

1. Supplementing the general anesthesia with a
vides excellent postoperative pain relief and
es can be done as outpatients. Modern anes-
agents allow for rapid recovery and ambula-
admission for medical or ophthalmic observa-
traumatic injuries, cardiac instability, or
nsive care. Postoperative management should
perioperative plan.

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Injuries of the Lid and Lacrimal System

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BASIC CONSIDERATIONS

Injury to the eyelids and lacrimal apparatus after penetrating and blunt trauma and bites is common. Penetrating trauma with a sharp object tends to produce a clean wound without tissue loss. Blunt trauma can produce abrasions, irregular lacerations, and partial avulsions. Bites, in addition to being contaminated, usually produce tearing of tissues without tissue loss. Each case is unique, requiring a tailored approach.

Knowledge of the anatomy and function is crucial to the successful management of these cases. Eyelid function depends on smooth contour and margins, absence of restriction from scarring and fibrosis, and the ability to make extremely rapid movements. Precise and delicate realignment of structures requires knowledge of the exact surgical anatomy and reconstructive procedures applicable to eyelids.

Normally functioning eyelids and lacrimal system are important for maintaining the health of the globe. Additionally, the aesthetic importance of the eyelids cannot be overstressed. For these reasons, even seemingly minor lacerations to the vital structures can present a great challenge.

DIAGNOSIS

1. Obtaining a detailed history—focusing on the cause, location, and time of injury and whether safety glasses were worn—is essential in determining the degree of contamination and the presence of foreign bodies. A patient's tetanus immunization history determines the need for a tetanus toxoid booster or tetanus immune globulin. Time of the last oral intake must be determined if surgical intervention is needed. Animal bites should be reported to the local or state public health department. Accurate documentation also is essential, particularly if future legal action is anticipated.
2. A complete ocular examination should be performed to rule out associated intraocular trauma, although the full examination of a child may need to be deferred until the patient is under anesthesia. Even a minor penetration of the eyelid should arouse suspicion of a penetrating injury to the globe. Management of the lid laceration is undertaken after management of any globe injury (1).
3. The clinician should determine and document the extent of the orbital and eyelid injuries (1). Initial evaluation of the extent of lacerations requires gentle cleaning and separation with a cotton swab. The edges of the lid lacerations often adhere to each other in relatively normal orientation, disguising a more serious injury. Photographs should be obtained, if possible, to document the nature and extent of the injuries.
4. The nature and extent of the eyelid injury influences the choice of surgical procedure. The presence and degree of tissue loss should be estimated. Involvement of the lid margin should be determined. A laterally displaced punctum suggests a laceration involving the lacrimal drainage system (2). Involvement of the medial canthal tendon and a naso-orbital fracture can result in rounding of the medial canthus or telecanthus (3). Visible orbital fat confirms penetration of the orbital septum (4). The presence of some levator function, despite limitation secondary to lid edema, suggests an intact levator.
5. Computed tomographic imaging can aid in evaluation if the mechanism of injury and the depth of resultant periorbital injuries suggest a possible orbital fracture or the presence of an orbital foreign body (see Chapter 5). Magnetic resonance imaging may be useful if a wooden foreign body is suspected (5).
6. After the examination, a lubricating ointment can be applied to the cornea if no corneal laceration is present. A saline dressing and protective shield should be applied to the eyelid laceration to prevent drying of tissues and further injury before the repair. In general, protruding foreign bodies should not be disturbed until the time of repair.

MANAGEMENT

General Considerations

1. Timing of repair of eyelid injuries should ideally be within 24 hours of injury (1). However, eyelid injuries can easily be repaired up to several days later. Life-

location, and time of injury in determining the degree of patient's tetanus immunization booster or tetanus immunized if surgical intervention is or state public health department particularly if future legal action

ed to rule out associated in a child may need to be defined prior penetration of the eye to the globe. Management of any globe injury (1).

extent of the orbital and eyelid lacerations requires gentle retraction of the lid lacerations of the lid lacerations of the lid, disguising a more serious laceration, to document the nature

of the choice of surgical procedure should be estimated. Involvement of laterally displaced punctum of the lacrimal system (2). Involvement of the lacrimal system can result in rounding of the orbital fat confirms penetration of the globe for function, despite limitation.

tion if the mechanism of injury suggests a possible orbital injury (see Chapter 5). Magnetic resonance imaging is suspected (5).

is applied to the cornea if no protective shield should be used over the tissues and further injury to the eyelid should not be disturbed

within 24 hours of injury (1). In severe cases, sutures should be placed several days later. Life-

threatening and vision-threatening injuries take precedence over periorbital injuries, but protection of the cornea to prevent ulceration must be a priority. In cases of significant tissue loss, primary closure should be undertaken if possible. Skin grafting at the time of primary closure is rarely necessary. Definitive repair, which may include skin grafts and tissue flaps, should be delayed as long as possible to allow scars to mature.

2. Antibiotic prophylaxis is not usually necessary for most uncomplicated lacerations of the eyelid and lacrimal system. Application of an antibiotic-steroid ointment is helpful in lubricating the eye, decreasing inflammation, and minimizing crusting around sutures to facilitate suture removal. For grossly contaminated wounds or bites, antibiotics should be given for prophylaxis against infection. Amoxicillin-clavulanate (Augmentin, SmithKline Beecham), 40/mg/kg/day up to 500 mg three times daily, is effective against anaerobes and penicillinase-producing staphylococci (6). For surgery involving the sinuses, preoperative antibiotic prophylaxis with a single dose of cefazolin (Ancef, SmithKline Beecham), 1 to 2 g intravenously, is usually sufficient (6).
3. Tetanus prophylaxis is considered for all patients (7). Primary immunization consists of a series of three tetanus injections given before 7 years of age. A tetanus booster (0.5 ml of tetanus, diphtheria intramuscularly) is necessary for adult patients every 10 years. For contaminated or puncture wounds, immunized patients should receive a booster if it has been more than 5 years since their last booster. Patients with uncertain immunization status and a clean, non-puncture wound should receive a tetanus booster and completion of their immunization series. Patients with uncertain immunization status and a tetanus-prone wound should receive a tetanus injection and a 250-IU dose of tetanus immune globulin intramuscularly.
4. Rabies prophylaxis is also important for patients who sustain animal bites (8). If a pet watched for 10 days develops rabies, if a wild animal cannot be found but is suspected to have rabies, or if rabies is found on examination of the animal in question, rabies prophylaxis should be administered. Initially, 20 IU/kg of rabies immune globulin is given half intramuscularly and half infiltrated at the wound. Additionally, 1 ml of human diploid cell rabies vaccine is given intramuscularly on days 0, 3, 7, 14, and 28.
5. Adequate wound cleansing is necessary to remove foreign material embedded in the wound and to minimize bacterial contamination. Normal saline, irrigated with force through a 19-gauge needle on a 30-ml syringe, reduces bacterial counts and experimental wound infection by 90% (9).
6. The choice of suture material is determined by the site where it is to be used. Nonabsorbable 8-0 silk is used for the eyelid skin and lid margin. Nonabsorbable 6-0 nylon is used for the more robust skin of the brows. Skin sutures can be removed in 4 to 7 days, but the lid margin sutures should be left in place from 7 to 10 days. In children or patients in whom suture removal is difficult, 7-0 chromic sutures can be used. Absorbable 6-0 polyglactin 910 sutures (Vicryl) are used to repair the tarsus.

7. The choice of anesthesia can be local, regional, or general. Local anesthesia by infiltration of the surrounding tissue through the wound with 1% or 2% lidocaine with 1:100,000 epinephrine is used for small lacerations. We rarely use regional anesthesia, which requires multiple injections including the infraorbital, supraorbital, infratrochlear, and supratrochlear nerves for sufficient anesthesia of the periorbital area and lacrimal system. General anesthesia is used in children and in cases of extensive injury. In cases requiring lacrimal intubation, 10% cocaine or Afrin (Schering-Plough)-soaked material placed beneath the inferior turbinate may reduce bleeding.

Simple Lacerations Involving Skin Alone or Skin and Orbicularis

1. Lacerations involving skin alone or skin and orbicularis muscle require skin closure alone with fine suture technique. Deep sutures should not be used except possibly in lacerations involving the brow. Wound edges on eyelid skin are approximated with interrupted 8-0 silk sutures for irregular lacerations. Flaps, corners, and identifiable landmarks should be sutured first. Running 8-0 silk sutures can be used for linear lacerations. Skin sutures can be removed in 4 to 7 days.
2. Triangular or curved linear lacerations of eyelid skin result in contraction of the skin flap, which at first glance may seem to represent a loss of soft tissue. However, frequently the tissue can be readily stretched to fill the defect, and true tissue loss is not the case. For small losses of eyelid skin and orbicularis, primary closure is usually possible, particularly in the upper lid, where redundancy of tissue is the usual situation. Where primary closure is likely to cause lid retraction or lagophthalmos, slight undermining of the surrounding tissue can be used to mobilize a skin-muscle flap (Fig. 8-1).
3. Lacerations involving larger losses of eyelid skin may require skin grafts, which can be taken from the opposite upper eyelid or from retroauricular or supraclav-

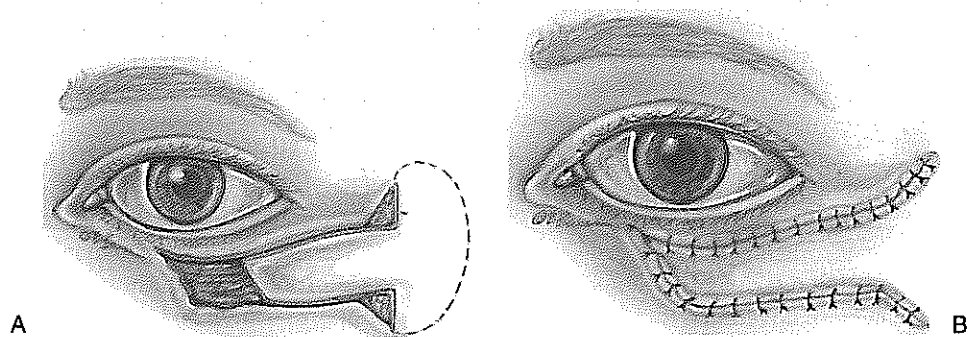
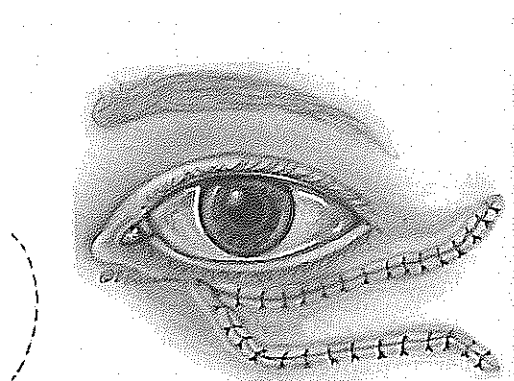


FIG. 8-1. A: Skin-muscle flap. Undermining of the skin and orbicularis allows advancement of the flap to close the area of the avulsed eyelid skin. Burrow's triangles are removed to facilitate flap advancement. B: The skin and orbicularis are reapproximated with 8-0 silk suture.

regional, or general. Local anesthesia by through the wound with 1% or 2% lidocaine is used for small lacerations. We rarely use multiple injections including the infraorbital, trochlear nerves for sufficient anesthesia system. General anesthesia is used in children. In cases requiring lacrimal intubation, (soaked) material placed beneath the skin.

Skin Alone or Skin and Orbicularis

Skin and orbicularis muscle require skin closure. Deep sutures should not be used except at the brow. Wound edges on eyelid skin are approximated with interrupted sutures. Flaps, if needed, should be sutured first. Running 8-0 silk sutures in the tarsus can be removed in 4 to 7 days. Loss of eyelid skin results in contraction of the lid which may seem to represent a loss of soft tissue. This can be readily stretched to fill the defect, and small losses of eyelid skin and orbicularis, particularly in the upper lid, where redundancy is present, can be removed. Where primary closure is likely to cause undermining of the surrounding tissue, a skin flap (Fig. 8-1) of eyelid skin may require skin grafts, which can be taken from the eyelid or from retroauricular or supraclav-



Advancement of the skin and orbicularis allows advancement of eyelid skin. Burow's triangles are removed to facilitate closure. Orbicularis are reapproximated with 8-0 silk suture.

icular areas. However, the best skin available for grafting should not be used in the acute setting and should be saved if at all possible if later reconstructive maneuvers are needed.

Lacerations Involving the Eyelid Margin

1. The lid margin and tarsus require precise realignment to prevent contour irregularities, notching, or trichiasis. All sutures have to be placed in a fashion that will not cause corneal abrasion. Scar contraction tends to work against attempts at restoring normal contour. Tissue may be limited, restricting excision of lacerated or shredded edges. In most cases of margin lacerations, a fine reapproximation of the cut edges is preferable to trimming of edges. It can be difficult to achieve fine, straight cuts through the lid margin and tarsus of a swollen hemorrhagic lid, and tissue may be removed, which results in additional stress on the repair postoperatively. In many cases, it may be preferable to close the wound primarily and revise scarring with re-excision at a later date under more controlled circumstances.
2. Reconstruction begins with tarsal reapproximation (Fig. 8-2). A 6-0 polyglactin suture on a small-diameter needle (e.g., Ethicon S28 or S29) is placed 3 mm from the lid margin and tied with the knot on the anterior surface of the tarsus and the posterior loop of the suture just anterior to the conjunctiva. This prevents any possibility of corneal abrasion. Alignment of the lid margin is examined, and the remainder of the tarsal plate is similarly closed. At most, three to four sutures in the upper tarsus and two sutures in the lower tarsus are typically needed.
3. The lid margin is repaired next. Sutures aligning the lashes and the tarsal plates are placed, as is a third suture in the area of the gray line if needed. Tra-

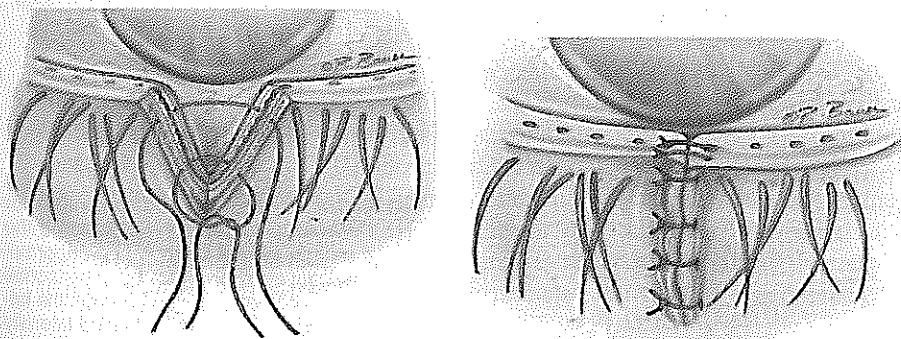


FIG. 8-2. A: Eyelid margin repair. The tarsal plate is reapproximated with two to three 6-0 Vicryl mattress sutures placed as illustrated. Placing all tarsal sutures before tying any suture can facilitate closure. **B:** The skin is reapproximated with interrupted 8-0 silk sutures. The sutures at the level of the gray line and meibomian orifices are cut short so as not to rub on the cornea.

ditionally, the ends of the sutures are left long so they can be brought onto the anterior surface of the lid and secured with another suture to prevent their rubbing on the cornea. However, we have found that carefully and closely trimming the 8-0 silk suture ends also prevents corneal abrasions and eliminates the possibility of the long ends working loose and abrading the cornea. The suture bites in the lid margin should be large enough to provide some bulging of the tissues, for there will be loosening as swelling decreases and contraction of tissues occurs, which can result in a small notch if the tissues were not initially bunched. Lid contour should be normal after closure of the tarsus and lid margin.

4. Skin and, if involved, levator tendon are then reapproximated. The lid margin sutures should be left in place from 7 to 10 days.
5. For tissue loss of one fourth to one third of the upper or lower eyelid, direct closure of a full-thickness eyelid avulsive injury is possible. Lateral canthotomy and cantholysis allows closure of slightly larger defects (Fig. 8-3). Even larger defects of the middle of the eyelid can be repaired by undermining the skin and orbicularis laterally and creating a subciliary incision to create a myocutaneous flap which can be pulled medially and sutured to remaining medial eyelid (Fig. 8-3). Other more severe tissue losses require reconstructive flaps or grafts, the discussion of which is beyond the scope of this text (10).
6. Avulsion of the lid margin and lashes in the absence of significant loss of tarsal tissues requires little initial surgical care in most cases. The margin often heals in a fashion smooth enough to prevent corneal injury. If there has not been significant loss of tarsus in a vertical direction, lagophthalmos may not be a prob-

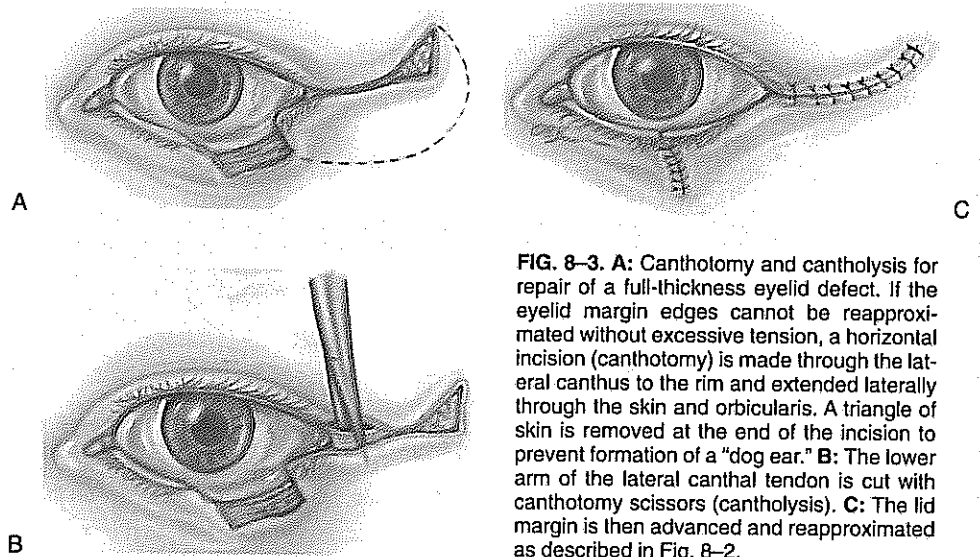
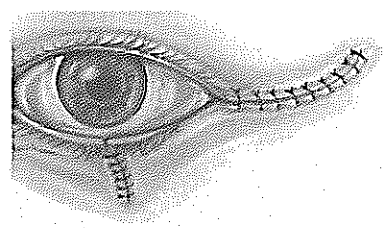


FIG. 8-3. A: Canthotomy and cantholysis for repair of a full-thickness eyelid defect. If the eyelid margin edges cannot be reapproximated without excessive tension, a horizontal incision (canthotomy) is made through the lateral canthus to the rim and extended laterally through the skin and orbicularis. A triangle of skin is removed at the end of the incision to prevent formation of a "dog ear." B: The lower arm of the lateral canthal tendon is cut with canthotomy scissors (cantholysis). C: The lid margin is then advanced and reapproximated as described in Fig. 8-2.

ing so they can be brought onto the other suture to prevent their rubbing that carefully and closely trim corneal abrasions and eliminates use and abrading the cornea. The is enough to provide some bulging; swelling decreases and contract a small notch if the tissues were not normal after closure of the tarsus and lid is reapproximated. The lid margin is closed.

On the upper or lower eyelid, direct closure is possible. Lateral canthotomy for larger defects (Fig. 8-3). Even larger defects are repaired by undermining the skin and making an incision to create a myocutaneous flap from the remaining medial eyelid (Fig. 8-4). This flap is then reapproximated with reconstructive flaps or grafts, the details of which are in the text (10).

In the absence of significant loss of tarsal tissue, direct closure is possible in most cases. The margin often heals well after lid injury. If there has not been significant loss of tarsus, lagophthalmos may not be a problem.



8-3. A: Canthotomy and cantholysis for repair of a full-thickness eyelid defect. If the lid margin edges cannot be reapproximated without excessive tension, a horizontal incision (canthotomy) is made through the lateral canthus to the rim and extended laterally through the skin and orbicularis. A triangle of tissue is removed at the end of the incision to prevent formation of a "dog ear." **B:** The lower margin of the lateral canthal tendon is cut with canthotomy scissors (cantholysis). **C:** The lid margin is then advanced and reapproximated as described in Fig. 8-2.

blem. Acute reconstruction is not needed and is best left to a later date when the situation is completely stabilized.

Lacerations Involving the Medial Canthus and Lacrimal System

1. Repair of the laceration should include internal stenting of the canaliculus (Fig. 8-4). Both the upper and lower lacrimal canaliculi should be probed and irrigated if examination shows that the eyelid injury is at or medial to the punctum. High-powered loupes or an operating microscope is useful to locate the proximal end of the canaliculus. If the laceration is close to the medial canthus, or if swelling of the surrounding tissues is present, identification of the proximal end may be difficult. Allowing tissue swelling to subside with time may help with identification. Irrigation of air or a milky corticosteroid solution through the opposite canalicular system may also help locate the proximal cut end.
2. A bicanalicular stent is used, such as the Guibor design (Concept), with stainless-steel probes swaged onto the silicone tubing. The probe is lubricated with an ophthalmic ointment and is first passed vertically through the punctum of the involved canaliculus. While stretching the lid, the probe is rotated 90 degrees to the horizontal plane and advanced out through the laceration. The probe is then placed into the proximal end of the canaliculus and advanced along the horizontal plane into the lacrimal lacerated sac. When it rests against the medial orbital wall, it is rotated to the vertical plane and advanced through the nasolacrimal duct. A grooved director under the inferior turbinate is used to externalize the probe from the nares. The process is repeated for the uninvolved canaliculus. The silicone tubes are brought from the nares and tied together using 6-0 silk suture. The knot is retracted back into the laceration, and a second knot is placed proximal to the first, forming a smaller loop in the silicone tubing. The first knot is removed, and the second knot is pulled through the canalicular system so that the knot rests in the lacrimal sac, keeping the tubes in place (11). The silicone tubes are then trimmed 1 cm proximal to the nares. The canthal ligament and connective tissue adjacent to the canaliculus are sutured with 6.0 polyglactin 910, allowing the reapproximation of the canaliculus.
3. Superficial injuries of the medial canthal area not involving the lacrimal drainage system can be repaired by primary closure using 8.0 silk for skin closure and 6.0 polyglactin 910 if closure of the deep layers is required.
4. Laceration of the medial canthal ligament is repaired by reapproximating the lacerated ends of the ligament with 6-0 polyglactin 910. Avulsion of the medial canthal ligament from the anterior lacrimal crest is repaired by suturing the tendon to the periosteum with a 5-0 or 6-0 nonabsorbable suture (nylon or polyester).

Lacerations Involving the Lateral Canthus

Direct closure of lateral canthal lacerations is possible if at least 70% of the upper and lower lid margins remain. The lateral tarsus is secured to the inner aspect of the lateral orbital rim periosteum with 5-0 or 6-0 mersilene.