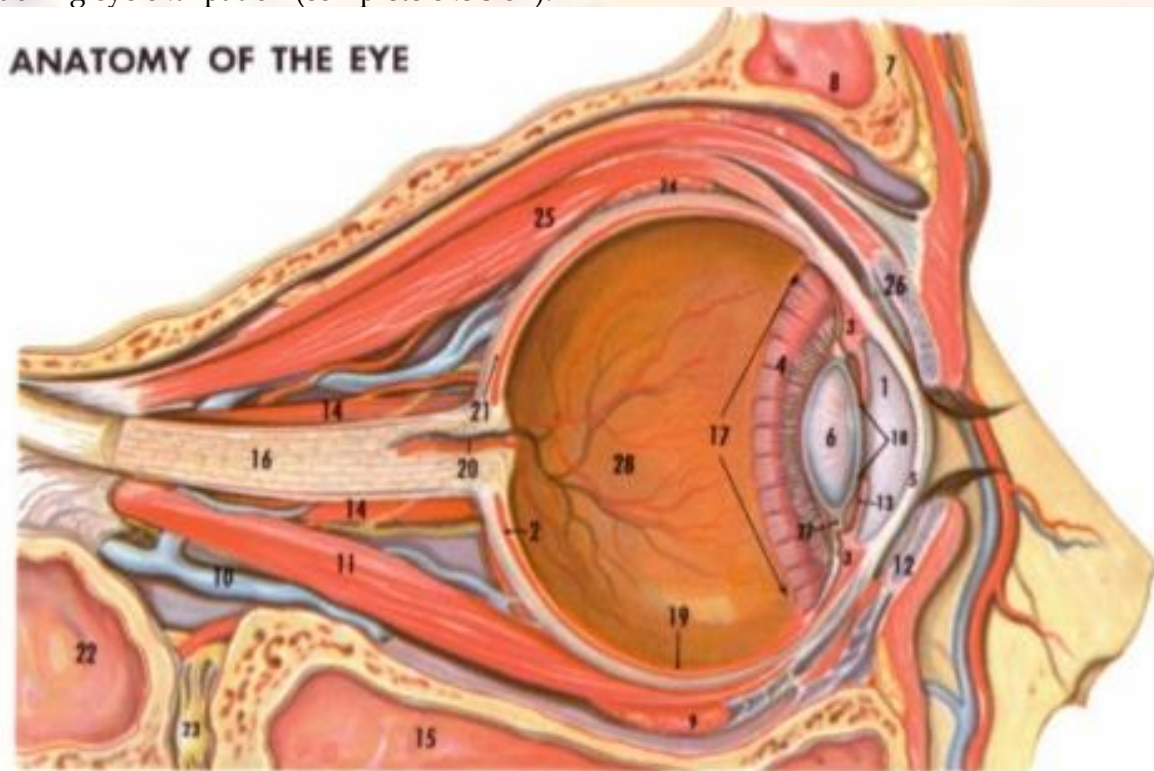


Relevant Anatomy

The anatomy of the eye can be divided into the structures of the eyeball (globe) and the adnexa. In the procedure described here, the adnexal structures are emphasized as the eyeball itself is removed. Structures of the adnexa include ocular muscles, orbital fasciae, the eyelids, conjunctiva, and the lacrimal apparatus. The eyelids have three basic layers; the outer skin, a fibromuscular layer, and the palpebral conjunctiva. The palpebral conjunctiva, together with the bulbar conjunctiva, comprises the conjunctival sac. The dorsal and ventral distal extremities of the sac are called fornices. The third eyelid attaches to a T-shaped plate of cartilage on the medial aspect of the eyeball. Between the dorsolateral wall of the orbit and the eyeball is the lacrimal apparatus. Several accessory glands of the lacrimal apparatus exist.

The muscles responsible for moving the eye are all located near the optic foramen behind the eyeball, except for the ventral oblique muscle. The ventral oblique muscle originates on the ventromedial wall of the orbit and passes laterally below the eyeball. The four rectus muscles all insert anterior to the equator of the eye at a dorsal, ventral, medial, and lateral site. The retractor bulbi muscle inserts posteriorly on the eyeball and envelopes the optic nerve.

The locations of the ophthalmic and maxillary nerves are also relevant to this procedure for local anesthesia of the eye. These nerves enter the orbit with the extraocular muscles through the foramen orbitorotundum, which is a combined round and orbital foramen that is unique to bovine species. This is the site of injection for anesthesia during eye extirpation (complete excision).

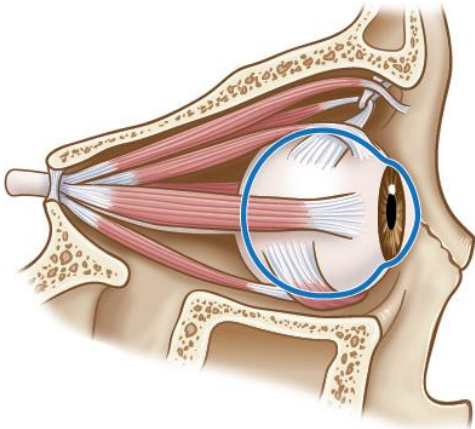


- | | | | |
|----------------------|------------------------------|-----------------------------|------------------------------|
| 1. Aqueous chamber | 8. Frontal sinus | 15. Maxillary sinus | 22. Sphenoid sinus |
| 2. Choroid | 9. Inferior oblique muscle | 16. Optic nerve | 23. Pterygopalatine ganglion |
| 3. Ciliary muscle | 10. Inferior ophthalmic vein | 17. Ora serrata | 24. Superior oblique muscle |
| 4. Ciliary processes | 11. Inferior rectus muscle | 18. Pupil of the iris | 25. Superior rectus muscle |
| 5. Cornea | 12. Inferior tarsus | 19. Retina | 26. Superior tarsus |
| 6. Crystalline lens | 13. Iris | 20. Retinal artery and vein | 27. Suspensory ligament |
| 7. Frontal bone | 14. Lateral rectus muscle | 21. Sclera | 28. Vitreous chamber |

General Surgical Techniques

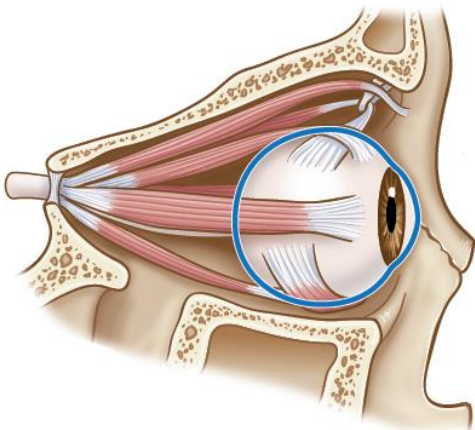
Indications for enucleation include extensive inflammation or trauma to the adnexa of the eye, orbit, or globe, painful glaucomatous eyes, extensive ocular tumors, or congenital defects that result in exposure damage. The two types of enucleation commonly used are subconjunctival or transpalpebral ablation techniques. In large animal surgery, the transpalpebral technique is recommended.

NB: Evisceration is the removal of the contents of the globe, leaving the cornea, sclera, extraocular muscles and adnexal structures in place. This is done before placing a silicon cosmetic prosthesis into the corneoscleral shell.



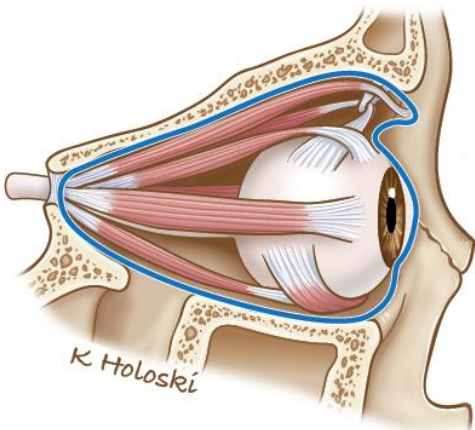
Evisceration:

The contents of the eye are removed, but the outer layer of the eyeball (sclera) is left intact.



Enucleation:

The entire eye, including the globe, is removed but the orbital contents are left in place.



Exenteration:

The contents of the eye socket are removed, including the muscles, lacrimal gland, optic nerve and various bones of the orbit.

TRANSPALPEBRAL ENUCLEATION

Enucleation involves the removal of the globe entirely and only. Thus, leaving ocular adipose tissue and muscles and lacrimal gland within the bony orbit. Enucleation is indicated for neoplastic involvement of the cornea (invasion of the anterior chamber) and the upper, lower, or third eyelid. Note if the neoplasia seems extensive than enucleation is not recommended, and the better first choice procedure will be Exenteration. It is also not indicated if neoplasia involves the bony orbit or has metastasized to regional lymph nodes; it is nearly impossible to remove the tumor successfully in such cases. Septic panophthalmitis, severe trauma beyond repair, and severe trauma with loss of globe contents are also indications for enucleation.

After appropriate preparation, standing sedation (Ketamine stun is recommended), the eyelids are paralyzed (Peterson block and Auriculopalpebral block is recommended. However, a 4 point-retrobulbar block can be used (Figure 13.16 and Figure 15.2A)) and topical anesthesia (Splash blocks of Lidocaine and Saline is recommended) applied. and thorough nasolacrimal duct lavage, the eyelids are sutured together with a simple continuous pattern or clamped. Suture with 18 gauge hypodermic needle and non-absorbable 2.0 nylon (Supramid) allows for quicker work, ingenuity in emergency cases, decreases trauma and decreases bleeding when compared to using an eyed needle with a knot. If an eyed needle is to be used avoid making a knot, instead loop the suture through the eye twice.

Ensure to leave long lengths of suture material at each end to make a square knot and creating a handle to hold the eye and its contents upwards. Suturing the eyelids closed decrease the spread of infected material during the procedure. A circumferential incision 1.5cm away from the eyelid margin is made through the skin into the subcutaneous tissues of the eyelid (Figure 15.2B) but not through the conjunctiva. Cut along the orbital rim with scalpel blade separating layers of tissue to prevent incision of the globe and contents.

The lateral and medial canthal ligaments securing the eyelids to the orbit bones are transected. As traction is applied to the freed eyelids, dissection is continued caudally toward the orbit rim, (Figure 15.2C), taking care to stay external to the conjunctival sac, which should remain closed.

Close to the orbit rim the deep fascia forming the orbital septum is penetrated, and the extraocular muscles and tissues within the orbital cone can be visualized. In cases of panophthalmitis or when enucleation is necessary because of severe orbital cellulitis, the extraocular muscles and the other soft tissues within the periorbita should be excised as widely as possible or transpalpebral exenteration should be performed. Significant bleeding will occur in these cases.

In other cases, in which infection of the eye is not a concern, intraoperative bleeding is considerably lessened if each rectus muscle is transected at its tendon of insertion on the sclera. As each muscle is encountered, one blade of a Metzenbaum scissor is inserted between the muscle and sclera, and the scissor is pulled anterior toward the limbus before cutting, thus ensuring that the transaction occurs through muscle tendons, which bleed much less than the muscle belly.

The dorsal and ventral oblique muscle insert deep to each respective rectus muscle and may have very short tendons of insertion. They are transected close to the sclera. After rectus and oblique muscle transection, the globe is grasped, and gentle traction is applied, thus making the retractor muscles that form a cone around the optic nerve easier to visualize.

Traction on the globe should be minimal to decrease vagal nerve stimulation and avoid potential damage to the optic chiasm. With gentle medial traction on the globe, the surgeon should attempt to "strum" the optic nerve retractor muscle cone using an approach from the dorsolateral side of the orbit.

Once the location of the nerve has been confirmed, clamp with a curved haemostat and position the blades of a large curved serrated utility scissor in front of the haemostat around the cone and cut. A scalpel blade can also

be used by scraping the blade against the haemostat to sever the optic nerve. The cone is rarely visualized directly because of variable amounts of orbital fat and hemorrhage; therefore, digital palpation is important.

One or two cuts of properly placed scissors will almost completely free the globe. It is held in one hand, and the remaining medial attachments severed. The attachments to the medial cantus should be cut last as most of the bleeding occurs here.

The entire third eyelid should be removed at this time. To prevent postoperative lacrimocele formation, it is recommended the lacrimal gland located in the periorbita of the dorsolateral orbit ventral to the orbit rim be surgically removed as well.

Meticulous hemostasis during enucleation is time consuming, and in most cases not necessary. In the enucleation technique described above, no attempt is made to ligate the optic nerve and muscle cone because ligatures placed around the optic nerve and muscle cone are difficult to place, usually slip, result in tissue trauma in the process, may increase vagal stimulation, and can act as a foreign body inciting an inflammatory response.

The orbit is packed with sponges and pressure is applied as closure commences, but all sponges are removed before the subcutaneous tissues are completely closed. An absorbable suture (no. 2-0) is used to close subcutaneous tissues; a nonabsorbable suture is used in the skin in a cruciate or horizontal mattress pattern, (Figure 13-17). Begin the first suture at the ventral commissure of the incision. The tilt of the head will determine the ventral commissure of the incision (it may be either medial or lateral). Include adequate skin in the suture and apply marked tension. Before placing the last suture, remove the temporary 4-inch by 4-inch sterile gauze pack with a haemostat. Insert or inject antibiotics into the orbit. Place the final mattress sutures. Additional simple interrupted can be added in between to decrease the chance of bleeding through the sutured skin.

These sutures prevent bacterial infection and act as a pressure bandage. The tight seal with a skin suture seems to allow pressure to build up within the orbit and to create haemostasis through a tamponade effect. Some surgeons prefer to use an absorbable suture in the skin, to obviate the need for suture removal; this would be useful on the range, where it may be impractical to round up the animal for suture removal.

Suture with 18 gauge hypodermic needle and non-absorbable 2.0 nylon (Supramid) allows for quicker work, ingenuity in emergency cases and decreases trauma and so blood loss (compared to an eyes needle with a knot).

A pressure bandage is applied for 24 hours and the pressure of the sutured incision combined with the bandage will almost always be adequate to stop hemorrhage. Drains are not necessary unless there is pre-existing infection. Antibiotics should be given for 5 to 7 days after surgery. Sutures are removed 2-3 weeks postoperatively. Check the enucleated eye and conjunctival sac; there should be no break in the conjunctiva if proper technique was employed. Periconjunctival incisions helps ensure a sterile enucleation (Figure 7-3).

Complications of this procedure include extensive hemorrhage from the optic artery, infection, dehiscence, recurrence of disease, and convulsions due to inadvertent injection of lidocaine into the meningeal reflection of the optic nerve while performing the retrobulbar block. Orbital infections following enucleation in a field setting may be common, but recurrence of squamous cell carcinoma has not been found to occur frequently. The prognosis for this procedure is generally good but varies with the presenting disease.

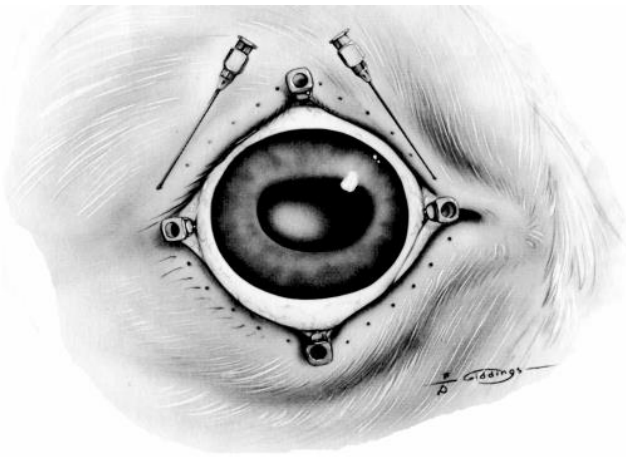


Figure 13-16 Injection sites for local anesthesia before transpalpebral enucleation in cattle. Five to 10 ml of lidocaine is injected at each site to produce anesthesia and proptosis.

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FIGURE 7-2. In an enucleation, the elliptic incisions should include all neoplastic tissue. Adequate normal tissue on the upper and lower lids should be left for optimal closure.

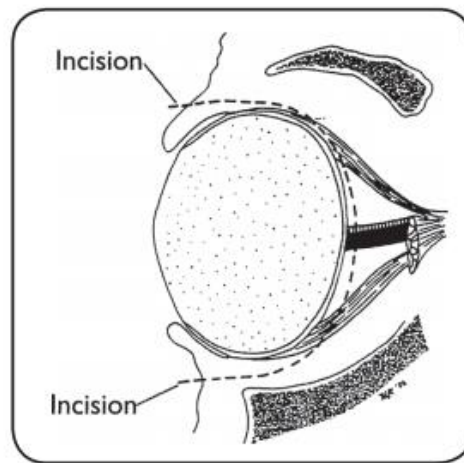


FIGURE 7-3. Side view of proposed periconjunctival incisions.

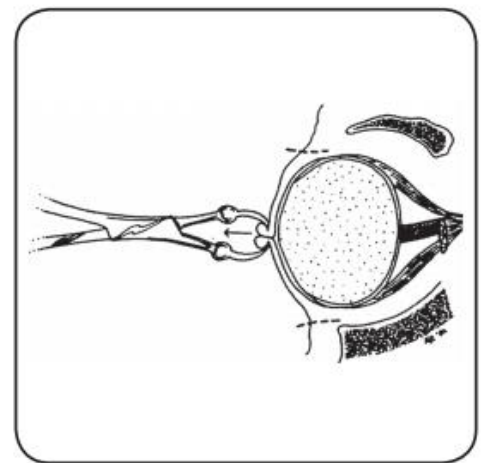


FIGURE 7-4. Towel clamps applied to lid edges.

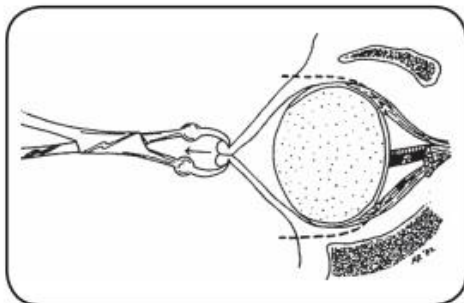


FIGURE 7-5. Traction applied to lids while skin and periconjunctival tissue are being incised.

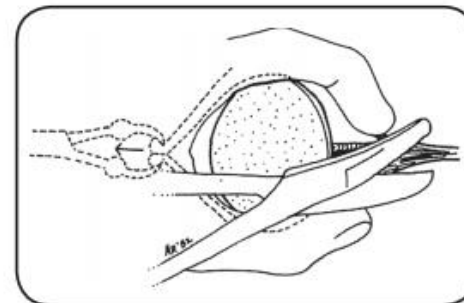


FIGURE 7-6. Traction applied in a postglobal transection.

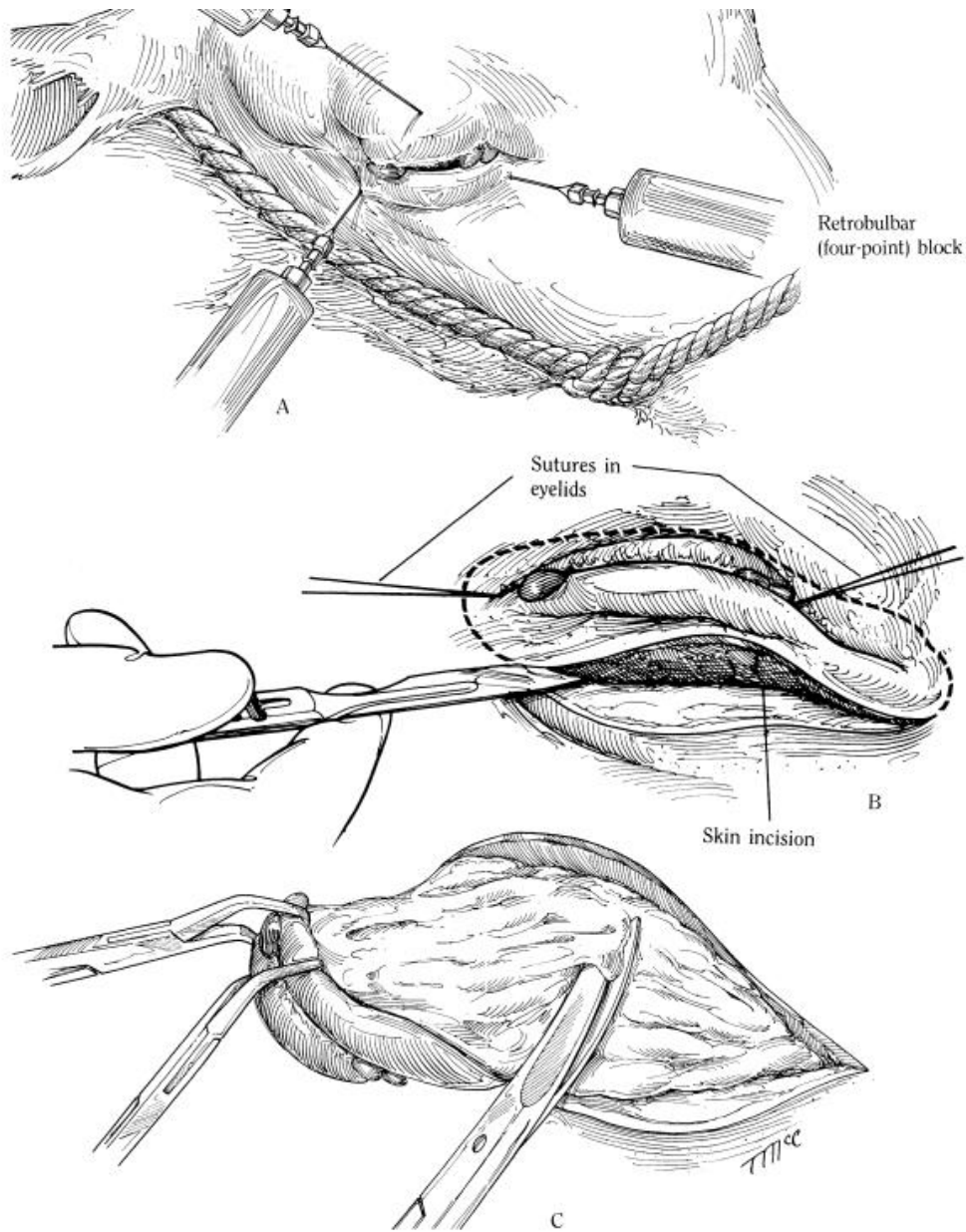


Fig. 15.2. A-D. Eye enucleation in cattle.



Figure 13-17 Closure of the surgical site following enucleation in a cow.

TRANSPALPEBRAL EXENTERATION

Exenteration means the globe and as much of the ocular contents as possible are removed. This is ideal for infections or neoplasia in the eye, to ensure that spread to other tissues are curbed. For exenteration surgery, the dissection is done outside the extra ocular eye muscles and conjunctiva, all of which are removed with the globe (Figure 13-18A). For extensive Squamous cell carcinoma in cattle, this may be the preferred procedure. The same transpalpebral approach is recommended. The procedure above is followed exactly (Transpalpebral Enucleation) the main difference is the complete removal of all ocular contents. The plane of dissection is against the bony orbit. All extraocular eye muscles are removed along with a substantial portion of the optic nerve (Figure 13-18B).

Emphasis is placed on removing all orbital contents such as the lacrimal gland, adipose tissue and muscle attachments to the bony orbit. This is done utilizing large curved scissors and curved forceps. Using scalpel blades are not recommended to remove the attachments of ocular contents. Care must be taken when using scalpel blades, especially if the globe and the ocular contents have not been disconnected from the bony orbit. The scalpel blades can break inside of the bony orbit or puncture the globe potentially spreading infected material as this surgery is performed with an animal in standing sedation. Intermittently throughout the removal of the globe and ocular contents insert a finger into the orbit and sweep it across the bony surface to identify any attachments that still needs removal.

Removal of the optic nerve, its attached muscles and the common tendinous ring was difficult. Clamping it all down with the curved haemostat reduces haemorrhage and provides a safe cutting surface with the scissors. A drain may be necessary for 48 to 72 hours. Skin is closed as explained above (Transpalpebral Enucleation).

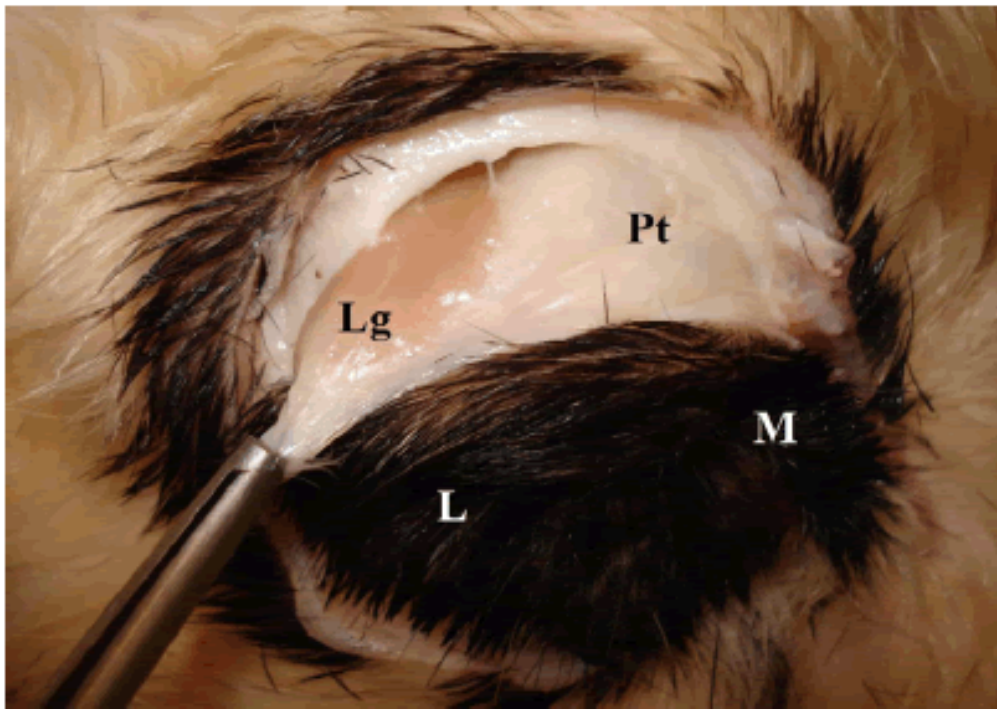


Figure 1: A photograph displaying situation of the lacrimal gland in a Lori sheep eye. The upper part of the eye has been dissected to expose the gland (Lg) which is located on the orbit and in a dorsolateral situation to the eyeball. The surrounding connective tissue (Pt) and lateral (L) and medial (M) corners of the eye is observed.

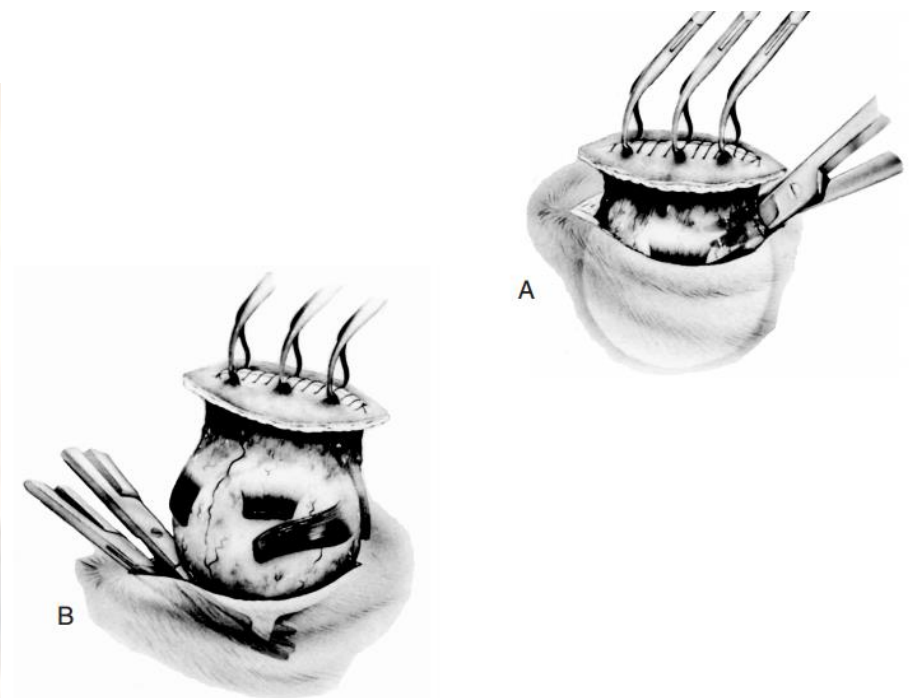
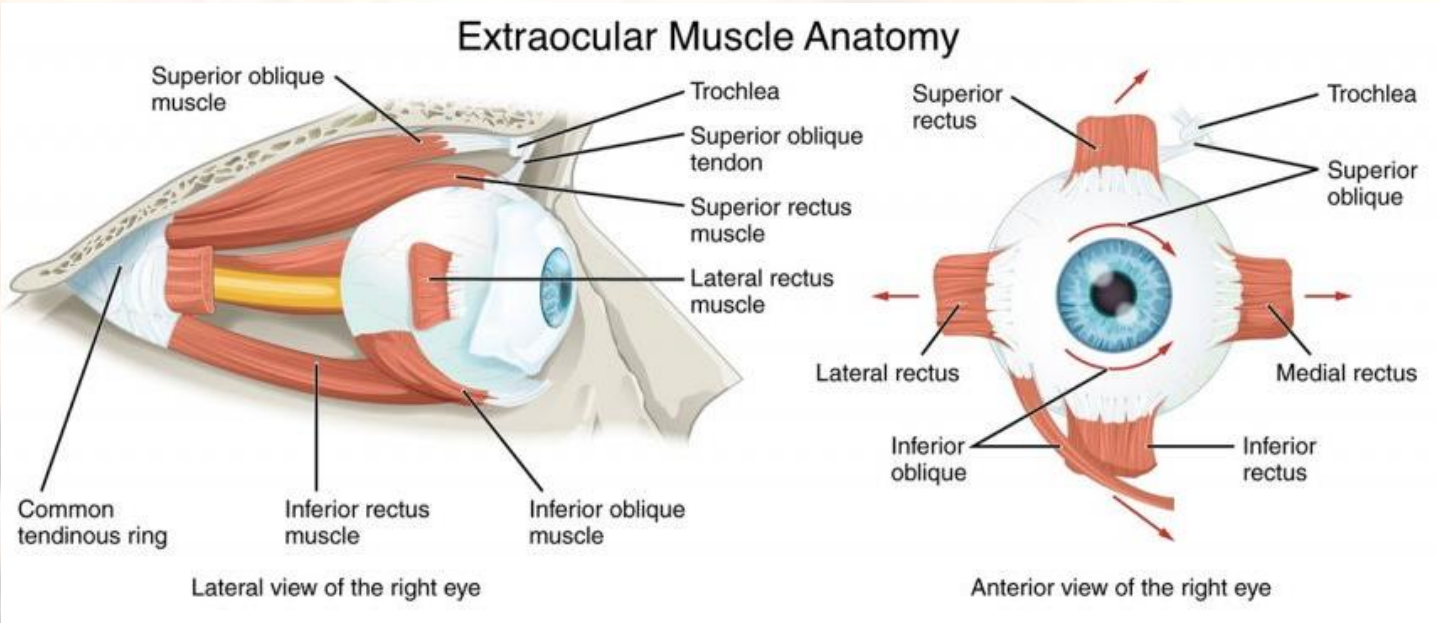
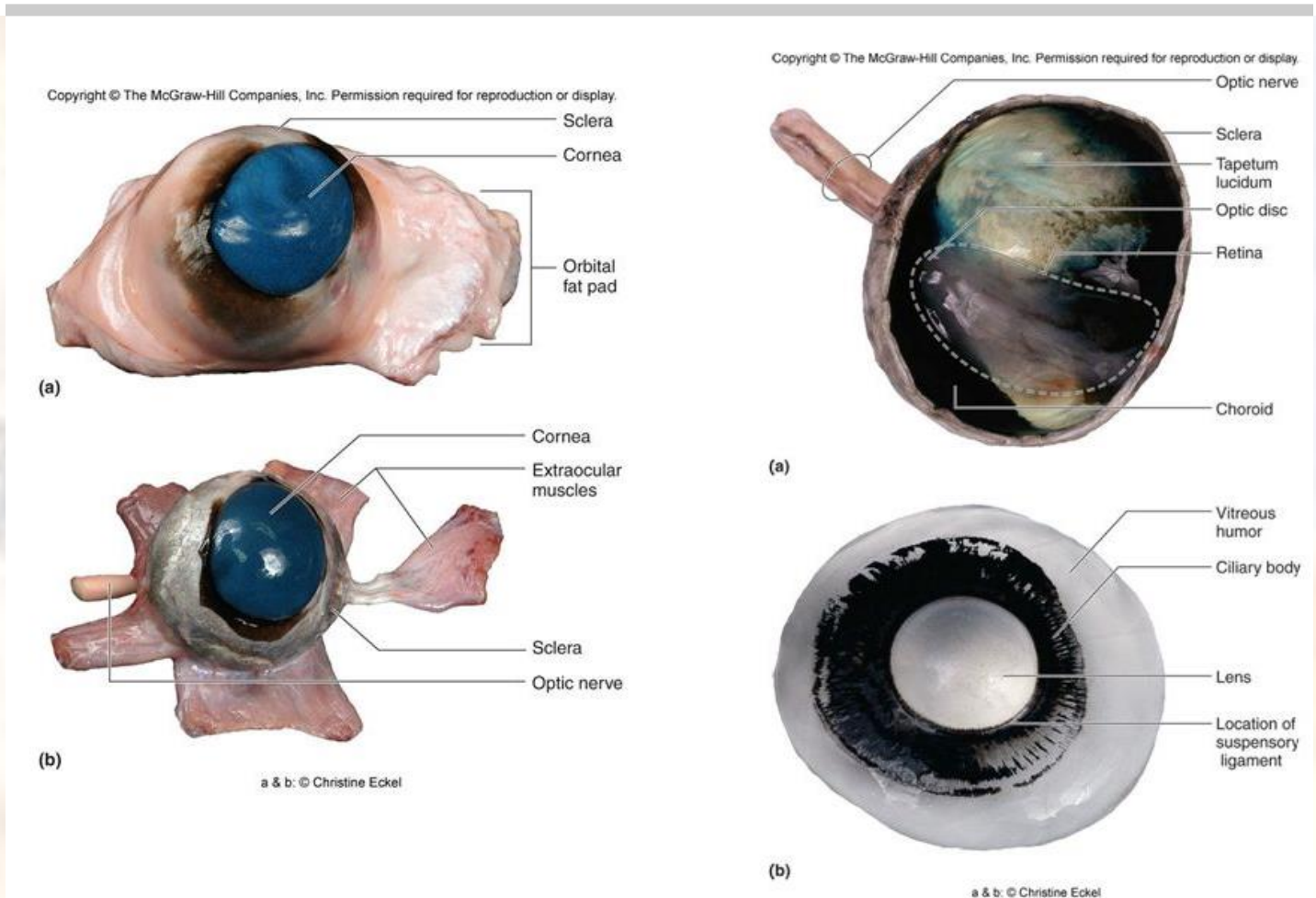


Figure 13-18 A, A periocular incision is made and dissection performed outside the extraocular muscles to the orbital apex. B, The optic nerve and associated vessels are clamped, ligated, and transected.

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Cow eye: External and internal anatomy



MEMBRANA NICTITANS EXCISION

Other than Squamous cell carcinoma, major diseases of the nictitating membrane are rare. Lacerations of the nictitans can occur. Traumatized nictitans require careful examination to ensure the cartilage is not exposed on the bulbar surface, which could cause chronic corneal irritation. Orbital fat may prolapse into the nictitans and resemble a neoplastic swelling. The lacrimal gland surrounding the cartilage at the base of the nictitans can become hypertrophied. The nictitans is a common site for foreign bodies (usually plant material) and the bulbar surface of the nictitans must be examined in all cases of refractory corneal ulcers. In sheep and goats, intense follicular hyperplasia of the nictitans may occur with conjunctivitis caused by *Chlamydia* spp., *Mycoplasma* spp., or *Rickettsia* spp.

Squamous cell carcinoma also commonly develops on the membrana nictitans. If the tumors are less than 2 to 2.5cm in diameter and involve only the free margin of the nictitans like the mass in Figure 13-22A, they can be successfully removed by excising the entire nictitating membrane with the animal standing. Although this procedure can result in keratoconjunctivitis sicca in a dog or cat, large animal species depend less on the secretions of the membrana nictitans gland, and it can usually be removed without consequence.

The patient should be premedicated for 24 hours with topical antibiotics. After standing sedation (Ketamine stun is recommended), the eyelids are paralyzed (Peterson block and Auriculopalpebral block) and topical anesthesia (Splash blocks of Lidocaine and Saline is recommended) applied.

The conjunctival sac is lavaged with sterile saline. The eye is retropulsed, and the nictitans is grasped with a mosquito hemostat on the free margin. Note, since this is a nictitans removal grasping the free margin is acceptable. However, for inspection of the nictitans membrane grasp tissue away from the free edge to reduce visible damage seen by the client. At this point inspect the inner surface of the nictitans membrane where the small pleats of conjunctiva tend to have foreign bodies.

Once the nictitans is everted, and the extent of the tumor on the bulbar surface of the nictitans is confirmed. The surgeon ensures sufficient normal nictitans tissue dorsally and ventrally to allow complete removal. The dorsal and ventral surfaces are thinner than the middle third which is made of a thick cartilage. As the nictitans is stretched across the cornea towards the lateral canthus, curved Kelly hemostats are clamped across the folds of normal nictitans conjunctiva dorsal and ventral to the tumor so their tips almost touch each other medially at the base of the "T" cartilage.

Scissors or a scalpel blade held in the fingers are used to cut along the clamps, leaving the clamps on the patient. Another clamp is then placed across the base of the "T" cartilage and the remainder of the nictitans excised. This clamp must be placed as far medially as possible is there is more tumor lesions beyond the clamp consider removing the entire eye. The clamps should remain on the patient for at least 5 minutes, longer if possible. The eye and lids must not be manipulated after the procedure is completed except to remove the clamps. Minor hemorrhage is inconsequential. If a neoplasm is extensive and involves the hyaline cartilage area, surgically remove the entire third eyelid at the base. Control hemorrhage with a pressure pack. Flush eye with saline and ocular antibiotics such and penicillin-streptomycin (never oxytetracycline which burns).

Complications are uncommon but include incomplete excision, excessive hemorrhage, and, rarely, orbit fat prolapse. Incomplete excision should not occur if the clamps are carefully applied. If clear margins sufficient for clamp placement beyond the tumor are not available, the procedure should be aborted and removal under general anesthesia planned. Hemorrhage and orbit fat prolapse occur rarely if the clamps remain in place for at least 5 minutes. Hemorrhage can be controlled by manual direct pressure or a pressure bandage applied to the head and left in place for 24 hours. Orbit fat prolapse is of more concern and will worsen as the patient wakes up and retracts the eyeball. If possible, the clamps should be replaced and the conjunctiva oversewn with 5-0 synthetic absorbable suture. Prolapsing fat should not be removed because chronic enophthalmos will result. General anesthesia may be required to replace severe fat prolapses.

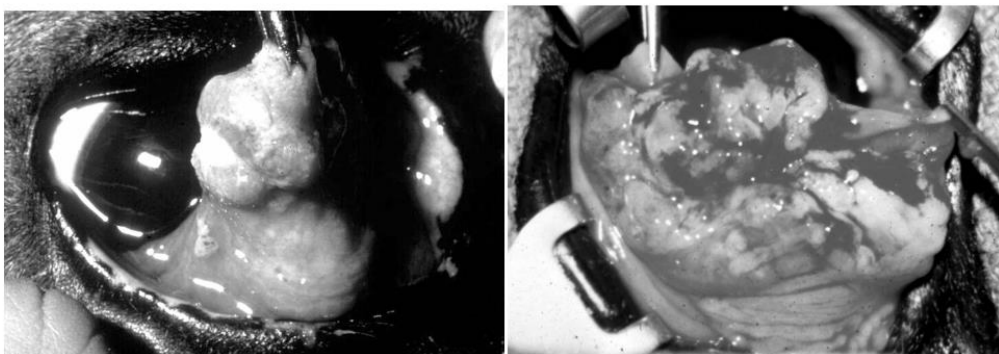


Figure 13-22 A, Squamous cell carcinoma of the membrane nictitans suitable for a standing nictitans excision. Note the wide border of normal nictitans below (and above) the lesion. B, More extensive SCC nictitans and conjunctiva lesion, which require more dissection, thus making the lesion unsuitable for a standing surgical procedure.