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# A surgical approach for extensive orbital exenteration in dogs; a description of technique and its application in 4 cases

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**Abstract**

**Objective:** To describe a surgical approach for preplanned orbital exenteration.

**Animals studied:** Indications included intraconal orbital mass lesions. Four dogs were included, 3 with neoplasia and one with retro bulbar nodular fasciitis.

**Procedure:** To facilitate complete removal of lesions, exenteration was performed by a new procedure for wide access. The frontalis and temporalis muscles were elevated and retracted through a single U-shaped skin incision. Zygomatic arch osteotomy was performed, followed by a 360-degree peritomy and zygomatic process osteotomy. The eyelids were divided from each other through the lateral cantus and then folded forward to expose the globe. The orbit was exenterated by blunt and sharp dissection. Osteotomies were closed with cerclage wires, soft tissues closed and the skin wound sutured in a T-shape.

**Results:** The present exenteration procedure gave excellent access to remove orbital contents flush with the optic foramen and orbital fissure. Postoperative swelling and pain were limited and healing uneventful. Two of the 3 neoplasia cases experienced tumor recurrence involving the brain at 18 and 20 months postoperatively, respectively. Both of these had optic canal or intracranial tumor extension preoperatively. Long-term complications included mild concavity of the operated side of the face.

**Conclusions:** The present approach for preplanned exenteration offers excellent access for complete removal of orbital contents to the level of the optic foramen. Complications due to the surgical method are few and limited.

KEYWORDS
canine, exenteration, orbit, orbital neoplasia, orbitectomy, orbitotomy

## 1 | INTRODUCTION

Orbital neoplasia in small animals may arise from any tissue in the orbit.[1] Up to 75% of canine orbital tumors are malignant and 92% are primary intraorbital.[2-4] Exenteration involves removal of all orbital contents. Contemporary textbooks describe a trans palpebral exenteration approach.[5] Trans frontal orbitotomy and partial orbitectomy with orbital reconstruction for removal of orbital lesions with preservation of the ocular globe have been published.[6-8] Also, improvised intraoperative conversion of a trans frontal orbitotomy procedure into an exenteration has been described.[8]

Trans frontal orbitotomy is based on 3 steps: zygomatic arch osteotomy, temporalis muscle retraction, and zygomatic process osteotomy. To preserve the facial nerve, a double skin incision is employed, leaving a strip of skin across the surgical field. Access to the orbit is excellent but the globe itself is less accessible.[8]

  

This report presents a different surgical approach including the 3 steps mentioned but designed especially for preplanned exenteration in cases of intraconal orbital neoplasia making the globe unsalvageable. This approach offers superior exposure and access to the globe and the orbit simultaneously, while still preserving the orbital septum to facilitate closure. Also, asepsis is improved and peritomy for globe removal is facilitated.

This method was developed to remove malignant orbital lesions to the level of the optic foramen in case of impending intracranial extension. Whereas descriptions of conventional exenteration in contemporary standard reference literature are brief,[5,9,10] the present article strives to convey detailed information on the extensive exenteration technique presented here.

## 2 | MATERIALS AND METHODS

Four cases of intraconal orbital mass lesions were included, as summarized in Table 1. The location and extent of involvement were investigated using ultrasonography (US), computerized tomography (CT) and/or magnetic resonance imaging (MRI) (Table 1). In case 1, the mass lesion extended from the ocular globe to the level of the optic canal. In case 2, in addition, there was manifest contralateral extension into anterior ventral portions of the brain. In both cases, the mass lesion filled and expanded the entire orbital cone. In cases 3 and 4, mass lesions were located centrally in the orbital cone, filling 50% to 75% of the length of the cone and expanding it to about twice its mid-width. There was no skeletal involvement in any of the 4 cases. All cases were free from signs of metastatic disease by thoracic radiography. Regional lymph nodes were normal by palpation and by CT or MRI. In case 4, a biopsy was taken from remaining tissues at the optic foramen at the conclusion of exenteration. Cadaver dissection specimens were used to generate material for Figures 1-5 of this article. For comparison of techniques, Figure 7 shows a likewise created image of a different surgical procedure, that of trans frontal orbitotomy.

### 2.1 | Presurgical preparation and anesthesia

All patients were anesthetized using acepromazine maleate 0.05 mg/kg IV (Plegicil, Pharmaxim AB, Helsingborg, Sweden), methadone 0.3 mg/kg IV (Metadon, Recip AB, Solna, Sweden) and propofol 0.4 mL/kg IV (Propofol-Lipuro 10 mg/mL, B.Braun, Melsungen, Germany) followed by isoflurane by inhalation for maintenance (Forene, Intervet International, Boxmeer, Netherlands). The periocular area was clipped and prepared with dilute povidone iodine (Jodopax vet 50 g/kg, 2 mL per 1000 mL, Pharmixim AB).

### 2.2 | Surgical technique

A single U-shaped skin incision is made for preplanned exenteration (Figure 1). It courses anteriorly along the sagittal crest, curves laterally along the temporal line and proceeds obliquely across the zygomatic process of the frontal bone. It then continues ventrally anterior to the orbital ligament, touches the eyelid fissure at the lateral canthus, runs down to the lower edge of the zygomatic arch

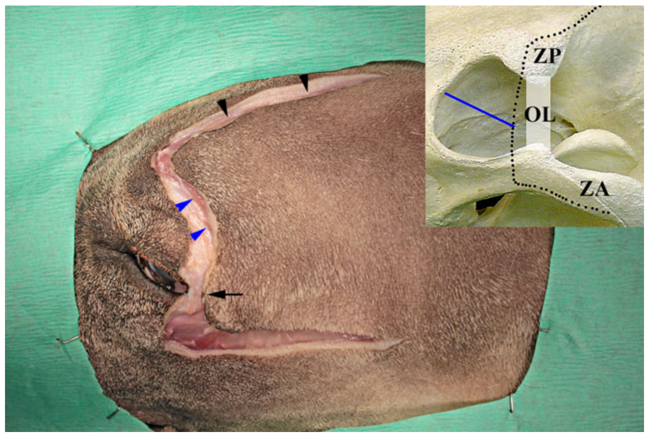


**FIGURE 1** Cadaver specimen to show skin incision. Inset shows incision (dotted line) in relation to bony structures and eyelid fissure (blue line). Any canthal tissue remaining on the posterior cut skin edge is trimmed off (black arrow). To proceed, elevate the frontalis muscle along its dorsomedial edge (black arrowheads) and then cut its insertion (blue arrowheads). ZP, zygomatic process; OL, orbital ligament; ZA, zygomatic arch

**TABLE 1** Signalment, diagnostic modalities, diagnosis, follow-up time and outcome

| Case # | Breed | Age | Gender | Imaging | Diagnosis | Follow-up | Outcome |
|---|---|---|---|---|---|---|---|
| 1 | Canary Mastiff | 7 y | F | CT | Nerve sheath tumor | 20 mo | Recurrence, euthanasia |
| 2 | Boxer | 8 y | F | US/CT/MRI | Meningioma | 18 mo | Recurrence, euthanasia |
| 3 | Border terrier | 11 y | M | US/CT | Nodular fasciitis | 36 mo | No recurrence |
| 4 | Small Munsterlander | 13 y | F | MRI | Histiocytic sarcoma | 23 mo | No recurrence |

F, female; M, male; CT, computerized tomography; US, ultrasonography; MRI, magnetic resonance imaging; y, years; mo, months.

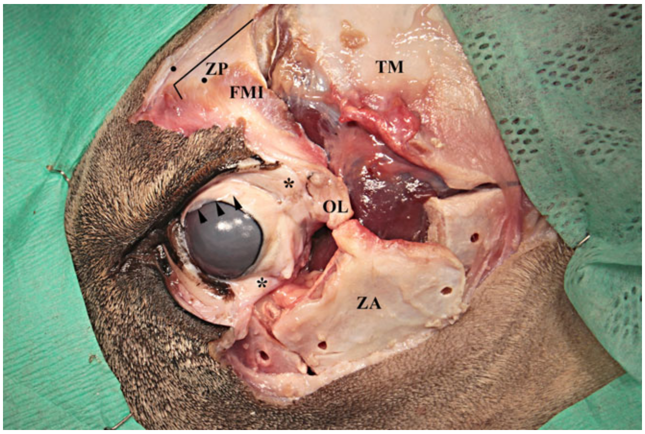


**FIGURE 2** Cadaver specimen. The skin, subcutis and frontalis muscle have been retracted posteriorly and wet packed (out of view to the right). The temporalis muscle fascia (TM) has been incised and zygomatic arch (ZA) osteotomy has been performed with holes predrilled for closure with cerclage. Note straight incision across orbital ligament (OL). A peritomy has been started (arrowheads), to be continued for 360°. Splitting of the canthus and conjunctival sac laterally has left 2 separated strips of conjunctiva (asterisks). An angled osteotomy of the zygomatic process (ZP) is denoted by the black line, with predrilled holes as indicated by black dots. In a live patient, exposed tissues would be wet draped

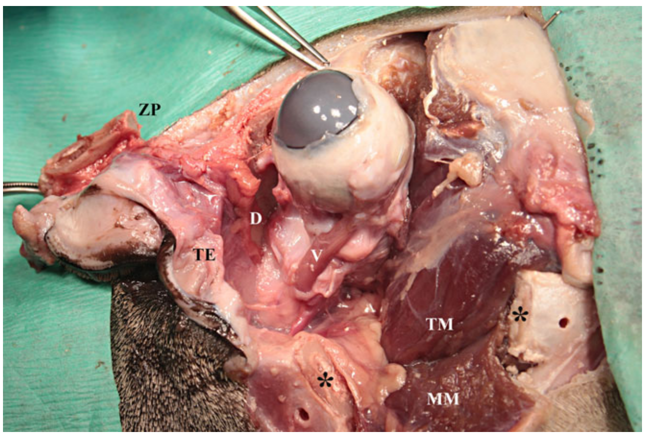


**FIGURE 3** Cadaver specimen. Exposure completed. The zygomatic process (ZP), the upper eyelid and the orbital ligament have been retracted anteromedially and the lower eyelid folded ventromedially. The temporalis (TM) and masseter (MM) muscles have been separated bluntly to allow ventral retraction of the zygomatic arch (out of view, ventrally). The TM has been retracted posteriorly. Different parts of the orbit can be widely exposed by moving the globe and orbital cone in appropriate directions. Here, the anteroventral portion is seen, with the dorsal (D) and ventral (V) oblique muscles. The eyelid edges, palpebral conjunctiva and the third eyelid (TE) still remain. Notice the wide access with the absence of a skin strip across the surgical field. In a live patient, exposed tissues would be wet draped. Asterisks denote cut ends of zygomatic arch

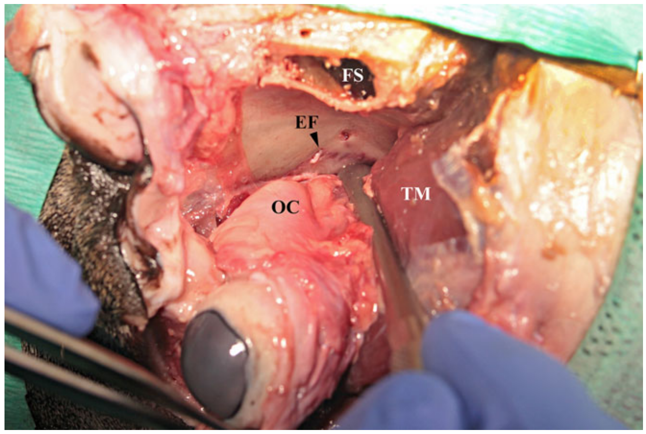


**FIGURE 4** Cadaver specimen. Dissection to the optic foramen and fissure. The Freer elevator rests at the dorsal edge of the extra ocular muscle insertions around said foramina. The ethmoidal foramen (EF, arrowhead) is useful as a landmark during dissection posteriorly. By using a Gelpi wound retractor visualization may be improved further, see Figure 5. TM, temporalis muscle; FS, opened frontal sinus; OC, orbital cone

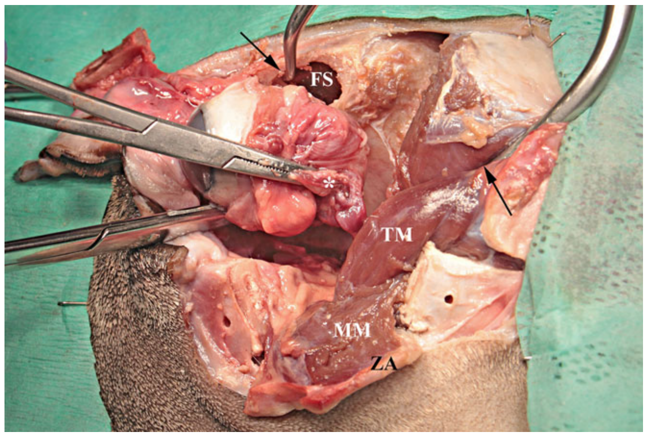


**FIGURE 5** Cadaver specimen. Orbital cone removal completed. The apex of the cone has been clamped flush with the optic foramen and cut between the clamp and the foramen; asterisk marks the cut end. The globe and orbital cone are removed in an intact block. Note the Gelpi wound retractor placement to retract the TM (black arrows). FS, frontal sinus; TM, temporalis muscle; MM, masseter muscle; ZA, zygomatic arch, asterisk denotes cut end of orbital cone

and finally angles to proceed caudally along this edge. The 2 ends of this incision are extended as far caudally as necessary for the amount of exposure needed. Any small piece of lateral canthal tissue remaining on the posterior cut skin edge is trimmed off with scissors (Figure 1). This is in contrast to the double skin incision employed in the previously published trans frontal orbitotomy procedure.[8]

The frontalis muscle (FM) first is identified and elevated along its dorsomedial edge (Figure 1). Its anterior insertion then is cut just posterior to the upper bony orbital rim and orbital ligament. The FM is separated bluntly from the underlying temporalis muscle (TM) fascia and a U-shaped flap of skin, subcutis and FM is elevated, retracted caudally and covered with saline-soaked gauze. After this, the 2 orbitotomy steps of TM elevation and zygomatic arch resection are taken as previously described elsewhere (Figure 2).[8] The TM elevation is evident from a comparison of the present Figures 2, 4, and 5. Zygomatic arch resection by oscillating saw is made in 2 oblique cuts after predrilling of holes for cerclages (Figures 2 and 3). The anterior cut must not involve the adjacent molar tooth alveoli.

The orbital ligament is cut straight across (Figure 2). The previously advocated step incision to spare the zygomaticofacial nerve[8] does not apply, as that nerve will be removed with the exenterated tissues.[11]

Following this, the conjunctival sac and lateral canthus are split horizontally to separate the upper eyelid from the lower (Figure 2) and a 360-degree peritomy is performed with fine Stevens tenotomy scissors (Figure 2, arrowheads). A zygomatic process osteotomy is performed with an oscillating saw, applied in 2 cuts at right angles as indicated in Figure 2. Also, note the positions for predrilled holes for cerclages. This is as previously described elsewhere.[8]

The zygomatic process, the orbital ligament and the upper eyelid are retracted anteromedially. The lower eyelid is folded ventromedially over the ventral orbital rim. The eyelid edges and palpebral conjunctiva at this point are left intact to protect the eyelid stroma from desiccation and possible bacterial contamination (Figure 3). Following these measures, the orbit will be widely accessible all around the globe and orbital cone (Figures 3 and 4).

Exposure thus accomplished, exenteration itself is begun by blunt dissection with Stevens tenotomy scissors around the ocular globe from the limbus caudally. Ventromedially, the level of dissection depends on the location and extent of the orbital lesion to be addressed. With lesions located near or possibly involving the third eyelid, dissection is between the third eyelid and the medial bony orbital wall, to include the third eyelid with the globe and orbital cone for removal. With lesions located well away from the ventromedial anterior aspect of the orbit, dissection is directed between the third eyelid and the globe, leaving the third eyelid to be removed later in the procedure (Figure 3).

Blunt dissection proceeds caudally external to the orbital cone, preserving the integrity of the periorbita. Medially, the ethmoidal artery will be severed at the ethmoidal foramen (Figure 4). A Freer elevator is used bluntly to dissect the extraocular muscle insertions from the bone around the optic foramen and orbital fissure, working from the periphery inwards around these orifices (Figure 4). Then, the optic nerve and surrounding soft tissues at the apex of the orbital cone are clamped with a curved hemostat and severed with scissors (Figure 5). To avoid contamination of the orbit with neoplastic cells from within the orbital cone, the transection is made posterior to the clamp. Any identifiable hemorrhages are cauterized using $CO_2$ laser or radio frequency diathermy, or are clamped with hemostatic titanium clips (Vitalitec, Vitalitec International Inc, Plymouth, MA, USA). The optic nerve stump is not ligated routinely, but the stump and remaining perineural tissues are coagulated with $CO_2$ laser or radio frequency diathermy further to prevent neoplastic remains.

Upon completion of exenteration, the zygomatic arch and the zygomatic process of the frontal bone are repositioned and fixated with 0.8-1.0 mm cerclage wires. The TM is repositioned and its fascia is sutured as described elsewhere for trans frontal orbitotomy.[8] Then the orbital ligament is reattached; simple interrupted suturing will suffice, as following exenteration there will be little tension on the ligament.

Thereafter, the eyelid edges and remaining palpebral conjunctiva are removed, including the skin of the medial canthus. First, the eyelid skin is incised with a scalpel, parallel to and 5-6 mm from the eyelid margins and around the medial canthus; then eyelid edge and medial canthus excision are completed with scissors. Following this, the 2 remaining strips of conjunctiva are undercut with scissors and removed from lateral to medial (Figure 2, asterisks). Also, the third eyelid is removed, unless this has been performed earlier in the procedure.

A bupivacaine splash block is applied for anesthesia (Marcain 5 mg/mL, 0.1 mL/kg; Atra Zeneca PLC, London, UK).[12] In case of remaining capillary hemorrhages, the orbit may be packed with resorbable hemostatic sponges. Thereafter the cut edges of the tarsal plates of the upper and lower eyelids are sutured to each other across the orbital opening. The flap of FM and skin is repositioned and the FM is sutured back to its insertion as previously described.[8] Subcutaneous tissues are sutured and the skin of the upper and lower eyelids is closed across the sutured tarsal plates. Finally, the large U-shaped skin incision is closed, resulting in a T-shaped skin suture line at the level of the previous lateral canthus (Figure 6).

All buried sutures are of 4-0 or 3-0 polyglactic acid (Vicryl, Ethicon, San Lorenzo, PR, USA). The skin is closed with 3-0 polyethylene (Ethilon, Ethicon) or staples (Proximate, Ethicon Endosurgery LLC, PR, USA).

## 2.3 | Postoperative care

Animals were hospitalized for 2-3 days after surgery. Postoperative care included methadone 0.3 mg/kg IV q4 hours for the first 24 hours, followed by buprenorphine 0.018 mg/kg SC q8 hours for another 1-2 days (Temgesic,

**FIGURE 6** Case 2 2 days after surgery. Note the T-shaped suture line at the position of the now obliterated lateral canthus. Swelling is moderate. There is a minimal amount of serosanguinous fluid at the wound

Indivior UK Ltd, Slough, Berkshire, UK). Carprofen was administered PO for 10-14 days at 2 mg/kg q12 hours (Rimadyl, Orion Pharma Animal Health, Sollentuna, Sweden). No routine prophylactic perioperative antibiotic therapy was used, but in case 1 amoxicillin 20 mg/kg PO (Vetrimoxin, Ceva Animal Health, Lund, Sweden) was administered from day 2 through day 5 due to minimal serosanguineous transudation from the surgical wound on days 1-3 (Figure 6).

## 3 | RESULTS

Surgical exposure, exenteration and closure were uneventful in all cases. The globe and the orbit were excellently accessible simultaneously (Figures 2 and 3). There was ample space for surgical manipulation reaching to the optic foramen and orbital fissure (Figure 4). The use of a Gelpi retractor clearly contributed to exposure (Figure 5).

Histopathology results and outcome are summarized in Table 1. No residual neoplastic tissue was identified by histopathology of the biopsy taken from the remaining tissues at the optic foramen in case 4.

All patients appeared adequately analgesed. Mild-to-moderate swelling of the surgical area abated over 10-14 days (Figure 6). There were no signs of postoperative infection in any case. All animals ate soft food without noticeable discomfort from the day after surgery. Sutures or staples were removed at 2 weeks postoperatively.

In case 1, minimal serosanguinous transudation occurred through the sutured skin wound during the first 3 days postoperatively (Figure 6). Amoxicillin was administered as detailed above. In cases 1 and 4, a small amount of blood escaped from the ipsilateral nostril 2 days after surgery. Also in case 4, a small subcutaneous seroma occurred lateral to the zygomatic arch at 2 weeks after surgery and resolved slowly over several weeks.

In all animals, the operated side of the face became moderately concave in the region of the anterior orbital opening over 4-6 months' time. This did not appear to cause discomfort or masticatory problems. There were no other long-term complications attributable to orbital exploration or exenteration.

In case 1, local recurrence was detected by MRI by the referring veterinarian at 11 months postoperatively, leading to euthanasia at 20 months. In case 2, blindness of the remaining eye occurred at 18 months. The animal was euthanized by the referring veterinarian with suspicion of progression of preexisting intracranial neoplasia. There were no clinical signs of metastasis outside of the primary tumor site at the time of local recurrence in these 2 cases. Necropsy was not performed. In cases 3 and 4, there were no clinical indications of recurrence or metastasis.

## 4 | DISCUSSION

The previously published transfrontal orbitotomy procedure was developed to allow for adaptable and extensive exposure of orbital contents while preserving such important structures as the ocular globe, the lacrimal gland and nerve, and the facial and zygomaticofacial nerves. The facial nerve was spared by the use of a double skin incision, leaving a skin strip along the nerve across the surgical field to the eyelids. The latter nerve was preserved by a step incision through the orbital ligament.[8]

However, when removal of the globe is preplanned as in the exenteration method presented here, preservation of lacrimal gland, lacrimal nerve, and facial nerve no longer remains an objective. Also, the skin strip across the surgical field in orbitotomy may compromise asepsis and does impede access to the ocular limbus for the peritomy necessary for exenteration.

Hence, the 2 procedures of orbitotomy and exenteration are based on completely different objectives and aim for completely different goals. While the previously published trans frontal orbitotomy[8] aims to remove malignancies while preserving as much tissue as possible—the globe and its important ancillary structures—the present exenteration procedure was created for maximal access to remove as much tissue as possible, including globe and malignancies, without restrictions.

The following important features define the present exenteration approach and result in wide open, unimpeded access to both the orbit and the globe simultaneously (Figures 3-5).

*First*, a single U-shaped skin incision transecting the facial nerve is employed in the present exenteration approach (Figure 1), in contrast to the double skin incision used in the previously published orbitotomy to preserve a strip of skin across the surgical field along the spared facial nerve (Figure 7).[8]

*Second*, in the absence of a remaining posterior skin connection in the present exenteration approach, the upper and lower eyelids can be separated by splitting through the canthus and conjunctival sac laterally (Figure 2).

*Third*, the orbital ligament is cut straight across in exenteration (Figure 2). A step incision as employed in trans frontal orbitotomy to spare the zygomaticofacial nerve is not a consideration when the present technique is applied and neither will there be any need to adjust the ligament length at closure following exenteration, as may happen in orbitotomy.[8] This avoids a difficult act of dissection that is not indicated with exenteration.

Thereafter, temporal muscle elevation, zygomatic arch resection, and zygomatic process osteotomy will be performed as previously described for trans frontal orbitotomy, although retraction of the temporalis muscle is improved by the use of a Gelpi retractor (Figure 5), rather than a Penrose drain sling.[8]

*Fourth*, the steps above leave the entire lateral aspect of the globe accessible, greatly facilitating the 360-degree peritomy (Figure 2) necessary in exenteration finally to separate the globe completely from eyelids and conjunctiva. This is far more difficult with the previous trans frontal orbitotomy method due to the persistence of a skin strip connected to the eyelids laterally (Figure 7).

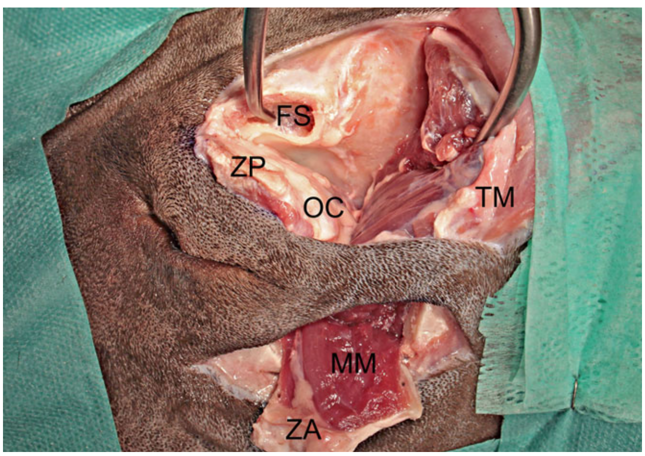


**FIGURE 7** Cadaver specimen; in contrast to the present study, showing different exposure by trans frontal orbitotomy for comparison. A skin strip persists across the surgical field. The upper and lower eyelids are connected to each other and to the skin strip laterally. The globe and the orbit cannot be accessed simultaneously; moving the eyelids to expose the one, will cover the other. ZP, zygomatic process (osteotomized); OC, orbital cone; TM, temporalis muscle; MM, masseter muscle; ZA, zygomatic arch (resected)

*Fifth*, separation of the eyelids laterally allows for tissues to be retracted in 4 different directions. The zygomatic arch is moved ventrally. The temporalis muscle is retracted posteriorly, the upper eyelid, orbital ligament, and zygomatic process are retracted anteromedially and the lower eyelid ventromedially. This will make the entire orbit and the globe totally accessible simultaneously and from any direction (Figures 3 and 4). Such simultaneous availability of globe and orbit is impossible with the previously described trans frontal orbitotomy (Figure 7).[8] In orbitotomy, tissues are retracted in only 3 directions, the still connected eyelids and skin strip preventing the fourth.[8]

*Sixth*, as the conjunctiva and eyelid edges are removed only right before closure, the eyelid stroma is protected against desiccation and possible bacterial contamination through most of the procedure.

*Seventh*, the T-pattern skin closure allows for the widely open surgical wound to be closed without complications.

The above surgical approach has a decisive effect, creating absolutely total, unparalleled exposure for exenteration (Figures 3 and 4). Still, closure is no more difficult than with trans frontal orbitotomy.[8]

Also, in contrast to conventional trans palpebral exenteration methods,[9,10] the procedure presented here preserves the orbital septum to facilitate solid closure across the anterior orbital opening. A prolene mesh scaffold across the opening hence was not deemed necessary and was not used.[9] The palpebral conjunctiva and eyelid edges are left in situ until closure to protect the eyelid stroma. However, it is important finally to remove all of the conjunctiva and the membrana nictitans lacrimal gland; otherwise, conjunctival mucocoeles or lacrimal cysts may form, respectively.[13] The eyelid edges must be removed to allow for skin healing.

The intention behind this extensive exenteration procedure is to allow for removal of the orbital cone flush with the optic foramen and orbital fissure, to avoid leaving behind any residual neoplastic tissue. Clamping of the apex of the cone is performed to prevent escape of neoplastic tissue, rather than to avoid hemorrhage. Cauterizing the remaining orbital cone stump is performed with both of these intentions. Despite this, 2 of the present 3 neoplasia cases recurred locally. However, extension into the optic foramen (case 1) or into the brain (case 2) was evident by preoperative imaging. Hence, these cases were operated upon with a palliative intention. The third malignancy case (case 3) experienced no recurrence during the 18 months of follow-up. The biopsy taken from the orbital apex in this case showed no histopathological evidence of neoplastic tissue, indicating that exenteration had been performed with a clean margin as desired. Ancillary postoperative therapy like radiation or chemotherapy was not readily available for these 4 cases but should be considered when possible.

Hemorrhage from the optic foramen region was minimal and easily stopped by laser coagulation. Hemorrhage elsewhere in the exposed area was handled routinely by ligation, diathermy cauterization or manual pressure. Although not used here, in the case of diffuse capillary hemorrhage hemostatic sponges may be placed in the orbit before closure.[7]

Local intraoperative splash anesthesia with bupivacaine was used. This has been shown to be equally as effective as retro bulbar injection blocks.[12] Also, the latter may be less applicable to neoplastic growth within the surgical area. Other options include lidocaine-bupivacaine-infused absorbable gelatin hemostatic sponges.[14]

As discussed for trans frontal orbitotomy[8] the large skin flap created by the U-shaped incision of the present exenteration approach resembles a temporal axial pattern flap. Neither in orbitotomy[8] nor in the present cases were there any indications of compromised blood circulation or healing problems. The T-shaped skin suture line of the present approach potentially could cause healing problems. However, many different dermatoplasty procedures result in Y- or T-shaped suture lines that heal well, granted skin tension is considered properly.[15] In the authors' experience, skin tension in orbitotomy and exenteration has proven itself minor.[7,8] The present skin incisions all healed uneventfully.

The small amount of blood noted at the ipsilateral nostril of cases 1 and 4 at 2 days after surgery may represent hemorrhage from the severed ethmoidal artery (Figure 4), pooling in the nasal cavity to escape later. No other interference with intranasal structures is included in the present procedure.

Preoperative fine needle aspiration biopsies were avoided due to the deeply inaccessible tumor locations and potential risk for neoplastic spread at sampling. A biopsy from the remaining tissues at the optic foramen, prior to cauterization with laser or diathermy, was taken only in case 4 but would be preferable in all cases to check for residual neoplastic tissue. Although no abnormalities of regional lymph nodes were detected by palpation or by CT/MRI imaging, fine needle sampling should have been considered preoperatively further to assess for metastasis. There were no clinical signs of metastasis outside of the primary tumor site at the time of local recurrence in the present cases 1 and 2.

Prophylactic antibiotic therapy was not employed, in accordance with restrictive contemporary antibiotic policy.[16,17] Postoperative wound infection did not occur but amoxicillin was used in case 1 on day 2-5 postoperatively to prevent infection in the presence of mild serosanguinous transudation from the surgery wound.

Descriptions of complications in conventional exenteration in contemporary standard reference literature are brief,[5,9,10] but laceration of the maxillary artery or perforation through the muscular orbital floor has been mentioned.[10] Hence, the surgeon needs to be familiar with orbital anatomy. In the authors' opinion, advanced diagnostic imaging is essential to plan for extensive exenteration. The present authors have found contrast CT studies useful to determine the interrelationships of large vessels and orbital lesions.[10,11] Also, in the near future, models created by three-dimensional printing of such images may further improve understanding of the topography of orbital lesions.[18]

In the authors' opinion, the method presented here offers far superior exposure for tumor removal as compared to conventional exenteration techniques (Figures 3 and 4). Also, it greatly improves exposure over that of the previously published trans frontal orbitotomy[8] (Figure 7), especially as it offers simultaneous access to both the globe and the orbit (Figures 2 and 3). However, in cases with any indication of skeletal involvement by diagnostic imaging, exenteration would need to be combined with orbitectomy.[6,7]

The present study pertains to intraconal tumors. In the authors' opinion, this same method would be useful for removal of extraconal lesions as well. Removal of the orbital lacrimal gland is included in descriptions of conventional exenteration,[5] but it was not removed in the present procedure. Removal of the third eyelid is postponed until after removal of the globe and orbital cone with intraconal lesions. Possibly, with adaptation of the present procedure for anteromedial extraconal lesions, these points may need to be reconsidered.

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