

## **EAR SURGERY: PRACTICAL TIPS FOR SUCCESS AND COMPLICATION AVOIDANCE**

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Surgery of the ear is commonly indicated in small animal practice for a variety of causes including otitis externa, otitis media as well as traumatic and neoplastic conditions of the bulla, ear canal and pinna. The complexity of these interventions can range from very basic to highly complex and ear surgery remains an area of soft tissue surgery that is associated with significant morbidity.

In order to perform some of the more advanced surgeries an in depth knowledge of regional anatomy is vital. The cartilaginous ear canal is made up of the pinna, which is supported by the auricular cartilage. The pinna is continuous with the vertical canal, which then becomes more perpendicular to the skull base and continues as the horizontal canal. The annular cartilage fuses with the auricular cartilage but during dissection of the ear canal an obvious step can be appreciated between these two cartilages. The annular cartilage attaches to the skull at the external acoustic meatus, which forms the entrance to the tympanic bulla and is the insertion site of the tympanic membrane.

The arterial supply to the external ear comes from a branch of the external carotid artery and venous blood drains to the maxillary vein. The retroarticular vein lies just rostral to the external auditory meatus and can easily be damaged during dissection. When this occurs it can be challenging to grasp and cauterize or ligate the vessel due to limited accessibility. Sustained packing of the area in combination with placement of a topical hemostatic agent such as an absorbable gelatin sponge is usually successful in stopping the hemorrhage.

Several important neurological structures lie within the surgical field especially when total ear canal ablation is performed and neurological complications are the most common group of complications associated with ear surgery. Axons from postganglionic sympathetic neurons course close to the wall of the middle ear in dogs and cats and are particularly exposed in cats during curettage of the tympanic bulla during TECA-BO surgery. Damage to these fibers can result in Horner's syndrome. The facial nerve exits the stylomastoid foramen immediately caudal to the external auditory meatus and then travels ventrally and cranially around the aspect of the tympanic bulla. The entrance to the inner ear at the epitympanic recess lies on the dorsomedial aspect of the tympanic bulla. Signs of vestibular disease can result in damage to the structures of the inner ear if over-exuberant curettage occurs in this area or if a fracture is propagated into this area during bulla osteotomy. It is important to remember that unlike dogs who in general have one compartment to the bulla, the feline tympanic cavity consists of two compartments, a larger ventromedial and a smaller cranio-lateral compartment which are separated by a bony septum. It is imperative to penetrate both cavities of the bulla in cats as disease is usually not limited to one cavity.

*Surgery of the pinna* – Occasionally traumatic lesions may require resection of a portion of the pinna if devascularization and necrosis of a portion of the pinna has occurred. However, more commonly pinna surgery is indicated for treatment of neoplastic lesions. The most common neoplasm involving the pinna is squamous cell carcinoma. These lesions are particularly common in cats that lack pigment in their pinnae. These cats have been shown to have a 13.4x greater risk of developing SCC compared to those cats with pigmented pinnae.<sup>1</sup> In cases where SCC is present a complete pinnectomy is often required to achieve a clean surgical margin. Pinnectomy is a simple procedure that involves a full-thickness incision medially and

laterally that penetrates through the auricular cartilage. The skin margins which have a tendency to retract away from the cartilage are primarily sutured and healing in most cases is uneventful as long as the patient is prevented from self-traumatizing the area. The prognosis for cats with SCC of the pinna is good with one study documenting a disease free interval and median survival time of 681 and 799 days respectively.<sup>2</sup>

*Surgical management of otitis externa* - Cases that have become refractory to medical management or animals that have such severe canal stenosis or obstruction that medical management can no longer be administered are surgical candidates. A variety of surgical procedures have been described over the years for otitis externa including lateral wall resection (Zepp procedure), vertical canal ablation, subtotal ear canal ablation with bulla osteotomy (STECA-BO) and total canal ablation with bulla osteotomy (TECA-BO). Lateral wall resection is the simplest of these procedures but has become seemingly less popular in recent years and is only indicated in patients that lack significant disease in their horizontal canals. After an initial skin incision is made over the lateral aspect of the vertical canal, dissection down to the cartilage is performed. The cranial and caudal margins of the lateral vertical ear canal are incised in order to create a cartilaginous flap. The flap is turned ventrally and sutured to the ventral margin of the skin incision in order to create a cartilaginous drainage board. The procedure does not remove any of the diseased cartilaginous canal but merely has the potential to improve access for administration of medications and can change the microenvironment of the ear canal by improving ventilation, and reducing humidity thus discouraging bacterial growth. However, results of this surgery have been disappointing with one study reporting an unacceptable surgical outcome in 55% of cases overall and in 86.5% of the cocker spaniels in which it was performed mainly due to progression of disease.<sup>3</sup> Lateral wall resection may be used successfully for resection of small well-circumscribed non-malignant masses of the lateral aspect of the vertical canal although these lesions are rare. Vertical canal resection is another procedure that has fallen out of favor for management of otitis externa. In this procedure the vertical canal is isolated by resecting in a circumferential fashion around the proximal aspect of the ear canal as is done in a total ear canal resection. Dissection is continued as close as possible to the cartilage of the vertical canal until the point where the horizontal canal starts. At this point the vertical canal is amputated and the margin of the epithelium of the ear canal is sutured to the skin to create a new external ear orifice that is located in a more ventral location. The remainder of the skin incision is closed routinely. Similarly to the lateral wall resection vertical canal ablation may be a useful technique for resection of small well-circumscribed benign masses emanating from the wall of the vertical canal. Stenosis of the small orifice that is created can occur and clipping of the hair around the orifice may be necessary to prevent obstruction of air flow. Stenosis can be minimized by creation of a small drainage board as is performed with the Zepp procedure. While both the lateral wall and vertical canal resection have the advantage of minimizing the risk of damage to the neurovascular structures located closer to the base of the ear canal and the tympanic bulla they have lost favor in the management of otitis due to their inability to remove all of the diseased tissue. TECA-BO and a recently reported modification termed the STECA-BO<sup>4</sup> are generally more appropriate for most dogs with moderate to severe signs of otitis externa and media but do carry a higher risk of neurovascular complications. For many years it has been known that an ear canal ablation without bulla osteotomy would result in a high incidence of fistula formation after surgery.<sup>5</sup> The importance of performing the osteotomy therefore cannot be overemphasized. The STECA-BO was recently described in 18 dogs as a potentially less

invasive alternative to TECA-BO that also allows preservation of the proximal vertical canal with potentially better ear carriage.<sup>4</sup> In a traditional TECA-BO surgery dissection of the entire vertical and horizontal canal is performed staying as close to the cartilaginous canal as possible. Facial nerve paralysis occurs in 13-36% of dogs depending on which study is quoted and is usually the result of excessive retraction of the nerve during the dissection.<sup>6</sup> Transection of the nerve is also possible and usually occurs when tissue around the horizontal canal that remains attached to the perineural tissues is being removed with some force causing the nerve to be withdrawn in a traumatic manner. In most cases, however, where transection has not occurred, facial nerve paralysis is temporary. If function does not return the third eyelid commonly functions as a surrogate for lubrication of the eye during globe retraction although this does not occur in all cases and severe corneal ulceration with the loss of function can occur in extreme cases. In cats facial nerve paralysis has been described in 56% of TECA-BO cases post-operatively and was permanent in 28% of cases in one study.<sup>7</sup> Horner's syndrome is principally seen in cats and has been reported to occur in 42% of cats of which it was permanent in 14 percent.<sup>7</sup> Although animals with Horner's syndrome have obvious cosmetic changes that are readily visible to owners it generally does not appear to be associated with significant detriment to quality of life in the post-operative period. Vestibular dysfunction is thankfully the least common (3-8% incidence in dogs) of the neurological disorders seen in small animals after TECA-BO but has the most profound affect on quality of life in the post-operative period.<sup>6</sup> Damage to the inner ear may occur due to overzealous curettage of the dorsomedial aspect of the bulla. The author has also seen this complication after fracturing of the bulla during the osteotomy procedure. When performing the bulla osteotomy it is advised that small pieces of bone be removed or that a burr be used. Significant pressure applied to rongeurs on larger pieces of bone can propagate fractures in the area of the petrous temporal bone that can result in vestibular dysfunction. Recovery from vestibular signs can be incomplete and can take several months.

Fistula formation after TECA-BO is another potentially serious complication that can arise if any infected epithelium or canal tissue is not removed. The incidence of this complication is between 2-10% and treatment is usually limited to re-exploration of the surgical site as antibiotics are not usually successful in managing these infections.<sup>6</sup> Re-exploration can be performed using either a ventral or lateral approach, the latter being chosen if remaining cartilage is detected on pre-operative advanced imaging studies which are recommended. However, owners should be aware that even after re-exploration recurrence of signs is possible.<sup>8</sup>

*Surgical treatment of ear canal neoplasia* – Tumors of the ear canal are predominantly malignant in origin especially in cats. Ceruminous gland adenocarcinoma (CGA) is the most common tumor in cats and dogs with squamous cell carcinoma being almost as common as CGA in cats. Metastasis is uncommon, however, with spread to lymph nodes and lungs documented in less than 10% of cases.<sup>9</sup> Total ear canal ablation is firmly established as the procedure of choice for malignant ear canal tumors to provide the best long-term control of local disease. In dogs with malignant ear canal tumors median survival time has been documented to be 58 months.<sup>9</sup> Cats with CGA have a median survival time of 49 months. However, survival time for those cats with SCC was only 3.8 months in one study.<sup>9</sup>

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