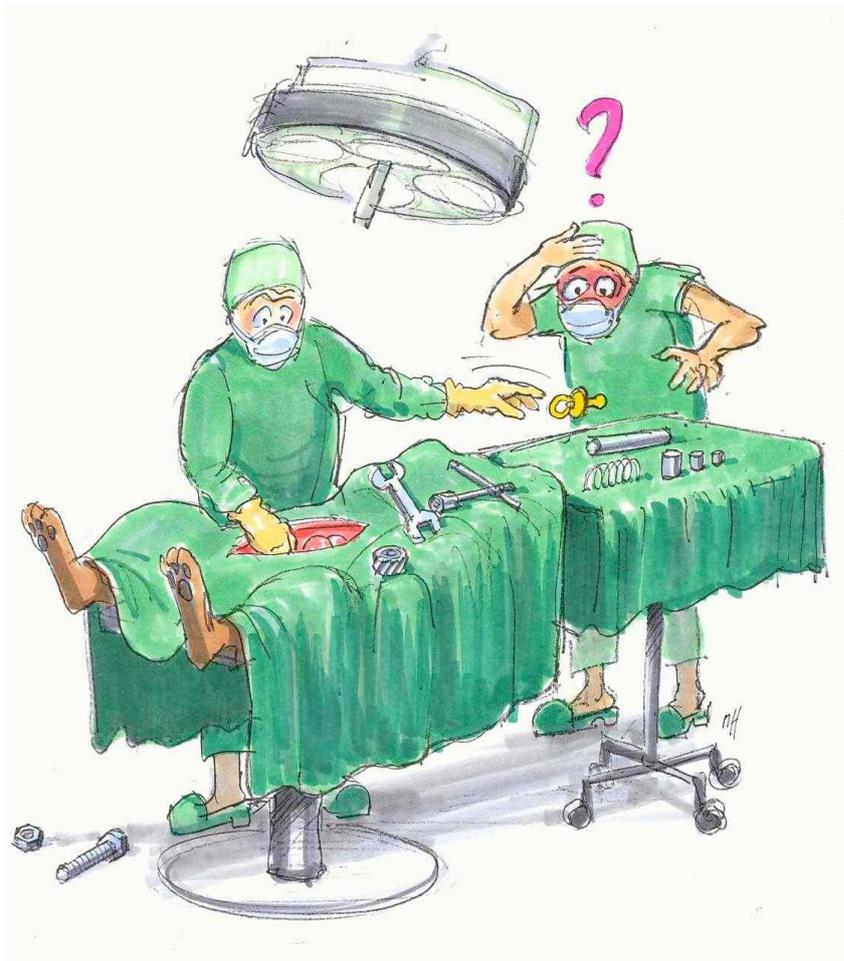


Handout

Advanced Course in Small Animal Soft Tissue Surgery



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Time planning

Schedule Day 1:

0900	Welcome		JN
0910	Skin surgery part: axial pattern flaps and grafts	Theory	DK
0945	Upper airway surgery	Theory	DK
1015	Lower airway surgery	Theory	DK
1045	Break		DK
1100	Surgery of the head 1: ears	Theory	DK
1145	Surgery of the head 2: Glandulas, thyroidea, oncosurgery	Theory	DK
1215	Lunch		
1315	Organisational remarks for the practical exercises		
1330	Ex 1: Skin graft Ex 2: Nares/palatum Ex 3: TECA-LBO Ex 4: Removal Gl. mandibularis	Practicals Practical (if there is time)	All All
1600	Break		
1615	Cases	Interactive	DK
1700	End of day 1		

Schedule Day 2

0900	Urogenital surgery in dogs and cats	Theory	DK
1000	Perineal hernia	Theory	DK
1030	Break		
1045	Surgery of the gastrointestinal tract	Theory	DK
1145	Other important surgeries in the abdominal cavity (nephrectomy, splenectomy, hernia repair)	Theory	DK
1215	Lunch		
1315	Organisational remarks for the practical exercises		
1330	Ex 4: Obturatorius flap Ex 5: Splenectomy Ex 6: Nephrectomy Ex 7: Gastropexy Ex 8: Enterectomy Ex 9: Anal sac removal	Practicals Practical (if there is time)	All All
1615	Break		
1630	Cases		DK
1700	End of day 2		

1 Skin surgery

1.1 Introduction

Reconstructive surgery on the skin is necessary after trauma due to vehicles, thermal injury or after vast excision of tumors. The latter is especially demanding, as many oncology surgeries ask for large margins free of tumor cells. The main surgical problems associated with the above mentioned problems are the lack of healthy tissue and excessive tension during wound closure, which may result in vascular compromise, wound dehiscence and skin necrosis.

It may be wise to consult a surgical textbook before large amounts of skin are removed. Many oncologic procedures demand a good planning. It is even possible, to stretch the skin 1-2 days before surgery with stay sutures. The gain of tissue will help during closure. Standard skin reconstruction methods are the tension relieving incisions, the local subdermal flaps, the local axial pattern flaps, the distant pedicle flaps and the skin grafts. If ever possible, the easiest method to close a skin defect is chosen.

As a definition, flaps are nourished by their original blood supply. Special interest is therefore given to the local vascular anatomy and a gentle handling of the pedicle. Grafts are dermal tissues, which are freed from their blood supply and any subcutaneous tissue. They rely on the recipient bed, from which they receive a new vascular ingrowth and nourishing.

1.2 Tension relieving techniques

Tension relieving procedures are performed to reduce tension in wounds, which do not require any other reconstructive procedures. Good examples are a midline palatal defect (only mucosa) or an surgical procedure on the tarsal or carpal region. As the primary wound may be difficult to close, parallel incisions are made along the dental arcade or a couple of centimetres from the access to the surgical site. The primary wound is then closed without tension, whereas the relieving incision may heal by secondary intention.

A Z-plasty is also a very effective technique to release tension adjacent to an incision or to increase the length of skin along linear scars across curved flexor surfaces. A „Z"-shaped incision is drawn onto the skin with equal length and angles

of 60 degrees to the central limb. The lengthening will take place in direction of the central limb. The skin and the two triangular shaped flaps are undermined. The triangles are then transposed into the opposing donor beds. Subcutaneous tissue and skin are sutured with an interrupted suture pattern.

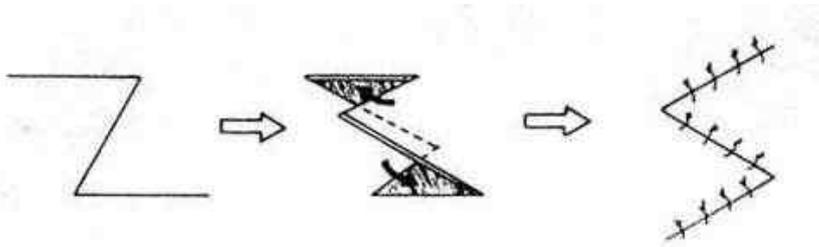


Figure 1: Z plasty, length gain along the middle axis

1.3 Local skin flaps

Skin flaps offer a reconstructive method without the undesirable effect of second intention healing. The vascular supply for the flaps comes from the deep or subdermal plexus of the skin. It has its normal limits, when the flap is too long or the flap is rotated more than 90 degrees. Flaps relying only on the subdermal vessel have their limits and are not appropriate for large skin wounds and defects involving the lower extremities. According to the method of transfer they can be classified as advancement, rotation and transposition flaps.

1.3.1 Advancement flap

The skin flap is moved forward into the defect without lateral movement. This technique is mostly used in square or rectangular wounds. The base of the flap should always be larger than the tip, and is should be made larger than the defect. An alternative to the advancement flap is the H-plasty, where two single advancement flaps from each side of the wound are used to close it.

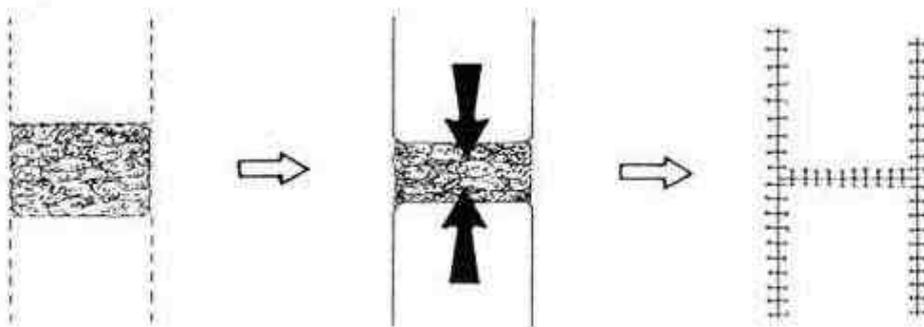


Figure 2: Double advancement flap; H-plasty

1.3.2 Rotation flap

A rotation flap is semicircular pedicle flap, commonly used to close triangular defects. It is used in the region of the elbow/thorax and stifle joint and on the head.

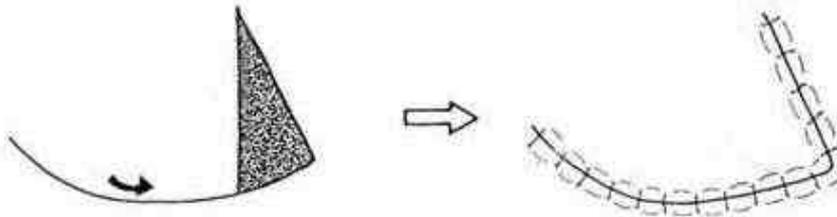


Figure 3: Rotation flap

1.3.3 Transposition flap

Transposition flaps demand good planning and preoperative marking on the skin (special pen). The donor site is a region with abundant skin (e.g. thoracal oder abdominal region). The flap is elevated directly adjacent to the defect, which means that he has a common border with the area to be covered. The maximal angle at the pivot point is 90 degrees. The recipient area and the donor bed are primarily closed with subcutaneous and skin sutures. In areas with large undermining, a drainage may be necessary.

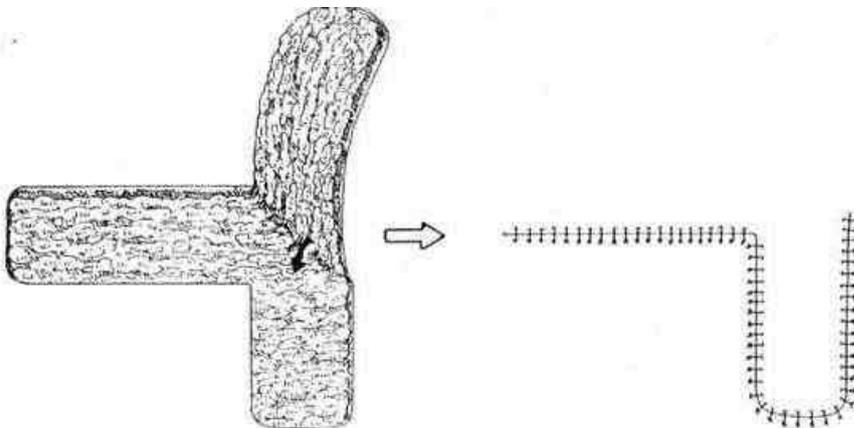


Figure 4: Transposition flap

1.4 Axial pattern flaps

Portions of skin are nourished by a direct cutaneous artery, which allow the surgeon to transfer large skin segments in a single stage. The following axial pattern flaps have the potential to be used in clinical settings:

Omcervical axial pattern flap

Thoracodorsal axial pattern flap

Superficial brachial axial pattern flap

Caudal superficial epigastric axial pattern flap (caudal part of the mammary complex)

Cranial superficial epigastric axial pattern flap (cranial part of the mammary complex)

Deep circumflex iliac dorsal axial pattern flap

Deep circumflex iliac ventral axial pattern flap

Genicular axial pattern flap

Reverse saphenous conduit flap

Caudal auricular axial pattern flap

The vessel (pedicle) has to be identified during elevation of the donor portion. In contrast to the subdermal flaps, the axial pattern flaps may be longer, because the main artery is also transposed to the recipient site. Therefore, some of the axial pattern flaps have the potential to be used on extremities (e.g. caudal and cranial superficial epigastric axial pattern flap).

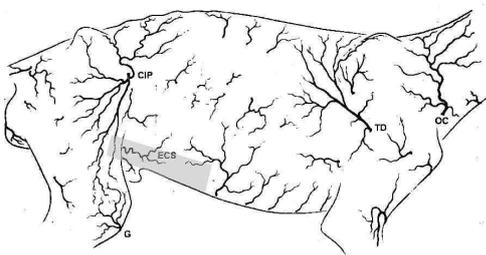


Figure 5: The caudal superficial epigastric pedicle flap is commonly used to cover defects involving the caudal abdomen, flank, inguinal area, prepuce, perineum, thigh and the rear limb. In cats the flap may reach down to the tarsal area. The flap includes the last three or four mammary glands, which remain functional. Ovariohysterectomy is recommended in female animals.

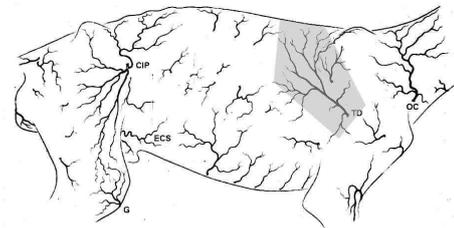


Figure 6: The thoracodorsal pedicle flap is commonly used to close defects involving the shoulder, forelimb, elbow, axilla and thorax.

1.5 Skin grafts

A graft is a portion of epidermis and dermis completely removed from the body (thoracic or abdominal skin) and transferred to a recipient site. It is dependent on revascularisation from the recipient bed. Therefore all subcutis has to be removed (full thickness graft) or only parts of the dermis (split thickness grafts) are used in order to achieve adherence, plasmatic imbibition and later inosculation, which have to take place to keep the graft viable at the beginning. Finally vascular ingrowth from the recipient bed leads to stable adherence and nutritional supply of the graft.

Grafts are demanding procedures and need experience. They are used, where a flap is not feasible. As a first premise, the recipient area must be clean, free of debris, healthy and covered with granulation tissue. Then the graft must be harvested with caution and prepared accordingly. It can be extended by making small stab incisions (mesh graft). After placing the graft and a possible drainage, a bandage covers the surgical site for 5 days. Only then, the first bandage change is undertaken. Grafts need weeks to months for full adherence and survival.

Seed grafts are small portions of dermis, harvested with a biopsy punch. They are prepared as above and placed into small pockets in the recipient area. The seed grafts may be secured with single sutures. They grow and cover the whole area completely with skin after a couple of weeks.

2 Respiration tract surgery

2.1 Brachycephalic syndrome

The division of dogs into dolichocephalic, mesocephalic and brachycephalic is based on skull measurements from German and American authors. A new S-index was introduced in 2005 by a group of Swiss researchers. The S-index describes the nasal skull to cranial skull relation. It is easily determined on radiographs. Dogs with S-index lower than 1.25 are considered to belong to a brachycephalic breed. The following breeds are typical representatives for brachycephaly: Chihuahua, Bulldogs, King Charles Spaniel, Maltese, Pekingese, Miniature Pinscher, Shi Tzu, Yorkshire Terrier and Boxer. Recent investigations from a Swiss Historical Museum show, that the S-indices in all of these breeds have been reduced over the last 100 years.

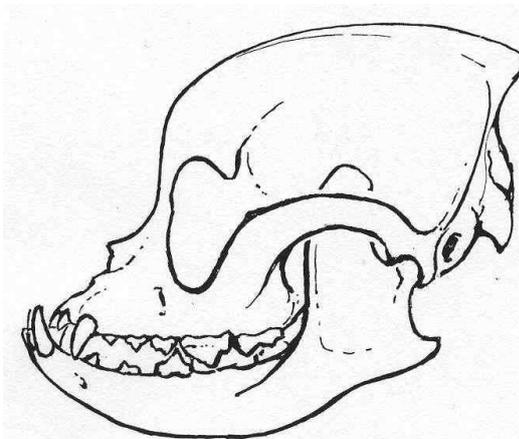


Figure 7: Typical skull from a brachycephalic dog

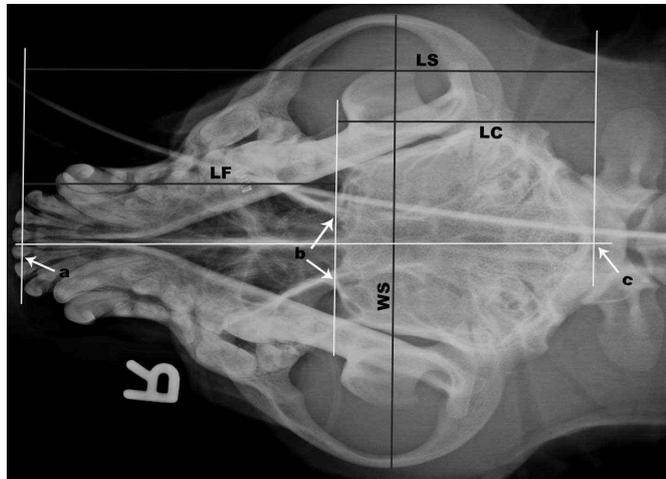


Figure 8: Skull measurements to identify the S-Index (LF/LS)

It is obvious to take the shortened nose of brachycephalic breeds as a starting point for explanation. Human efforts in breeding dogs have changed the anatomy of the respiratory tract, which led to an increased resistance during inhalation. The main obstructions are seen at the narrowed nostrils and the endoturbinalia. In order to obtain sufficient oxygen, laboured breathing leads to increased negative pressure in the upper airways. With this negative pressure, the soft tissues are drawn into the lumen and become hyperplastic or natural openings, as the larynx, may collapse. The secondary manifestations of the brachycephalic syndrome, such as prolonged soft palate, everted laryngeal sacculles, narrowed rima glottidis or the collapse of the cartilaginous respiratory tract constrict the lumen even more.

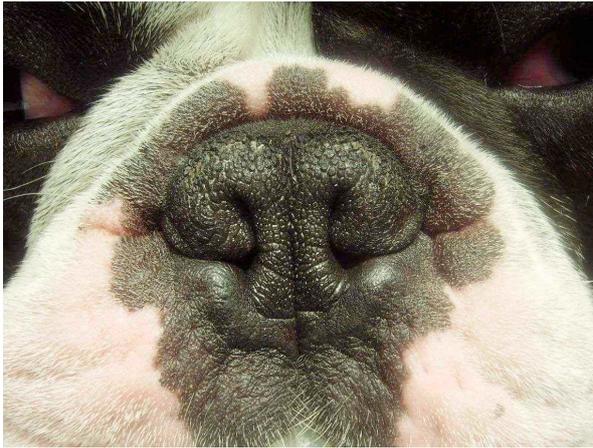


Figure 9: Narrow nostrils in a brachycephalic dog

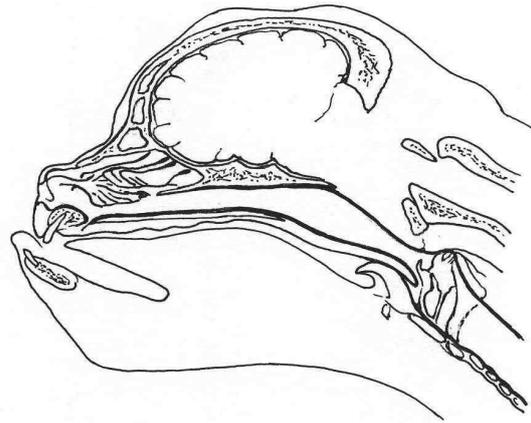


Figure 10: Sagittal view through the skull of a brachycephalic dog. The soft palate is too long

Affected dogs suffer from stress intolerance, and pant even after short exercises. Panting is the airway passage through nose (inspiration) and mouth (expiration) in order to get rid of a surplus of heat, transported by a humidified air. As this procedure is impeded in brachycephalic dogs due to their short nose, they may have increased body temperature in summer even minimal physical activity. The stridor is generated in the narrow nostrils. The prolonged soft palate audibly flutters in the inspired air producing a stertor. It is heard mainly during sleeping periods, when the pharynx collapses. The overlong soft palate may even be trapped into the larynx, causing asphyxia. Dyspnea and heat problems only lead to death, if the dog is forced to intensive exercise. However, severely affected animals undergo a vicious circle, which constrains their normal activity more and more.

Diagnosis and therapy are normally executed in the same anesthesia due to obvious risks in the postanesthetic period. The widening of the stenotic nostrils is the most important step. This should prevent secondary changes such as the protrusion of soft tissues of the nasopharynx or the collapse of the larynx and the trachea. The procedure consists of removing a deep triangle of the wings of the nostrils and of the plica alaris. As a general rule, a No 11 blade should be inserted fully into the nose. Bleeding is heavy and is stopped temporarily with Q-tips. The wound edges are adapted with a non-absorbable thread. By this procedure, the clinical signs should considerably improve. An alternative way is to remove parts of the nostrils and some endoturbinata with a laser.

An elongated soft palate should be shortened with scissors to the correct length, in order to prevent interference with the epiglottis. It is sutured with a non-absorbable suture material. For the correct length, the tip of the epiglottis or the middle of the tonsils can be given as the caudal landmark. The shortening of the soft palate can also be performed by a laser technique. After widening of the nostrils and shortening

of the soft palate the prognosis is generally quite good. The everted laryngeal sacculles are cut off with long scissors.

Instructions for the exercise:

Stenotic nares:

1. Place the animal in sternal recumbency
2. Plan a deep wedge removal, including the alar fold (!)
3. Excise the wedge with a scalpel blade No 11
4. Suture the wound edges with one to three stitches
5. Control breathing of the animal over 24 hrs

Overlong soft palate:

1. Place the animal in sternal recumbency
2. Fix the endotracheal tube to the lower jaw
3. Estimate the length of the soft palate. Physiological position means, that the end of the soft palate is on the height of the tip of the epiglottis or approximately on the half of the tonsil length
4. Use long Metzenbaum scissors, forceps and a rapid absorbable suture material (eg Vicryl[®] rapid)
5. Cut the soft palate in increments and immediately suture it in a continuous pattern to control hemorrhage.
6. Alternatively, a carbon dioxide laser may be used to cut the soft palate (excellent hemorrhage control, expensive, security precautions)

2.2 Laryngeal paralysis

Laryngeal paralysis can result from isolated neuromuscular dysfunction or can be a manifestation of a generalized polyneuropathy or polymyopathy. Congenital laryngeal paralysis occurs in the Bouvier des Flandres and in Siberian Husky breeds, usually before 6 months of age. Acquired causes include traumatic injury, neuropraxia from tumors, polyneuropathy (metabolic, toxic and others) and polymyopathy (myasthenia gravis). Spontaneous laryngeal paralysis occurs most frequently in middle-aged to older large-breed dogs.

Clinical findings of laryngeal paralysis result from impairment of the three functions of the larynx and include upper airway obstruction (stridor, dyspnea, exercise intolerance, collapse, cyanosis, hyperthermia), aspiration, and altered vocalization. Diagnosis is established by laryngoscopic examination during light anesthesia. In animals with laryngeal paralysis, the rima glottidis does not enlarge during inspiration and may instead show paradoxical inward movement. Animals with laryngeal paralysis should be evaluated for concurrent neuromuscular disease, especially dysphagia or megaesophagus which greatly enhance the risk for aspiration pneumonia after surgery.

Emergency medical treatment for laryngeal paralysis consists of rest, supplemental oxygen cooling, and intravenous corticosteroids. On occasion, a temporary tracheostomy is necessary to relieve acute respiratory distress. Surgical treatment advocated for laryngeal paralysis include ventriculocordectomy, partial laryngectomy, castellated laryngofissure, and arytaenoid lateralization. The first three procedures produce inconsistent results or require much experience. The arytaenoid lateralisation is the preferred method by most surgeons. Unilateral lateralization is sufficient to relieve airway obstruction in most cases and decreases the risk for postoperative aspiration.

Technique:

1. Place the animal in lateral recumbency
2. The incision is made in the skin and subcutaneous tissue caudally from the angle of the mandible and below the jugular veins
3. The larynx is exposed by separation of the sternohyoideus and sternocephalicus muscles
4. The thyropharyngeus muscle is incised along the border of the thyroid cartilage. The cartilage is retracted laterally to expose the arytaenoid cartilage

5. The muscular process of the arytaenoid cartilage and the cricoarytaenoideus dorsalis muscle are identified. The cricoarytaenoideus dorsalis muscle is divided
6. The cricoarytaenoid articulation is disarticulated with scissors. In rare cases, the arytaenoid-arytaenoid articulation is separated
7. A 0 polypropylene suture is passed through the caudodorsal border of the cricoid cartilage and then through the muscular process of the arytaenoid cartilage. The suture is tied to abduct the arytaenoid cartilage.
8. The thyropharyngeus muscle is closed with 4-0 sutures. Subcutis and skin are closed.

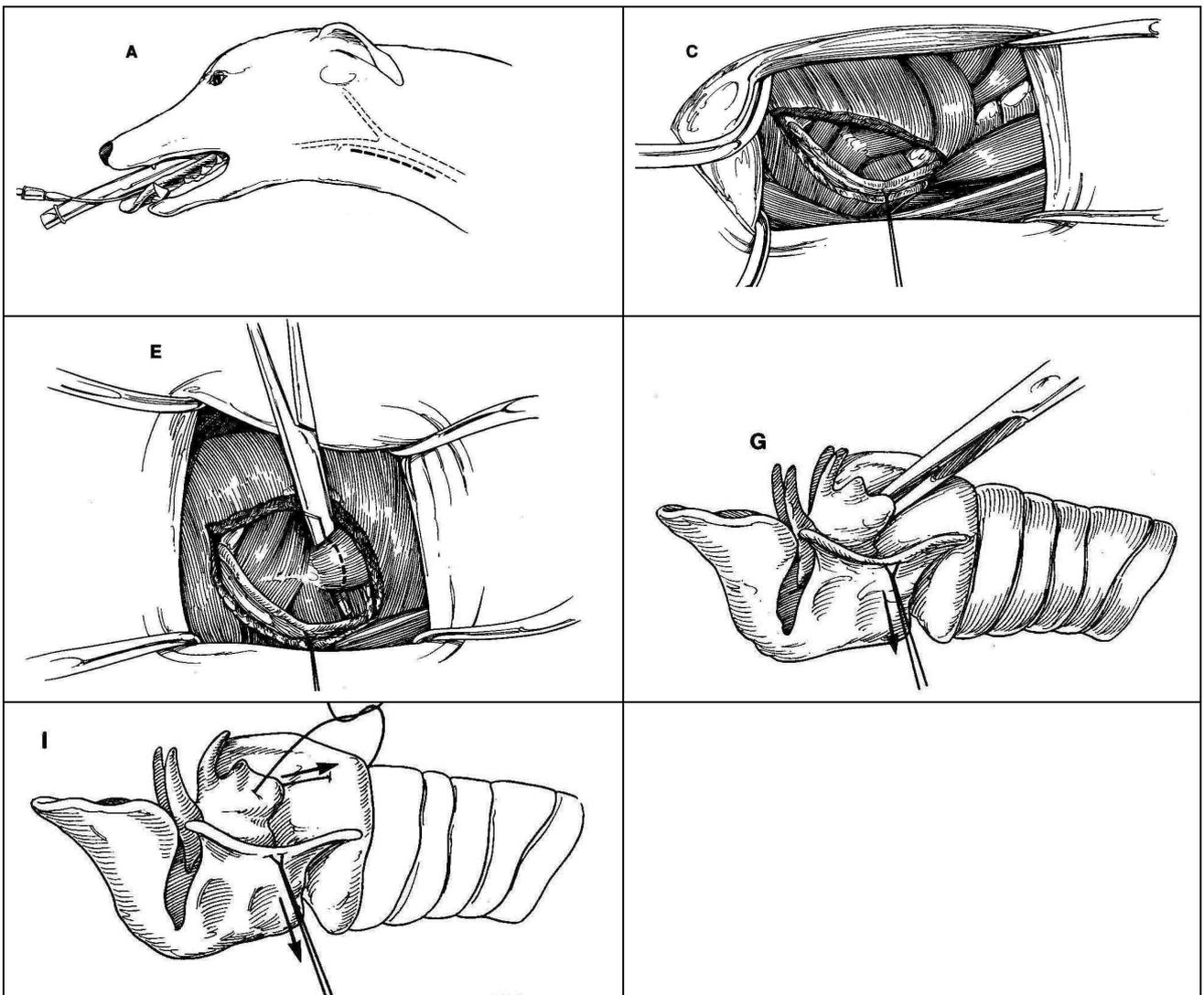


Figure 11: Surgery for laryngeal paralysis

2.3 Tracheal collapse

The trachea consists of 35- to 45 C-shaped tracheal rings. Anular ligaments connect the rings. On the dorsal side, the tracheal muscle can be found. Vascularisation are provided by the thyreoideal artery and some bronchoesophageal arteries.

Tracheal collapses are seen in toy breed dogs, mainly pomeranians, poodles, Yorkshire Terriers, Chihuahuas and pugs. The overall incidence is 0.5 %. Dogs are presented at the averaged age of 7 years with clinical problems.

A multifactorial pathophysiology is suspected in primary tracheal collapse. The cartilaginous rings and the trachealis muscle seem to be weakened due to a generalized chondrodysplasia. Causes for secondary tracheal collapsed are: heart and lung diseases, overweight, Cushing's disease, trauma to the trachea, stenosis in the upper airways (brachycephalic syndrome or laryngeal paralysis). They all force the body to a increased negative pressure in the upper airways. during inspiration. As a result, the lumen in the trachea is further narrowed. Tracheal collapse can be split into 4 degrees, each step meaning 25 % less lumen. According to the pressure conditions during expiration and inspiration, the intrathoracical trachea may collapse during expiration and the extrathoracical trachea during inspiration.

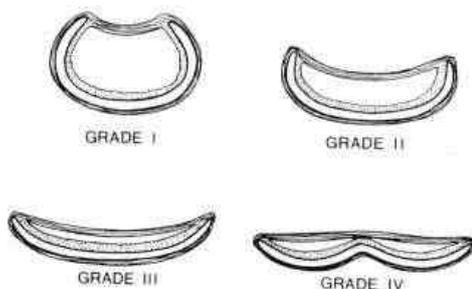


Figure 12: Different degrees of tracheal collapses

The predominant clinical signs of tracheal collapse are coughing and dyspnea, accompanied by different sounds from the respiratory tract (stridor). Coughing is elicited by gentle palpation of the trachea. Physical performance is reduced. In rare cases, the dogs become cyanotic.

The clinical signs are very typical. Radiographs or fluroscopy taken during inspiration and expiration may demonstrate the collapse. However, tracheobronchoscopy is the gold standard for diagnosis.

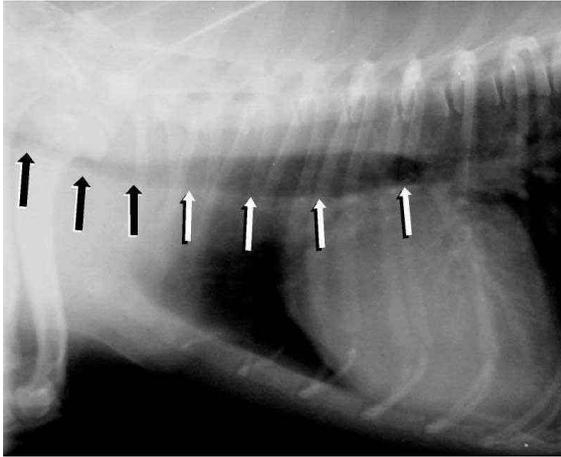


Figure 13: Radiograph demonstrating collapse of the extrathoracic trachea (black arrows, from wikipedia.com)

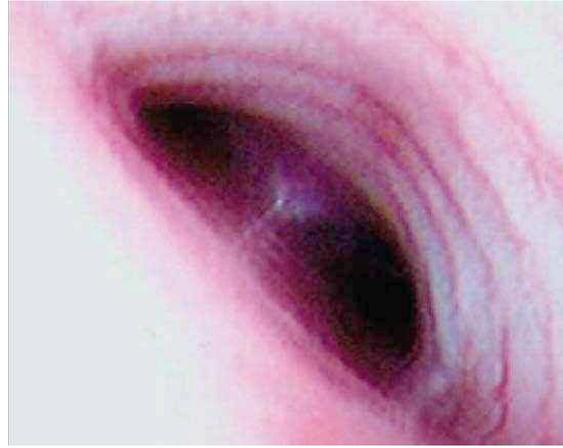


Figure 14: Tracheobronchoscopic view of a collapsing trachea (from Payne et al., Compendium, 2006)

Before surgical correction is performed, all predisposing factors should be detected and corrected (e.g. brachycephalic syndrome), because all procedures carry a certain risk. Conservative treatment consists of antitussiva, antibiotics, bronchodilators, weight reduction, reduction to smoke exposure and avoidance of neckbands. In 65-80 % of all cases, these measures are successful. Candidates for a surgical treatment are dogs with degrees 3 and 4 and those with unsuccessful medical therapy. There are three possible solutions: (1) The plication of the trachealis muscle, which is a rather simple procedure with a certain tendency for recurrence of the clinical signs. (2) A extraluminal prosthesis can be fixed to the trachea as multiple single rings (distance of 6-8 mm) or as a spiral device. It is sutured to the tracheal cartilages with some non absorbable stitches, leaving enough blood supply. The success rate is reported to be quite high (75-85 %) in extrathoracic collapses. (3) Endoluminal stents have been adopted from the human biliary surgery. Initially, the complication rate was extremely high because of constant coughing, infection, migration or break of the stent. Today, the very long Schneider-Wallstent is regarded as the best option. It is placed under tracheoscopic guidance and is self expanding to a large and constant diameter. The tracheal mucosa grows into the metallic grid and holds it in place.

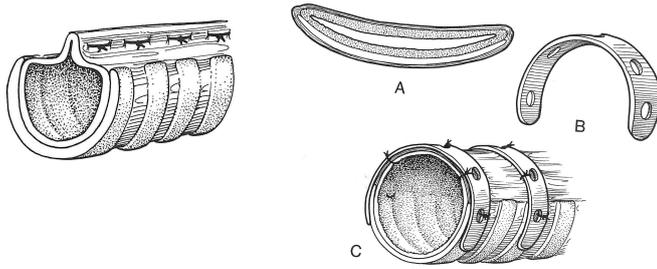


Figure 15: Plication of the trachealis muscle (from Slatter D, Textbook of small animal surgery, 2003)

Figure 16: Extraluminal prosthesis with interrupted rings (from Slatter D, Textbook of small animal surgery, 2003)



Figure 17: Intraluminal Schneider-Wallstent (from Payne et al, Compendium, 2006)

2.4 Thoracotomies and lobectomies

Thoracotomy may be performed by incising between the ribs (intercostal thoracotomy) or by splitting the sternum (sternotomy). The approach used depends on the exposure needed and underlying disease process. A lung lobectomy is best performed through an intercostal thoracotomy. If further exposure is needed a rib can be resected either cranially or caudally the original incision (rib resection thoracotomy). This improves visibility by about 33%. Also the incision can be extended over the sternum (transsternal thoracotomy) which has the same effect. The ribs displace easier cranially, therefore the incision should be rather caudally than cranially the recommended intercostal space.

Thoracic structure	Intercostal Space	
	Left	Right
Heart and pericardium	4, 5	4, 5
Ductus arteriosus	4 (4, 5 cat)	
Pulmonic stenosis	4	
Pericardectomy	5	5
Cardiopulmonary bypass	4, 5	4, 5
Lungs	4-6	4-6
Cranial lobe		4, 5
Intermediate lobe		5
Caudal lobe	5, 6	5, 6
Esophagus		
Cranial	3, 4	3-5
Caudal	7-9	7-9
Caudal vena cava		7-9
Thoracic duct		
Dog		8-10
Cat	8-10	

Figure 18: Recommendations for the selection of the approach to the thoracic structures

Example: Intercostal thoracotomy at the 4th intercostal space

A) Locate the approximate intercostal space and sharply incise the skin, subcutaneous tissues, and cutaneous trunci muscle. The incision should extend from just below the vertebral bodies to near the sternum. Deepen the incision through the latissimus dorsi muscle with scissors. Verify the correct intercostal space by palpating the first rib.

B) Transect the scalenus (attaches at the 5th rib) and pectoral muscles with scissors perpendicular through their fibers, then separate the muscle fibers of the serratus ventralis muscle at the selected intercostal space.

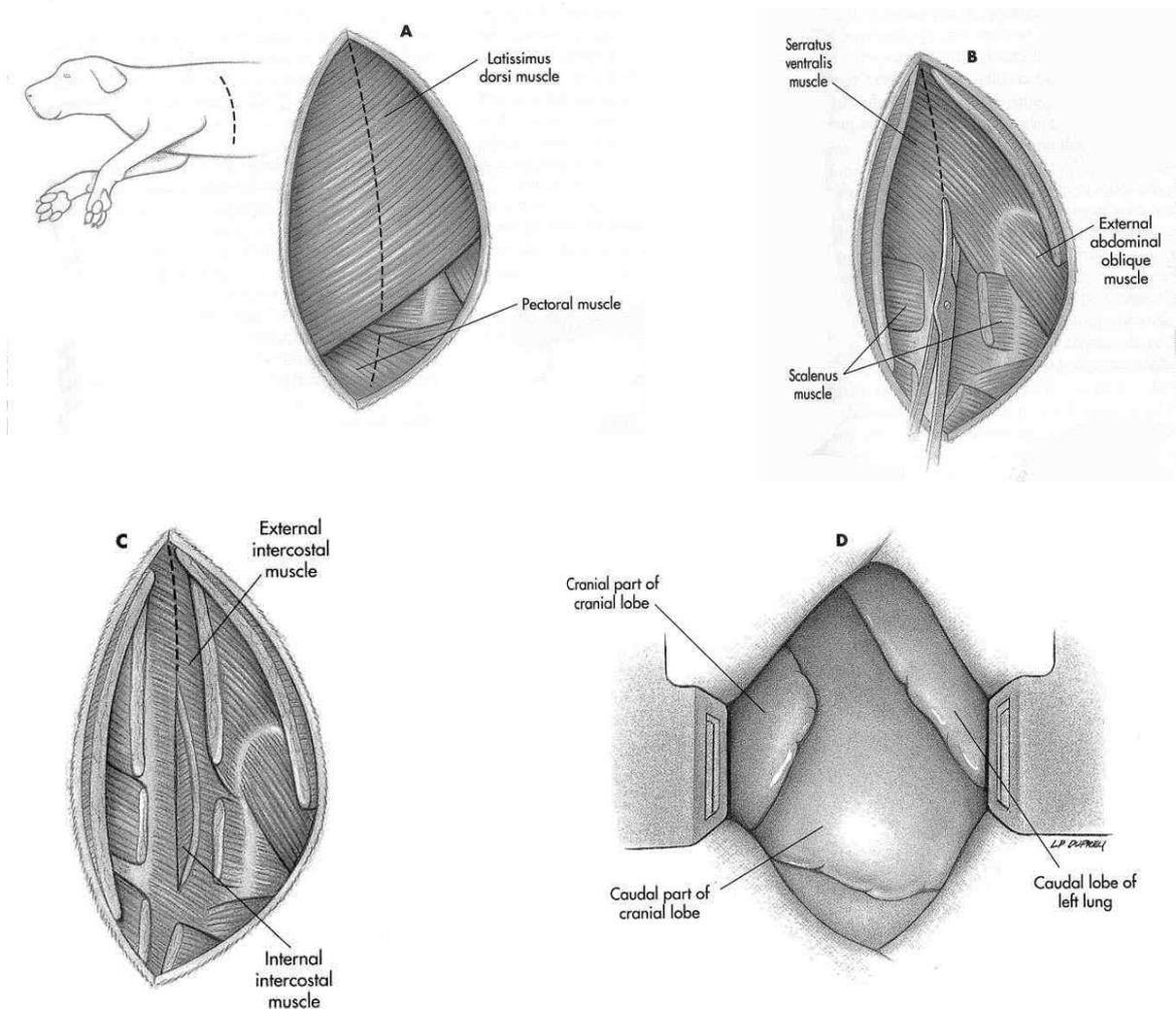


Figure 19: A-D, Approach to the thorax (from Orton, Small Animal Thoracic Surgery)

C) Near the costochondral junction, place one scissor blade under the external intercostal muscle fibers and push the scissors dorsally in the center of the intercostal space to incise the muscle. Incise the internal intercostal muscle similarly.

After identifying the lungs and pleura use closed scissors or a blunt object to penetrate the pleura. Extend the incision dorsally and ventrally to achieve the desired exposure. Avoid incising the internal thoracic vessels near the sternum.

D) Use a Finochietto retractor to spread the ribs.

Example: Complete lung lobectomy

Indications:

- Neoplasia
- Lung lobe torsion
- Abscesses
- Spontaneous pneumothorax (Bullae/Blebs)
- Severe traumatic injury

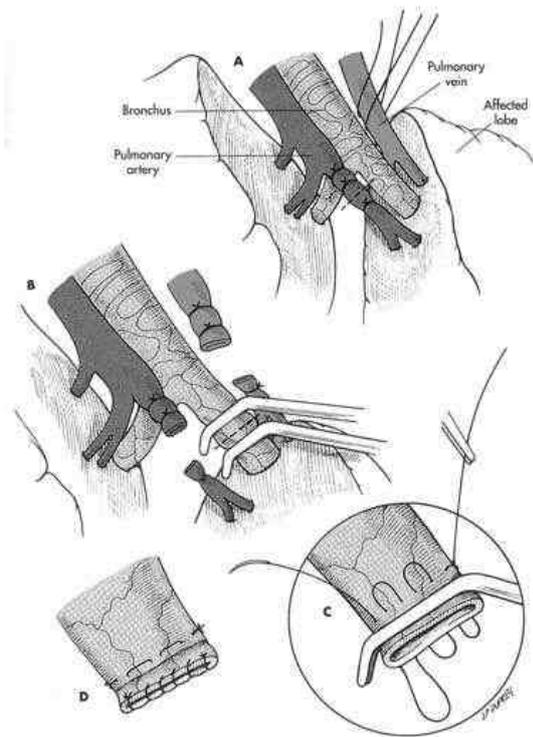


Figure 20 : A-C, Lobectomy (from Orton, Small Animal Thoracic Surgery)

Procedure:

A) Identify the affected lobe and isolate it with moistened sponges. Blunt dissection of the vessels should be parallel not perpendicular to the long axis of the vessels. The pulmonary artery is exposed and divided first by retracting the lung lobe ventrally

and caudally. The vein is then exposed and divided by retraction of the lobe dorsally and cranially. All vessels are triple ligated with silk.

B) After the vessels are divided, the lobar bronchus is clamped with a noncrushing tangential clamp and divided approximately 3mm distal to the clamp.

C) The bronchial stump is closed with 4-0 suture in continuous mattress pattern. The suture ends are „tagged“ with forceps, the clamp is removed, and the bronchial stump is oversewn with a continuous pattern. Fill the chest cavity with warmed, sterile saline solution. Inflate the lungs and check for air leaks. Place a chest tube remove all the sponges and close the thorax.

Closure:

1) Rib closure is accomplished by preplaced heavy-gauge interrupted circumcostal sutures passed bluntly through adjacent intercostal spaces.

2) The serratus ventralis and scalenus muscles are closed in a single layer. The latissimus dorsi, cutaneous trunci muscle and subcutaneous tissues, and skin are closed in separate layers.

3 Surgery of the ears

3.1 Anatomy

The outer ear is the pinna. It consists of a cartilage with skin and a lot of vessels. At the region of the helix, the ear channel begins. It runs down in vertical, then horizontal direction. It is lined up with a cutaneous epithelium, hair and cerumen producing glands. The corresponding cartilages are called cartilago auricularis and cartilago anulare. At the end of the channel, the tympanic membrane closes the outer ear. Around the ear, the glandula parotis can be found, together with the facial nerve, which crosses ventral to the anular cartilage.

The bony part of the middle ear is called cavum tympani. It has two chambers. In cats, it is separated by a septum. The bigger ventral part is a sonic amplifier. The medial part carries the bones for the direct sound transmission (hammer, incus, stapes) from the tympanic membrane to the vestibular foramen at the entrance to the inner ear. The tympanic nerve crosses the bulla. The Eustachian tube connects the middle ear with the nasopharynx and regulates pressure differences.

The vestibular organ is located in the inner ear. It transforms the sound into neurosignals. It does not play an important role in surgery.

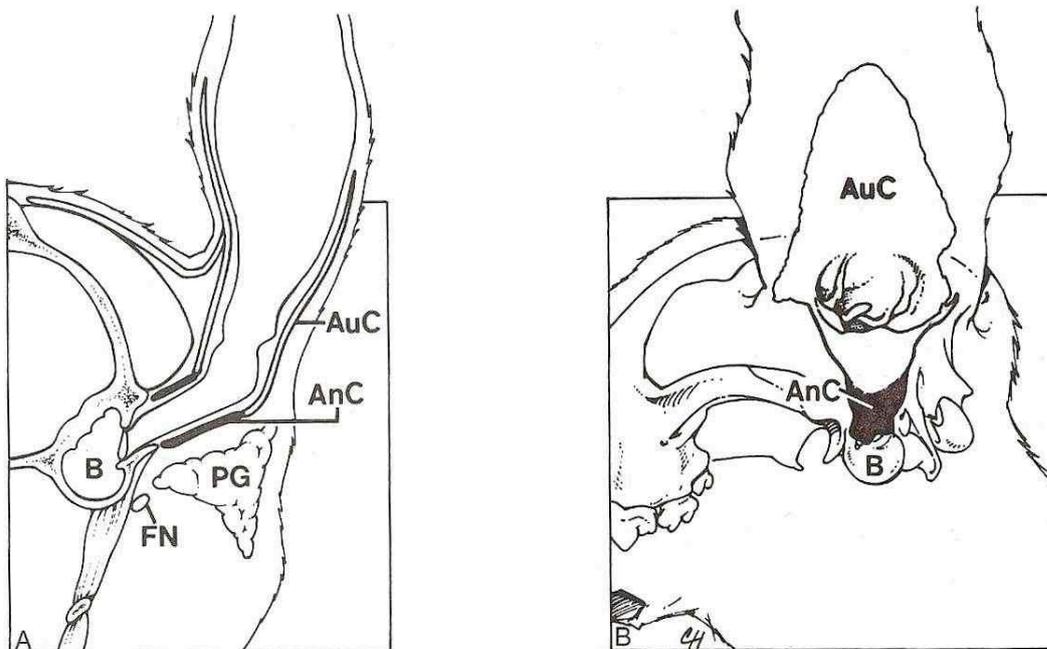


Figure 21: Scheme of the canine ear (B = bulla; FN = facial nerve, PG = parotid gland; AnC = anular cartilage; AuC = auricular cartilage), from Slatter D (2003), textbook of small animal surgery

3.2 Otitis externa

Inflammations of the outer ear channel occur in 10-20% of all dogs and 2-6 % of all cats at least once in their lifetime. There is a predisposition for poodles, cocker spaniels and fox terriers. The aetiology can be summarized under three “P”s: (1) primary factors as dermatology problems, allergies or hypothyreosis, (2) prediposition as ear form, moisture and warmth, and (3) perpetual factors as ear channel stenosis, hyperplasia, edema, infections or otitis media. Amongst the most common microorganisms, we find staphylococci, proteus, pseudomonas, streptocci, E. coli, corynebacteria or malassezia (candida).

The first clinical signs are head shaking and scratching on the ear, triggered by the pruritus. After that, the dog may not allow to touch his ears. A foul odour is noticed, followed by dry and brown to purulent discharge. With time, the ear channel gets hyperplastic and narrow, which perpetuate the signs. Deafness and facial nerve palsy are common sequels in chronic cases. Normally, the symptoms are typical. Enhanced diagnostic database include bacterial culture, otoscopy and skull radiographs, which should identify any involvement of the bulla.

The initial therapy for otitis externa is provided by an internist or dermatologist. More than 80 % of all end stage ear channel infections have one or more underlying dermatology problems such as pyoderma, atopia or hypothyreosis. Only in case of remission or severe stenosis, a surgical therapy may start. However, it should not be delayed after head tilt, because any advancement of the infection into the inner ear is associated with a guarded prognosis.



Figure 22: Middle grade otitis externa with hyperplasia



Figure 23: Otoscopic view of a chronic otitis externa, the tube is still open



Figure 24: Ruptured tympanic membrane after ascending otitis externa

The gold standard for chronic otitis externa is a total ear canal ablation together with a lateral bulla osteotomy (TECA LBO). It has been shown, that in chronic stages of the disease, the tympanic membrane cannot stop the advancement and the bulla is always affected. A TECA LBO results in a very good cosmetic outcome, because the pinna is left intact. A little bit caution is given to the facial nerve, which runs directly ventral to the anular cartilage and which may be embedded in inflamed tissue. After detaching the well prepared auditory tube, the entrance into the bulla is opened with rongeurs. The bulla is then curetted with caution to avoid damage to the nerves of the autonomic nerve system. A drainage is only set in very contaminated areas. Complications followed by a TECA LBO are temporary facial nerve palsy, Horner's syndrome (enophthalmus, ptosis, miosis, protrusion of the third eyelid), and late fistulation of not removed cutaneous tissue. The hearing is reduced after TECA LBO. However this was already the case before the intervention. Sonic waves are transmitted through the bones of the skull and allow a reduced sensitivity.

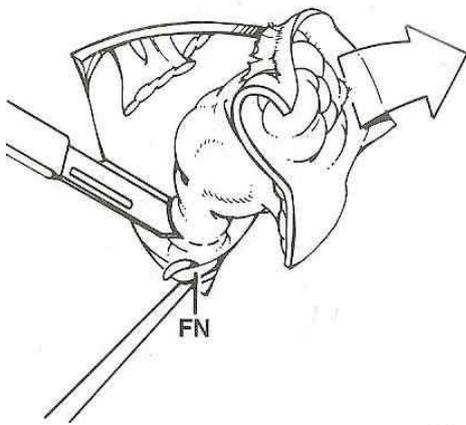


Figure 25: Detachment of the outer ear channel (left = cranial; FN = facial nerve)

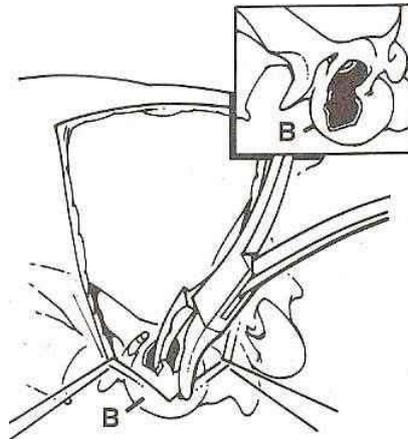


Figure 26: Opening of the bulla with rongeurs (B= bulla).

The removal of the outer ear channel alone (Zepp surgery) is not so common anymore, because it implies, that the inflammation is limited to the horizontal ear channel, which is normally treated conservatively. These candidates are presented to the surgeon, when the infection has advanced further to the depth and a TECA LBO is indicated.



Figure 27: Cosmetic appearance after TECA LBO. A drainage is only necessary with severe contamination of the bulla

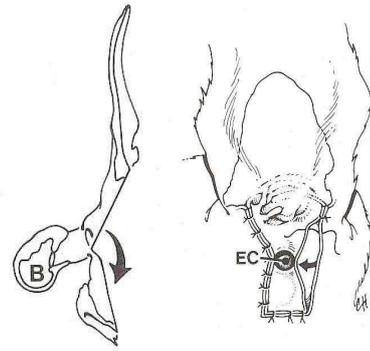
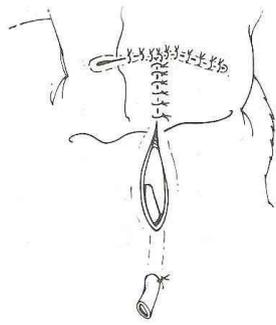


Figure 28: Scheme of the lateral ear channel ablation (Zepp), EC = ear channel

3.3 Otitis media

A canine bacterial otitis media mostly is the sequel of an otitis externa, less common after trauma or foreign body penetration through the tympanic membrane. An otitis media is treated as an otitis externa with a TECA LBO.

In cats, the situation is different. Most otitis media are caused by polyps invading from the Eustachian tube or from the outer ear channel. Polyps are seen with young cats and viral respiratory tract diseases. For a long time, the cats are asymptomatic. Then, a head tilt, Horner's syndrome or signs of air way obstructions are noticed. Polyps are detected visually or with an otoscope. The bullae are radiographed with an open mouth technique or by two angled sideviews. Affected bullae show reduced amounts of air filling and thickening of the bone.

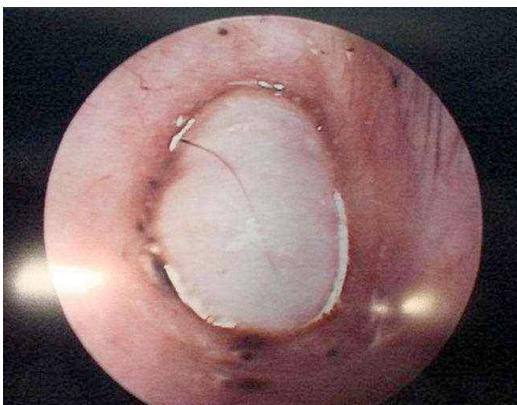


Figure 29: Otoloscopic view from the ear channel of a cat with a polyp, filling the whole tube.



Figure 30: Open mouth view displaying the bullae. The left bulla is thickened.

Polyps can be removed by gentle tracking. However, parts may remain in the ear or bulla and cause remission. Ventral bulla osteotomy is indicated with beginning neurological deficits (Horner's syndrome). The polyp is removed and the bulla is

gently curetted and flushed. A vast opening of the bulla allows granulation tissue to invade and provide fast healing.



Figure 31: Ventral bulla osteotomy in a cat, the bulla is opened, left = cranial

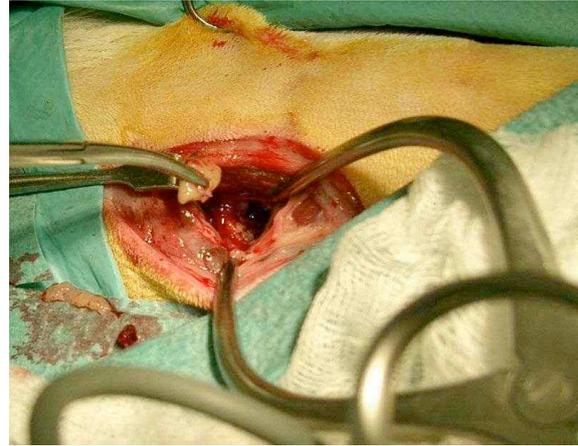


Figure 32: Removal of parts of the polyp after wide opening of the bulla

3.4 Neoplasia

Aural neoplasia is very uncommon. White cats are predisposed to squamous cell carcinomas on the pinna. The prognosis is bad, even with radical excision. Ceruminous gland adenomas are the most common tumor of the dog. It is benign in the dog, but malignant in the cat. Further neoplasia are melanoma, fibrosarcoma, mast cell tumor and basal cell tumor. Depending on the localisation, a pinnectomy or a total ear canal ablation is indicated, together with accompanying radio- or chemotherapy.

3.5 Othematome

Concepts of pathogenesis and treatment of the othematome have undergone important changes in the last years. First, it was thought, that trauma would be the etiology. Blood was evacuated regularly with cannulas or chronic othematomas were split, flushed and sutured with interrupted stitches in longitudinal direction.

Nowadays notion is, that the othematome belongs to a general skin problem. The fluid accumulation is the result of a vasculitis, which may accompany the underlying disease. Therefore, the skin problem is treated first, mostly with corticosteroids. Only in very chronic cases and with predictable deformation of the pinna, a surgical approach is indicated.



Figure 33: White cat with squamous cell carcinoma on the pinna

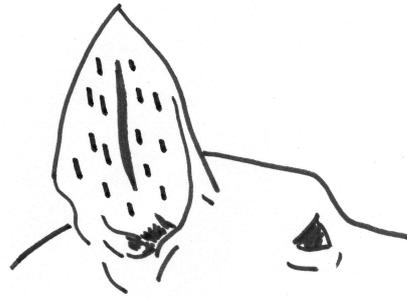


Figure 34: Surgical treatment of an otitis externa with longitudinal splitting, curettage and ligatures.

3.6 Injuries

Simple skin lacerations are sutured with some interrupted stitches. Wide lacerations with cartilage defects must be sutured in two rows including the cartilage. Losses of parts of the cartilage normally demand reconstruction techniques or reduction of the pinna. Large skin defects can be closed by suturing the ear temporarily to the neck region, which would then act as a donor bed. After 2-weeks the ear is freed from the neck with the skin and the defect is closed.

4 Selected surgeries of the head

4.1 Salivary mucocele in dogs

Pathophysiology:

A mucocele (sialocele) is the accumulation of saliva that has leaked from a salivary gland or duct into the subcutaneous or submucosal tissue. Mucoceles are surrounded by granulation tissue, because saliva irritates tissue and causes inflammation. The inciting cause of a mucocele is rarely identified, but trauma of a salivary gland or duct, for example due to choke chains or bite wounds, is probably the most common reason. Sialoliths, neoplasia or foreign bodies may also cause mucoceles. Although most mucoceles arise from the sublingual gland or duct, they may manifest as cervical, sublingual, or pharyngeal mucoceles. Cervical mucoceles are most common.

Cervical mucoceles are located at the intermandibular space or ventral neck region. Sublingual mucoceles (Ranulas) are located inside the mouth in the sublingual area. Pharyngeal mucoceles are located in tissue adjacent of the pharynx. Zygomatic mucoceles are located ventral to the eye globe. They are caused by damage of the zygomatic gland or duct.

Clinical presentation:

Mucoceleles are relatively common in Poodles, Dachshounds, German Shepherds, and Australian Silky Terriers . Mucoceles are rare in cats. Mucoceles do present as gradually growing, painless, fluctuant swellings. Depending on the site they occur different symptoms can be present. Sublingual mucoceles may cause abnormal food uptake or oral bleeding. Pharyngeal mucoceles obstruct the pharynx and can cause dyspnea and dysphagia. Zygomatic mucoceles result in periorbital swelling and exophthalmus.

Differential diagnosis:

Abscess, foreign bodies, sialadenitis, tumors of salivary glands or lymph nodes, cysts

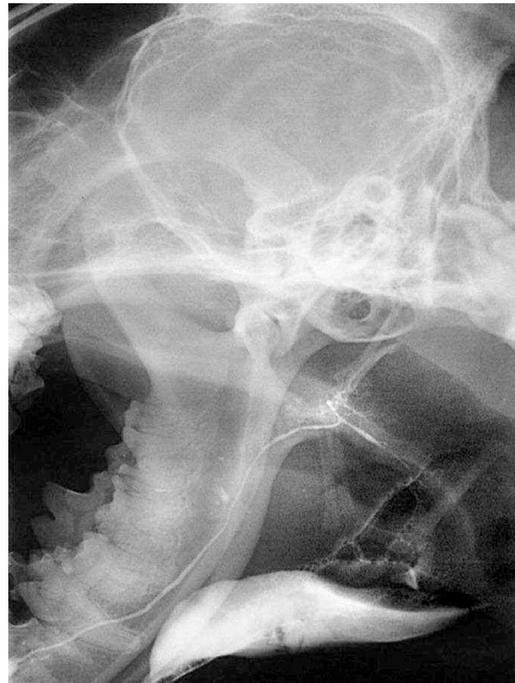


Figure 35: Sialogramm showing rupture of the sublingual salivary duct and accumulation of saliva in the neck

Further diagnostic tests:

A clear, yellowish or blood-tinged mucoid fluid can be aspirated, characteristic for saliva. Cytology with mucus-specific stain (periodic acid-Schiff) confirms the presence of saliva in unclear cases. Histology of the salivary gland and is performed if neoplasia is suspected. Histology of the wall of the mucocele does allow differentiation between mucoceles and cysts. Cysts have an epithelial lining, mucoceles don't.

In median located cervical mucoceles it can be difficult to determine the affected side. When the dog is placed in dorsal recumbency the fluid usually shifts towards the affected side. At surgery, the inner surface of the mucocele can be digitally palpated through a stab incision. The lining towards the unaffected side is usually smooth, whereas the lining towards the affected side is irregular and connections to the salivary gland may be felt. Sialography can be used in large dogs to determine the affected side and document the area of leakage.

Surgical anatomy:

Dogs have four major salivary glands, the mandibular (red), the sublingual (yellow), the parotic (blue), and the zygomatic gland (green) (see figure below). The mandibular salivary gland is large and ovoid, and shares a common fascia with the sublingual gland. It is located between the linguofacial and maxillary veins as they merge into the external jugular vein.

The sublingual salivary gland consists of a monostomatic and polystomatic part. Both the mandibular duct and the duct of the monostomatic part of the sublingual gland run towards the floor of the mouth and open on a small papilla lateral to the frenulum. The polystomatic part of the sublingual gland is located just below the submucosa along the

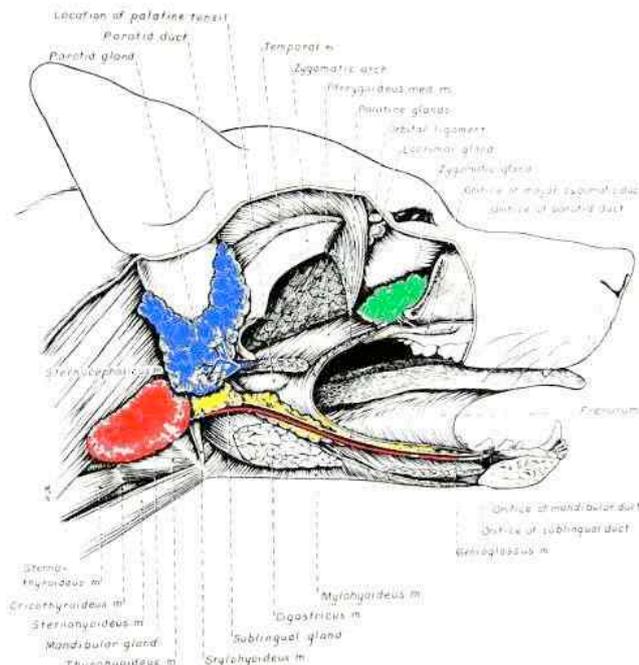


Figure 36: Anatomy of the salivary glands

mandibular duct and opens directly into the mouth.

Treatment:

Although most mucoceles arise from the sublingual salivary gland, the close proximity between the sublingual and mandibular gland prevents surgical excision of only the sublingual gland without traumatizing the mandibular gland and duct. Treatment for cervical mucoceles therefore consists of surgical excision the monostomatic part of the sublingual gland and the mandibular gland. Sublingual mucoceles (ranula) are treated by marsupialization. Pharyngeal mucoceles can be treated by marsupialization or excision of the mandibular and sublingual gland. Treatment for zygomatic mucoceles consists in surgical excision of the zygomatic gland.

Prognosis:

The prognosis is excellent after excision of the affected gland. Glands may be resected bilaterally without causing clinical symptoms. Complications are uncommon (> 5%), and include seroma formation and recurrence of mucocele. Recurrence is due to incomplete excision of the affected salivary gland.

Exercise: Surgical excision of the sublingual and mandibular salivary gland

- The dog is positioned in lateral recumbency, with the head and neck extended and a pad placed under the neck in order to rotate the ventral aspect dorsally.
- The mandibular salivary gland is identified between the linguofacial and maxillary veins, as they merge into the external jugular vein.
- The skin is incised from the caudal edge of the angle of the mandibula to the the external jugular vein.
- The thin platysma muscle is divided.
- The common capsule of mandibular and sublingual gland is incised without damaging the branch of the second cervical that crosses the capsule.
- Blunt dissection of the glands from the capsule is started caudally.
- Branches of great auricular artery and vein enter the mandibular gland on the dorsomedial side. They are identified and ligated.
- The dissection is continued rostrally, following the sublingual gland and mandibular and sublingual ducts until the digastric muscle is seen. Be careful not do disrupt the thin ducts.
- The lingual nerve is identified, which courses across the ducts between the digastric and masseter muscle.
- The digastric muscle can be transected (and later re-sutured) to improve visualization.
- The mandibular and sublingual ducts are transected and ligated just caudal to the lingual nerve (it does not matter if the ducts rupture before they can be ligated as long as all glandular tissue has been removed).
- One or two penrose drains are placed into the area of the former mucocele.
- The capsule, the platysma muscle, the subcuicis, and skin are closed.

Exercise: Marsupialization of sublingual mucocele (ranula)

- The dog is placed in lateral or ventral recumbency with the mouth held open.
- An elliptical piece of mucosa and wall of the ranula is excised.
- The lining of the ranula is sutured to the sublingual mucosa, creating a wide opening.

4.2 Thyroidectomy in cats

Presurgical considerations

Hyperthyroidism is one of the common diagnosed endocrine diseases in cats and is generally associated with adenomatous hyperplasia of one or both thyroid glands. Approximately 80% of affected cats have bilateral involvement and in 5% the thyroid mass is ectopic (i.e. thoracic inlet or cranial mediastinum). Excessive circulating thyroxine increases the metabolic rate and sensitivity to catecholamines. Clinical findings reveal weight loss, polyphagia, hyperactivity, tachycardia, gallop rhythms, vomiting, diarrhea and hyperexcitability. In 10% of the cases, the cat is profoundly depressed and weak. This form is called apathetic hyperthyroidism.

The laboratory findings can include following abnormalities: increased PCV, neutrophilic leucocytosis, eosinopenia, lymphopenia, elevated aminotransferase and alkaline phosphatase. Most affected cats have high serum T4 but normal thyroxine concentration can not exclude hyperthyroidism.

The treatment options consist of iodine 131, medical treatment with antithyroid drugs and surgery. Before surgery is performed, the cat should be made euthyroid. This reduces anesthetic risk associated with metabolic and cardiovascular abnormalities due to hyperthyroidism. The medical treatment before surgery consists of methimazole 5mg/cat bid/tid. In euthyroid state you should repeat at least the kidney values before surgery, because the high metabolism might have obscured renal failure.

Surgical anatomy

The thyroid glands are positioned laterally and slightly ventral to the fifth to eighth cartilage rings of the trachea. The left lobe is usually located caudally to the right

lobe. Normally they are 2cm long and 0,3 cm wide. Two parathyroid glands are associated with each of the two thyroid glands. The external parathyroid gland is located at the cranial pole (cranial thyroid artery!) and the internal gland is positioned within the thyroid at the caudomedial aspect. The blood supply is derived from the cranial thyroid artery (branch of the common carotid artery) and the caudal thyroid artery (branch of the brachiocephalic artery), that is not always present in cats. The venous drainage is from the cranial and caudal thyroid veins.

There are several structures of importance located in close proximity to the thyroid glands: Common carotid artery, jugular vein, recurrent laryngeal nerve, parathyroid glands, oesophagus and trachea. The thyroidectomy may be performed via an intracapsular w/o modification or extracapsular technique.

Surgical technique:

The cat is placed in dorsal recumbency with the neck slightly hyperextended

- make a skin incision from the larynx to a point cranial to the manubrium
- separate sternohyoid and sternothyroid muscles
- identify the important structures
- perform a thyroidectomy; pay attention to the parathyroid glands and the vasculature

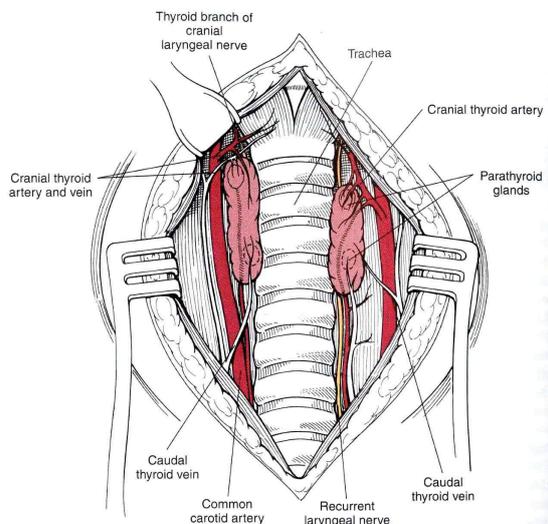


Figure 37: Surgical anatomy at the thyroid

4.3 Oncologic procedures of the skull

Maxillectomy

Surgical diseases of the oral cavity are common in dogs and cats. They include congenital and traumatic abnormalities, foreign bodies, dental disease, and neoplasia.



Figure 38: Malignant melanoma



Figure 39: Fibrosarcoma

Oral tumours accounts for 6% of canine cancer and is the fourth most common cancer overall. Malignant melanomas are most frequently represented, followed by squamous cell carcinomas, and fibrosarcomas. Amongst the benign tumours, the fibrous, ossifying, and acanthomateous epulis are most frequently seen in the dog.

Most patients are presented with a mass in the mouth noticed by the owner. They have signs of increased salivation, exophthalmia, epistaxis, weight loss, halitosis, bloody oral discharge, or dysphagia. Loose teeth, especially in a patient with generally good dentition, should alert the clinician to possible underlying neoplastic bone lysis.

The diagnostic evaluation for oral cancer is critical due to the wide ranges of cancer behaviour and therapeutic options available. If the cancer is suspected of being malignant, thoracic radiographs can be performed prior to biopsy. Cancers that are adherent to bone, should have head radiographs or computer tomography taken under anaesthesia. These evaluations will assist in determining the clinical stage of cancer and the extent of resection when surgery is indicated. Incisional biopsy of the mass, and fine needle aspiration of regional lymph nodes will be the final steps of the staging. Most neoplasia of the skull will be locally invasive, but only do have late metastatic disease (with malignant melanoma as an exception).

Surgery, cryosurgery, and irradiation are the principal therapies utilized for oral tumours. When feasible, surgical excision is the most economical, fastest, and most

curative treatment. Radical surgeries such as maxillectomy, are well tolerated by the patient and indicated for lesions with extensive bone invasion, which are not felt to be radiation responsive or are too large for cryosurgery.

There are 4 types of maxillectomy: the rostral hemimaxillectomy, the bilateral rostral maxillectomy (premaxillectomy), the central hemimaxillectomy, and the caudal hemimaxillectomy. Rostral surgeries of the maxilla are easier to perform and followed by less complication than more caudal surgeries. The most frequent complication is the dehiscence, followed by haemorrhage, and infection. The surgical outcome after maxillectomy is very good. Only rostral maxillectomies result in severe cosmetic change.

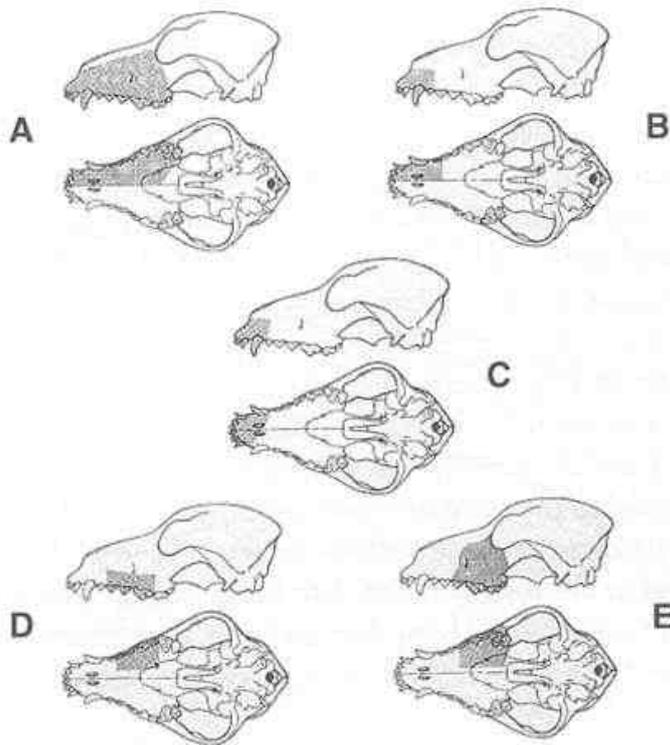


Figure 40: Types of maxillectomies

Partial mandibulectomy performed in a midbody section has easy to perform and will mostly result in excellent outcome, even perfect dental occlusion.

5 Urogenital surgery

5.1 Perineal urethrostomy

Introduction

The most common indication for perineal urethrostomy in cats is feline (or idiopathic) lower urinary tract disease (FLUTD or ILUTD). The term FLUTD is used to describe an idiopathic, generally non-infectious, inflammatory process of the lower urinary tract. Urethral obstruction, due to plugs, crystals or calculi, leads to a life threatening condition. Cats at risk for obstructive FLUTD are overweight, male castrated indoor cats. Other indications for perineal urethrostomy are urethral strictures, trauma or neoplasia. The aim of the perineal urethrostomy is to create a larger urethral opening, allowing passage of plugs or calculi.

Obstructed cats have to be stabilized before surgery, especially if obstruction has been present for more than 36 hours. Stabilization includes passage of a urethral catheter and correction of uremia and hyperkalemia with intravenous fluids. In cats with hyperkalemia 0,9 % saline is used. Cystocentesis bears the risk of bladder disruption and is therefore reserved for cats, where passage of a urethral catheter is absolutely impossible.

Surgical anatomy

Urethral diameter is much wider in the pelvic than in the penile urethra. The pelvic urethra ends at the level of the bulbourethral glands (1). The crura penis (2) have to be severed at their attachment on the ilium for sufficient mobilization of the penis. The retractor penis muscle (3) lies dorsal to the penile urethra and has to be removed before opening the urethra.

Surgical technique

- The anus is closed with a purse-string suture.
- If possible, a urethral catheter is inserted for better visualization of the urethra.
- The cat is positioned in sternal recumbency with the pelvis elevated and the hindlimbs hanging over the padded edge of the slightly tilted operation table. The tail is fixed over the back. Intact males have to be castrated first.
- An elliptical skin incision is performed around the penis, starting half way between the anus and the prepuce.

- The glans penis is grasped with Allis tissue forceps to help manipulate the penis. - The penis is freed bluntly, until the crura penis (PeC) are visible on the lateral aspect.
- The insertions of the crura penis (PeC, ischiourethral and ischiocavernosus muscles (IUM, ICM)) at the ischium are cut with scissors, as close to the bone as possible.
- The penile ligament (PeL) ventrally is cut with Metzenbaum scissors. Free the ventral area of the pelvic canal with fingers. After that, the penis should be movable towards caudally and the bulbourethral glands should be clearly visible.
- The retractor penis muscle (RPM) on the dorsal aspect of the urethra is removed with Metzenbaum scissors from distal to proximal without severing the urethra.

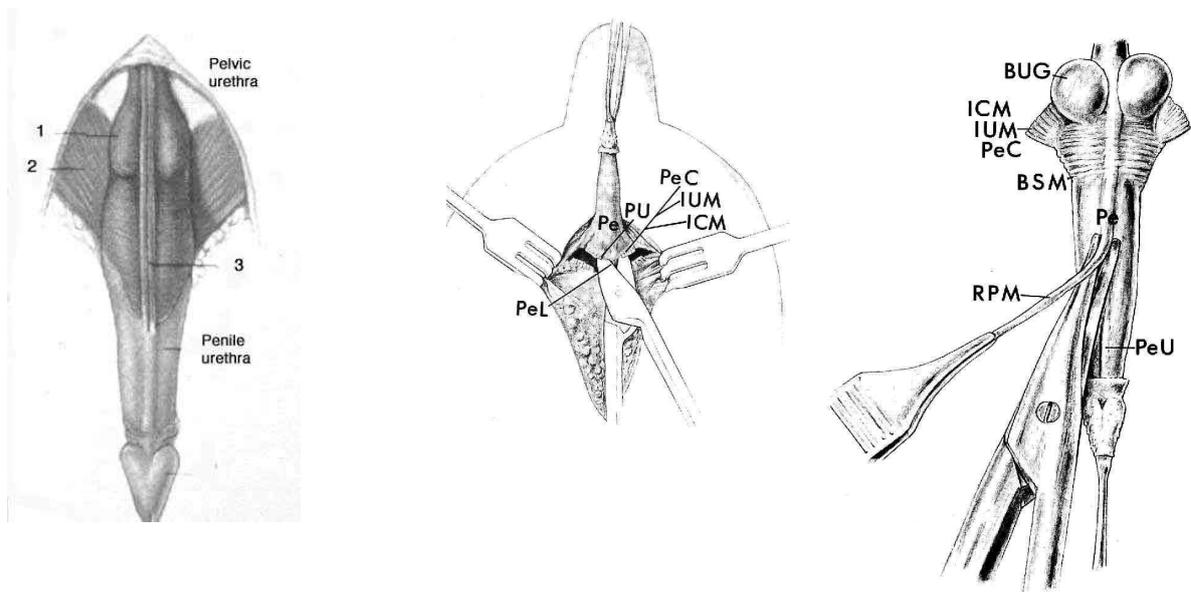


Figure 41: Preparation of the urethra; severing the crura penis (ICM, IUM) and the retractor penis muscle (RPM)

- The urethral lumen is then opened from distal with straight iris scissors. The incision is continued proximally to the pelvic urethra, just beyond the level of the bulbourethral glands. The opening should be large enough to allow easy insertion of a Halsted mosquito hemostat into the proximal urethral lumen.
- The urethrostomy is created by suturing the urethral mucosa to the skin with 5-0 non-resorbable, monofilament suture material with a taper-cut needle (Polypropylen, Prolene®).
- First, 5 single interrupted sutures are preplaced at the proximal end at a 10, 11, 12, 1 and 2 o'clock position and are then tied.
- The urethrostomy is then continued on both sides from a 9 and 3 o'clock position towards distally with a simple continuous suture pattern, in order to create a channel of an approximate length of 1 to 1,5 cm.
- To prevent bleeding, a submucosal transfixation ligature is placed around the distal end of the penis, before it is amputated.

- The remaining skin incision is closed routinely by suturing the subcutis and skin with an interrupted suture pattern.

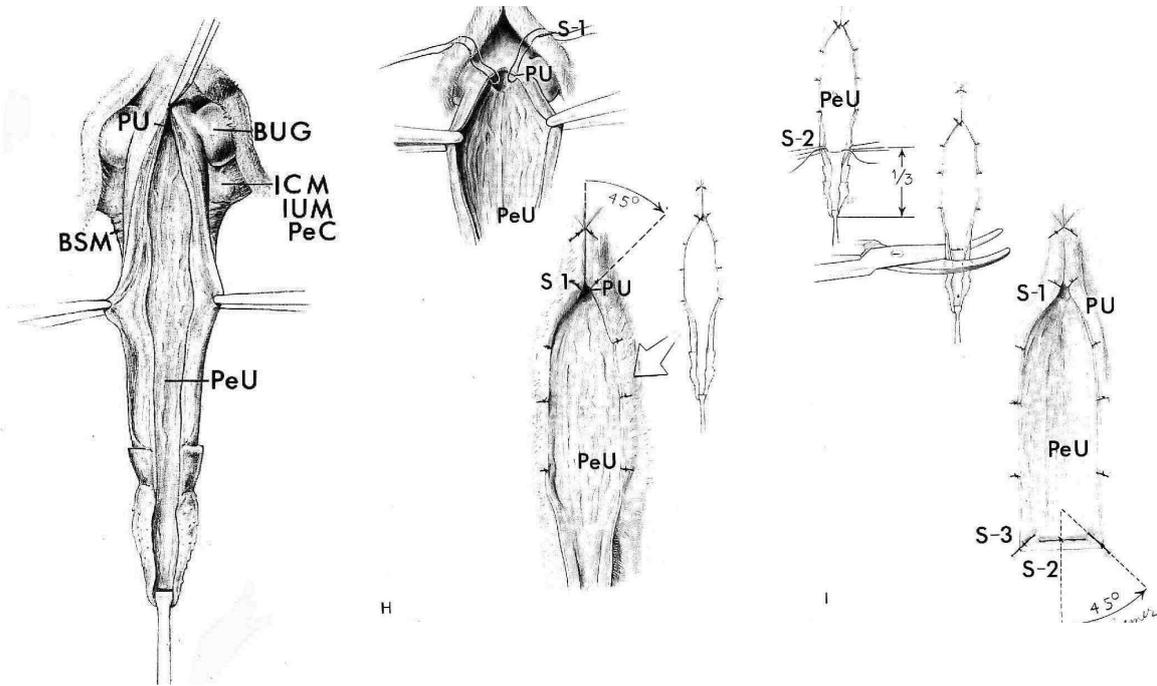


Figure 42: Splitting of the penile urethra and sutures to the skin; the glans is cut.

Postoperative management

The area around the urethrostomy site is protected with a fatty ointment (Vaseline) to prevent urine scalding. The urethrostomy should be protected from licking either with a neck collar or a gauze sponge, sutured loosely over the area. Potassium values should be monitored and corrected as needed, because postobstructive diuresis may lead to hypokalemia. In cases with positive urine cultures, antibiotics are given for 2 or 3 weeks. Sutures are removed after 10 days. Dietary management might be necessary in cases with struvite or oxalate calculi.

The complication rate after perineal urethrostomy is low, if proper surgical technique has been advocated. The most common complication is urethral stricture formation due to making the stoma too small (i.e. the stoma in the proximal penile urethra instead of the distal pelvic urethra). Urinary or fecal incontinence may occur, if pelvic nerves are damaged. Cats with a perineal urethrostomy are at increased risk for urinary tract infection. Therefore urine should be cultured 4 weeks postoperatively.

5.2 Canine scrotal urethrostomy

Scrotal urethrostomy is indicated with recurrent urolithiasis and non successful dietetic treatment. The dogs is castrated.

Technique:

- castration and ablation of the scrotum
- introduction of a catheter
- Preparation of the retractor penis muscle and fixation on one side to the abdominal wall
- opening of the urethra in the middle line, on a length of 3 to 8 cm
- flushing of the urethra, removal of the stones
- sutures of the mucosa to the skin with single interrupted sutures or with a continuous pattern, using polypropylene material

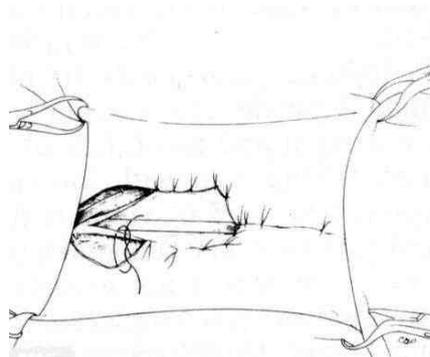
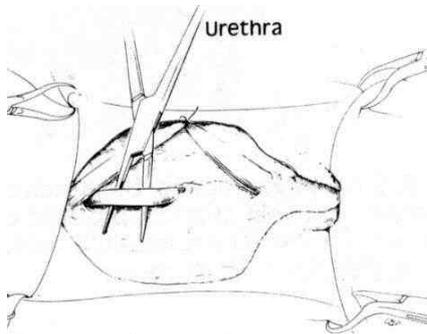


Figure 43: The retractor penis muscle is sutured aside; the urethra going to be incised

Figure 44: Suturing the urethral mucosa to the skin

Some stones, located directly caudal to the penile bone, can only be removed by a mini urethrostomy. The incision shall then not be sutured, because stricture is expected. Bleeding for a couple of days will follow, but stop by time.

5.3 Cystotomy

Common indications for a cystotomy are neoplasms or uroliths. Because of the delicate area in the dorsocaudal region (sphincter, entrance of the ureters), a ventral cystotomy is preferred.

Technique:

- void the bladder manually or via catheter
- Approach the bladder through a celiotomy or preputial access
- lift the bladder out of the abdominal wall

- place two stay sutures
- open the bladder ventrally
- in case of uroliths, the bladder is flushed in both directions and the bladder trigon is inspected carefully
- bacterial cultures are best made with a full piece of mucosa
- neoplasms are always removed with full thicknesses of the bladder wall
- vesicourachal diverticles are seen in 25 % of all cats with hematuria or dysuria. They are removed
- closure of the bladder is accomplished with a double layer method (first layer with mucosa and submucosa; continuous suture, adapting; second layer with submucosa and serosa, inverting, continuous suture), using catgut, polydioxanon or polyglyconate.

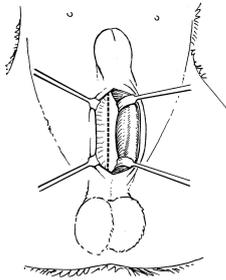


Figure 45: Penile approach

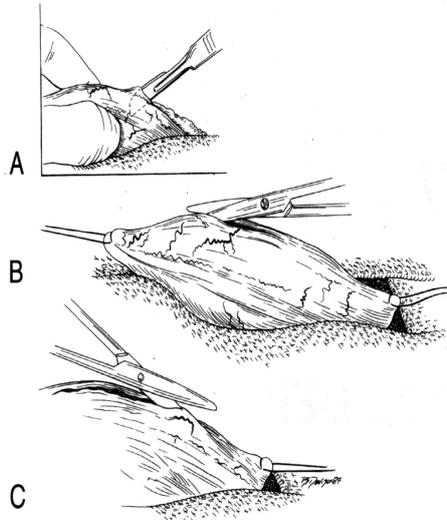


Figure 46: Bladder opening

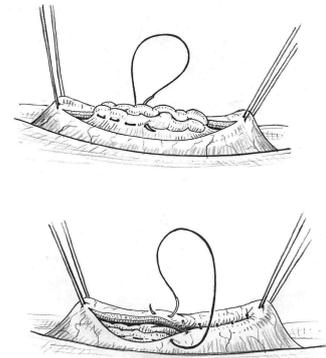


Figure 47: Double layer bladder closure

5.4 Nephrectomy

Kidneys are removed after trauma, when the kidney itself is crushed or the ureters severed. Other indications are uroliths, nephroliths, abcessaion, neoplasia or cystoid diseases. Sometimes, ureters are incidentally incorporated into ligatures of the ovars.

Technique:

- midline celiotomy

- opening of the peritoneal layer over the kidney
- identification of the arteries and veins at the hilus (there might be even 2 arteries in dogs) and ligation of arteries and veins
- preparation of the ureter and ligation close to the bladder

I recommend silk for ligation of the vessels. Mass ligation should be avoided. Postoperative complications are rare.

5.5 Canine ureteral ectopia

(adapted from Prof. S. Arnold)

Ureteral ectopia is a rare condition in the dog but it is the most common cause of urinary incontinence in juvenile dogs. Ureteral ectopia is a congenital abnormality. One or both ureters do not enter the urinary bladder at the normal site. The terminal ureter may be within the bladder wall (intramural) or separated from the bladder wall (extramural) and discharge into the urethra, the vagina or the uterus. In dogs ectopic ureters usually are intramural (in cats usually extramural) and enter the urethra. Other abnormalities are present in many cases of which hydro-ureter either alone or in combination with hydronephrosis is the most frequent. Additional common findings include urinary tract infection and hypoplasia of the bladder.

Breed and sex disposition

9 out of 10 dog with ectopic ureters are bitches and there is a breed disposition for Labrador Retrievers and Golden Retrievers in the UK; for Siberian Husky, Newfoundland, Bulldog, West Highland White terriers, Fox terriers and Skye terriers in North America.

Clinical signs

Usually the dogs are presented to a Veterinarian at a young age. As soon as they are house-trained, the owner will notice that the dog is dripping urine without taking the appropriate position for miction. However, there are dogs with ectopic ureters which become not incontinent until adolescence. In particular, male dogs can reach the age of 9 years until they become incontinent. Therefore ureteral ectopia must be considered in the differential diagnosis of urinary incontinence in dogs of all ages.

Diagnosis

A diagnosis is made by means of a combined contrast study: An intravenous urography and urethrocystography. Ectopic ureteral orifices can also be recognised by endoscopy or ultrasound.

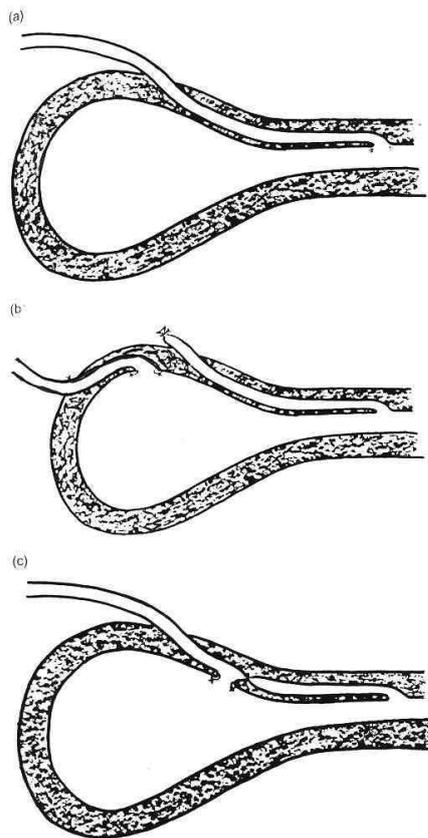


Figure 48: a) Schematic representation of the course of an intramural ectopic ureter with a urethral termination; b) Schematic representation of the extravescicular ureteral transplantation technique. The ureter is ligated, sectioned and tunneled through the bladder wall; c) Schematic representation of the intravesicular ureteral transplantation technique. The ureter is stomatised into the bladder lumen and ligated distal to the stoma.

Treatment options

Ureteronephrectomy (in cases with severe hydronephrosis)

Extravesicular transplantation (tunneling technique with extramural ureter): The ureter is ligated and cut; the bladder is opened ventrally; through a stab incision in the dorsolateral area, the ureter is grasped and pulled into the lumen. The opening is widened and sutured to the bladder mucosa.

Intravesicular transplantation (stomatization technique with intramural ureter): The bladder is opened ventrally and the ureter identified (not easy). Ureter and bladder mucosa are opened on 5-10 mm length and the wound margins are sutured to the bladder. The distal part of the urethra is ligated.

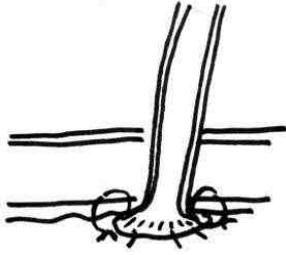


Figure 49: Extravesicular technique



Figure 50: Intravesicular technique

Complications

After extravascular technique, hydronephrosis requiring a second procedure (ureteronephrectomy) is the most common complication, occurring in 10 % of the cases. After the intravesicular technique, transient dysuria is noted in 15 % of the patients.

Prognosis

40 to 67 % of the dogs with ectopic ureters remain incontinent in spite of successful surgery. Hypothetical explanations include the presence of concurrent sphincter mechanism incompetence, reduced bladder capacity and interference of the ectopic remnant with urethral closure function. Female sex and normal upper urinary tract morphology increase the risk of persisting incontinence, while male sex and hydronephrosis / ureteral dilation decrease the risk.

References

- Holt, P.E., Hotston Moore, A. (1995): Canine ureteral ectopia: an analysis of 175 cases and comparison of surgical treatments. *Vet Rec* 136:345-349.
- McLoughlin, M.A., Chew, D.J. (2000): Diagnosis and surgical management of ectopic ureters. *Clin Techn Small Anim Pract* 15:17-24.

6 Perineal surgery

6.1 Perineal hernia repair

Perineal hernia occurs when pelvic diaphragm muscles fail to support the rectal wall. The exact cause of the muscular weakness is unknown, but several factors have been proposed. The muscle weakness may be associated with male hormones, straining, and congenital or acquired muscle weakness or atrophy. Atrophy possibly of neurogenic origin has been identified in some animals with hernias. Herniation may be unilateral or bilateral and most often occur between levator ani muscle, external anal sphincter and obturatorius internus muscle. Caudal displacement of intraabdominal organs or deviation of the rectum into the perineum can occur. Contents found in the hernial sac may include jejunum, colon, and prostate. Retroflexion of the bladder occurs in 20% of patients. This may result in urinary obstruction and is then considered as emergency. However, more commonly retroperitoneal fat and fluid fill the sac. Tenesmus, constipation, and perineal swelling are the three most consistent clinical findings. Tenesmus is the result of the collection of excessive feces in a rectal dilatation or sacculation in the perineal hernia. Rectal palpation is the most important part of physical examination.

There are several surgical methods: A combination of colopexy, vaspexy, and cystopexy and the obturatorius flap. Sometimes it is necessary to use them in combination.

Surgical anatomy

The structures involved in surgical repair of perineal hernia include the pelvic diaphragm, the perineal fascia, and the nerves and vessels in the proximity of these structures. The levator ani and coccygeus muscles form the lateral boundary of the rectum or the medial boundary of the pelvic diaphragm. The sacrotuberous ligament and the superficial gluteal muscle form the lateral aspect of the pelvic diaphragm. The ventral area is built by the internal obturator muscle. The striated muscle surrounding the anal canal is called the external anal sphincter.

The internal pudendal artery and vein and the pudendal nerve are bound together by loose connective tissue, and this neurovascular bundle passes ventrolaterally to the coccygeus muscle and continues caudomedially across the dorsal surface of the internal obturator muscle. At the caudal border of the ventral aspect of the external anal sphincter muscle, the pudendal nerve gives off the caudal rectal nerve. This branch of the pudendal nerve provides motor innervation to the external anal sphincter muscle.

Surgical technique for the colopexy, vaspexy, and cystopexy

1. Castrate open
2. Celiotomy
3. Colopexy:

pull the colon descendens cranially, a helping person is checking rectally that the ampulla recti is tubular and not kinked; sacrifice peritoneum caudal to left kidney in a length of 8 cm, use two rows of diagonal sutures between colon and peritoneum, enter the lumen with the suture (e.g. polydioxanon), preplace the dorsal line; tie all sutures

4. Vaspexy:

Loosen the ductus deferens from the vessels; cut a tunnel into the peritoneum and m. transversalis, use the apex of the bladder as landmark for your tunnel; pull the ductus deferens with a mosquito clamp in a caudocranial direction through the tunnel; each ductus is sutured to itself and the abdominal wall with diagonal sutures;

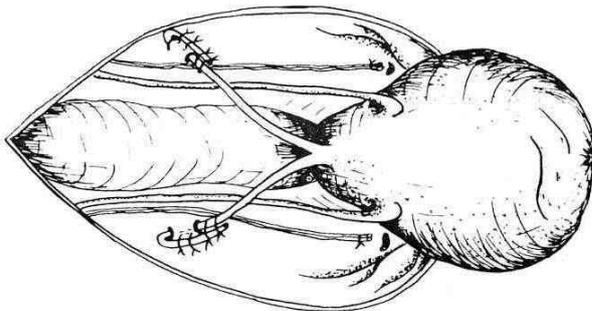


Figure 51: Vaspexy

5. Cystopexy:

Scarifice the abdominal wall on the right side next to the bladder neck, do the same to the bladder serosa, use diagonal sutures to fix the bladder to the abdominal wall.

Internal obturator muscle transposition

The internal obturator muscle transposition technique for treatment of perineal hernia has been first described in 1983. The elevation of the internal obturator muscle allows closure of the defect under less tension, compared to standard herniorrhaphy. The operation can be performed bilaterally, although a staged procedure causes less postoperative discomfort and complications. Reported complication rates range from 14% - 67%. Complications include rectal prolapse, wound infection and seroma, urinary and fecal incontinence and flatulence. Recurrence rates between 4,6% and 23% are reported.

The internal obturator muscle transposition can be combined with leftside colopexy, vaspexy and cystopexy. This addition reduces the recurrence rate.

The pelvic diaphragm is the vertical closure of the pelvic cavity. It consists mainly of the levator ani and the coccygeal muscle and the deep and superficial perineal fascia. They connect the pelvic floor to the caudal vertebrae. Important vessels and nerves are the caudal gluteal artery, the pudendal artery and nerve and the caudal rectal artery and nerve.

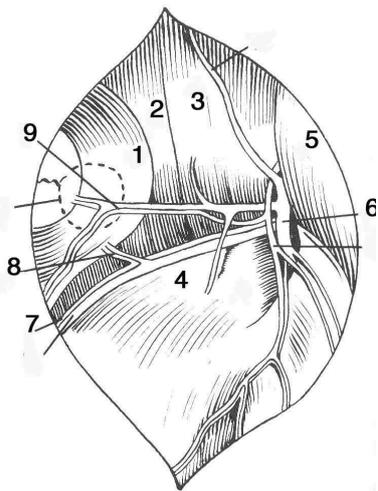


Figure 52: Surgical anatomy: 1) External anal sphincter muscle, 2) Levator ani muscle, 3) Coccygeus muscle, 4) Internal obturator muscle, 5) Superficial gluteal muscle (sacrotuberous ligament is behind it), 6) Caudal gluteal artery, 7) Pudendal artery and nerve, 8) Caudal rectal artery and nerve, 9) Perineal artery and nerve

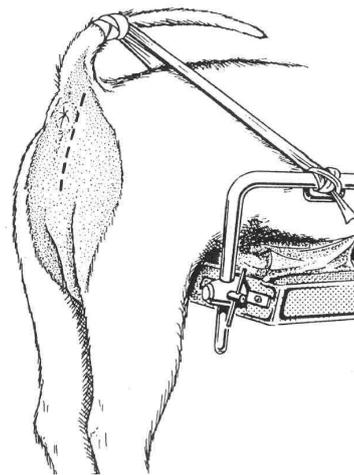


Figure 53: Positioning of the dog for perineal hernia repair

Surgical technique:

The anal sacs are evacuated, a lubricated gauze tampon is inserted into the rectum and a purse string suture is placed around the anus.

The animal is positioned in sternal recumbency with the pelvis elevated and the hindlimbs hanging over the padded edge of the table. The tail is loosely fixed over the back.

A slightly curved vertical skin incision is made lateral to the anus from the base of the tail to the ischiatic arch. The superficial perineal fascia is incised the same way.

Hernial contents are gently freed and repositioned into the pelvic cavity. Hernial reduction is maintained by packing the defect with a moistened sponge.

Identify the muscles involved in the hernia, the pudendal artery and nerve, the caudal rectal artery and nerve and the sacrotuberous ligament.

The attachment of the internal obturator muscle (4) is incised at the periosteum along the caudal border of the ischium with a scalpel from medially towards laterally. The incision is continued laterally and cranially with scissors.

The internal obturator muscle (4) is elevated from the ischium with a periosteal elevator up to the caudal border of the obturator foramen. For additional mobility, the internal obturator tendon is dissected just medial to the sacrotuberous ligament, which lies behind the superficial gluteal muscle (5). Be careful not to damage the ischiadic nerve and the pudendal nerve and vessels (6).

The internal obturator muscle is then flapped towards dorsomedially.

Preplace simple interrupted or cruciate pattern sutures, using 0 or 2-0 monofilament sutures material with a large curved needle (for example Polydioxanone, PDS®). All sutures are spaced less than 1 cm apart.

The apposition begins dorsally by suturing the external anal sphincter muscle (2) to the coccygeus muscle (3). Then sutures are placed between the internal obturator (4) and the external anal sphincter muscle medially (avoid the anal sacs), and between the internal obturator and the coccygeus muscle laterally.

The sutures are tied, beginning dorsally. Remove the sponge used to maintain reduction before tying the last sutures.

Suturing the perineal fascia to the external anal sphincter muscle eliminates dead space. Subcutis and skin are closed in a single interrupted suture pattern.

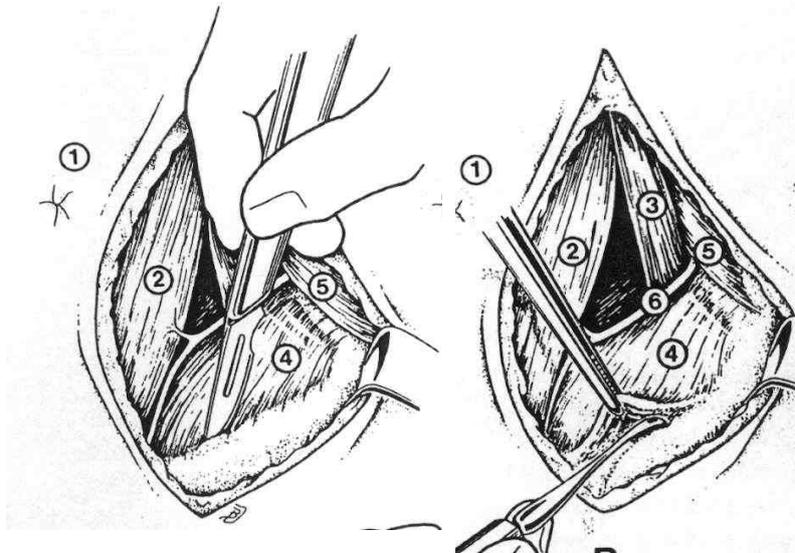


Figure 54: Detachment of the internal obturator muscle with blade and periosteal elevator

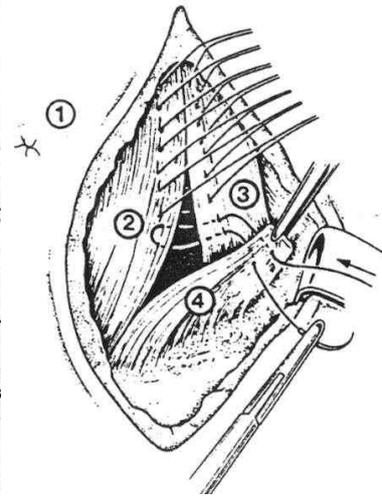


Figure 55: Placement of the sutures

6.2 Anal sac removal

Indications for removal of anal sacs are chronic obliteration, inflammation and neoplasia. Adenocarcinomas are frequently seen in female dogs. They may produce parathyroid like hormones, which result in high blood calcium levels.

Before the anal sacs are surgical removed, infection and inflammation are treated with antibiotics. This has the advantage, that tissue around the sac is spared, such as the external anal sphincter muscle and the rectalis caudalis nerve. Incontinence is a common sequel to anal sac removal, but normally disappears after a couple of days.

After induction of anesthesia, clipping and proper positioning in sternal recumbency and elevated back, the faeces is removed from the rectum and some swabs are pushed into the anus. Both anal sacs are voided.

Closed method:

The anal sac is probed in order to identify the distal end. The skin is incised. The tissue around the anal sac is prepared and detached carefully. After preparation to the mucocutaneous border, the anal sac is severed and the opening flushed and closed.

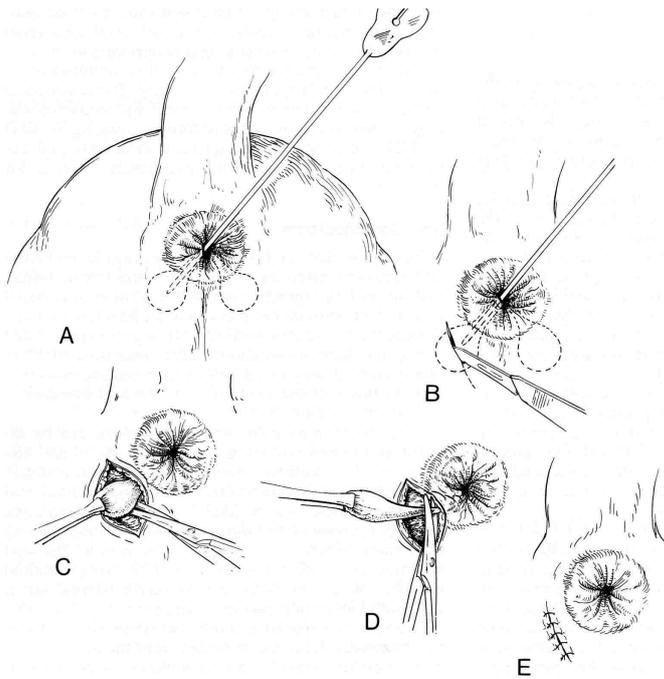


Figure 56: Closed method to remove anal sacs

Open method:

The anal sac is probed. All tissue is cut to the probe. The anal sac is open. All surrounding material is freed from the anal sac. The advantage is, that all glands are seen and removed. The outer sphincter is always cut and sutured.

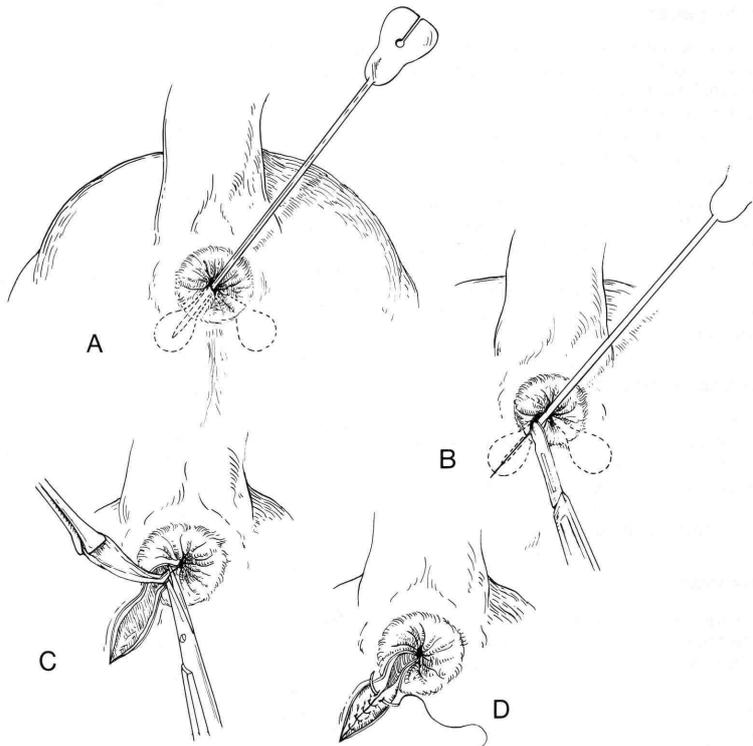


Figure 57: Open method to remove anal sacs

Perineal fistulation however is another disease. German shepherd are predisposed. The disease is supposed to be autoimmungenic. A surgical removal is not indicated and seldom solves the problem. Tacrolimus ointment helps to alleviate the clinical signs; in severe cases, cyclosporine (5 mg/kg) or cyclosporine (2mg/kg) plus ketokonazol (5 mg/kg) is administered.

7 Selected abdominal surgeries

7.1 Celiotomy, exploration, biopsy techniques

The most common major operation performed on dogs and cats (ovariohysterectomy) and many procedures on other body systems require surgical access to the abdomen. In the majority of cases, this access is obtained through the ventral midline.

The aponeurosis of all abdominal wall muscles form the linea alba in the ventral midline. This zone in dogs is visible as a trough of 2 to 3 mm width between the paired rectus abdominis muscles. The inner surface is formed by the transverse fascia that blend in with the inner sheet of the rectus abdominis muscle and the peritoneum.

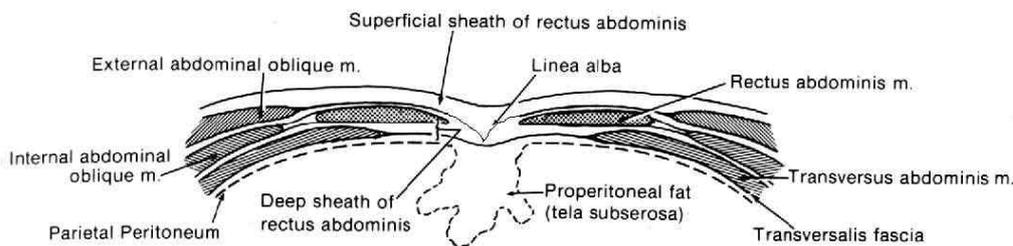


Figure 58: Sagittal section through the ventral abdominal wall.

7.1.1 Ventral midline approach

(median celiotomy)

The surgical site should always be prepared so that an extension of the incision is possible. Thus the hair is clipped for the whole distance from the xyphoid to the pubis and for a zone of approximately 5 to 10 cm on each side of the midline. The patient is positioned in dorsal recumbency and draped with 3 layers of sterile towels. After skin incision, subcutaneous vessels are sealed by diathermy. Excessive undermining of the subcutaneous tissue is avoided because the fascia receives some blood supply from the overlying subcutaneous and adipose tissue. Also excessive diathermy can lead to delays in healing.

For caudal incisions in male dogs, the skin incision is directed paramedian to one side of the penis and prepuce. The preputial muscles and blood vessels are divided so that the prepuce and the penis can be reflected laterally and the linea alba incised

along the midline. The linea alba is grasped with tissue forceps and elevated, while the point of the scalpel blade is inserted through it. Once the peritoneum is punctured, a finger is to confirm the absence of adhesions before the incision is extended with scissors. In dogs the falciform ligament frequently obstructs adequate exposure of abdominal contents. It can be removed by avulsion of the linea alba. Hemostasis of individual bleeders by diathermy is important. Once the abdominal cavity has been entered, saline-moistened laparotomy sponges are placed and a self-retaining balfour retractor is inserted. Occasional lavage is used to protect exposed viscera from desiccation.

7.1.2 Exploration of the Abdominal Cavity

All abdominal organs should be closely inspected in a systematic step by step procedure, so that none of the organ systems is forgotten. Despite an obvious finding, the exploration should be finished in the same manner.

After inserting the balfour retractor continue with the following protocol:

Carefully shift the spleen out of the abdominal cavity, after inspection, cover with moistened sponges and put it aside. Inspection of the omentum and palpation of the stomach, cardia, greater curvature and pylorus. Go on to the duodenum as far as to the plica duodenocolica. Carefully look at the pancreas without manipulating. Palpate all the liver lobes and check patency of the common bile duct by slight pressure on the gall bladder. Change to the pubis. From there look for the descending colon, follow retrograde and palpate transverse colon and ascending colon. Then shift the cecum out of the abdominal cavity. Continue retrograd inspection and check ileum and jejunum until you get to the plica duodenocolica again. Have a look at intestinal lymph nodes. Kidneys and adrenal glands as well as retroperitoneum with ureters and large parts of the peritoneum can be visualised by pulling the duodenum (right side) or the descending colon (left side) upwards and towards the midline. Palpate now the urinary bladder and don't forget uterus and ovaries in female or the prostate in male animals.

7.1.3 Intraabdominal Biopsy Techniques

Stomach

Stay sutures or Babcock tissue forceps are placed to stabilize the stomach. The abdominal cavity is walled off with moistend sponges. Take a ellipsoid full thickness biopsy in a relatively avascular area. A two-layer-technique with a continous suture pattern and synthetic absorbable suture material should be used for closure. The first layer is everting, the second is inverting.

Intestine

Again the surrounding is walled off with sponges. Intestinal contents are expressed from the region of the biopsy. A full thickness incision is made at the antimesenteric border and a longitudinal specimen is taken off. Any everting mucosa is trimmed with scissors before closure is begun. The defect is closed using a single layer of a appositional continuous suture pattern.

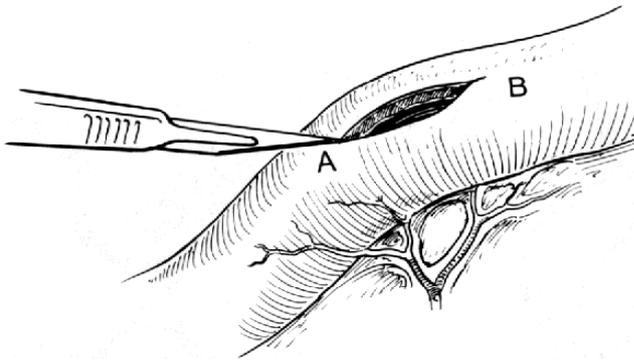


Figure 59: Longitudinal, antimesenteric incision, removing a longitudinal specimen

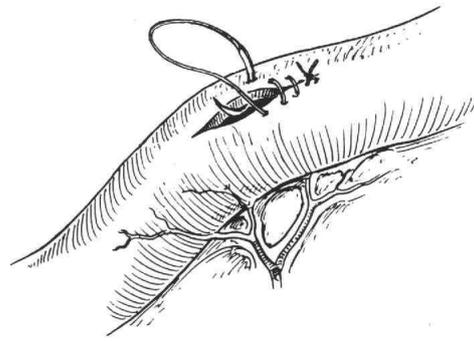


Figure 60: Continuous, appositional suture pattern through all layers

Pancreas

Pancreatitis can be caused either by rough tissue handling and excessive surgical trauma to the gland or its blood supply. With the suture fracture technique we gain large enough specimens with little surgery time and litterally no untoward effects.

The mesoduodenum or the deep leaf of the omentum is incised for access to the right or left lobe of the pancreas and tissue to be resected is isolated. A ligature is tied, crushing the parenchyma and ligating ducts and vessels. Tissue distal to the ligature is removed and the rent in the mesoduodenum / greater omentum is sutured (Fig. 4a-4c). One must take care not to to disrupt blood supply to the duodenum or the spleen.

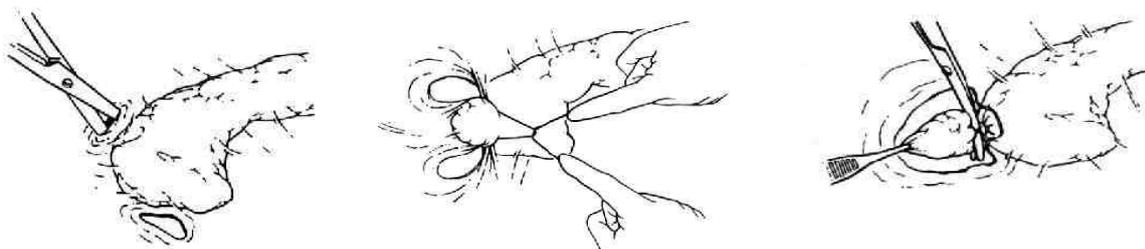


Figure 61:4a - 4c: Biopsy of the pancreas by suture fracture technique

Liver

Biopsy specimens from the liver margins are representative for the generalized parenchymal changes in most liver diseases. A marginal biopsy is most easily taken by looping a ligature (Catgut 0) over a protruding liver lobe margin. The parenchyma is crushed as the ligature is tightened. The tissue is removed by severing distal to the ligature. A small stump of hepatic parenchyma must be left to prevent the ligature from slipping off. Singular changes in liver parenchyma must be resected by partial or total lobectomy.

Kidneys

It is possible to obtain a sample of kidney tissue without having to open the abdomen using guided needle aspiration. The needle must be directed toward one of the poles of the kidney and not at the hilus to avoid damaging the renal vessels, pelvis or ureters. Before biopsy the benefits must be weighed against the risk. Complications observed are gross or microscopic hematuria, fatal hemorrhage and hydronephrosis. If larger samples are wanted a longitudinal wedge biopsy can be performed. A wedge of tissue 2 to 5 mm thick can be removed from the parenchyma in a sagittal incision. The nephrotomy is closed by apposing the two renal parenchymal flaps with gentle digital pressure. Hemorrhage usually ceases within 5 minutes, and the clotted blood has virtually glued the two halves together (sutureless nephrotomy closure). The incision in the renal capsule is closed with 3/0 or 4/0 absorbable sutures in a simple continuous pattern.

Urinary bladder

Stay sutures are placed at either side of the ventral midline near the apex. The bladder is well padded off the abdominal cavity. The incision site for biopsy specimen is in the most avascular and convenient area of the bladder between the two stay sutures. Avoid the trigonal area and the ureteral orifices. Watertight closure of the bladder is ensured by a double-layer everting-inverting suture pattern with absorbable, monofilament 3/0 or 4/0 material. By means of this, contact of suture with urine is avoided.

7.1.4 Closure of the abdomen

Before closing, carefully count the sponges. The abdominal cavity is lavaged with sterile saline at body temperature to minimize heat loss. Lavage is effective because bacterial numbers are greatly reduced. All lavage fluid must be aspirated. Then, the midline incision is closed in three layers: rectus abdominis muscle and its sheath, subcutaneous tissue, and skin.

The most feared complication, incisional herniation, can be avoided by correct adaptation of anatomical structures. Proper choice of suture material, suture pattern, suture interval and suture technique further diminish the risk of complications.

Suture material

Surgical gut or chromic gut lose their tensile strength more quickly than synthetic suture materials. They also tend to initiate an inflammatory reaction, eventually leading to granuloma formation. Surgical gut or chromic gut is not recommended for fascial closure. Recommended are monofilament, absorbable or nonabsorbable suture materials.

Suture pattern

A continuous suture in a simple adapting pattern, especially a monofilament suture with little friction between itself and tissue, distributes the tension equally over the entire length of the incision and resists dehiscence as well as interrupted sutures. Where the knot is made, an additional two to three throws are recommended in the continuous suture.

Suture placement

The proper suture interval is unknown, but one should approximate the linea alba without allowing the viscera to protrude between the stitches, not weaken the fascia with multiple perforations nor compromise the blood supply to the fascia by placing sutures too close together. In dogs and cats, this means placing sutures 3-10 mm apart. In general closure of the outer sheath of the rectus abdominis muscle is sufficient.

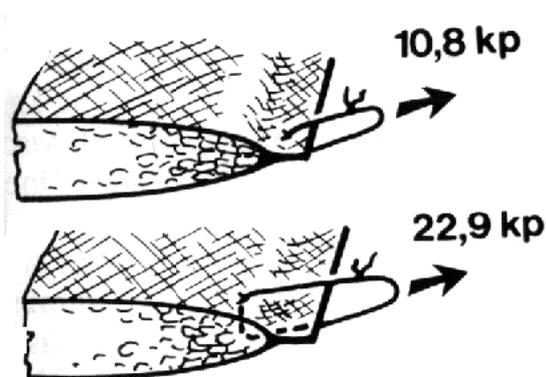


Figure 62: Incorrect and correct placement of sutures in the linea alba. The numbers indicate the holding strength in Kilopond

Recommendation

For closure of the linea alba the recommendation is to use polydioxanon 3/0 to 1 USP depending on body weight (PDS) in a simple continuous pattern. The sutures

should be 3 to 10 mm apart and each suture placed 5 to 10 mm from the incised edge of the linea alba. Sutures should always include the external leaf of the rectus abdominis muscle sheath. Make 7 throws in the knots at the beginning and the end of the suture. For the subcutis we use polydioxanon (3/0 or 4/0 USP) in a interrupted pattern and for the cutis loose interrupted sutures with a nonabsorbable material or staplers.

7.2 Splenectomy

Indications:

- Splenomegaly resulting from neoplasia, torsion, immun-mediated thrombocytopenia and anemia, congestion, and lymphoproliferative diseases.
- Splenic infarct

Anatomy:

The spleen is situated in the left cranial abdominal quadrant. Splenic artery divides into a dorsal and ventral branch. The dorsal branch gives off the short gastric arteries. The left gastroepiploic artery arises from the ventral branch of the splenic artery. The spleen is innervated by sympathetic (from the celiac plexus) and parasympathetic (from the vagus) nerve fibers.

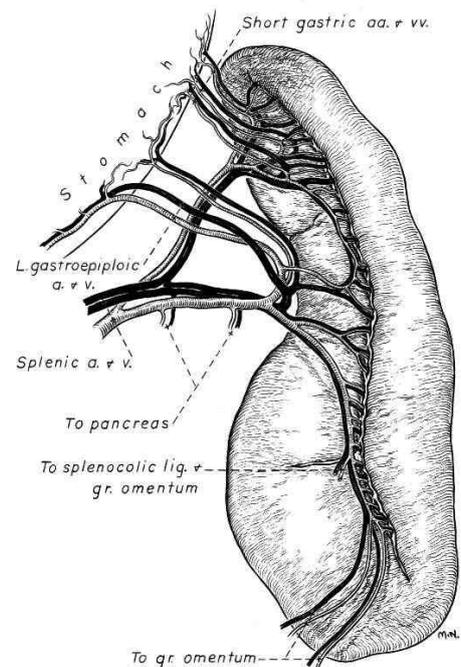


Figure 63: Surgical anatomy of the spleen

Technique of the splenectomy:

- midline celiotomy
- Insertion of Balfour retractor – Exploration of the abdomen
- The spleen is carefully delivered from the abdomen, caudally to the left side.
- There is the potential risk to rupture the spleen due to manipulation !!
- double ligation (2-0 silk or 2-0 catgut) of all the vessels as close to the hilus as possible
- Alternatively, open the omental bursa, and isolate the splenic artery. Identification of the branches to the left limb of the pancreas and of the a. gastroepiploica - sinistra.

- Double ligation distal of the a. & v. gastroepiploica sinistra, double ligation of the cranial vessels of the spleen under preservation of the short gastric branches supplying the gastric fundus, if possible
- Closure of the celiotomy

Postoperative care and assessment

Animal should be closely observed for 24 hours for evidence of hemorrhage. The hematocrit should be evaluated every few hours until the animal is stable. Four days cage rest, followed by 3-4 weeks of restricted activity

Complications

- ventricular tachycardia in dogs with anemia, hypotension, leukocytosis or rupture of a mass of the spleen. Normalisation after 10 days with cage rest.
- Hemorrhage

7.3 Enterectomy, anastomosis, bowel plication

Introduction

Intestinal resection and anastomosis is a commonly performed procedure in small animal surgery. The intestinal mucosa is very susceptible to ischemia and necrosis. If the mucosal barrier breaks down, bacteria and endotoxins may enter the systemic blood flow and/or the peritoneal cavity and cause sepsis and/or peritonitis. Diseases that lead to ischemia or necrosis of the intestinal wall therefore require resection of the involved segment. The most common disease processes leading to an enterectomy are foreign bodies, intussusceptions, strangulation of intestinal loops in hernial rings, intestinal trauma (bite wounds, shot wounds) and volvulus. After intussusceptions a bowel plication, which is described later, is always performed. Also intestinal tumors require intestinal resection and anastomosis.

A lot of techniques have been described for intestinal suturing. The single layer approximating suture patterns have clearly shown advantages over inverting or everting techniques, such as less luminal narrowing, better apposition of intestinal wall layers, less adhesion formation and quicker initial healing. In addition, a continuous approximating pattern leads to less mucosal eversion, better vascularization in the first 3 weeks and a shorter operation time than interrupted approximating sutures (Ellison et. al., 1982). A modified continuous suture pattern minimizes the potential complication of luminal narrowing (Weisman et. al., 1999).

Anatomy

The intestinal wall consists of 4 layers: mucosa, submucosa, muscularis and serosa. The submucosa is the toughest tissue and ensures holding of the suture material. The blood supply of most of the intestine arises from the A. mesenterica cranialis. Proximally, the duodenum is supplied by branches of the A. coeliaca. The jejunal blood vessels reach the intestine over the mesenterium. The intestinal vascularization is therefore better on the mesenterial side than on the antimesenterial side. One exception is the ileum with its antimesenterial vessel.

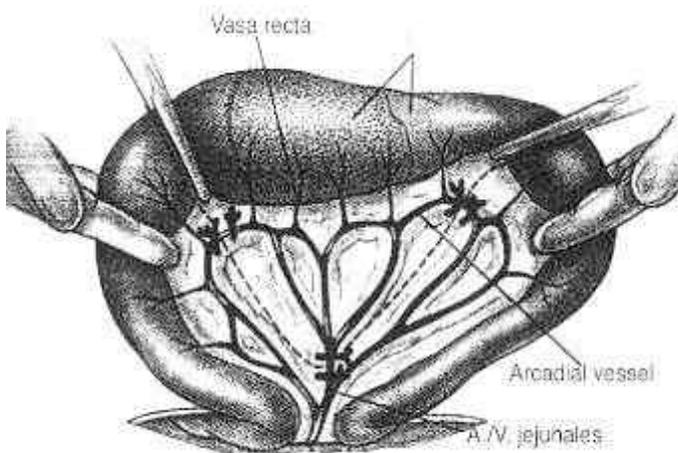


Figure 64: Anatomy of the intestins

Surgical material

Besides the standard instrumentation, a Balfour retractor and Doyen intestinal forceps are useful. The ideal suture material for the intestine is monofilament and resorbable and is used with a swaged-on cutting round needle (Polydioxanone (PDS) or polyglyconat (Maxon)). Suture material size varies between 3-0 and 4-0 and depends on the size of the animal.

7.3.1 Enterectomy and anastomosis

Animals undergoing intestinal resection and anastomosis receive perioperative antibiotics (Cephalosporine, 22 mg/kg i.v.) and fluid replacement (Ringer solution, 10 ml/kg/h). Animals showing signs of shock, sepsis or peritonitis require stabilization with aggressive fluid therapy before performing an emergency enterectomy. In cases

with intestinal obstruction and accumulation of air, nitrous oxide should be avoided during anesthesia.

The following surgical steps are performed for a jejunal enterectomy:

- Coeliotomy via ventral midline incision
- Placement of a Balfour retractor – exploration of the abdominal cavity
- Determination of the area to be resected and placing bowel segment out of the abdominal cavity with moistened sponges
- Isolating branches of the jejunal arteries and veins that supply the devitalized bowel with curved mosquito forceps and double ligating them (silk 3-0)
- Isolating the arcual vessels in the mesenteric fat and double ligating them at the resection point (silk 3-0)
- Milking intestinal content out of the segment to be resected and closing the intestinal lumen either by an assistant with middle and index finger or with Doyen forceps.
- Resection of the intestinal segment: Because the antimesenteric blood supply is fragile, the incision line runs in an angle of 60° to the intestine. An even smaller angle (up to 45°) can be chosen to enlarge the circumference of the cut in cases with luminal disparity of the bowel ends.

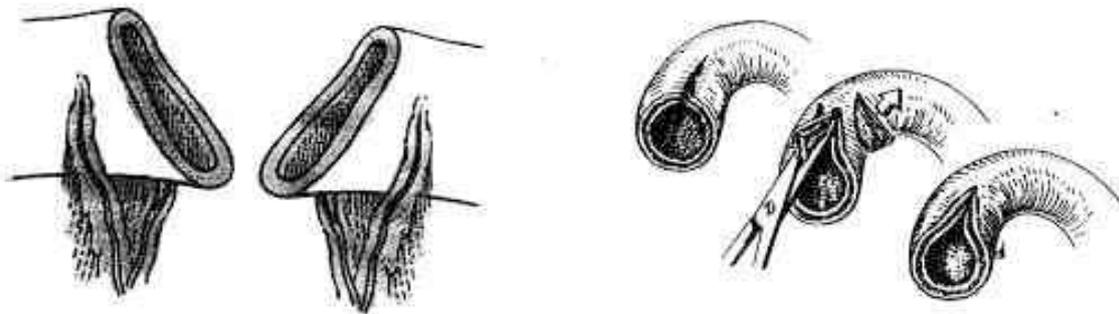


Figure 65: Trimming of intestins to avoid stricture and dehiscence.

- If there is to much luminal disparity a wedge is excised from the antimesenteric border of the smaller segment (1-2 cm long and 1-3 mm wide) to enlarge the circumference.
- Trimming everted mucosa with Metzenbaum scissors
- Placing a simple approximating suture on the mesenteric border of the intestine and leaving the end long (3-5 cm)
- Placing a second suture on the antimesenteric border and also leaving an end long
- Starting the simple continuous suture with the second needle from the antimesenteric towards the mesenteric border. **The bites involve all intestinal**

layers and should be placed 2-3 mm apart and about 3-4 mm away from the edge. A knot is tied at the mesenteric border with the free end of the first knot.

- Suturing the other half of the intestine with the other needle from the mesenteric to the antimesenteric border and tying it to the free end of the other suture.
- Closure of the mesenterium in a simple continuous suture pattern (be careful not to damage to jejunal blood vessels)
- Changing gloves and contaminated instruments and flushing the abdominal cavity with 1 (cat) to 5 (large dog) liters of warm Ringer's solution. Don't remove the coagula on the enterectomy side, as they are part of the initial healing process!
- Placing omentum over the suture line
- Routine closure of the abdominal cavity (abdominal fascia, subcutis and cutis)

The postoperative management in uncomplicated cases consists of analgesia for 2-3 days (Butorphanol, 0,2 –0,4 mg/kg i.v. every 2-4 hours) and intravenous fluid and electrolyte (potassium!) replacement until the patient is allowed to eat. Drinking water is allowed 8 hours postoperative. Feeding is begun after 12 to 24 hours postoperative with small portions of a low fat diet. Antibiotics are only necessary in cases with peritonitis or after a breakdown in asepsis, for example spilling of intestinal contents into the abdominal cavity.

Complications can include dehiscence, perforation, peritonitis and stenosis. They can be minimized by preservation of the vascular supply and a gentle apposition of the intestinal layers by a correct suture technique (the complication rate is as low as 2%, Weisman et. al., 1999). If there has to be resected more than 80% of the entire length of the intestine (for example in a volvulus) the animal will develop a short-bowel-syndrom.

7.3.2 Bowel plication

The recurrence rate after intussusceptions is quite high (25 %). Therefore, after reduction or enterectomy of the intussusception a bowel plication is recommended. As intussusceptions are thought to occur after enteritis, the localisation of the new intussusception can be anywhere along the small intestine. Plication is an entero-enteropexy from the duodenocolic ligament to the iliocolic junction. A monofilament, absorbable suture material is used.

1. The small intestine is placed in gentle loops, which should be around 15 cm long.
2. The adjacent loops are each secured by placing 2 sutures halfway between the mesenterium and the antimesenterium.

3. The stitches must include the submucosal layer.
4. The ends of the loops should be left free (that means the stitches not to near to the loop end) to prevent acute angles, which could complicate intestinal passage.



Figure 66: Plication technique

7.4 Gastropexy

Canine acute GDV is a potentially catastrophic condition in which emergency medical and surgical therapy and intensive postoperative care are needed to optimize the chance of successful outcome. GDV occurs most commonly in large or giant, deep chested breeds of dogs. The onset of clinical signs is typically peracute or acute. Initial signs include restlessness hypersalivation, and retching. These signs are usually followed by further discomfort and gradual abdominal distension.

Physical examination findings reflect gastric dilatation and circulatory and respiratory compromise. A distended abdomen, tachycardia, poor peripheral pulse quality, prolonged periphery refill time, pale and dry mucous membranes, tachypnea and dyspnea may occur depending on duration and severity of the episode.

Dogs with GDV develop local and systemic consequences that result in hypovolemia, placing them at risk for gastric and splenic vascular compromise, focal and generalized bacterial infections, initiation and propagation of local and systemic inflammation, disseminated coagulopathy, shock, and death.

Management of hypovolemia to prevent or treat shock is the primary goal of emergency treatment of GDV. Fluid therapy should be started at a rate of 90ml/kg/h

using a balanced electrolyte solution. In giant breed dogs HES (450/0,7) administered at 10-20 ml/ kg may provide more rapid initial circulatory resuscitation. These fluid resuscitation protocols should be followed by high volume crystalloid administration (20ml/kg/h) for maintenance of resuscitation.

Gastric decompression should be attempted as soon as possible. It can usually be achieved by orogastric intubation of the conscious or sedated animal. The tube selected should be measured from external nares to the caudal edge of the last rib and marked. The dog should be placed in a sitting position and the tube gently rotated in a counterclockwise direction.

If orogastric intubation is not possible, gastrocentesis - in the right or left paracostal space at the site of greatest tympany- usually facilitates orogastric intubation. Radiographs with the animal in right lateral recumbency is the initial examination of choice. The radiographic features of GDV include a large, dilated, gas filled gastric shadow, which may be divided into to compartments by soft tissue of the lesser curvature and the proximal duodenum, which courses caudally from the abnormally positioned pylorus in the craniodorsal quadrant of the abdomen. If gastric perforation has occurred, pneumoperitoneum is present.

Intraoperative fluid should remain at a high rate (10-20 ml/kg/h) to offset further deterioration in hemodynamics during surgery.

Surgery

The immediate aim of surgery is to return the stomach to its normal position and evaluate it and the spleen for signs of irreversible vascular compromise. Any necrotic portions of stomach and spleen should be removed and the stomach emptied completely. Finally, a gastropexy should be performed in an attempt to prevent recurrence of the volvulus.

Anesthesia is induced with a combination of ketamin (10mg/kg) and midazolam (0.25 mg/kg) and maintained with isofluran. A cranioventral midline celiotomy is performed. The stomach is covered by the greater omentum when a clockwise volvulus has occurred. First, the stomach is repositioned. If the gastric rotation is in a clockwise direction, downward pressure on the right side of the stomach along with gentle traction on the pylorus will aid counterclockwise rotation.

Gastric decompression is then easily achieved intraoperatively by orogastric tubing. After decompression, the pylorus should be identified and grasped gently with the hand. Careful inspection of the stomach and spleen should be performed.

The junction between the fundus and body along the greater curvature of the stomach is the most common site of gastric necrosis following GDV. If the serosal surface is either torn, gray-green, or black 10 minutes after anatomic reduction of the stomach, ischemia should be suspected and subsequent tissue necrosis anticipated. Resection of the affected portion of the stomach should be performed. A fullthickness gastric wall resection is carried out until the cut edges are actively bleeding to ensure healing without further necrosis. Closure of the stomach following partial resection is performed in two layers. Gastric necrosis and perforation can occur up to 5 days after surgery, especially if resection was performed.

The spleen can sustain vascular damage or occlusion following GDV. Any devitalized portion of splenic tissue should be resected. If the spleen has undergone torsion around its pedicle, splenectomy is performed before reducing the twist to lessen the risk of releasing toxins, myocardial active substances, and thromboemboli in the systemic circulation.

Without gastropexy recurrence rates of up to 80 % have been reported. Therefore, all affected dogs should have a gastropexy. The common procedures for accomplishing gastropexy are incisional gastropexy, circumcostal gastropexy, belt loop gastropexy and, right - sided tube gastropexy.

Permanent incisional gastropexy is a relatively simple, quick method of gastropexy, avoiding the complications associated with tube gastropexy and the technical difficulties or complications associated with circumcostal or belt loop gastropexy.

Surgical technique for permanent incisional gastropexy

A longitudinal incision is made into the seromuscularis, located over the ventral surface of the pyloric antrum equidistant from the lesser and greater curvatures. An incision is also made into the peritoneum and internal fascia of the rectus abdominal or transverse abdominal muscles, located in the right ventrolateral abdominal wall.

The edges of the gastric incision are sutured to the abdominal wall incision using a simple continuous suture pattern with 2-0 or thicker monofilament nonabsorbable material. The deeper (dorsal- cranial) incisional margins are sutured first, followed by the more superficial margin, creating an imperforate circular stoma. With disruption of mesothelial surfaces deep infiltration of fibrous tissue into the abdominal and gastric muscles occurs at the gastropexy site.

Postsurgical plan

Fluid therapy should be maintained at a rate of 8 to 10 ml/kg/h using a balanced electrolyte solution for the first 24 hours. Systemic administration of opioid analgesics

(e.g. intramuscular morphine 0,5 mg/kg every 4 to 6 hours) will reduce postoperative discomfort. It is useful to monitor PCV and total protein intermittently. ECG records should be made during the first 72 hours. Cardiac arrhythmias are common following an acute episode of GDV. They are usually ventricular in origin and range from intermittent ventricular premature conduction to sustained ventricular tachycardia. Cardiac arrhythmias may need to be treated if there is evidence of poor cardiac performance.

An abnormal hemostatic profile or a clinical bleeding tendency should be interpreted as evidence of disseminated intravascular coagulopathy. Replacement of consumed coagulation factors using fresh frozen plasma should be considered.

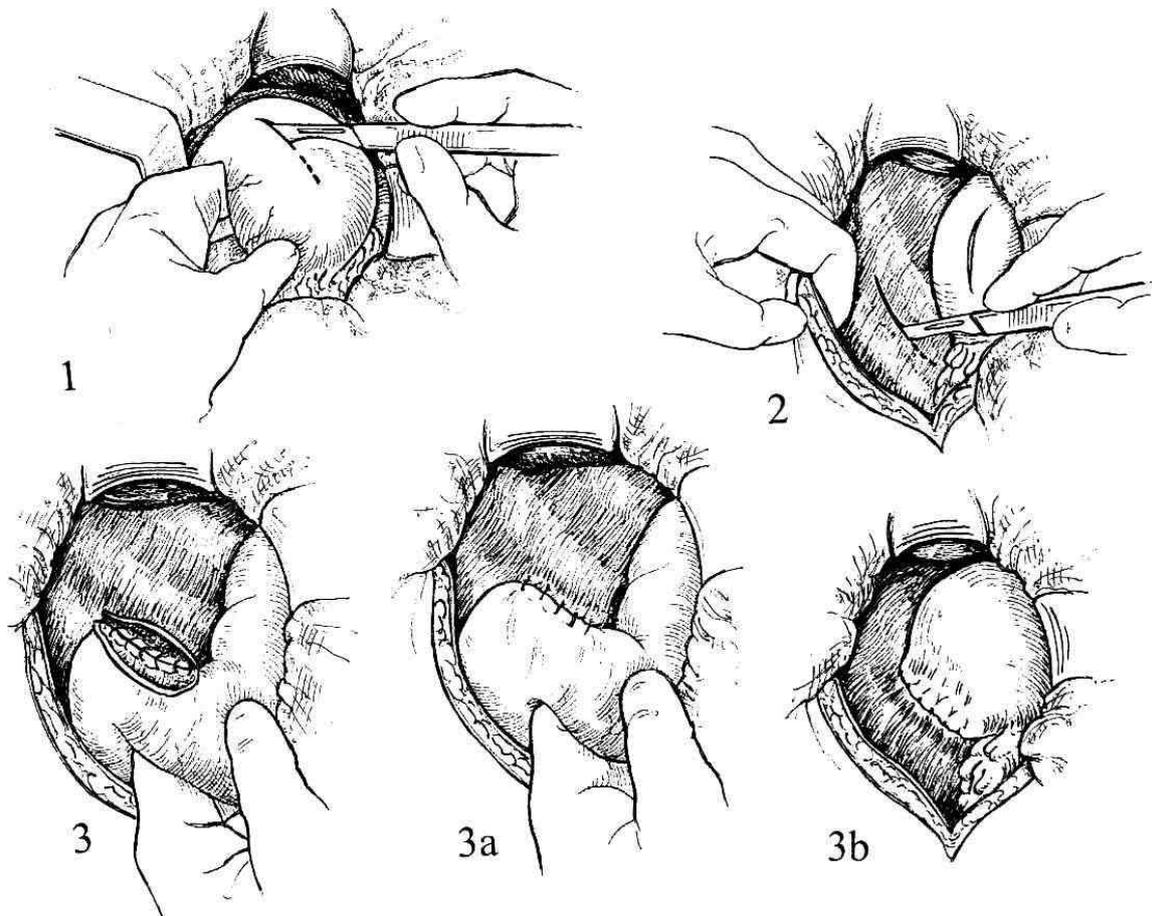


Figure 67: Incisional gastropexy

7.5 Diaphragmatic hernia

Trauma is the most common cause of diaphragmatic hernia in cats and dogs. Direct injuries of the diaphragm from thoracoabdominal stab or gunshot are rare compared to the indirect injuries in car accidents or falls from great heights. The mechanism in indirect injuries is suspected to be a sudden increase in intra-abdominal pressure with the glottis open. The diaphragmatic tears are either circumferential, radial or a combination. The diaphragmatic costal muscles are more often ruptured than the central tendon. Herniation of viscera is usually immediate after the injury. Clinical symptoms depend on the herniated abdominal viscera. Although no pathognomonic signs of diaphragmatic hernia have been identified, respiratory signs predominate. Most patients have dyspnea and exercise intolerance. Interference with cardiorespiratory function by compression of caudal vena cava and lungs and incarceration, obstruction, and strangulation of abdominal organs are the chief effects.

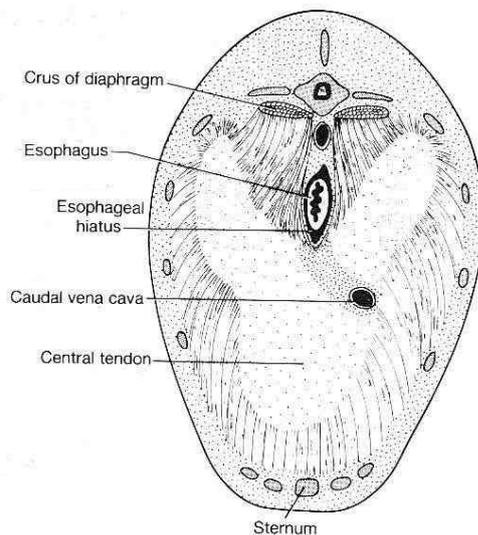


Figure 68: Functional anatomy of the diaphragm

Diagnosis

Radiography is the most useful test for diagnosis of diaphragmatic hernia. The first radiographic view is in the position that causes least distress. The finding of viscera in the thorax is diagnostic. But more often a partial loss of the normal line of the diaphragm or lung lobe collapse and pleural fluid are detectable. In these cases diagnostic ultrasonography is the most useful alternative.

Treatment

Herniorrhaphy is performed at the earliest opportunity in a stable patient. Acutely injured animals are treated for shock, allowed to rest quietly, and given supplemental oxygen. Surgery is only performed on an emergency basis in the presence of life-threatening hypoventilation due to compression of the lungs by abdominal viscera (e.g. gastric tympany following stomach herniation).

Intravenous catheterization, fluid therapy, adequate monitoring and a heating pad are essential. After anesthetic induction, the insertion of an endotracheal tube allows maintenance of gaseous anesthesia and controlled ventilation, adequate pulmonary expansion and oxygenation.

Midline celiotomy is the preferred approach. Using this approach it is not necessary to know the position of the tear before surgery and it allows inspection of all the abdominal viscera.

- An incision is made in the linea alba from the xyphoid to beyond the umbilicus. The Gelpi retractor is placed into the rectus abdominis muscle. A generous incision facilitates exposure of the diaphragm and abdominal viscera. The falciform ligament is excised to improve exposure.
- The hernia is reduced. This can usually be easily done by gentle traction. Incarcerated spleen and liver are often friable and need careful handling. For irreducible hernia (relative undersize of the hernia ring, the hole is enlarged with a ventrally directed radial incision.
- Perform herniorrhaphy, commencing at the most dorsal aspect and proceeding ventrally, using a continuous suture pattern and an absorbable suture material. Use long needle holders and tissue forceps.
- The peritoneal cavity is filled with warm saline to check for leakage. Major leaks are closed with additional interrupted sutures.
- Re-establish negative intrathoracic pressure by thoracocentesis through the diaphragm using the butterfly catheter and syringe.
- All abdominal organs are carefully inspected for viability.
- Close the celiotomy with absorbable, monofilament suture material in a simple, continuous pattern. Evacuate residual air with butterfly catheter and syringe.

Aftercare

A thoracic radiograph is taken before recovery from anesthesia as there is concern about persisting pneumothorax, pleural effusion, and collapsed lung lobes. Let the animal recover from anesthesia in a heated oxygen cage.

For liver incarceration and biliary tract injury (proliferation of clostridial organisms and release of toxins after repositioning) prophylactic antibiotics are given before and 2 to 3 days after surgery. Maintenance fluid requirements are continued until the animal eats spontaneously.