous tissue. Excessive subcutaneous tissue will inhibit vascular ingrowth and lessen the chances for a successful graft.

Following removal of the graft, further thinning is performed. The graft must be handled with extreme care. The graft can be placed flat on the surgeon's gloved finger, with the subcutaneous side facing up. Westcott scissors, held parallel to the graft, are used to trim excess subcutaneous tissue from the underside of the tissue. If the graft begins to move or "bunch up," it should be placed flat again against the finger before more subcutaneous tissue is removed. If

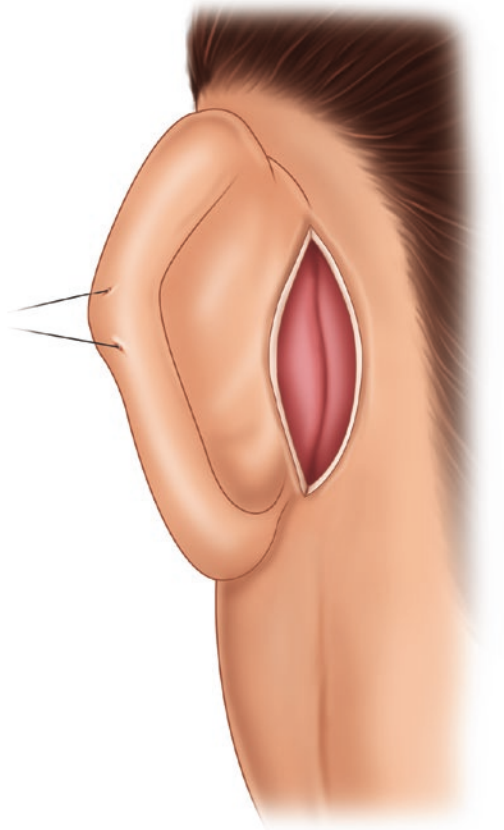

Fig. 6.21 A full-thickness skin graft can be harvested from the retro auricular sulcus, the supra clavicular area or the upper arm

the graft is not resting flat, the scissors may penetrate the surface and create a "buttonhole."

Multiple interrupted 6-0 plain gut sutures are used to secure the graft to the wound edges. Antibiotic ointment may be placed over the wound. Several 6-0 silk or nylon sutures are placed several millimeters away from the graft edge. The ends of these permanent sutures are left long, because they will be used to tie a cotton-Telfa bolster over the graft (Fig. 6.22). A small bolster may be held securely with only two sutures, but larger bolsters may require up to eight sutures. A small piece of Telfa is placed over the graft and covered by a wet piece of cotton. The permanent sutures are tied over the cotton; they will hold light pressure on the graft for the first postoperative week (Fig. 6.23).

An alternative method of securing the graft (as seen in the video) involves placing the same cotton Telfa bolster over the graft. One-half-inch-wide steristrips then cover and place pressure on the bolster. A folded eye pad or 4 by 4 is placed over this and taped in place for extra pressure. The outer dressing is removed in 2 days and the bolster in 7 days.

Closure of the retro auricular area is with 5-0 chromic sutures, placed in a near-far-far-near or

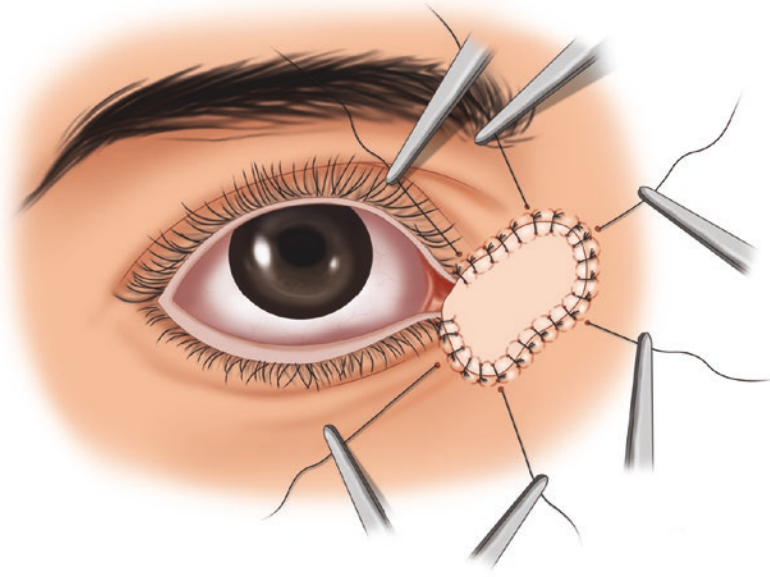

Fig. 6.22 A skin graft is sutured over the wound. Multiple 6-0 silk sutures, placed several millimeters from graft, will be used to secure the bolster

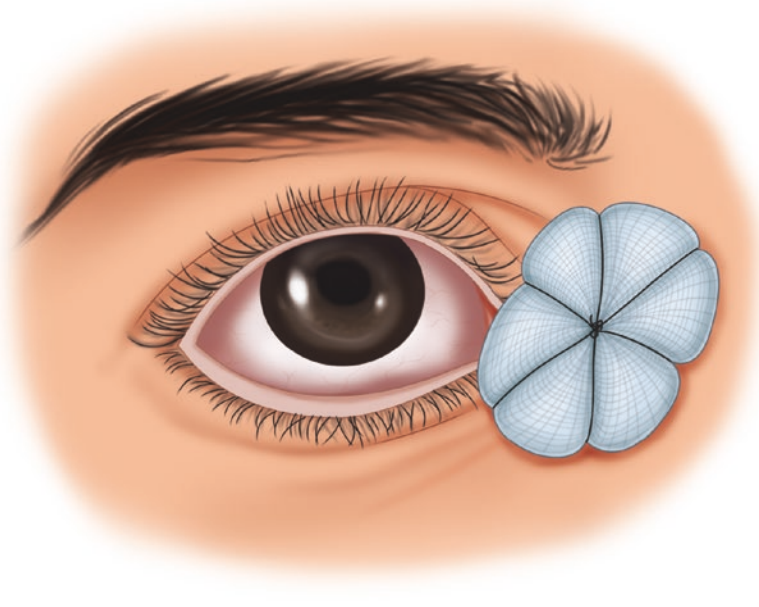

Fig. 6.23 A bolster is secured over the skin graft

other tension-reducing pattern. The wound is covered with antibiotic ointment, and a Glasscock-type dressing is placed on the ear. This dressing places mild tension on the ear, to reduce the incidence of postoperative bleeding.

The upper arm graft site is closed with several subcutaneous 4-0 Vicryl sutures. The skin is closed with a running 5-0 nylon suture or staples. These are removed in 2 weeks.

Floppy Eyelid Syndrome

7

Kathryn P. Winkler and Geoffrey J. Gladstone

Floppy eyelid syndrome (FES) is an eyelid malposition characterized by increased horizontal eyelid laxity. Patients most often present with complaints of mucus discharge and ocular irritation, which is worse and more frequent upon awakening. There is a papillary conjunctivitis, most prominent on the upper tarsal conjunctiva, and the upper eyelid is easily everted with upward traction on the lid.

Etiology

The etiology of FES is likely multifactorial. There is evidence of decreased elastin in the tarsal plate as demonstrated by histopathologic examination. Additionally there may be a possible upregulation of matrix metalloproteinases. FES is associated with numerous disorders. Most commonly, the condition is associated with an obese body habitus and obstructive sleep apnea (OSA). It is thought that patients with OSA often have a preference for sleeping prone and have interrupted and disturbed sleeping patterns, which results in mechanical stretching, rubbing and irritation of the upper lids on the bedsheets, resulting in papillary conjunctivitis. Often, patients will have a preference for a left or right head position or a face down position while sleeping, causing the lashes to point in the opposite direction of the preferred head position or straight down. The co-occurrence of OSA and FES is an important association of which to alert patients and their primary care physicians due to the morbidity and mortality associated with OSA. It is important to note, however, that FES may occur in the absence of OSA or obesity. Other associations include Down syndrome, keratoconus, frequent eye rubbing, hyperglycemia, blepharoptosis, and dermatochalasis.

Examination

During examination it is important to note any mucus or mucoid discharge along the lashes. Upward traction on the upper eyelid will result in easy eversion, particularly with temporal traction. There is eyelid laxity, as defined by an

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increase in distraction of the eyelid from the globe. A papillary conjunctivitis and hyperemia of the conjunctiva on the palpebral conjunctiva of the upper lid is most often present. Occasionally there is an associated punctate keratitis, worse on the superior cornea. The tarsal plate is rubbery, floppy, and flaccid. Often, the lids will demonstrate eyelid imbrication as well.

Surgical Management

Conservative management includes lubrication, patching, or using a shield over the eye while sleeping. Occasionally, if FES is associated with OSA, symptoms will improve with the initiation of CPAP. This is presumably because the patient sleeps in a supine position with less disrupted sleep.

When conservative measures fail, surgical intervention with horizontal tightening of the eyelid is indicated. Blepharoptosis repair alone with a levator advancement is not sufficient for improving the ptosis associated with FES. The horizontal tightening procedure involves excision of both tarsus and skin, although in different amounts. The skin is marked with a T-shaped planned incision.

The horizontal component measures approximately 25 mm and the vertical component approximately 15 mm (Fig. 7.1, Video 7.1). These measurements may vary depending on how much horizontal tightening is desired. The vertical incision mark should be lateral to the cornea to avoid any post-operative irritation from sutures. A #15 Bard-Parker blade is used to incise the skin along the previously placed markings. Skin flaps are elevated medially and laterally to the vertical incision. A full thickness eyelid incision extending from the margin to just superior to the superior tarsal border is made using a #11 blade. This incision in the tarsus should be just deep to the vertical skin incision. The medial lid is then distracted laterally to overlap the lateral lid in order to determine the amount of eyelid shortening needed. The amount of tarsus to be excised should be judged intra-operatively. Care should be taken to ensure the punctum is not distracted laterally by more than several millimeters. Once the amount of tissue to be excised is determined, the margin is marked with a #11 blade. A full thickness tarsal incision is then carried out from margin to just superior to the superior edge of the tarsus. Westcott scissors are then used to complete the excision in a pentagonal wedge fashion.

The margin is then approximated with a vertical mattress, inverted, buried, interrupted 6-0 Vicryl suture at the grey line (Fig. 7.2). The tarsus is then approximated using two partial thickness 6-0 Vicryl sutures. It is important these remain partial thickness to avoid irritation to the cornea. The lash line is then approximated with a simple interrupted 6-0 Vicryl suture.

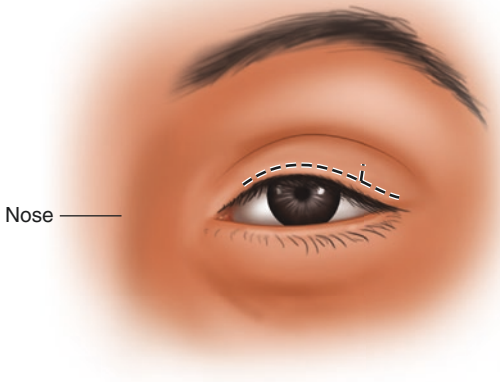

Fig. 7.1 Incisions for floppy eyelid repair

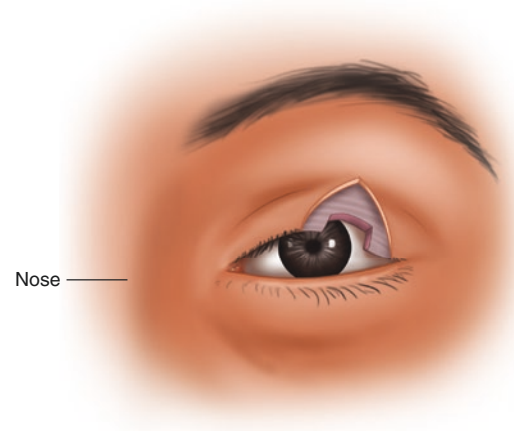

Fig. 7.2 Eyelid margin and tarsus are excised

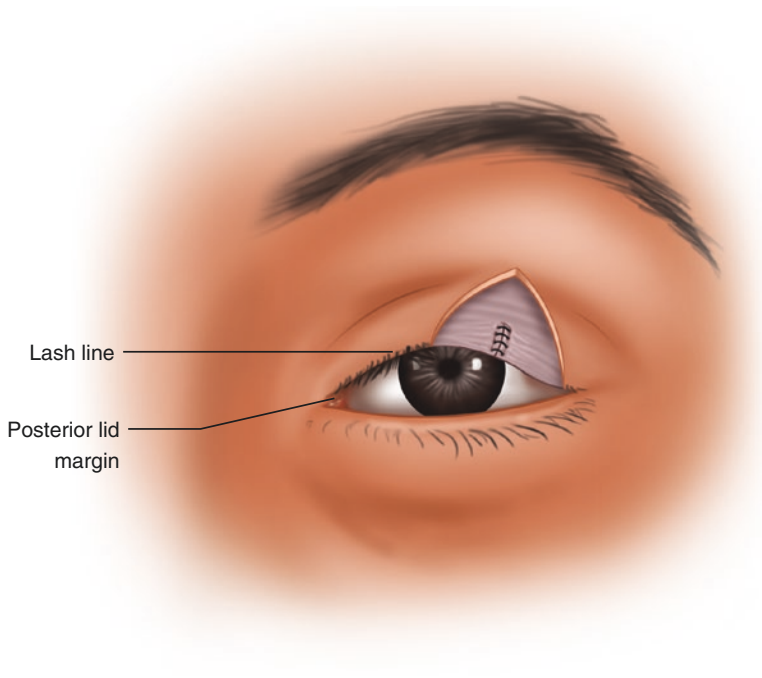

Fig. 7.3 The margin should be well approximated with slight eversion

The margin should be well approximated with slight eversion (Fig. 7.3). The amount of skin to be excised is then determined in an overlap technique similar to the previous tarsus overlap technique.

The amount of skin excised is typically significantly less than the amount of tarsus excised (Fig. 7.4). The skin is excised using Westcott scissors. The inferior edges of the flaps are sutured using a 6-0 plain gut suture. These edges are then attached to the inferior edge of the incision with the same 6-0 plain gut suture, which is then tied and cut with a small tail. The remainder of the incisions are closed using a running or interrupted 6-0 plain gut suture.

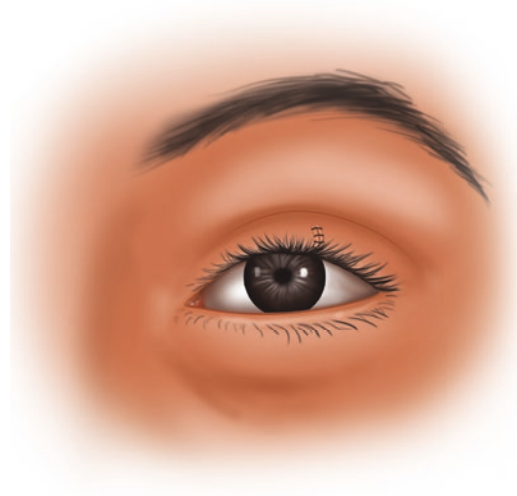

Fig. 7.4 Skin is redraped, excised, and sutured

Lacrimal Disorders

8

Geoffrey J. Gladstone, Timothy Ekhlassi, and Kathryn P. Winkler

3-Snip Punctoplasty

Epiphora can be caused by a stenosis of the punctum and vertical canaliculus. A single vertical incision in the canaliculus will allow access to the lacrimal system, for irrigation or tube placement, but restenosis will occur promptly. A 3-snip punctoplasty removes the internal wall of the vertical canaliculus allowing similar access and restenosis will not typically occur (Video 8.1). Mitomycin C can be applied at the end of the procedure to increase the success rate.

The skin just anterior to the vertical canaliculus and the conjunctiva beneath it are injected with a 50:50 mixture of Lidocaine 2% and Marcaine 0.5%. The punctum and proximal canaliculus are dilated with a punctum dilator. A sharp Westcott scissors is inserted into the vertical canaliculus and moved far laterally and a vertical incision made. The internal wall of the canaliculus is grasped with a fine-toothed forceps and the scissor moved far medially and an additional vertical incision made. A final horizontal incision is performed at the base of the vertical canaliculus removing the tissue. The entire internal, vertical wall of the canaliculus is removed (Fig. 8.1). No cautery is used. If desired, a two-minute application of 0.05% mitomycin C can be applied with a cotton tip applicator and the area then irrigated to remove residual mitomycin.

Endoscopic Dacryocystorhinostomy

Goals and Principles

Endoscopic dacryocystorhinostomy (EDCR) is a surgical procedure that bypasses an obstruction of the nasolacrimal duct by creating an alternate passage from the lacrimal sac to the nasal cavity. It is usually performed to alleviate excessive tearing or discharge secondary to this partial or complete nasolacrimal duct obstruction. It can be performed after a failed previous DCR or in a patient without previous surgery (Video 8.2).

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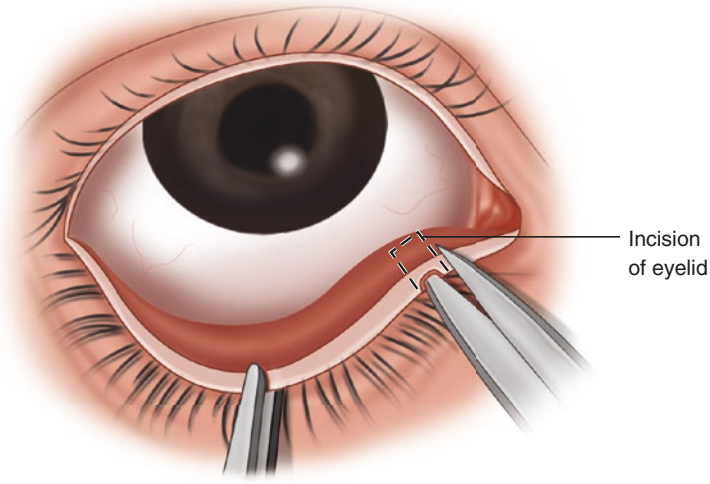

Fig. 8.1 Scissors placed inside vertical canaliculus. Area of tissue to be removed is indicated

A DCR can be performed either externally, with a skin incision, or internally via an EDCR or a transcanalicular DCR. The main advantage of an EDCR, as opposed to an external approach, is the lack of a visible scar resulting from an EDCR. Many studies have reviewed the success rates of external DCR versus EDCR with varying results. Many larger studies have found similar success rates between the two procedures. For experienced endoscopic surgeons, the surgical time of an EDCR may be less than that of an external DCR.

Because a skin incision is not necessary, an EDCR can be performed in a patient with an acute dacryocystitis. However, an attempt to resolve the acute dacryocystitis with oral antibiotics is typically made prior to surgical intervention. An endonasal examination using an endoscope is performed prior to surgery to look for septal deviation and intranasal tumors. A significantly deviated nasal septum may require a septoplasty prior to the EDCR. Insufficient intranasal room makes the EDCR procedure difficult. Before surgery, various tests are performed to evaluate the lacrimal system. These include lacrimal irrigation and probing of the cannaliculi, basic secretor testing, and palpation of the lacrimal sac looking for discharge.

Preoperative Management

To minimize bleeding during surgery it is ideal to stop a variety of medications prior to surgery. These include aspirin, cox-1 non-steroidals, Coumadin, Plavix, and any other medications that inhibit hemostasis. When prescribed by another physician, these should not be stopped without their consent. It is important to ascertain how long the patient may be off these medications and how soon after surgery it is appropriate to restart them.

Anesthesia

The patient is asked to clear their nasal passage approximately 30 min prior to surgery. Two sprays of a nasal decongestant, 0.05% oxymetazoline, are administered to the nasal cavity on the surgical side. After 5 min, administration of nasal decongestant is repeated. The patient is then brought into the operating room and sedated. While most patients tolerate the procedure under monitored intravenous sedation, some patients require general anesthesia. Under sedation, 18 in. of half-inch gauze soaked in 4% cocaine solution is packed in the area of the middle turbinate for 5 min. Local anesthesia using a 50:50 mixture of 2% lidocaine with 1:100,000 epinephrine with 0.5% bupivacaine with 1:200,000 epinephrine is injected into the conjunctiva of the upper and lower eyelids adjacent to the puncta. The nasal packing is removed and a 4 mm zero-degree endoscope is

brought into the field. The same local anesthetic mixture is administered under direct endoscopic visualization to the mucosa of the anterior middle turbinate, uncinate process, lateral nasal wall, and nasal septum. The injection is given under direct visualization with the endoscope and blanching of the mucosa is noted. With the endoscope, another strip of cocaine-soaked gauze is placed between the lateral nasal wall and middle turbinate for at least five more minutes. This will further shrink the mucosa and provide more working area during surgery. Hemostasis is the most important factor in maintaining an excellent view during endoscopic lacrimal surgery.

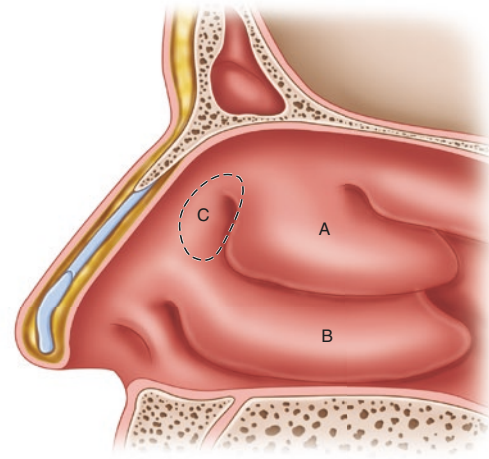

Fig. 8.2 Middle turbinate (A). Inferior turbinate (B). Area of bone and mucosa to be removed (C)

Mucosa Removal

The nasal packing is removed and the endoscope is placed within the nose. Occasionally, the middle turbinate is infractured with the blunt end of a periosteal elevator to enable an unobstructed view of the uncinate process and avoid blocking of the ostium. This maneuver is performed gently to avoid potential CSF leaks, as the middle turbinate attaches directly to the cribriform plate superiorly.

A guarded monopolar cautery on a pure coagulation setting is used to cauterize the nasal mucosa of the lateral nasal wall just anterior to the middle turbinate from the attachment of the turbinate to the inferior edge of the turbinate. The boundaries for cautery extend 10 mm anterior to the uncinate process and 10 mm inferior to the root of the middle turbinate (Fig. 8.2). Care is taken to avoid cautery of the middle turbinate. Alternatively, a sickle blade may be used to incise the mucosa and an elevator can be used to elevate a mucosa flap. The cautery is advantageous for its hemostatic properties (Fig. 8.3).

Once cauterized, the mucosa is removed with the sharp edge of a periosteal elevator in a downward motion exposing the underlying bone. A Blakesley or Takahashi forceps is used to clear any mucosal fragment still in the way. Clearing the mucosa reduces bleeding during bone removal (Fig. 8.4).

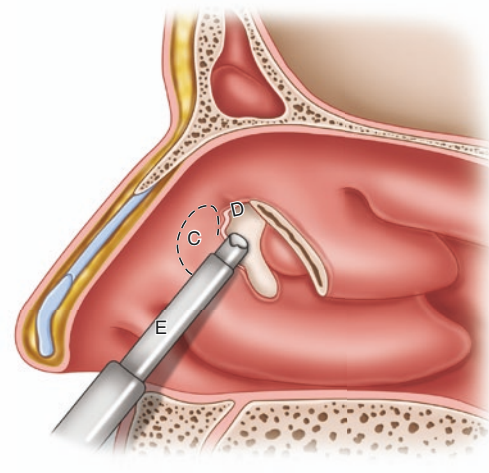

Fig. 8.3 Mucosa removed with Bovie cautery (E). Nasal mucosa (C). Lacrimal fossa bone (D). Portion of turbinate removed for clarity

Osteotomy

Bone removal begins at the posterior edge of the exposed bone using a medium-sized 90-degree Kerrison rongeur. The rongeur is used to remove the frontal process of the maxilla, as well as some lacrimal bone, to expose the lacrimal sac. To safeguard against incising the lacrimal sac during the osteotomy creation, ensure that the rongeur is always in contact with the bone (Fig. 8.5).

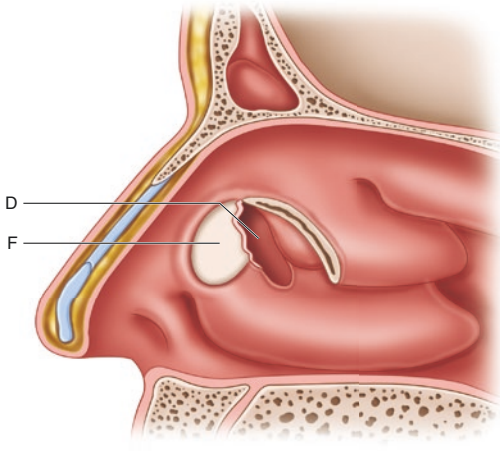

Fig. 8.4 Area of bone to be removed (F) and uncinate process (D)

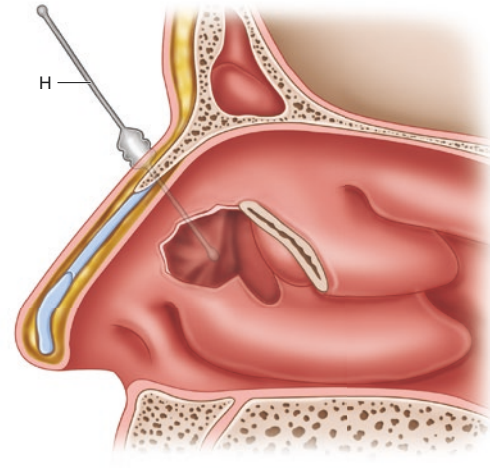

Fig. 8.6 Bowman probe (H) tenting the lacrimal sac

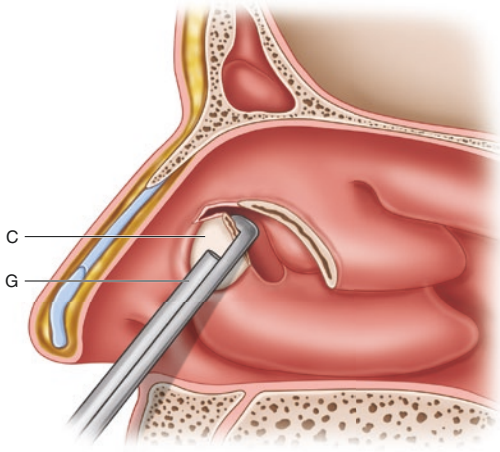

Fig. 8.5 Kerrison rongeur (G) used to remove lacrimal fossa bone (C)

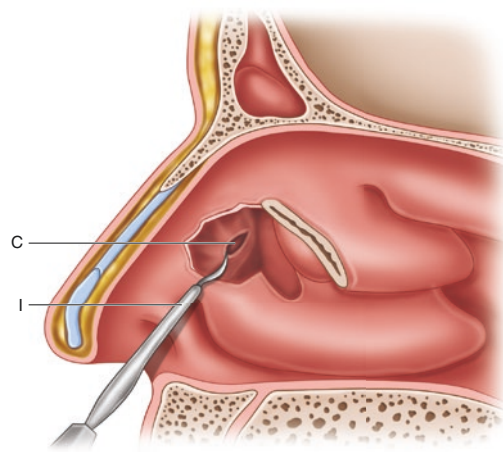

Fig. 8.7 Sickle blade (I) incising lacrimal sac (C)

Lacrimal Sac Incision

After punctal dilation, a 1-0 Bowman probe is passed through the upper canalicular system and tents the medial wall of the lacrimal sac (Fig. 8.6). The tented sac is then incised vertically with a sickle blade (Fig. 8.7). Enlargement of the sac opening is performed with the same blade or by gently tearing the mucosa with Blakesley or Takahashi forceps.

Placement of the Silicone Stent

Silastic tubing is passed through both canaliculi, the ostium, and into the nose. Under mild tension, tubes are tied in a square knot (Fig. 8.8). A 5 mm section of a Robinson catheter may be tied over this knot to facilitate repositioning in the event of tube prolapse. No dressing or medication is required postoperatively.

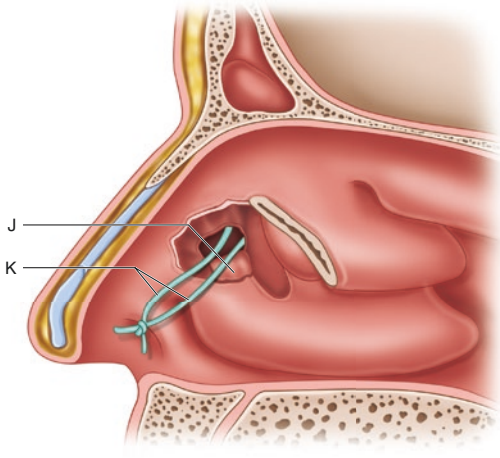

Fig. 8.8 Silastic tubing (K) tied in nose. Lacrimal sac flap (J)

Postoperative Management

Postoperative care for EDCR is rather simple. The main precaution is to avoid eye rubbing, which can displace the tube. The patient is asked to not blow their nose for the first week since this can cause epistaxis. After the first week, they are asked to use saline nasal spray multiple times per day on the operative side and to then blow their nose. This helps remove intranasal debris and makes the nose feel less congested. This can be stopped after one or two weeks. Ideally the tube should be left in place for at least 3 months, at which time the tube is cut at the canthus and the patient forcefully expels the tubing by blowing their nose. Occasionally, the tube will need to be manually retrieved. Retesting of the lacrimal system is now performed with irrigation.

Complications

Bleeding is one of the most common complications after EDCR. The best way to avoid bleeding is by the preoperative measures of discontinuing any anticoagulation and the local anesthetic techniques discussed earlier. If intraoperative bleeding does not resolve, nasal pledgets soaked in 0.05% oxymetazoline can be of use during the procedure. In addition, the patient may be advised to used 0.05% oxymetazoline nasal spray up to three times daily for 3 days postoperatively if any epistaxis occurs. Nasal packing may be required if bleeding cannot be stopped. If nasal packing is to be left in place, the patient needs to be placed on a course of oral antibiotics.

Complications may be encountered intraoperatively due to aggressive dissection. Excessive temporal dissection may result in damage to intraorbital contents such as the medial rectus muscle. If orbital fat is encountered it is best to avoid further dissection in that area. Superiorly, the skull base may be encountered resulting in a cerebrospinal fluid leak. This is best avoided by removing bone only overlying the lacrimal sac. It is best to reorient oneself by pressing on the lacrimal sac or passing a bowman probe if there is a question of the location of the lacrimal sac. If a cerebrospinal fluid leak does occur, the operation should be terminated and a neurosurgical consultation should be initiated.

If the silastic tubing prolapses, the patient can try to blow the nose forcefully while occluding the opposite nostril. After a few unsuccessful attempts, the tubing can be temporarily taped to the nose or cheek to avoid ocular irritation. In a cooperative patient, the tube can be repositioned easily. Minor prolapse is sometimes amenable to external feeding of the tube back into the nose. When this is attempted with more significant prolapse, the tubing will often curl into the lacrimal sac and later recoil. In this instance, the tube should be pulled back into the nasal cavity using bayonet forceps. An endoscope aids in tube localization, but often the Robinson catheter is visible with only a speculum. Prior to entering the nose, a nasal decongestant can be used to shrink the mucosa and help with minor bleeding. In addition, an inhaled mucosal anesthetic can be used for comfort. Ideally the tube should be left in place for at least 3 months.

Endoscopic Conjunctivodacryocystorhinostomy with Modified Jones Tube

Goals and Principles

A complete bypass of the lacrimal system may be indicated in several instances. These include failed dacrycystorhinostomy, canalicular blockage, tear hypersecretion, and lacrimal pump failure secondary to facial nerve paralysis. Canalicular blockage impedes the flow of tears through the lacrimal system. Tear hypersecretion can cause epiphora despite a patent lacrimal system by overwhelming the system. Facial paralysis causes lacrimal pump failure because without the blink mechanism, the lacrimal sac cannot generate negative pressure to draw tears into the lacrimal system. The endoscopic conjunctivodacryocystorhinostomy (CDCR) bypasses the entire lacrimal system, taking the tears from the area of the caruncle directly to the nose.

Workup

Canalicular blockage can be demonstrated by attempting to probe the canaliculi. The inability to advance a probe through the canaliculi is an indication for endoscopic CDCR. When probing and irrigating the system yields normal results but epiphora is present despite the absence of ocular surface disease, tear hypersecretion should be suspected. This may be evidenced by higher than normal readings on basal tear secretion/Schirmer testing. Finally, nasal endoscopy should be performed to examine for structural factors affecting surgery, as well as to examine for endonasal tumors. Specifically, significant septal deviation can make the placement of a Jones tube difficult.

Surgical Procedure

The surgical procedure for endoscopic CDCR begins with the administration of anesthesia in an identical manner to that for DCR (Video 8.3). In addition, the same local anesthesia mixture is administered to the medial canthus in the same area as the planned tract of the modified jones tube, at a 45° inferomedial direction.

Once local anesthesia has been administered, a tract for the Jones tube is formed with a 10- or12-gauge Angiocath. A bend is placed in the Angiocath prior to placement to assist anterior placement of the tube (Fig. 8.9). In a 45° inferomedial direction, the Angiocath is advanced through the middle of the caruncle. Excision of the caruncle is not recommended as this promotes internal migration of the modified Jones tube. The Angiocath is pushed through the lacrimal bone and into the nasal cavity. Firm pressure must be maintained on the back of the Angiocath to prevent the needle from sliding out of the plastic catheter (Fig. 8.10). Endoscopic visualization is used as the needle passes into the nasal cavity.

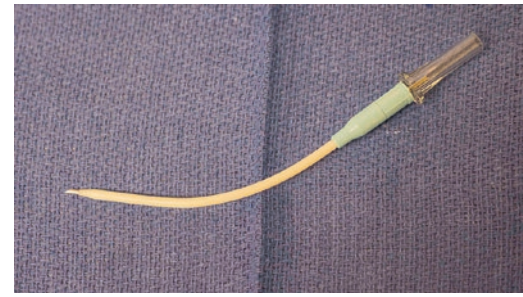

Fig. 8.9 Catheter is bent to keep the intranasal ostium anterior

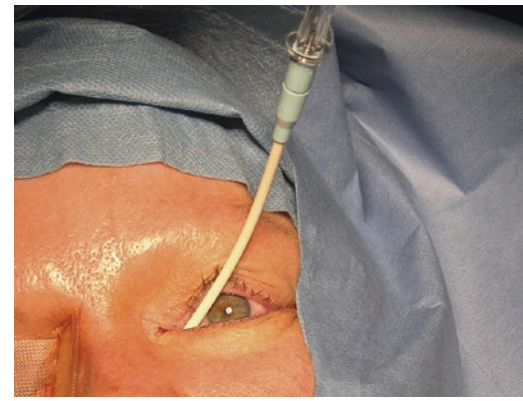

Fig. 8.10 Catheter entering the caruncle and exiting in the middle meatus

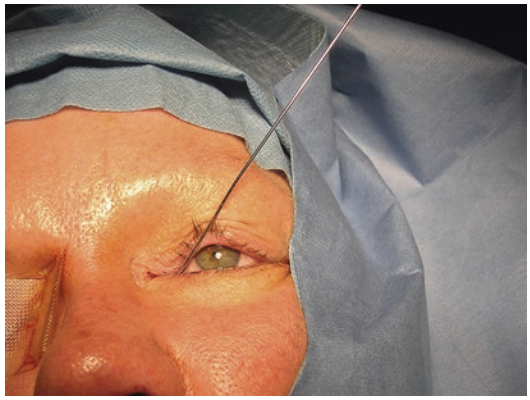

Fig. 8.11 Plastic catheter removed and 20-gauge wire in place

Fig. 8.12 Gladstone-Putterman modified Jones tube ready to be inserted

The needle is retracted, leaving the plastic catheter in place.

A 9-inch 20-gauge guide wire is passed through the catheter, held securely, and the plastic catheter is then removed (Fig. 8.11). A 4 mm × 19 mm Gladstone-Putterman modified Jones tube is then passed over the wire. This tube was designed with an internal flange 4 mm distal to the external flange. The added flange functions like an arrowhead to secure the tube against internal and external migration or ejection with forceful nose blowing, sneezing, or coughing (Fig. 8.12). The modified tube inserts in a similar fashion as the original design, except that a palpable click is felt when the internal flange traverses the medial canthal tissues. Both thumbnails are used on the external flange to effectively push the tube into position. Ideally, the distal end of the tube is situated midway between the lateral wall and septum, and is situated just anterior to the middle turbinate. If the tube length is not appropriate, a longer or shorter tube may be inserted, with the guide wire in place. Tube exchange is done carefully to avoid shattering the glass tube. If forceps do not deliver the tube easily, a 2-0 silk suture may be wrapped around the proximal end to aid in gentle extraction. Once the proper tube is inserted, the guide wire is removed.

To encourage the tube to heal without internal migration, a 6-0 double-armed silk suture is double-wrapped around the external flange. Both needles are passed through the medial canthus

Fig. 8.13 Final position of tube in medial canthus. The suture is passed through a rubber band bolster

and tied over skin with a sterile rubber band bolster (Fig. 8.13). The bolster and suture are removed one week postoperatively. No dressing or medications are needed postoperatively.

Special Surgical Considerations

Occasionally the distal end of the Jones tube may be too close to the middle turbinate. This situation risks tube occlusion and external migration. Intraoperative partial middle turbinectomy avoids these complications. Local anesthetic is injected into the substance of the turbinate. The inferior portion of the turbinate to be removed is crushed with a small curved hemostat. Bounding the

offending portion of the turbinate, the hemostat is applied to the superior border, attempting to join the compressed areas. Following the crushed lines, curved endoscopic turbinate scissors incise the portion of the turbinate. Persistent connections often require gentle twisting with a Blakesley forceps for amputation of the piece. Pulling on the turbinate is discouraged as it can lead to cerebrospinal fluid leakage.

Postoperative Management

The patient is asked to not blow their nose for the first week since this can cause bleeding. After this time, they are instructed to place a finger over the proximal end of the modified Jones tube whenever they blow their nose, sneeze, or cough. This avoids externally displacing the tube. The rubber band bolster is removed one week after surgery.

Complications

Poor postoperative drainage results from misplacement or displacement of the tube. Tears cannot enter a tube that is displaced anteriorly. The course of action is to reposition the Jones tube more posteriorly. The tube must be removed, usually by wrapping a 2-0 silk suture around the external flange to minimize the risk of tube breakage. Contraction of medial canthal tissues around the tube can necessitate the use of Westcott scissors to release the tissue from the tube. The 12-gauge Angiocath reenters the caruncular tissues posteriorly in relation to previous placement. Jones tube insertion follows as previously described.

Similarly, posterior placement of a tube is repositioned more anteriorly. Exaggerated posterior position of the Jones tube causes ocular irritation and risks conjunctival blockage of the proximal tube opening.

Internal migration of the tube also causes obstruction of the proximal end, and possibly the distal end, of the Jones tube. When caruncular tissues are needlessly excised, inward displacement is more likely. Removing these tubes can be challenging. Sometimes a soft instrument is used intranasally to coax the tube outward. Westcott scissors are used to release contracted medial canthal tissues overlying the external flange. Once the tube is exposed, 2-0 silk suture can aid in extraction. Dissection should be purposeful to cause minimal disruption of the medial canthal tissues. In the event of extensive tissue manipulation, subsequent replacement of the tube should await adequate healing. This will reduce the probability of repeated internal migration.

External displacement of the tube precludes tear entry and may cause eyelid or ocular irritation. Occasionally, manual pressure can re-lock the Jones tube in position. Intranasal examination may reveal a treatable cause of this migration. Possibilities include contact with the nasal septum, which require placement of a shorter tube. As mentioned previously, partial turbinectomy is necessary if the middle turbinate pushes on the distal end of the tube.

Sometimes, even a perfectly placed Jones tube can be blocked by redundant conjunctiva. Simple chemosis may resolve with a depo steroid injection, but resection of excessive tissue can also be curative. Topical or depo steroid may be used to quiet irritation of the medial canthal tissues.

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