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Enucleation in Small Animals: Anatomical Basis and Surgical Technique

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Introduction

The health of an animal's eyes is paramount to its quality of life, and veterinary ophthalmology plays a crucial role in maintaining ocular well-being. Despite advancements in medical and surgical treatments for various eye conditions, there are instances where the best course of action for an animal's comfort and long-term health is the complete surgical removal of the eyeball and its associated structures. This procedure, known as **enucleation**, is one of the most common orbital surgeries performed in small animal veterinary practice.

Common indications for enucleation are extreme trauma to the cornea or internal eye, uncontrolled eye infection (endophthalmitis), eye tumours, excessive eye displacement (proptosis), or severe glaucoma that is intractable by other means. While enucleation should be reserved only after every other option has been tried—especially for eyes that retain vision—it can provide immediate relief from years of painful eye problems and prevent the need for regular eye medication.

Anatomy of the Small Animal Eye and Orbit

A thorough understanding of the ocular and orbital anatomy is fundamental for performing a successful enucleation and managing potential complications. The eye (globe) is a delicate and complex sensory organ, housed within a protective bony cavity called the **orbit**.

The Eyeball (Globe): The globe itself is a spherical structure composed of three tunics:

- **Fibrous Tunic:** The outermost layer, consisting of the transparent **cornea** anteriorly and the opaque, white **sclera** posteriorly.
- **Vascular Tunic (Uvea):** The middle layer, comprising the **iris** (controlling pupil size), the **ciliary body** (producing aqueous humor and controlling lens shape), and the **choroid** (providing nourishment to the retina).
- **Nervous Tunic:** The innermost layer, the **retina**, which contains photoreceptors responsible for vision.

Connecting the eye to the brain is the **optic nerve (Cranial Nerve II)**, which transmits visual information. This nerve exits the posterior aspect of the globe.

Associated Structures within the Orbit: The orbit is much more than just a bony socket; it contains a complex array of tissues that support and protect the globe:

- **Extraocular Muscles:** Six muscles (dorsal, ventral, medial, lateral rectus; dorsal and ventral oblique) are responsible for precise eye movements, along with the retractor bulbi muscle, which pulls the globe deeper into the orbit for protection.
- **Eyelids (Palpebrae):** Upper and lower folds of skin and muscle that protect the globe, spread tear film, and include the eyelashes.

- **Conjunctiva:** A thin, transparent mucous membrane lining the inner surface of the eyelids (palpebral conjunctiva) and reflecting onto the anterior sclera (bulbar conjunctiva).
- **Third Eyelid (Nictitating Membrane**
- **Lacrimal Gland:** Located dorsolateral to the globe, this gland produces the aqueous portion of tears.
- **Fat and Connective Tissue**
- **Nerves and Vessels**

During enucleation, careful attention must be paid to these structures, particularly the optic nerve (which must be transected) and the extraocular muscles (which need to be detached). Preservation of as much orbital fat and soft tissue as possible is often desirable to minimize postoperative cosmetic depression.

Indications for Enucleation

While vision preservation is always the primary goal in veterinary ophthalmology, enucleation becomes a necessary and humane option in specific circumstances. The most common indications include:

1. **Severe Ocular Trauma:**
    - **Globe Proptosis:** Particularly in brachycephalic breeds (e.g., Pugs, Shih Tzus), severe proptosis (extrusion of the eyeball from the orbit) often results in optic nerve damage, muscle avulsion, and irreparable globe damage, leading to permanent blindness and pain.
    - **Globe Rupture/Laceration:** Extensive penetrating injuries or blunt trauma that severely compromise the integrity of the cornea or sclera, leading to loss of intraocular contents or inability to repair.
2. **Uncontrolled Intraocular Infection (Endophthalmitis/Panophthalmitis):**
    - Severe bacterial or fungal infections within the eye that are unresponsive to aggressive medical therapy.
3. **Intraocular Neoplasia:**
    - Primary intraocular tumors (e.g., melanoma, sarcoma) that are locally invasive, rapidly growing, or cause significant pain and secondary glaucoma.
4. **Severe, Intractable Glaucoma:**
    - Glaucoma is a painful condition characterized by increased intraocular pressure (IOP), leading to optic nerve degeneration and blindness. When medical management (topical and systemic medications) fails to control pain and IOP, and vision is lost, enucleation provides immediate and lasting pain relief.
5. **Chronic, Painful Blind Eye:**
    - Any long-standing ocular condition that has resulted in permanent blindness and causes chronic pain that cannot be managed effectively with medication (e.g., chronic uveitis, phthisis bulbi, or other end-stage diseases).
6. **Orbital Disease:**
    - While less common, some severe orbital infections (e.g., abscesses) or tumors that involve the globe itself may necessitate enucleation for complete disease resolution.

Surgical Procedure: Techniques and Considerations

Types of Enucleation Techniques

There are primarily two main approaches to enucleation, each with its own advantages and disadvantages:

1. **Transpalpebral Enucleation (Eyelid-Sparing):**
    - **Description:** This technique involves incising the skin around the eyelids, excising the globe along with the entire conjunctival sac, third eyelid, and all associated lacrimal and accessory lacrimal glands and

extraocular muscles. The eyelid margins (including the hair follicles) are also removed. The eyelids are then permanently sutured closed over the orbital contents.

- **Indications:** This is the preferred method when there is concern for contamination (e.g., severe infection, ruptured globe), or when ocular or periocular neoplasia (e.g., eyelid tumors, conjunctival tumors, aggressive intraocular tumors) requires removal of all potentially affected tissues to achieve clear margins.
- **Advantages:** Provides excellent isolation of diseased or infected tissue, reducing the risk of recurrence (in neoplasia) or spread of infection. It ensures complete removal of all tear-producing structures, preventing postoperative discharge.
- **Disadvantages:** Can be associated with more postoperative swelling and bruising. If not meticulously performed, there can be increased optic nerve traction, potentially affecting the contralateral eye in rare instances. Postoperative orbital depression (sunken appearance) can be more pronounced due to the removal of all orbital contents.

2. **Subconjunctival Enucleation (Conjunctiva-Sparing):**
   - **Description:** This technique begins with an incision in the conjunctiva (often after performing a lateral canthotomy for better exposure) and dissection of the globe from the surrounding conjunctiva and extraocular muscles. The globe, optic nerve, and extraocular muscles are excised, but most of the conjunctiva, lacrimal gland, and third eyelid gland are left intact. The remaining conjunctiva is then closed, and the eyelids are sutured shut.
   - **Indications:** Often considered for non-neoplastic, non-infectious conditions where maximal cosmetic outcome is desired and there is no concern for neoplastic cells or infection within the conjunctiva or glands (e.g., intractable glaucoma, chronic blind painful eye).
   - **Advantages:** Generally results in less postoperative swelling and bruising. By leaving the conjunctiva and lacrimal tissue, it provides more orbital volume, leading to a cosmetically superior outcome with less orbital depression. The dissection may involve less hemorrhage compared to the transpalpebral approach if performed carefully.
   - **Disadvantages:** Requires meticulous technique to ensure complete removal of the globe without leaving any remnants. There is a theoretical risk of infection if the conjunctival sac was contaminated. If tear-producing glands are left, mucoceles or chronic discharge can occasionally occur, although rare. A **lateral canthotomy** (incision at the lateral corner of the eye) is often required to improve surgical visibility, especially in breeds with deep-set eyes or for large globes.
3. **Lateral Enucleation (A Variant):**
   - **Description:** This is not a distinct method from transpalpebral or subconjunctival but rather an approach that emphasizes a lateral canthotomy for significantly enhanced access to deeper orbital structures. It often incorporates elements of the subconjunctival approach initially.
   - **Indications:** Particularly helpful in dolichocephalic (long-headed) dog breeds or cases with very deep-set eyes where surgical access via a standard approach is limited. It

allows for better visualization of the retrobulbar space.

- **Similarities and Drawbacks:** Shares procedural steps and potential benefits/drawbacks with the subconjunctival approach, primarily due to the conjunctival incision and subsequent dissection planes.

After the globe and desired associated structures are removed, hemostasis is carefully achieved. The orbital space can be left to granulate and fill with tissue, or in some cases, an intraorbital prosthesis (e.g., silicone sphere) may be implanted to maintain orbital volume, though this is less common in general practice and carries its own risks. The skin edges are then meticulously sutured to permanently close the eyelid aperture, creating a cosmetic outcome.

Postoperative Care

- Pain Relief: Administer prescribed NSAIDs and opioids such as tramadol. Observe for signs of pain such as vocalization or lethargy. Use cold compresses to minimize swelling.
- Incision Protection: An Elizabethan collar is critical to prevent pets from manipulating the surgical area.
- Wound Observation: Inspect daily for swelling, redness, discharge, or dehiscence of the wound.
- Restricted Activity: Restrict physical activity up to two weeks. Keep pets indoors.
- Feeding: Begin with water, followed by small amounts of food. Normal feeding normally returns within 24 hours.
- Environmental Adaptation: Maintain environment as normal for pets adapting to blindness.
- Veterinary Follow-Up: Follow through on all appointments to check on healing.
- Monitor for Complications: Inform the vet if there are symptoms of infection, abnormal swelling, foul odour, or other severe signs. There can be rare complications such as fistulas, mucoceles, or even emphysema in certain breeds of dogs

Conclusion

Enucleation is an essential surgical procedure for small animal trauma, intraocular neoplasia, or chronic glaucoma. Although the procedure itself is simple, success is achieved through accurate patient choice, effective preparation, and expertise. Adequate post-operative care is important in ensuring easy recovery and enhanced animal welfare. Enucleation is a last resort, yet it remediates severe pain and manages incurable eye disease.

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