

4 Ocular Emergencies

4.1 Introduction

Ophthalmologic emergency patients can be divided into two main groups:

a) Trauma caused by direct or indirect injuries. Examples within this group include luxation of the globe as well as burns, or blunt, superficial or perforating trauma to the lids, conjunctiva, cornea, or the entire globe.

b) Ocular diseases which, because of their aggressiveness or rapid development (1–2 days), can lead to severe pain, loss of sight, or loss of the entire globe, and thus require direct treatment. Examples of these include retrobulbar processes;¹ aggressive ulcers with melting edges (see 10.6.3.2), which may perforate; anterior uveitis; glaucoma; lens luxation; and acute blindness due to such causes as posterior uveitis, retinal detachment, and involvement of the optic papilla and nerve by hemorrhage, inflammation, or neoplasia. These diseases are discussed in the subsequent relevant sections of this book, organized on a morphologic and pathogenetic basis.

Trauma to the bony orbit, globe, and/or adnexa can be caused by foreign bodies or by direct or indirect injuries in the form of moderate or severe blows (automobile accidents or even punishing blows from the owner), or from being stabbed, shot, bitten, or scratched.



Plate 4.1:

Provoked luxation (proptosis) of the globe in a Pekingese. Pekingese and Shih Tzu should be restrained by the owner, taking care that no undue pressure is exerted on the head, resulting in forced propulsion of the globe. The length of the fissure (usually 30–34 mm) and the tension of the orbicular muscle prevent spontaneous replacement. The scleral, conjunctival, and venous drainage is blocked, which causes additional swelling.

4.2 Luxation and proptosis of the globe

Luxation of the globe refers to a dislocation of the globe through lid fissures, as proptosis can be defined as frontal dis-



Plate 4.2:

Luxation or proptosis of the globe approximately 20 minutes after a car accident (OD, dog).



Plate 4.3:

Luxation or proptosis of the globe approximately 40 minutes after a car accident. Note: ventrally to the globe is free blood, indicating tissue rupture. In this patient, almost all of the eye stalk had been torn away, making reposition senseless.

placement of the globe in general. Luxation of the globe (Plate 4.1–4.3) is one of the ophthalmologic and veterinary emergencies. The luxation is usually caused by an automobile accident or injury from another animal such as bites from another dog or kicks from a horse. The direct contact with the automobile bumper and/or compression of the zygomatic arch can force the globe forward so that it is luxated out of the orbit and rostral to the palpebral fissure. If the eye is bitten, it may be pulled outwards by a canine tooth. The arterial supply remains intact but the venous drainage is blocked. If the lid fissure is of normal length (in dogs with macroblepharon there may be proptosis but rarely luxation), the globe will be blocked outside the lid fissure, the lid margins will entropionize, and will stick with their dry, hairy outer surface behind the globe. The conjunctiva becomes congested and thus quickly swells and goes intensively red. The cornea is severely damaged and the optic nerve irreversibly damaged either immediately or within a few hours. Brachycephalic breeds such as the Pekingese and the Shih Tzu deserve separate attention here. In these breeds the globe lies in such a shallow orbit and the opening between the eyelids is so large that the globe can luxate through the opening with ease (Plate 4.1). Hyperactivity or a tantrum of the dog can be enough to cause luxation. The globe can also luxate easily if the animal requires excessive restraint on the examination table. Such dogs should be restrained by the owner with the hand around the animal's neck, taking care that undue pressure is not exerted to the head resulting in a forced propulsion of the globe. These dogs should never be held by the skin of the neck.

Therapy: As a first step, the eyelids must be immediately pulled back over the globe. Unfortunately, an owner seldom

succeeds in doing this. If immediate replacement of the eye in the orbit is impossible, the globe should be protected against further damage and drying by applying, for example, salad oil. The patient should then be brought as soon as possible to the veterinarian. During transport, self-mutilation must be prevented by fixation.

The veterinarian should first inspect the eye for total rupture of the muscles or the optic nerve, especially when free blood is present (Plate 4.3). Thereafter, the eye is protected with "initial choice" antibiotic and lacrilube ointments. If the patient is still somewhat dazed by the accident, a lateral canthotomy (incision with a pointed scalpel) can be performed immediately (Fig. 4.1). Otherwise, the patient is anesthetized (if its condition allows it) and then the canthotomy is performed. If minimal inflammatory sequelae are present and no traumatic myotomies are manifest, canthotomy is sometimes not necessary. The eyelids are then pulled over the globe by the use of two Allis forceps or two strabismus hooks. Sometimes, gentle pressure must be applied to the globe via a moistened cotton bud.

A temporary tarsorrhaphy is performed by placing two or three horizontal mattress sutures (4-0 or 5-0, cutting, micro-point or round body needle), using infusion set tubing or sterile wide rubber bands to prevent the suture from cutting into the tissues. The mattress sutures are placed by inserting the needle 5–7 mm from the edge of the lid and exiting through the edge itself, in or just outside the orifices of the meibomian glands and inside the cilia (Fig. 4.1, 4.2). Sutures placed too far outside can cause entropion. Sutures placed through the conjunctiva may result in an egg slicing effect to the cornea. The needle is introduced at the corresponding location in the edge of the opposite lid. The canthotomy incision is closed very

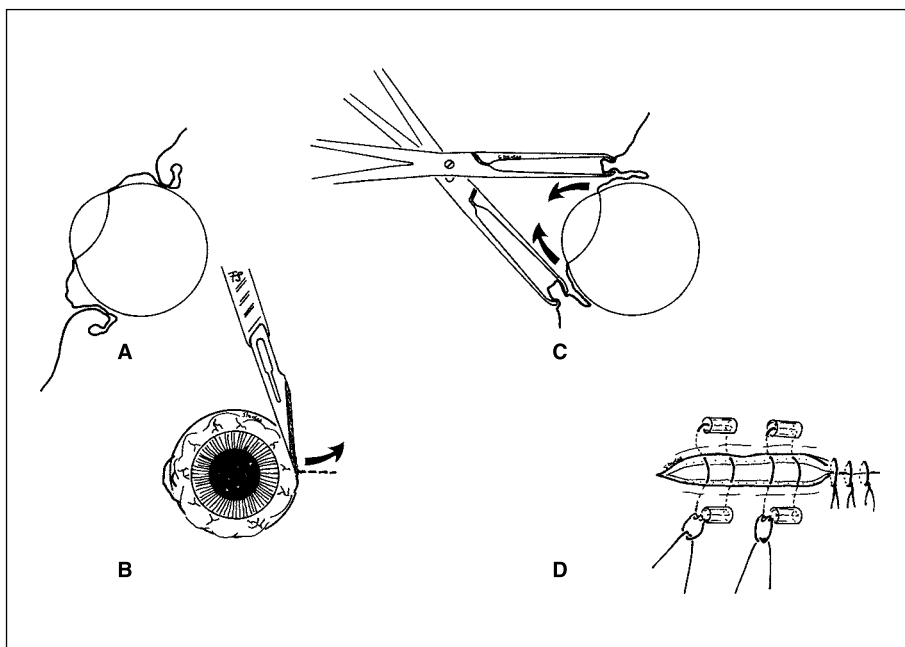


Fig. 4.1: Luxation of the globe (A). Canthotomy (B), reposition (C), suturing method (D).

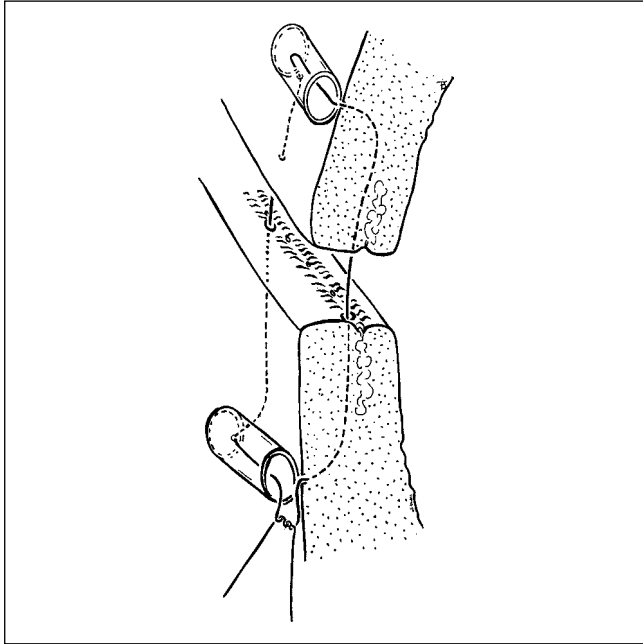


Fig. 4.2:
Temporary tarsorrhaphy. Method of suturing in section.

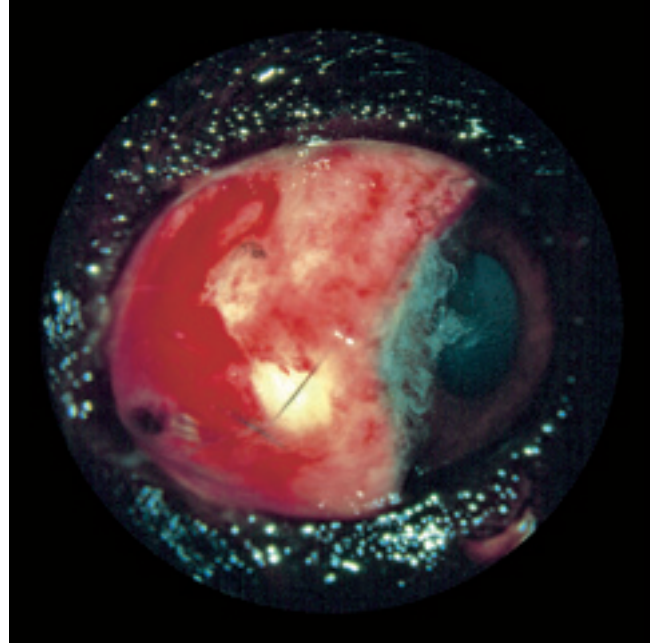


Plate 4.4:
Luxation or proptosis of the globe after repositioning (OS). The medial rectus muscle is ruptured, causing a divergent strabismus.

precisely, starting with a figure-of-eight suture. Prophylactic “initial choice” antibiotic and atropine ointments are applied behind the nictitating membrane before the sutures are knotted. After-care consists of applying the same medication in the lateral canthus, between the eyelids, and anti-inflammatory drugs are prescribed (e.g. carprofen). After 3–5 days the medial suture is removed. If there is still an apparent tendency to luxation, the remaining suture is left in place for a few more days.

A complicating tearing of the medial rectus and medial retractor oculi muscles often results in a diverging strabismus after the luxation (Plate 4.4). Not much can be done about this in the field; even veterinary ophthalmologists can rarely perform this type of muscle surgery for the re-establishment of a normal position. Searching for the torn muscle ends will cause severe surgical trauma unless the surgeon is experienced in this procedure. In an attempt to correct the strabismus as much as possible, the leading margin of the nictitating membrane can be attached to the lateral scleral conjunctiva by the use of 1 or 2 mattress sutures (see 10.6.3). This method does not prevent a recurrence of globe luxation, but may assist in repositioning the globe. The divergent strabismus may disappear or improve spontaneously within 6–8 weeks.

After the tarsorrhaphy sutures are removed, appropriate antibiotic ointment is administered. Atropine ointment is further used if anterior uveitis is present. In addition, anti-inflammatory agents may be indicated as frequently as 4 times daily, for about 10 days. The canthotomy sutures are removed 10–12 days after the accident.

Prognosis: Usually, the prognosis for preservation of the globe and restoration of vision is reasonably favorable, provided that the luxation has not been present for longer than 1–2 hours (<15 minutes in Pekingese). However, the prognosis for vision is dependent on the severity of the injury. If there has been severe trauma to the globe resulting in avulsion of the medial extrinsic muscles or the optic nerve, retinal detachment, hyphema, or contusion of the globe (see 4.4.2), blindness or phthisis bulbi is inevitable. In the case of very severe damage to the muscles and the optic nerve, direct enucleation is usually the best solution.

Complications: If there seems to be a tendency for the luxation to recur after the first suture has been cut, the second suture should remain in place for a few more days. If exophthalmos is still present, a permanent tarsorrhaphy can be performed. For this purpose, a strip of skin 10–15 mm long and 1 mm wide is removed just outside the upper and lower lid margins. The proximal edges of the upper and lower wounds are then sutured together over the lid edges (5-0 silk or nylon). The result is a tissue bridge over the rims of the lids that holds the globe in place. After-care consists of administration of “initial choice” antibiotic ointment for 10 days, followed by an indifferent, protective ointment (e.g. vitamin A ointment). After a few months the tissue bridge can be transected. The wounds close spontaneously. In cases of very severe damage, especially after rupture of multiple muscles or the optic nerve, enucleation of the eye may be unavoidable.

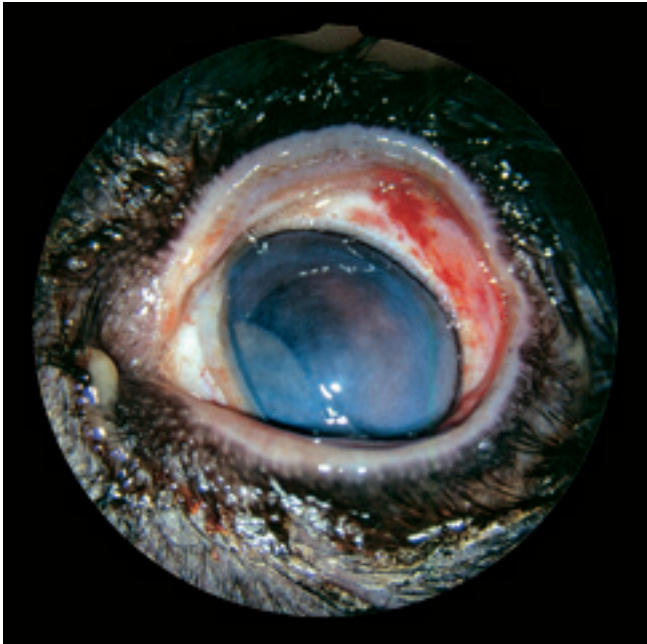


Plate 4.5: Chemical burn (quick lime) of the eye (OS, dog). The lid margins are depigmented and swollen. The scleral conjunctiva shows defects and hemorrhages. The cornea is very edematous.

Prevention: In the brachycephalic breeds (e.g. Pekingese, Shih Tzu), a medial canthoplasty can be considered as a preventive measure, in which the palpebral fissure is shortened (see 7.8.1).

Note: not in the lateral canthus; a medial canthoplasty also prevents nasal fold, caruncle trichiasis and medial canthus entropion irritation. If necessary, the animal should be referred to someone experienced in this surgery. The buyers as well as the breeders of dogs of predisposed breeds need to be reminded emphatically that the eye should be able to function freely and requires a real orbit for protection.

4.3 Chemical burns

Acids and alkalis, such as battery acid, detergents, and quick-lime, can cause very severe corneal burns (Plate 4.5). Acids are slightly less dangerous because they cause precipitation of protein which hinders a deeper penetration into the cornea. Alkalis penetrate quickly and cause severe damage to the cornea and the deeper structures. This results in irreversible damage to those structures involved, leading to complete scarring of the cornea and irreparable damage to the anterior uvea.

There is profuse, diffuse edema of the cornea. The conjunctiva is edematous and has hemorrhagic defects. The owner must irrigate the eye immediately, preferably with liberal amounts of lukewarm tap water, or any other water available. The first seconds / minutes are, by far, the most important. In the case of a distinct alkali burn, vinegar or boric acid solutions may be useful. After local anesthesia, the veterinarian can then irrigate the eye for 5–10 minutes with lukewarm 0.9 % NaCl solution (1–2 l) or with an EDTA solution. The conjunctival sac should be examined for possible residues of the injurious material.

After-care consists of “initial choice” antibiotic and 1 % atropine eye drops and, for a few days, if fluorescein staining is negative, topical anti-inflammatory agents. Parenteral anti-prostaglandins and corticosteroids may be necessary. If the endothelium has been destroyed, only a corneal transplant offers a solution, but even this is unlikely to be successful if the peripheral endothelium or anterior uvea has also been damaged.

4.4 Blunt trauma

Blunt trauma can be recognized by the tearing of the tissues of the orbit, the adnexa, the globe, and its contents, and all the consequences of this. Hemorrhages and post-traumatic inflammation can cause severe swelling, especially in the cat. Tearing of the zonular fibers of the lens can induce lens luxation and subsequent glaucoma. There may also be orbital fractures. Appropriate therapy requires an accurate diagnosis, in which radiographic and ultrasound examination are of great importance.

4.4.1 Orbital fractures

Closed orbital fractures which result in little displacement require no special treatment except rest and the provision of soft food. Fractures of the zygomatic arch, in which the globe is either pressed anteriorly or, less often, posteriorly, should be repositioned and fixation should be by osteosynthesis. Fracture of the symphysis of the mandible, with secondary rotation of one-half of the mandible, can result in dislocation of the coronoid process and thus exophthalmos.



Plate 4.6:
Suffusion between the scleral conjunctiva and the sclera after a corrective blow with the leash (OS, dog).



Plate 4.7:
Diffuse hyphema after a car accident (OS, dog).

4.4.2 Contusion of the globe

Contusion of the globe can have very different effects. Although the trauma is most often rostrolateral, the pressure wave can be transmitted deep into and behind the eye, so that retinal and retrobulbar damage are among the possible sequelae. Thus, a complete examination of the eye, possibly including additional examinations (e.g. indirect ophthalmoscopy, slit-lamp biomicroscopy, tonometry, ultra-sonography, MRI), is essential.

4.4.2.1 Suffusion (hyposphagma)

Suffusion or (subconjunctival) hemorrhages usually result from rupture of the subconjunctival vessels above the relatively stiff sclera, and hence the blood spreads out in the space between the sclera and the conjunctiva (Plate 4.6). Severe swelling results, which may prevent closure of the lid fissure. Often the trauma is caused by a blow with the hand or some object, or by strangulation. Hemorrhages can, however, be caused by diseases such as coagulation disorders or malignant lymphoma. Acute hemorrhages can sometimes be stopped by application of 0.1–1.0 % epinephrine drops. Therapy consists of a prophylactic “initial choice” antibiotic ointment for 5–8 days. If there is much swelling, preventing lid closure, additional indifferent ointment or artificial tears should be administered every hour. Suffusion hemorrhages are normally absorbed within 5–10 days if the cause is removed.

4.4.2.2 Traumatic corneal edema

Traumatic corneal edema usually progresses into the stroma. This cloudiness is usually reversible. The administration of steroidal anti-inflammatory drops, 2–4 times daily, for a few days, can be considered after the cornea has been found to be negative on fluorescein staining.



In birds, keratitis is often caused by handling or by cage trauma.

4.4.2.3 Hyphema

Hyphema or hemorrhage in the anterior chamber is a frequent complication after trauma (Plate 4.7). There is little evidence that any therapy is of much benefit. However, keeping the animal quiet with cage rest is beneficial. Some ophthalmologists advocate the administration of 0.1 % epinephrine and/or 1 % atropine drops in the acute stage to stop the hemorrhage, but it has almost always stopped spontaneously before the drops take effect. Atropine may prevent posterior synechiae. Prescription of “initial choice” antibiotics and dexamethasone eye drops must be considered if synechia formation is expected, especially in horses. Within 1–2 days, the erythrocytes in the anterior chamber will settle to the bottom, resulting in a dense red horizontal line with a cleared area lying above it (Plate 4.8). Removal of the blood via a ventral paracentesis (small opening in the limbus) is seldom indicated

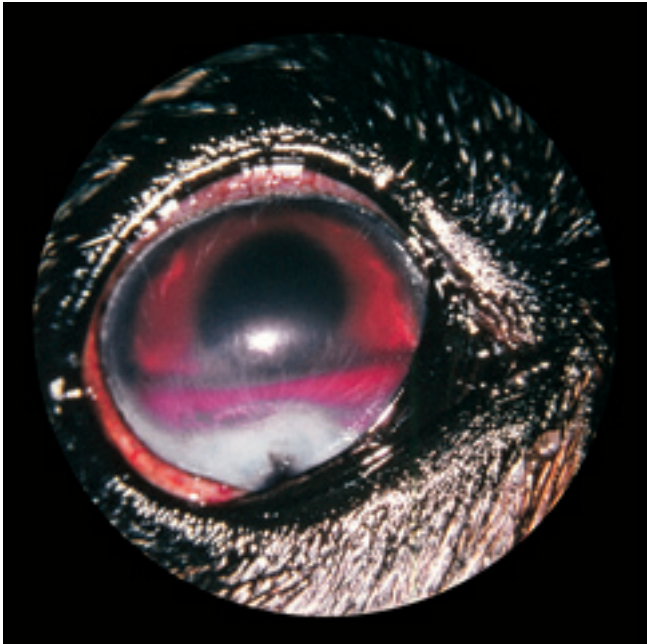


Plate 4.8: Horizontal line of erythrocytes in the anterior chamber, 36 hours after a car accident (OD, dog). In the part undergoing clearing above the line, the pupil is just visible again.

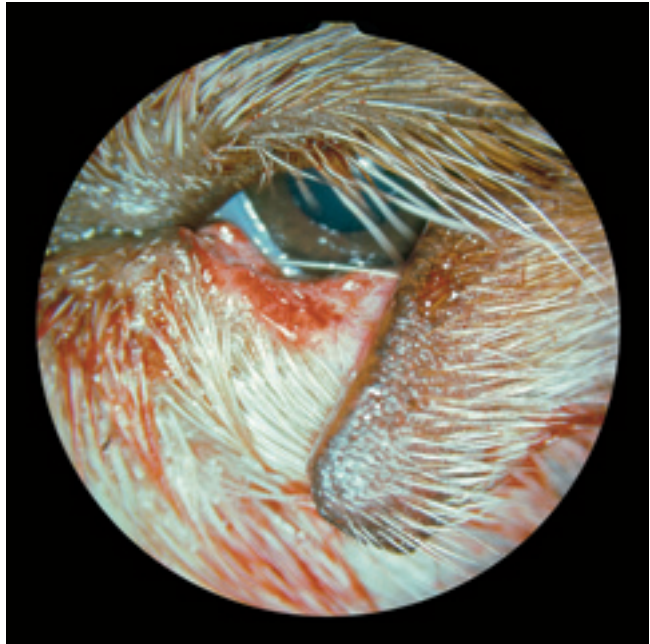


Plate 4.9: Laceration of the lower lid after a dog bite (OS). Lid wounds should be almost without exception sutured immediately (see also Plate 4.10).



Plate 4.10: Lid laceration caused by barbed wire in a horse (OS). Lid lacerations should be surgically treated immediately (see also Plate 4.11).

in animals. In addition, the alternating administration of atropine and pilocarpine or the use of heparin ointment does not really hasten absorption. A hyphema that does not clear, or bilateral hyphema, is usually not the result of trauma but more likely a sign of hemorrhagic diathesis, e.g. in malignant lymphoma (see 12.9) and further examination should be carried out in that direction.

4.4.2.4 Trauma with deeper penetration

Trauma with deeper penetration can have extremely variable consequences. Hence in addition to hyphema, there can be tearing of the iris, tearing of the zonular fibers with subsequent lens luxation, hemorrhage in the vitreous or the fundus, and retinal edema or retinal ablation. Treatment thus depends upon the findings. Hemorrhages can sometimes be stopped with topical epinephrine, though direct surgical intervention may be indicated in some cases. If lens luxation is found, treatment for glaucoma is started as an emergency measure (see 11.3.3). Inflammatory processes can be suppressed with steroidal anti-inflammatory drops or parenteral steroidal or NSAIDs; though with the latter one must be aware of their anti-thromboxane effect and hence the increased bleeding tendency with NSAIDs. Often it is advisable to refer patients with signs of deep trauma to the skull also to an eye specialist.



Plate 4.11:

Scar of a lid laceration almost identical to the one shown in Plate 4.9, but after spontaneous healing (OS, dog). The retraction of the orbicularis muscle and scar retraction have resulted in a nodule of scar tissue and ventral traction of the lid edge. Because of the "lucky" location of the wound, the nictitating membrane has partly taken over the lid function and protects the cornea.

4.5 Penetrating or perforating trauma

Perforating trauma and tissue separation are usually caused by thorns, splinters, claws, or teeth. In horses, training whips and nails in the stalls are often incriminated. In the case of periocular soft tissue swelling, the use of corticosteroids or NSAIDs has to be considered.



Because the skin around the eye is almost directly over the bony skull, the skin is frequently torn away or complicating fractures are present with this type of trauma. Therapy is as given below. Adequate tetanus prevention is essential.

4.5.1 Lid lacerations and conjunctival sac wounds

Eyelids and conjunctival sac wounds are often right-angled and bleed heavily (Plate 4.9–4.11). If the lid edge has been cut through, the defect will enlarge spontaneously in the lid via contraction of the orbicularis oculi muscle. Wounds in the

eyelid should therefore always be sutured immediately, even if they are more than 8 hours old. The use of topical anesthesia and/or sedation for the necessary surgical correction is generally not adequate, especially in the horse. The correction has to be performed under general anesthesia, using a high-quality magnification operation loupe. Hair along the wound edges can be clipped away if it does not lead to unnecessary damage. Both the wound in the lid and the conjunctival sac must be very thoroughly irrigated. Mechanical wound debridement should be kept to a minimum. A water-pick is an excellent method of providing irrigation and wound debridement.

The wound in the edge of the lid must be closed very precisely with a figure-of-eight or mattress suture (5-0 or 6-0 monofilament nylon, [cutting] round body needle; absorbable only for aggressive or difficult to handle, high anesthesia-risk patients). The suture is started 1–2 mm from the margin, where hair growth starts (Fig. 4.3). The meibomian gland openings

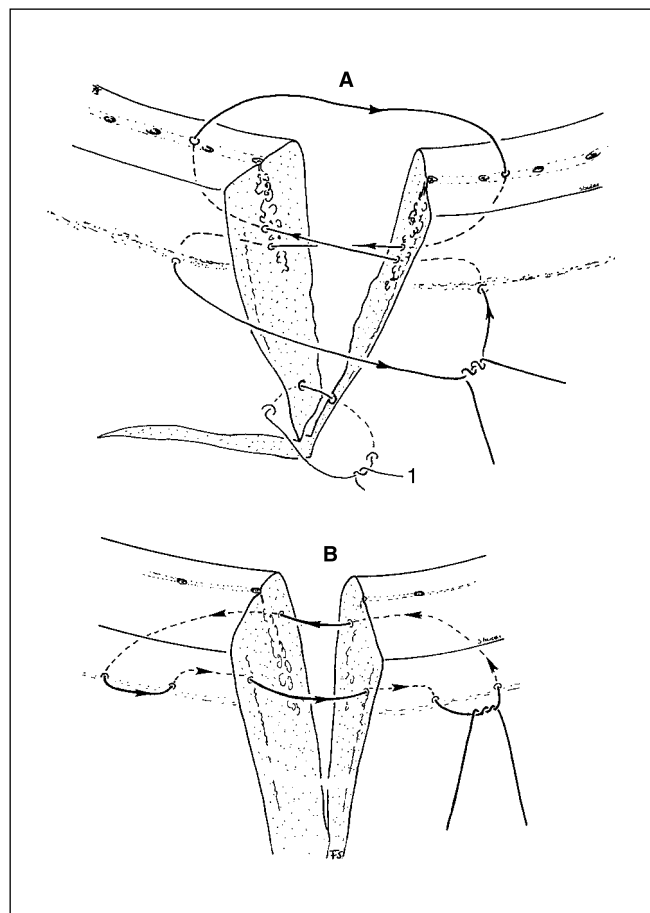
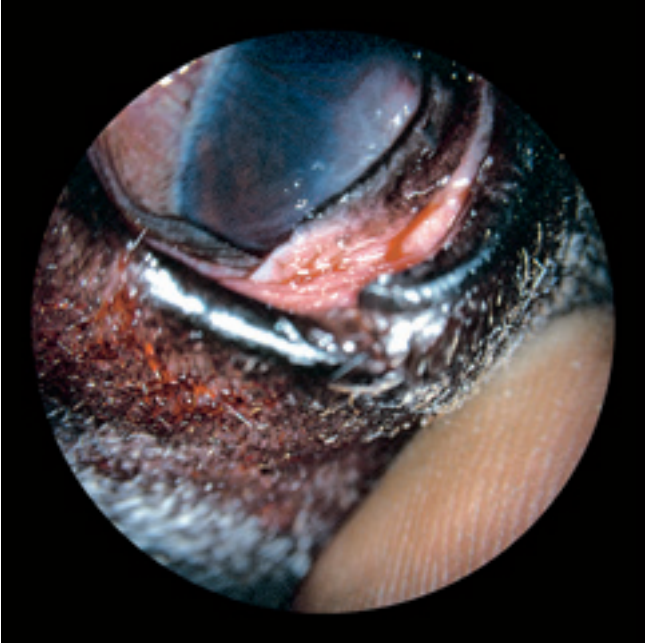


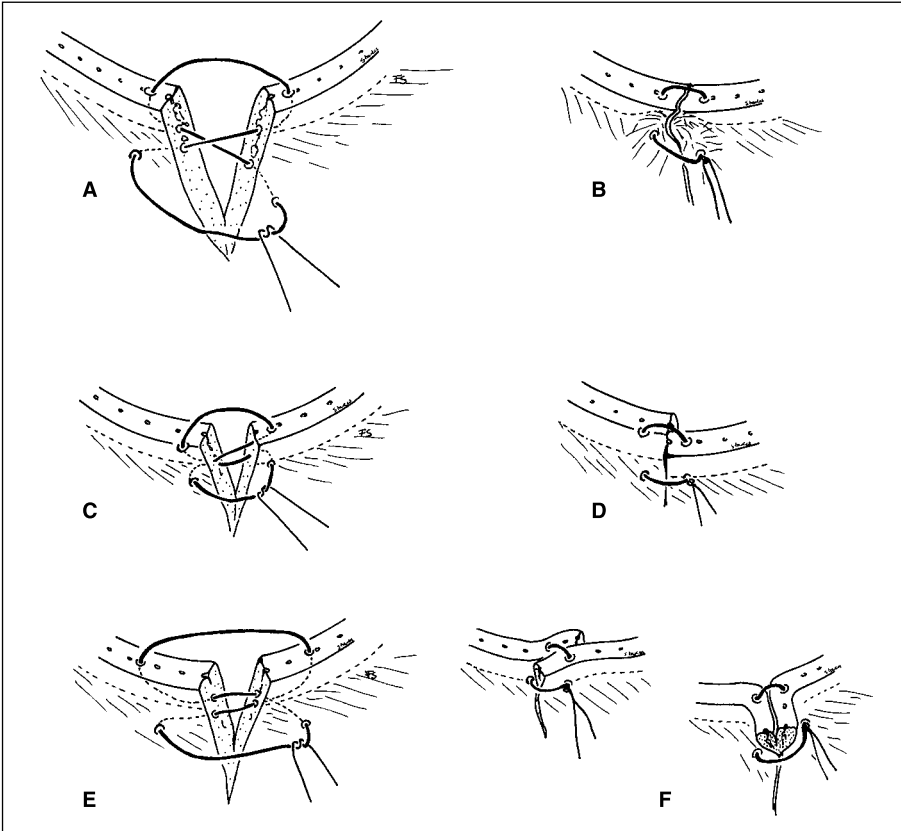
Fig. 4.3:

Laceration of the lid margin. Methods of suturing using a figure-of-eight (A) or a U-form (B) suture. Thereafter, the conspicuous points of the wound are sutured (1).

**Plate 4.12:**

Scar of a not "lege artis" sutured lid laceration (OD, dog), as shown in Figs. 4.4 E and F.

are used as a guide line for precise realignment. Horizontal or vertical mismatching (Fig. 4.4 and Plates 4.11, 4.12) of the two parts of the lid edge are unacceptable. Small defects in the conjunctiva rarely have to be sutured. Sometimes, non-perforating U-sutures can be used (see also 4.5.2). After the lid edge has been closed, the most conspicuous points of the wound (e.g. angles) are brought together with simple interrupted sutures. The remaining parts of the wound are then closed by placing additional sutures halfway between the previous sutures until the wound edges are adequately closed. This method prevents unequal traction upon the wound edges. The maximal distance between sutures should not be more than 2 mm. After-care consists of applying topical antibiotic ointment to the eye and the wound. Other clinicians avoid topical therapy and administer antibiotics parenterally. If contamination is evident and concern about bacterial infection is present, culture and sensitivity tests are indicated. The veterinarian should evaluate the progression of healing and modify the treatment as necessary.

**Fig. 4.4:**

Suturing of a laceration of the lid margin as it should not be done. The figure-of-eight-suture has been started at an unequal distance and too far away from the margin (A), with the result (B). Incongruous suture: at the left side 1 mm outside of the margin and at the right side in the line of the meibomian gland openings (C) and its result (D). Suture located too far away from the margin (E) and its result (F).

4.5.1.1 Lacerations of the lid edge including the lacrimal canaliculus

Lacerations of the medial canthus are rare, though when they occur they are usually in the lower lid and accompanied by laceration of the lacrimal ducts. The canaliculi are located in the swollen wound by intubation. An S-shaped 000 probe or Worst pigtail probe (preferably with an eye in the tip) is introduced via the upper punctum into the wound (Fig. 4.5). A 0.7- to 1.3-mm diameter silicone tube is either placed over the tip of the probe or cut on a slant and inserted into the eye in the tip of the probe. The tube is pulled through the upper punctum via the entrance in the wound and the sacculus. The probe is then introduced through the lower punctum to the wound and the other end of the silicone tube is pulled through the rest of the lower canaliculus to the lower punctum. The ends are tied together by a 5-0 silk suture. This way of tying is quick, but both ends may irritate the cornea. Irritation from the ends can be avoided by making a circular tubing (Fig. 4.5, 6.8) or if the ends are fixed to the medial canthal skin using a simple interrupted suture. A strand of 6-0 monofilament nylon is passed through the tube, the length of the tube is adjusted and the strand is knotted, leaving the tube in a ring through the canaliculi and sacculus (see 6.4.2). The wound in the lid margin is closed with a figure-of-eight suture and the

rest of the wound by single interrupted sutures. The tubing is left in place for 2–3 weeks.

4.5.1.2 Lacerations with loss of tissue

When there is loss of tissue at the margin of the lid, retraction will enlarge the defect even more. If reconstructive blepharoplasty cannot be done directly, 1–2 tension sutures should be inserted (Fig. 7.26). Cutting into the tissue by the sutures should be prevented by the use of pieces of silicone or infusion tube. If possible a blepharoplasty should be performed immediately. The reverse triangle method (Fig. 7.23) is appropriate for closure of a small, deeper defect. Broad, shallow defects should be corrected by an H-plasty (Fig. 7.25). Even larger defects can be closed by a rotating (Fig. 7.3) or sliding flap, or a Z-plasty.

4.5.2 Conjunctival lacerations

Larger defects of the conjunctiva or nictitating membrane are closed with continuous sutures (6-0 to 8-0 absorbable material, [cutting] round body or spatula needle), preferably free of knots. The animal should be referred if necessary. The suturing

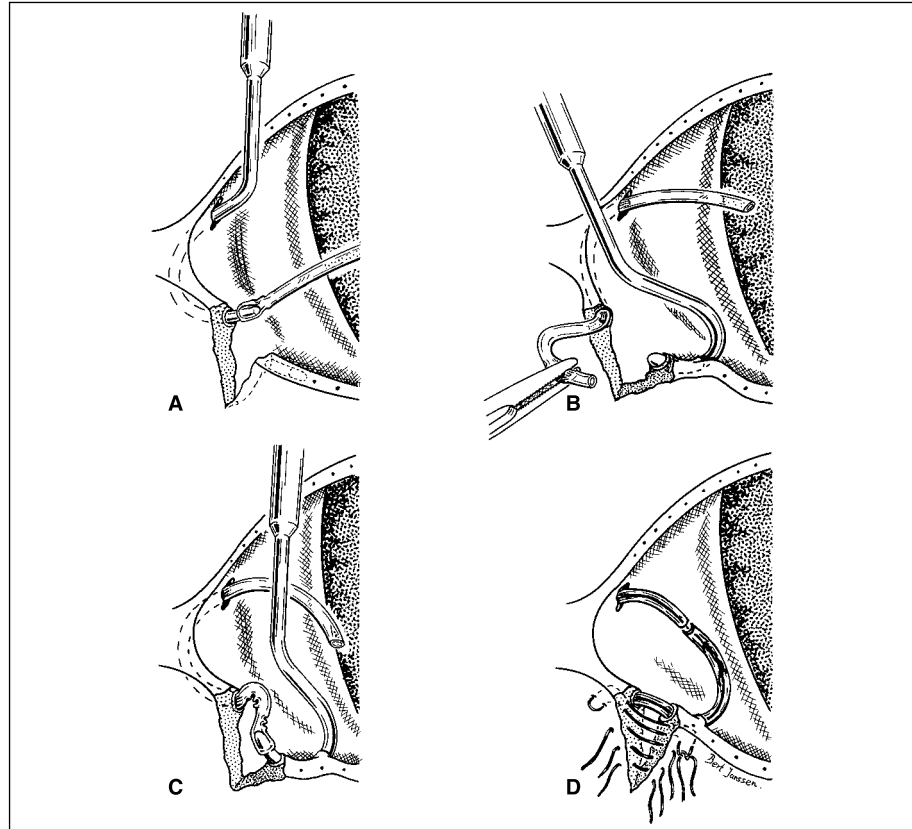


Fig. 4.5: Lid-edge laceration through the inferior canaliculus. Connection is guaranteed by the introduction of a silicone tube. After that the wound is sutured (alternative suturing, see Fig. 4.3).

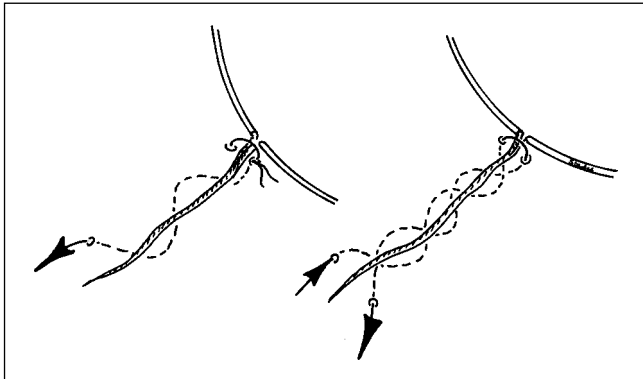


Fig. 4.6: Defect in the nictitating membrane. Method of suturing with as few knots as possible.

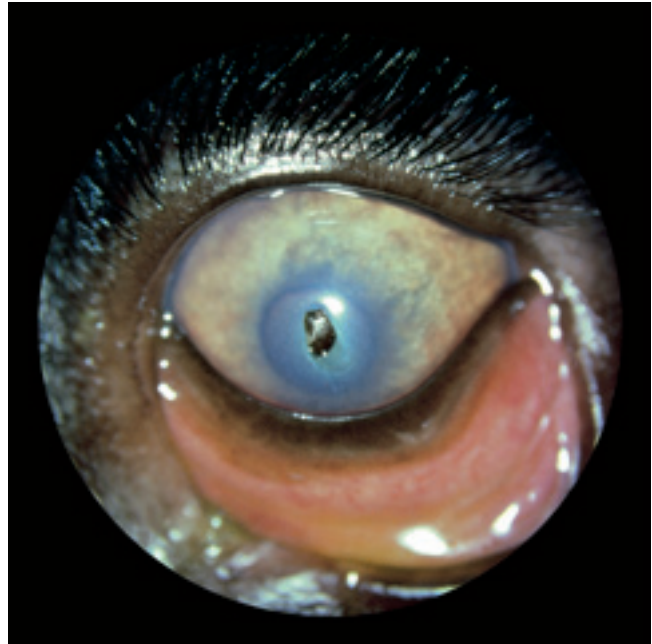


Plate 4.13: Foreign body centrally on/in the cornea (OS, dog), one day after contact. It is the covering layer of a plant bud. It has been sucked with its concave side into the tear film and subsequently into the cornea (see also Plate 4.14).

must never result in traction scars, as these lead to irritation. If traction cannot be avoided it is better to leave the conjunctival wound open. Knots should be avoided or placed beneath the conjunctiva. The defect in the conjunctiva accompanying a wound in the lid edge rarely needs to be sutured.

4.5.3 Corneal lacerations

Corneal wounds can occur with or without a foreign body and can be superficial, deep, or perforating. The patient has severe blepharospasm, profuse tear production, corneal edema, and possibly a prolapse of coagulated material, even iris, into the wound.

4.5.3.1 General rules of treatment

Veterinarians who do not have all the necessary materials or who lack the experience or confidence to undertake procedures involving the cornea should refer patients with foreign bodies or severe corneal defects. When there are very deep defects in the cornea that reach Descemet's membrane (which does not stain with fluorescein) or penetrate into the anterior chamber, oversuturing of the nictitating membrane can be considered (see 10.6.3), but this requires considerable time, is

not the method of initial choice and will require an extra anesthesia.

Before referral, severely contaminated wounds should be cultured and sensitivity tests run to select the best antibiotic. Further treatment will dictate the type of "specific choice" antibiotic to be used afterwards. Exudate may be dissolved by a collagenase inhibitor such as acetylcysteine, and the contamination removed by saline lavage. Bacterial invasion is stopped by effective, penetrating "initial choice", broad-spectrum antibiotic drops. Pain caused by ciliary muscle spasm is relieved (cycloplegia) with 1% atropine, also in eye drops. "Treatment" with topical anesthetics will delay epithelial healing, mask further damage, and therefore must be seen as a professional mistake. The release of prostaglandins is decreased by anti-prostaglandins. For transport and during the healing period, the patient can be fitted with a protective collar or hood.

4.5.3.2 Non-perforating corneal wounds

Non-perforating corneal wounds can be shown by fluorescein staining. Foreign bodies such as plant material (Plates 4.13, 4.14) and particles of food which have been thrown to the dog to catch (e.g. potato chips, dried shrimp) can be irrigated or removed under local anesthesia using foreign body forceps. Thorns that have penetrated into the corneal stroma (Plates 4.15–4.17) and lie completely within it, but have not

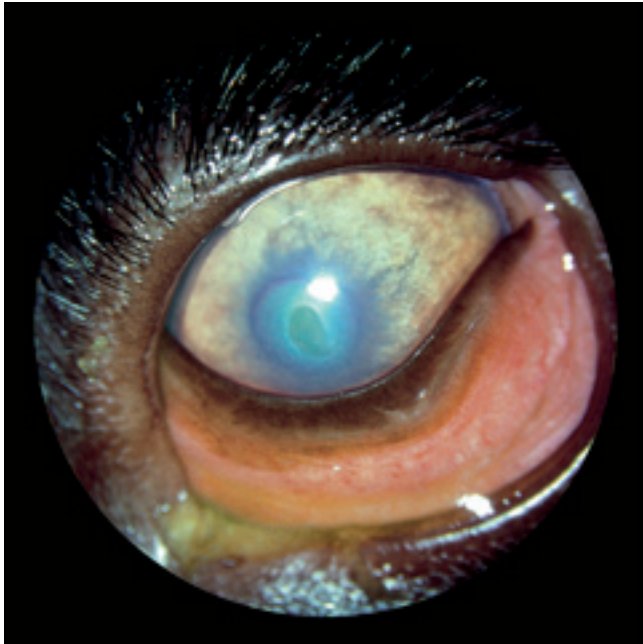


Plate 4.14:
Defect after the removal of the foreign body shown in Plate 4.13 (OS, dog).

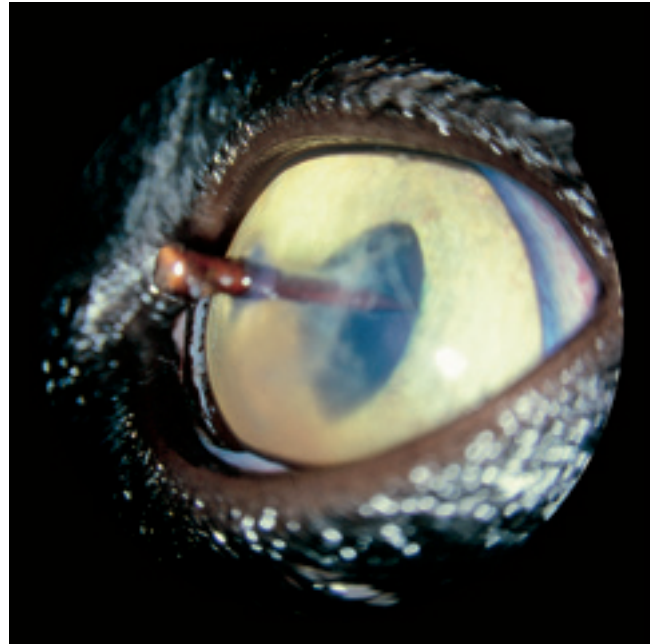


Plate 4.15:
Corneal perforation of a thorn into the lens in the eye of a cat (OS; see also Plate 4.16).

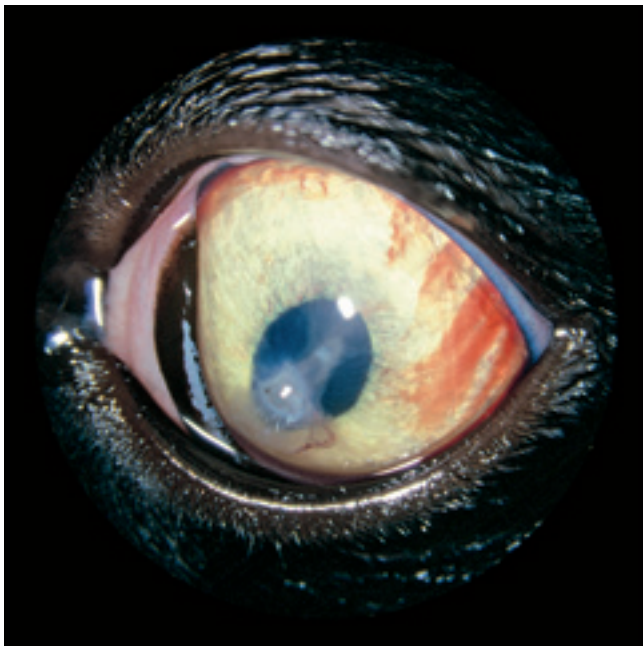


Plate 4.16:
Corneal defect directly after the removal of a thorn: a covering "tube" around the channel of introduction of the thorn and flares of free blood in the anterior chamber. (OS; same eye as shown in Plate 4.15).

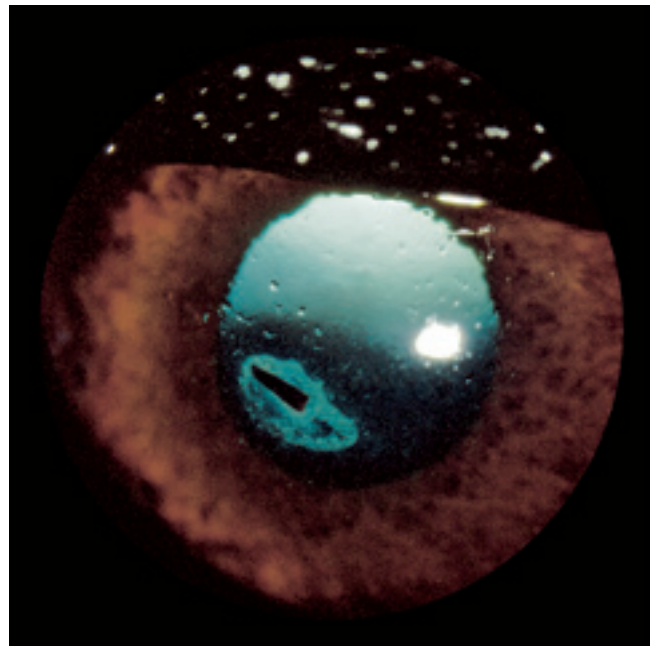
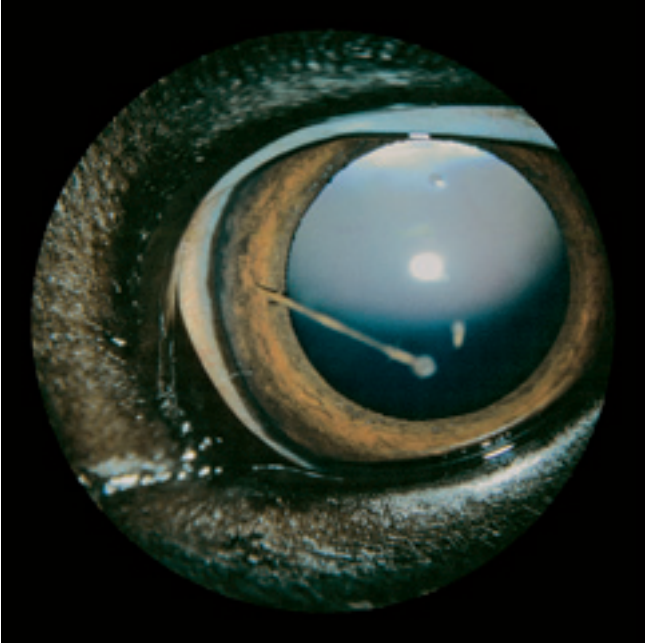
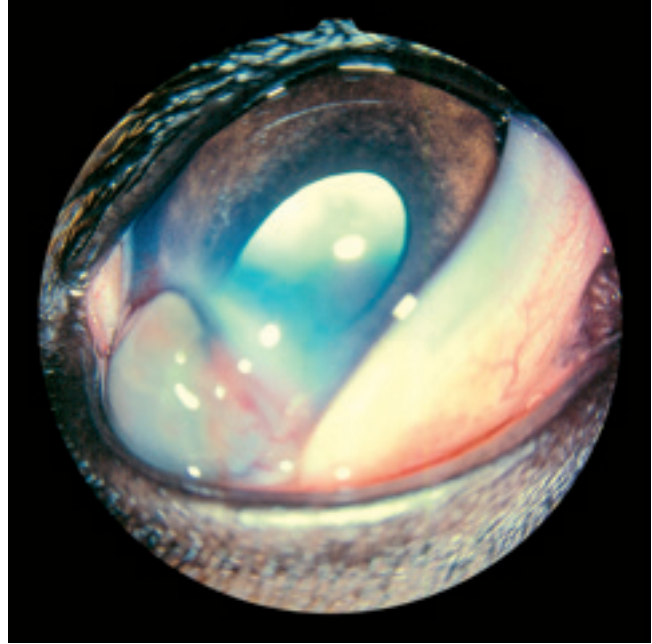


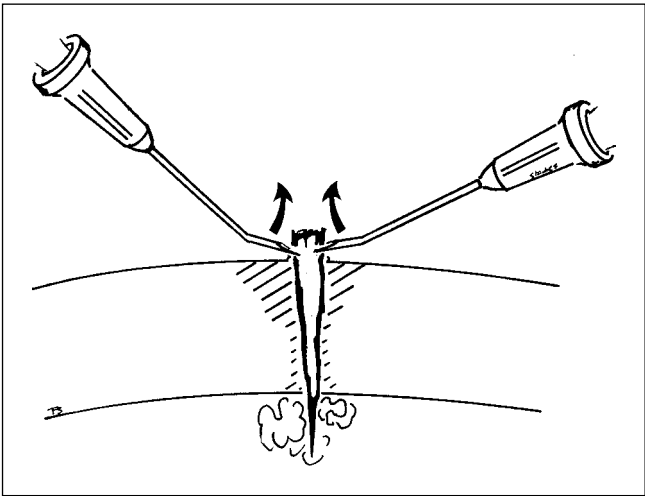
Plate 4.17:
Thorn in the corneal stroma with a ring of edema around it (OS, dog). The darker spot ventral to the back of the thorn is the port of entry.

**Plate 4.18:**

Eye of a dog with the history: "for some days there has been a thorn or a worm in the anterior chamber" (OS). The strand from the cornea to the collarette on the surface of the iris at 9 o'clock is a persistent pupillary membrane.

**Plate 4.19:**

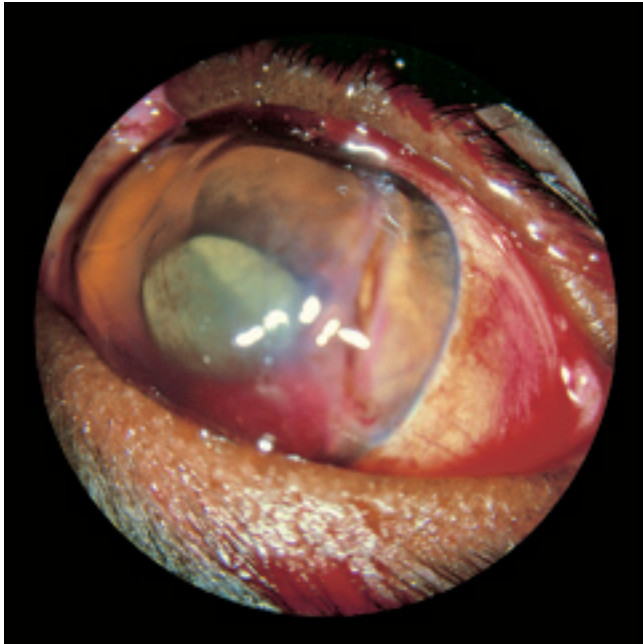
Staphyloma near the limbus at 7 o'clock, after a traumatic corneal perforation, one day after the accident (OD, dog). The anterior chamber is clear, the edge of the pupil is sharp, and the surface of the iris does not show distinct signs of uveitis.

**Fig. 4.7:**

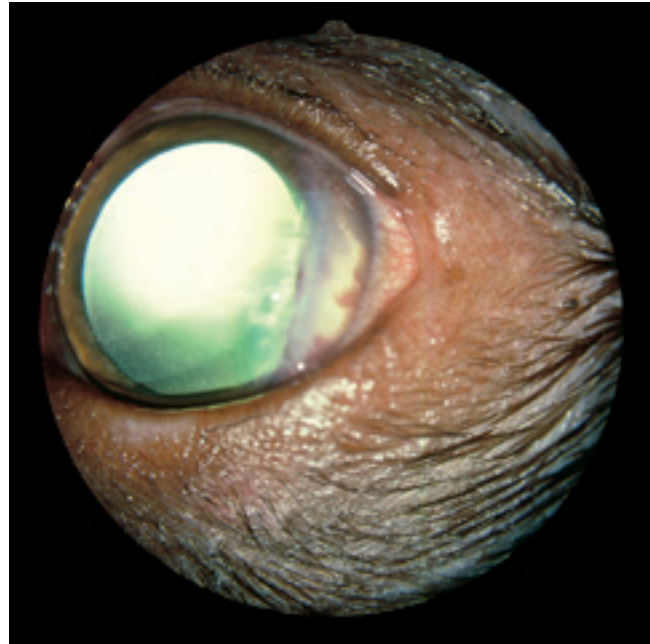
Removal of a thorn out of the cornea by the use of two fine cannulas. At the tip of the thorn is a lump of exudate.

penetrated into the anterior chamber, should be removed by incising the overlying cornea with a corneal scalpel. If the animal is quiet, a local anesthetic is sufficient. If insufficient help is available, or the animal is difficult to restrain, the patient is sedated or anesthetized. Eye trauma located medially usually requires inhalation anesthesia with muscle relaxation (and so artificial respiration), especially in large animals, and the use of stay sutures. After thorough irrigation of the conjunctival sac and further inspection of the eye, treatment following removal of such a foreign body consists of topical "initial choice" antibiotics 4 times daily. If anterior segment involvement is manifest, 1% atropine to effect is also indicated. Also the use of special contact lenses may be indicated. The defect should heal within a few days.

Defects that are deeper than one third of the thickness of the cornea require a longer time to heal. There is usually also a temporary ingrowth of vessels and granulation tissue, leading to formation of a scar. Once epithelialization has occurred, some clinicians prescribe steroidal anti-inflammatory agents to control or reduce the development of granulation tissue and vascularization. However, this is only safe if the healing process can be evaluated by slit-lamp biomicroscope, and the results should not be overestimated.

**Plate 4.20:**

Corneal laceration of a dog's eye, some hours after a cat scratch (OS). There is an aqueous flare and the iris shows signs of post-traumatic uveitis. The wound was closed with seven interrupted sutures (monofilament nylon, 9-0; see also Plate 4.21).

**Plate 4.21:**

Corneal scar of a cat scratch, after the removal of the stitches, 18 days after the accident (OS, dog; same eye as shown in Plate 4.20). The aqueous flare has resorbed and the pupil is round and in mydriasis (induced by atropine).

4.5.3.3 Perforating corneal defects

Perforating corneal defects are usually caused by objects that strike the cornea at great speed, such as cat claws, thorns, or airgun/shotgun pellets. The associated trauma to the iris can cause hemorrhage into the anterior chamber as well as outside the eye, via prolapse of the iris through the corneal wound. This will be accompanied by a severe inflammatory reaction in the uvea. When there is deeper penetrating trauma, cataract or hemorrhage into the vitreous or retina can occur. The eye should not be irrigated, and any substances prolapsing through the wound should be left undisturbed until just before suturing. If the animal is tractable and further examination to determine course of action is necessary, a topical anesthetic should be administered. In addition, topical "specific choice" broad-spectrum antibiotic and atropine eye drops should be given.

Thorns which are in part still clearly visible above the corneal surface can be extracted with a foreign body forceps (Plate 4.15, 4.16). If the thorn is deeper, attempts to remove it with forceps only cause corneal edema and there is a great risk that the thorn may be propelled by the forceps into the anterior chamber or, worse, into the iris and/or lens. An attempt can be made to remove a thorn lying deep in the cornea by lifting it out with two bent 0.45-mm (26 gauge) hypodermic needles (Fig. 4.7). In the case of a penetrating foreign body, one should be sure that the resulting defect can be sutured immediately after removal; otherwise the patient should be referred immediately.

Perforating wounds in the cornea (Plates 4.19–4.21) should be sutured under general anesthesia with muscle relaxation, using e.g. 8-0 or 9-0 monofilament nylon or absorbable material with a spatula-shaped needle. Muscle relaxation is preferred so that the eye will rotate in a standard gaze position; this results in less traction during surgery to the compromised eye. Corneal tissue is scarce and thus the laceration is not debrided. Small, clean iris prolapses can be replaced through the cornea with a spatula. A large or contaminated iris prolapse (Plate 4.19) should be excised by electrocautery. The corneal sutures should be placed into about two thirds of the depth of the stroma (Fig. 4.8). Caution should be exercised not to penetrate the full thickness of the cornea. An air bubble or a viscoelastic is introduced to move the iris away from the cornea, and then the pressure in the anterior chamber is reformed by introducing a special aqueous fluid replacement solution, such as balanced salt solution (BSS).

When a larger part of the cornea is missing, a conjunctival oversuturing method (see 10.6.3.5) or a free transplant can be used for closure.

After-care consists of "specific choice" antibiotics, atropine, and steroidal anti-inflammatory drops to treat the anterior uveitis that is present in every patient that suffers this type of injury. These agents should be used 6 times daily for the first few days and the frequency modified as the situation dictates. The use of steroidal anti-inflammatory drops is only safe if the healing process can be evaluated frequently by a slit-lamp

biomicroscope. In many patients, parenteral steroidal or NSAIDs are given. After 1–2 days, the eye should be examined and evaluated for severity of post-traumatic uveitis (see 12.10) and secondary glaucoma (see 11.2). The sutures are removed after 14–16 days.

Shotgun and airgun (Plates 4.22–4.24) pellets can produce disastrous destruction in the eye. Cats, in particular, which come home with a damaged eye after a few days absence (Plate 4.22), should be examined radiographically for the possible presence of a pellet. Usually, such a damaged eye can only be treated for post-traumatic uveitis (see 12.10.1). Pellets can seldom be removed without causing even more severe operative trauma. However, they usually become encapsulated and then seldom cause problems. Lead intoxication is only a consideration if there are many (>50) lead pellets present.²

Literature

1. BISTNER, S.I. & AGUIRRE, G.D.: Management of ocular emergencies. *Vet. Clin. North Am.* **2**: 359, 1972.
2. SCHMIDT, G.M., DICE, P.F. & KOCH, S.A.: Intraocular lead foreign bodies in four canine eyes. *J. Small Anim. Pract.* **16**: 33, 1975.



Plate 4.22:

Lid (see arrow) and corneal laceration caused by an air rifle bullet (24 hours after the shooting; OS).

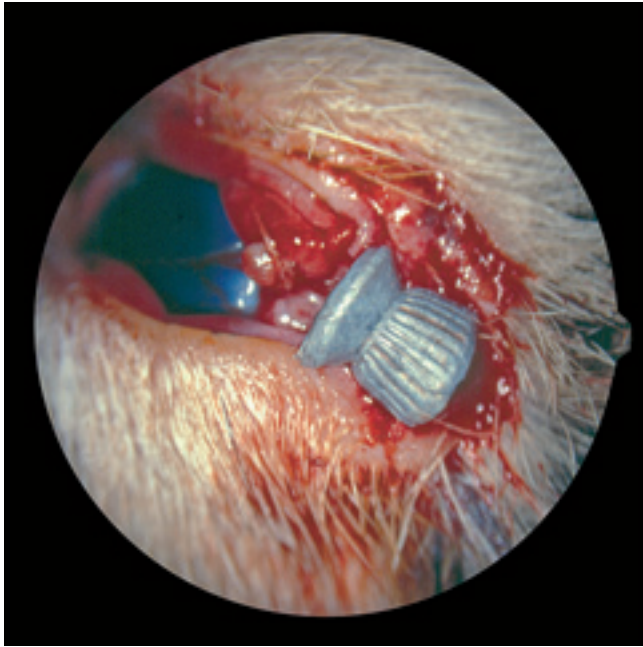


Plate 4.23:
Air rifle bullet, directly after removal from the retrobulbar tissues behind the right eye of a cat.

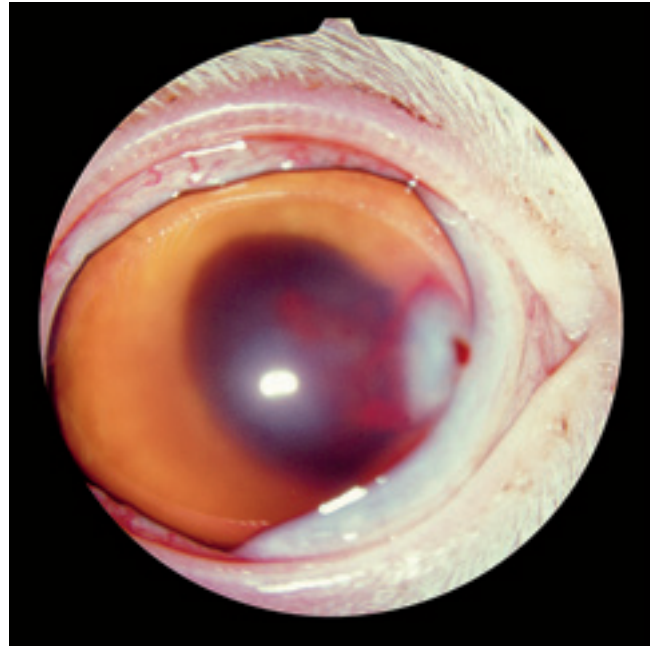


Plate 4.24:
Corneal defect with a ring of edema and blood in the anterior chamber, after the penetration of a shotgun pellet (OD, cat).

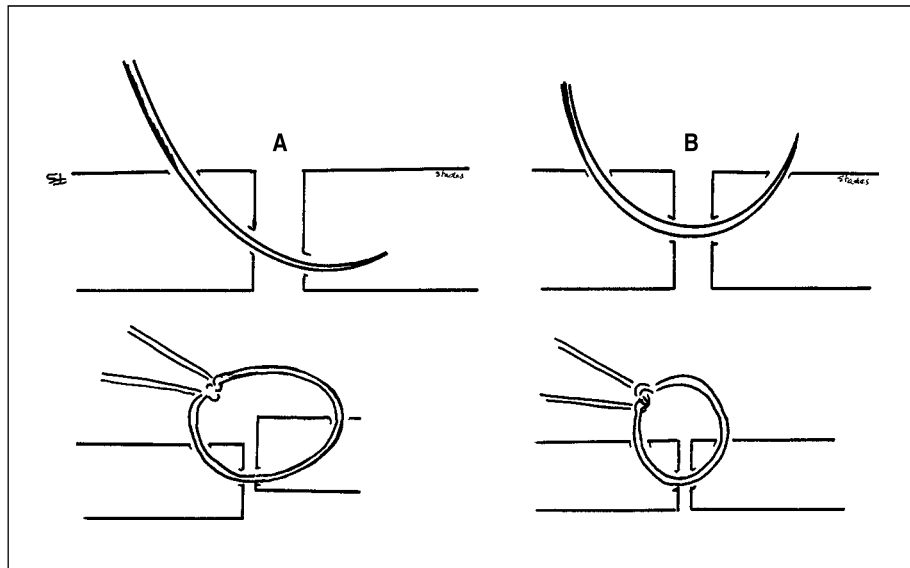


Fig. 4.8:
Suturing of tissue layers has to be done at the same level and the same distances (left incorrect, asymmetrical; right correct, symmetrical). In this way the layers will fit together correctly.