



Exenteration in Fish*

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William Wildgoose graduated from Glasgow Veterinary School in 1977 and has worked in small animal practice in London since then. He has a special interest in exotic pets and ornamental fish in particular, and obtained a postgraduate RCVS Certificate in Fish Health and Production in 1997. He was editor of the Fish Veterinary Journal for 3 years before contributing to and editing the second edition of the BSAVA Manual of Ornamental Fish in 2001.

Ocular diseases of fish are relatively common and often associated with other systemic disease. Fish do not have eyelids to protect the delicate tissues, and the corneal surface is in intimate contact with the environment, which predisposes the eye to disease. In most species of fish, the eye is in similar proportion to the rest of the body, and the degree of protrusion is only slight. However, in fancy varieties of goldfish there can be some substantial variations in size and protrusion (Figs 1-3), which makes them more prone to injury and disease. Minor lesions are often overlooked and ocular disease is noticed by the owner only when it is at an advanced stage. The anatomy of the eye and its pathology are reviewed in other texts.^{1,2} Ocular disorders following trauma or due to advanced stages of infectious, inflammatory and neoplastic diseases in fish may necessitate surgical intervention.³⁻⁵ Enucleation is the removal of the eye leaving the eye muscles and remaining orbital contents intact. Exenteration is the removal of the entire orbital contents, including the eye, extraocular muscles, fat and connective tissues and is usually performed for invasive orbital tumours.

This article is a review of cases where the eye was removed by the author. All were privately owned pet fish and included several goldfish (*Carassius auratus*), half of which were varieties with a naturally enlarged globe or eyeball. The pathologies seen included neoplasia (fibromas, retinal tumors, smooth muscle carcinoma, neurofibroma), uveitis and traumatic injury. Many were cases where conservative or medical treatment had failed, and the severity of disease resulted in marked protrusion or avulsion of the eye.

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Fig 1. The oranda has a normal-sized globe that protrudes very little and is often surrounded by a large fleshy cap of skin on its head.



Fig 2. Some varieties of goldfish have a massively enlarged and protruding globe and are described as "telescope-eyed" goldfish.



Fig 3. The "bubble-eye" goldfish has large fluid-filled sacs below a relatively normal-sized globe.



Fig 4. This 8-year-old black moor goldfish is a variety that has a naturally enlarged globe. The left eye started to protrude due to retrobulbar swelling for 2 weeks prior to presentation. A small amount of viscous fluid was aspirated from the left retrobulbar space, and some spindle-shaped cells were seen under high power. No treatment was administered because the owner preferred to wait until the problem deteriorated. One month later, a large cystic swelling had developed ventrally and displaced the globe dorsally as shown. Removal of the eye was considered the only viable alternative to euthanasia.

The surgical approach and technique for removing the eye is relatively simple. Fine surgical instruments and a magnifying head loupe are often required due to the small size of the eye. The fish is anesthetized by immersion in an appropriate agent and removed from the water. It is possible to perform the procedure within a few minutes, but longer anesthesia may require intermittent flushing of the gills with anesthetic solution using a syringe or a recirculating anesthetic system.⁶ The patient is placed in lateral recumbency with the affected eye positioned uppermost (Fig 5). The site may be lightly swabbed with sterile saline solution or dilute povidone iodine

solution (1:100) and draped. However, maintaining a sterile surgical field can be difficult, and postoperatively the site is often left exposed to the environment.

The periocular skin attaching the eye to the orbital rim is incised with a scalpel or curved scissors. The globe is then displaced from the orbital socket to allow exposure of the extraocular muscles and optic nerve (Fig 6). Care should be taken to minimize traction on the optic nerve at this stage while it is still attached to the brain. The extraocular muscles are severed at their origin within the orbital socket (Fig 7). The optic nerve and vessels are clamped using fine forceps and the eye is removed by cutting through



Fig 5. Following anesthesia by immersion in a solution of tricaine methane sulfonate (MS-222), the fish was removed from the water and placed in lateral recumbency.

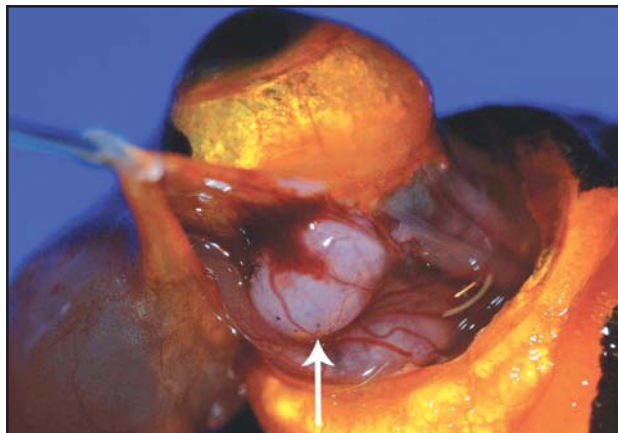


Fig 6. The periocular skin was incised to allow the globe to be displaced from the orbital socket. Part of an intraocular retinal tumor (arrow) had protruded into the retrobulbar space and was associated with the large cystic structure ventral to the globe.



Fig 7. The muscular attachments were severed at their origin within the orbit, and the eye was removed by cutting through the optic nerve and vessels.

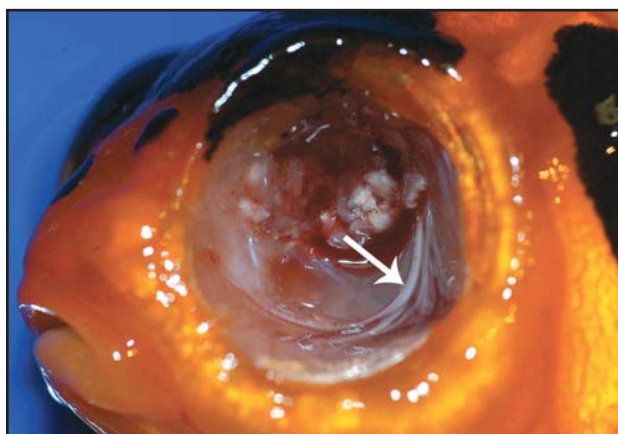


Fig 8. The surgeon must avoid injuring the maxillary and buccal branches of the cranial nerves (arrow) that run along the margin of the orbit.

these tissues. It is important to avoid injury to the maxillary and buccal branches of cranial nerve VII and mandibular branch of cranial nerve V, which run along the margin in the ventrolateral quadrant of the orbit (Fig 8). Due to the small size and depth of the orbital socket, it is often difficult to ligate the blood vessels. Hemorrhage may be controlled using direct pressure, a drop of phenylephrine or epinephrine (adrenaline), collagen powder (e.g., Emovet®, Nelson Veterinary Ltd) or cautery with heat or electrosurgery (Fig 9).

Postoperatively, the orbital socket can be left open or packed with a waterproof paste, such as Orabase® (Convatec), which contains methylcellulose, pectin and gelatin (Fig 10). These products are often used to treat mouth ulcers in humans and are available over the counter in pharmacies. They assist in the control of minor hemorrhage and help owners overcome the

initial shock of seeing their enucleated pet. In some species, such as puffer fish, there may be sufficient loose skin on the head to enable it to be sutured over the orbital socket. The closed wound may then be sealed using tissue adhesive, although this has proved irritant to the skin of some fish. Parenteral antibiotics, such as enrofloxacin (10 mg/kg), should be administered immediately following surgery and continued by immersion or in food for 10 days. Postoperative analgesia should be provided (e.g., butorphanol at 0.4 mg/kg given as a single intramuscular injection). Sodium chloride salt is added to the water at 1-2 g/L to minimize wound infection and reduce the osmotic effects on exposed tissues in freshwater fish.

In the author's experience, postoperative survival has been poor. This has been mainly attributed to undetected systemic disease, such as systemic mycobacteriosis, at the time of surgery. The true

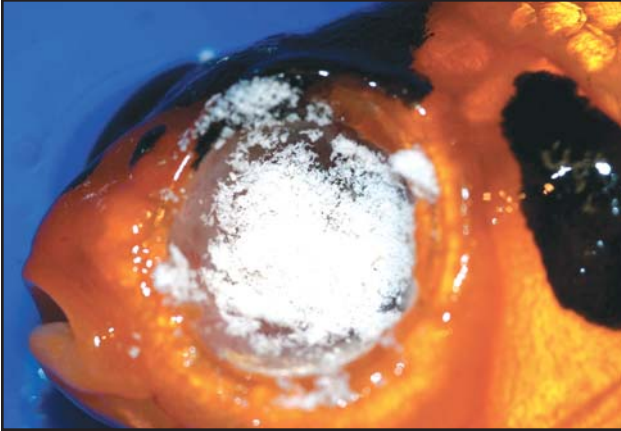


Fig 9. Heat cautery and some sterile collagen powder were used to control minor hemorrhage from the optic vessels.

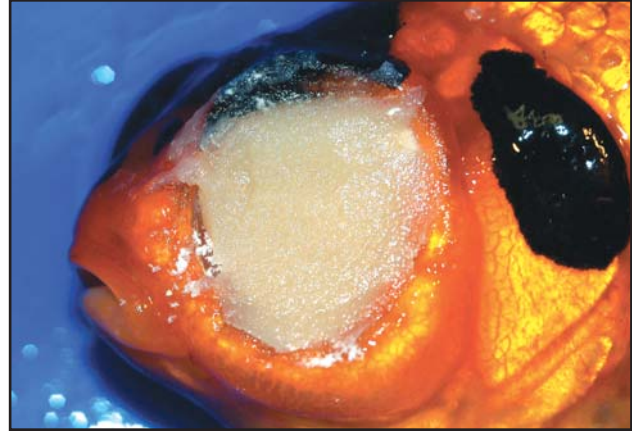


Fig 10. The orbit was packed with a waterproof paste to assist in hemostasis, and an antibiotic and analgesic were administered by injection.



Fig 11. The waterproof paste in this case absorbed some moisture and became swollen but still remained in the orbital socket 21 hours following surgery.

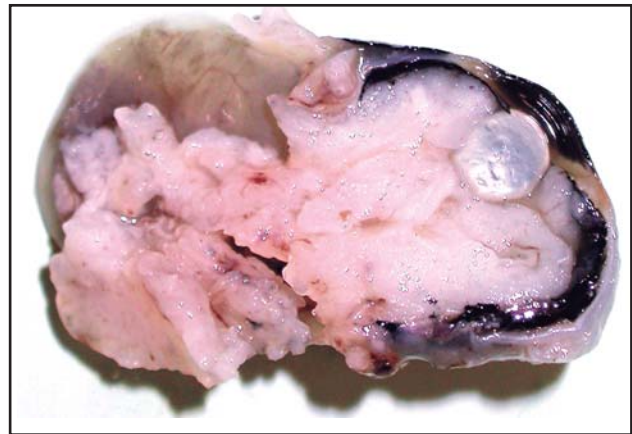


Fig 12. The extensive nature of the lesion is apparent in this hemisection of the eye following fixation in buffered formal saline. Histologic evaluation suggested that this was a tumor of the retina or choroid body.

Courtesy David L. Williams

extent of neoplasia, particularly with invasion or metastases into the brain and excessive blood loss, has also been considered as the cause of failure. However, a third of the author's cases survived for over 6 months and these tended to be healthy fish with localized non-invasive lesions or severe physical trauma to the globe. One case with a large corneal fibroma survived for 5.5 years following removal of the eye.

The loss of an eye in some fish may render them unsuitable for further display in public aquaria. Although one paper has described the fitting of a prosthetic eye,⁴ long-term retention of the prosthesis has been poor. This may be due to remodelling of the facial bones on the side where the eye has been removed and is often evident after a few months (Figs 13, 14).

The gross appearance of uveitis in some fish can be dramatic but they may continue to swim, eat and behave relatively normally. In some cases it may be impractical to remove the eye due to lack of on-site facilities, or the owner may decline the procedure. Eyes with extensive uveitis will often stabilize with conservative treatment and while the eye may become shrunken and non-functional (Figs 15, 16), fish can survive and feed with only one eye and, in some cases, when completely blind.

It is important to consider if the risk and limited survival following removal of the eye is likely to benefit the patient. While some factors, such as the progressive nature of neoplasia or the extent of physical trauma, may limit the options and necessitate immediate exenteration, other cases should be selected carefully. Radiography can be used to



Fig 13. This common goldfish had a massive corneal fibroma and is shown immediately following removal of the eye. Within a few months, there was significant flattening of the orbital socket.

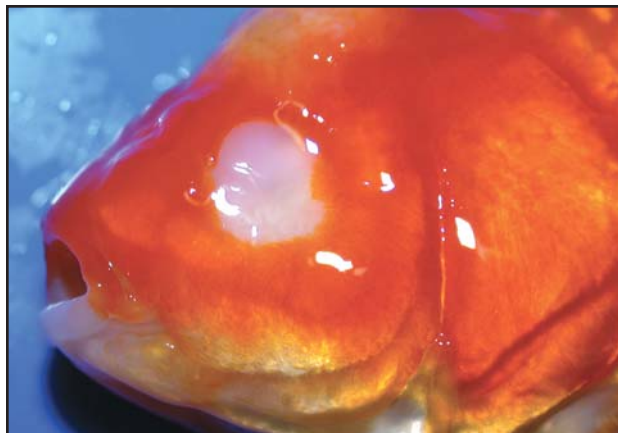


Fig 14. Thirty months later, the same fish was presented with several large fibromas developing on other parts of the body. Although the healed surgical site is non-pigmented the orbital socket had virtually disappeared.



Fig 15. The eye of this common goldfish was enlarged and protruding for five months before presentation. At the owner's request, no action was taken because the fish appeared to be unaffected by the lesion.



Fig 16. The fish was examined 5 months later after the globe had collapsed and become phthysical. The fish still remains active and healthy 3.5 years later. The cause is unknown but histopathologic examination of a similar lesion in another co-habiting fish revealed granulomatous uveitis.

identify some internal disease, such as fluid in the swim bladder or granulomatous changes in the kidney, which may not yet be clinically apparent. Ultrasound can usefully assess the extent of some pathologic changes inside the affected eye, such as intraocular neoplasia.

Although exenteration is a useful approach for traumatic and non-invasive neoplastic lesions, it is less successful for treating other diseases of the eye, particularly uveitis, which is often caused by systemic granulomatous disease.

References and Further Reading

1. Williams CR, Whitaker BR: The evaluation and treatment of common ocular disorders in teleosts. *Sem Avian Exotic Pet Med* 6:160-169, 1997.
2. Whitaker BR: Ocular disorders. *In* Wildgoose WH (ed): *BSAVA Manual of Ornamental Fish* 2nd ed. Quedgeley, UK, BSAVA, 2001, pp 147-154.
3. Harms CA, Wildgoose WH: Surgery. *In* Wildgoose WH (ed): *BSAVA Manual of Ornamental Fish* 2nd ed. Quedgeley, UK, BSAVA, 2001, pp 257-266.
4. Nadelstein B, Bakal R, Lewbart G: Orbital exenteration and placement of a prosthesis in fish. *J Am Vet Med Assoc* 211:603-606, 1997.
5. O'Hagan BJ, Raidal SR: Surgical removal of a retrobulbar haemangioma in a goldfish (*Carassius auratus*). *Vet Clin No Am Exot Anim Pract* 9:729-733, 2006.
6. Ross LG: Restraint, anaesthesia and euthanasia. *In* Wildgoose WH (ed): *BSAVA Manual of Ornamental Fish* 2nd ed. Quedgeley, UK, BSAVA, 2001, pp 75-84.
7. Harms CA, Lewbart GA, Swanson CR, et al: Behavioral and clinical pathology changes in Koi carp (*Cyprinus carpio*) subjected to anesthesia and surgery with and without intra-operative analgesics. *Comp Med* 55(3):221-226, 2005.

