Lateral Canthal Anchoring

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Learning Objectives: After studying this article, the participant should be able to: 1. Understand the principles involved in canthal support for patients undergoing cosmetic and reconstructive surgery. 2. Understand the variations in surgical techniques required to perform canthal anchoring in differing patients. 3. Describe the significance and techniques of canthal anchoring (canthoplasty and canthopexy) as they relate to cosmetic and reconstructive lower lid surgery. 4. Describe the effect of canthal anchoring on the function of the upper and lower lids and eyelid fissure shape.

Any surgeon performing cosmetic or reconstructive surgery procedures on the lower lid or midface through the lower lid should be comfortable with canthal anchoring procedures. Appropriate canthal anchoring is effective in preventing postoperative lower-lid malposition, in ensuring eyelid closure, and in improving or maintaining proper eye shape. In many patients, a canthopexy (nonlysis canthal anchoring) is effective. However, in patients with significant horizontal laxity, cantholysis with appropriate lid shortening is required. It should be remembered that canthal anchoring, no matter how well performed, will not prevent severe lower-lid complications in cases of over-resection of lower-lid skin and of poorly performed midface procedures that do not support the lower lid and cheek. (Plast. Reconstr. Surg. 112: 222, 2003.)

Securing the attachments of the eyelid at the lateral canthus has been emphasized as part of a surgeon’s armamentarium to control the position and preserve the function of the eyelids, particularly in the lower lid. Lateral canthoplasty (canthal anchoring with lysis) and lateral canthopexy (nonlysis canthal anchoring) are terms that have been used to describe this procedure; both can be encompassed by the general term canthal anchoring. The concept of tightening the lower lid at the lateral canthus (as opposed to shortening the lid by midlid resection) was first popularized by Bick,1 and others,2 and was soon accepted as the standard procedure for lower-lid stabilization. For 25 years, this principle has been applied to patients undergoing lower-lid blepharoplasty3–8 and has, in recent years, been incorporated into the translid cheeklift.9–12

In some cases, eyelid operations can be performed satisfactorily without canthal anchoring, so the question one must ask is, Why perform it at all? The strength and positioning of the attachment of the eyelids at the lateral canthus control the shape of the eyelid fissure and the blinking movement of the eyelids. When performed with blepharoplasty or cheek lift, secure attachment of the eyelids with lateral canthal anchoring ensures that the eyelids close properly postoperatively and allows the surgeon to control the position of the eyelids to produce the desired shape of the eyelid fissure.

REVIEW OF EYELID ANATOMY

The body of the eyelid is composed of an anterior and posterior lamella. The posterior lamella consists of the tarsal plate, the conjunctiva, the inferior retractor (capsulopalpebral fascia), and the tendons of the tarsus that attach internally, inside the orbital rim. The anterior lamella—primarily the skin, orbicularis muscle, and septum—attaches externally and anteriorly, at the edge of the orbital rim (Fig. 1, left). At the lateral canthus, there is a bidirectional pull on the eyelid. The posterior lamella inserts inside the lateral orbital rim and causes the curve of the...
lower lid to hug the globe, whereas the anterior lamella inserts externally at the rim edge. In the inner canthus, the orbicularis is composed of additional muscle originations that course internally from the tear sac and deep from the sac into the lid (Fig. 1, right). In the inner canthus, the orbicularis muscle rises to its greatest strength from these heads of muscle origination, which provide the majority of tone to the lower lid. The deep originations are also the primary "motor" for the blinking and closure movements of the eyelids. The central and lateral pretarsal orbicularis muscles have a very passive role in everyday eyelid function of blinking, lid tone, and the lacrimal pump mechanism. They function primarily as emergency, squeezing muscles for protection and animation.

MECHANICS OF EYELID CLOSURE

Experience has been gained from patients with benign essential blepharospasm who have undergone extensive myectomy of the extracanthal orbicularis oculi muscles of the eyelid. From these patients we have learned that wide excisions of pretarsal, preseptal, and orbital orbicularis muscles from the extracanthal part of the eyelid can be performed, but if the inner canthal orbicularis heads are spared, the eyelids will have no malposition and retain normal tone and blinking.

The extracanthal orbicularis (nonshaded elements of the orbicularis muscles, Fig. 2) can be considered to play a small role, if any, in the everyday eyelid activity of blinking, the tone of position, and the lacrimal pump mechanism. The integrity of the inner canthal heads and their innervation are essential for normal blinking and resting eyelid tone.

Another important part of the mechanics of eyelid closure is the need for firm anchoring of the tendons of the eyelids at the lateral orbital rim. The course of orbicularis muscle is oblique and circular, and if unopposed, its contracture will cause a nasal vector of pull of the eyelids with blinking. With firm anchoring of the eyelids at the lateral canthus, the nasal forces of contraction are converted into a vertical vector, which draws the eyelids together to give normal closure (Fig. 3, above). If the lateral canthal attachments be-
Fig. 2. (Left) The pretarsal, preseptal, and orbital portions make up the orbicularis oculi muscle. (Right) The darkly shaded medial component of the orbicularis represents the portion responsible for eye closure with blinking, lower lid tone, and lacrimal pump mechanics and emphasizes the bifunctional division into the extracanthal and canthal orbicularis regions.

Fig. 3. (Above) Normal eyelid closure with adequate canthal anchoring. (Below) “Fish-mouthing” of the lids on attempted closure due to inadequate lateral canthal anchoring. There is a nasal migration of the eyelid with attempted closure.
come dehisced or loose for any reason, with poor anchoring of the eyelids at the lateral orbit, then when canthal orbicularis muscle contracts, the normal vertical vector of closure is lost and attempted eyelid closure causes only nasal migration and “fish-mouthing” of the eyelids (Fig. 3, below). Dehiscence of the lateral canthal attachments can be caused by the aging process or by edema or interruption following surgical procedures.

The patients in Figure 4, above and center, have the typical appearance of lateral canthal dehiscence following blepharoplasty. They have poor eyelid closure, fish-mouthing of the eyelids, and nasal movement of the lateral canthus on attempted closure.

The patient in Figure 4, below, has a milder case of dehiscence. She shows deficient closure caused by loss of canthal fixation due to edema and postoperative scarring, even though no operation was performed in the

Fig. 4. (Above and center) Patients show obvious lateral canthal dehiscence. (Below) Patient shows more subtle changes even though the patient was very symptomatic.
lateral canthal area (the patient had only laser skin resurfacing with fornix fat removal). This illustrates that even subtle amounts of canthal dehiscence may cause significant symptoms and make patients uncomfortable and unhappy. Postoperatively, patients with dehiscence problems may complain of exposure symptoms and a pulling sensation in the canthus (“my eyes just do not feel right”).

**Eyelid Fissure Shape**

Lateral canthal anchoring allows the surgeon to control and refine the shape of the eyelid fissure. Normal eyelid fissure shape varies; in general, however, the edge of the lower lid rests at the inferior limbus or just above it, and the lateral canthal angle is in line with the inferior edge of the pupil (Fig. 5, above). The downward displacement of the canthus and lower lid that occurs with age is a constant (Fig. 5, below).

What are the visible elements that actually define the shape of the eye fissure? The main points of reference are the amount of white sclera exposed on either side of the cornea, nasally and laterally (i.e., the scleral triangles). Normally, the lateral scleral triangle is larger, wider, and more pointed than the nasal scleral triangle. There is usually no “scleral show” under the inferior limbus (Fig. 6).

Indentation of the eyeball against the eyelids affects the shape of the eye fissure and the scleral triangles. It has been shown that the curve of the upper lid mathematically fits the curve of a sphere, so that upper-lid curvature is solely the result of the indentation of the globe.

**Fig. 5.** (Above) A patient with a youthful, “normal” eye fissure shape. (Below) Diagram shows the changes in fissure shape from youth to age.

**Fig. 6.** The main points of reference that define the shape of the eye fissure are the scleral triangles on either side of the cornea. The lateral scleral triangle is normally larger and wider than the nasal scleral triangle.
against the lid. This is not so with the lower lid. Indentation by the globe does influence its shape, but the tone and position of the canthal attachments of the lower lid are also important for lid curvature. Thus, indentation by the globe against the lids influences both upper-lid and lower-lid curvature, but lower-lid curvature is also influenced by the tone of the canthal attachments.

Globe position, or prominence, affects the shape of the eyelid fissure and also influences the surgical positioning for canthal anchoring. It has been our practice to measure globe prominence before the operation to help plan what type of canthal anchoring to perform (Fig. 7). In a large series of patients, 65 percent fell within the 15-mm to 17-mm range as measured with the Hertel exophthalmometer (H. Hirmand, unpublished data). In these patients, standard positioned anchoring of the canthus, placed in line with the inferior edge of the pupil, did not adversely change the shape of the eye fissure.

SURGICAL TECHNIQUES IN CANTHAL ANCHORING

Anchoring with the Standard Positioned Eye

The decision whether to perform a nonlysis canthal anchoring (canthopexy) or lysis canthal anchoring (canthoplasty) is made using the intraoperative lower-lid distraction test. With the patient recumbent on the operating table, if the lower lid can be grasped and pulled away from the globe more than 2 to 3 mm, and there is little “snap back” of the lid against the globe, canthal anchoring with a lysis canthoplasty combined with shortening of the lower lid at the lateral canthus should be performed. If there is minimal distensibility and a firm “snap back” of the lower lid, a canthopexy (nonlysis canthal anchoring) can be performed.

Canthopexy (Nonlysis Canthal Anchoring)

When a canthopexy (nonlysis canthoplasty) is performed in an eye with standard prominence, the canthus is set in line with the inferior edge of the pupil (Fig. 8). A double-armed 4-0 suture with half-circle needles is used. We prefer permanent sutures (the authors presently use 4-0 Mersilene sutures with P-2 needles). The conjoined tendon (upper and lower lids) is grasped securely with the suture. The double-armed suture is then passed through the periosteum at least 4 mm inside the lateral orbital rim, in line with the inferior edge of the pupil. The sutures are tied externally in the lateral orbital rim periosteum 3 to 4 mm from the rim’s edge.

Canthoplasty (Lysis Canthal Anchoring)

If there is laxity of the lower lid as determined by the intraoperative distraction test, a
lysis of the lower-lid tendon is performed at the canthal angle. A small trim of the edge of the lower lid is needed for shortening. The amount of trim is determined by testing the canthus against the orbital rim for redundancy.

The same suture as described above is used and is passed through the edge of the tarsal plate in the lower lid, starting at its inferior edge and exiting at the gray line just beneath the epithelium. The suture is then passed through the

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**Fig. 8.** (Above) Standard canthal anchoring with lysis (canthoplasty) and without lysis (canthopexy) in a patient with standard eye position as measured by the Hertel exophthalmometer. The canthal anchoring is placed at the inferior edge of the pupil. (Center) The drawing illustrates the proper placement of the canthal anchoring suture through the lower and upper lateral canthal tendon. The canthal anchoring is placed at the inferior edge of the pupil. (Below) The axial view illustrates appropriate internal suture placement to keep the lower eyelid tight against the globe.
lateral tendon of the upper lid through a de-epithelialized area. The double-armed suture is then introduced into the lateral orbital rim periosteum, as described above. Canthal anchoring must be placed well inside the lateral orbital rim. It is harder for posterior placement with pexy because of the interposed tissue, unless a double-armed suture is used (Fig. 8). It is important to include the upper lid in the anchoring for alignment and to provide fixation for firm upper-lid closure (particularly in patients who may have upper-lid laxity as well). During the operation, the authors always consider the first placement of the canthal anchoring as a trial. If the position of the lower
lid’s edge is not satisfactory after initial placement, it is redone.

A third variation of canthal anchoring has recently been described by one of the authors.18 This procedure is effective in patients undergoing combined lower-lid and midface rejuvenation using a “closed” technique, in which the lower lid is not opened. The pretarsal and preseptal orbicularis muscles are left attached to the septum. A lateral extension of the pretarsal orbicularis is sutured to the periosteum of the inside of the orbital rim just above the level of the pupil (Fig. 9). Placement of the medial suture must be inside the orbital rim to ensure that the lower lid is stabilized and has not pulled away from the globe. This variation of canthal anchoring has the advantage of avoiding direct surgery to the lateral canthus, but it does not address the problem of horizontal lower-lid laxity, if present. The patient in Figure 10 is shown preoperatively and 10 months after an endoscopically assisted midface lift with vertical orbicularis redraping and pretarsal orbicularis canthopexy.

Deep-Set Eyes

If a standard canthal anchoring, positioned as above, is used in patients with deep-set eyes (defined as exophthalmometer measurements of 15 mm or less), it will cause an upward “clotheslining” of the lower lid and narrowing of the eyelid fissure (Fig. 11). This can produce a patient who will complain after the operation, “Doctor, you made my eye look smaller. I have narrow, squinty eyes now.” With deep-set eyes, the fixation point of canthal anchoring must be shifted downward and more internally to prevent upward clotheslining of the lower lid. This fixation prevents the narrowing of the eyelid fissure and a “small eye” (Fig. 11). Narrowing of the fissure in a patient with deep-set eyes is manifest by a reduction in the size of the lateral scleral triangle. Figure 12, above, is a preoperative picture brought in by a patient to show the shape of her eye fissure that was pleasing to her before she had any operations. The eyes in the Figure 12, center, show narrow-
ing of the fissure following a blepharoplasty; in Figure 12, below, the same patient is shown after reanchoring of the lateral canthus, modified for patients with deep-set eyes, with a downward and inward placement of the anchoring. This reanchoring enlarged and restored the shape of her lateral scleral triangles (Fig. 13).

Figure 14 shows an unoperated patient with deep-set eyes (Fig. 14, left; Hertel measurement, 15 mm) and (Fig. 14, right) the same patient after a cheek lift which included canthal anchoring modified for the deep-set eye. Notably, there is no postoperative reduction in the size of her lateral scleral triangles.

Prominent Eyes

In patients who have prominent eyes (measuring 18 mm or greater with the exophthalmometer), a standard positioned anchoring may cause a downward clotheslining of the lower lid in the opposite direction as seen the deep-set eye, with a retraction of the lower lid. This downward clotheslining produces scleral show beneath the cornea and causes an abnormal enlargement of the lateral scleral triangle. In these patients, the fixation for canthal anchoring is shifted upward to prevent the downward clotheslining (Fig. 15). In many of these cases, a pexy without lysis is used because of the increased distance of the canthus from the lateral orbital rim. Figure 16 shows a patient with prominent eyes (Hertel measurement, 18+ mm) just over a week after canthal anchoring modified for the prominent eye.

Increasing eye prominence can produce more difficult problems that cannot be compensated for by modification of the canthal anchoring technique alone. In these patients, additional procedures are needed to prevent postoperative scleral show. With increasing prominence, the first additional procedure that may be needed is the release of the inferior retractor (capsulopalpebral fascia) in the lower lid to allow the lid edge to rise upward on the globe. Cases with more severe prominence require release of retractors and the use of primary spacer inserts (such as AlloDerm, LifeCell Corp., Branchburg, N.J.) to bolster the lower-lid position upward.19

Lid Laxity

The presence of significant lower-lid laxity can be determined by the intraoperative distraction test as described above. Lysis canthal anchoring with shortening of the eyelid should be performed in patients with lax lower lids (Fig. 17). Failure to address laxity of the lower lid can result in ectropion (Fig. 18). The patient shown underwent transconjunctival

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Fig. 12. (Above) View of a patient with deep-set eyes before any operations. (Center) After blepharoplasty, the patient experienced upward clotheslining causing smaller lateral triangles that produced a “squinty” look. (Below) Same patient after corrective canthal anchoring with the modification for deep-set eyes. A desired, larger lateral scleral triangle is achieved as the lower eyelid has been moved downward ~2 mm.
blepharoplasty with only a small pinch of skin removed, but no canthal anchoring. As previously mentioned, the upper lid can also be lax and “floppy” (the floppy upper-lid syndrome is common in obese men) and should also be included in the canthal anchoring procedure.

RECONSTRUCTIVE CANTHAL ANCHORING

Canthal anchoring is often performed as part of a reconstructive procedure to correct complications following cosmetic surgery procedures or trauma. In many cases, the soft tissue in the canthal angle (periosteum, connective tissue) has lost its integrity because of damage and scarring and will not support canthal refixation by itself. In cases that have milder changes, the reanchoring of the lateral canthus can be reinforced with a local periosseal flap\textsuperscript{20–22} or a fascial graft.\textsuperscript{4} More severe cases, particularly those with multiple previous surgical procedures, resist correction, even with soft-tissue supplementation. Direct anchoring to the bone of the internal orbital rim is needed, with drill-hole fixation. Drill-hole anchoring of the lateral canthus is not new and has been used by some as a means of primary fixation.\textsuperscript{23,24} In the authors’ experience, to date, it has been reserved for reconstructive cases.\textsuperscript{21}

A single drill hole in the lateral orbital rim is used. To determine the position of the drill hole, the lateral canthus is grasped and tucked against the lateral orbital rim until the desired lower-lid position is obtained. The position is marked with methylene blue dye, and a drill hole is made at that point,
slanting inward (Fig. 19). A double-armed Mersilene suture with half-circle needles is used for fixation. If no lysis is needed, the suture is double-looped into the canthal tissue and then both suture arms are brought through the single hole. If lysis is needed, a single loop of suture is brought through the canthal edges of the lids, and then the arms are brought out through the hole. Both arms of the suture are secured to the deep temporal fascia. Figure 20, left, shows a patient who had a previous cosmetic surgery procedure and additional attempts

Fig. 15. Diagram shows downward “clotheslining” of the lower lid in patients with prominent eyes (Hertel measurement, >18 mm). In these patients, fixation for canthal anchoring needs to be supraplaced above the inferior pupillary edge to prevent downward clotheslining of the eyelid.

Fig. 16. (Left) Preoperative and (right) postoperative views of a patient with prominent eyes who experienced improvement in lower eyelid position with canthal supraplacement.
of canthal fixation with soft-tissue reanchoring. She requested additional correction of the distortion of her eyelid fissure and deficient eyelid closure. Figure 20, right, shows the patient after drill-hole reanchoring of the canthus.

**COMPLICATIONS**

Complications following a carefully performed canthal anchoring procedure are generally rare and relatively minor. Chemosis can occur with any variation of the technique. It is generally short-lived, but occasionally it can require a temporary tarsorrhaphy suture or patching of the eye. Healing deformities, including webbing or lid misalignment, can occur with cantholysis. Lower-lid displacement away from the globe may occur if the vector of fixation is not internal and placed well inside the orbital rim. The same is true if significant lower-lid laxity is not corrected as part of the technique.10

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**REFERENCES**

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Fig. 19. (Above, left) Diagram shows the position of the drill hole on the orbital rim. In many cases, the ideal position will be higher or lower. The proper position of the drill hole can be determined by positioning the canthus against the lateral rim until the desired eye fissure shape is obtained. (Above, right) Passage of suture and fixation to the deep temporal fascia. (Below) Axial view showing the proper vector of the inward slant of the drill hole.

Fig. 20. (Left) Patient with canthal retraction, scleral show, and deficient eyelid closure (“I can still see light when I try to close my eyes”) after initial operation and ineffective secondary attempts at repair with a soft-tissue operation. (Right) Postoperative view of patient after canthal reanchoring with drill hole fixation.

Self-Assessment Examination follows on the next page.
1. THE MOST IMPORTANT EFFECT OF LATERAL CANTHAL ANCHORING WHEN PERFORMED DURING COMBINED LOWER-LID BLEPHAROPLASTY AND MIDFACE LIFT IS:
   A) Natural shape of palpebral fissure
   B) Functional eyelid closure
   C) Elevation of the midface
   D) Position of the lower eyelid
   E) Preservation of normal lacrimal pump mechanism

2. THE ANTERIOR LAMELLA OF THE LOWER LID (SKIN, ORBICULARIS, SEPTUM) ATTACHES TO THE EXTERNAL (OUTSIDE) EDGE OF THE ORBITAL RIM:
   A) True
   B) False

3. REGARDING THE ORBICULARIS OCULI MUSCLE, THE GREATEST STRENGTH OF THE MUSCLE WHICH PROVIDES THE MAJORITY OF TONE TO THE LOWER LID IS LOCATED AT:
   A) Medial canthal region
   B) Lateral canthal tendon
   C) Central pretarsal region
   D) Lateral pretarsal region
   E) Central preseptal region

4. WHAT VISUAL ELEMENT IS MOST IMPORTANT IN DEFINING SHAPE OF THE PALPEBRAL FISSURE?
   A) Relationship of upper lid to superior corneal limbus
   B) Relationship of lower lid to inferior corneal limbus
   C) Intercanthal distance
   D) Amount of sclera exposed on either side of the cornea
   E) Height of the palpebral fissure

5. THE DECISION TO PERFORM EITHER CANTHOPEXY OR CANTHOPLASTY AT THE TIME OF TRANSPALPEBRAL MIDFACE LIFTING IS BEST MADE:
   A) Preoperatively based on lower lid position and tone
   B) Preoperatively based on eyeball prominence measured with the Hertel exophthalmometer
   C) Preoperatively based on the patient’s age and skin type
   D) Intraoperatively based on lower lid distraction test
   E) Intraoperatively based on the amount of skin resected from lower lid during blepharoplasty

6. IN PATIENTS WITH NORMAL EYEBALL POSITION DETERMINED BY EXOPHTHALMOMETER MEASURING, THE POSITION OF LATERAL CANTHAL FIXATION DURING CANTHOPEXY IS AT WHAT LEVEL?
   A) 4 mm inside the lateral orbital rim in line with the lower border of the pupil
   B) 4 mm inside the lateral orbital rim in line with the upper limbus
   C) 4 mm inside the lateral orbital rim in line with the nasion
   D) At the lateral orbital rim in line with the medial canthus
   E) At the lateral orbital rim in line with the lower corneal limbus

To complete the examination for CME credit, turn to page 366 for instructions and the response form.