Surgical treatment of auricular and external ear canal disease in the dog and cat

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Introduction

The pinna or auricle is a skin-covered extension of the auricular cartilage. Dermatitis of the auricles is usually part of generalized skin diseases, like hypersensitivity (atopy, food hypersensitivity) and contact hyper-sensitivity. Some diseases are however limited to the auricle and may require a surgical therapy, like othaematoma or auricular tumours requiring pinnectomy. These techniques and the most commonly performed procedures of the ear canal such as lateral wall resection, vertical ear canal ablation (VECA), and total ear canal ablation (TECA) will be discussed in this lecture. Indications for these types of surgery are usually proliferative or unresponsive otitis externa, chronic otitis media or ear canal neoplasia.

Ear lacerations

Trauma to the auricle is common in cats and dogs and is usually the result of fighting or traffic accidents. Because of the profuse bleeding, immediate treatment is recommended and consists of clipping or shaving the hairs around the wound. The wound should then be cleaned and debrided if necessary. Fine interrupted sutures with resorbable monofilament suture material are used to close the wound, starting at the edge of the ear. Sutures are then placed on both sides of the wound to approximate the skin, while avoiding the cartilage. Aftercare includes an Elizabethan collar, antibiotics for 7 days and NSAID’s for 3 days.

Othaematoma (aural hematoma)

Aural hematoma results from bleeding within the cartilage layers of the pinna and is characterized by a fluctuating mass between the concave and convex sides of the pinnae. The exact cause is unknown, but in most cases otitis externa is found as well. Surgical treatment is necessary in most cases because without treatment the pinna will shrivel and subsequent ossification of the cartilage will cause continuous irritation. Surgery should be postponed until coagulation has taken place, usually after 3 days. The purpose of surgery is to remove the blood clot and to press the layers of the pinna together. With an S-shaped incision the pinna is opened on the concave side and blood clots and fibrin are removed. Interrupted mattress sutures are placed through all layers of the pinna with atraumatic absorbable suture material on a straight needle. Systematic interruption of the blood vessels should be prevented by placing the sutures parallel to the incision line or in a criss-cross manner. A protective and wound fluid absorbing bandage should be placed over the ear.

Pinnectomy

Indications for pinnectomy are malignant tumors (squamous cell carcinoma in cats), severe trauma and pinnal abscess or chronic infection in dogs and chronic relapsing polychondritis in cats. A skin incision is made around the base of the pinna. In cats vessels can be coagulated with electrocautery, in dogs vessels should be ligated. Pinnectomy is performed with scissors in both species. In cats, the dorsal skin can be advanced over the cartilage edge and sutured to the medial skin with interrupted sutures using absorbable material. In dogs closure of a subcutaneous layer, if necessary over a penrose drain, helps in diminishing tension on the skin sutures. The skin is closed with interrupted sutures using absorbable or nonabsorbable material.
Lateral wall resection

There are only few indications for lateral ear canal resections, the procedure should be reserved for small neoplastic lesions of the lateral aspect of the vertical ear canal.\textsuperscript{1,2} A site one half the length of the vertical ear canal is marked below the horizontal ear canal.\textsuperscript{1,2} Two parallel skin incisions are then made lateral to the vertical ear canal, extending from the tragus to the marked site and connected ventrally. The skin flap is dissected dorsally, exposing the lateral cartilaginous wall. With scissors the vertical canal is cut to the level of the horizontal canal cranially and caudally, from the pretragic incisure and intertragic incisure respectively. The cartilage flap is reflected distally and the distal half with the neoplastic lesion is resected. The proximal half is used as a draining board. The skin flap is removed and sutures are now placed from the epithelial tissues to the skin.\textsuperscript{1,2}

Vertical ear canal ablation

This may be the technique of choice when neoplasia is confined to the vertical ear canal.\textsuperscript{1,2} The procedure is started as described for the total ear canal ablation, with the vertical ear canal dissected to the level of the horizontal ear canal.\textsuperscript{1,2} The entire vertical canal should be freed from all muscular and fascial attachments. The vertical canal is then transected ventrally 1 to 2 cm dorsal to the horizontal canal. The remnant of the canal is incised cranially and caudally to create dorsal and ventral flaps. These flaps are reflected upward and downward respectively and sutured to the skin. Closure of the remainder of the wound is as described for TECA with remodeling of the pinna.

Total ear canal ablation

A V-shaped incision is made in the skin from the intertragic incisure to the ventral limit of the vertical ear canal and from the tragohelicine incisure to the same ventral point.\textsuperscript{1,2} The skin flap is retracted dorsally and the lateral aspect of the vertical ear canal is exposed. The cartilage and the skin of the medial wall of the ear canal are separated from the cartilage and the skin on the inner side of the base of the pinna by use of strong scissors.\textsuperscript{1,2} The vertical ear canal is now dissected to the level of the horizontal ear canal. Appropriate care should be taken to avoid the facial nerve in this area. The dissection is continued with freeing the horizontal part of the ear canal from the surrounding tissues to the level of the external acoustic meatus. The cartilaginous part is separated from the osseous part with scissors and removal of all of the skin lining the osseous external ear canal is accomplished with a small curette.\textsuperscript{1,2} The procedure is completed when after removal of the tympanic membrane, no secretory tissue is left and only bone is visible.\textsuperscript{1,2} When this is performed correctly, no lateral bulla osteotomy is necessary in absence of chronic otitis media.\textsuperscript{2} With chronic otitis media and accumulation of inflammatory tissue or thick exsudate in the middle ear cavity, a lateral bulla osteotomy is performed from this point on.\textsuperscript{1,2} After completion of the TECA or TECA with LBO, the pinna is remodeled and sutured with absorbable suture material.\textsuperscript{1,2} A penrose drain is placed and subcutaneous tissue and skin under the pinna are closed in a routine matter. Complications after TECA are facial nerve paralysis, wound infection and dehiscence and chronic fistulation, but most complications can be avoided with meticulous surgical technique.

References

Surgical treatment of middle and inner ear disease in the dog and cat

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Introduction

Otitis media generally develops as an extension of otitis externa through a perforated tympanum. Pharyngeal infections may, in rare instances, extend to the middle ear through the auditory tube. Cats may develop otitis media through this route as a sequela to upper respiratory tract disease. Other causes of otitis media include fungal infections (Aspergillus, Candida), neoplasia, cholesteatoma, inflammatory polyps, trauma, primary secretory otitis media (or otitis media with effusion in Cavalier King Charles Spaniels and other brachycephalic breeds) and primary tumors. The therapy of otitis media and/or interna consists of systemically delivered broadspectrum antibiotics. Amoxicillin potentiated with clavulonic acid or enrofloxacine are first choice antibiotics. When the tympanic membrane is intact, but bulging, a myringotomy could be performed under general anesthesia. Chronic unresponsive or recurrent otitis media warrants surgical intervention. Total ear canal ablation with lateral bulla osteotomy should be considered in cases with severe secondary changes of the external ear canal and concurrent otitis media. If the external ear canal is not affected, a ventral bulla osteotomy may be performed to remove gross exsudate and establish drainage from the middle ear.

Primary Secretory Otitis Media (or Otitis Media with Effusion)

PSOM is an uncommon disease of unknown etiopathogenesis which predominantly affects Cavalier King Charles Spaniels. Current hypotheses regarding the cause of the disease include obstruction or dysfunction of the Eustachian tube with decreased drainage of the mucus from the middle ear and increased production of viscous mucus caused by inflammatory, hypersensitivity or allergic reactions of the middle ear and Eustachian tube mucosa. Findings on otoscopy in dogs with PSOM range from completely normal ear canals to ear canals with narrowing of the horizontal parts or slight diffuse thickening of the skin lining the ear canals and ceruminous otitis externa. In most affected ears, a bulging, opaque but intact tympanic membrane can be seen (pars flaccida). Diagnostic imaging (CT-scan, MRI) is mandatory for proper evaluation of the middle ear, treatment planning and for exclusion of other differential diagnoses. The extent and type of hearing impairment should be examined with electrophysiological methods like brainstem-evoked response audiometry. A definitive diagnosis can be achieved following myringotomy; typically a highly viscous, opaque mucus effusion is removed from the tympanic bulla. Culture of this mucus is negative in most cases. Tympanostomy tubes (grommets) provide continual tympanic cavity ventilation and drainage and are an acceptable alternative to repeated myringotomy.

Feline Inflammatory Polyps

Polyps are benign, nonneoplastic, pedunculated inflammatory masses arising from the mucosal lining of the middle ear, Eustachian tube or nasopharynx. Cats typically present at an age younger than 3 years with nasal discharge, sneezing, stridor, voice change, dyspnea, and dysphagia when the mass is located in the nasopharynx; signs of otitis media/interna, such as head tilt, loss of balance, nystagmus and Horner’s syndrome when the base is in the tympanic cavity; or signs of an external ear canal mass, such as otorrhea, head shaking, and a visible mass when the polyp protrudes through the tympanic membrane. Visual observation of a mass on otoscopic or nasopharyngeal examination usually provides a diagnosis. Advanced imaging with CT and histopathology might be necessary in less clear cases. Simple traction avulsion is generally recognized as sufficient in most cases, especially when no middle ear involvement is present. Some authors nonetheless recommend bulla osteotomy in all patients, whereas others argue to treat with simple traction initially and reserve bulla osteotomy only for recurring cases.
Lateral approach to the horizontal ear canal and traction-avulsion

After aseptic preparation of the surgical site, an incision is made in the skin in a dorsoventral direction over the palpable vertical part of the ear canal, starting just craniocaudal to the tragus over approximately 2.5 cm. After blunt dissection to the ear canal, a stab incision is made to open it and a small closed haemostatic forceps is then introduced into the ear canal, meticulously following the direction of the horizontal ear canal until the polyp is encountered. The polyp is grasped as close as possible to the osseous meatus, rotated and removed with traction. The middle ear cavity is flushed with warm saline. The cartilage of the ear canal is closed with 4-0 monofilament suture material in an interrupted pattern, the subcutis and skin are closed routinely.

Removal of middle ear polyp by ventral bulla osteotomy

The cat is placed in dorsal recumbency and aseptically prepared for surgery. An incision is made parallel with the midline, centered 2-3 cm toward the affected side from halfway the mandible to the level of the atlas. The platysma muscle is incised and linguofacial vein is retracted. The incision is then deepened by blunt dissection between digastricus muscle and hypoglossal and styloglossal muscles until the bulla can be palpated. A Steinmann pin can be used to make a hole on the ventral aspect, the opening can be enlarged with a small rongeur. In cats both compartments should be opened. All polyp-associated soft tissue and attachments should be carefully removed using small curettes, especially in the dorsal compartment. Material is collected for culture, sensitivity testing, cytology and histopathology. The cavity is flushed and drained with a Penrose drain. Closure is routine.

Lateral bulla osteotomy

After total ear canal ablation, the tissues from the lateral aspect of the bulla are bluntly dissected as close to the bone as possible avoiding damage to the facial nerve and branches of the external carotid artery with small periosteal elevators or raspatories. The lateral and ventral aspect of the bulla can now be removed with Kerrison, Böhler and/or Zaufal-Jansen rongeurs until adequate visualization of the middle ear cavity is possible. Samples can be obtained for culture and susceptibility testing and for cytology or histopathology. A bone curette is used to gently remove any remaining epithelium or debris from within the bulla, taking care to preserve the auditory ossicles and cochlea on the dorsomedial side of the bulla. After curettage the tympanic cavity is copiously lavaged with warm saline and closure is as for TECA.

References
Diagnostic work-up and treatment of nasal disease in the dog

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Introduction

The nasal plane or nasal planum is the first and hairless part of the nose of dogs and cats, and is covered with thick keratinized epidermis. It includes the nostrils or nares, which are separated from each other by a groove or philtrum. During inhalation, air enters the nasal vestibule and is then directed into three longitudinally oriented chambers, the ventral, middle and dorsal nasal meatuses. The conchae consist of the rostrally located ventral (maxilloturbinates) conchae, the smaller dorsal (dorsal nasoturbinates) conchae, and the caudally located ethmoidal conchae (ethmoturbinates). After passage through the meatuses and over the conchae, inspired air exits the nasal cavity through the paired nasal choanae located between the caudal aspect of the hard palate and the vomer. Air then enters the nasopharynx dorsal to the soft palate.

Clinical signs and clinical examination of the nose.

Especially unilateral discharge, purulent material coming from one side of the nose, is the clearest indicator of intranasal disease. Sneezing and reverse sneezing are other indicators of nasal and nasopharyngeal disease. Bilateral nasal discharge in conjunction with systemic illness is usually indicative of lower airway disease. After the history has been taken, a thorough clinical examination of the respiratory tract has to follow. Additional examination of the nose and nasal cavities primarily consists of diagnostic imaging (radiography, CT-scan, MRI) and endoscopy. Culture, cytology and histology are only used in conjunction with nasal endoscopy.

Diagnostic imaging of the nose

Radiography is the number one additional diagnostic procedure to perform for patients with nasal and nasopharyngeal disease. This requires general anesthesia and close attention to positioning and exposure factors and only provides a limited view of regional anatomy. The standard lateral view is especially helpful for detecting abnormalities of the frontal sinuses, the nasopharynx and in combination with oblique views in detecting dental problems. The intra-oral dorsoventral view is the most informative and helpful view for assessment of the nasal cavity. CT-scan imaging is a more expensive technique, and requires general anesthesia as well, but produces images that represent thin, cross-sectional slices of the skull without problems of superimposition inherent to survey radiography. It provides better tissue contrast and improves visualisation of the bony structures.

Diseases of the nasal cavities

Bilateral rhinitis is very common in both dogs and cats and is usually the result of a primary viral infection with secondary bacterial infection. Although definite criteria are lacking, loud and frequent sneezing with large amounts of bilateral watery discharge fit with allergic rhinitis. An exact etiology is unknown.

Nasal foreign body

Frequent sneezing is the primary clinical sign of nasal foreign body, with rubbing of the front paws at the nose. In chronic cases, unilateral mucopurulent discharge will be the most obvious clinical sign. During rhinoscopy under general anesthesia the foreign body usually can be seen and removed with special forceps. Foreign bodies that cannot be removed under endoscopic guidance, will have to be removed by surgery.
Nasal aspergillosis

Mycotic rhinitis is a common disease in dogs and usually caused by *Aspergillus* species. Exposure to large fungal inocula and/or decreased local resistance of nasal mucosa after trauma could predispose for invasive nasal Aspergillosis. Erosion of the nasal planum with depigmentation and an abundant unilateral or bilateral sanguinopurulent, mucopurulent or hemorrhagic nasal discharge are usually noted. Depression as a result of pain and extension of the infection to the frontal sinus can occur. Nasal air passage is usually unobstructed. The diagnosis can be made on clinical signs and radiographs of the nasal cavity with evidence of turbinate destruction and irregular areas of increased and decreased radiolucency. On rhinoscopy cavernous areas caused by marked destruction of turbinates and conchal atrophy can be seen. Obvious mats of fungal hyphae or masses of dried, inspissated mucous can be seen. When there is no macroscopical evidence of fungal hyphae in the nasal sinus, trepanation of the frontal sinus should be done. Samples for culture and cytologic and histopathologic examination should always be collected. Topical therapy is indicated and advised by most specialists. A success rate of 70% has been reported with single infusions of clotrimazole (1 hour soak). Success rates up to 90% have been described after surgical tube placement and treatment with enilconazole (2dd 10 mg/kg, dilute 1:10) for 14 days.

Nasal tumor

Intranasal tumours are more common in dogs than in cats. Most tumours are malignant and occur in middle-aged and old animals (median age between 8 and 10 years). Eighty percent of canine intranasal tumours are malignant and approximately two thirds of them are of epithelial origin (adenocarcinoma, SCC and undifferentiated carcinoma). Their malignant nature is reflected more by their progressive local invasiveness than by distant metastasis to lymph nodes and lungs. Clinical signs include nasal discharge, sneezing, epistaxis, facial and/or oral deformity, epiphora due to obstruction of the nasolacrimal duct, stridor, exophthalmos due to a retrobulbar mass effect and central neurologic signs usually due to expansion of the tumour through the cribiform plate. Air passage through the nose is usually obstructed. The diagnosis is made on clinical signs, radiographic signs showing destruction of normal turbinate pattern and diffuse increased soft tissue density, CT-scan or MRI and histopathologic examination of rhinoscopy assisted biopsy. Radiotherapy appears to be the most effective treatment for nasal tumours. Whether radiation therapy should be combined with surgical debulking is controversial. Surgery as the sole treatment of dogs with nasal tumours has not prolonged survival time. However, surgery may palliate clinical signs in some dogs by alleviating obstruction and epistaxis.

References & Suggested Readings

Introduction

Brachycephalic dogs like English and French Bulldogs, Pugs, Pekingese, Shih Tzus, Shar Peis, Boston Terriers and Persian and Himalayan cats frequently present with signs of upper airway obstruction as a result of an anatomical distortion of their faces caused by an exaggerated and incorrect breed selection. Their head shape is the result of an inherited developmental defect of the bones of the base of the skull, which grow to a normal width, but reduced length without proportionate reduction of the soft tissues of the head. The subsequent increased airway resistance in their hypoplastic airways results in an increased inspiratory effort (obstructive breathing pattern with stertor/stridor) and eventually leads to dyspnea, heat and exercise intolerance, and secondary gastrointestinal abnormalities (gagging, vomiting and regurgitation as a result of hiatal hernia, esophagitis, gastritis, and pyloric mucosal hyperplasia) as well. Dogs with these anatomical brachycephalic abnormalities and clinical signs of upper airway obstruction are suffering from “brachycephalic (obstructive) airway syndrome” or BOAS. The primary components of BOAS are increased nasal resistance as a result of stenotic nares and aberrant or protruding turbinates, pharyngeal hypoplasia (redundant pharyngeal folds) with elongated soft palate and, especially in the English Bulldog, tracheal hypoplasia. Secondary components, resulting from the chronic increased negative intra-airway pressure, include everted tonsils, everted laryngeal saccules and laryngeal collapse. Even though individual animals can sometimes be effectively managed with medication, surgery or a combination of these, efforts of the veterinary community should be directed at prevention of this condition that strongly affects the welfare of the aforementioned breeds.

Diagnostic workup

Dogs in dyspnea with stridor per definition have obstructive upper airway disease, whereas dogs in dyspnea without stridor typically have lower airway disease. A sniffing or nasal stridor indicates obstruction of airflow through the nasal passages, snoring is typically associated with (naso)pharyngeal disease, whereas a laryngeal stridor (g-sound or sawing sound) is associated with laryngeal disease. Coughing, gagging, retching, regurgitation and vomiting are frequently present as well and indicate secondary or concurrent lower airway or gastro-intestinal disease. Physical examination findings are usually unremarkable except for the possible audible stridor and the obvious brachycephalic conformation of the animal. In addition, most patients demonstrate some degree of stenosis of the nares and increased, referred, respiratory noises upon thoracic auscultation. Radiographic examination of the head, neck and chest is useful for recognition of obstructing structures in the pharynx and larynx, tracheal hypoplasia, and to detect secondary aspiration pneumonia or pulmonary edema. The tracheal diameter can be measured at the thoracic inlet and expressed as a percentage of the thoracic inlet diameter. In bulldogs, the tracheal diameter is a mean of 12.7% of the thoracic inlet compared with 20% in nonbrachycephalic breeds. In some patients, a sliding hiatal hernia can be observed. Radiographs do not however provide information on the degree of pharyngeal and laryngeal hypoplasia and associated pharyngitis and laryngitis, nor does it allow for a proper evaluation of the nasal passages (aberrant conchae) and nasopharyngeal diameter. CT-scan imaging is therefore recommended in brachycephalic animals. This allows for a much more accurate evaluation of the bony abnormalities, measurements of airway diameter, presence of nasopharyngeal turbinates and potential concurrent middle ear disease, also related to brachycephaly.
Direct inspection of the pharynx and larynx with a laryngoscope is however the most important diagnostic procedure to determine the degree of pharyngeal and laryngeal hypoplasia and secondary everted tonsils and laryngeal collapse. With flexible endoscopes the nasopharyngeal area can be completely inspected and aberrant nasopharyngeal turbinates can be visualized.

Treatment

Animals in severe respiratory distress need to be evaluated quickly and intubated if respiratory arrest is imminent. Most animals respond to cold intravenous fluids, sedation with acetylpromazine (0.01 mg/kg IV), oxygen supplementation, and dexamethasone (0.05 to 0.1 mg/kg IV) to decrease pharyngeal and laryngeal swelling. Intravenous access is mandatory in either case but should be obtained with as little restraint and stress to the animal as possible. Long-term treatment of brachycephalic airway syndrome is aimed at reducing airway resistance and alleviating obstruction, either medically and/or surgically. Maintaining an adequate body weight and condition, a clean, fresh and cool environment and regular controlled exercise are advised. Corticosteroids can be used to treat mucosal swelling, whereas broad-spectrum antibiotics are indicated in cases with (aspiration) pneumonia. Any pre- or postoperative gastrointestinal signs are aggressively treated with a proton pump inhibitor (omeprazole 0.7 mg/kg PO q24hr), a prokinetic (cisapride [0.2 mg/kg PO q8hr] or metoclopramide constant rate infusion [1 to 2 mg/kg/d IV]), and an antacid. Cerenia (Maropitant, 1.0 mg/kg SC q24hr) is a neurokinin (NK₁) receptor antagonist that might be useful in reducing the likelihood of regurgitation during anesthesia. The components of the syndrome that are amenable to surgical correction are stenotic nares, aberrant turbinates, elongated soft palate, everted laryngeal saccules and laryngeal collapse.

References

Surgical treatment of laryngotracheal disease in the dog

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Introduction

The throat is a conduit for both the respiratory and the digestive tract and comprises the pharynx and larynx. The larynx is a cartilaginous structure consisting of the cricoid, thyroid and paired arytenoid cartilages and the epiglottis. These cartilages interact under the control of the neuromuscular system of the larynx to protect the lower airways (coughing), to regulate the respiratory airflow and to vocalize. The trachea functions as a conduit for air transport to and from the lungs. Common diseases of the larynx, trachea and bronchi include infection (kennel cough, cat flu), but only diseases that require surgical intervention will be discussed in this lecture.

Brachycephalic obstructive syndrome

Brachycephalic animals typically have signs of upper airway obstruction as a result of their anatomical and functional abnormalities. The most important components of BOS that are amenable to surgical correction are stenotic nares, overlong soft palate, and laryngeal collapse (eversion of lateral saccules).

Laryngeal Paralysis

Laryngeal paralysis is a complete or partial failure of the arytenoid cartilages and vocal folds to abduct during inspiration. Acquired laryngeal paralysis usually is idiopathic but may occur secondary to trauma or disease or it may be iatrogenic after surgery. Physical examination is usually unremarkable with the exception of tachypnea with a laryngeal stridor, panting and sometimes hyperthermia. Radiographs of the neck and thorax are made to exclude other causes of the dyspnea. The diagnosis can be made on visual evaluation of laryngeal function during a superficial plane of general anesthesia. The arytenoids are in a paramedian position in affected animals and show no active abduction during inspiration. Denervation of the laryngeal muscles can be diagnosed during electromyography. With acute dyspnea, an emergency medical treatment should be started with sedation, corticosteroids, supplemental oxygen and cooling when necessary. If the obstruction and/or mucosal swelling is severe, a temporary tracheostomy should be performed. Permanent surgical treatment is recommended in stabilised patients. Many surgical techniques have been described, but arytenoid lateralization procedures are recommended, because of the consistently good results with minimal complications. Either a cricoid or a thyroid-arytenoid lateralisation procedure can be performed.

Laryngeal tumors

Primary laryngeal tumors occur occasionally in dogs and cats and are usually malignant and of epithelial origin. In most cases the presenting symptoms are dyspnea and hoarseness. The “breaking of the voice” is a symptom strongly arousing suspicion of laryngeal tumor. Staging of the tumor should be done with CT or MRI and thoracic radiographs when pharyngeal or laryngeal surgery is being considered. Some can be removed via ventral laryngotomy.

Tracheostomy

Silastic tracheal cannulas or stainless steel cannulas with an inner cannula that can be removed and cleaned are preferred. The patient is placed in dorsal recumbency with a pillow under the neck. A transverse skin incision is made over the trachea at the midpoint between the larynx and the thoracic inlet. The subcutaneous
fat and the sternothyroid and sternohyoid muscles are divided in the midline by blunt dissection. A small self-retaining wound retractor is inserted into the wound and the ligament between two adjacent rings is incised with a no. 11 scalpel. A small forceps is placed on one of the rings beside the incision. The scalpel is then used to make a circular incision around the forceps. A round piece of tracheal cartilage is removed to produce an opening of the same size and shape as the tracheal tube or cannula. The cannula is inserted and sutured to the skin with four sutures. In addition, two cotton ribbons are attached to the wings of the tracheal cannula and tied around the neck. The cannula is left in place until the upper airway is patent. Silastic cannulas have an inner cannula that should be cleaned every two hours. After removing the cannula, the tracheostomy wound is not sutured, but left open to heal spontaneously. Healing is usually rapid because the incision was made parallel to the natural skin folds, which will result in good apposition of the wound margins.

**Permanent Tracheostomy**

A permanent stoma of the trachea is sometimes the only solution when an obstructive disease of the upper airways is beyond treatment and a tracheal cannula has become a necessary condition for continuation of life. Home-care of a permanent tracheostomy is however elaborate and difficult.

**Tracheal tumor and tracheal resection and anastomosis**

Tracheal tumors are rare in dogs and cats, but cause signs of progressive luminal obstruction and sometimes coughing. Malignant lymphoma and adenocarcinoma have been reported in cats, reported tumors in dogs include many types of epithelial and mesenchymal proliferations. Radiography can reveal a mass in the lumen of the trachea, outlined by air. But tracheobronchoscopy is essential for determining the exact location and extent of the tumor, the diameter of its base of attachment necessary for pre-operative planning, and of course for taking samples for histopathology. Surgical excision is the treatment of choice for tracheal neoplasms. The split-ring technique with apposition of simple interrupted sutures is recommended for tracheal anastomosis after tracheal resection.

**Tracheal collapse**

Clinical signs in patients with tracheal collapse are characterized by a honking cough and progressive dyspnea. The defect is most commonly diagnosed in the Yorkshire Terrier and in other popular miniature breeds. Medical and conservative treatment have a prominent place in managing the clinical signs, surgery should be reserved to those cases refractory to medical management. Externally supporting the collapsed trachea by means of partly open rings is the most suitable surgical method for long-term use.

**References & Suggested Readings**

Cosmetic and reconstructive surgery of the face

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Introduction

Reconstruction of facial defects is often required after radical resective surgery of tumours, for closure of traumatic wounds, (and) for the repair of burns or chemical damage to the skin and for a variety of palpebral problems. However, facial defect reconstruction can be very challenging as not only is cosmesis of importance to owners but the repair of defects in close proximity to the eyes, nostrils, ears and lips must ensure it allows for normal function of these structures and prevent secondary problems. The bridge of the nose is more difficult to reconstruct than other areas of the face due to a paucity of local tissues. The modified nasal rotation flap allows for a cosmetic closure of this difficult area using local tissues. Both unilateral and bilateral use of this flap is described. As lips often have an abundance of loose skin, especially in dogs, most lip defects can easily be reconstructed using geometric closure techniques and advancement of local tissues. Simple rectangular and wedge resections shouldn’t create a problem for veterinary surgeons but full thickness labial advancement of the lower and upper lip, buccal rotation, and labial/buccal reconstruction with transposition skin flaps are more elaborate surgical techniques. Examples of subdermal plexus flaps commonly used in the head area are the transposition flap, rotation flap and advancement flaps. Especially the latter one is very commonly used. The three axial pattern flaps that can be used for the reconstruction of large facial defects are the facial artery, superficial temporal, and caudal auricular axial pattern flaps, all of which will be discussed in this lecture.

Modified nasal rotation flap

This flap for nasal tip reconstruction was described recently whereby a crescentic perialar skin excision is made to enable advancement of the skin of the cheek towards the nose. A second, triangular excision is made on the contralateral side of the defect to prevent a dog-ear upon closure of the defect. Upon closure, the sutures are placed in the alar and alar-labial groove, yielding the excellent cosmetic appearance of the flap in people. A modification of this flap was successfully performed in a dog with a large rostral nasal defect.

Full thickness labial advancement flap

This technique is used to close rostral defects of the lower lip. The inferior labial artery and vein provide the blood supply to the lower lip and should be preserved. The lower lip is easier to mobilize than the upper lip. As a result, the skin incision required for rostral advancement is only a few centimeters, even in large defects. The labial advancement flap for the upper lip entails complete elevation of the entire thickness of the upper lip to maximize its advancement into rostral labial defects. The blood supply is dependent on the superior labial artery and vein. When necessary, the flap can be combined with partial maxillectomy. Retraction of the flap can cause unilateral distortion of the nasal planum, but this usually subsides over 1-2 weeks.

Buccal rotation

The full-thickness buccal rotation flap is a variation of the labial advancement flap. It is primarily indicated after resection of large parts of the upper lip. The buccal rotation technique will advance the labial commissure rostrally which may result in mild facial asymmetry.
Advancement flap
One of the easiest and most versatile flaps is the U-flap. The U-flap’s viability is based on the subdermal plexus. The flap can be created in the area of the frontal sinuses, between the ears and even extend caudally towards the neck to create a flap that can be advanced towards the nose.

Facial artery axial pattern flap
The facial artery axial pattern flap can be used to cover defects involving the rostral and lateral nasal regions and the maxilla. The base of the facial artery axial pattern flap is located at the commissure of the lip. Hence, the flap is perfused by the superior and inferior labial arteries. The caudal border of the flap is defined by the lateral aspect of the atlas. Sufficient skin is usually harvested however with the flap extending to the level of the vertical ear canal, which also reduces the risk of necrosis of the tip of the flap. The lateral borders of the flap are the caudal mandible ventrally and the ventral aspect of the zygomatic arch dorsally.

Superficial temporal axial pattern flap
The vascular supply consists of a cutaneous branch of the superficial temporal artery. The subdermal plexus that lies both superficial and deep to the frontal muscle is incorporated in the flap. The flap is used to cover defects involving the maxilla and the maxillofacial area (lateral side of the nose). The anatomic boundary of the base of the flap is determined by the lateral orbital rim. The width of the flap is limited rostrally by the eye and caudally by the ear. Hence, the width of the flap is equal to the length of the zygomatic arch.

Caudal auricular axial pattern flap
The caudal auricular axial pattern flap is used to reconstruct defects in the neck and caudodorsal part of the skull including the dorsal and ventral orbital area. The base of the caudal auricular axial pattern flap is centered over the lateral wing of the atlas. The branches of the caudal auricular artery and vein are directed caudodorsally. The caudal auricular artery is located approximately 1 cm caudal to the base of the scutiform cartilage of the auricle. This flap is also known as the platysma myocutaneous flap.

References
Cosmetic and reconstructive surgery of the neck and thorax

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Introduction

Reconstruction of skin defects in the neck or thoracic area is usually relatively easy in dogs and cats, because of their considerable amount of loose skin in this area. In most cases defects can be closed using local skin flaps. The axial pattern flaps that can be used for the reconstruction of large defects in the neck or trunk area are the omocervical, thoracodorsal, and the cranial and caudal superficial epigastric flaps. The muscle and myocutaneous flaps that can be used for this area include the external abdominal oblique and the cutaneous trunci and lattisimus dorsi myocutaneous flaps. The forelimb fold transposition flap technique is a versatile flap than can be used for defects of the upper arm or sternal region.

Thoracodorsal axial pattern flap

Thoracodorsal axial pattern flaps can be developed to cover defects involving the shoulder, forelimb, elbow axilla, and thorax in the dog and cat. The thoracodorsal axial pattern flap is based upon the cutaneous branch of the thoracodorsal artery and associated vein, which arborizes in a dorsal direction behind the scapula. The cranial boundary of this flap is the spine of the scapula. The caudal boundary is the skin parallel to the cranial incision, equal to the distance from the cranial incision to the caudal shoulder depression. The incisions are made to the dorsal midline, but can be extended to the contralateral side. A standard peninsular or hockey stick configuration can be created, depending on the location and size of the defect.

Cranial superficial epigastric flap

The cranial superficial epigastric axial pattern flap can be used to close large sternal skin wounds after tumour resection or injury. The flap is based on the cranial superficial epigastric artery. Depending on the size of the patient, the base of the flap is located in the region of the cranial epigastric vessel, entering the skin lateral to the abdominal midline and a few centimeters caudal to the cartilaginous border of the ventral thorax. The flap may include mammary glands three, four, and possibly, five. In the male, the end of the flap must be cranial to the prepuce to enable closure of the donor site and minimize necrosis of the flap. The midline of the abdomen serves as the central border of the flap, whereas the distance from the midline to the mammary teats serves as the reference of measurement for the lateral incision. The flap can be either peninsular or island by design.

Caudal superficial epigastric flap

The caudal superficial epigastric axial pattern flap can be used to cover skin defects on the medial and lateral aspect of the pelvic limb, caudal abdomen, flank, inguinal area, prepuce and perineum. In a female patient the mammary glands are included. The surgeon should keep in mind that mammary tissue in the female dog remains active until the dog is ovarioectomised. If the procedure is performed on a male patient, the base of the prepuce must be included, to prevent ischemia of the flap. The preputial branch of the superficial epigastrical vein must be ligated.

External abdominal oblique muscle flap

The external abdominal oblique muscle flap can be used to close full-thickness wall defects in the abdominal or caudal thoracic wall. The oblique abdominal muscle consists of two parts: the costal part arises
from the 5th to the 13th rib, and the lumbar part from the 13th rib to the thoracolumbar fascia. The aponeurosis of the muscle inserts on the linea alba and its fibers are directed caudoventrally. The neurovascular pedicle exists of branches of the cranial abdominal artery, the cranial hypogastric nerve and a satellite vein. This pedicle must be preserved when the lumbar external abdominal muscle flap is pivoted into the thoracic or abdominal wall defect.

**Cutaneous trunci myocutaneous flap**

The cutaneous trunci flap is a compound flap that can be used to close full-thickness defects on the trunk as well as large wounds on the thoracic limb. The landmarks for the cutaneous trunci myocutaneous flap are: the ventral border of the acromion, the caudal border of the triceps muscle, the head of the 13th rib and the axillary fold. The dorsal flap border is drawn from a point ventral to the acromion caudal to the border of the triceps muscle, towards the last rib. The ventral border is parallel to the dorsal border, starting in the axillary skin fold.

**Latissimus dorsi myocutaneous flap**

The latissimus dorsi muscle originates from the thoracolumbar fascia of the thoracic and lumbar spinous processes and from muscular attachments to the last two or three ribs. The most prominent artery is the branch emerging from the fifth intercostal space entering the latissimus dorsi muscle. This artery is responsible for a great deal of perfusion of the middle part of the muscle. Intercostal arteries also supply segmental branches of the dorsal portion of the latissimus dorsi muscle and overlying cutaneous trunci muscle. The landmarks for the latissimus dorsi myocutaneous flap are the ventral border of the acromion, the caudal border of the triceps muscle, the head of the 13th rib and the axillary skin fold.

**Forelimb fold transposition flap**

The forelimb skin fold, loosely overlying the triceps musculature, can be elevated as a transposition flap and used to close skin wounds in the adjacent axillary, thoracic and sternal area of the dog and cat. The forelimb skin fold is grasped to determine the amount of skin that can be harvested as a skin flap. Symmetrical lateral-medial skin incisions are outlined with a marking pen where the folds can still easily be compressed with the fingers without compromising closure of the donor site. Incisions are connected in a U fashion, proximal to the elbow after which the flap is carefully undermined, elevated, opened and transposed into the desired destination.

**References**